

### Nuclear Reactions Worksheet

Fill in the box and write the equation in the opposite form (either long or short).

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|---|--|
| 1. ${}_{17}^{33}\text{Cl} (n, \square) {}_{15}^{31}\text{P}$          | 2. ${}_{17}^{37}\text{Cl} + {}_1^1\text{H} \rightarrow \square$ (no short form please)     |
| 3. ${}_{11}^{23}\text{Na} (\alpha, \square) {}_{11}^{23}\text{Na}$    | 4. ${}_{8}^{16}\text{O} + {}_1^1\text{H} \rightarrow {}_{7}^{13}\text{N} + \square$        |
| 5. ${}_{11}^{23}\text{Na} (\alpha, \square) {}_{12}^{26}\text{Mg}$    | 6. ${}_{99}^{253}\text{Es} + \square \rightarrow {}_{101}^{256}\text{Md} + {}_0^1\text{n}$ |
| 7. ${}_{11}^{23}\text{Na} (n, \beta^-) \square$                       | 8. ${}_{15}^{31}\text{P} + \square \rightarrow {}_{14}^{28}\text{Si} + {}_2^4\text{He}$    |
| 9. ${}_{4}^9\text{Be} (\square, n) {}_{6}^{12}\text{C}$               | 10. ${}_{42}^{98}\text{Mo} + {}_1^2\text{H} \rightarrow \square + {}_0^1\text{n}$          |
| 11. ${}_{3}^7\text{Li} (p, \alpha) \square$                           | 12. ${}_{5}^{11}\text{B} + {}_2^4\text{He} \rightarrow {}_0^1\text{n} + \square$           |
| 13. ${}_{48}^{113}\text{Cd} (\square, \gamma) {}_{48}^{113}\text{Cd}$ | 14. ${}_{92}^{238}\text{U} + {}_{6}^{12}\text{C} \rightarrow 4 {}_0^1\text{n} + \square$   |
| 15. ${}_{3}^6\text{Li} (n, \alpha) \square$                           | 16. ${}_{92}^{238}\text{U} + {}_{6}^{12}\text{C} \rightarrow \square + 6 {}_0^1\text{n}$   |
| 17. ${}_{1}^2\text{H} (\gamma, p) \square$                            | 18. ${}_{5}^{10}\text{B} + \alpha \rightarrow \square + {}_{7}^{13}\text{N}$               |
| 19. $\square (d, p) {}_{15}^{32}\text{P}$                             | 20. ${}_{4}^9\text{Be} + {}_1^1\text{H} \rightarrow {}_{3}^6\text{Li} + \square$           |
| 21. ${}_{92}^{238}\text{U} (\square, \square) {}_{93}^{239}\text{Np}$ | 22. ${}_{17}^{35}\text{Cl} + {}_0^1\text{n} \rightarrow {}_{16}^{35}\text{S} + \square$    |
| 23. ${}_{17}^{37}\text{Cl} (\square, \alpha) {}_{16}^{35}\text{S}$    | 24. ${}_{94}^{239}\text{Pu} + {}_2^4\text{He} \rightarrow \square + {}_0^1\text{n}$        |
| 25. ${}_{13}^{27}\text{Al} (\alpha, n) \square$                       | 26. ${}_{30}^{64}\text{Zn} + \square \rightarrow {}_{29}^{63}\text{Cu} + {}_0^1\text{n}$   |
| 27. ${}_{98}^{249}\text{Cf} (\square, 4n) {}_{106}^{263}\text{Unh}$   | 28. ${}_{83}^{209}\text{Bi} + \alpha \rightarrow {}_{85}^{211}\text{At} + \square$         |
| 29. $\square ({}_{5}^{11}\text{B}, 4n) {}_{103}^{257}\text{Lr}$       | 30. $\square + {}_1^2\text{H} \rightarrow {}_{28}^{61}\text{Ni} + {}_2^4\text{He}$         |
| 31. ${}_{7}^{14}\text{N} (\square, p) {}_{8}^{17}\text{O}$            | 32. ${}_{7}^{14}\text{N} + {}_0^1\text{n} \rightarrow {}_{6}^{14}\text{C} + \square$       |
| 33. ${}_{11}^{23}\text{Na} (\alpha, \square) {}_{13}^{27}\text{Al}$   | 34. ${}_{24}^{54}\text{Cr} + {}_1^1\text{H} \rightarrow {}_{25}^{54}\text{Mn} + \square$   |
| 35. ${}_{11}^{23}\text{Na} (\alpha, \square) {}_{13}^{26}\text{Al}$   | 36. ${}_{52}^{125}\text{Te} + {}_1^1\text{H} \rightarrow {}_0^1\text{n} + \square$         |
| 37. ${}_{46}^{106}\text{Pd} (n, p) \square$                           | 38. ${}_{1}^2\text{H} + {}_{1}^2\text{H} \rightarrow {}_{1}^1\text{H} + \square$           |

