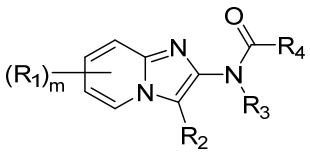
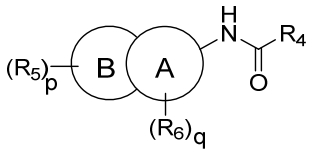
CLAIMS

[Claim 1] A compound of formula (I) or (V), or a pharmaceutically acceptable salt thereof,



(I)

or



(V)

,

wherein,

ring A is 9- to 10-membered bicyclic heteroaryl;

ring B is fused with ring A, and ring B is selected from C_{4-7} cycloalkyl, C_{4-7} cycloalkenyl, 4- to 7-membered heterocycloalkyl and 4- to 7-membered heterocycloalkenyl;

each R_1 is independently selected from H, F, Cl, Br, I, OH, NH_2, CN, CF_3, C_{2-4} alkyl, C_{1-4} alkoxy, C_{3-7} cycloalkyl and 4- to 7-membered heterocycloalkyl, wherein the C_{2-4} alkyl, C_{1-4} alkoxy, C_{3-7} cycloalkyl and 4- to 7-membered heterocycloalkyl are each independently and optionally substituted with 1, 2 or 3 R_a;

R_2 is selected from cyclobutyl, C_{5-8} bridged cycloalkyl, C_{5-8} spirocycloalkyl, phenyl, 5- to 6-membered heteroaryl, 4- to 7-membered heterocycloalkyl and C_{5-8} cycloalkenyl, wherein the cyclobutyl, C_{5-8} bridged cycloalkyl, C_{5-8} spirocycloalkyl, phenyl, 5- to 6-membered heteroaryl, 4- to 7-membered heterocycloalkyl and C_{5-8} cycloalkenyl are each independently and optionally substituted with 1, 2 or 3 R_b;

R_3 is selected from H and -C(O)C_{1-4} alkyl;

R_4 is selected from C_{1-6} alkyl, C_{1-6} alkoxy, -CH_2-C_{3-7} cycloalkyl and -CH_2-4- to 7-membered heterocycloalkyl, wherein the C_{1-6} alkyl, C_{1-6} alkoxy, -CH_2-C_{3-7} cycloalkyl and -CH_2-4- to 7-membered heterocycloalkyl are each independently and optionally substituted with 1, 2, 3, 4 or 5 R_c;

each R_5 is independently selected from H, F, Cl, Br, I, =O, C_{1-4} alkyl and C_{1-4} alkoxy, wherein the C_{1-4} alkyl and C_{1-4} alkoxy are each independently and optionally substituted with 1, 2 or 3 halogen;

each R_6 is independently selected from H, F, Cl, Br, I, CN, C_{1-4} alkyl, C_{1-4} alkoxy, C_{3-7} cycloalkyl, 3- to 7-membered heterocycloalkyl and phenyl, wherein the C_{1-4} alkyl, C_{1-4} alkoxy, C_{3-7} cycloalkyl, 4- to 7-membered heterocycloalkyl and phenyl are each independently and optionally substituted with 1, 2 or 3 R_{6a};

each of R_a and R_c is independently selected from H, F, Cl, Br, I, OH, NH_2, CN, CH_3 and CF_3;

each R_b is independently selected from H, F, Cl, Br, I, =O, OH, NH_2, CN, C_{1-4} alkyl and C_{1-4} alkoxy, wherein the C_{1-4} alkyl and C_{1-3} alkoxy are each independently and optionally substituted with 1, 2 or 3 F;

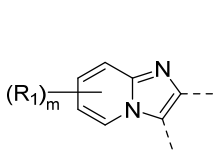
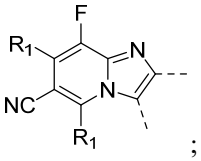
each R_{6a} is independently selected from H, F, Cl, Br, I, OH, NH_2, CN, C_{1-4} alkyl and C_{1-4} alkoxy, wherein the

