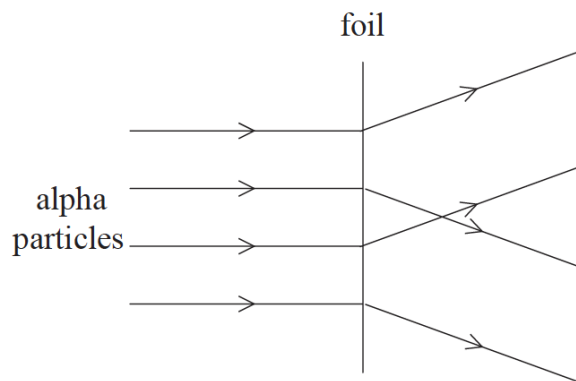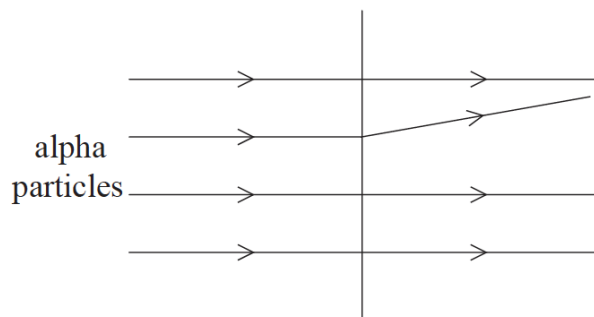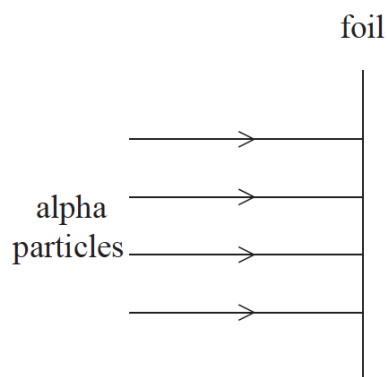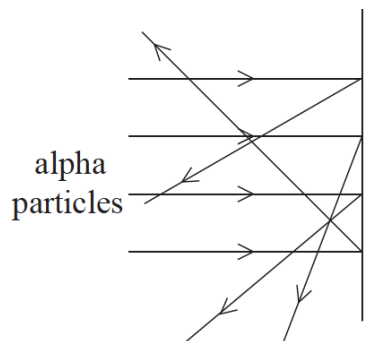# Nuclear-practice-2-MC *[27 marks]*

1. In the Geiger–Marsden experiment alpha particles were directed at a thin *[1 mark]* gold foil. Which of the following shows how the majority of the alpha particles behaved after reaching the foil?
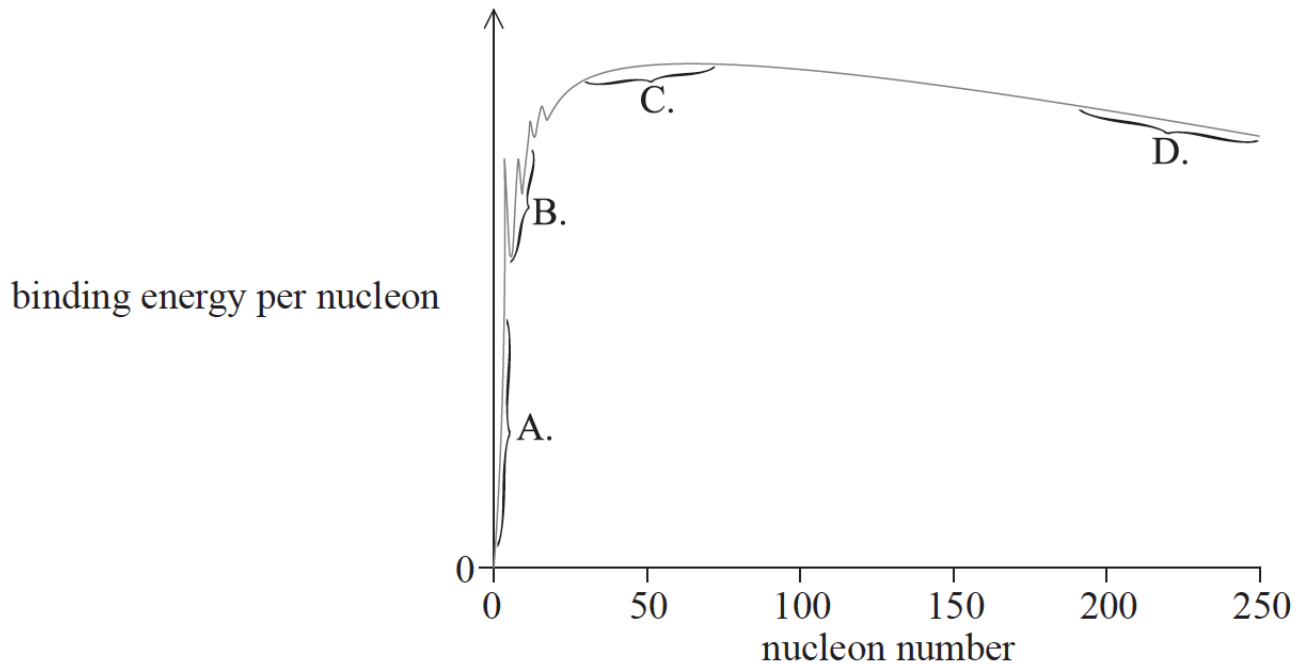
2. The graph shows the relationship between binding energy per nucleon   *[1 mark]*
    and nucleon number. In which region are nuclei most stable?