39.  ${}_{11}^{23}\text{Na} (\alpha, \square) {}_{12}^{25}\text{Mg}$
40.  ${}_{1}^2\text{H} + \square \rightarrow {}_{1}^1\text{H} + {}_{0}^1\text{n}$
41.  ${}_{5}^{10}\text{B} (\square, \square) {}_{4}^{10}\text{Be}$
42.  ${}_{29}^{63}\text{Cu} + {}_{1}^1\text{H} \rightarrow \square + {}_{0}^1\text{n} + {}_{13}^{25}\text{Al}$
43.  ${}_{14}^{29}\text{Si} (\text{d}, \text{n}) \square$
44.  ${}_{98}^{252}\text{Cf} + {}_{5}^{10}\text{B} \rightarrow \square + 3 {}_{0}^1\text{n}$
45.  ${}_{3}^6\text{Li} (\square, \alpha) {}_{2}^3\text{He}$
46.  $\square + {}_{2}^4\text{He} \rightarrow {}_{97}^{243}\text{Bk} + {}_{0}^1\text{n}$
47.  ${}_{92}^{238}\text{U} (\alpha, \square) {}_{94}^{240}\text{Pu}$
48.  ${}_{3}^6\text{Li} + {}_{0}^1\text{n} \rightarrow {}_{2}^4\text{He} + \square$
49.  ${}_{93}^{237}\text{Np} (\square, 3\text{n}) {}_{95}^{238}\text{Am}$
50.  ${}_{6}^{12}\text{C} + {}_{1}^1\text{H} \rightarrow {}_{7}^{13}\text{N} + \square$
51.  ${}_{41}^{93}\text{Nb} (\alpha, \text{n}) \square$
52.  ${}_{20}^{44}\text{Ca} + {}_{1}^1\text{H} \rightarrow {}_{21}^{44}\text{Sc} + \square$
53.  ${}_{29}^{63}\text{Cu} (\text{d}, 2\text{n}) \square$
54.  ${}_{15}^{31}\text{P} + {}_{1}^2\text{H} \rightarrow {}_{15}^{32}\text{P} + \square$
55.  ${}_{29}^{63}\text{Cu} (\text{d}, \square) {}_{30}^{64}\text{Zn}$
56.  ${}_{15}^{30}\text{P} + \square \rightarrow {}_{14}^{30}\text{Si} + {}_{1}^1\text{H}$
57.  ${}_{18}^{40}\text{Ar} (\text{d}, \square) {}_{18}^{41}\text{Ar}$
58.  ${}_{27}^{59}\text{Co} + {}_{0}^1\text{n} \rightarrow {}_{27}^{60}\text{Co} + \square$

Below are several fission reactions. Please fill in the missing portions.

59.  ${}_{92}^{235}\text{U} + {}_{0}^1\text{n} \rightarrow {}_{56}^{141}\text{Ba} + \square \text{Kr} + 3 {}_{0}^1\text{n}$
60.  ${}_{92}^{235}\text{U} + {}_{0}^1\text{n} \rightarrow {}_{52}^{137}\text{Te} + \square \text{Zr} + 2 {}_{0}^1\text{n}$
61.  ${}_{92}^{235}\text{U} + {}_{0}^1\text{n} \rightarrow \square \text{Rb} + {}_{55}^{137}\text{Cs} + 3 {}_{0}^1\text{n}$
62.  ${}_{92}^{235}\text{U} + {}_{0}^1\text{n} \rightarrow {}_{38}^{94}\text{Sr} + {}_{54}^{140}\text{Xe} + \square {}_{0}^1\text{n}$
63.  ${}_{92}^{235}\text{U} + {}_{0}^1\text{n} \rightarrow \square + {}_{61}^{151}\text{Pm} + 3 {}_{0}^1\text{n} + 4 \beta^{-}$
64.  $\square + {}_{0}^1\text{n} \rightarrow {}_{58}^{144}\text{Ce} + {}_{36}^{94}\text{Kr} + 2 {}_{0}^1\text{n}$
65.  $\square \text{U} + {}_{0}^1\text{n} \rightarrow {}_{51}^{133}\text{Sb} + {}_{41}^{98}\text{Nb} + 3 {}_{0}^1\text{n}$