C_{1-4} alkyl and C_{1-4} alkoxy are each independently and optionally substituted with 1, 2, 3, 4 or 5 F;

m is selected from 1, 2, 3 and 4;

p and q are each independently selected from 1, 2 and 3;

with the proviso that,

1) when R_2 is selected from phenyl and 5- to 6-membered heteroaryl, and the phenyl and 5- to 6-membered heteroaryl are each independently and optionally substituted with 1, 2 or 3 R_b, the structural fragment  is ;

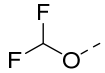
or,

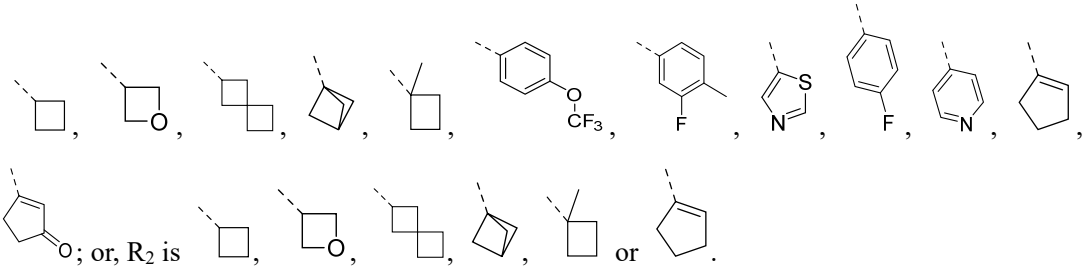
2) when R_2 is cyclobutyl, and the cyclobutyl is optionally substituted with 1, 2 or 3 R_b, m is selected from 2, 3 and 4.

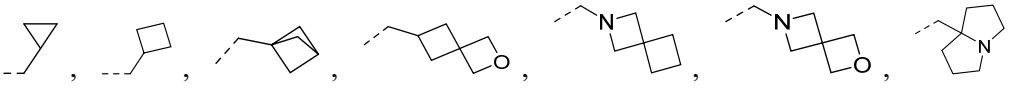
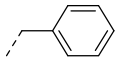
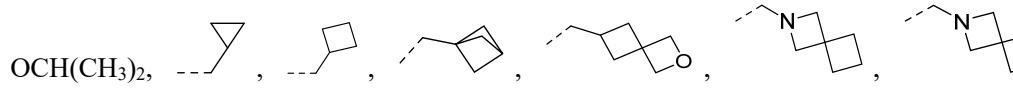
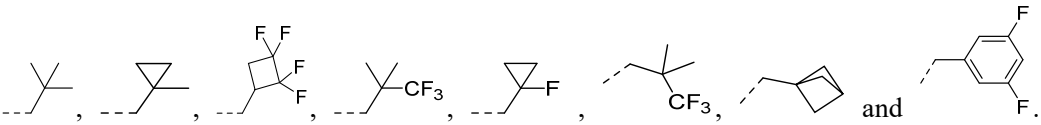
[Claim 2] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein, each R_a is independently selected from H, F and OH.

