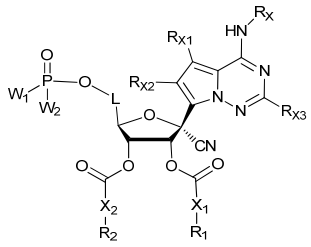
## CLAIMS

1. A compound of formula (I):



(I)

wherein,

$R_X$ is H or OH;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D, halogen, $-R_a$, $-C(O)R_a$, $-C(O)OR_a$, $-C(O)NR_bR_c$, $-NR_bR_c$, $-NR_aC(O)R_b$, $-NR_aC(O)OR_b$, $-NR_aC(O)NR_bR_c$, $-OR_a$, $-OC(O)R_a$, $-OC(O)NR_bR_c$, $-NR_aS(O)_2R_b$, $-S(O)_2NR_a$, $-S(O)R_a$ or $-S(O)_2R_a$;

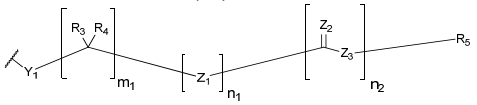
wherein each of $R_a$, $R_b$ and $R_c$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_b$ and $R_c$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

$X_1$ and $X_2$ are independently a bond, O, S or NH;

$R_1$ and $R_2$ are independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

L is $CH_2$, $CD_2$ or CHD;

$W_1$ is formula (A):



formula (A)

wherein,

$Y_1$ is O or S;

$Z_1$ is O, NH or S;

$Z_2$ is O, NH or S;

$Z_3$ is a bond, O, NH or S;

$m_1$ is 1, 2, 3, 4, 5 or 6;

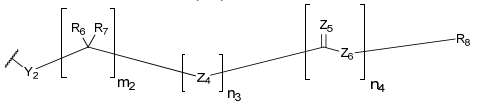
$n_1$ is 0 or 1;

$n_2$ is 0 or 1;

each of $R_3$ and $R_4$ is independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_3$ and $R_4$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_5$ is H, D, $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

$W_2$ is formula (B):




formula (B)

wherein,

$Y_2$ is O, NH or S;

$Z_4$ is O, NH or S;

$Z_5$ is O, NH or S;

$Z_6$ is a bond, O, NH or S;

$m_2$ is 0, 1, 2, 3, 4, 5 or 6;

$n_3$ is 0 or 1;

$n_4$ is 0 or 1;

each of $R_6$ and $R_7$ is independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_8$ is H, D, $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

or, any one of $W_1$ and $W_2$ together with the 3'-position C atom of glycosyl form $-Y_3-$, wherein $Y_3$ is O, NH or S;

or, $W_1$ and $W_2$ together with the P atom to which they are attached, form $-Y_4(C(R_3R_4)_p)Y_4-$, wherein $Y_4$ is O, NH or S, and p is 2, 3, 4 or 5;

each R is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R", up to full deuteration;

each R' is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R' on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

wherein each of $R_d$, $R_e$ and $R_f$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_e$ and $R_f$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

each R" is independently D, halogen, $-R_g$, $-C(O)R_g$, $-C(O)OR_g$, $-C(O)NR_hR_j$, $-NR_hR_j$, $-NR_gC(O)R_h$, $-NR_gC(O)OR_h$, $-NR_gC(O)NR_hR_j$, $-OR_g$, $-OC(O)R_g$, $-OC(O)NR_hR_j$, $-NR_gS(O)_2R_h$, $-S(O)_2NR_g$, $-S(O)R_g$ or $-S(O)_2R_g$, or two R" on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl,

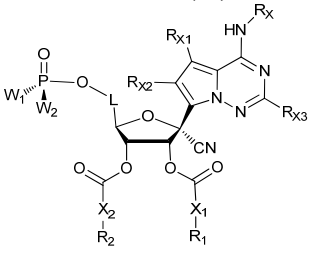
$C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

wherein each of $R_g$, $R_h$ and $R_j$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_h$ and $R_j$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

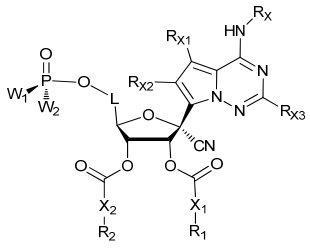
or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

preferably, wherein the compound has one or more of the following definitions:

i) which is of formula (Ia) or formula (Ib):



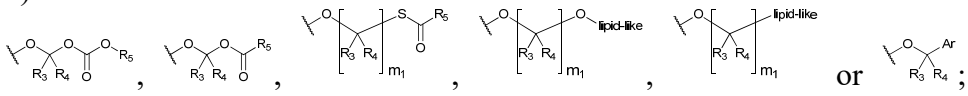
formula (Ia), or



formula (Ib)

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof; and

ii) wherein $W_1$ is:

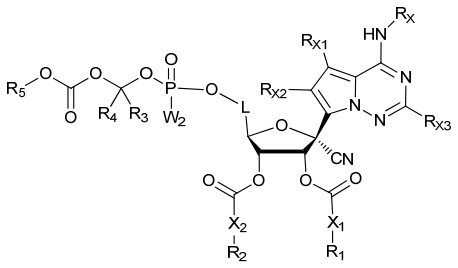


; wherein, lipid-like is $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl or $C_{8-28}$ alkynyl, wherein said $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl and $C_{8-28}$ alkynyl are optionally substituted with one or more R;

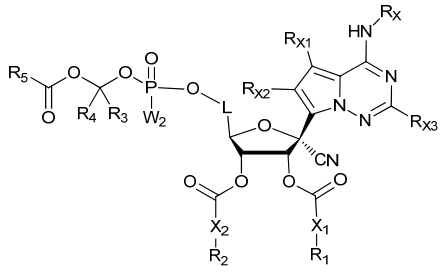
Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

$R_3$, $R_4$, $R_5$, $m_1$ and R are as described in claim 1.

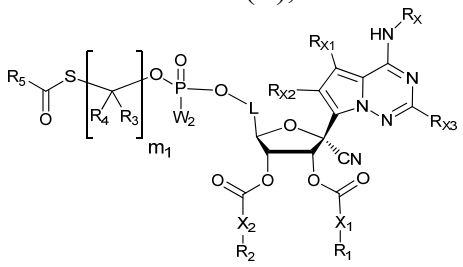
2. The compound of claim 1, which is a compound of formula (II), (III) or (IV):



formula (II),



formula



(III), or

formula (IV)

wherein,

$R_X$ is H or OH;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D, halogen, -$R_a$, -C(O)$R_a$, -C(O)O$R_a$, -C(O)N$R_b$$R_c$, -N$R_b$$R_c$, -N$R_a$C(O)$R_b$, -N$R_a$C(O)O$R_b$, -N$R_a$C(O)N$R_b$$R_c$, -O$R_a$, -OC(O)$R_a$, -OC(O)N$R_b$$R_c$, -N$R_a$S(O)$_2$$R_b$, -S(O)$_2$N$R_a$, -S(O)$R_a$ or -S(O)$_2$$R_a$;

wherein each of $R_a$, $R_b$ and $R_c$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_b$ and $R_c$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

$X_1$ and $X_2$ are independently a bond, O, S or NH;

$R_1$ and $R_2$ are independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

L is $CH_2$, $CD_2$ or CHD;

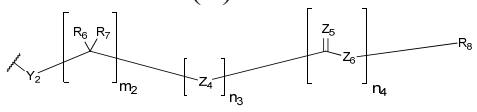
$m_1$ is 1, 2, 3, 4, 5 or 6;

$R_3$ and $R_4$ are independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_3$ and $R_4$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-}$

$_6$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_5$ is H, D, $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

$W_2$ is formula (B):




formula (B)

wherein,

$Y_2$ is O, NH or S;

$Z_4$ is O, NH or S;

$Z_5$ is O, NH or S;

$Z_6$ is a bond, O, NH or S;

$m_2$ is 0, 1, 2, 3, 4, 5 or 6;

$n_3$ is 0 or 1;

$n_4$ is 0 or 1;

each of $R_6$ and $R_7$ is independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_8$ is H, D, $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

or, $W_2$ together with the 3'-position C atom of glycosyl form $-Y_3-$, wherein $Y_3$ is O, NH or S;

each R is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R on the same atom or two adjacent atoms, together with

the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R", up to full deuteration;

each R' is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R' on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

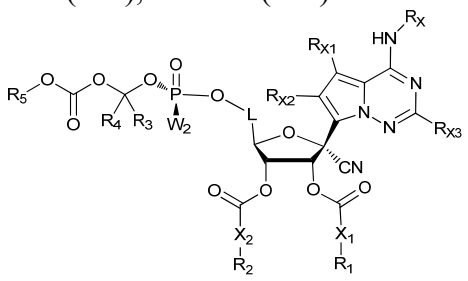
wherein each of $R_d$, $R_e$ and $R_f$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_e$ and $R_f$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

each R" is independently D, halogen, $-R_g$, $-C(O)R_g$, $-C(O)OR_g$, $-C(O)NR_hR_j$, $-NR_hR_j$, $-NR_gC(O)R_h$, $-NR_gC(O)OR_h$, $-NR_gC(O)NR_hR_j$, $-OR_g$, $-OC(O)R_g$, $-OC(O)NR_hR_j$, $-NR_gS(O)_2R_h$, $-S(O)_2NR_g$, $-S(O)R_g$ or $-S(O)_2R_g$, or two R" on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

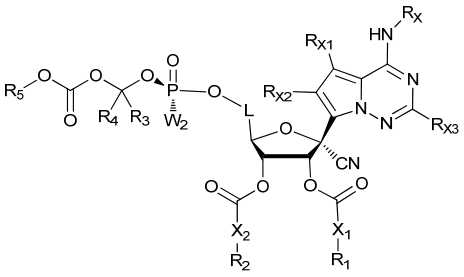
wherein each of $R_g$, $R_h$ and $R_j$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_h$ and $R_j$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof.

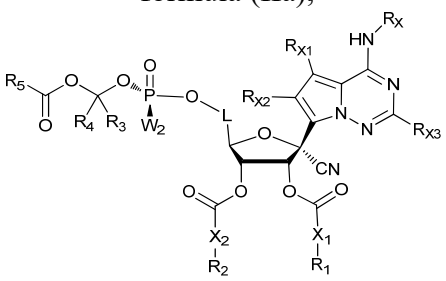
3. The compound of claim 2, which is a compound of formula (IIa), formula (IIb), formula (IIIa), formula (IIIb), formula (IVa) or formula (IVb):



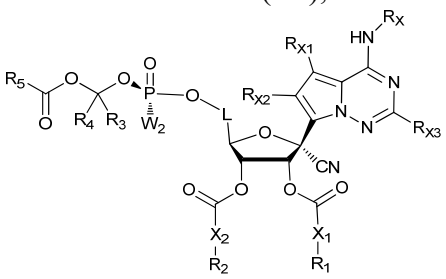
formula (IIa),



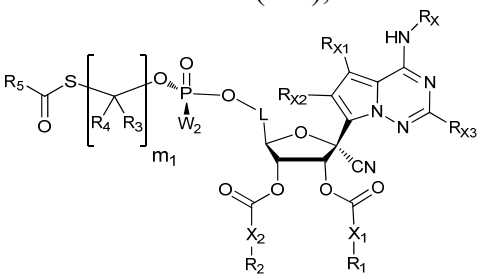
formula (IIb),



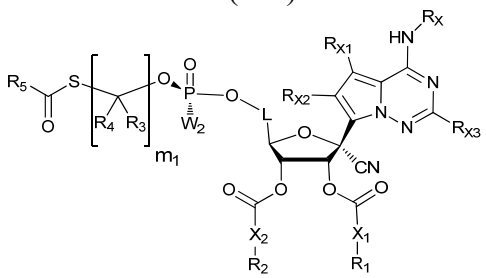
formula (IIIa),



formula (IIIb)



formula (IVa) or

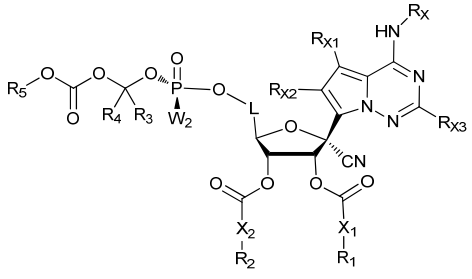


formula (IVb)

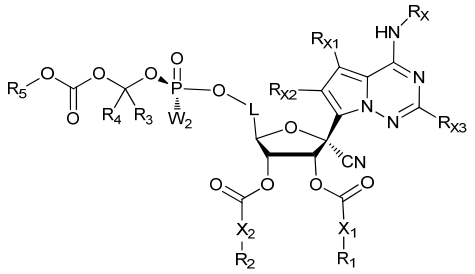
or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

preferably, wherein the compound has any one of the following definitions:

i) which is a compound of formula (IIa) or formula (IIb):



formula (IIa),



formula (IIb),

wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

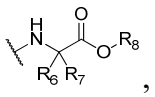
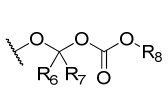
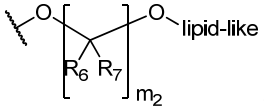
$X_1$ and $X_2$ are independently a bond, O, S or NH, preferably a bond or O, and more preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H, D, halogen, $C_{1-6}$ alkyl or $C_{1-6}$ haloalkyl, preferably H or D;

$R_5$ is $C_{1-6}$ alkyl (preferably isopropyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

$W_2$ is  ,  ,  or  ;

each of $R_6$ and $R_7$ is independently H, D, $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl) or $-OR_d$, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, which is optionally substituted with one or more R', which is optionally substituted with one or more deuterium atoms, up to full deuteration;

each R' is independently $-C(O)OC_{1-6}$ alkyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, preferably $-C(O)OC_{1-6}$ alkyl or phenyl;

$R_8$ is $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, preferably $C_{1-6}$ alkyl or $C_{3-6}$ cycloalkyl, which is optionally substituted with one or more R, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

Ar is phenyl, which is optionally substituted with one or more R;

R is independently D, $C_{1-6}$ alkyl or $-OC_{1-6}$ alkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

$m_2$ is 1, 2, 3, 4, 5 or 6, preferably 2, 3 or 4;

lipid-like is $C_{8-28}$ alkyl or $C_{8-28}$ alkenyl, preferably $C_{12-20}$ alkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

$R_d$ is independently $(CH_2)_{1-3}$-$C_{6-10}$ aryl or $(CH_2)_{1-3}$-5-10 membered heteroaryl, preferably $CH_2$-phenyl, which is optionally substituted with one or more R";

R" is independently D, halogen or -$OC_{1-6}$ alkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

alternatively, wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

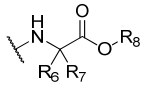
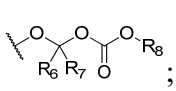
$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H, D, halogen, $C_{1-6}$ alkyl or $C_{1-6}$ haloalkyl, preferably H or D;

$R_5$ is $C_{1-6}$ alkyl (preferably isopropyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

$W_2$ is  or  ;

each of $R_6$ and $R_7$ is independently H, D or $C_{1-3}$ alkyl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, which is optionally substituted with one or more R', which is optionally substituted with one or more deuterium atoms, up to full deuteration;

each R' is independently -C(O)$OC_{1-6}$ alkyl or $C_{6-10}$ aryl, preferably -C(O)$OC_{1-6}$ alkyl or phenyl;

$R_8$ is $C_{1-6}$ alkyl or $C_{3-6}$ cycloalkyl, which is optionally substituted with one or more R, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

R is independently -$OC_{1-6}$ alkyl;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

alternatively, wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

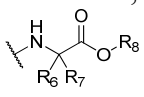
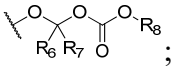
$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H, D, halogen, $C_{1-6}$ alkyl or $C_{1-6}$ haloalkyl, preferably H or D;

$R_5$ is $C_{1-6}$ alkyl (preferably isopropyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

$W_2$ is  or  ;

each of $R_6$ and $R_7$ is independently H, D or $C_{1-3}$ alkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

$R_8$ is $C_{1-6}$ alkyl or $C_{3-6}$ cycloalkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

alternatively, wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

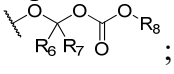
$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H, D, halogen, $C_{1-6}$ alkyl or $C_{1-6}$ haloalkyl, preferably H or D;

$R_5$ is $C_{1-6}$ alkyl (preferably isopropyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

$W_2$ is  or  ;

Ar is phenyl, which is optionally substituted with one or more R;

R is independently $C_{1-6}$ alkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

each of $R_6$ and $R_7$ is independently H, D or $C_{1-3}$ alkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

$R_8$ is $C_{1-6}$ alkyl or $C_{3-6}$ cycloalkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof; or

alternatively, wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

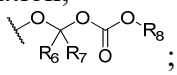
$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H or D;

$R_5$ is isopropyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

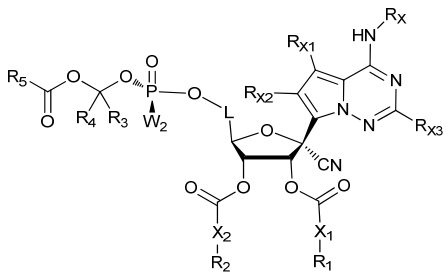
$W_2$ is  ;

each of $R_6$ and $R_7$ is independently H or D;

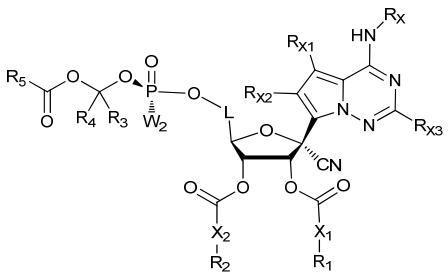
$R_8$ is isopropyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

ii) which is a compound of formula (IIIa) or formula (IIIb):



formula (IIIa),



formula (IIIb)

wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

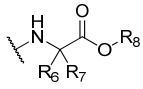
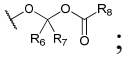
$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more D, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H or D;

$R_5$ is $C_{1-6}$ alkyl, which is optionally substituted with one or more D, until they are completely deuterated;

$W_2$ is  ,  or  ;

each of $R_6$ and $R_7$ is independently H, D or $C_{1-3}$ alkyl, which is optionally substituted with one or more D, up to full deuteration;

$R_8$ is $C_{1-6}$ alkyl, which is optionally substituted with one or more D, up to full deuteration;

Ar is phenyl, which is optionally substituted with one or more R;

R is independently $C_{1-6}$ alkyl, which is optionally substituted with one or more D, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

alternatively, wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

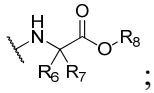
$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted

with one or more D, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H or D;

$R_5$ is $C_{1-6}$ alkyl (preferably tert-butyl), which is optionally substituted with one or more D, up to full deuteration;

$W_2$ is  ;

each of $R_6$ and $R_7$ is independently H, D or $C_{1-3}$ alkyl, which is optionally substituted with one or more D, up to full deuteration;

$R_8$ is $C_{1-6}$ alkyl, which is optionally substituted with one or more D, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

alternatively, wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more D, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H or D;

$R_5$ is $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl, preferably isopropyl), which is optionally substituted with one or more D, up to full deuteration;

$W_2$ is  ;

Ar is phenyl, which is optionally substituted with one or more R;

R is independently $C_{1-6}$ alkyl, which is optionally substituted with one or more D, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof; or

alternatively, wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

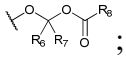
$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more D, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H or D;

$R_5$ is $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl, preferably tert-butyl, more preferably isopropyl), which is optionally substituted with one or more D, up to full deuteration;

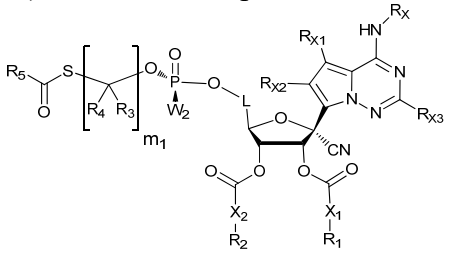
$W_2$ is  ;

each of $R_6$ and $R_7$ is independently H or D;

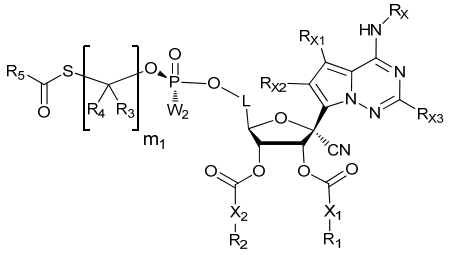
$R_8$ is $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl, preferably tert-butyl, more preferably isopropyl), which is optionally substituted with one or more D, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof; and

iii) which is a compound of formula (IVa) or formula (IVb):



formula (IVa), or



formula (IVb)

wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

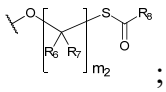
$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more D, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$m_1$ is 1, 2 or 3;

$R_3$ and $R_4$ are independently H or D;

$R_5$ is $C_{1-6}$ alkyl (preferably tert-butyl), which is optionally substituted with one or more D, up to full deuteration;

$W_2$ is  or  ;

$m_2$ is 1, 2 or 3;

each of $R_6$ and $R_7$ is independently H or D, which is optionally substituted with one or more D, up to full deuteration;

$R_8$ is $C_{1-6}$ alkyl (preferably tert-butyl), which is optionally substituted with one or more D, up to full deuteration;

Ar is phenyl, which is optionally substituted with one or more R;

R is independently $C_{1-6}$ alkyl, which is optionally substituted with one or more D, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or a solvate thereof.

4. The compound of claim 2 or 3, or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, wherein the compound has any one of the following definitions:

i) wherein:

$R_X$ is H or OH;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D, halogen or $C_{1-6}$ alkyl, wherein said $C_{1-6}$ alkyl are optionally substituted with one or more deuterium atoms, up to full deuteration;

$X_1$ and $X_2$ are independently a bond, O, S or NH;

$R_1$ and $R_2$ are independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

L is $CH_2$, $CD_2$ or CHD;

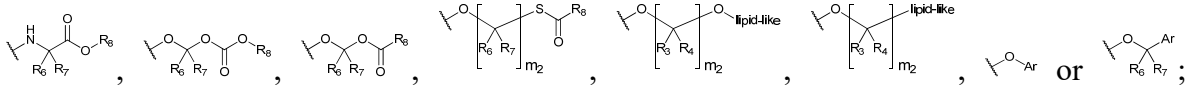
$m_1$ is 1, 2 or 3;

$R_3$ and $R_4$ are independently H, D, $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, or $R_3$ and $R_4$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7

membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl and 3-7 membered heterocyclyl are optionally substituted with one or more R';

$R_5$ is $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl and $C_{2-28}$ alkenyl are optionally substituted with one or more R;

$W_2$ is:




wherein,

$m_2$ is 1, 2, 3, 4, 5 or 6;

each of $R_6$ and $R_7$ is independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_8$ is $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

lipid-like is $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl or $C_{8-28}$ alkynyl, wherein said $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl and $C_{8-28}$ alkynyl are optionally substituted with one or more R;

Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

each R is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R", up to full deuteration;

each R' is independently D, halogen, -$R_d$, -C(O)$R_d$, -C(O)O$R_d$, -C(O)N$R_e$$R_f$, -N$R_e$$R_f$, -N$R_d$C(O)$R_e$, -N$R_d$C(O)O$R_e$, -N$R_d$C(O)N$R_e$$R_f$, -O$R_d$, -OC(O)$R_d$, -OC(O)N$R_e$$R_f$, -N$R_d$S(O)$_2$$R_e$, -S(O)$_2$N$R_d$, -S(O)$R_d$ or -S(O)$_2$$R_d$, or two R' on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

wherein each of $R_d$, $R_e$ and $R_f$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_e$ and $R_f$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

each R" is independently D, halogen, -$R_g$, -C(O)$R_g$, -C(O)O$R_g$, -C(O)N$R_h$$R_j$, -N$R_h$$R_j$, -N$R_g$C(O)$R_h$, -N$R_g$C(O)O$R_h$, -N$R_g$C(O)N$R_h$$R_j$, -O$R_g$, -OC(O)$R_g$, -OC(O)N$R_h$$R_j$, -N$R_g$S(O)$_2$$R_h$, -S(O)$_2$N$R_g$, -S(O)$R_g$ or -S(O)$_2$$R_g$, or two R" on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

wherein each of $R_g$, $R_h$ and $R_j$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_h$ and $R_j$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

ii) wherein,

$R_X$ is H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen;

$X_1$ and $X_2$ are independently a bond or O;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl or $C_{6-10}$ aryl;

L is $CH_2$, $CD_2$ or CHD;

$m_1$ is 1, 2 or 3;

$R_3$ and $R_4$ are independently H, D or $C_{1-6}$ alkyl;

$R_5$ is $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl; and

iii) wherein,

$R_X$ is H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H or D;

$X_1$ and $X_2$ are independently a bond or O;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl;

L is $CH_2$, $CD_2$ or CHD;

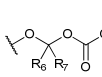
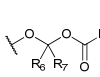
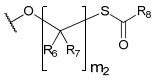
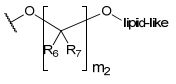
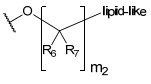
$m_1$ is 1, 2 or 3;

$R_3$ and $R_4$ are independently H or D;

$R_5$ is $C_{1-6}$ alkyl.

5. The compound of any one of claims 2 to 4, or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, wherein the compound has any one of the following definitions:

i) wherein:

$W_2$ is  ,  ,  ,  ,  ,  ,  or  ;

wherein, $m_2$ is 1, 2, 3 or 4;

each of $R_6$ and $R_7$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{3-6}$ cycloalkyl and 3-7 membered heterocyclyl are optionally substituted with one or more R';

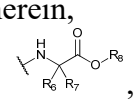
each $R_8$ is independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl or $C_{2-28}$ alkynyl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl and $C_{2-28}$ alkynyl are optionally substituted with one or more R;

lipid-like is $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl or $C_{8-28}$ alkynyl, wherein said $C_{8-28}$ alkyl,

$C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl and $C_{8-28}$ alkynyl are optionally substituted with one or more R;

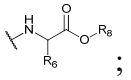
Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

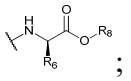
ii) wherein,

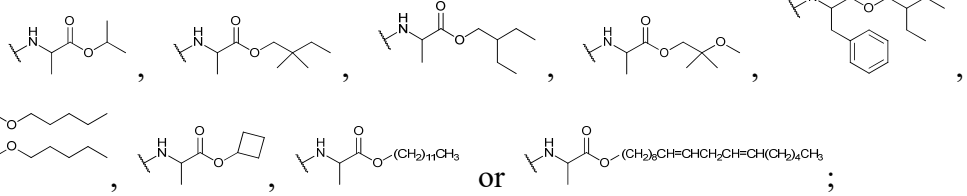
$W_2$ is  ,

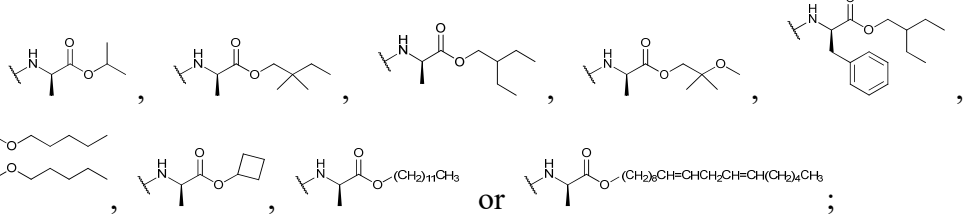
wherein, $R_6$ is $C_{1-6}$ alkyl, and $R_7$ is H, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl, wherein said $C_{1-6}$ alkyl and $C_{3-6}$ cycloalkyl are optionally substituted with one or more groups selected from phenyl or -C(O)O$C_{1-6}$ alkyl;

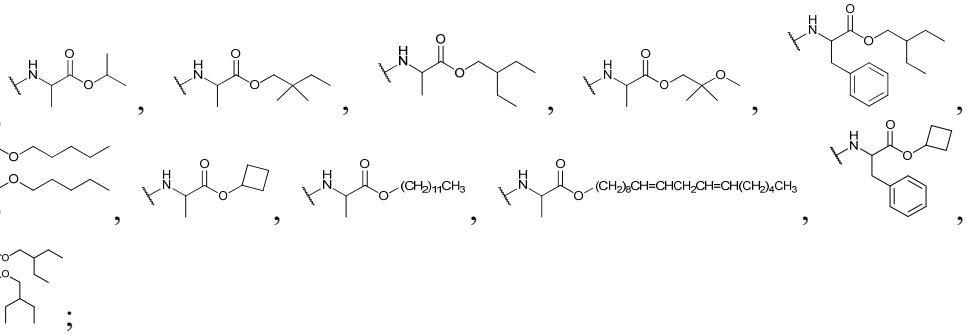
$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl, wherein said $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl is optionally substituted with one or more $C_{1-6}$ alkoxy;

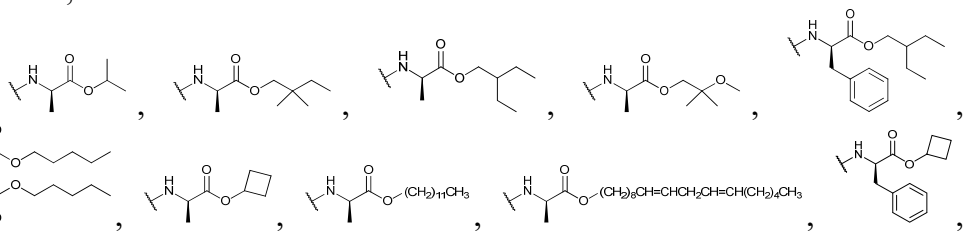
preferably, $W_2$ is  ;

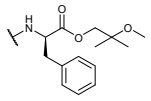
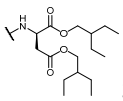
preferably, $W_2$ is  ;

preferably, $W_2$ is  ;

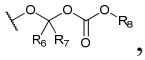
preferably, $W_2$ is  ;

preferably, $W_2$ is  ;

preferably, $W_2$ is  .

