0 5 Radioactive nuclei can emit alpha, beta or gamma radiation.

0 5 . 1 Which type of radiation is the most penetrating?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

0 5 . 2 Which type of radiation is the most ionising?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

0 5 . 3 Which type of radiation has the longest range in air?

[1 mark]

Tick **one** box.

Alpha (α) ☐

Beta (β) ☐

Gamma (γ) ☐

Question 5 continues on the next page

When radioactive isotopes in the Earth's crust decay they release energy.

The decay causes the heating of rocks in the crust.

0 5 . 4 **Figure 8** shows the decay of uranium–238 (U–238) into thorium–234 (Th–234).

Figure 8

$$^{238}_{92}\text{U} \longrightarrow ^{234}_{90}\text{Th} + ^{4}_{2}\text{He}$$

Complete **Table 2** to show the number of neutrons and protons in the nuclei.

[2 marks]

Table 2

Isotope	Number of neutrons	Number of protons
uranium–238	146	
thorium–234		90

0 5 . 5 Geothermal power stations pump water through heated rocks.

The temperature of the water increases from 20 °C to its boiling point of 100 °C

Calculate the change in thermal energy when the mass of water heated is 150 kg

Specific heat capacity = 4 200 J/kg °C

Use the Physics Equations Sheet.

[3 marks]

____

____

____

Change in thermal energy = ____________________ J

8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	gamma		1	AO1 6.4.2.1
05.2	alpha		1	AO1 6.4.2.1
05.3	gamma		1	AO1 6.4.2.1
05.4	<table><tr><th>isotope</th><th>number of neutrons</th><th>number of protons</th></tr><tr><td>uranium-238</td><td>146</td><td>**92**</td></tr><tr><td>thorium-234</td><td>**144**</td><td>90</td></tr></table>		1 1	AO2 6.4.1.2
05.5	$\Delta\theta$ = 80 °C E = 150 × 4200 × 80 E = 50 400 000 (J)	an answer of 50 400 000 scores **3** marks allow 50 000 000 (J) allow **max 2** marks for correct calculation using incorrect value of $\Delta\theta$ allow **1** mark for correct calculation using θ = 20 **or** θ = 100	1 1 1	AO2 6.3.2.2
Total			**8**	