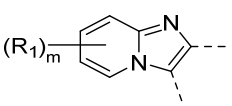
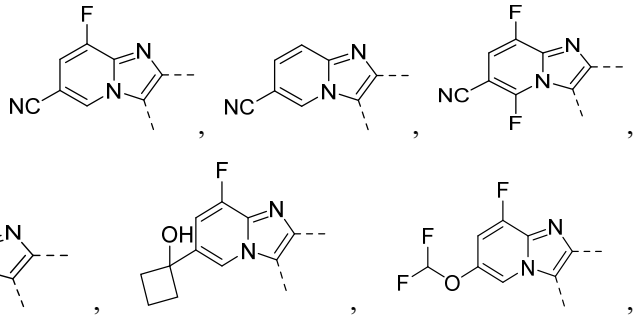
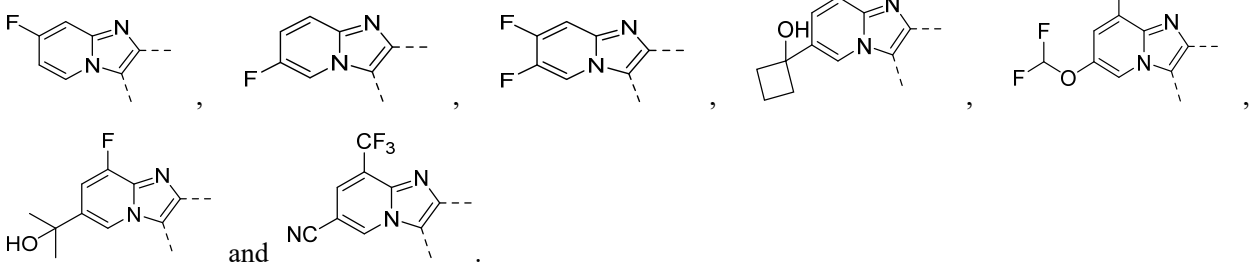
[Claim 3] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein, each R_b is independently selected from H, F, =O, CH_3 and OCF_3.

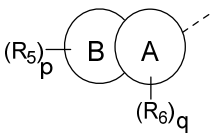
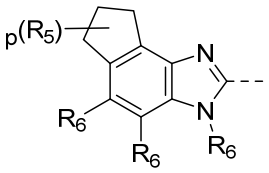
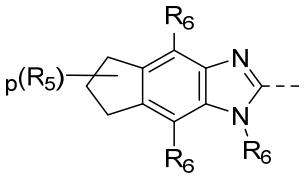
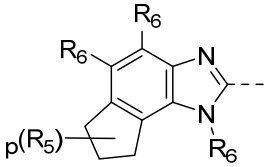
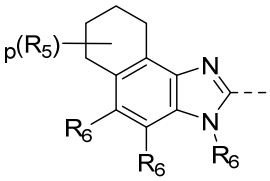
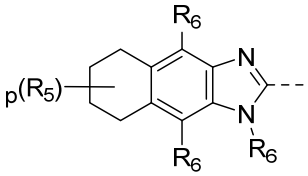
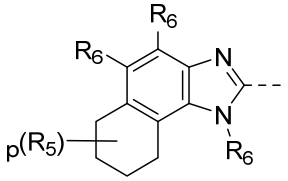
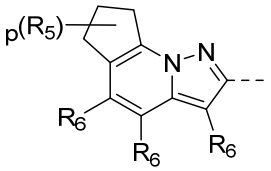
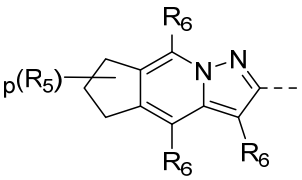
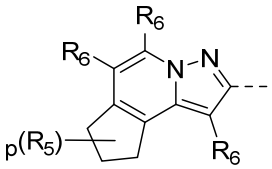
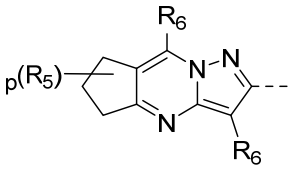
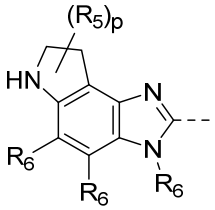
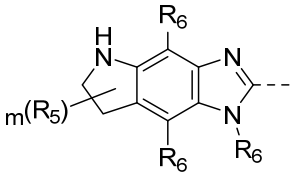
