Worksheet #1

Balancing Nuclear Equations

When balancing nuclear equations, the sums of the atomic and mass numbers must be the same on both sides of the equation. In some cases one of the symbols in the list below will be used to complete the equation. If a new element is formed, you may need to refer to a periodic table to determine the symbol that accompanies an atomic number. The first two equations have been balanced for you.

Alpha particle	α	$^{4}_{2}He$	Beta particle	β	$^{0}_{-1}e$
Gamma ray	γ	$^{0}_{0}\gamma$	Proton	p	$^{1}_{1}H$
Neutron	n	$^{1}_{0}n$	Positron	β^+	$^{0}_{+1}e$

1. $_{13}Al^{27} + {}_{2}He^{4} \rightarrow {}_{15}P^{30} +$ $_{0}n^{1}$
2. $_{29}Cu^{63} + {}_{1}H^{2} \rightarrow 2\ {}_{0}n^{1} +$ $_{30}Zn^{63}$
3. $_{30}Ca^{65} \rightarrow {}_{29}Sc^{65} +$ $\beta^+ / {}^{0}_{+1}e$
4. $_{4}Be^{9} + {}_{2}He^{4} \rightarrow {}_{6}C^{12} +$ $^{1}_{0}n$
5. $_{15}P^{31} + {}_{1}H^{2} \rightarrow {}_{15}P^{32} +$ $^{1}_{1}H$ / P
6. $_{17}Cl^{37} +$ $^{2}_{1}H$ $\rightarrow {}_{16}S^{35} + {}_{2}He^{4}$
7. $_{15}P^{30} +$ $^{1}_{0}n$ $\rightarrow {}_{14}Si^{30} + {}_{1}H^{1}$
8. $_{1}H^{2} + {}_{1}H^{2} \rightarrow {}_{1}H^{1} +$ $^{3}_{1}H$
9. $_{6}C^{11} \rightarrow {}_{+1}e^{0} +$ $^{11}_{5}B$
10. $_{29}Cu^{63} + {}_{1}H^{2} \rightarrow {}_{30}Zn^{64} +$ $^{1}_{0}n$
11. $_{1}H^{2} +$ γ $\rightarrow {}_{1}H^{1} + {}_{0}n^{1}$
12. $_{15}P^{31} + {}_{1}H^{1} \rightarrow {}_{14}Si^{28} +$ $^{4}_{2}He$ / α
13. $_{7}N^{14} +$ α / $^{4}_{2}He$ $\rightarrow {}_{8}O^{17} + {}_{1}H^{1}$
14. $_{94}Pu^{239} + {}_{1}H^{1} \rightarrow {}_{0}n^{1} +$ $^{239}_{95}Am$
15. $_{29}Cu^{63} + {}_{1}H^{1} \rightarrow {}_{17}Cl^{38} + {}_{0}n^{1} +$ $^{35}_{13}Al$
16. $_{29}Cu^{63} + {}_{1}H^{2} \rightarrow {}_{29}Cu^{64} +$ ($^{1}_{1}H$) / p

Radiation Science and Engineering Center
The Pennsylvania State University
University Park, PA 16802

17. $_{92}U^{235} + {}_{0}n^{1} \rightarrow {}_{42}Mo^{95} +$ $^{139}_{50}Sn$ $+ 2\,{}_{0}n^{1}$

18. $_{3}Li^{6} + {}_{0}n^{1} \rightarrow {}_{2}He^{4} +$ $^{3}_{1}H$

19. $_{3}Li^{6} + {}_{1}H^{2} \rightarrow {}_{4}Be^{7} +$ $^{1}_{0}n$

20. $_{51}Sb^{121} + {}_{0}n^{1} \rightarrow {}_{51}Sb^{122} +$ γ

21. $_{82}Pb^{214} \rightarrow {}_{-1}e^{0} +$ $^{214}_{83}Bi$

22. $_{29}Cu^{63} + {}_{1}H^{2} \rightarrow {}_{1}H^{3} +$ $^{62}_{29}Cu$

23. $_{7}N^{14} +$ $^{1}_{0}n$ $\rightarrow {}_{6}C^{14} + {}_{1}H^{1}$

24. $_{3}Li^{6} + {}_{1}H^{1} \rightarrow {}_{2}He^{4} +$ $^{3}_{2}He$

25. $^{241}_{95}Am \rightarrow {}_{93}Np^{237} + {}_{2}He^{4}$

26. $_{1}H^{2} + {}_{1}H^{2} \rightarrow {}_{2}He^{3} +$ $^{1}_{0}n$

27. $_{14}Si^{28} + {}_{1}D^{2} \rightarrow {}_{14}Si^{29} +$ $p / {}^{1}_{1}H$

28. $_{4}Be^{9} + {}_{2}He^{4} \rightarrow {}_{3}Li^{6} +$ $^{7}_{3}Li$

29. $_{27}Co^{59} + {}_{0}n^{1} \rightarrow {}_{27}Co^{60} +$ γ

30. $_{18}Ar^{40} + {}_{1}H^{2} \rightarrow {}_{18}Ar^{41} +$ $^{1}_{1}H$

31. $_{7}N^{14} + {}_{2}He^{4} \rightarrow {}_{1}H^{1} +$ $^{17}_{8}O$

32. $_{9}F^{18} \rightarrow {}_{8}O^{18} +$ $\beta^{+} / {}^{0}_{+1}e$

33. $_{4}Be^{9} + {}_{2}He^{4} \rightarrow {}_{6}C^{12} +$ $^{1}_{0}n$

34. $_{92}U^{239} \rightarrow {}_{-1}e^{0} +$ $^{239}_{93}Np$

35. $_{16}S^{32} + {}_{0}n^{1} \rightarrow {}_{1}H^{1} +$ $^{32}_{15}P$

36. $_{94}Pu^{239} + 2\,{}_{0}n^{1} \rightarrow {}_{-1}e^{0} +$ $^{241}_{95}Am$

37. $_{89}Ac^{237} \rightarrow {}_{-1}e^{0} +$ $^{237}_{90}Th$

38. $_{90}Th^{237} \rightarrow {}_{88}Ra^{233} +$ $^{4}_{2}He$

39. $_{92}U^{235} \rightarrow {}_{90}Th^{231} +$ $^{4}_{2}He$

40. $_{90}Th^{231} \rightarrow {}_{91}Pa^{231} +$ $^{0}_{-1}e$