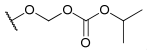
 or  ;

iii) wherein,

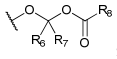
$W_2$ is  ,

wherein, $R_6$ and $R_7$ are H;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

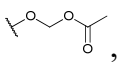
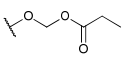
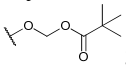
preferably, $W_2$ is  ;

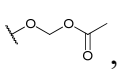
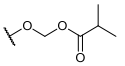
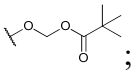
iv) wherein,

$W_2$ is  ,

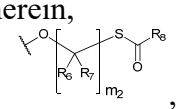
wherein, $R_6$ and $R_7$ are H;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

preferably, $W_2$ is  ,  or  ;

preferably, $W_2$ is  ,  or  ;

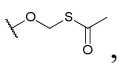
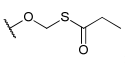
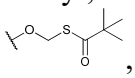
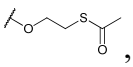
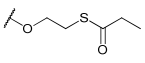
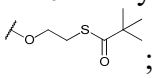
v) wherein,

$W_2$ is  ,

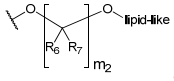
wherein, $m_2$ is 1 or 2;

$R_6$ and $R_7$ are H;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

preferably, $W_2$ is  ,  ,  ,  ,  or  ;

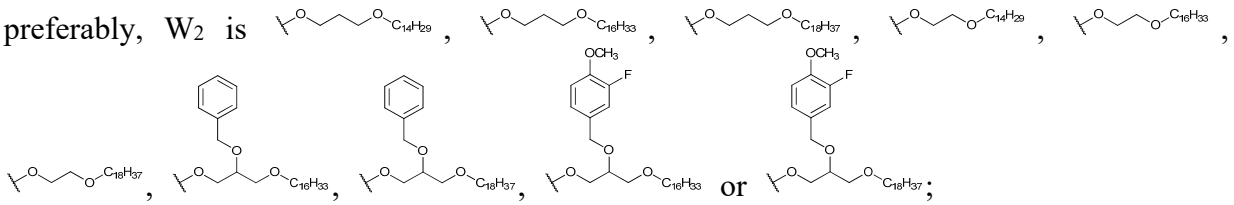
vi) wherein,

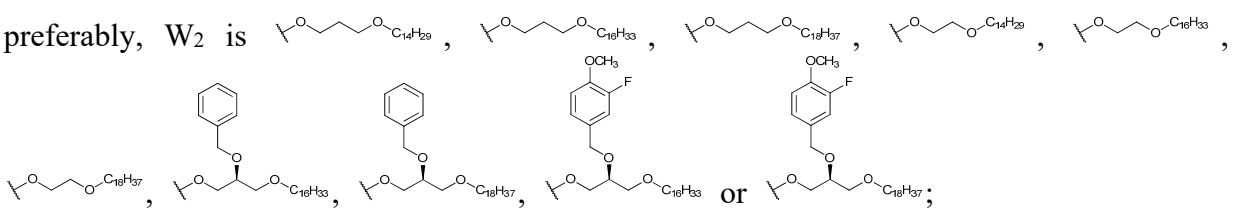
$W_2$ is  ,

wherein, $m_2$ is 2, 3 or 4;

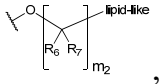
$R_6$ and $R_7$ are independently H or $C_{1-6}$ alkoxy, wherein said $C_{1-6}$ alkoxy is optionally substituted with one or more groups selected from $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl or 5-10 membered heteroaryl is optionally substituted with one or more groups selected from halogen or $C_{1-6}$ alkoxy;

lipid-like is $C_{8-28}$ alkyl or $C_{8-28}$ alkenyl;

preferably, $W_2$ is  ;

preferably, $W_2$ is  ;

vii) wherein,

$W_2$ is  ,

wherein, $m_2$ is 2, 3 or 4;

$R_6$ and $R_7$ are H;

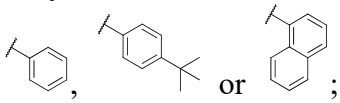
lipid-like is $C_{8-28}$ alkenyl;

preferably, $W_2$ is ;

viii) wherein,

$W_2$ is  ,

wherein, Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl or 5-10 membered heteroaryl is optionally substituted with one or more $C_{1-6}$ alkyl;

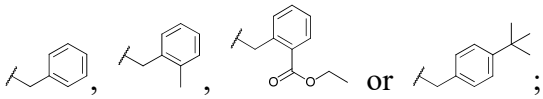
preferably, $W_2$ is  ;

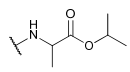
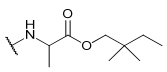
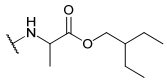
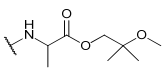
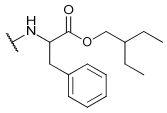
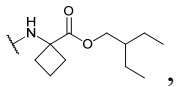
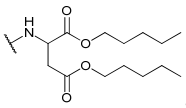
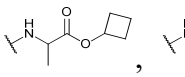
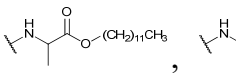
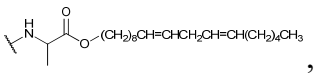
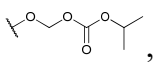
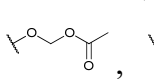
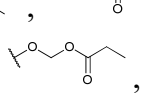
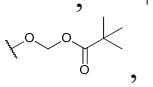
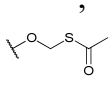
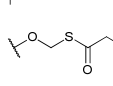
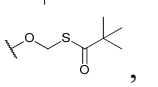
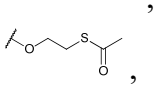
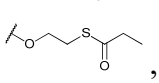
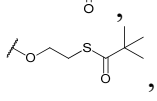
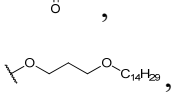
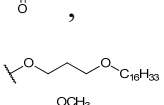
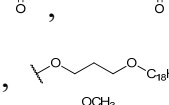
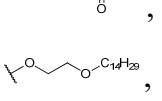
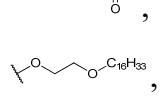
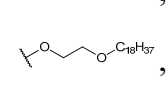
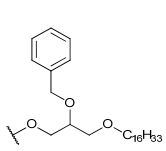
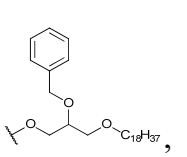
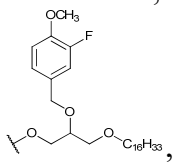
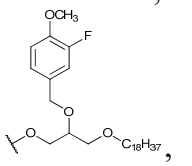
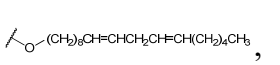
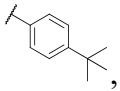
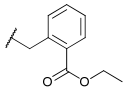
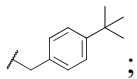
ix) wherein,

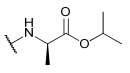
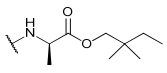
$W_2$ is  ,

wherein, $R_6$ and $R_7$ are H;

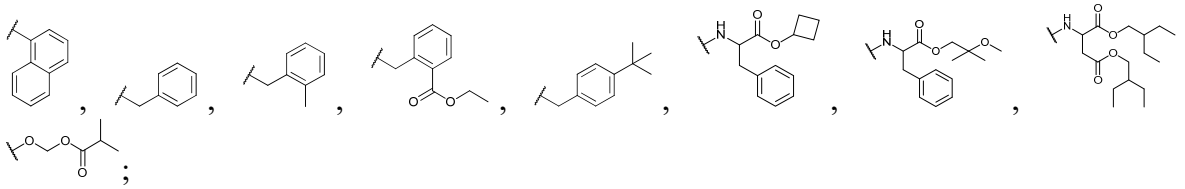
Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl or 5-10 membered heteroaryl is optionally substituted with one or more groups selected from $C_{1-6}$ alkyl or -$C(O)OC_{1-6}$ alkyl;

preferably, $W_2$ is  ; and

x) wherein, $W_2$ is  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  , or  ;

preferably, $W_2$ is  ,  , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , or ;

preferably, $W_2$ is , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , , ,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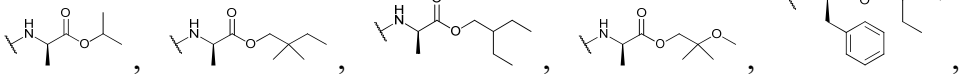
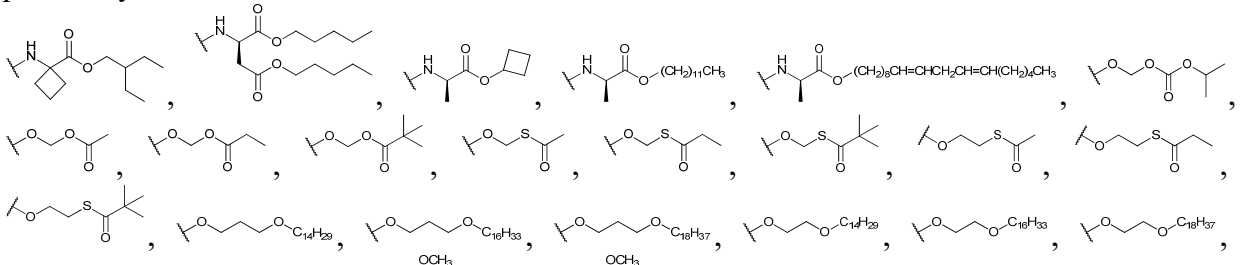
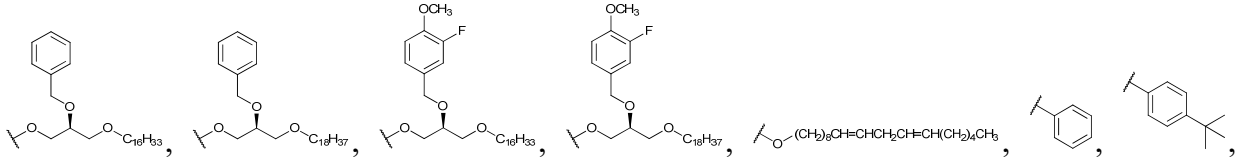
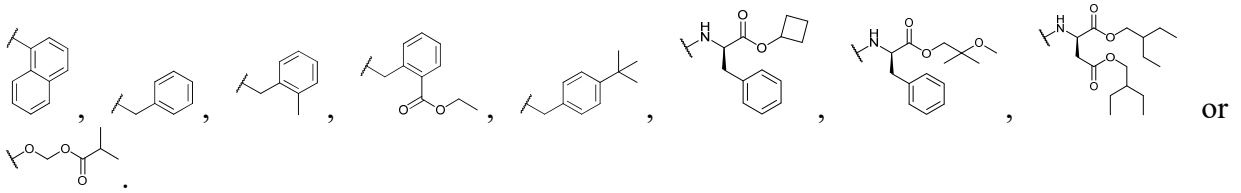
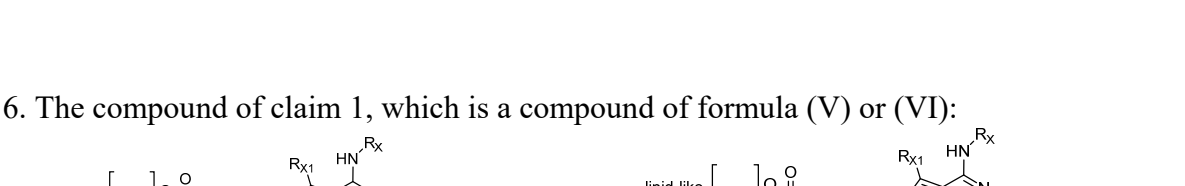
preferably, $W_2$ is 

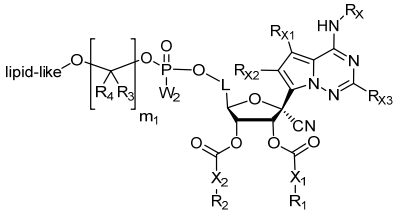


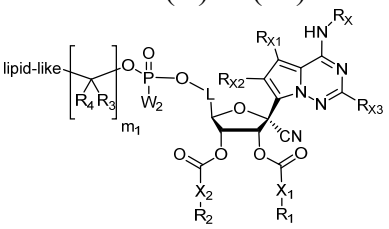





or .

6. The compound of claim 1, which is a compound of formula (V) or (VI):


formula (V), or


formula (VI)

wherein,

$R_X$ is H or OH;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D, halogen, $-R_a$, $-C(O)R_a$, $-C(O)OR_a$, $-C(O)NR_bR_c$, $-NR_bR_c$, $-NR_aC(O)R_b$, $-NR_aC(O)OR_b$, $-NR_aC(O)NR_bR_c$, $-OR_a$, $-OC(O)R_a$, $-OC(O)NR_bR_c$, $-NR_aS(O)_2R_b$, $-S(O)_2NR_a$, $-S(O)R_a$ or $-S(O)_2R_a$;

wherein each of $R_a$, $R_b$ and $R_c$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_b$ and $R_c$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered

heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

$X_1$ and $X_2$ are independently a bond, O, S or NH;

$R_1$ and $R_2$ are independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

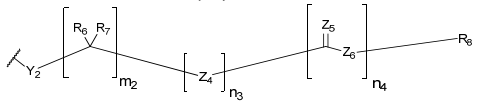
L is $CH_2$, $CD_2$ or CHD;

$m_1$ is 1, 2, 3, 4, 5 or 6;

$R_3$ and $R_4$ are independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_3$ and $R_4$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

lipid-like is $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl or $C_{8-28}$ alkynyl, wherein said $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl or $C_{8-28}$ alkynyl is optionally substituted with one or more R;

$W_2$ is formula (B):




formula (B)

wherein,

$Y_2$ is O, NH or S;

$Z_4$ is O, NH or S;

$Z_5$ is O, NH or S;

$Z_6$ is a bond, O, NH or S;

$m_2$ is 0, 1, 2, 3, 4, 5 or 6;

$n_3$ is 0 or 1;

$n_4$ is 0 or 1;

each of $R_6$ and $R_7$ is independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-}$

$_6$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_8$ is H, D, $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

or, $W_2$ together with the 3'-position carbon C of glycosyl form -$Y_3$-, wherein $Y_3$ is O, NH or S;

each R is independently D, halogen, -$R_d$, -C(O)$R_d$, -C(O)O$R_d$, -C(O)N$R_e$$R_f$, -N$R_e$$R_f$, -N$R_d$C(O)$R_e$, -N$R_d$C(O)O$R_e$, -N$R_d$C(O)N$R_e$$R_f$, -O$R_d$, -OC(O)$R_d$, -OC(O)N$R_e$$R_f$, -N$R_d$S(O)$_2$$R_e$, -S(O)$_2$N$R_d$, -S(O)$R_d$ or -S(O)$_2$$R_d$, or two R on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R", up to full deuteration;

each R' is independently D, halogen, -$R_d$, -C(O)$R_d$, -C(O)O$R_d$, -C(O)N$R_e$$R_f$, -N$R_e$$R_f$, -N$R_d$C(O)$R_e$, -N$R_d$C(O)O$R_e$, -N$R_d$C(O)N$R_e$$R_f$, -O$R_d$, -OC(O)$R_d$, -OC(O)N$R_e$$R_f$, -N$R_d$S(O)$_2$$R_e$, -S(O)$_2$N$R_d$, -S(O)$R_d$ or -S(O)$_2$$R_d$, or two R' on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

wherein each of $R_d$, $R_e$ and $R_f$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_e$ and $R_f$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

each R" is independently D, halogen, -$R_g$, -C(O)$R_g$, -C(O)O$R_g$, -C(O)N$R_h$$R_j$, -N$R_h$$R_j$, -N$R_g$C(O)$R_h$, -N$R_g$C(O)O$R_h$, -N$R_g$C(O)N$R_h$$R_j$, -O$R_g$, -OC(O)$R_g$, -OC(O)N$R_h$$R_j$, -N$R_g$S(O)$_2$$R_h$, -S(O)$_2$N$R_g$, -S(O)$R_g$ or -S(O)$_2$$R_g$, or two R" on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl,

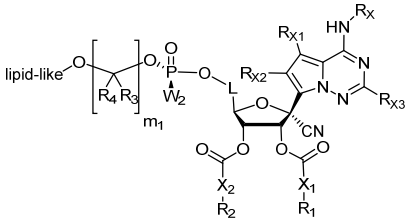
$C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

wherein each of $R_g$, $R_h$ and $R_j$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_h$ and $R_j$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

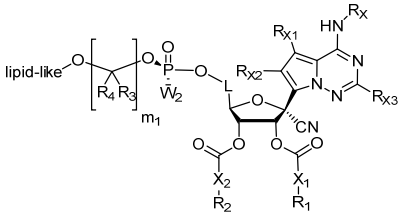
or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or a solvate thereof.

7. The compound of claim 6, wherein the compound has any one of the following definitions:

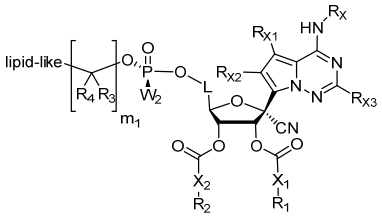
i) which is a compound of formula (Va), formula (Vb), formula (VIa) or formula (VIb):



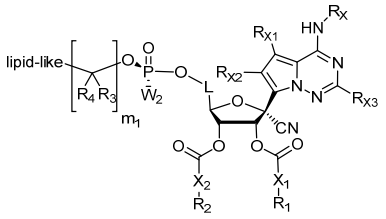

formula (Va),




formula (Vb),




formula (VIa), or




formula (VIb)

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

ii) wherein:

$R_X$ is H or OH;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D, halogen or $C_{1-6}$ alkyl, wherein said $C_{1-6}$ alkyl are optionally substituted with one or more deuterium atoms, up to full deuteration;

$X_1$ and $X_2$ are independently a bond, O, S or NH;

$R_1$ and $R_2$ are independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

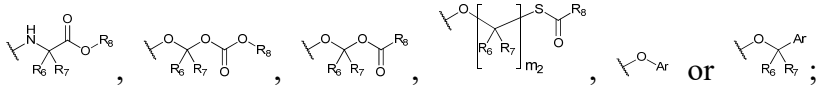
L is $CH_2$, $CD_2$ or CHD;

$m_1$ is 2, 3 or 4;

$R_3$ and $R_4$ are independently H, D, $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, or $R_3$ and $R_4$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl and 3-7 membered heterocyclyl are optionally substituted with one or more R';

lipid-like is $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{2-28}$ alkenyl or $C_{2-28}$ alkynyl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{2-28}$ alkenyl and $C_{2-28}$ alkynyl are optionally substituted with one or more R;

$W_2$ is:




or ;

wherein,

$m_2$ is 1, 2, 3, 4, 5 or 6;

each of $R_6$ and $R_7$ is independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_8$ is $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

each R is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R", up to full

deuteration;

each R' is independently D, halogen, -$R_d$, -C(O)$R_d$, -C(O)O$R_d$, -C(O)N$R_e$$R_f$, -N$R_e$$R_f$, -N$R_d$C(O)$R_e$, -N$R_d$C(O)O$R_e$, -N$R_d$C(O)N$R_e$$R_f$, -O$R_d$, -OC(O)$R_d$, -OC(O)N$R_e$$R_f$, -N$R_d$S(O)$_2$$R_e$, -S(O)$_2$N$R_d$, -S(O)$R_d$ or -S(O)$_2$$R_d$, or two R' on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

wherein each of $R_d$, $R_e$ and $R_f$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_e$ and $R_f$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

each R" is independently D, halogen, -$R_g$, -C(O)$R_g$, -C(O)O$R_g$, -C(O)N$R_h$$R_j$, -N$R_h$$R_j$, -N$R_g$C(O)$R_h$, -N$R_g$C(O)O$R_h$, -N$R_g$C(O)N$R_h$$R_j$, -O$R_g$, -OC(O)$R_g$, -OC(O)N$R_h$$R_j$, -N$R_g$S(O)$_2$$R_h$, -S(O)$_2$N$R_g$, -S(O)$R_g$ or -S(O)$_2$$R_g$, or two R" on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

wherein each of $R_g$, $R_h$ and $R_j$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_h$ and $R_j$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

iii) wherein,

$R_X$ is H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen;

$X_1$ and $X_2$ are independently a bond or O;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl or $C_{6-10}$ aryl;

L is $CH_2$, $CD_2$ or CHD;

$m_1$ is 2, 3 or 4;

$R_3$ and $R_4$ are independently H, D or $C_{1-6}$ alkoxy, wherein said $C_{1-6}$ alkoxy is optionally substituted with one or more groups selected from $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl or 5-10 membered heteroaryl is optionally substituted with one or more groups selected from halogen or $C_{1-6}$ alkoxy;

lipid-like is $C_{1-28}$ alkyl or $C_{2-28}$ alkenyl; and

iv) wherein,

$R_X$ is H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H or D;

$X_1$ and $X_2$ are independently a bond or O;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl;

L is $CH_2$, $CD_2$ or CHD;

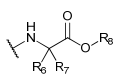
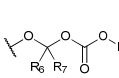
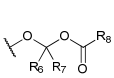
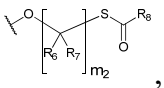
$m_1$ is 2, 3 or 4;

$R_3$ and $R_4$ are independently H, D or $C_{1-6}$ alkoxy, wherein said $C_{1-6}$ alkoxy is optionally substituted with one or more groups selected from $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl or 5-10 membered heteroaryl is optionally substituted with one or more groups selected from halogen or $C_{1-6}$ alkoxy;

lipid-like is $C_{1-28}$ alkyl or $C_{2-28}$ alkenyl.

8. The compound of any one of claims 6 to 7, or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, wherein the compound has any one of the following definitions:

i) wherein:

$W_2$ is  ,  ,  ,  ,  or  ;

wherein, $m_2$ is 1, 2, 3 or 4;

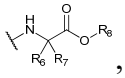
each of $R_6$ and $R_7$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{3-6}$ cycloalkyl

and 3-7 membered heterocyclyl are optionally substituted with one or more R';

each $R_8$ is independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl or $C_{2-28}$ alkynyl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl and $C_{2-28}$ alkynyl are optionally substituted with one or more R;

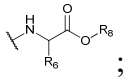
Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

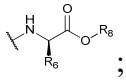
ii) wherein,

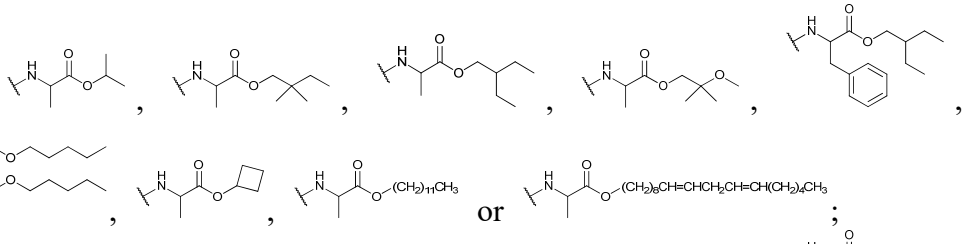
$W_2$ is  ,

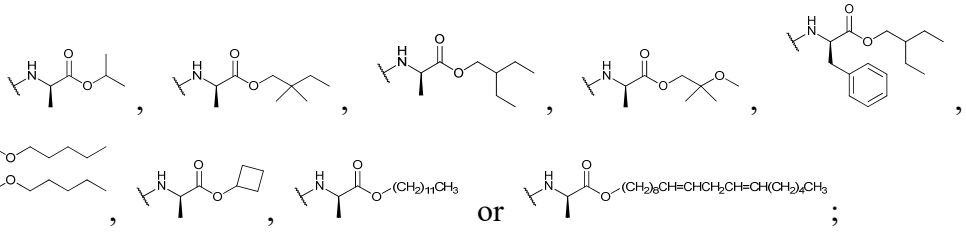
wherein, $R_6$ is $C_{1-6}$ alkyl, and $R_7$ is H, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl, wherein said $C_{1-6}$ alkyl and $C_{3-6}$ cycloalkyl are optionally substituted with one or more groups selected from phenyl or -C(O)O$C_{1-6}$ alkyl;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl, wherein said $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl is optionally substituted with one or more $C_{1-6}$ alkoxy;

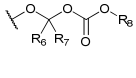
preferably, $W_2$ is  ;

preferably, $W_2$ is  ;

preferably, $W_2$ is  ;

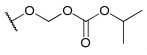
preferably, $W_2$ is  ;

iii) wherein,

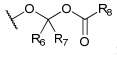
$W_2$ is  ,

wherein, $R_6$ and $R_7$ are H;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

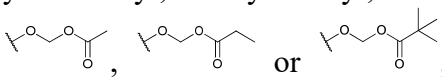
preferably, $W_2$ is  ;

iv) wherein,

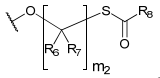
$W_2$ is  ,

wherein, $R_6$ and $R_7$ are H;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

preferably, $W_2$ is  ;

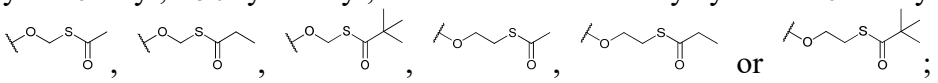
v) wherein,

$W_2$ is  ,

wherein, $m_2$ is 1 or 2;

$R_6$ and $R_7$ are H;

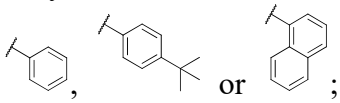
$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

preferably, $W_2$ is  ;

vi) wherein,

$W_2$ is  ,

wherein, Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl or 5-10 membered heteroaryl is optionally substituted with one or more $C_{1-6}$ alkyl;

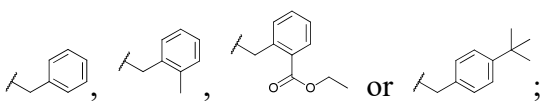
preferably, $W_2$ is  ;

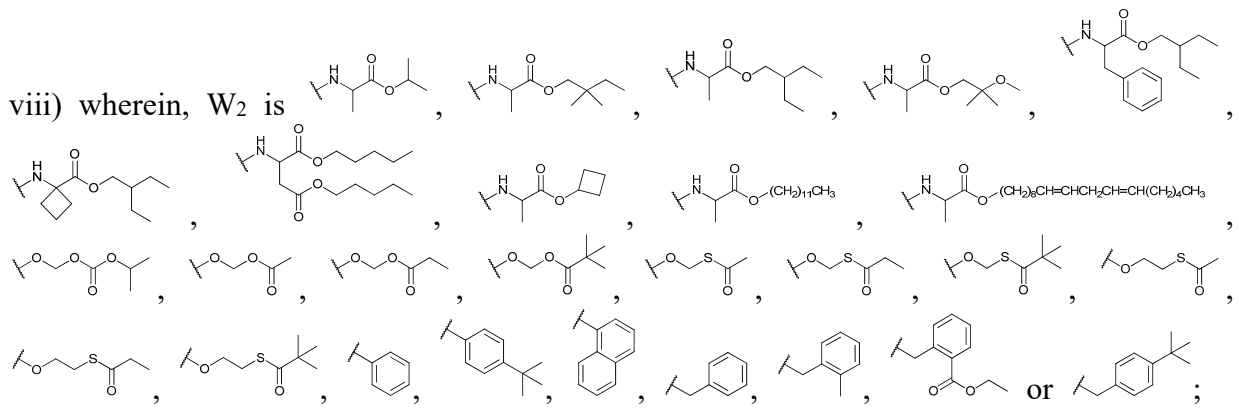
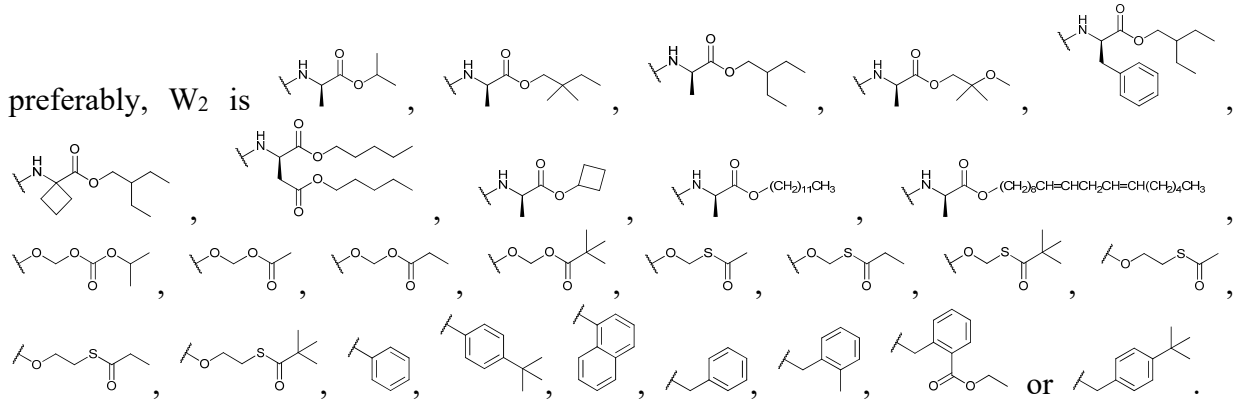
vii) wherein,

$W_2$ is  ,

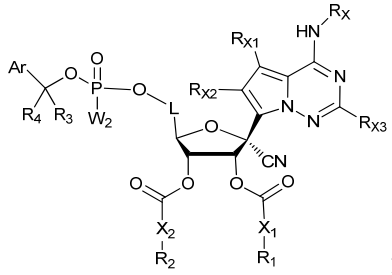
wherein, $R_6$ and $R_7$ are H;

Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl or 5-10 membered heteroaryl are optionally substituted with one or more groups selected from $C_{1-6}$ alkyl or -$C(O)OC_{1-6}$ alkyl;

preferably, $W_2$ is  ; and

viii) wherein, $W_2$ is  ; preferably, $W_2$ is  .