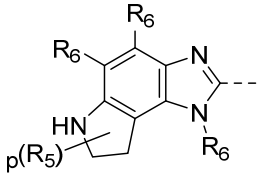
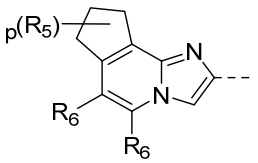
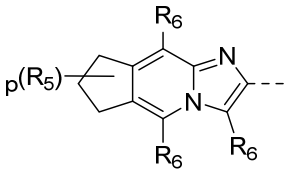
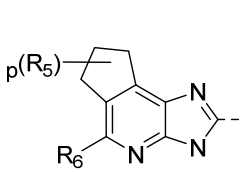
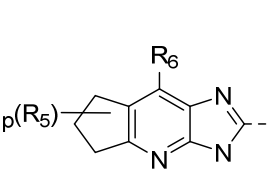
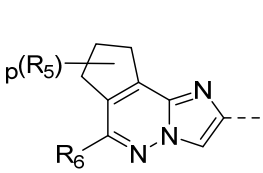
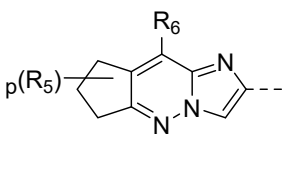
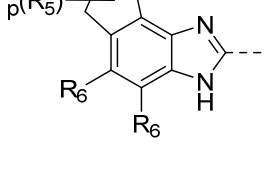
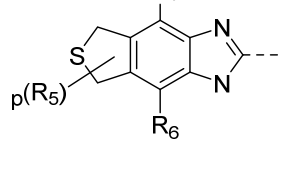
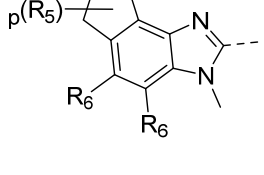
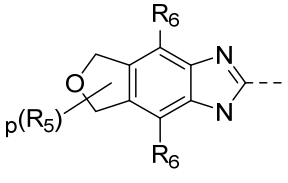
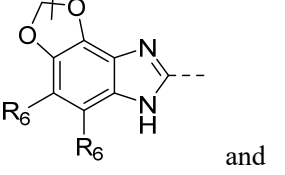
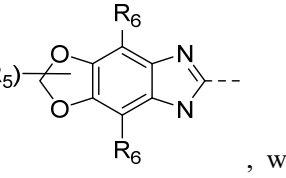
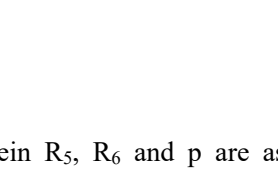
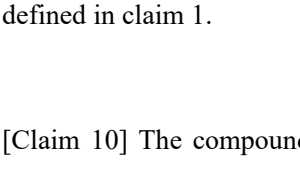
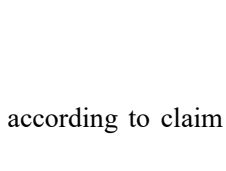
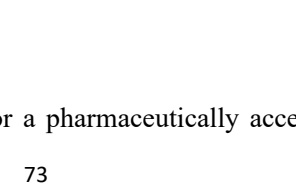
[Claim 4] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein, each R_c is independently selected from H, F and CH_3.

