CLAIMS

We claim:

1. A compound having a structure represented by formula I or a pharmaceutically acceptable salt thereof:

A—Y—E

I

wherein,
A is an antigen;
E is an active agent (e.g., a drug); and
Y is a linker which covalently links A to E and comprises an alkylene, alkenylene, alkynylene, cycloalkylene, heterocyclylene, arylene, or heteroarylene, or a combination thereof, wherein the linker comprises 1-100 carbon atoms, preferably 10-50 carbon atoms.

2. The compound of claim 1, wherein the linker is a heteroalkylene comprising 5-50 moieties selected from -CH_2-, -C(=O)-, -C(=O)-NR^1-, -NR^1-C(=O)-, -C(=O)-O-, -O-C(=O)-, -NR^1-C(=O)-NR^2-, -O-C(=O)-NR^1-, -NR^1-C(=O)-O-, -O-, and -S-; wherein each R^1 and R^2 is independently selected from H and alkyl.

3. The compound of claim 1 or 2, wherein the linker is a heteroalkylene comprising 5-50 moieties selected from -CH_2- and -O-.

4. The compound of any one of claims 1-3, wherein the linker comprises ethylene glycol.

5. The compound of claim 4, wherein the linker comprises 1-10 ethylene glycol moieties (e.g., 2, 4, 6, or 8 ethylene glycol moieties).

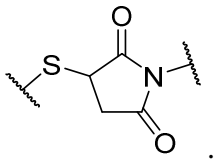
6. The compound of claim 1, wherein the linker is an alkylene comprising 5-50 methylene moieties.

7. The compound of claim 6, wherein the linker further comprises a moiety selected from
-C(=O)-, -C(=O)-NR^2-, -NR^2-C(=O)-, -C(=O)-O-, -O-C(=O)-, -NR^2-C(=O)-NR^3-, -O-C(=O)-NR^2-, -NR^2-C(=O)-O-, -O-, and -S-; wherein each R^2 and R^3 is independently selected from H and alkyl.

8. The compound of any one of claims 2-7, wherein the linker further comprises 1-5 -C(=O)-, -C(=O)-NR^2- or -NR^2-C(=O)- moieties (e.g., 1, 2, or 3 moieties); wherein each R^2 and R^3 is independently selected from H and alkyl.

9. The compound of any one of claims 2-8, wherein at least one -C(=O)- moiety is adjacent to E.

10. The compound of any one of claims 2-9, wherein the linker further comprises



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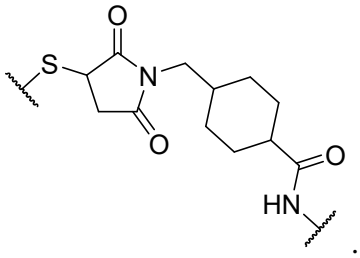
11. The compound of any one of claims 2-9, wherein the linker further comprises



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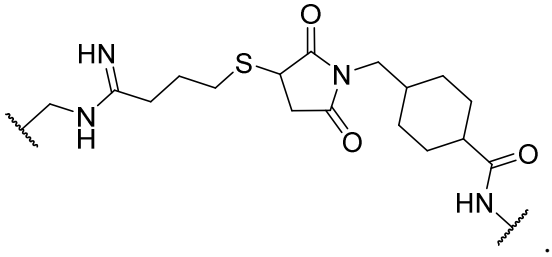
12. The compound of any one of claims 2-9, wherein the linker further comprises



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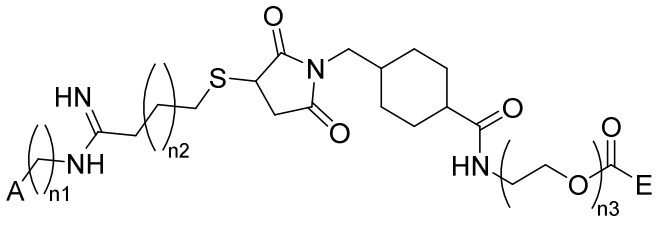
13. The compound of any one of claims 1-12, wherein the compound has a structure represented by formula Ia or a pharmaceutically acceptable salt thereof:



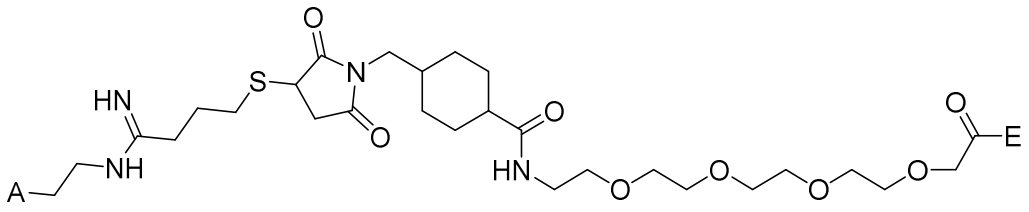
Ia

wherein

n1 and n2 are each independently selected from 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, or 20; and

n3 is 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10.

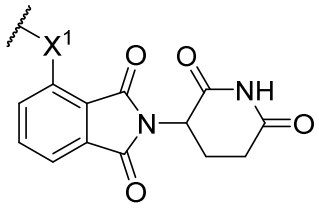
14. The compound of any one of claims 1-13, wherein the compound has a structure represented by formula Ib or a pharmaceutically acceptable salt thereof:

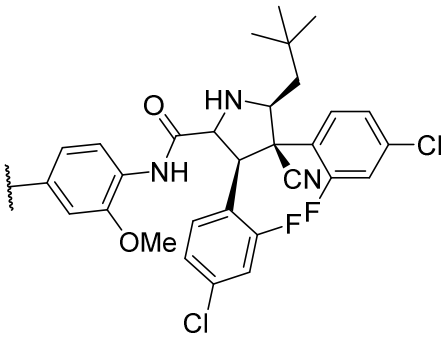
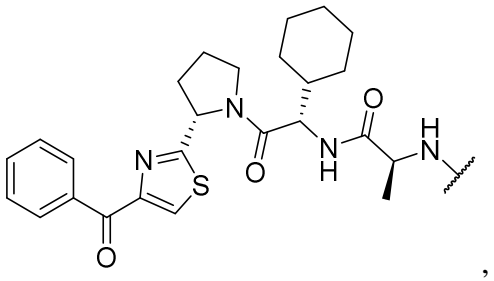


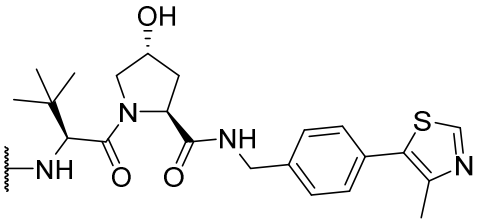
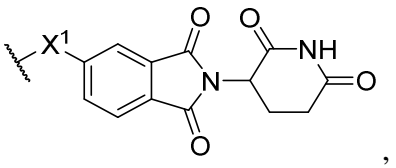
Ib.

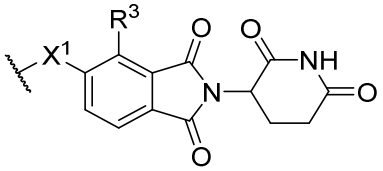
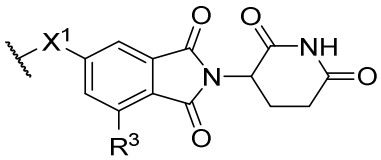
15. The compound of any one of claims 1-14, wherein E is a ligand for a ligase (*e.g.,* an E3 ligase).