9. The compound of claim 1, which is a compound of formula (VII):



formula (VII)

wherein,

$R_X$ is H or OH;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D, halogen, -$R_a$, -C(O)$R_a$, -C(O)O$R_a$, -C(O)N$R_b$$R_c$, -N$R_b$$R_c$, -N$R_a$C(O)$R_b$, -N$R_a$C(O)O$R_b$, -N$R_a$C(O)N$R_b$$R_c$, -O$R_a$, -OC(O)$R_a$, -OC(O)N$R_b$$R_c$, -N$R_a$S(O)$_2$$R_b$, -S(O)$_2$N$R_a$, -S(O)$R_a$ or -S(O)$_2$$R_a$;

wherein each of $R_a$, $R_b$ and $R_c$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_b$ and $R_c$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

$X_1$ and $X_2$ are independently a bond, O, S or NH;

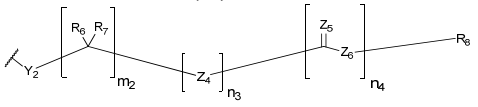
$R_1$ and $R_2$ are independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_3$ and $R_4$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

$W_2$ is formula (B):




formula (B)

wherein,

$Y_2$ is O, NH or S;

$Z_4$ is O, NH or S;

$Z_5$ is O, NH or S;

$Z_6$ is a bond, O, NH or S;

$m_2$ is 0, 1, 2, 3, 4, 5 or 6;

$n_3$ is 0 or 1;

$n_4$ is 0 or 1;

each of $R_6$ and $R_7$ is independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_8$ is H, D, $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl,

$C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

or, $W_2$ together with the 3'-position C atom of glycosyl form $-Y_3-$, wherein $Y_3$ is O, NH or S;

each R is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R", up to full deuteration;

each R' is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R' on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

wherein each of $R_d$, $R_e$ and $R_f$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_e$ and $R_f$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

each R" is independently D, halogen, $-R_g$, $-C(O)R_g$, $-C(O)OR_g$, $-C(O)NR_hR_j$, $-NR_hR_j$, $-NR_gC(O)R_h$, $-NR_gC(O)OR_h$, $-NR_gC(O)NR_hR_j$, $-OR_g$, $-OC(O)R_g$, $-OC(O)NR_hR_j$, $-NR_gS(O)_2R_h$, $-S(O)_2NR_g$, $-S(O)R_g$ or $-S(O)_2R_g$, or two R" on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

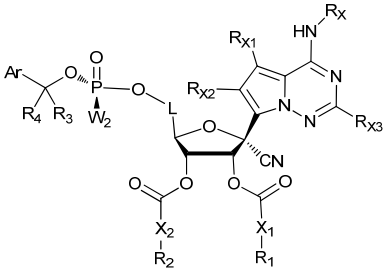
wherein each of $R_g$, $R_h$ and $R_j$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl,

3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_h$ and $R_j$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

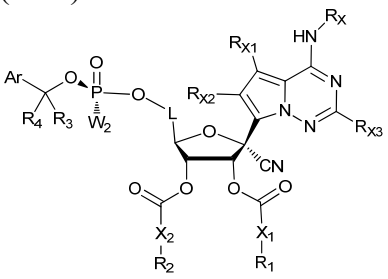
or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof.

10. The compound of claim 9, wherein the compound has any one of the following definitions:

i) which is a compound of formula (VIIa) or formula (VIIb):



formula (VIIa), or



formula (VIIb)

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof;

ii) wherein:

$R_X$ is H or OH;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D, halogen or $C_{1-6}$ alkyl, wherein said $C_{1-6}$ alkyl is optionally substituted with one or more deuterium atoms, up to full deuteration;

$X_1$ and $X_2$ are independently a bond, O, S or NH;

$R_1$ and $R_2$ are independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

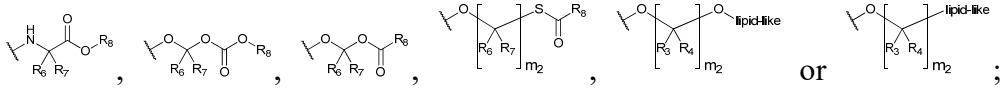
L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H, D, $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, or $R_3$ and $R_4$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl and 3-7 membered heterocyclyl

are optionally substituted with one or more R';

Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

$W_2$ is:



wherein,

$m_2$ is 1, 2, 3, 4, 5 or 6;

each of $R_6$ and $R_7$ is independently H, D, halogen, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{1-6}$ alkoxy, $C_{1-6}$ haloalkoxy, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R';

$R_8$ is $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl, $C_{2-28}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

lipid-like is $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl or $C_{8-28}$ alkynyl, wherein said $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl and $C_{8-28}$ alkynyl are optionally substituted with one or more R;

Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

each R is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, $-S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R", up to full deuteration;

each R' is independently D, halogen, $-R_d$, $-C(O)R_d$, $-C(O)OR_d$, $-C(O)NR_eR_f$, $-NR_eR_f$, $-NR_dC(O)R_e$, $-NR_dC(O)OR_e$, $-NR_dC(O)NR_eR_f$, $-OR_d$, $-OC(O)R_d$, $-OC(O)NR_eR_f$, $-NR_dS(O)_2R_e$, -

$S(O)_2NR_d$, $-S(O)R_d$ or $-S(O)_2R_d$, or two R' on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

wherein each of $R_d$, $R_e$ and $R_f$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_e$ and $R_f$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R";

each R" is independently D, halogen, $-R_g$, $-C(O)R_g$, $-C(O)OR_g$, $-C(O)NR_hR_j$, $-NR_hR_j$, $-NR_gC(O)R_h$, $-NR_gC(O)OR_h$, $-NR_gC(O)NR_hR_j$, $-OR_g$, $-OC(O)R_g$, $-OC(O)NR_hR_j$, $-NR_gS(O)_2R_h$, $-S(O)_2NR_g$, $-S(O)R_g$ or $-S(O)_2R_g$, or two R" on the same atom or two adjacent atoms, together with the atoms to which they are attached, form a $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

wherein each of $R_g$, $R_h$ and $R_j$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl or 5-10 membered heteroaryl, or $R_h$ and $R_j$ together with the N atom to which they are attached, form a 3-7 membered heterocyclyl or 5-10 membered heteroaryl; wherein said $C_{1-6}$ alkyl, $C_{1-6}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-6}$ alkenyl, $C_{2-6}$ alkynyl, $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more deuterium atoms, up to full deuteration;

iii) wherein,

$R_X$ is H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen;

$X_1$ and $X_2$ are independently a bond or O;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl, $C_{3-6}$ cycloalkyl or $C_{6-10}$ aryl;

L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H, D or $C_{1-6}$ alkyl;

Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl; and

iv) wherein,

$R_X$ is H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H or D;

$X_1$ and $X_2$ are independently a bond or O;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl;

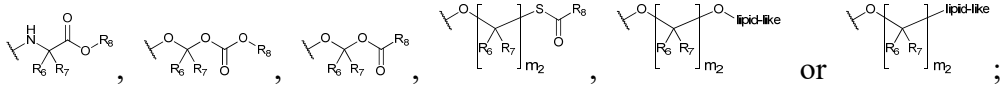
L is $CH_2$, $CD_2$ or CHD;

$R_3$ and $R_4$ are independently H or D;

Ar is $C_{6-10}$ aryl.

11. The compound of any one of claims 9 to 10, or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, wherein the compound has any one of the following definitions:

i) wherein:

$W_2$ is 

or ;

wherein, $m_2$ is 1, 2, 3 or 4;

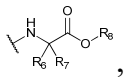
each of $R_6$ and $R_7$ is independently H, D, $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, wherein said $C_{1-6}$ alkyl, $C_{1-6}$ alkoxy, $C_{3-6}$ cycloalkyl and 3-7 membered heterocyclyl are optionally substituted with one or more R';

each $R_8$ is independently $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl or $C_{2-28}$ alkynyl, wherein said $C_{1-28}$ alkyl, $C_{1-28}$ haloalkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl, $C_{2-28}$ alkenyl and $C_{2-28}$ alkynyl are optionally substituted with one or more R;

lipid-like is $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl or $C_{8-28}$ alkynyl, wherein said $C_{8-28}$ alkyl, $C_{8-28}$ haloalkyl, $C_{8-28}$ alkenyl and $C_{8-28}$ alkynyl are optionally substituted with one or more R;

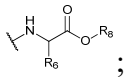
Ar is $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl and 5-10 membered heteroaryl are optionally substituted with one or more R;

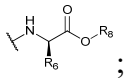
ii) wherein,

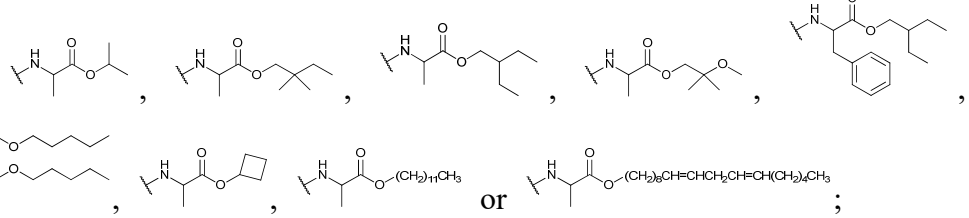
$W_2$ is  ,

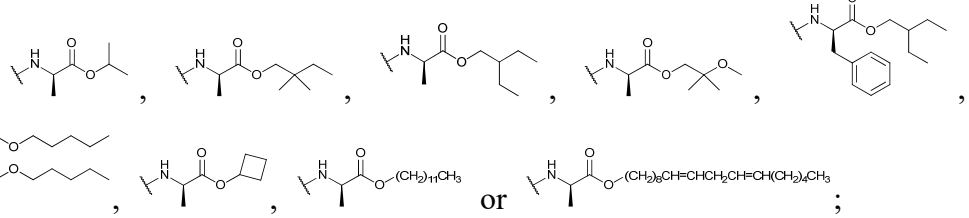
wherein, $R_6$ is $C_{1-6}$ alkyl, and $R_7$ is H, or $R_6$ and $R_7$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl, wherein said $C_{1-6}$ alkyl and $C_{3-6}$ cycloalkyl are optionally substituted with one or more groups selected from phenyl or -C(O)O$C_{1-6}$ alkyl;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl, wherein said $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl are optionally substituted with one or more $C_{1-6}$ alkoxy;

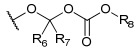
preferably, $W_2$ is  ;

preferably, $W_2$ is  ;

preferably, $W_2$ is  ;

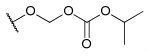
preferably, $W_2$ is  ;

iii) wherein,

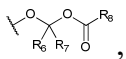
$W_2$ is  ,

wherein, $R_6$ and $R_7$ are H;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

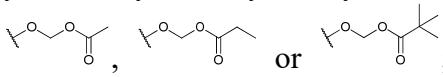
preferably, $W_2$ is  ;

iv) wherein,

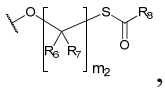
$W_2$ is  ,

wherein, $R_6$ and $R_7$ are H;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

preferably, $W_2$ is  ;

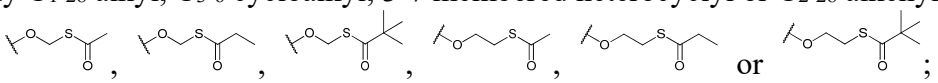
v) wherein,

$W_2$ is  ,

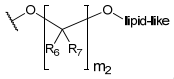
wherein, $m_2$ is 1 or 2;

$R_6$ and $R_7$ are H;

$R_8$ is independently $C_{1-28}$ alkyl, $C_{3-6}$ cycloalkyl, 3-7 membered heterocyclyl or $C_{2-28}$ alkenyl;

preferably, $W_2$ is  ;

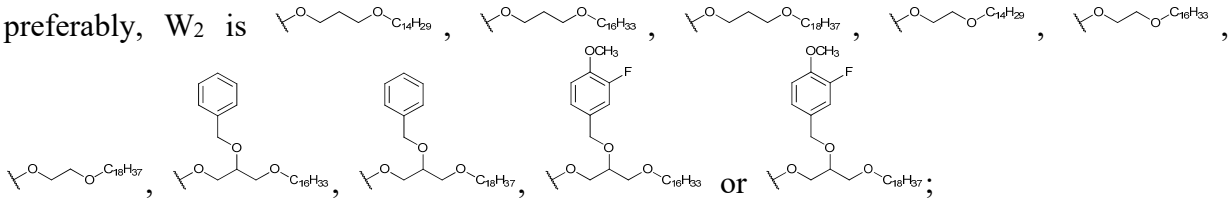
vi) wherein,

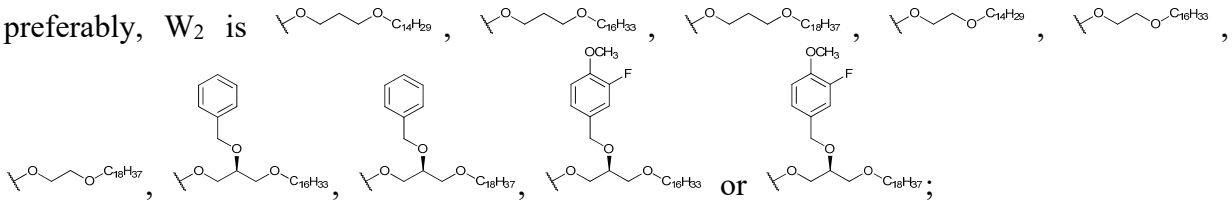
$W_2$ is  ,

wherein, $m_2$ is 2, 3 or 4;

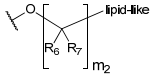
$R_6$ and $R_7$ are independently H or $C_{1-6}$ alkoxy, wherein said $C_{1-6}$ alkoxy are optionally substituted with one or more groups selected from $C_{6-10}$ aryl or 5-10 membered heteroaryl, wherein said $C_{6-10}$ aryl or 5-10 membered heteroaryl are optionally substituted with one or more groups selected from halogen or $C_{1-6}$ alkoxy;

lipid-like is $C_{8-28}$ alkyl or $C_{8-28}$ alkenyl;

preferably, $W_2$ is  ;

preferably, $W_2$ is  ;

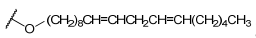
vii) wherein,

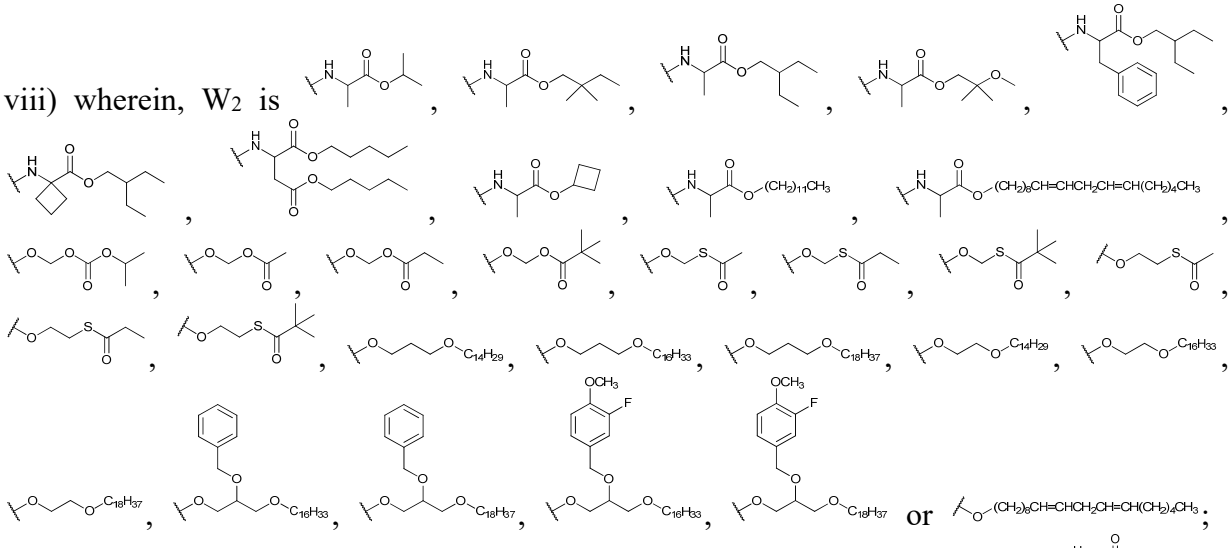
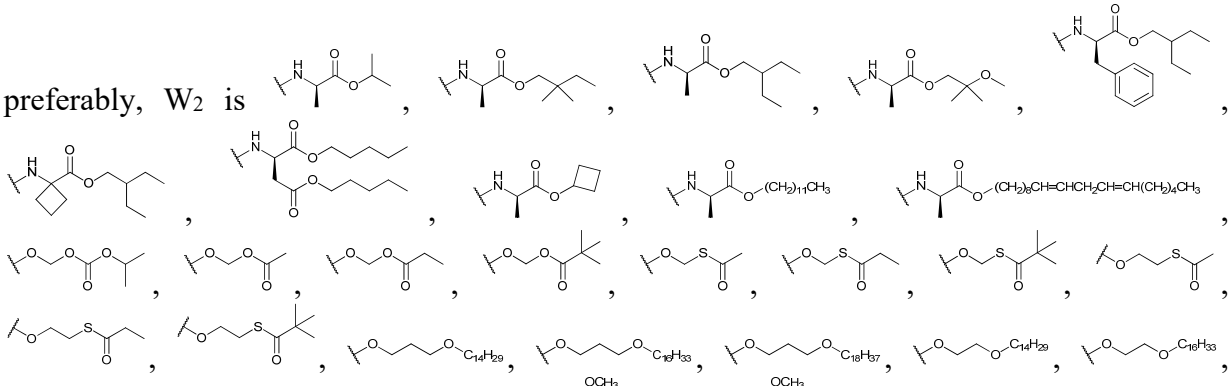
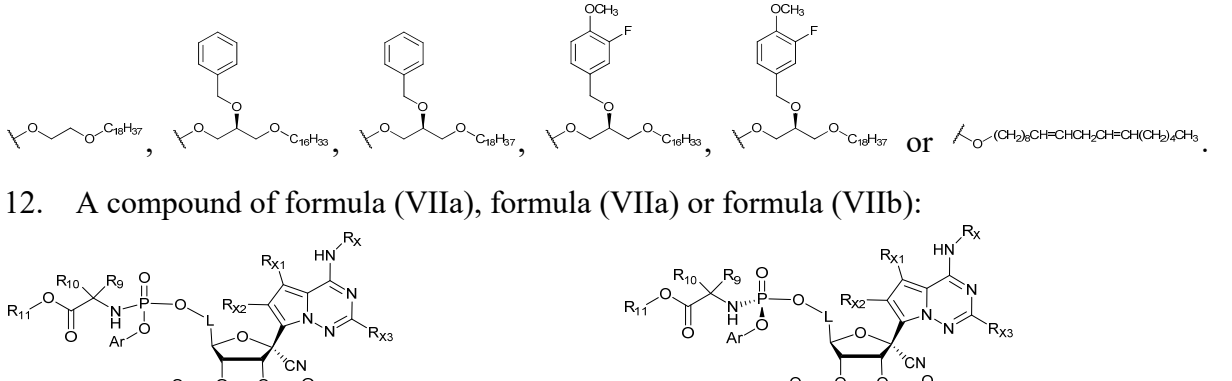
$W_2$ is  ,

wherein, $m_2$ is 2, 3 or 4;

$R_6$ and $R_7$ are H;

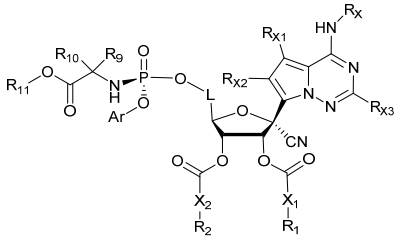
lipid-like is $C_{8-28}$ alkenyl;

preferably, $W_2$ is  ; and

viii) wherein, $W_2$ is  ,  ; preferably, $W_2$ is ,  .

12. A compound of formula (VIIa), formula (VIIa) or formula (VIIb):

 formula (VII),  formula (VIIa)

or  formula (VII)

wherein the compound has any one of the following definitions:

i) wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

$X_1$ and $X_2$ are independently a bond, O, S or NH, preferably a bond or O, and more preferably a

bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

$R_9$ is $CH_2$-$C_{6-10}$ aryl, $CH_2$-5-10 membered heteroaryl, $CH_2C(O)O$-$C_{1-6}$ alkyl, $CH_2C(O)O$-$C_{3-6}$ cycloalkyl or $CH_2C(O)O$-3-7 membered heteroaryl, preferably $CH_2$-phenyl, $CH_2C(O)O$-$C_{1-6}$ alkyl or $CH_2C(O)O$-$C_{3-6}$ cycloalkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration; and $R_{10}$ is H or D;

or, $R_9$ and $R_{10}$ together with the C atom to which they are attached, form a $C_{3-6}$ cycloalkyl or 3-7 membered heterocyclyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

Ar is phenyl, which is optionally substituted with one or more R;

R is independently D, $C_{1-6}$ alkyl or -$OC_{1-6}$ alkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration;

or a tautomer, a stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof; and

ii) wherein,

$R_X$ is H or OH, preferably H;

$R_{X1}$, $R_{X2}$ and $R_{X3}$ are independently H, D or halogen, preferably H or D;

$X_1$ and $X_2$ are independently a bond or O, preferably a bond;

$R_1$ and $R_2$ are independently $C_{1-6}$ alkyl (preferably $C_{1-3}$ alkyl, more preferably isopropyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

L is $CH_2$, $CD_2$ or CHD;

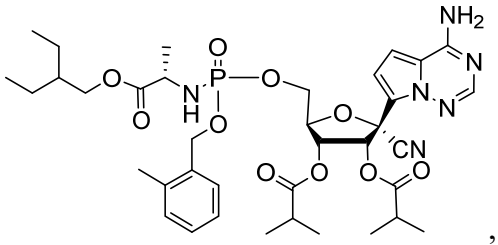
$R_9$ is $CH_2$-phenyl, $CH_2C(O)O$-$C_{1-6}$ alkyl or $CH_2C(O)O$-$C_{3-6}$ cycloalkyl, which is optionally substituted with one or more deuterium atoms, up to full deuteration; and $R_{10}$ is H or D;

Ar is phenyl, which is optionally substituted with one or more R;

R is independently $C_{1-6}$ alkyl (preferably tert-butyl), which is optionally substituted with one or more deuterium atoms, up to full deuteration;

or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof.

