____1. Which particle has a negative charge?
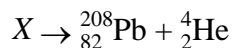
(A) a lithium ion   (C) an aluminum ion

(B) an alpha particle   (D) a beta particle
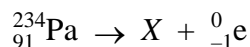
____2. According to the equation:

$$X \rightarrow {}^{208}_{82}Pb + {}^{4}_{2}He$$

The nucleus correctly represented by X is

(A) ${}^{204}_{80}Hg$
(B) ${}^{212}_{84}Po$
(C) ${}^{204}_{80}Bi$
(D) ${}^{212}_{84}Pb$

____3. Given the reaction:

$${}^{234}_{91}Pa \rightarrow X + {}^{0}_{-1}e$$

When the equation is correctly balanced the nucleus represented by X is

(A) ${}^{234}_{92}U$
(B) ${}^{235}_{92}U$
(C) ${}^{230}_{90}Th$
(D) ${}^{232}_{90}Th$

____4. When an alpha particle is emitted by an atom, the atomic number of the atom will

(A) decrease by 2   (C) decrease by 4

(B) increase by 2   (D) increase by 4

____5. Which type of radiation is most similar to high- energy x-rays?

(A) alpha   (C) neutron

(B) beta   (D) gamma

____6. What is the number of hours required for potassium-42 to undergo 3 half-life periods ? (The half life of K-42 is 12.4 hrs.)

(A) 6.2 hours   (C) 24.8 hours

(B) 12.4 hours   (D) 37.2 hours

____7. Nuclear fusion *differs* from nuclear fission because nuclear fusion reactions

(A) form heavier isotopes from lighter isotopes

(B) form lighter isotopes from heavier isotopes

(C) convert mass to energy

(D) convert energy to mass
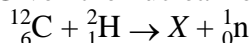
____8. Given the equation:

$${}^{14}_{7}N + {}^{4}_{2}He \rightarrow X + {}^{17}_{8}O$$
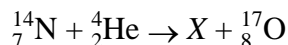
When the equation is correctly balanced, the particle represented by the X will be

(A) ${}^{0}_{-1}e$
(B) ${}^{1}_{0}n$
(C) ${}^{1}_{1}H$
(D) ${}^{2}_{1}H$

____9. Which isotope is used for dating archaeological discoveries and other very old things?

(A) carbon-12   (C) carbon-14
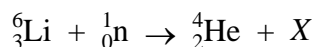
(B) carbon-13   (D) carbon-15

____10. Given the nuclear reaction:
$${}^{12}_{6}C + {}^{2}_{1}H \rightarrow X + {}^{1}_{0}n$$
When the equation is correctly balanced, the nucleus represented by the X is

(A) ${}^{14}_{6}N$
(B) ${}^{13}_{7}N$
(C) ${}^{13}_{7}C$
(D) ${}^{13}_{6}C$

____11. In the reaction:

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

The species represented by X is

(A) ${}^{2}_{1}H$
(B) ${}^{3}_{1}H$
(C) ${}^{3}_{2}He$
(D) ${}^{4}_{2}He$

____12. When a beta particle (${}^{0}_{-1}e$) is emitted by the nucleus of an atom, the mass number of the atom

(A) decreases   (C) remains the same

(B) increases

_____13. Which equation represents nuclear disintegration resulting in release of a beta particle?

(A) $^{220}_{87}\text{Fr} + ^{4}_{2}\text{He} \rightarrow ^{224}_{89}\text{Ac}$ (C) $^{32}_{15}\text{P} + ^{0}_{-1}\text{e} \rightarrow ^{32}_{14}\text{Si}$

(B) $^{239}_{94}\text{Pu} \rightarrow ^{235}_{92}\text{U} + ^{4}_{2}\text{He}$ (D) $^{198}_{79}\text{Au} \rightarrow ^{198}_{80}\text{Hg} + ^{0}_{-1}\text{e}$
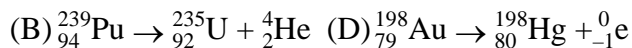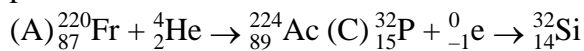
_____14. Aluminum-27 is bombarded with alpha particles according to the following nuclear equation:

$$^{27}_{13}\text{Al} + ^{4}_{2}\text{He} \rightarrow X + ^{1}_{0}\text{n}$$
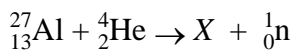
The radioactive element represented by X is an isotope of

(A) zinc   (C) sulfur

(B) phosphorus   (D) sodium

_____15. Which of these types of nuclear radiation has the greatest penetrating power?

(A) alpha   (C) neutron

(B) beta   (D) gamma

_____16. As an atom of a radioactive isotope emits an alpha particle, the mass number of the atom

(A) decreases   (C) remains the same

(B) increases

_____17. A radioactive element has a half-life of 2 days. Which fraction represents the amount of an original sample of this element remaining after 6 days?

(A) $\dfrac{1}{8}$

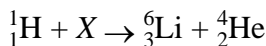(B) $\dfrac{1}{2}$

(C) $\dfrac{1}{3}$

(D) $\dfrac{1}{4}$

_____18. Which statement best describes gamma radiation?

(A) It has a mass of 1 and a charge of 1.

