Name:

CHAPTER 3: The nuclear atom review quiz

Multiple choice

1 The two main forms of radiation are:
- A cosmic radiation and ionising radiation.
- B non-ionising radiation and background radiation.
- C electromagnetic radiation and cosmic radiation.
- D ionising radiation and non-ionising radiation.

2 The general equation for alpha-decay is:
- A $^{A}_{Z}X \rightarrow {}^{A-4}_{Z}A - 4X + {}^{4}_{2}He$
- B $^{Z}_{A}X \rightarrow {}^{Z}_{A}X + {}^{2}_{4}He$
- C $^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}X + {}^{4}_{2}He$
- D $^{A}_{Z}X \rightarrow {}^{A-2}_{Z-4}X + {}^{2}_{4}He$

3 Which of the following best describes the structure of an atom?
- A A tightly bonded collection of negatively charged protons and neutrons (no charge) in the nucleus, which are surrounded by a cloud of small positively charged electrons
- B A tightly bonded collection of positively charged positrons and neutrons (no charge) in the nucleus, which are surrounded by a cloud of small negatively charged electrons
- C A tightly bonded collection of positively charged protons and neutrons (no charge) in the nucleus, which are surrounded by a cloud of small negatively charged electrons
- D A tightly bonded collection of negatively charged electrons and neutrons (no charge) in the nucleus, which are surrounded by a cloud of small positively charged positrons

4 Which of the following emissions would a sheet of paper be able to stop?
- A An alpha particle
- B A beta particle
- C Gamma rays
- D All of the above

5 Which of the following emissions have the least ionising effect?
- A Alpha particles
- B Beta particles
- C Gamma rays
- D None of the above – they all have strong ionising properties.

6 What evidence from the Geiger–Marsden experiment did Rutherford use in the development of his first atomic model?
- A Beta particles were always deflected from the gold foil towards the positive terminal of the detector.
- B Alpha particles were always deflected from the gold foil towards the negative terminal of the detector.
- C Alpha particles were sometimes deflected from the gold foil into the detector at very large angles.
- D All radioactivity went directly through the gold foil to the detector.

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How many neutrons are there in the nuclide $^{63}_{29}Cu$?

A 102
B 63
C 34
D 29

8 The nuclide $^{234}_{90}Th$ undergoes beta particle decay. Which of the following is the daughter nuclide?

A $^{226}_{88}Rn$
B $^{230}_{90}Th$
C $^{234}_{91}Pa$
D $^{238}_{92}U$

9 In order to form, $^{222}_{86}Rn$ undergoes nuclear decay. What is the other product of this reaction?

A An alpha particle
B A beta particle
C A gamma ray
D None of the above; the other product is an isotope of Rn.

10 In which of the following ways do chemical reactions and nuclear reactions differ?

A Chemical reactions release more energy than nuclear reactions.
B Nuclear reactions release more energy than chemical reactions.
C Chemical reactions involve nucleons; nuclear reactions involve atomic electrons.
D Chemical reactions involve rearranging atomic valence electrons; nuclear reactions involve all the atomic electrons.

11 A radioactive isotope has a half-life of 20 days. How long will it take for only one-eighth of the isotope to remain?

A 80 days
B 40 days
C 10 days
D 2.5 days

12 Naturally occurring rubidium comprises two isotopes: $^{85}_{37}Rb$ (occurring 72% of the time) and $^{87}_{37}Rb$ (occurring 28% of the time). Its relative atomic mass is closest to:

A 86 u
B 87 u
C 123 u
D 172 u

13 Terbium (Tb)–148 has 83 neutrons. It decays by positron emission to an isotope of gadolinium, Gd. The gadolinium nuclide then alpha decays to samarium (Sm)-144. What are the symbols for the nuclide of terbium-148 and samarium-144 in this decay series?

A $^{83}_{65}Tb$; $^{79}_{62}Sm$
B $^{148}_{83}Tb$; $^{144}_{79}Sm$
C $^{65}_{148}Tb$; $^{62}_{144}Sm$
D $^{148}_{65}Tb$; $^{144}_{62}Sm$

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How long will it take 4.0 mg of technetium-99m, with a half-life of 6.0 h, to decay to 20 μg?

A 6.0 h
B 12.0 h
C 24 h
D 48 h

15 In the neutron bombardment of aluminium, a new isotope of aluminium is formed. What is the other product of the reaction?

$${}^{1}_{0}n + {}^{27}_{13}Al \rightarrow {}^{28}_{13}Al + ?$$

A An alpha particle
B A beta particle
C A gamma ray
D None of the above

16 The initial mass of a sample isotope was found to be 32 g. After 12 days, the sample was again measured, and only 2 g of the original isotope remained. What is the half-life of the isotope?