13. A compound, or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, wherein, the compound is selected from the group consisting of: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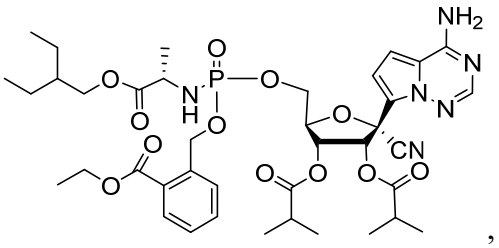
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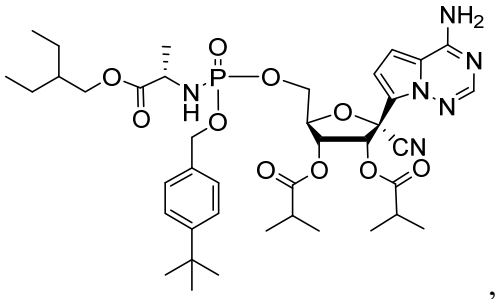
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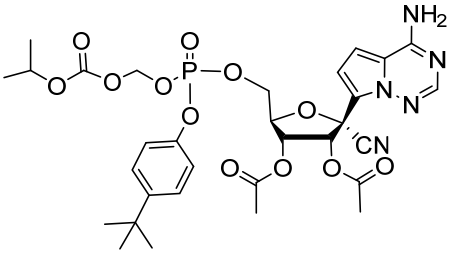
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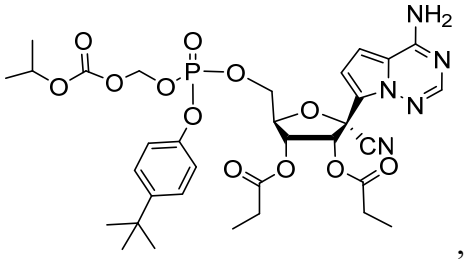
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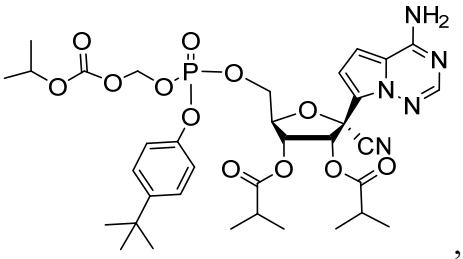
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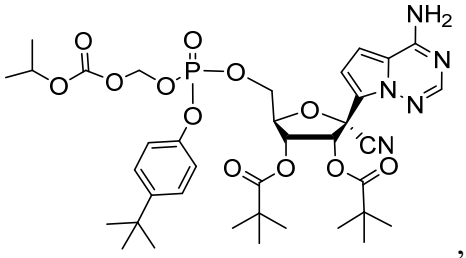
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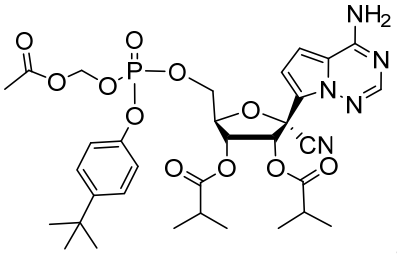
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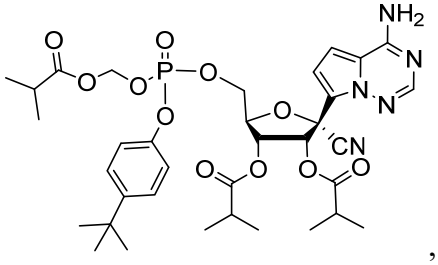
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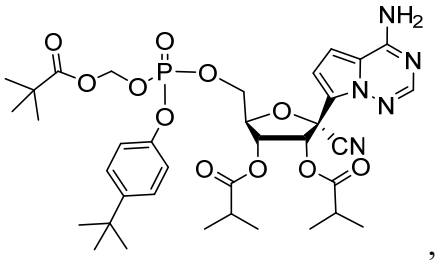
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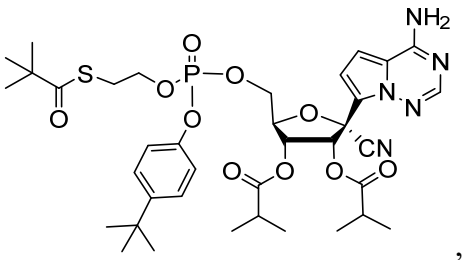
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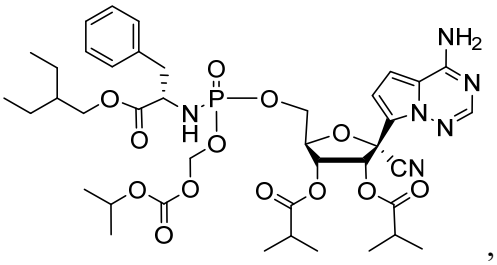
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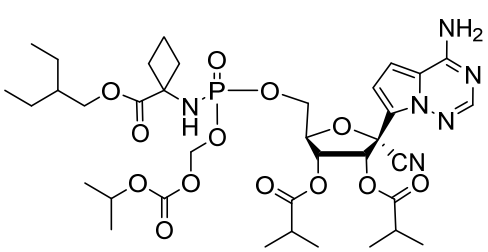
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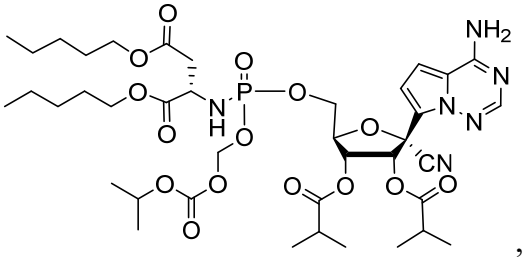
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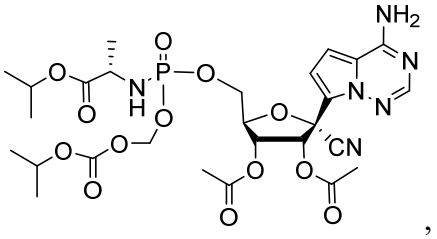
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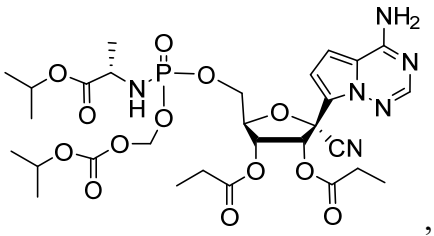
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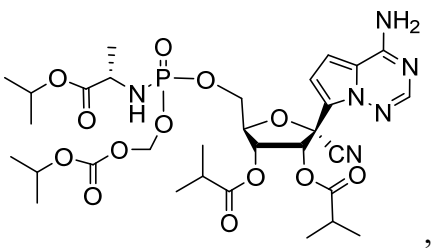
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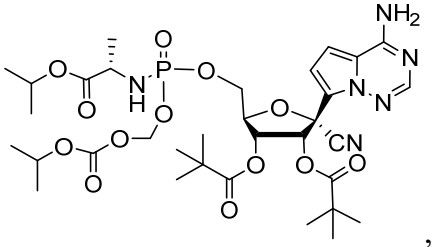
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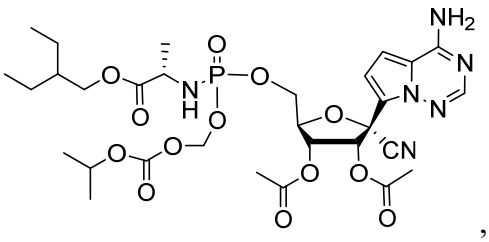
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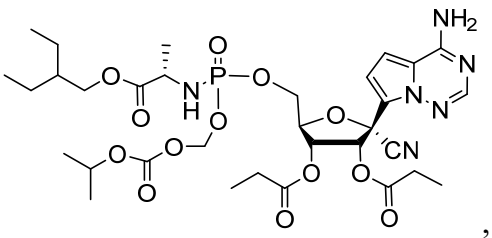
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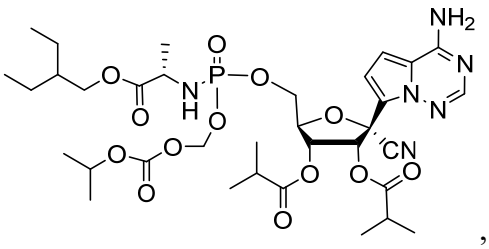
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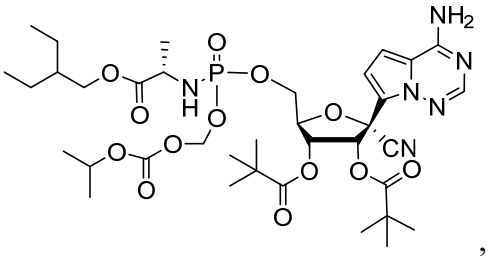
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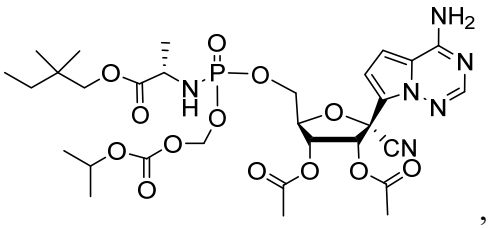
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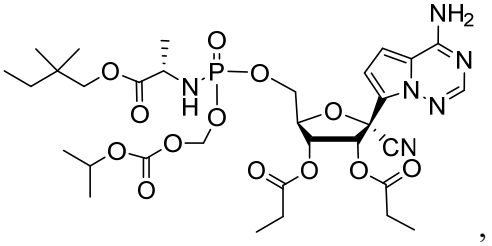
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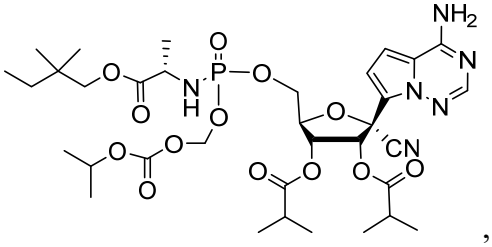
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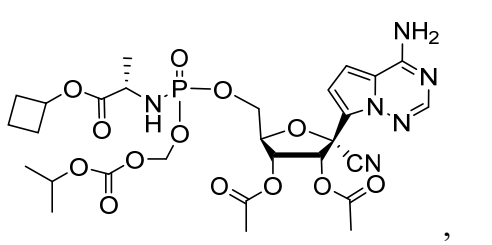
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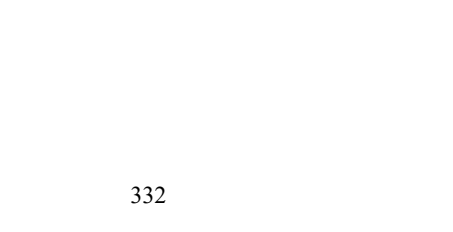
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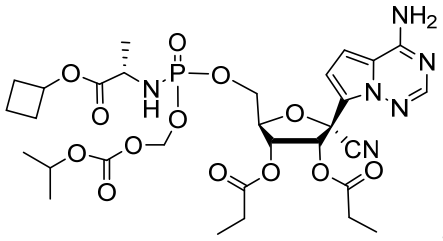
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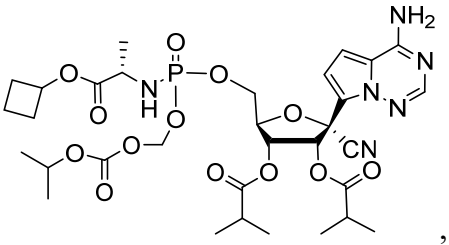
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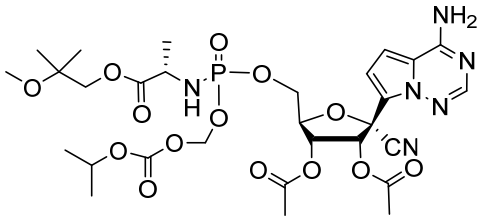
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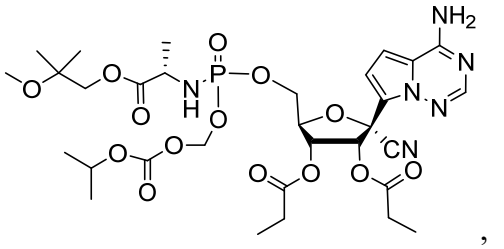
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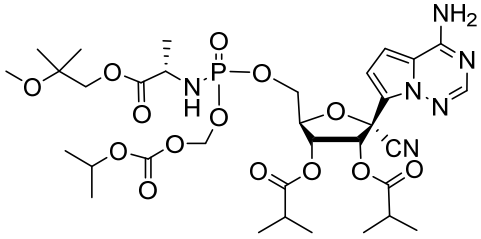
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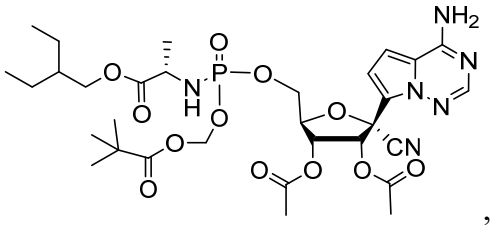
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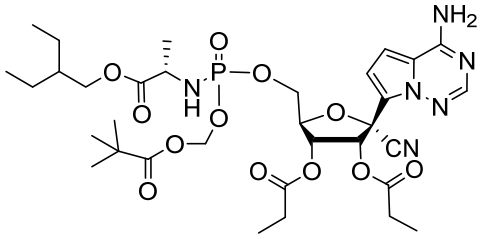
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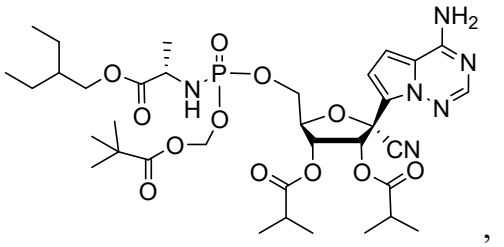
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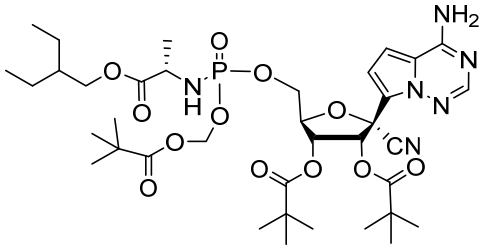
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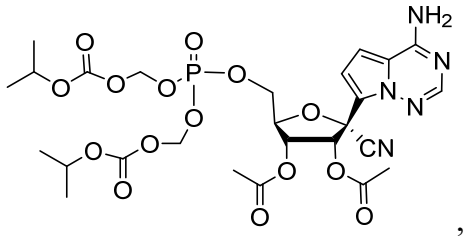
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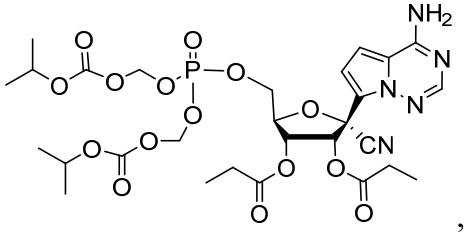
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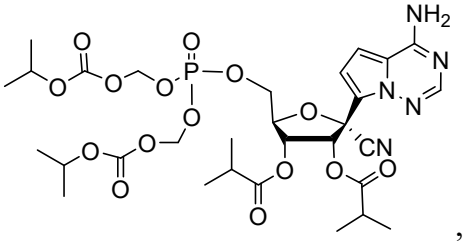
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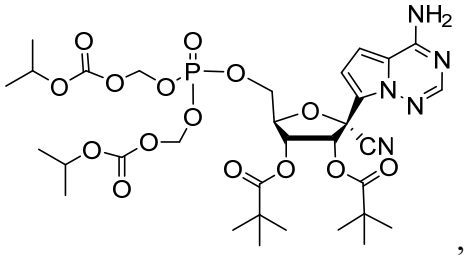
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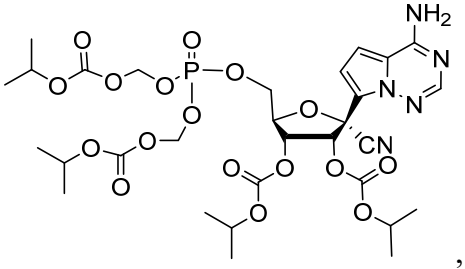
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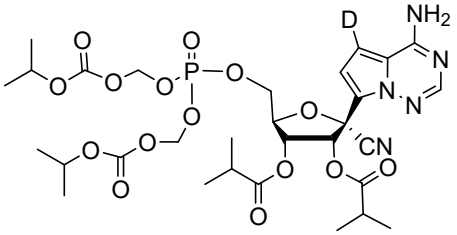
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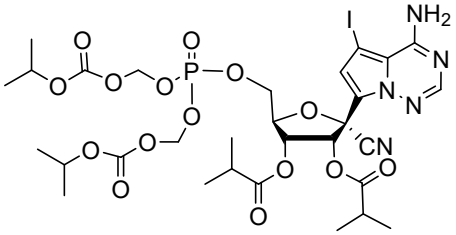
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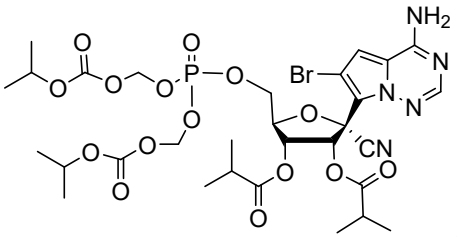
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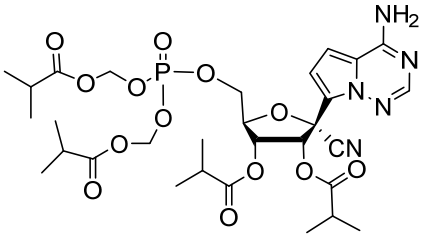
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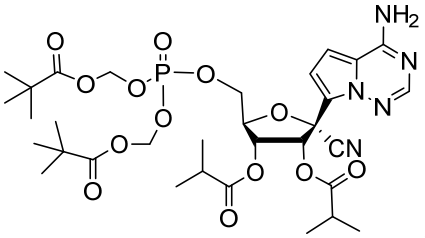
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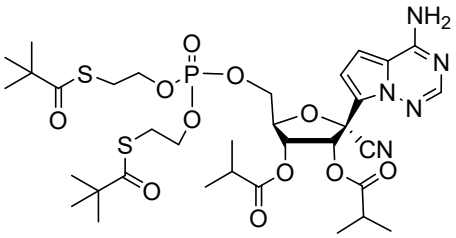
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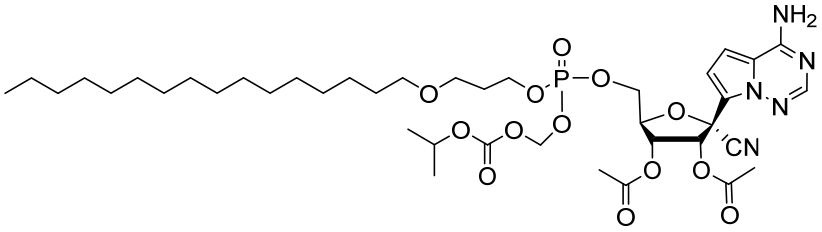
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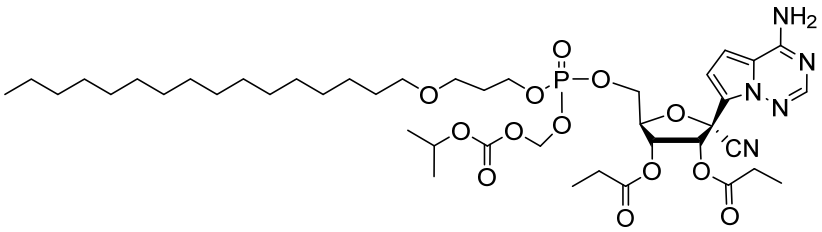
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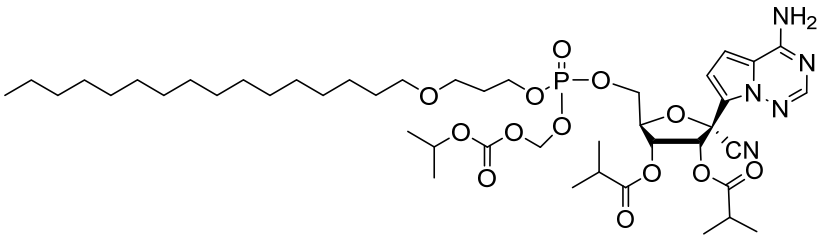
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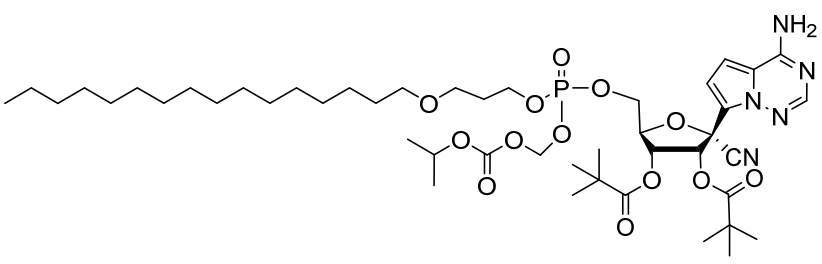
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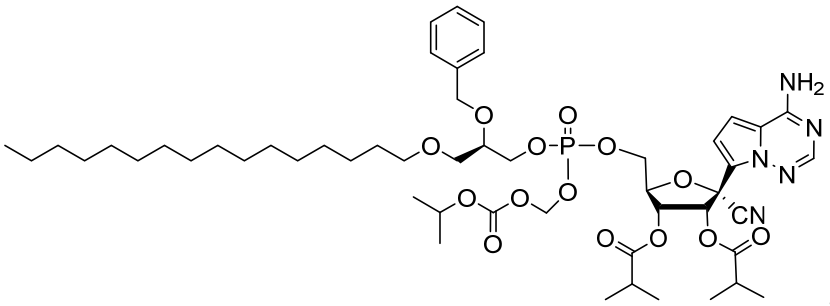
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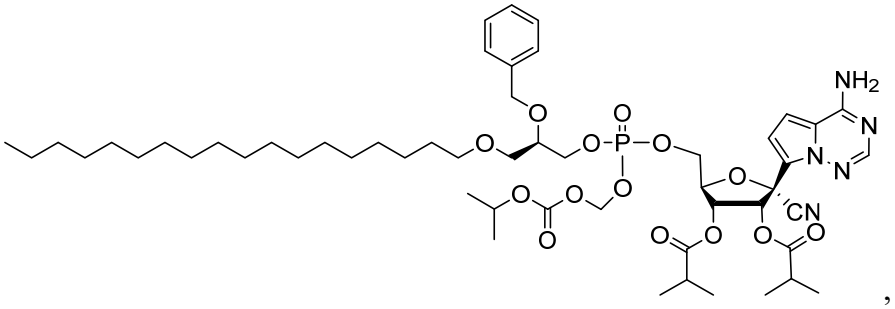
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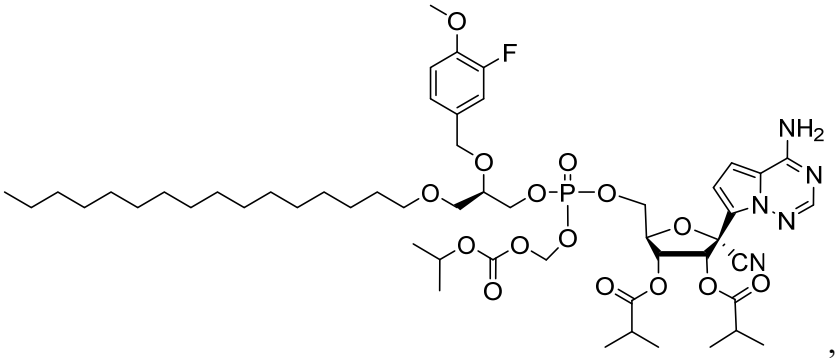
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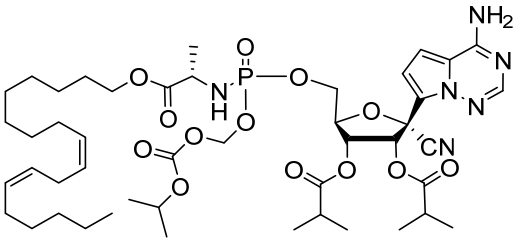
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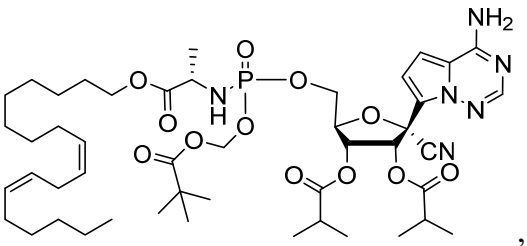
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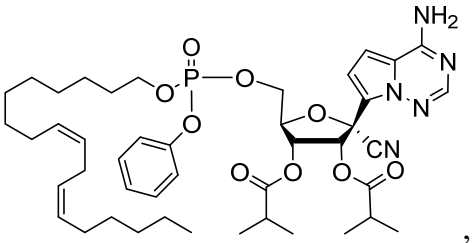
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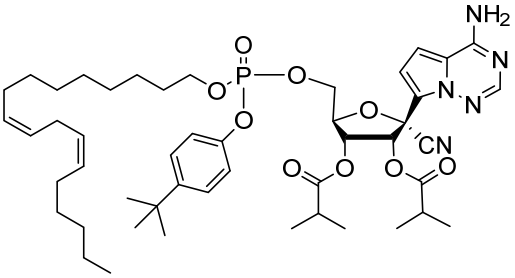
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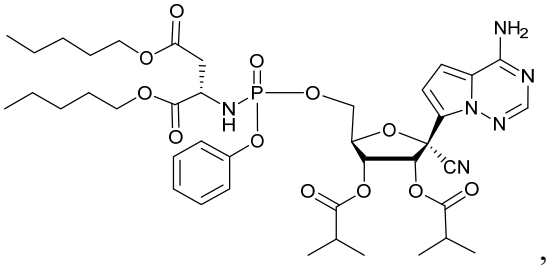
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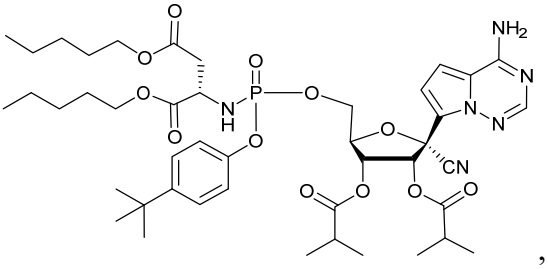
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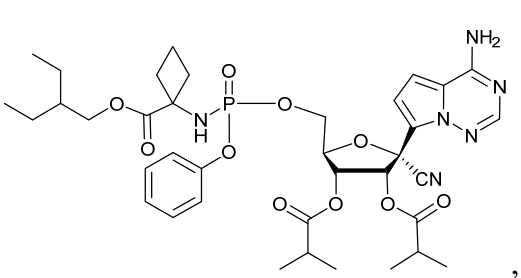
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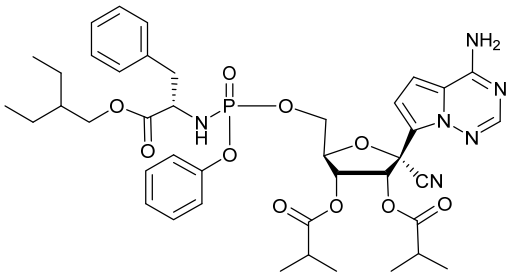
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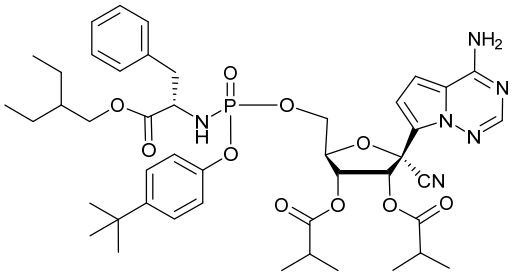
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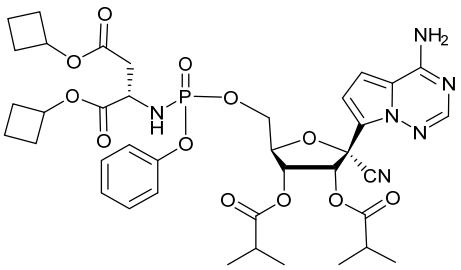
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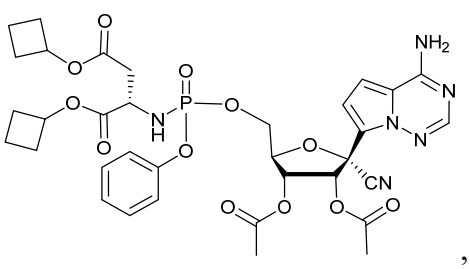
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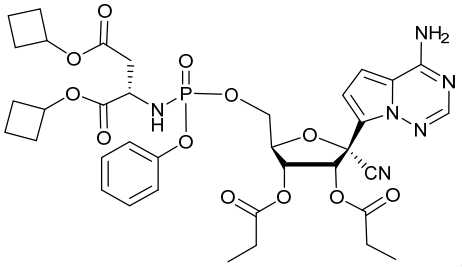
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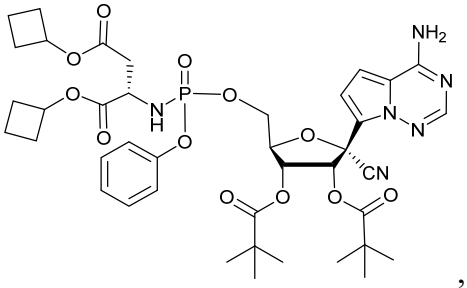
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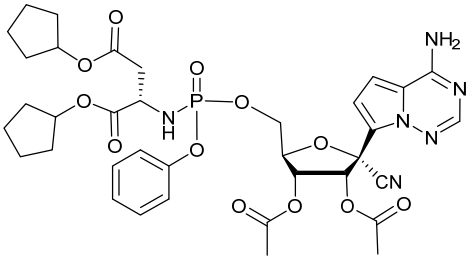
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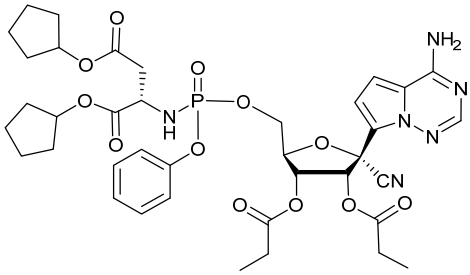
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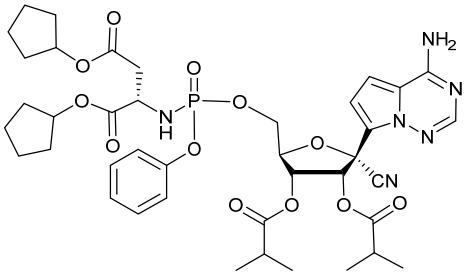
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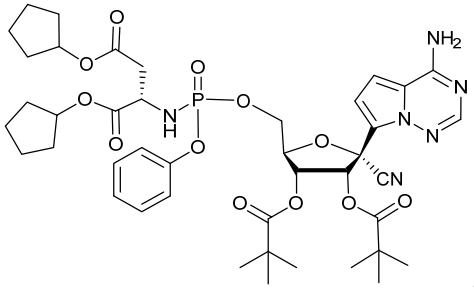
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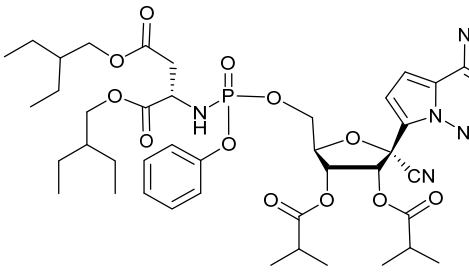
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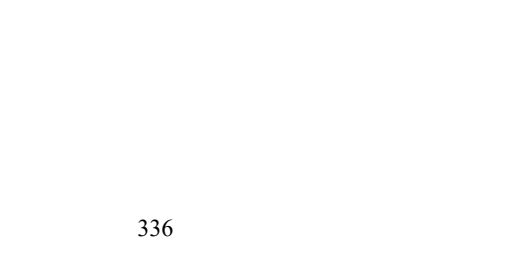
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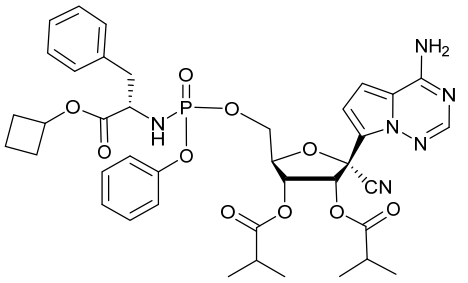
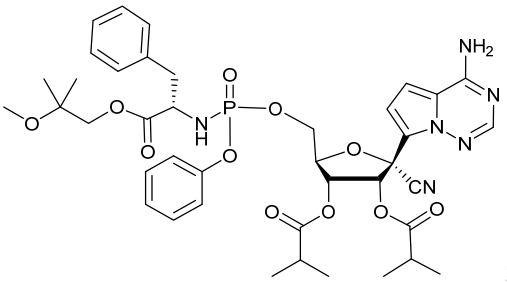
 or  ;