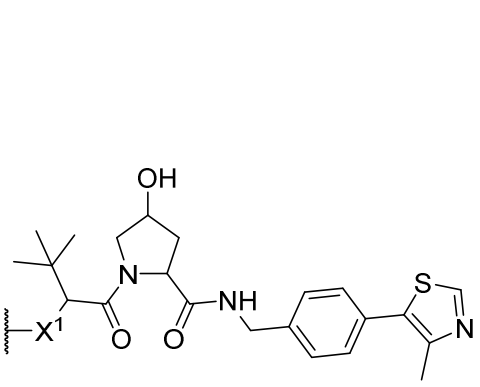
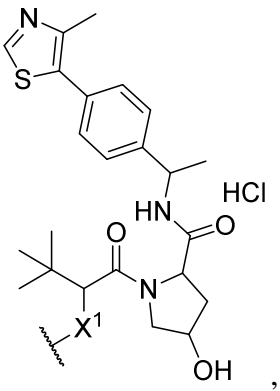
16. The compound of any one of claims 1-14, wherein E is a ligand for von Hippel-Lindau (VHL), cellular inhibitor of apoptosis (cIAP), cereblon (CRBN), or murine double minute 2 (MDM2).

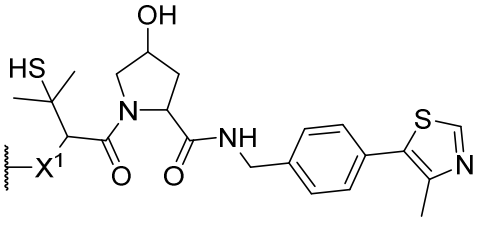
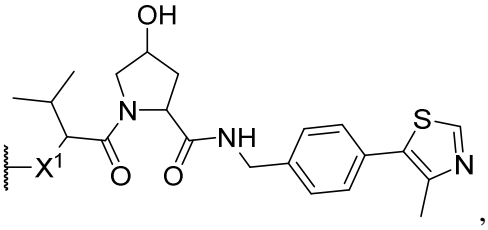
17. The compound of any one of claims 1-16, wherein E is ,