binding energy per nucleon

C.

B.

A.

0

0   50   100   150   200   250

nucleon number

D.

3. When compared with beta particles and gamma-ray photons, alpha   *[1 mark]*
    particles have the greatest

    A. mass.

    B. penetrating power.

    C. range in air.

    D. speed.

4. Which statement correctly describes the process of nuclear fusion?   *[1 mark]*

    A. The joining together of two small atoms to create a larger atom.

    B. The splitting up of a large atom to create two smaller atoms.

    C. The joining together of two small nuclei to create a larger nucleus.

    D. The splitting up of a large nucleus to create two smaller nuclei.

5. The nuclear reaction equation for the decay of a nucleus of thorium-231 *[1 mark]*
    (Th-231) to a nucleus of protactinium-231 (Pa-231) is shown below.

    $$^{231}_{90}\text{Th} \rightarrow \, ^{231}_{91}\text{Pa} + \beta^- + x$$

    The particle x is a/an

    A. proton.
    B. antineutrino.
    C. neutron.
    D. electron.

---

6. The half-life of a particular radioactive isotope is 8 days. The initial *[1 mark]*
    activity of a pure sample of the isotope is A.

    Which of the following is the time taken for the activity of the isotope to change by
    $\frac{7}{8}A$?

    A. 7 days
    B. 24 days
    C. 32 days
    D. 56 days

---

7. An electron is accelerated through a potential difference of 100 V. Which *[1 mark]*
    of the following gives the correct gain in kinetic energy of the electron in
    both joule and electronvolt?

	Joule / J	Electronvolt / eV
A.	100	100
B.	1.6×10^{-17}	100
C.	100	1.6×10^{-17}
D.	1.6×10^{-17}	1.6×10^{-17}

8. A nucleus of the isotope plutonium-238 $\left(^{238}\text{P}\right)$ decays into a nucleus of *[1 mark]* uranium by emitting an alpha particle. What is the nucleon number of the uranium nucleus?

A. 234
B. 236
C. 238
D. 240

9. Which of the following affects the rate at which a sample of a radioactive *[1 mark]* material decays?

A. The mass of the sample
B. The temperature of the sample
C. The volume of the sample
D. The pressure acting on the sample

10. Which of the following gives the correct number of protons and neutrons *[1 mark]* in a nucleus of carbon-14 $\left(^{14}_{6}\text{C}\right)$.

	Protons	Neutrons
A.	8	6
B.	6	8
C.	14	6
D.	6	14

11. A freshly prepared sample contains 4.0 µg of iodine-131. After 24 days, *[1 mark]* 0.5µg of iodine-131 remain. The best estimate of the half-life of iodine-131 is

A. 8 days.
B. 12 days.
C. 24 days.
D. 72 days.

12. Which nucleons in a nucleus are involved in the Coulomb interaction and *[1 mark]* the strong short-range nuclear interaction?

	Coulomb interaction	Strong short-range interaction
A.	protons	protons, neutrons
B.	protons	neutrons
C.	protons	protons
D.	protons, neutrons	neutrons

13. The nuclear equation below is an example of the transmutation of *[1 mark]* mercury into gold.

$$^{2}_{1}\text{H} + ^{199}_{80}\text{Hg} \rightarrow ^{197}_{79}\text{Au} + \text{X}$$
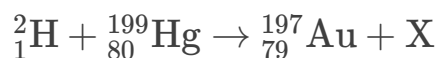
The particle **X** is a

1. gamma-ray photon.
2. helium nucleus.
3. proton.
4. neutron.

14. The Geiger–Marsden experiment provides evidence for *[1 mark]*

    A.   the existence of discrete atomic energy levels.

    B.   the existence of the neutron.

    C.   a dense positively charged nucleus.

    D.   the stability of some nuclei.

15. A radioactive isotope has a half-life of two minutes. A sample contains *[1 mark]* sixteen grams of the isotope. How much time elapses until one gram of the isotope remains?