A 6 days
B 4 days
C 3 days
D 1.5 days

17 The carbon-14 content of an ancient piece of wood was found to have 3.1% of that in living trees. Assuming that, over the ages, the ratio of carbon-14 to carbon-13 has remained the same in the atmosphere; about how old is the ancient piece of wood? The half-life of carbon-14 is 5730 years.

A 28 650 y
B 21 920 y
C 17 760 y
D 17 190 y

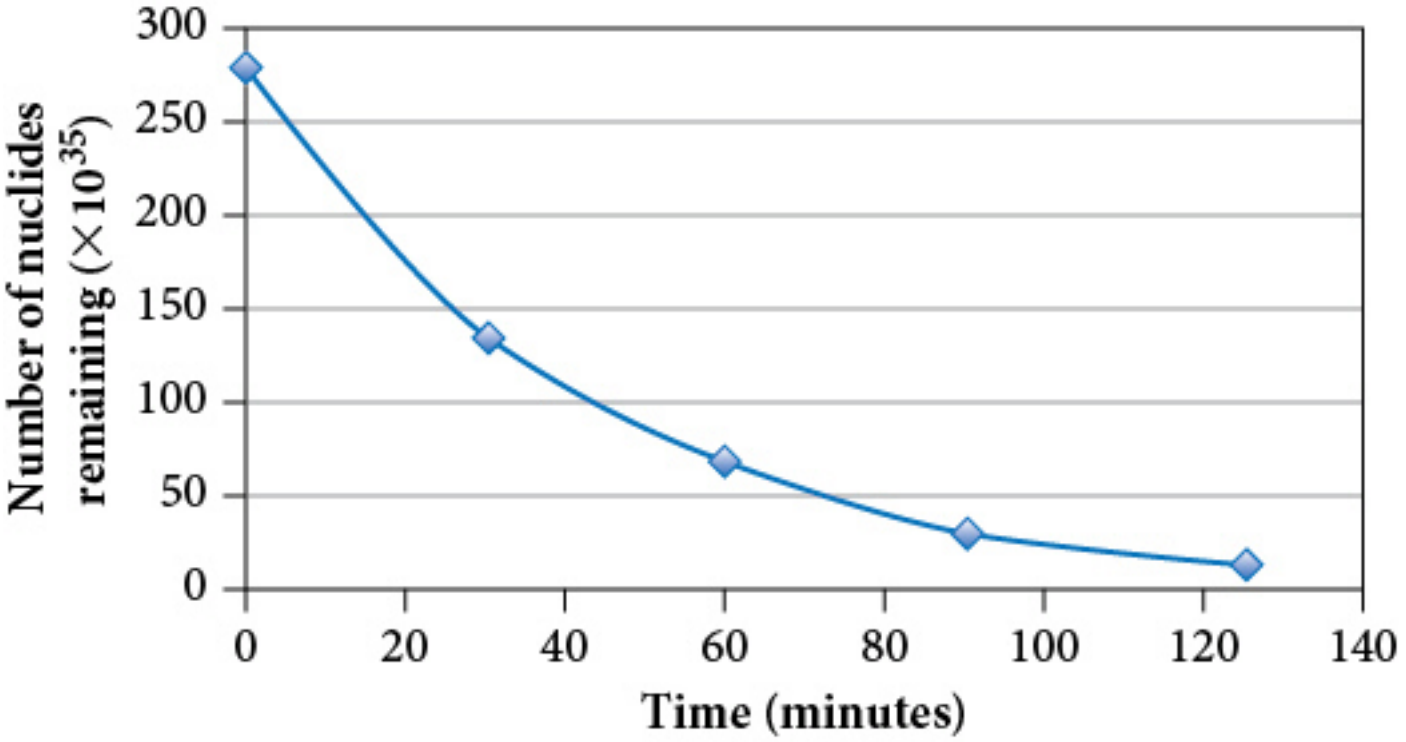
18 In an experiment using a radioactive source, physicists decide to accept data with an uncertainty of ±5%. What is the minimum number of counts they would need to record?

A 100 000
B 10 000
C 1 000
D 400

19 Beta emitters are often used in treatment because they:

A have high energies and longer effective half-lives.
B have short ranges in body tissue and relatively short biological half-lives.
C are less ionising than gamma rays but have longer effective half-lives.
D are easily detected in scanners outside the body over a shorter period of time.

20 The decay of a sample of the alpha particle emitter, thorium-226, is shown in the graph.



The half-life of the thorium-226 (in seconds) and the number of nuclides in the sample that have decayed after 100 minutes are:

A 1.8×10^3 s; 2.6×10^{37}

B 1.8×10^3 s; 2.6×10^{35}

C 3.6×10^3 s; 2.6×10^{37}

D 3.6×10^3 s; 2.6×10^{35}

Check Your Work Start Over