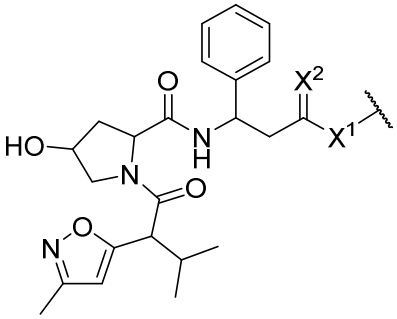
, ,

, ,

, ,

, ,

, ,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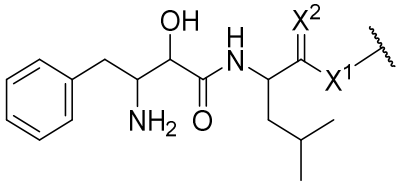
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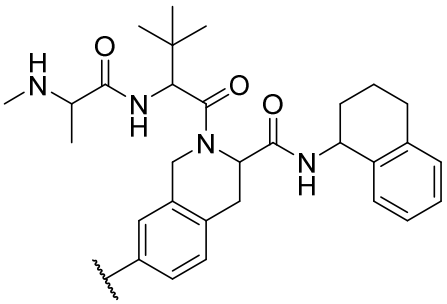
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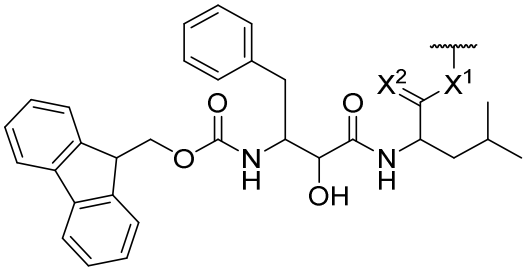
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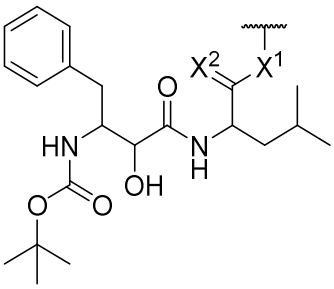
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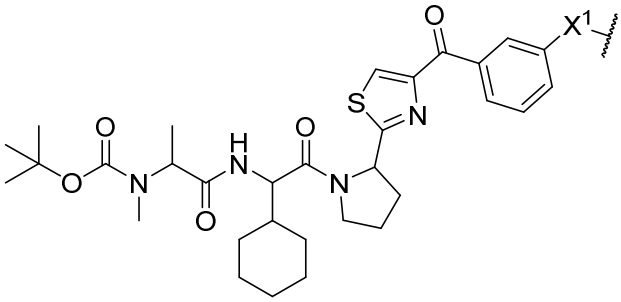
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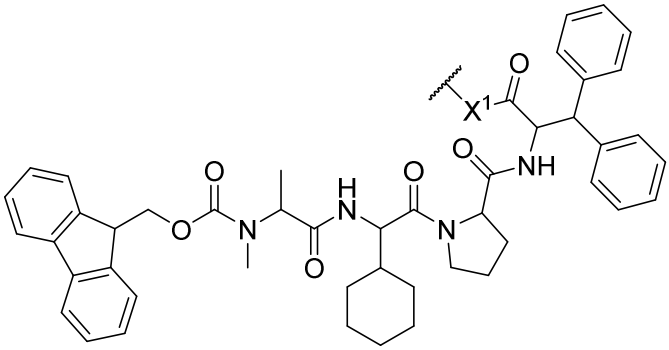
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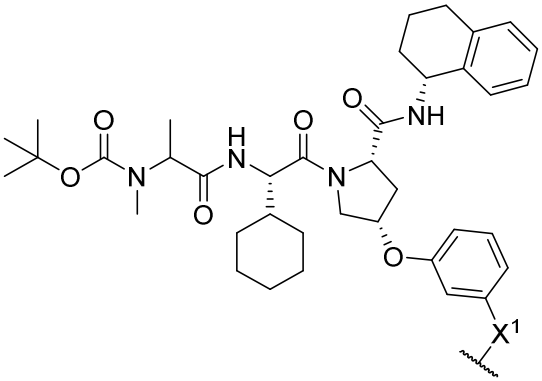