    A.   6 minutes

    B.   8 minutes

    C.   10 minutes

    D.   12 minutes

16. Data concerning nuclides are plotted using the axes below.   *[1 mark]*
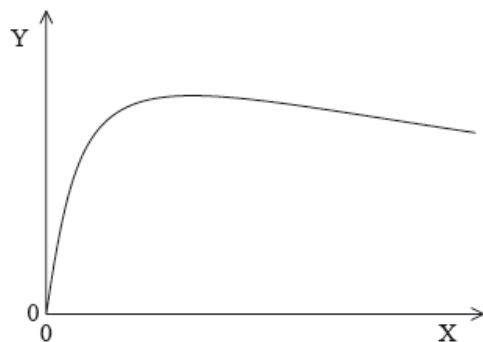
What are the axis labels for this graph?

	Y	X
A.	binding energy per nucleon	number of nucleons
B.	binding energy	number of protons
C.	number of protons	binding energy per nucleon
D.	number of nucleons	binding energy

17. Which of the following is true about beta minus (β^-) decay?   *[1 mark]*

A.   An antineutrino is absorbed.

B.   The charge of the daughter nuclide is less than that of the parent nuclide.

C.   An antineutrino is emitted.

D.   The mass number of the daughter nuclide is less than that of the parent nuclide.

18. Emission and absorption spectra provide evidence for   *[1 mark]*

A.   the nuclear model of the atom.

B.   natural radioactivity.

C.   the existence of isotopes.

D.   the existence of atomic energy levels.

19. Which of the following is true in respect of both the Coulomb interaction   *[1 mark]*
   and the strong interaction between nucleons in an atom?

	Coulomb interaction exists between	Strong interaction exists between
A.	protons only	neutrons only
B.	both protons and neutrons	neutrons only
C.	protons only	both protons and neutrons
D.	both protons and neutrons	both protons and neutrons

20. Which of the following correctly identifies the three particles emitted in   *[1 mark]*
    the decay of the nucleus $^{45}_{20}\text{Ca}$ into a nucleus of $^{45}_{21}\text{Sc}$?

    A. α, β^-, γ

    B. $\beta^-, \gamma, \bar{\nu}$

    C. $\alpha, \gamma, \bar{\nu}$

    D. $\alpha, \beta^-, \bar{\nu}$

21. The nuclear reaction   *[1 mark]*

$$^{2}_{1}\text{H} + ^{3}_{1}\text{H} \rightarrow ^{4}_{2}\text{He} + ^{1}_{0}\text{n}$$
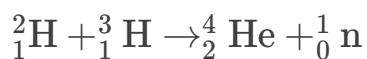
    is an example of

    A.   nuclear fission.

    B.   radioactive decay.

    C.   nuclear fusion.

    D.   artificial transmutation.

22. The relationship between proton number Z, neutron number N and   *[1 mark]*
    nucleon number A is

    A. $A = Z - N$.

    B. $Z = A + N$.

    C. $N = A - Z$.

    D. $N = A + Z$.

23. In the Geiger–Marsden experiment α-particles are scattered by gold   *[1 mark]*
nuclei. The experimental results provide evidence that

A. α-particles have discrete amounts of kinetic energy.

B.   most of the mass and positive charge of an atom is concentrated in a small
volume.

C.   the nucleus contains protons and neutrons.

D.   gold atoms have a high binding energy per nucleon.

24. A radio-isotope has an activity of 400 Bq and a half-life of 8 days. After 32 *[1 mark]*
days the activity of the sample is

A.   200 Bq.

B.   100 Bq.

C.   50 Bq.

D.   25 Bq.

25. The number of neutrons and the number of protons in a nucleus of an   *[1 mark]*
atom of the isotope of uranium $^{235}_{92}U$ are

	Neutrons	Protons
A.	92	143
B.	143	92
C.	235	92
D.	92	235

26. A sample contains an amount of radioactive material with a half-life of 3.5 *[1 mark]*
days. After 2 weeks the fraction of the radioactive material remaining is

A.   94 %.

B.   25 %.

C.   6 %.

D.   0 %.

27. The rest mass of a proton is $938\ \mathrm{MeV\,c^{-2}}$. The energy of a proton at rest *[1 mark]*
is

A. $9.38\ \mathrm{J}$

B. $9.38 \times 10^8 \times (3 \times 10^8)^2\ \mathrm{J}$

C. $9.38 \times 10^8\ \mathrm{eV}$

D. $9.38 \times 10^8 \times (3 \times 10^8)^2\ \mathrm{eV}$

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