Do not write outside the box

0 6 A thermal nuclear reactor uses enriched uranium as its fuel.
This is fuel in which the ratio of U-235 to U-238 has been artificially increased from that found in naturally-occurring ore.

0 6 . 1 Describe what happens when neutrons interact with U-235 and U-238 nuclei in a thermal nuclear reactor.

[3 marks]

0 6 . 2 The amounts of U-235 and U-238 in the ore decrease due to radioactive decay at different rates.

A sample of uranium ore today contains 993 g of U-238
The mass of U-238 in this sample was greater 2.00×10^{9} years ago.

Show that the mass of U-238 in this sample at that time was about 1.4 kg.

decay constant of U-238 = 1.54×10^{-10} year^{-1}

[2 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 A thermal nuclear reactor requires a minimum of 3.0% of its uranium mass to be U-235

The ratio of U-235 to U-238 in the ore has changed over time.
2.00×10^9 years ago, the sample in Question **06.2** contained 52 g of U-235

Deduce whether the sample had a high enough U-235 content to be used in a reactor 2.00×10^9 years ago.

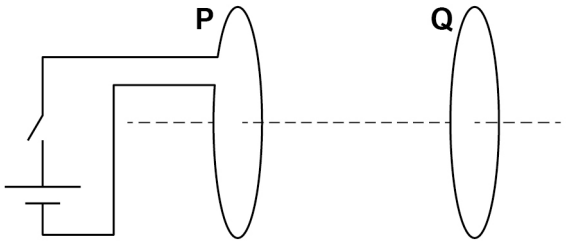
[1 mark]

6

END OF SECTION A

Do not write outside the box

2 7 A coil **P** is connected to a cell and a switch.
A closed coil **Q** is parallel to **P** and is arranged on the same axis.



Which describes the force acting on **Q** after the switch is closed?

[1 mark]

A steady and directed to the left ⬭

B steady and directed to the right ⬭

C short-lived and directed to the left ⬭

D short-lived and directed to the right ⬭

2 8 A point source emits gamma radiation. The intensity I of the radiation is measured at different distances d from the source.

Which graph will show a straight line through the origin?

[1 mark]

A I plotted against d ⬭

B I plotted against d^2 ⬭

C I plotted against d^{-1} ⬭

D I plotted against d^{-2} ⬭

Turn over for the next question

Do not write outside the box

2 9 The number of parent nuclei in a sample of a radioactive element is N at time t.
The radioactive element has a half-life $t_{\frac{1}{2}}$

The rate of decay is proportional to

[1 mark]

A N ⬭

B t ⬭

C $\frac{1}{t}$ ⬭

D $t_{\frac{1}{2}}$ ⬭

3 0 The table shows the masses of three particles.

Particle	Mass / u
proton	1.00728
neutron	1.00867
nucleus of lithium $^{7}_{3}\mathrm{Li}$	7.01436

What is the mass difference of a $^{7}_{3}\mathrm{Li}$ nucleus?

[1 mark]

A 4.99841 u ⬭

B 0.04216 u ⬭

C 0.04147 u ⬭

D 0.04077 u ⬭

Do not write outside the box

3 1 The mass of the fuel in a fission reactor decreases at a rate of 6.0×10^{-6} kg hour^{-1}.

What is the maximum possible power output of the reactor?

[1 mark]

A 75 MW ⬭

B 150 MW ⬭

C 300 MW ⬭

D 9000 MW ⬭

25

END OF QUESTIONS