

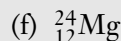
11.

Isotope	Mass Number	Atomic Number	Number of Neutrons
lithium-7	7	3	4
neon-22	22	10	12
silicon-29	29	14	15
sulfur-16	16	8	8
magnesium-24	24	12	12
magnesium-26	26	12	14

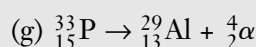
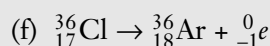
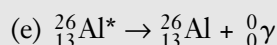
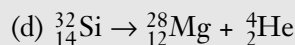
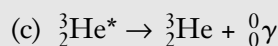
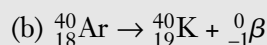
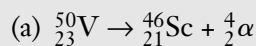
12. (a) 32 g
(b) 8 g
13. Argon-40, the daughter isotope in the pair, is a gas. Melting the rock drives the argon-40 out of the material, leaving only potassium-40. This resets the clock to zero.
14. A nuclear reaction is a process in which an atom's nucleus changes by gaining or releasing particles or energy.
15. A nuclear reaction involves changes in the nucleus of atoms, while a chemical reaction involves changes in electron arrangements.
16. A nuclear equation is a set of symbols that describes the changes that occur during a nuclear reaction.
17. The total mass number and the total charge do not change during a nuclear reaction.
18. A nuclear reaction can be induced by making a nucleus unstable through bombardment with alpha particles, beta particles, or gamma rays.

Understanding Key Ideas

19. (a) Both are electromagnetic energy.
(b) They have different wavelengths and energies.
20. Medical imaging and cancer treatments
21. Natural background radiation is the high-energy, fast-moving particles or waves found in our environment.
22. The number of protons in an atom is equal to the atomic number. The number of neutrons is equal to the mass number minus the atomic number.
23. (a) ${}_{81}^{201}\text{Tl}$
(b) ${}_{89}^{227}\text{Ac}$
(c) ${}_{87}^{221}\text{Fr}$
(d) ${}_{28}^{60}\text{Ni}$
(e) ${}_{90}^{234}\text{Th}$



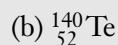
24. Note: ${}^4_2\text{He}$ can be used in place of ${}^4_2\alpha$ and ${}^0_{-1}e$ can be used in place of ${}^0_{-1}\beta$ in the following answers.



25. Nitrogen-14

26. 5739 years

27. (a) 50 micrograms
(b) 25 micrograms
(c) 12.5 micrograms

28. (a) ${}_{58}^{156}\text{Ce}$ 

29. (a) Fission
(b) Both
(c) Fission
(d) Fission
(e) Fusion
(f) Fusion

Applying Your Understanding

30. Accept all logical responses. For example, one might say that a fair coin toss is impossible to predict, as is identifying which specific nuclei will decay. On the other hand, in a coin toss, one could imagine that, with careful measurements, a successful prediction of how the coin will land could be made. No such prediction is possible for radioactive decay, even in principle.

Pause and Reflect Answer

Students should cover some of these points.

- Fission and fusion are both nuclear processes, which means they involve changes to the nuclei of atoms.