(B) It has a mass of 0 and a charge of –1.

(C) It has a mass of 0 and a charge of 0.

(D) It has a mass of 4 and a charge of +2.

_____19. Which type of radioactive emission has a positive charge and weak penetrating power?

(A) alpha particle   (C) gamma ray

(B) beta particle   (D) neutron

_____20. Given the nuclear equation:

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

The particle represented by X is

(A) $^{9}_{4}\text{Li}$

(B) $^{9}_{4}\text{Be}$

(C) $^{10}_{5}\text{Be}$

(D) $^{10}_{6}\text{C}$

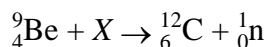_____21. In the reaction $^{239}_{93}\text{Np} \rightarrow ^{239}_{94}\text{Pu} + X$, what does X represent?

(A) a neutron   (C) an alpha particle

(B) a proton   (D) a beta particle

_____22. Which kind of nuclear radiation has high energy and no mass?
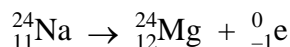
(A) alpha   (C) gamma

(B) beta   (D) neutron

_____23. In the reaction:

$$^{9}_{4}\text{Be} + X \rightarrow ^{12}_{6}\text{C} + ^{1}_{0}\text{n}$$

The X represents

(A) an alpha particle   (C) an electron

(B) a beta particle   (D) a proton

_____24. Given the reaction:

$$^{24}_{11}\text{Na} \rightarrow ^{24}_{12}\text{Mg} + ^{0}_{-1}\text{e}$$

This reaction is best described as

(A) alpha decay   (C) fission

(B) beta decay   (D) fusion

_____25. When a uranium nucleus breaks up into fragments, which type of nuclear reaction occurs?

(A) fusion   (C) replacement

(B) fission   (D) redox

____26. Given the nuclear equation:

$$^{14}_{7}N + X \rightarrow ^{16}_{8}O + ^{2}_{1}H$$

What is particle X?

(A) an alpha particle   (C) a deuteron

(B) a beta particle   (D) a triton

____27. Which equation represents alpha decay?

(A) $^{116}_{49}In \rightarrow ^{116}_{50}Sn + X$ (C) $^{38}_{19}K \rightarrow ^{38}_{18}Ar + X$

(B) $^{234}_{90}Th \rightarrow ^{234}_{91}Pa + X$ (D) $^{222}_{86}Rn \rightarrow ^{218}_{84}Po + X$

____28. Which type of reaction produces energy and intensely radioactive waste products?

(A) fusion of tritium and deuterium

(B) fission of uranium

(C) burning of heating oil

(D) burning of wood

____29. Given the equation:

$$^{14}_{6}C \rightarrow ^{14}_{7}N + X$$

Which particle is represented by the letter X?

(A) an alpha particle   (C) a neutron

(B) a beta particle   (D) a proton

____30. An 80 milligram sample of a radioactive isotope decays to 5 milligrams in 32 days. What is the half-life of this element?

(A) 8 days   (C) 16 days

(B) 2 days   (D) 4 days

____31. An original sample of a radioisotope had a mass of 10 grams. After 2 days, 5 grams of the radioisotope remains unchanged. What is the half-life of this radioisotope?

(A) 1 day   (C) 5 days

(B) 2 days   (D) 4 days

____32. As ^{14}C decays to ^{14}N, the number of protons in the nucleus

(A) decreases   (C) remains the same

(B) increases

____33. Which nuclear equation represents a fusion reaction?

(A) $^{238}_{92}U + ^{1}_{0}n \rightarrow ^{239}_{93}Np + ^{0}_{-1}e$

(B) $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{92}_{36}Kr + ^{141}_{56}Ba + 3\,^{1}_{0}n$

(C) $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$

(D) $^{1}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{2}He$

____34. Which statement explains why nuclear waste materials may pose a problem?

(A) They frequently have short half-lives and remain radioactive for brief periods of time.

(B) They frequently have short half-lives and remain radioactive for extended periods of time.

(C) They frequently have long half-lives and remain radioactive for brief periods of time.

(D) They frequently have long half-lives and remain radioactive for extended periods of time.

____35. Alpha particles were shot at gold foil in the famous gold foil experiment. An alpha particle has the same composition as a

(A) hydrogen nucleus   (C) beryllium nucleus

(B) deuterium nucleus   (D) helium nucleus

____36. Alpha particles and beta particles differ in

(A) mass, only

(B) charge, only

(C) both mass and charge

(D) neither mass nor charge

____37. The half-life of a radioactive isotope is 20.0 minutes. What is the total amount of a 1.00-gram sample of this isotope remaining after 1.00 hour?

(A) 0.500 g   (C) 0.250 g

(B) 0.333 g   (D) 0.125 g

____38. Which nuclear equation represents beta decay?

(A) $^{27}_{13}Al + ^{4}_{2}He \rightarrow ^{30}_{15}P + ^{1}_{0}n$

(B) $^{238}_{92}U \rightarrow ^{234}_{90}Th + ^{4}_{2}He$

(C) $^{14}_{6}C \rightarrow ^{14}_{7}N + ^{0}_{-1}e$

(D) $^{37}_{18}Ar + ^{0}_{-1}e \rightarrow ^{37}_{17}Cl$