Nuclear physics – A2 Physics P2

1. No.6

0 6 Fission and fusion are two processes that can result in the transfer of binding energy from nuclei.

0 6 . 1 State what is meant by the binding energy of a nucleus.

[2 marks]

0 6 . 2 Calculate, in MeV, the binding energy for a nucleus of iron $^{56}_{26}\text{Fe}$.

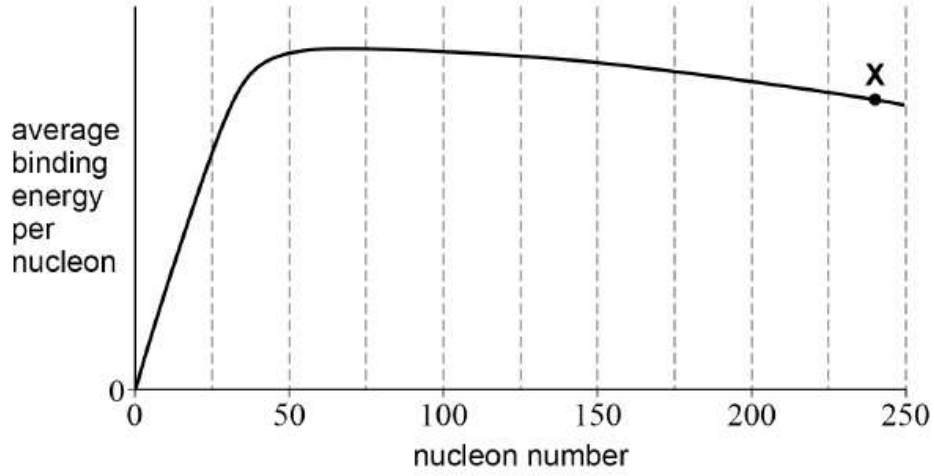
mass of $^{56}_{26}\text{Fe}$ nucleus $= 9.288 \times 10^{-26}$ kg

[3 marks]

binding energy = _____ MeV

Figure 10 shows a graph of average binding energy per nucleon against nucleon number for common nuclides.

Figure 10



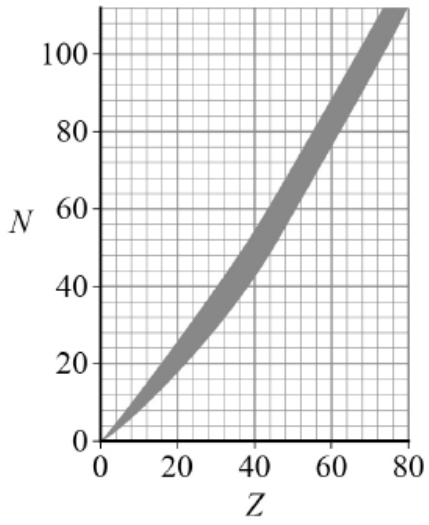
0 6 . 3 The nuclide labelled **X** in **Figure 10** undergoes fission.

Annotate **Figure 10** with $\mathbf{F_1}$ and $\mathbf{F_2}$ to show **one** possible pair of nuclides resulting from the fission of **X**.

[2 marks]

0 6 . 4 **Figure 11** shows a graph of N against Z for stable nuclides.

Figure 11



Deduce the likely initial mode of decay of $\mathbf{F_1}$ and $\mathbf{F_2}$.
Refer to **Figure 11** in your answer.

[3 marks]

2. No.25

What was deduced or observed in the Rutherford scattering experiment?

[1 mark]

A All gold atoms are not alike. ⬭

B Alpha particles are helium nuclei. ⬭

C Some particles were deflected through angles greater than 90°. ⬭

D The motion of most alpha particles was reversed. ⬭

3. No.26

Which row is correct for α, β and γ radiation?

[1 mark]

		α	β	γ	
A	Is it deflected by a magnetic field?	yes	yes	no	⬭
B	Is it deflected by an electric field?	yes	yes	yes	⬭
C	Does it have a positive charge?	yes	no	yes	⬭
D	Does it come from outside the nucleus?	no	yes	no	⬭

4. No.27

A sample of radioactive material consists of 200 g of nuclide **P** and 100 g of nuclide **Q**.

Nuclide **P** has a half-life of 2 days and nuclide **Q** has a half-life of 4 days.

What is the total mass of nuclides **P** and **Q** after 12 days?

[1 mark]

A 3.1 g ⬭

B 12.5 g ⬭

C 15.6 g ⬭

D 18.8 g ⬭

5. No.28

A nuclide has a half-life of 10 ms.

The decay constant for this nuclide lies between

[1 mark]

A 1 s^{-1} and 10 s^{-1}. ⬭

B 10 s^{-1} and 10^2 s^{-1}. ⬭

C 10^2 s^{-1} and 10^3 s^{-1}. ⬭

D 10^3 s^{-1} and 10^6 s^{-1}. ⬭

6. No.29

Which provides evidence for the existence of energy levels in nuclei?

[1 mark]

A the Rutherford alpha particle scattering experiment ⬭

B the existence of X-ray line spectra ⬭

C the existence of gamma radiation ⬭

D electron diffraction by crystals ⬭

7. No.30

Which is **not** true for gamma radiation?

[1 mark]

A It is more penetrating than alpha or beta radiation of the same energy through the same material. ⬭

B Its intensity is inversely proportional to the square of the distance from its source. ⬭

C It is emitted with discrete frequencies. ⬭

D When it is absorbed it makes the absorber radioactive. ⬭

8. No.31

In a thermal reactor, induced fission occurs when a $^{235}_{92}U$ nucleus captures a neutron.

Which statement is true?

[1 mark]

A The moderator absorbs excess neutrons. ⬭

B A large number of neutrons should be produced per fission to sustain the reaction. ⬭

C Slow neutrons are required for this induced fission. ⬭

D The control rods slow down neutrons. ⬭