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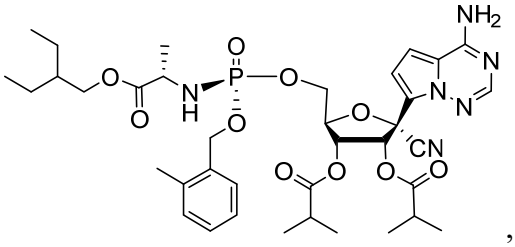
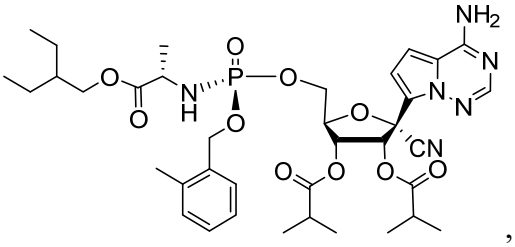
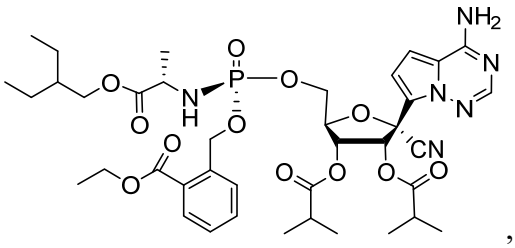
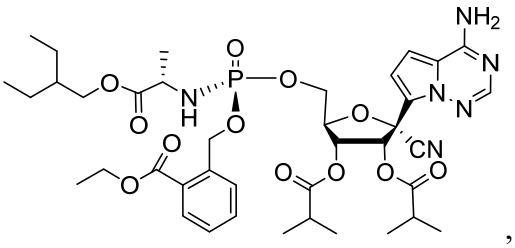
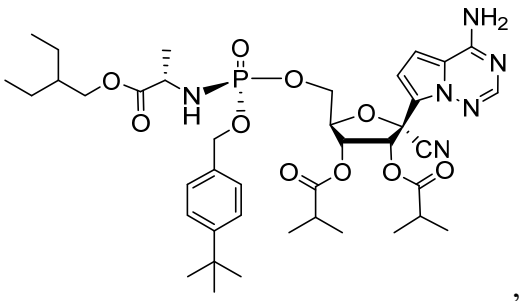
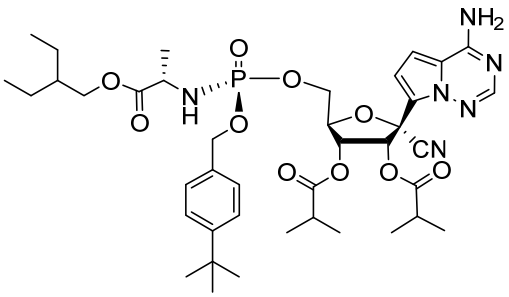
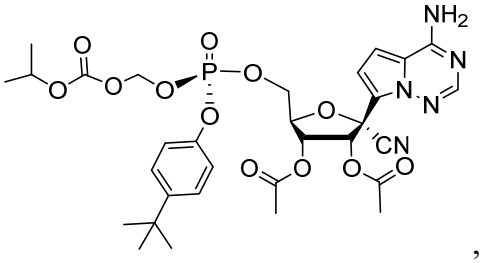
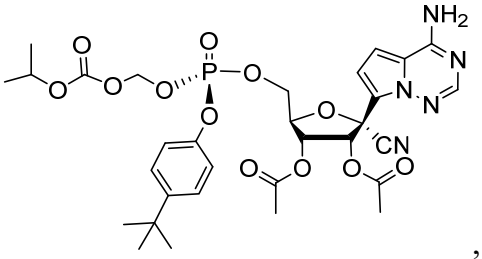
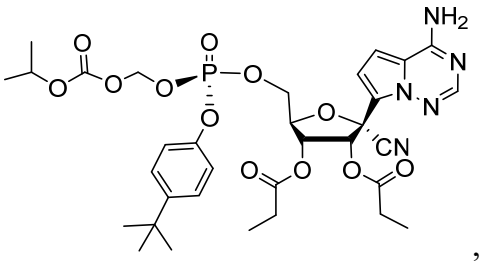
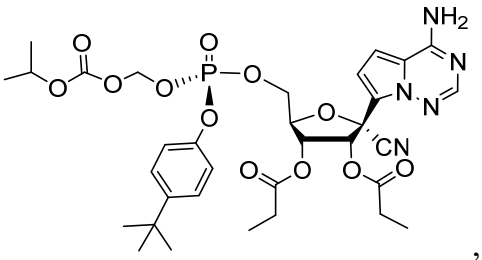
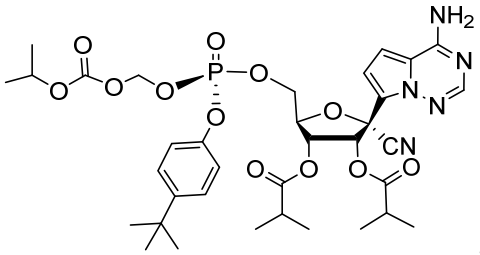
 ,  ,