[Claim 5] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein, each R_1 is independently selected from H, F, Cl, OH, NH_2, CN, CF_3, CH_2CH_3, $CH_2CH_2CH_3$, $CH(CH_3)_2$, $C(CH_3)_3$, OCH_3, OCH_2CH_3, $OCH_2CH_2CH_3$, $OCH(CH_3)_2$, cyclopropyl, cyclobutyl, cyclopentyl, oxetanyl, and azetidinyl, wherein the CH_2CH_3, $CH_2CH_2CH_3$, $CH(CH_3)_2$, $C(CH_3)_3$, OCH_3, OCH_2CH_3, $OCH_2CH_2CH_3$, $OCH(CH_3)_2$, cyclopropyl, cyclobutyl, cyclopentyl, oxetanyl, and azetidinyl are each independently and optionally substituted with 1, 2 or 3 R_a; or, each R_1 is independently selected from H, F, CN, CF_3, ,  and .

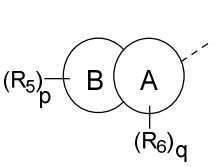
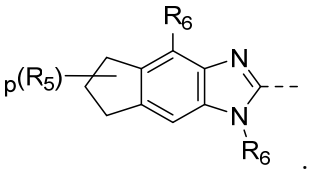
[Claim 6] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein, R_2 is selected from cyclobutyl, spiro[3.3]heptyl, bicyclo[1.1.1]pentyl, phenyl, pyrazolyl, thiazolyl, pyridyl, oxetanyl, azetidinyl, piperidyl, piperazinyl, cyclopentenyl and cyclohexenyl, wherein the cyclobutyl, spiro[3.3]heptyl, bicyclo[1.1.1]pentyl, phenyl, pyrazolyl, thiazolyl, pyridyl, oxetanyl, azetidinyl, piperidyl, piperazinyl, cyclopentenyl and cyclohexenyl are each independently and optionally substituted with 1, 2 or 3 R_b; or, R_2 is selected from ; or, R_2 is .

[Claim 7] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein, R_4 is selected from CH_2CH_3, $CH_2CH_2CH_3$, $CH(CH_3)_2$, $C(CH_3)_3$, $CH_2C(CH_3)_3$, OCH_3, OCH_2CH_3, $OCH_2CH_2CH_3$, $OCH(CH_3)_2$,  and , wherein the CH_2CH_3, $CH_2CH_2CH_3$, $CH(CH_3)_2$, $C(CH_3)_3$, $CH_2C(CH_3)_3$, OCH_3, OCH_2CH_3, $OCH_2CH_2CH_3$, $OCH(CH_3)_2$,  are each independently and optionally substituted with 1, 2, 3, 4 or 5 R_c; or, R_4 is selected from .

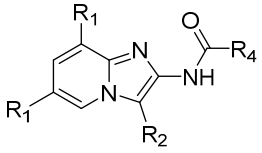
[Claim 8] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein, the structural unit  is selected from ,  and .

[Claim 9] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein, the structural unit  is selected from , , , , , , , , , , , , , , , , , , , , , , , , , , , , and , wherein R_5, R_6 and p are as defined in claim 1.

[Claim 10] The compound according to claim 9, or a pharmaceutically acceptable salt thereof, wherein the

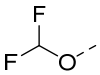
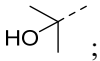
structural unit  is .

[Claim 11] The compound according to claim 1, or a pharmaceutically acceptable salt thereof, wherein the compound is