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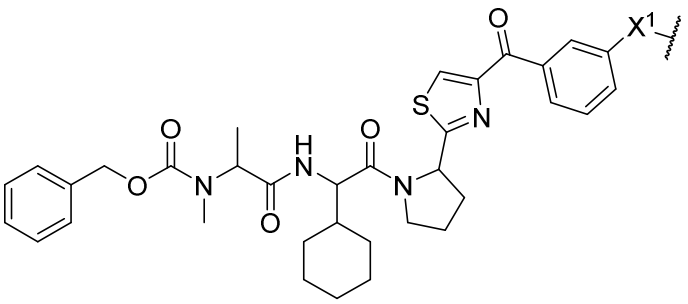
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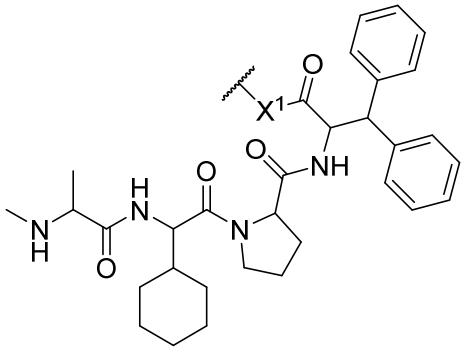
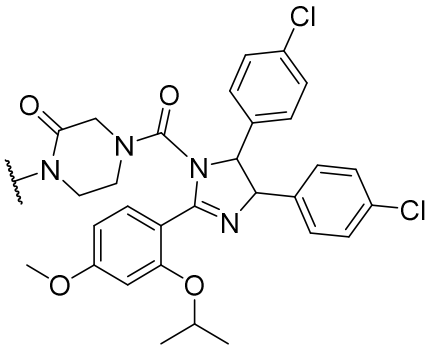
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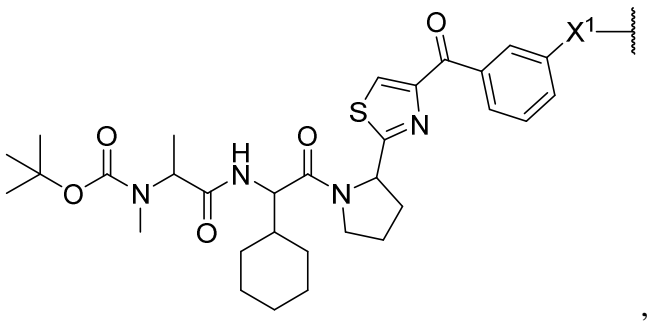
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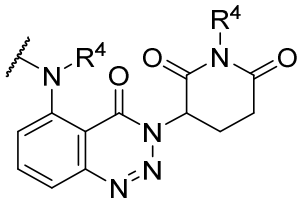
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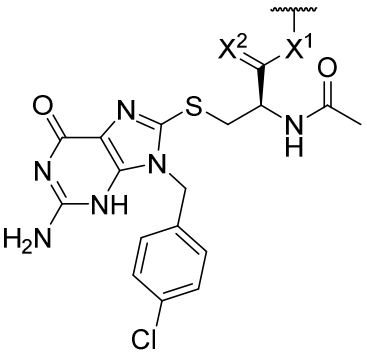
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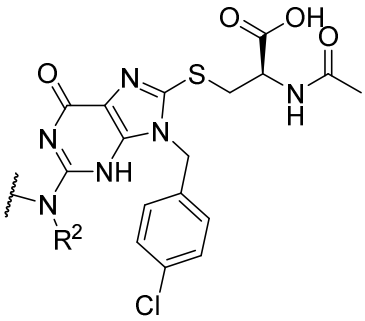
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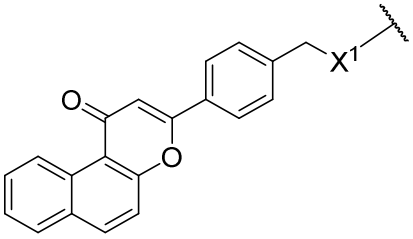
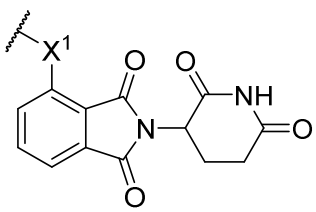
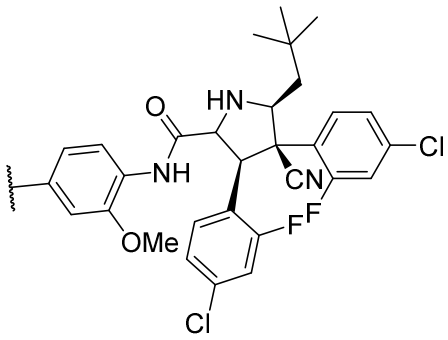