 ,  ,

 ,  ,

 ,  ,

 ,  ,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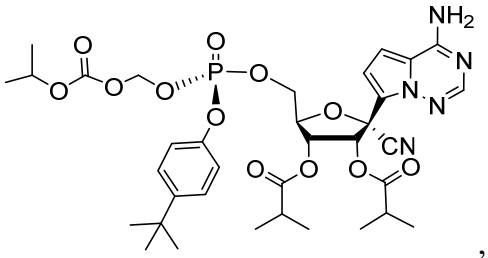
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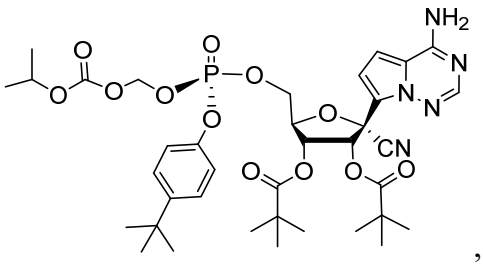
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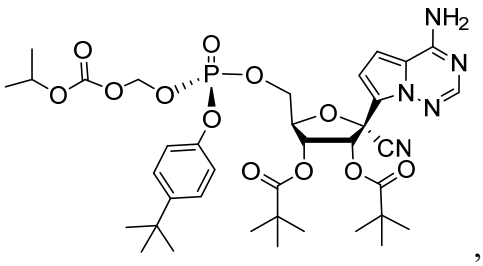
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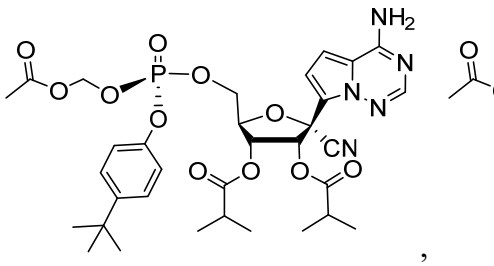
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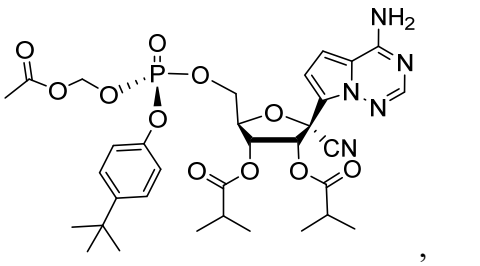
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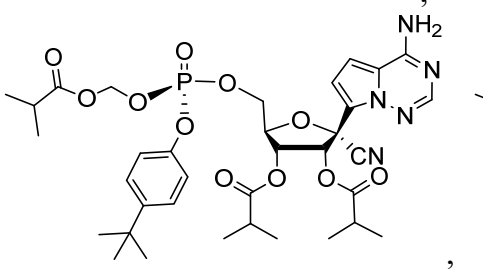
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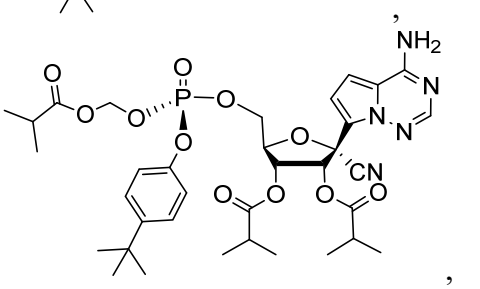
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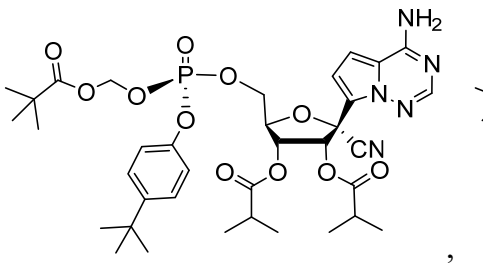
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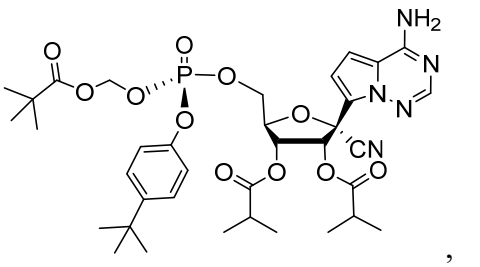
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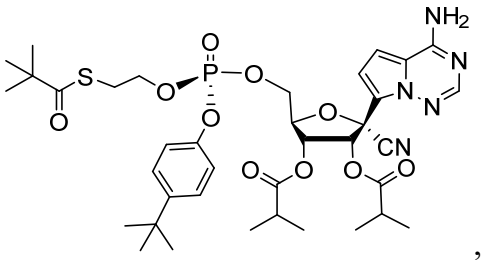
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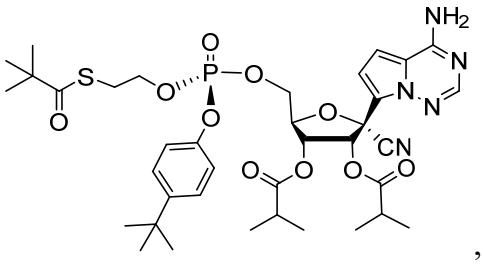
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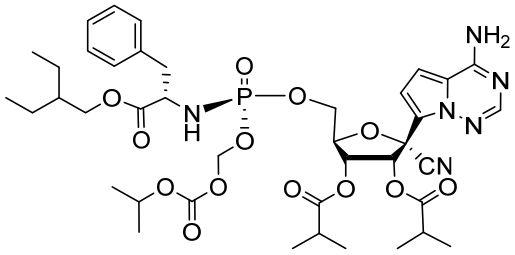
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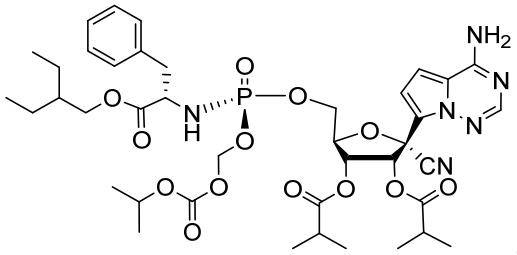
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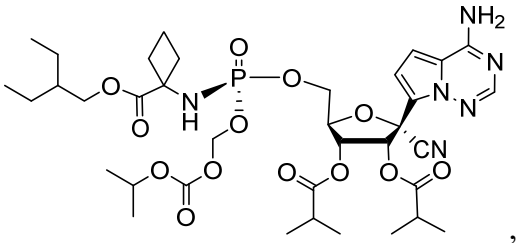
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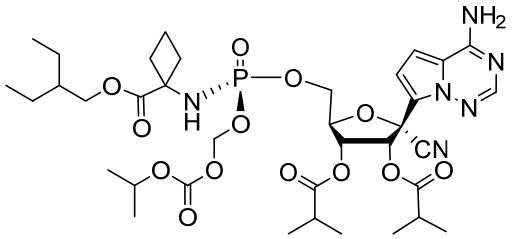
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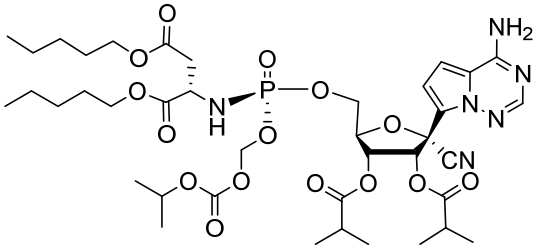
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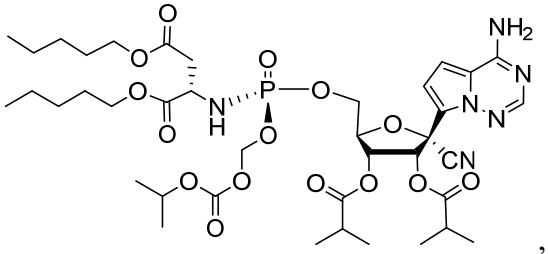
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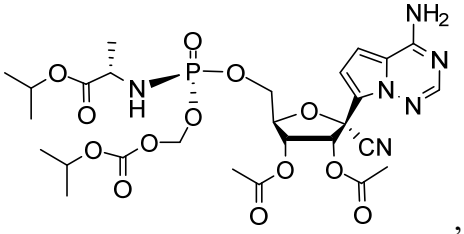
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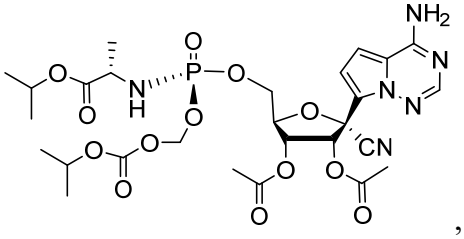
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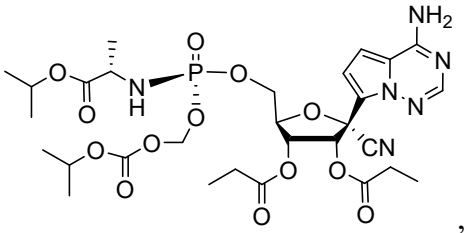
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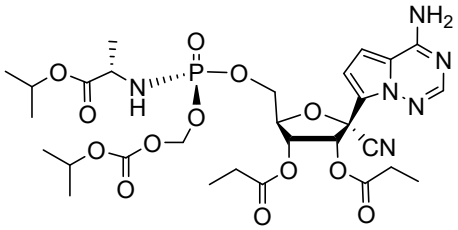
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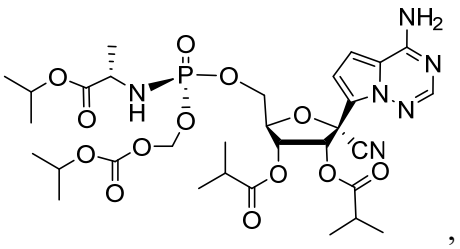
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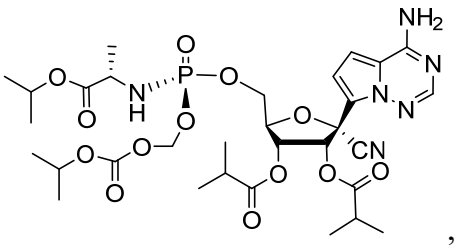
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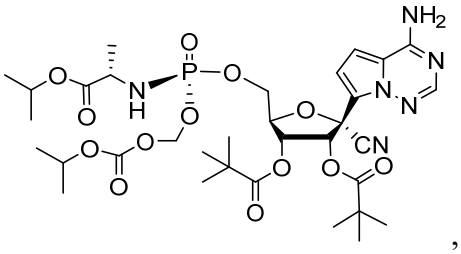
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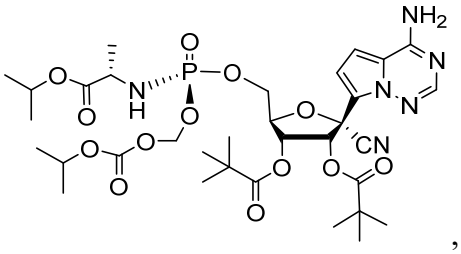
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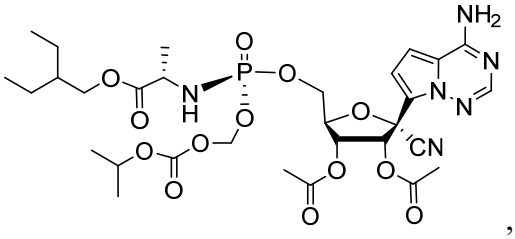
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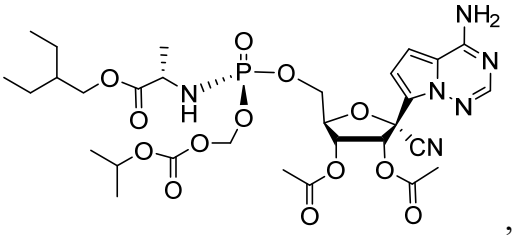
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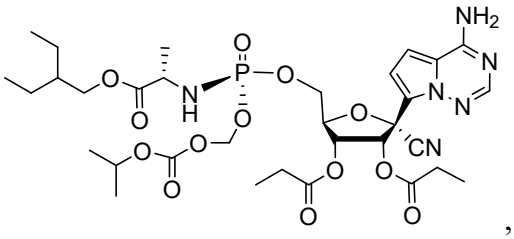
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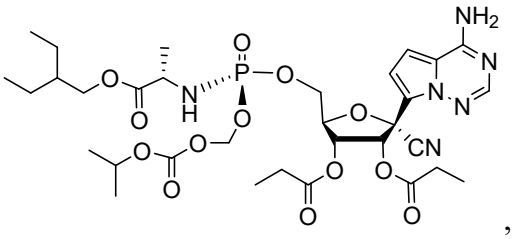
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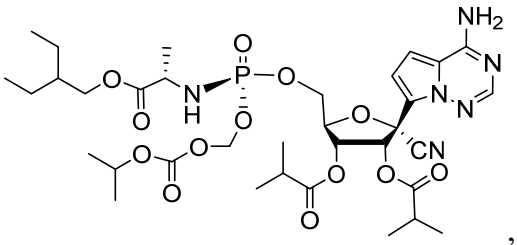
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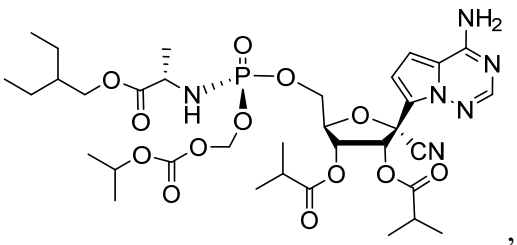
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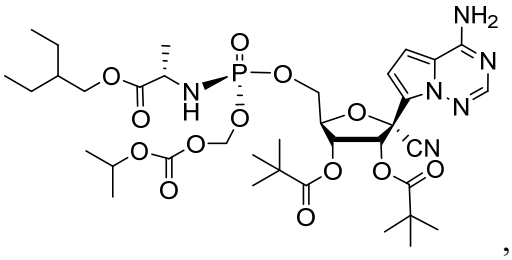
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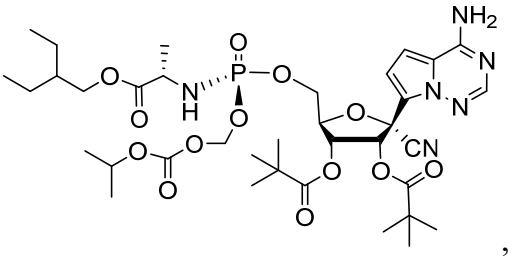
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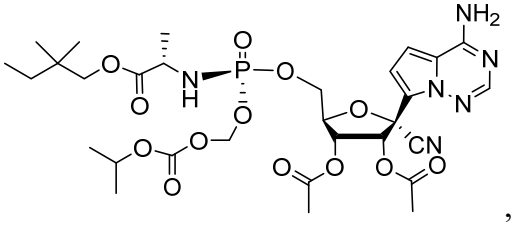
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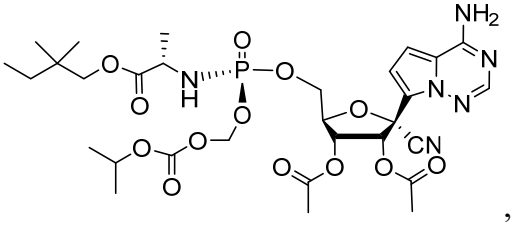
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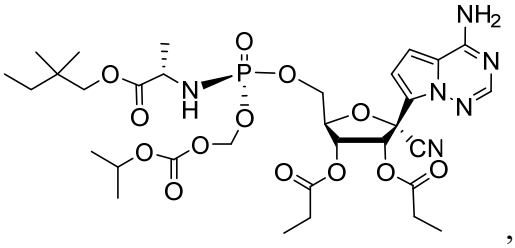
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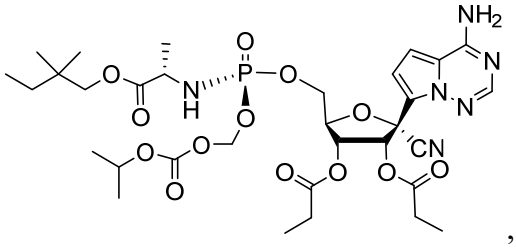
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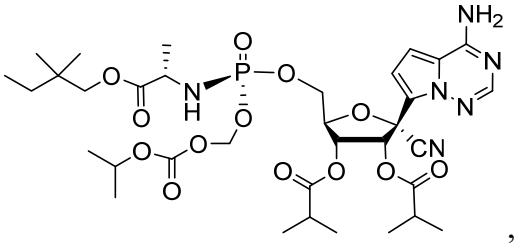
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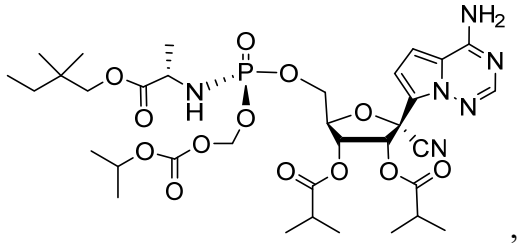
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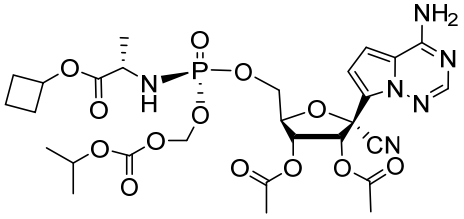
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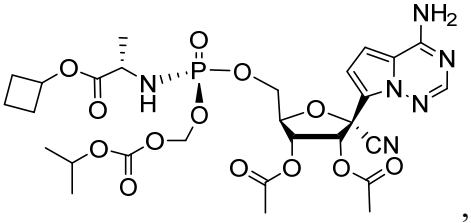
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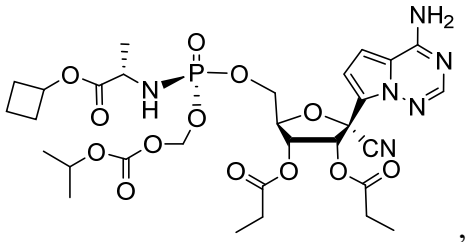
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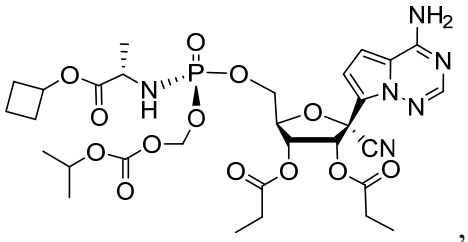
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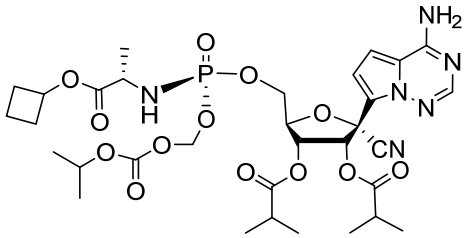
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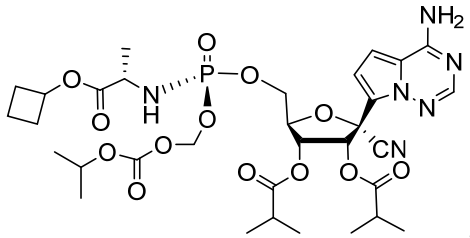
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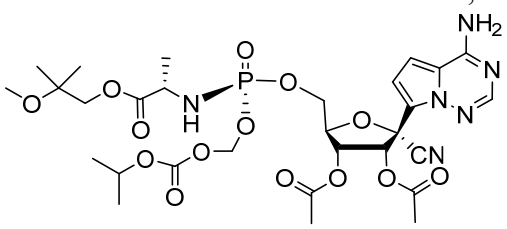
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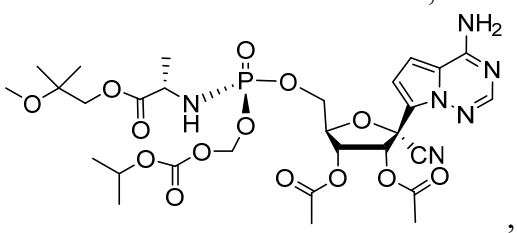
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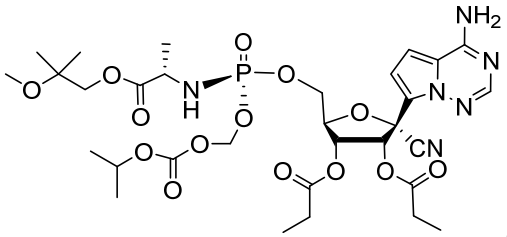
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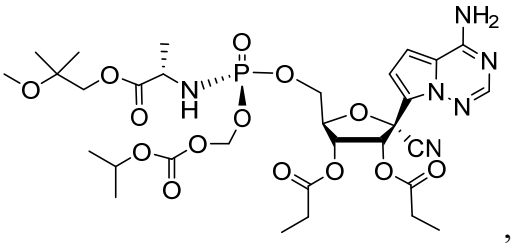
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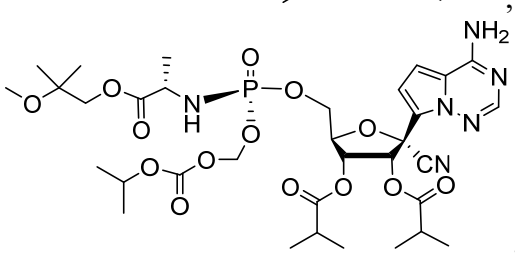
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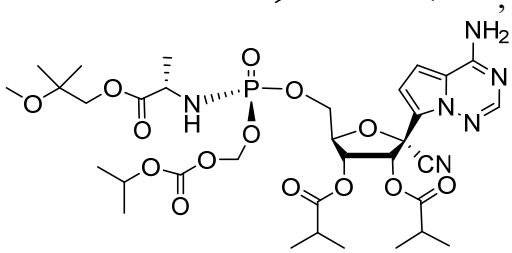
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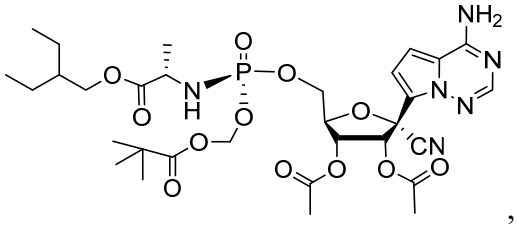
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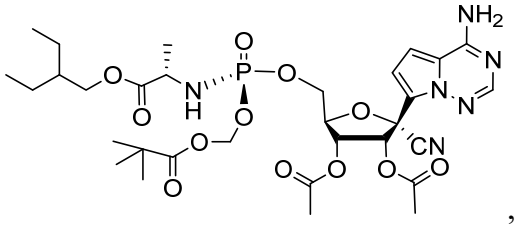
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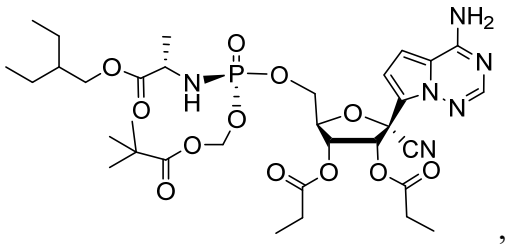
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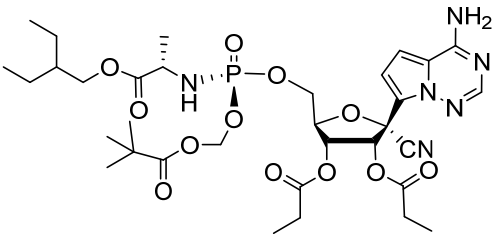
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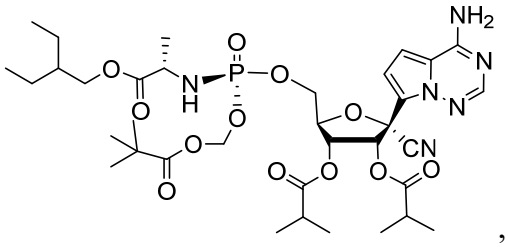
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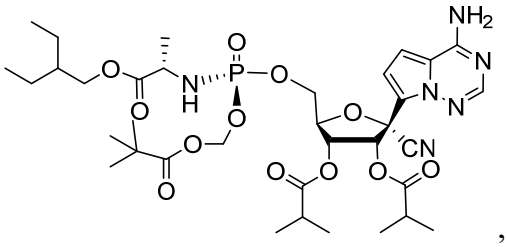
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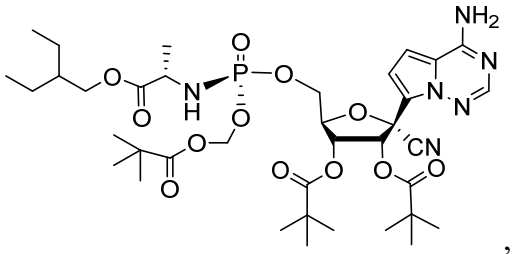
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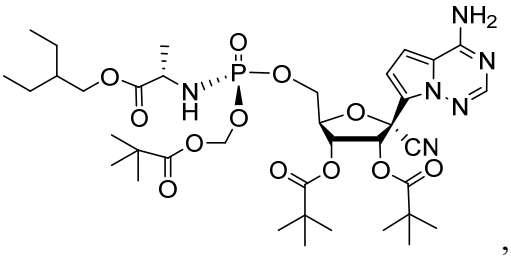
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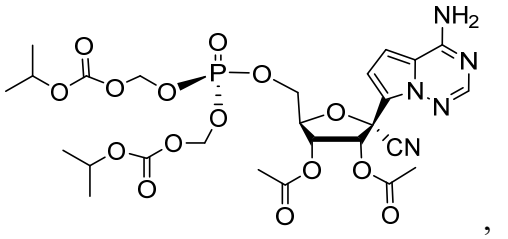
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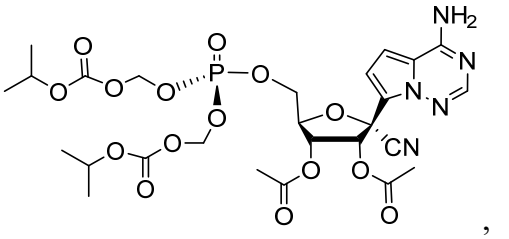
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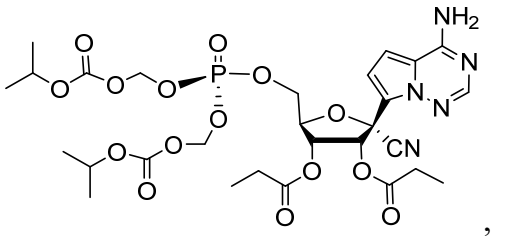
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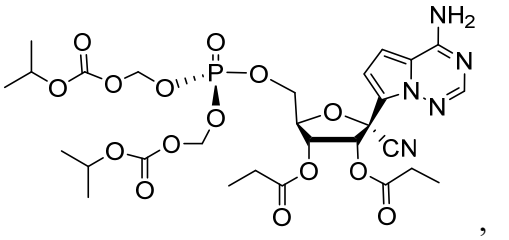
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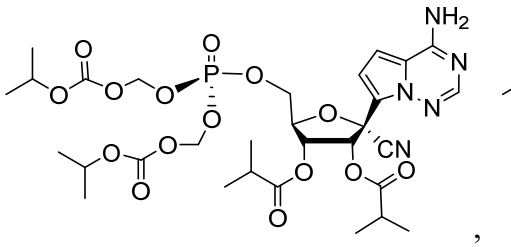
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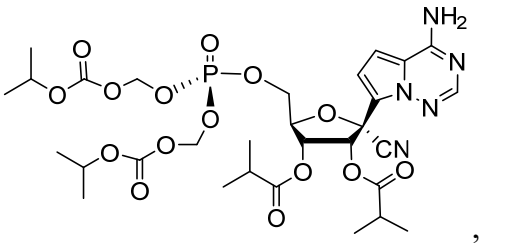
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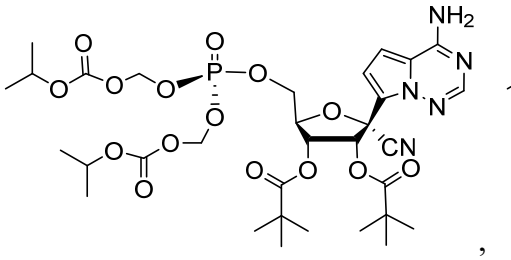
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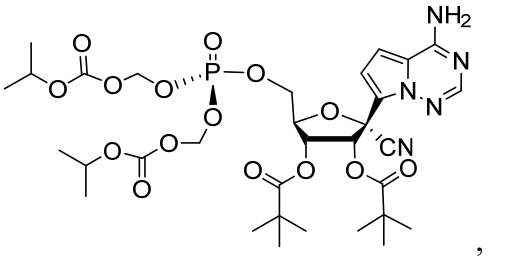
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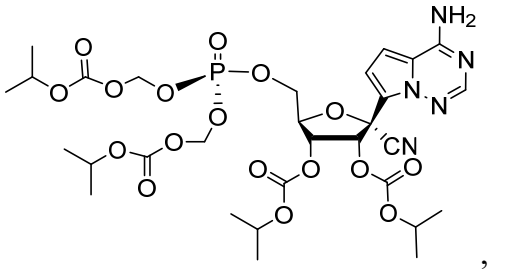
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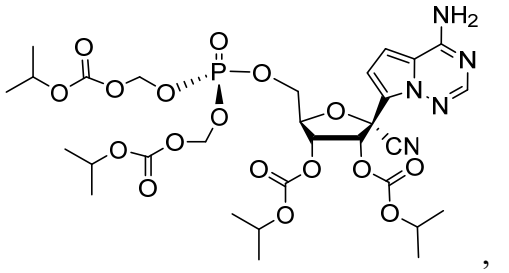
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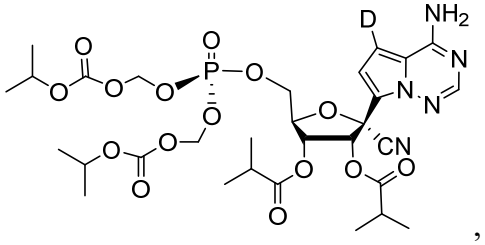
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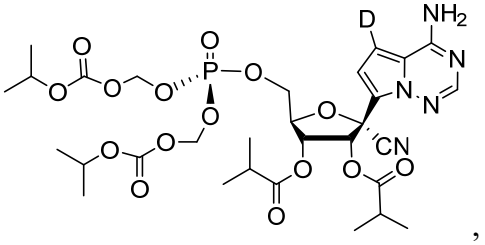
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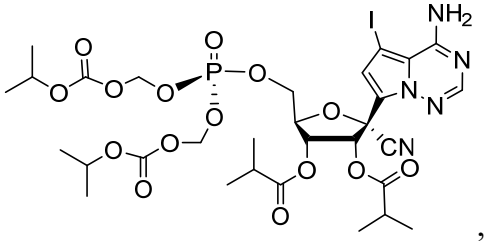
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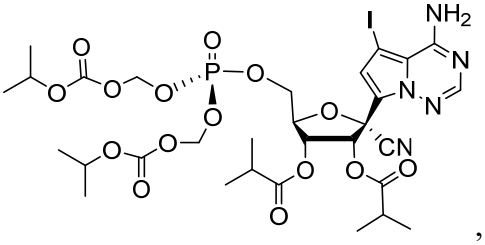
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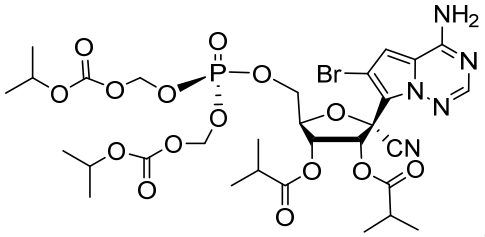
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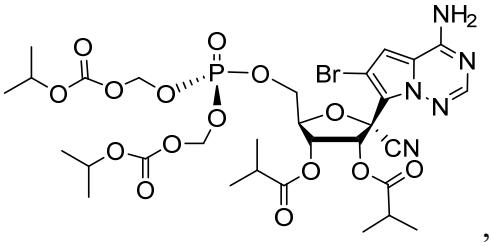
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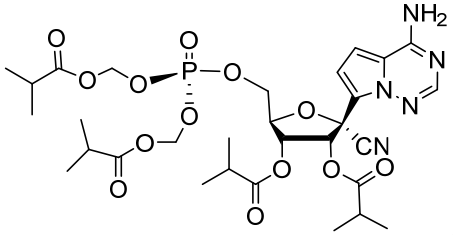
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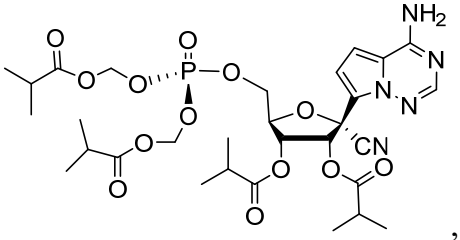
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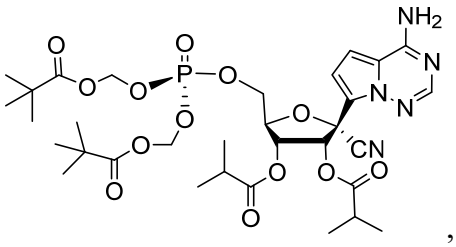
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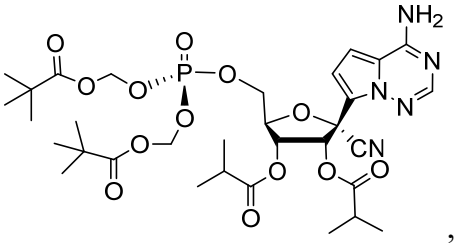
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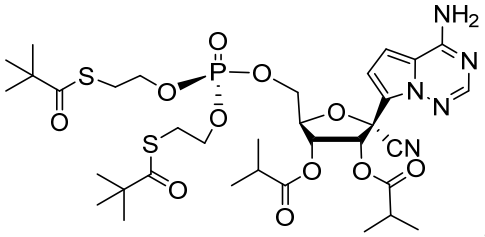
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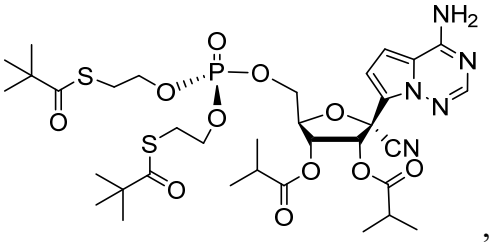
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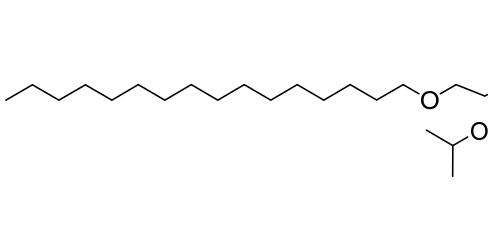
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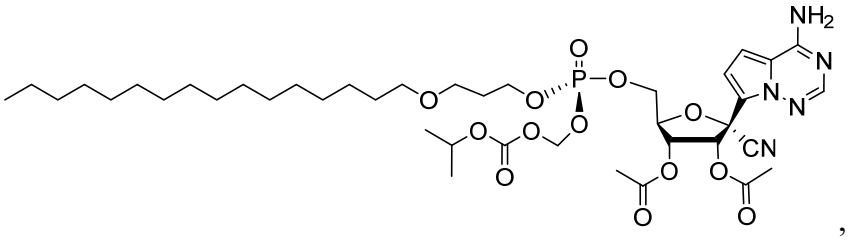
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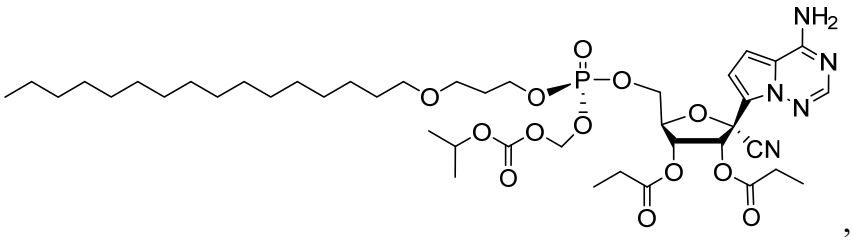
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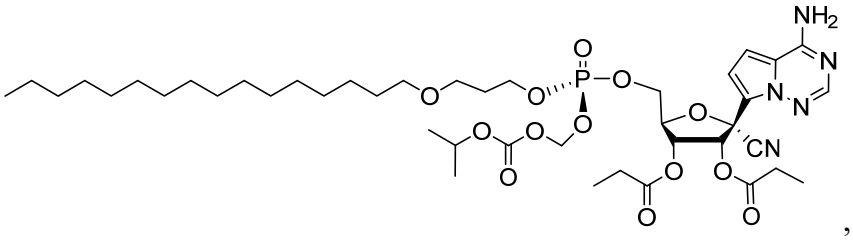
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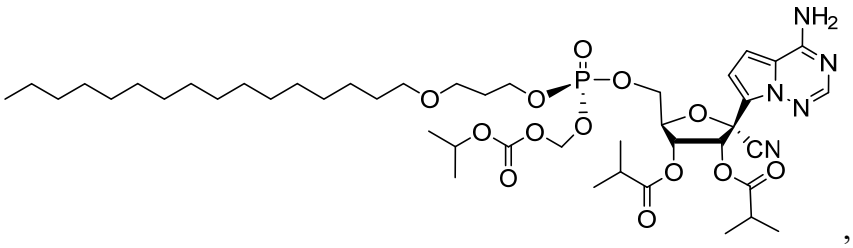
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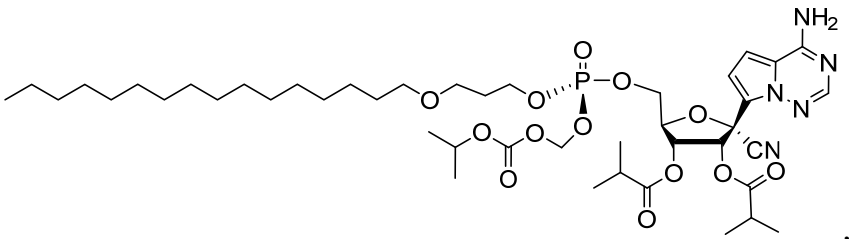
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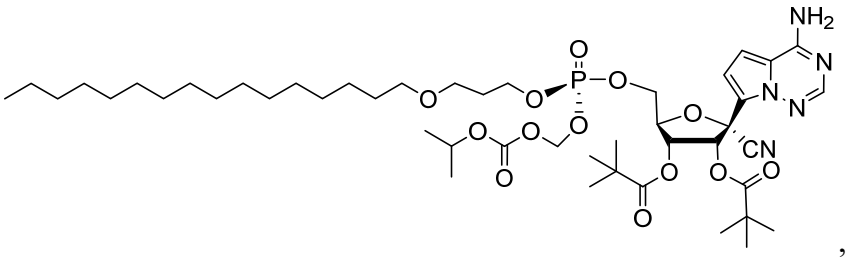
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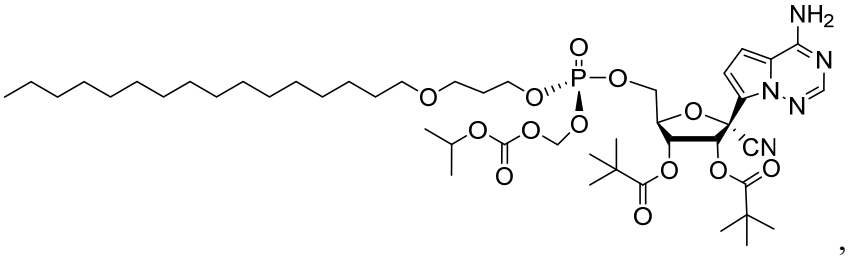
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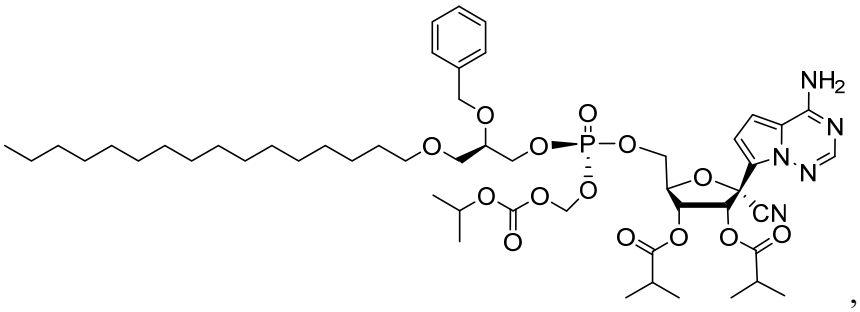
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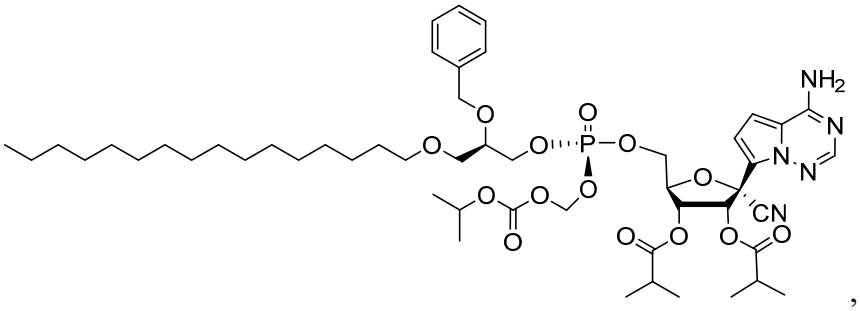
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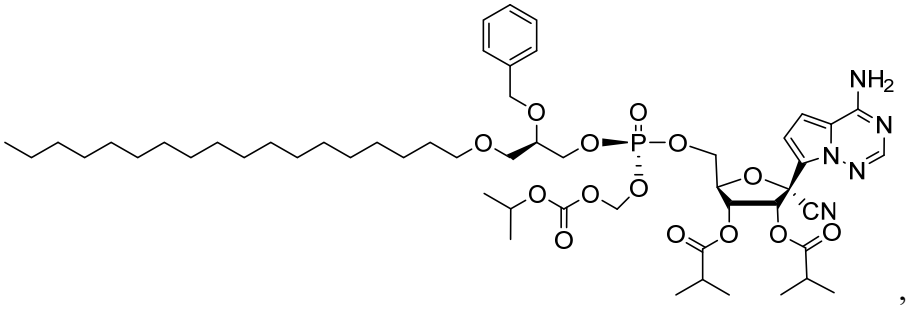
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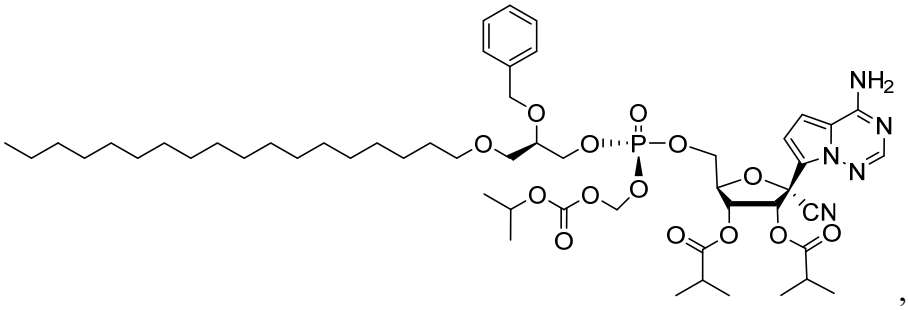
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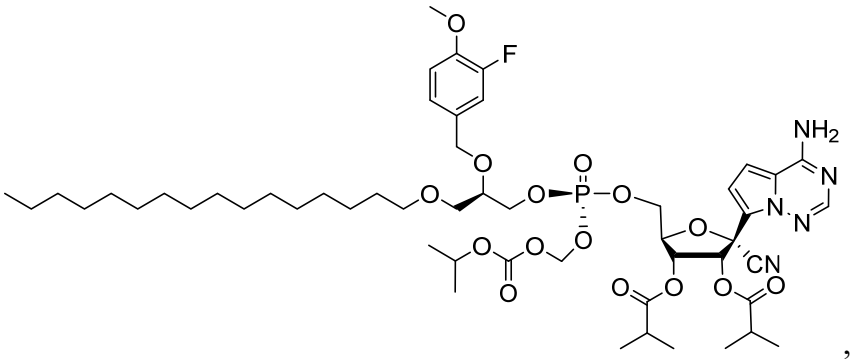
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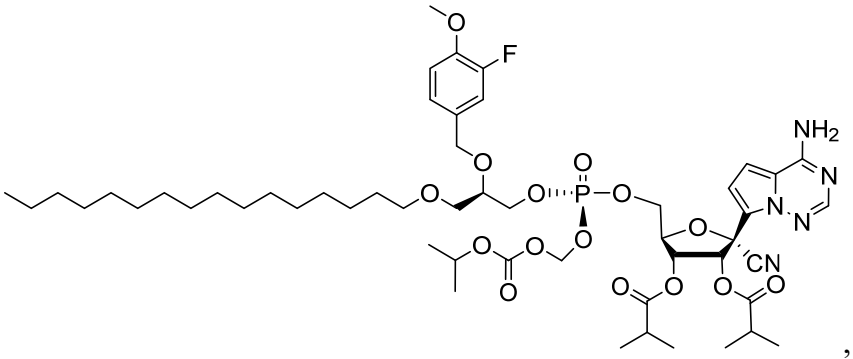
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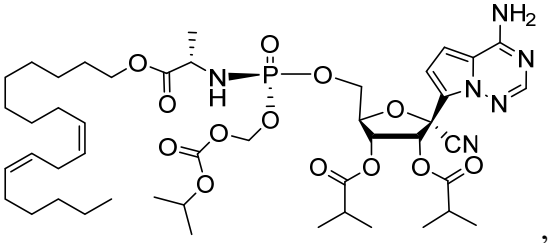
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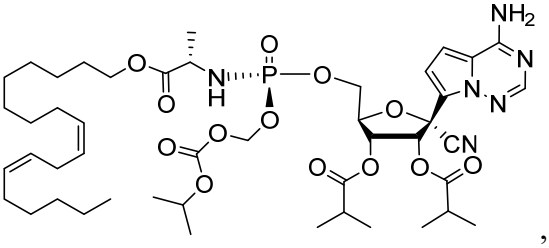
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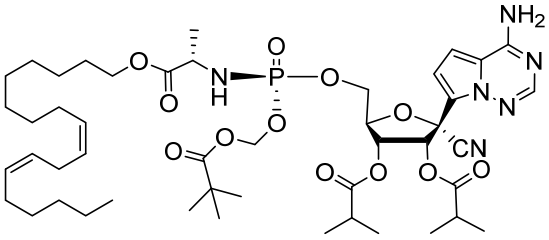
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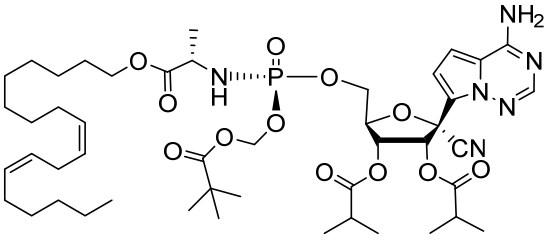
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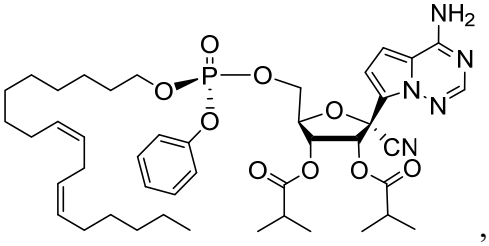
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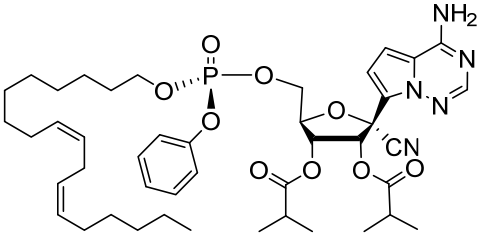
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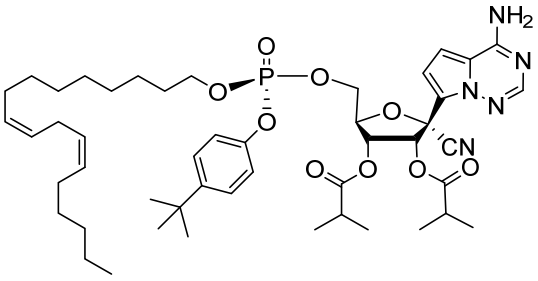
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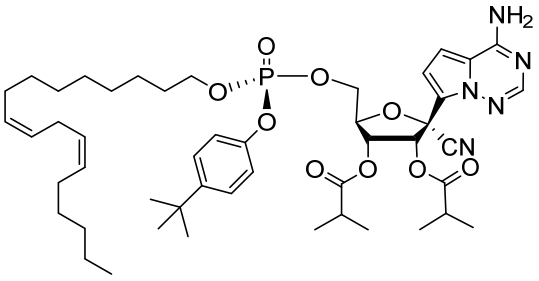
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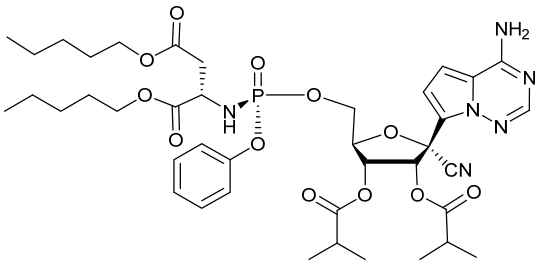
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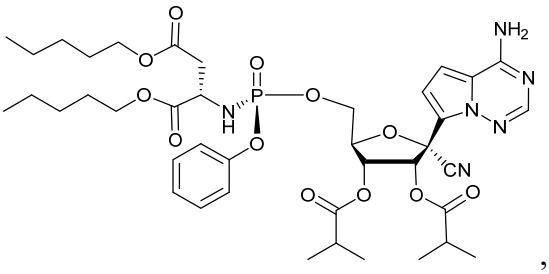
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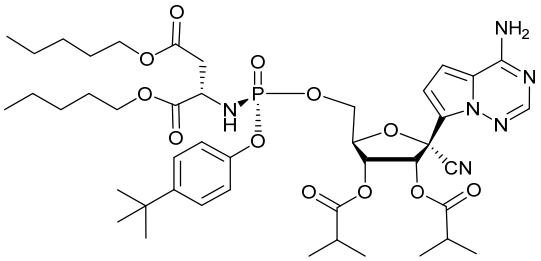
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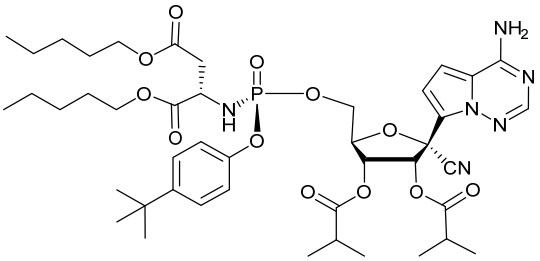
