

**0 6**

A thermal nuclear reactor uses a moderator to lower the kinetic energy of fast-moving neutrons.

**0 6 . 1**

Explain why the kinetic energy of neutrons must be reduced in a thermal nuclear reactor.

**[1 mark]**

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**0 6 . 2**

As a result of a collision with an atom of a particular moderator, a neutron loses 63% of its kinetic energy.

A neutron has an initial kinetic energy of 2.0 MeV.

Calculate the kinetic energy of the neutron after five collisions.

**[2 marks]**

kinetic energy = \_\_\_\_\_ eV

**Question 6 continues on the next page**

**Turn over ►**

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The kinetic energy of a neutron in a thermal nuclear reactor is reduced from about 2 MeV to about 1 eV.

Explain why the number of collisions needed to do this depends on the nucleon number of the moderator atoms.

**[2 marks]**

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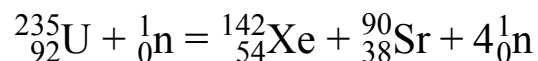
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**0 6 . 4**

One fission process which can occur in a thermal nuclear reactor is represented by the equation



Calculate in MeV the energy released in this fission process.

$$\text{mass of } {}_{92}^{235}\text{U} = 235.044 \text{ u}$$

$$\text{mass of } {}_{54}^{142}\text{Xe} = 141.930 \text{ u}$$

$$\text{mass of } {}_{38}^{90}\text{Sr} = 89.908 \text{ u}$$

$$\text{mass of } {}_0^1\text{n} = 1.0087 \text{ u}$$

**[3 marks]**

energy released = \_\_\_\_\_ MeV

**Question 6 continues on the next page**

**Turn over ►**

Do not write  
outside the  
box

0 6 . 5

Many magazine and newspaper articles focus on the risks of using nuclear power.

State **three benefits** of using nuclear power.

**[3 marks]**

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3 \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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**END OF SECTION A**



**1 8**

When a small radioactive source is placed in a cloud chamber, straight tracks about 4 cm long are observed. The same source is placed 10 cm from a Geiger tube and a count rate is detected. When a sheet of aluminium 5 mm thick is placed between the source and the Geiger tube the count rate falls to the background count rate.

Which types of radiation are emitted by the source?

**[1 mark]****A**  $\alpha$ ,  $\beta$  and  $\gamma$ **B**  $\beta$  and  $\gamma$ **C**  $\alpha$  and  $\gamma$ **D**  $\alpha$  and  $\beta$ **1 9**

A parallel-plate capacitor is made by inserting a sheet of dielectric material between two plates. Both plates are in contact with the sheet.

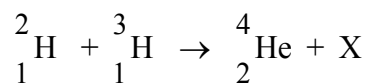
Which relative permittivity and sheet thickness give the greatest capacitance?

**[1 mark]**

	Relative permittivity	Thickness / mm	
<b>A</b>	2	0.40	<input type="checkbox"/>
<b>B</b>	3	0.90	<input type="checkbox"/>
<b>C</b>	4	1.0	<input type="checkbox"/>
<b>D</b>	6	1.6	<input type="checkbox"/>



- 3 0** A deuterium nucleus and a tritium nucleus fuse together to form a helium nucleus and a particle X. The equation for this process is:



What is X?

[1 mark]

**A** electron

**B** neutron

**C** positron

**D** proton

- 3 1** What effect are the control rods intended to have on the average kinetic energy and number of fission neutrons in a thermal nuclear reactor?

[1 mark]

	Average kinetic energy of fission neutrons	Number of fission neutrons	
<b>A</b>	unchanged	unchanged	<input type="checkbox"/>
<b>B</b>	reduced	unchanged	<input type="checkbox"/>
<b>C</b>	unchanged	reduced	<input type="checkbox"/>
<b>D</b>	increased	reduced	<input type="checkbox"/>

**END OF QUESTIONS**