(III) ,

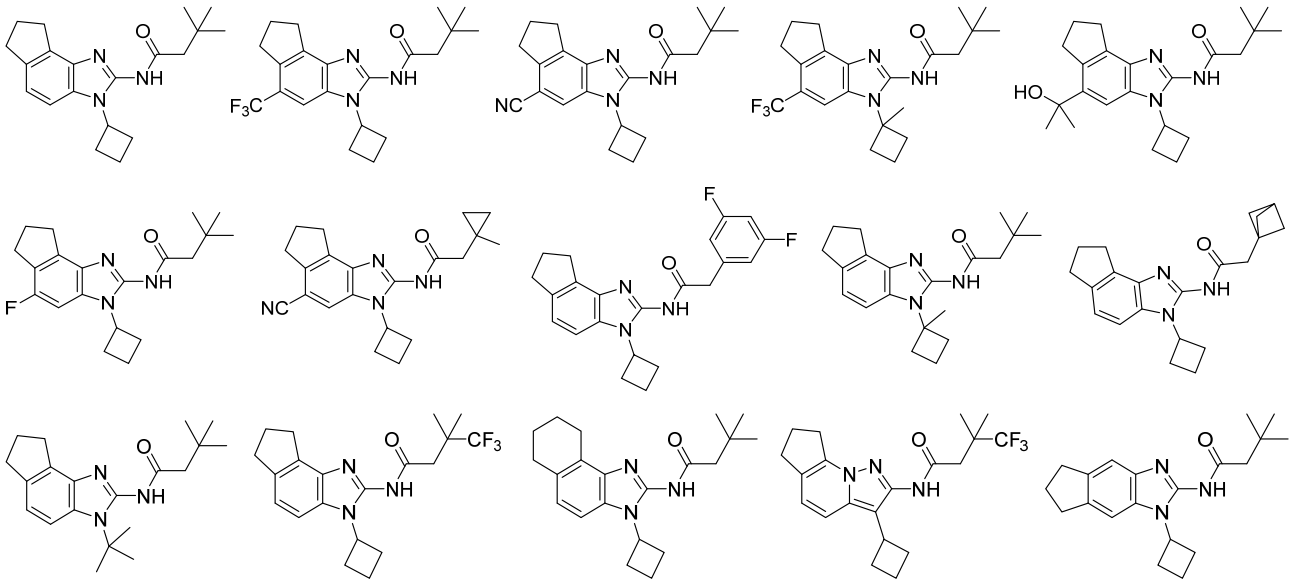
wherein,

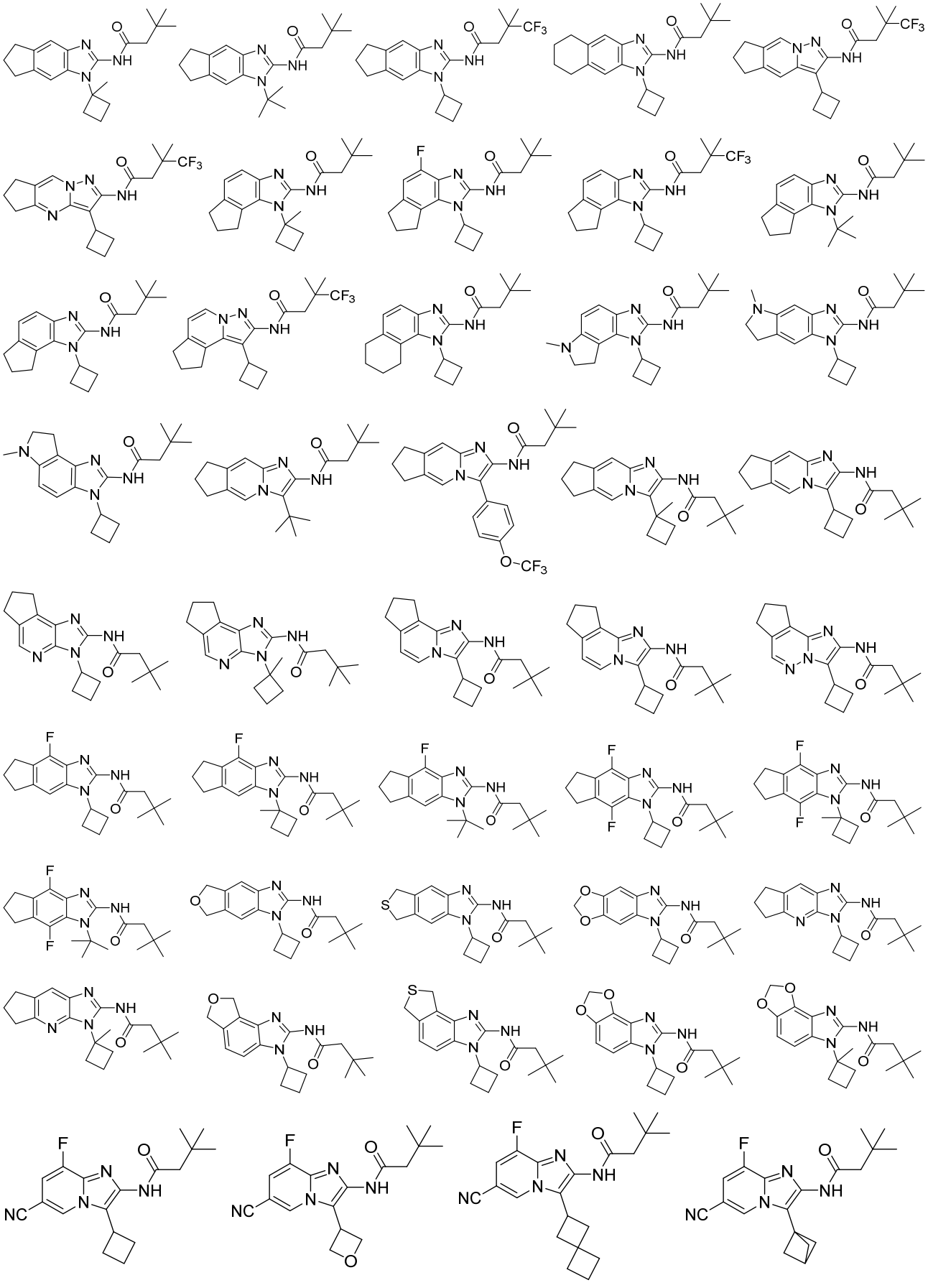
each R_1 is independently selected from H, F, CN, CF_3, ,  and ;