;

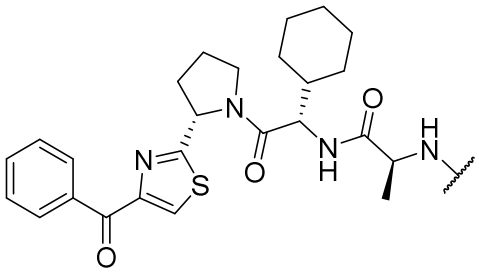
each X^1 and X^2 is independently selected from O, NR^4, and S;

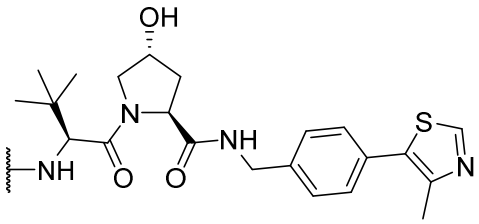
each R^3 is independently selected from halo (e.g., fluoro or bromo); and

each R^4 is independently H, alkyl, or aralkyl.

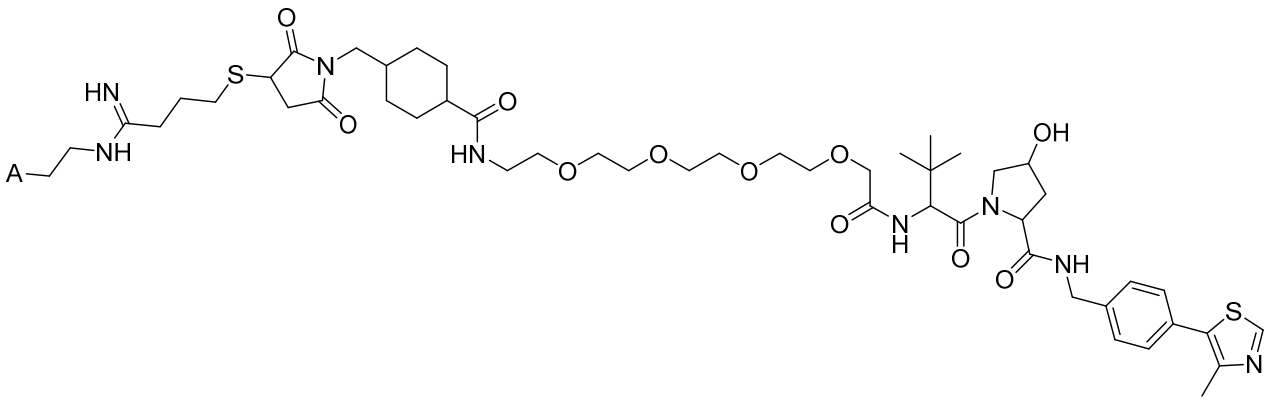
18. The compound of claim 17, wherein E is .

19. The compound of claim 17, wherein E is .

20. The compound of claim 17, wherein E is .

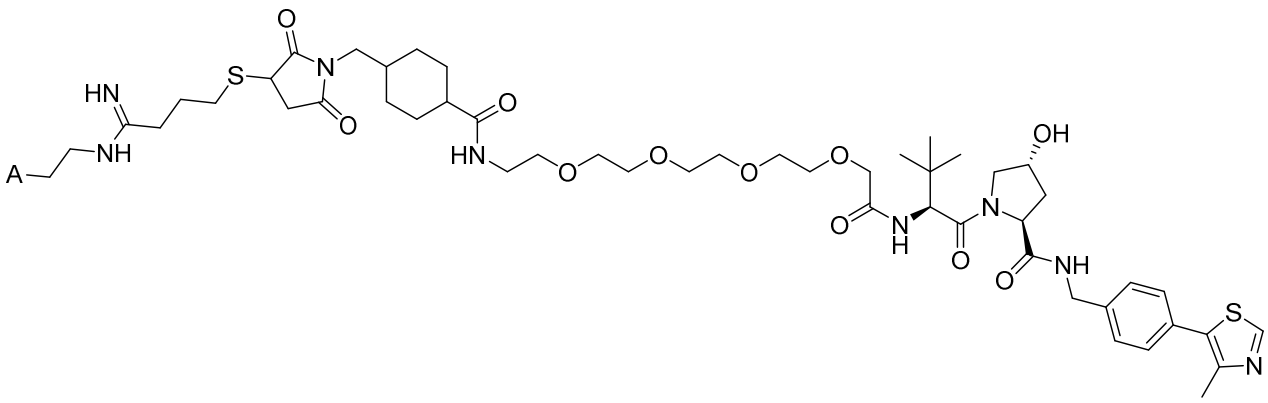
21. The compound of claim 17, wherein E is .

22. The compound of claim 1, wherein the compound has a structure represented by formula Ic or a pharmaceutically acceptable salt thereof:



Ic.

23. The compound of claim 1, wherein the compound has a structure represented by formula Id or a pharmaceutically acceptable salt thereof:



Id.

24. The compound of any one of claims 1-23, wherein A is a T antigen.

25. The compound of any one of claims 1-24, wherein the antigen is from a tumor (e.g., from tumor cells).

26. The compound of any one of claims 1-24, wherein the antigen is from an infection pathogen (e.g., a bacterium or virus).