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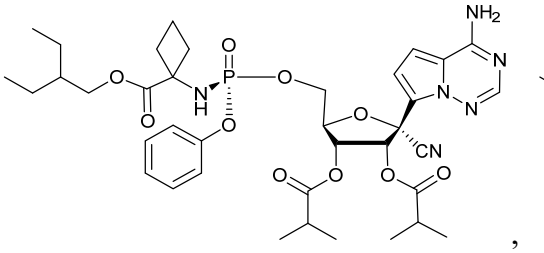
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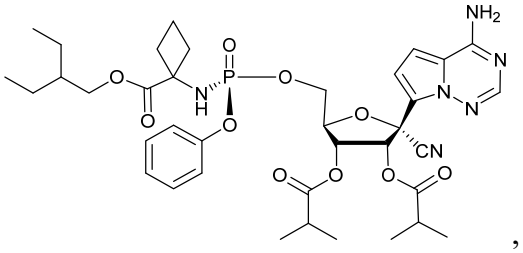
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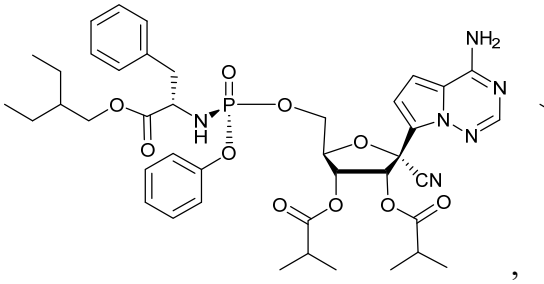
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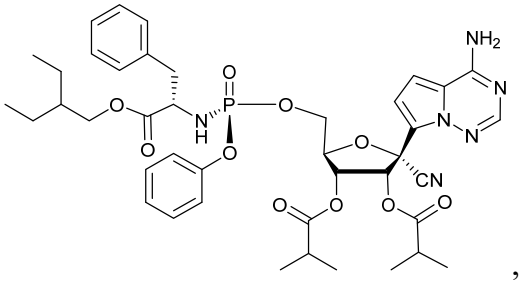
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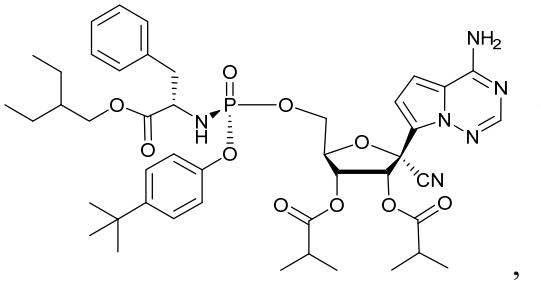
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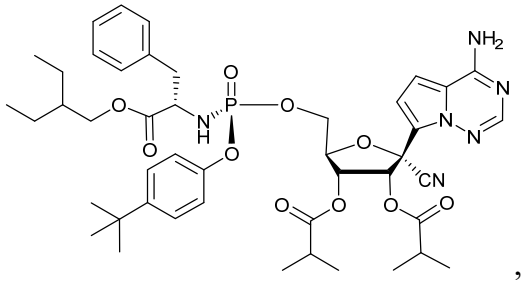
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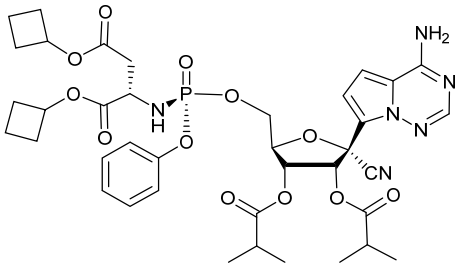
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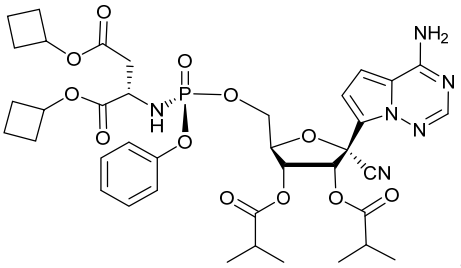
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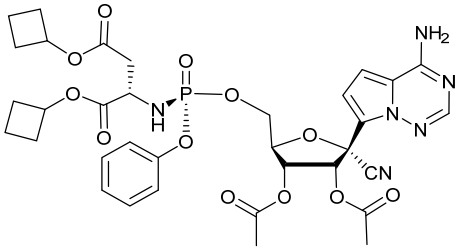
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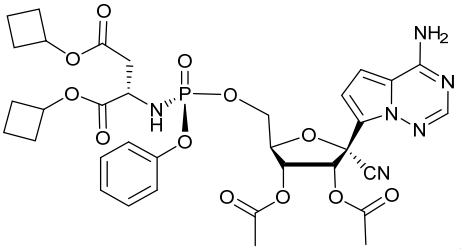
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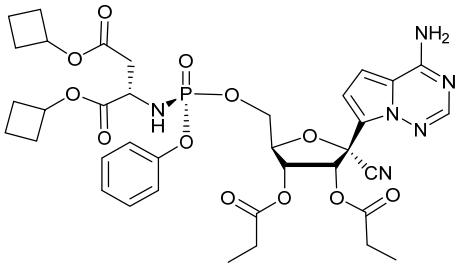
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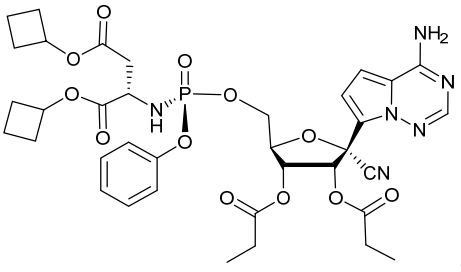
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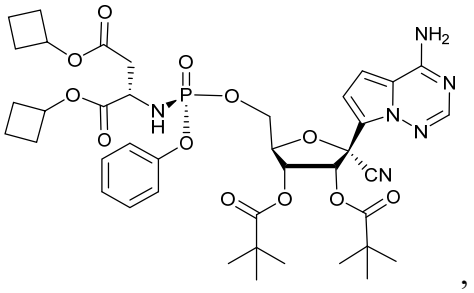
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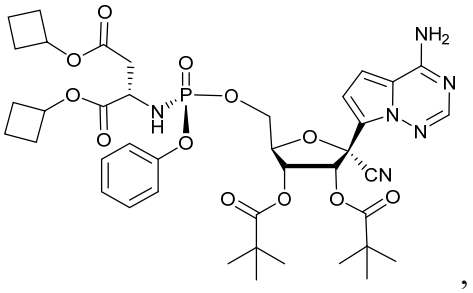
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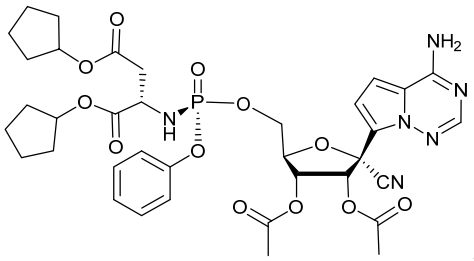
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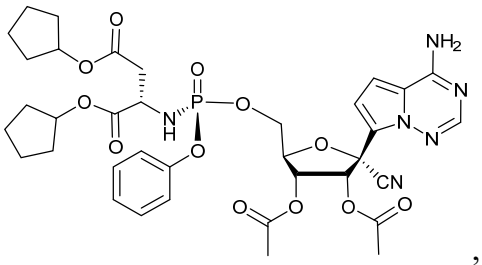
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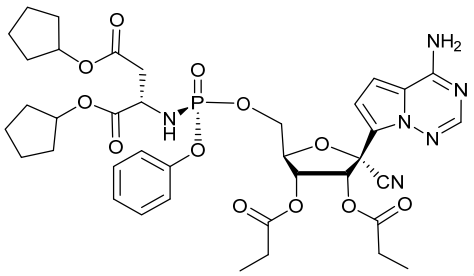
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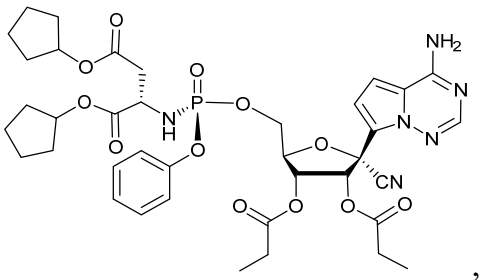
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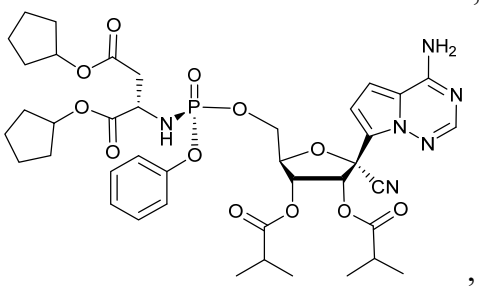
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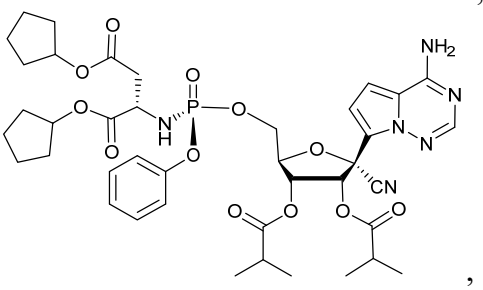
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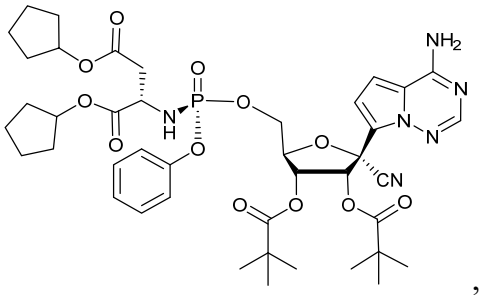
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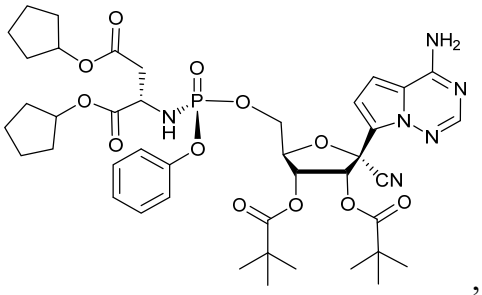
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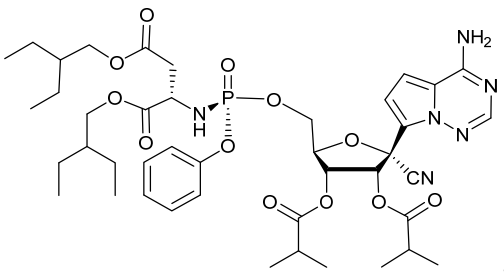
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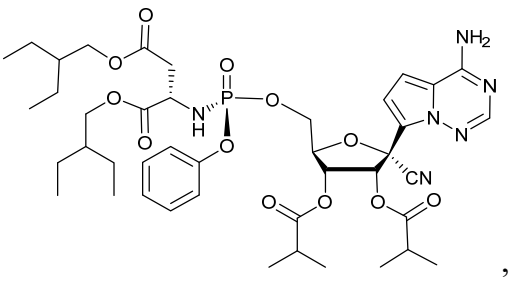
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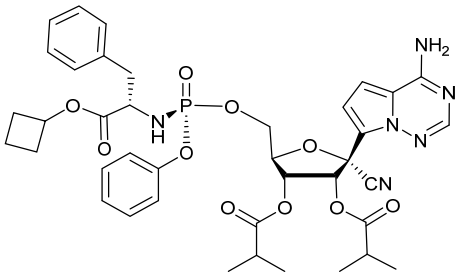
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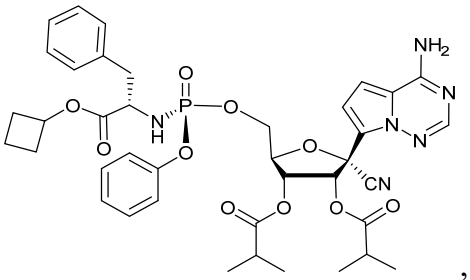
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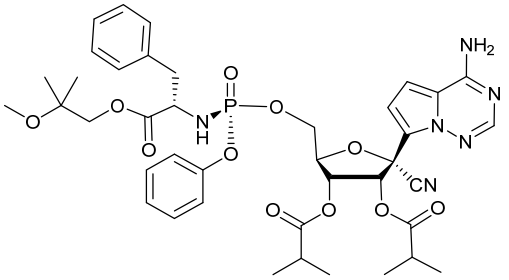
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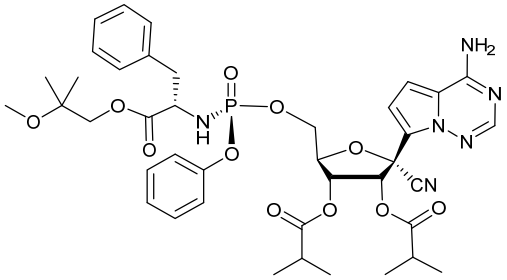
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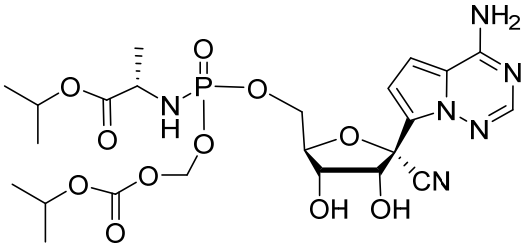
an intermediate compound, or tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, wherein, the intermediate compound is selected from the group consisting of: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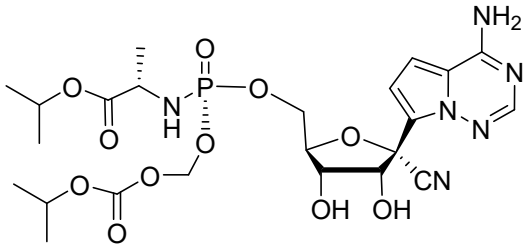
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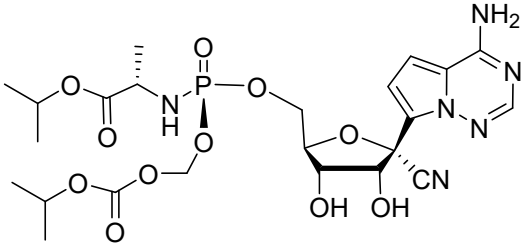
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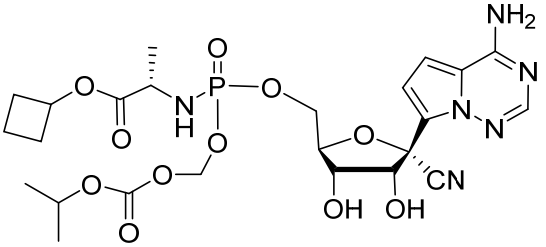
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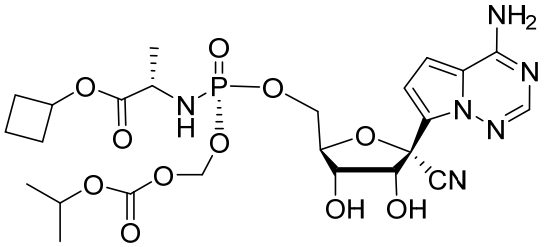
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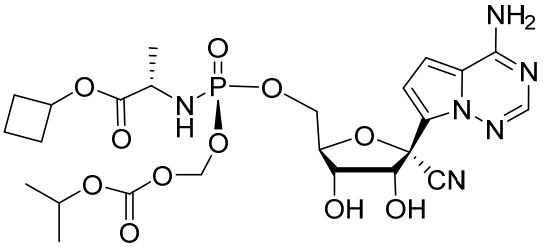
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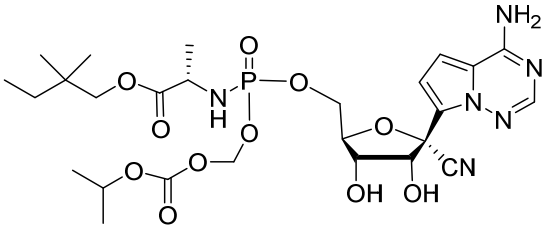
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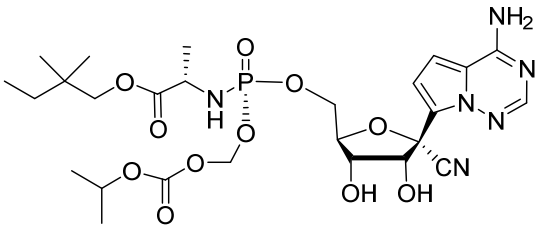
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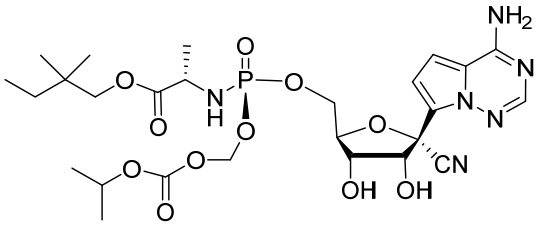
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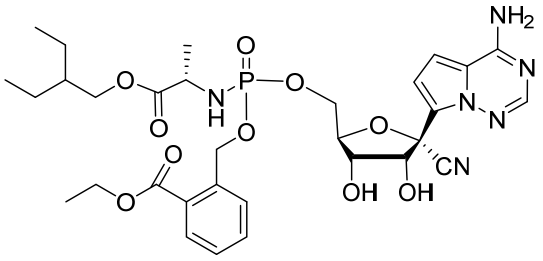
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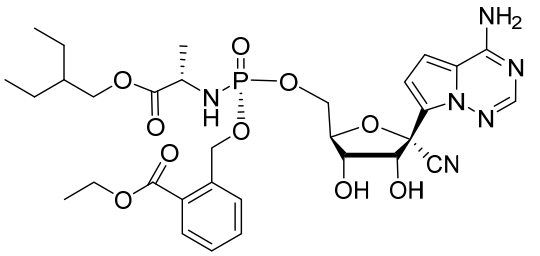
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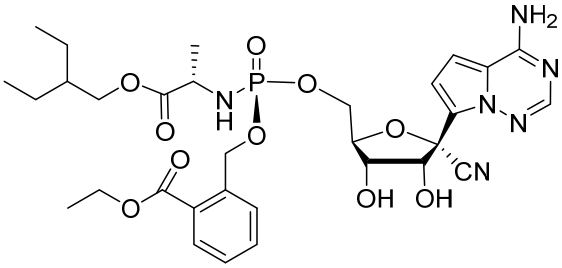
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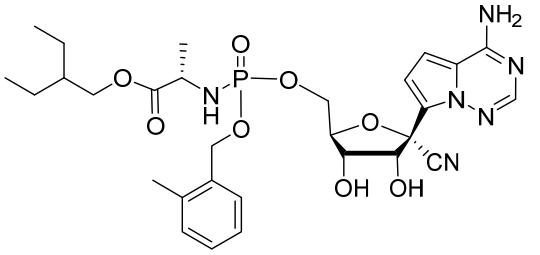
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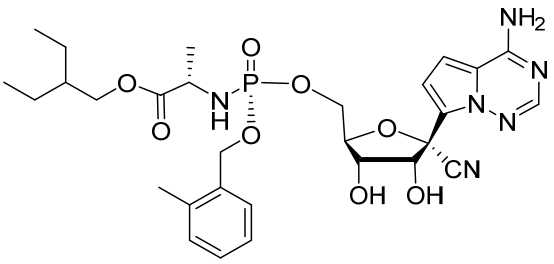
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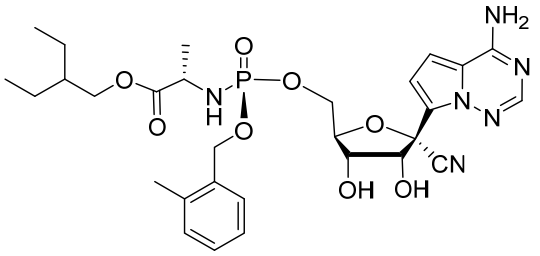
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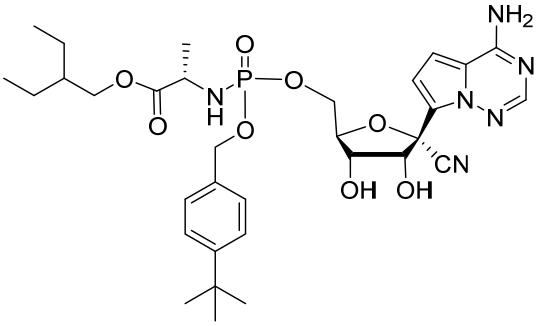
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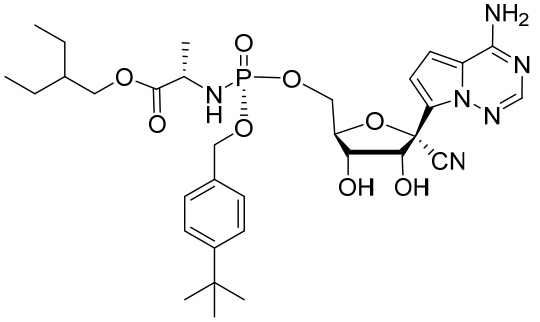
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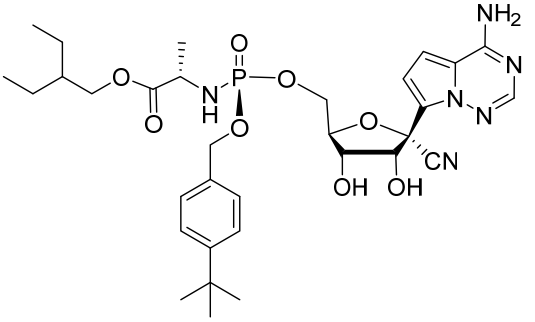
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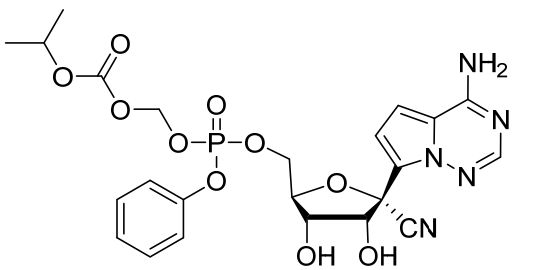
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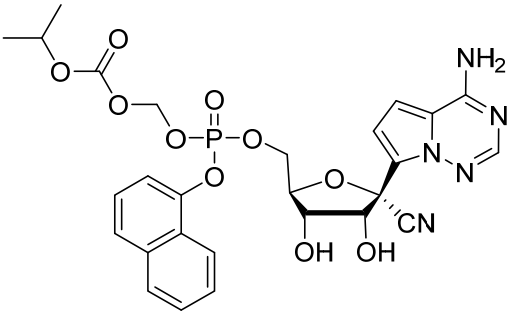
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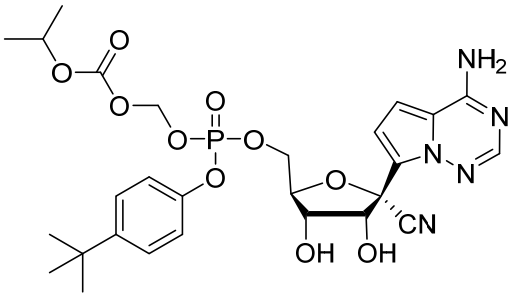
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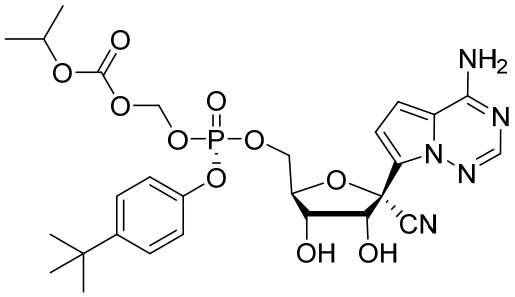
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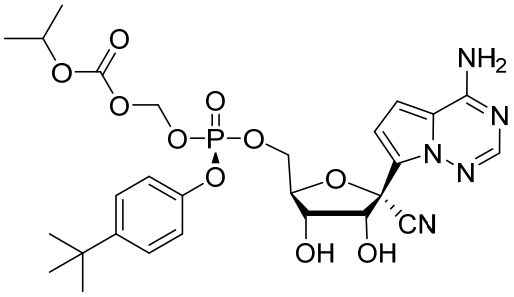
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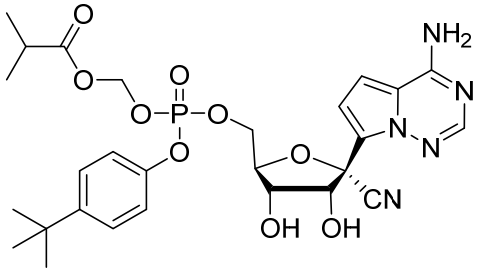
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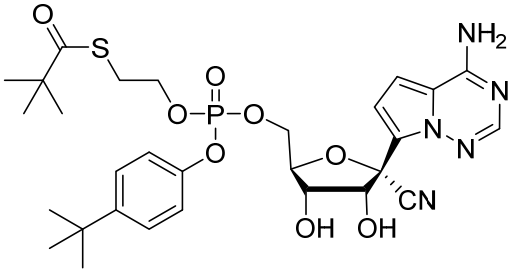
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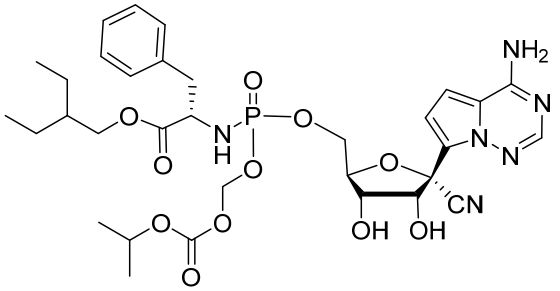
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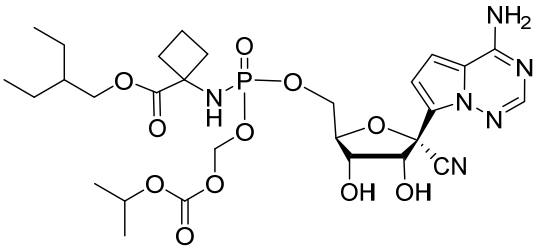
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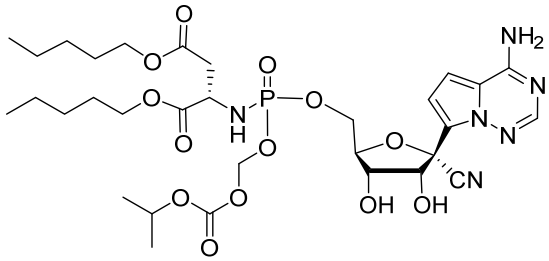
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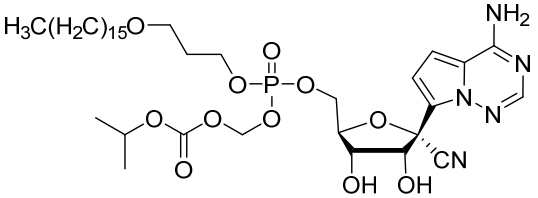
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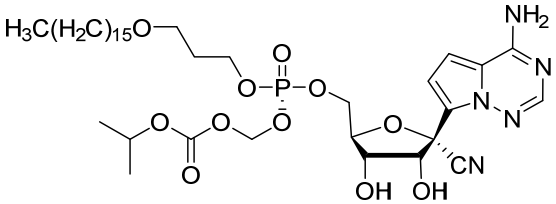
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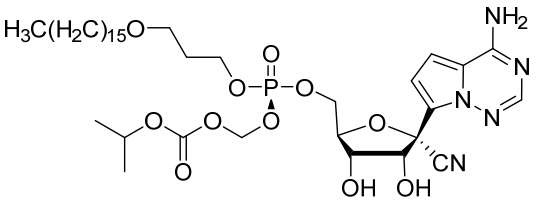
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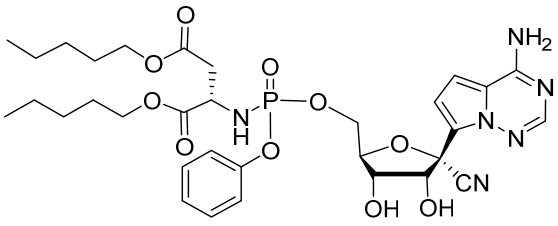
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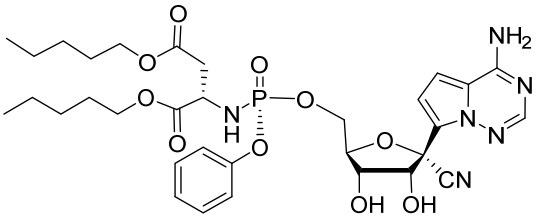
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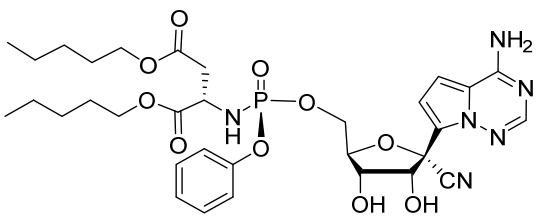
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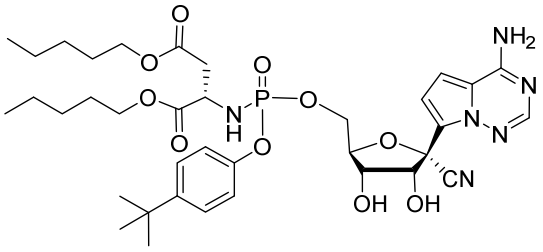
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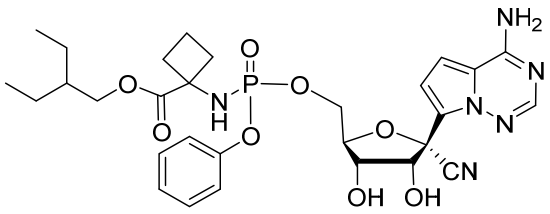
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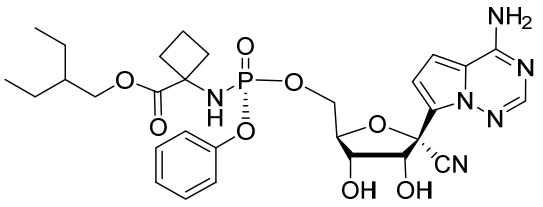
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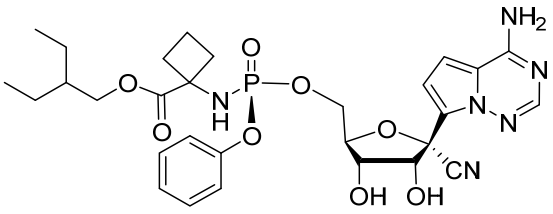
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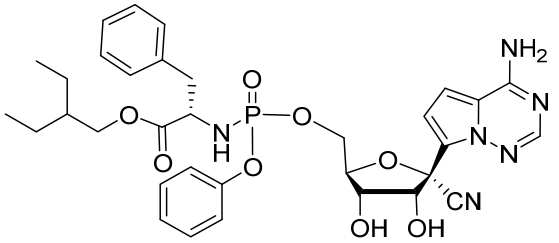
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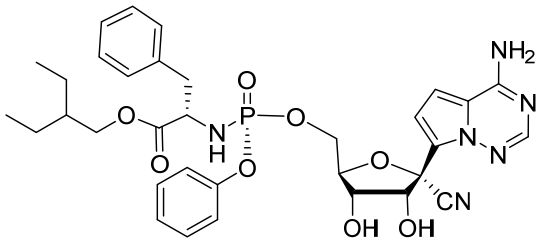
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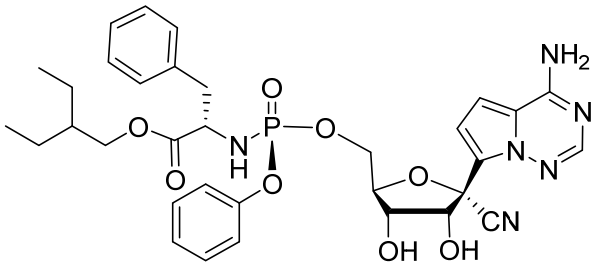
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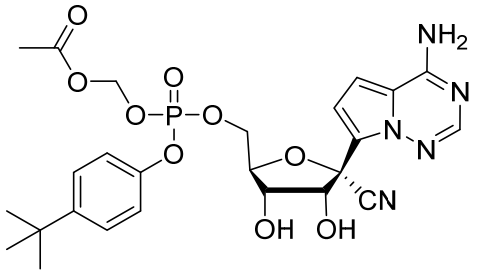
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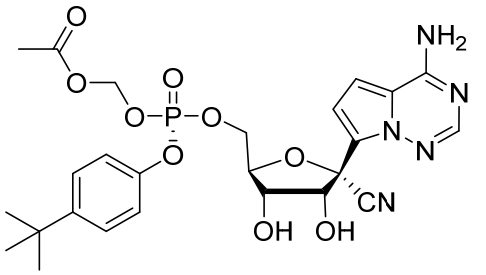
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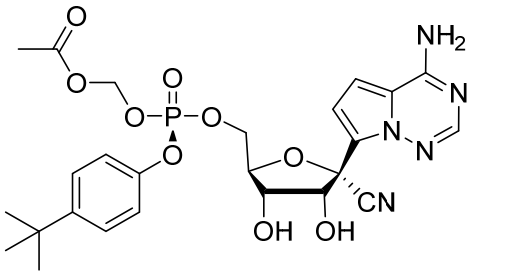
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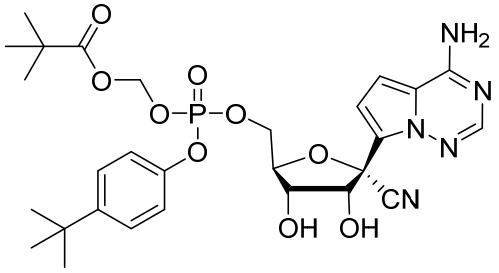
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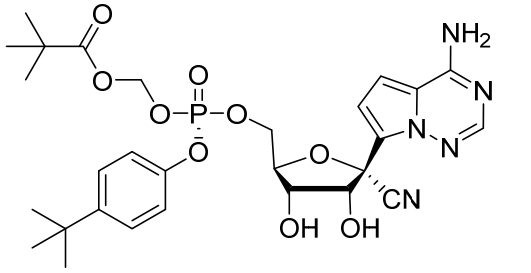
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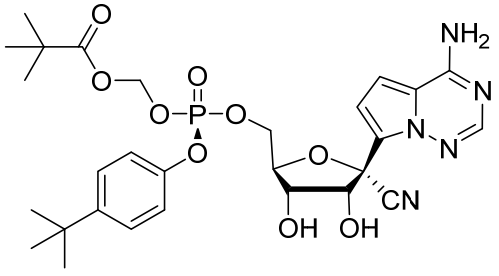
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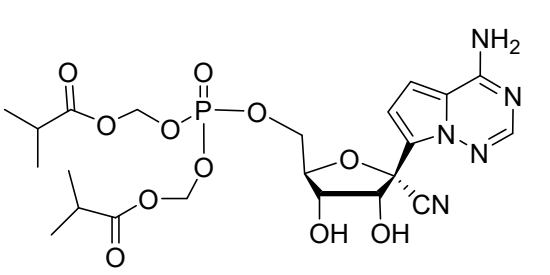
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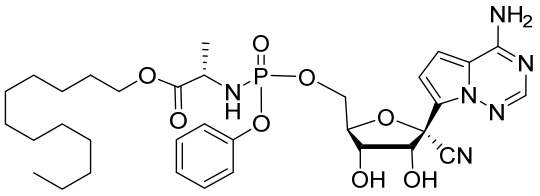
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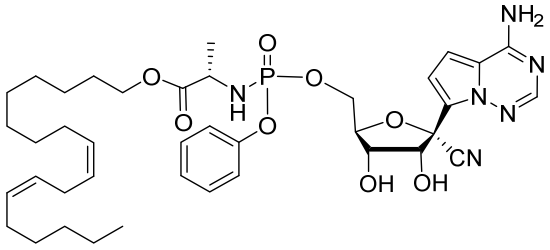
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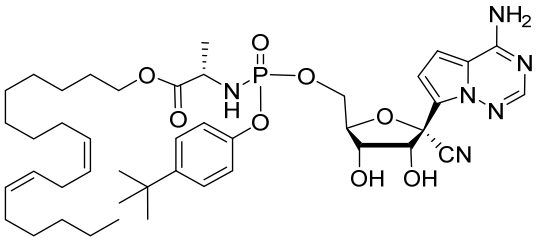
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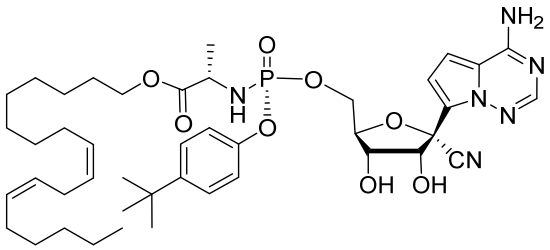
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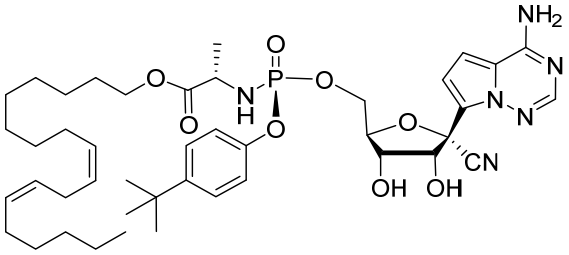
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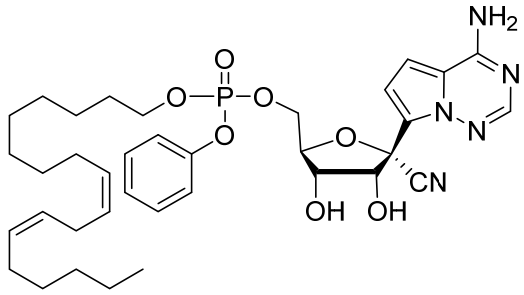
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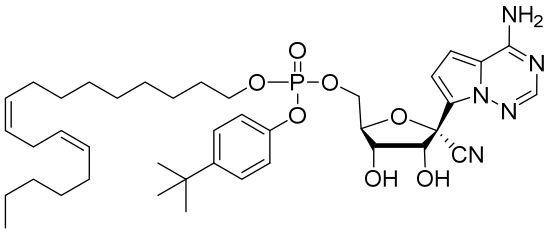
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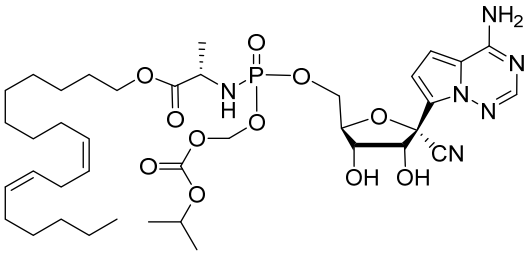
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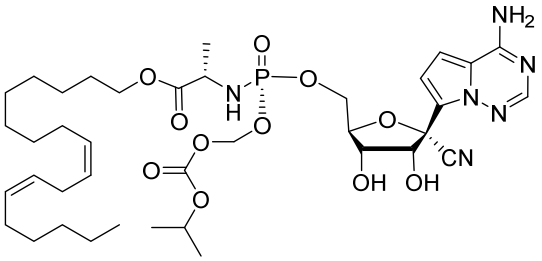
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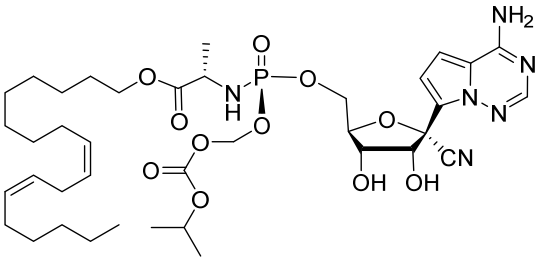
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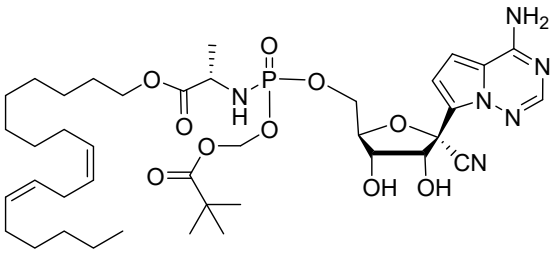
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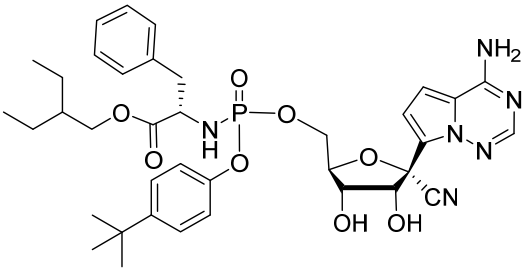
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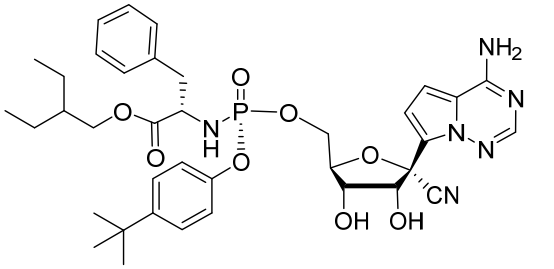
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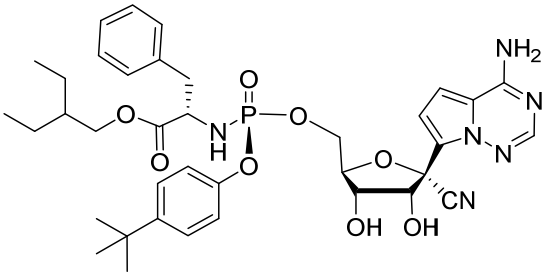
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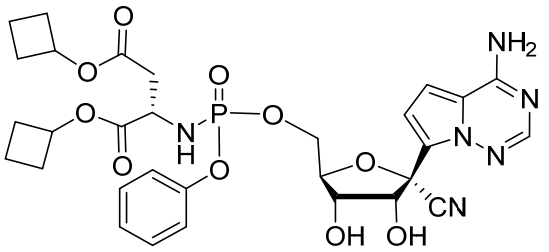
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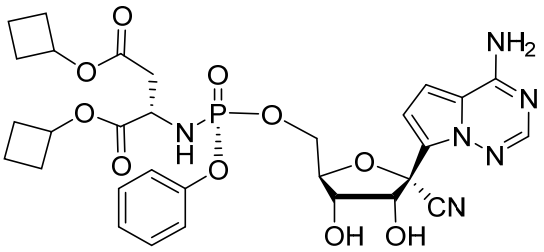
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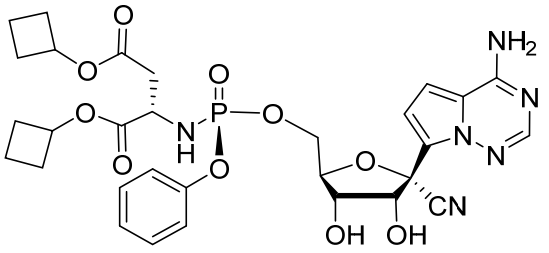
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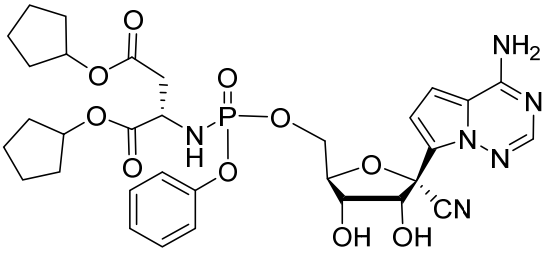
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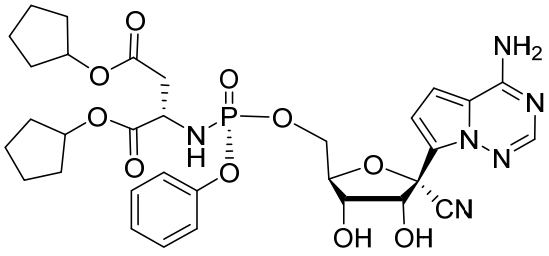
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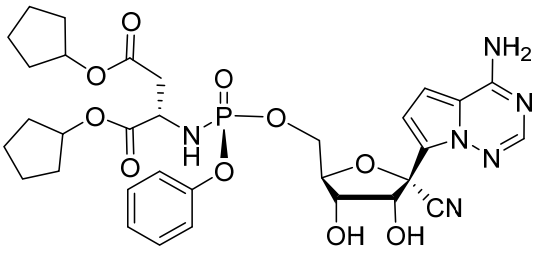
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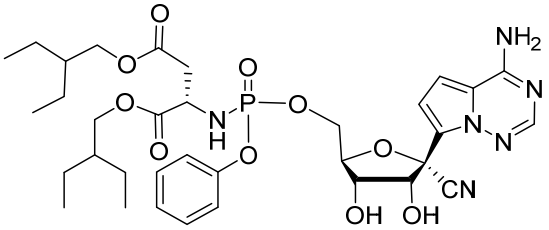
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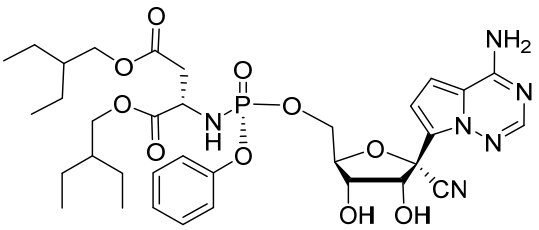
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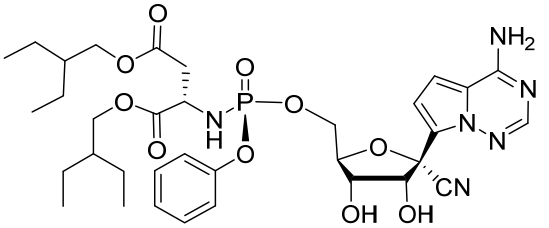
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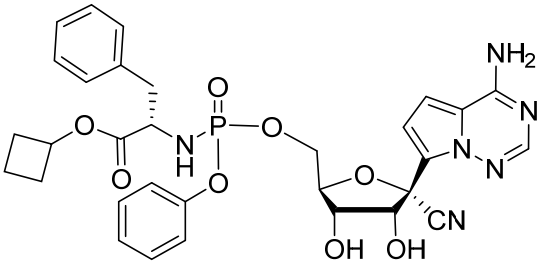
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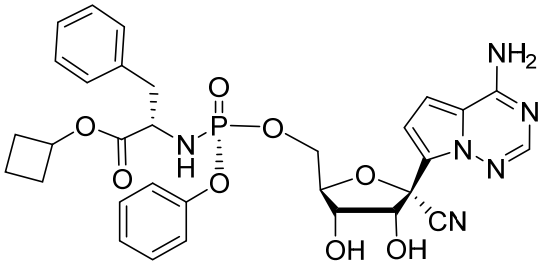
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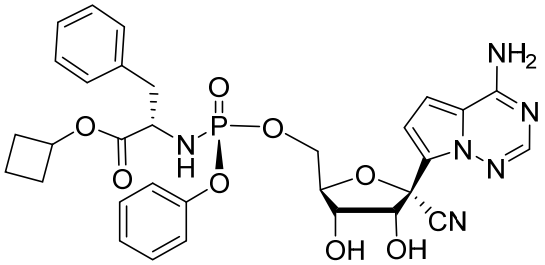
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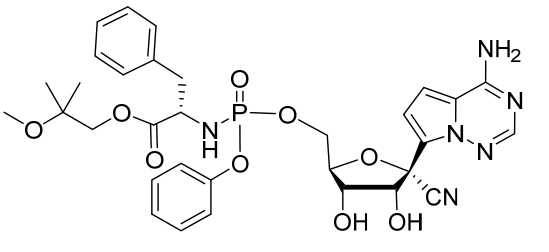
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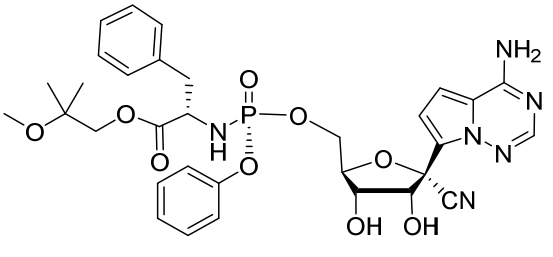
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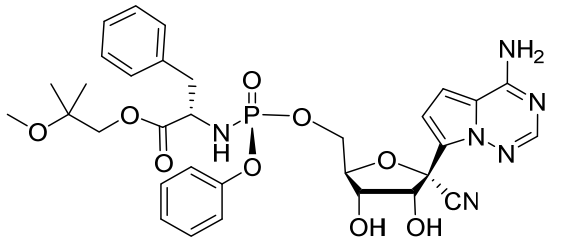