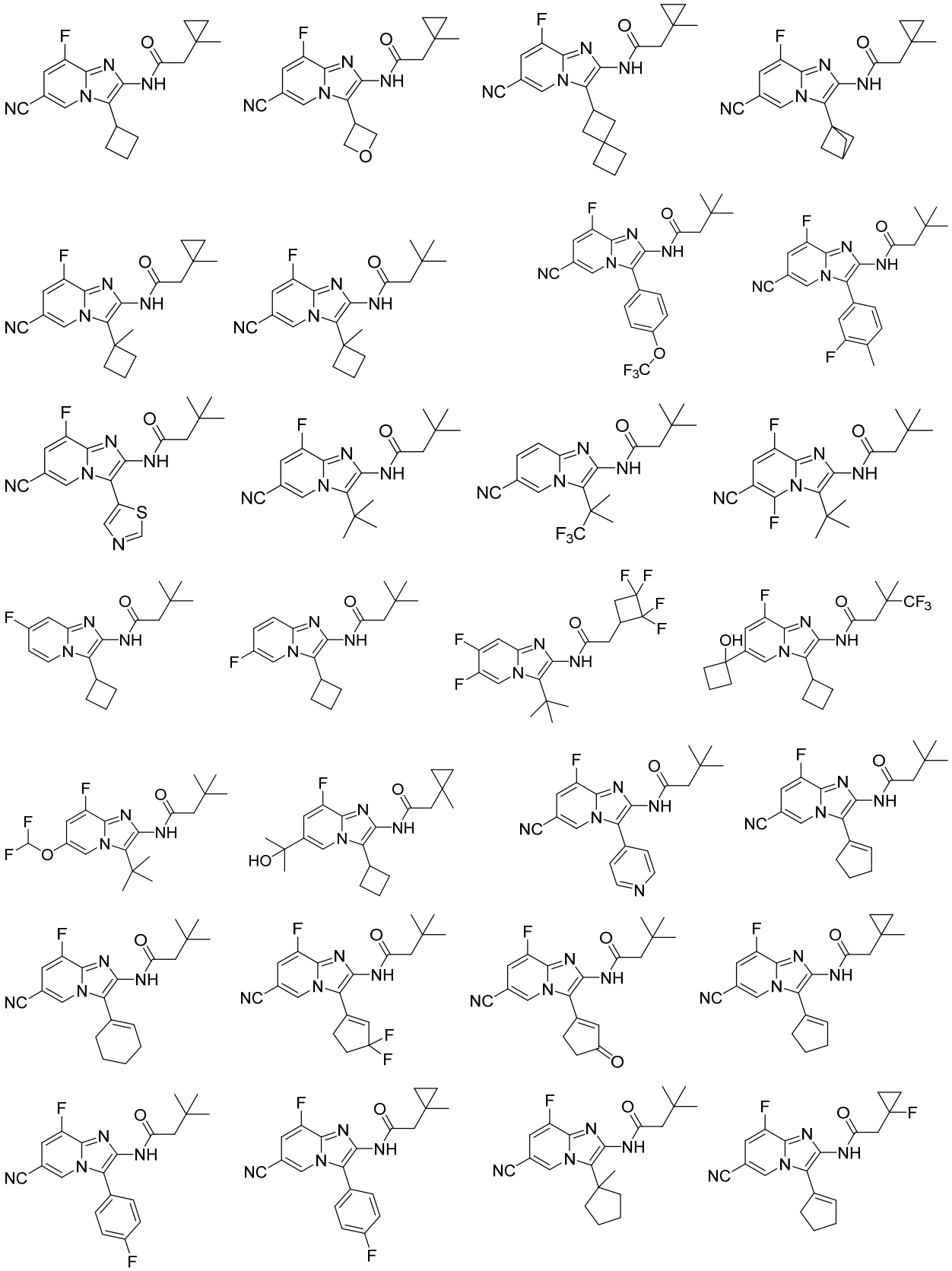
R_2 is selected from C_{5-8} bridged cycloalkyl, C_{5-8} spirocycloalkyl, 4- to 7-membered heterocycloalkyl and C_{5-8} cycloalkenyl, wherein the C_{5-8} bridged cycloalkyl, C_{5-8} spirocycloalkyl, 4- to 7-membered heterocycloalkyl and C_{5-8} cycloalkenyl are each independently and optionally substituted with 1, 2 or 3 R_b;