27. The compound of any one of claims 1-24, wherein the antigen is from prostate cancer tumor cells, liver tumor cancer cells, colorectal tumor cancer cells, ovarian tumor cancer cells, pancreatic tumor cancer cells, breast tumor cancer cells, melanoma tumor cancer cells, or bladder tumor cancer cells.

28. The compound of any one of claims 1-24, wherein the antigen is prostate-specific antigen (PSA), alpha-fetoprotein (AFP), carcinoembryonic antigen (CEA), cancer antigen 125 (CA-125), mucin-1 (MUC-1), melanoma-associated antigen (MAGE), or New York esophageal squamous cell carcinoma 1 (NY-ESO-1).

29. The compound of any one of claims 1-24, wherein A is a Simian Vacuolating Virus 40 T antigen (SV40 large TAg).

30. A nanoparticle, comprising a tumor antigen covalently linked to an active agent; and a plurality of lipids or lipidoids.

31. The nanoparticle of claim 30, wherein the tumor antigen covalently linked to an active agent has a structure represented by formula I:

A—Y—E

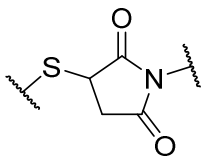
I

wherein,

A is the tumor antigen;

E is the active agent (e.g., a drug); and

Y is a linker which covalently links A to E and comprises an alkylene, alkenylene, alkynylene, cycloalkylene, heterocyclylene, arylene, or heteroarylene, or a combination thereof, wherein the linker comprises 1-100 carbon atoms, preferably 10-50 carbon atoms.

32. The nanoparticle of claim 30 or 31, wherein the tumor antigen is covalently linked to the active agent via  .

33. The nanoparticle of claim 30, wherein the active agent is a compound of any one of claims 1-29.

34. The nanoparticle of any one of claims 30-33, wherein the nanoparticle comprises a plurality of lipidoids.

35. The nanoparticle of any one of claims 30-33, wherein the nanoparticle comprises a plurality of lipids.

36. The nanoparticle of any one of claims 30-33, wherein the nanoparticle comprises a plurality of lipids and lipidoids.

37. The nanoparticle of any one of claims 30-36, wherein the lipids and lipidoids are selected from the group consisting of 113-O12B, cholesterol (Chol), 1,2-distearoyl-sn-glycero-3-phosphocholine (DSPC), 1,2-dimyristoyl-rac-glycero-3-methoxypolyethylene

glycol-2000 (DMG-PEG_{2k}), MC-3, SM-102, ALC0315, L88, and 93-O17S, or a combination of any of the foregoing.

38. The nanoparticle of any one of claims 30-36 , wherein the lipids and lipidoids are selected from the group consisting of 113-O12B, cholesterol (Chol), 1,2-distearoyl-sn-glycero-3-phosphocholine (DSPC), and 1,2-dimyristoyl-rac-glycero-3-methoxypolyethylene glycol-2000 (DMG-PEG_{2k}).

39. A pharmaceutical composition, comprising the nanoparticle of any one of claims 30-38; and a pharmaceutically acceptable excipient.

40. Use of a therapeutically effective amount of the compound of any one of claims 1-29, or a pharmaceutically acceptable salt thereof, or the nanoparticle of any one of claims 30-38 in the manufacture of a medicament for treating cancer in a subject in need thereof.

41. The use of claim 40, wherein the cancer is melanoma, breast cancer, ovarian cancer, spleen cancer, or lung cancer.

42. The use of claim 40 or 41, wherein an immune checkpoint inhibitor (e.g., a PD-1 inhibitor) is to be administered.

43. Use of a therapeutically effective amount of the compound of any one of claims 1-29, or a pharmaceutically acceptable salt thereof, or the nanoparticle of any one of claims 30-38 in the manufacture of a medicament for treating an infectious disease in a subject in need thereof.

44. The use of claim 43, wherein the infectious disease pathogen is a bacterium.

45. The use of claim 43, wherein the infectious disease pathogen is a virus.