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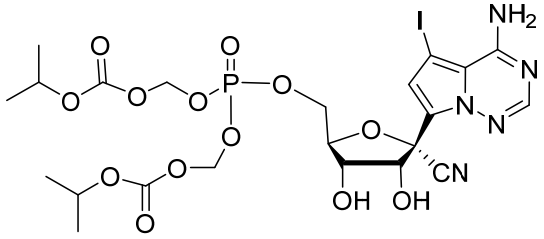

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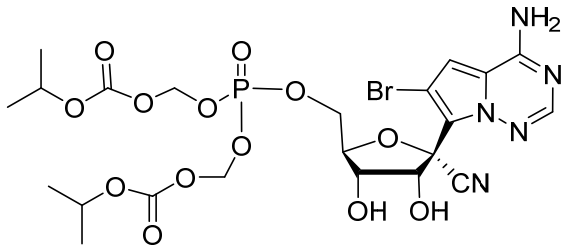

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14. A pharmaceutical composition comprising the compound of any one of claims 1 to 13, or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, and a pharmaceutically acceptable excipient, as well as optionally, other therapeutic agents.

15. Use of the compound of any one of claims 1 to 13, or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, or the pharmaceutical composition of claim 14 in the preparation of a medicament for the treatment and/or prevention of viral infections.

16. A compound of any one of claims 1 to 13, or a tautomer, stereoisomer, prodrug, crystalline form, pharmaceutically acceptable salt, hydrate or solvate thereof, or the pharmaceutical composition of claim 14, for use in therapy.

17. The use of claim 15, or the compound or composition of claim 16, wherein said viral infections are *Coronaviridae* infections, *Paramyxoviridae* infections, *Pneumoviridae* infections, *Picornaviridae* infections, *Flaviviridae* infections, *Filoviridae* infections, *Arenaviridae* infections, *Orthomyxoviridae* infections, or monkeypox;

preferably, said coronavirus is SARS-CoV virus and variants thereof, MERS-CoV virus and variants thereof and SARS-CoV-2 virus and variants thereof, other human coronaviruses (229E, NL63, OC43, HKU1 or WIV1), zoonotic coronaviruses (PEDV or HKU CoV isolates, such as HKU3, HKU5 or HKU9), feline coronaviruses (Feline Enteric Coronavirus or Feline infectious peritonitis virus) or porcine epidemic diarrhea virus; preferably, said coronavirus is SARS-CoV virus and variants thereof, MERS-CoV virus and variants thereof and SARS-CoV-2 virus and variants thereof; preferably, said coronavirus is SARS-CoV-2 virus and variants thereof; preferably, said SARS-CoV-2 virus variants are Alpha variant, Beta variant, Delta variant,

Gamma variant or Omicron variant;

preferably, said *Paramyxoviridae* is parainfluenza virus, measles or mumps virus;

preferably, said *Pneumoviridae* is RSV or Human metapneumovirus; preferably, said *Pneumoviridae* is RSV;

preferably, said *Picornavirridae* is Enterovirus or Rhinovirus;

preferably, said *Flaviviridae* are Dengue virus, Yellow Fever virus, West Nile virus, Zika virus, Japanese Encephalitis virus and Hepatitis C;

preferably, said *Filoviridae* is Ebola virus, Zaire ebolavirus, Bundibugio ebolavirus, Sudan ebolavirus, Tai Forest ebolavirus, Reston ebolavirus or Marburg virus;

preferably, said *Arenaviridae* is Lassa virus or Junin virus.