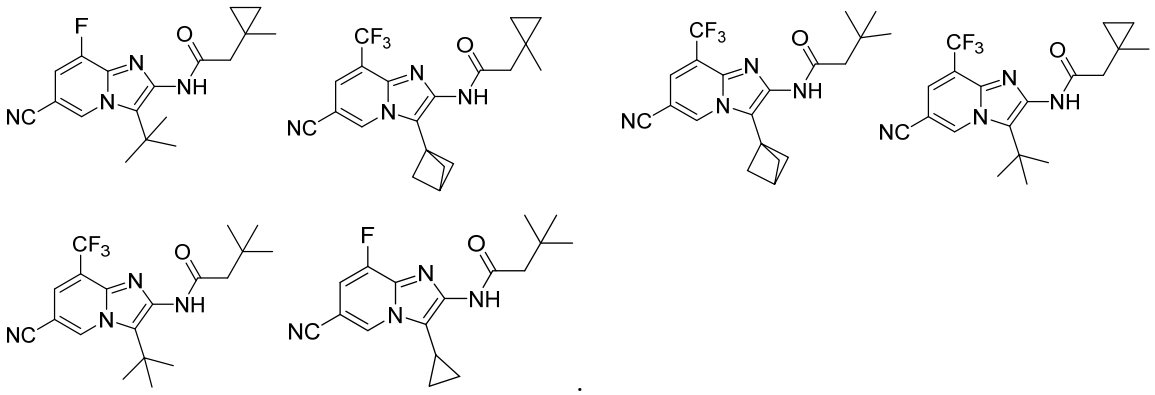
R_4 is selected from .

[Claim 12] A compound of the following, or a pharmaceutically acceptable salt thereof,









[Claim 13] A pharmaceutical composition, comprising a therapeutically or prophylactically effective amount of the compound according to any one of claims 1 to 12, or a stereoisomer or a pharmaceutically acceptable salt thereof; further, the pharmaceutical composition also comprises a pharmaceutically acceptable excipient.

[Claim 14] The compound according to any one of claims 1 to 12, or a pharmaceutically acceptable salt thereof, or the pharmaceutical composition according to claim 13, for use in medicine.

[Claim 15] Use of the compound according to any one of claims 1 to 12, or a pharmaceutically acceptable salt thereof, or the pharmaceutical composition according to claim 13 in the manufacture of a medicament for the treatment of a Kv7 potassium ion channel opener-related disease.

[Claim 16] The use according to claim 15, wherein, the Kv7 potassium ion channel opener-related disease is selected from epilepsy, inflammatory pain, neuropathic pain, migraine, depression, anxiety disorder, stroke, Alzheimer's disease, neurodegenerative disease, neuronal hyperexcitability, complication caused by cocaine abuse, nicotine withdrawal syndrome, alcohol withdrawal syndrome, and tinnitus.