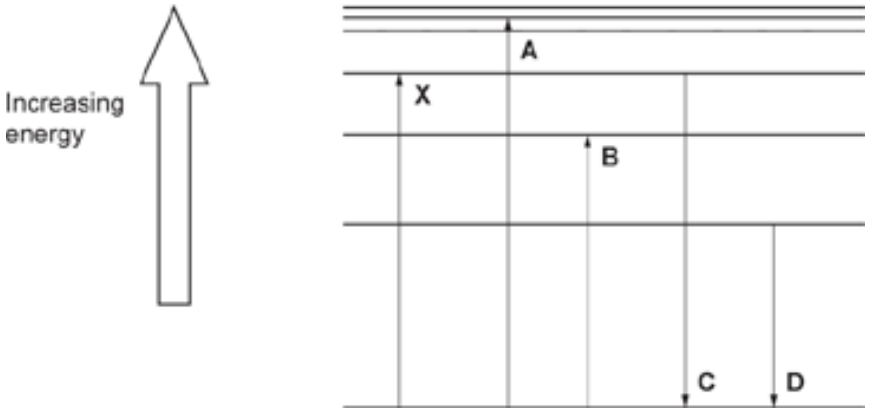
1. The diagram shows energy levels in an atom.

Arrow **X** shows the movement of an electron that has absorbed infrared radiation.

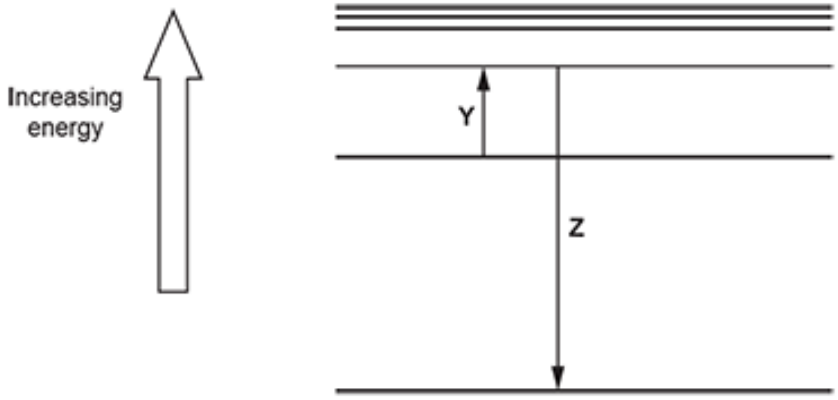


Which arrow shows the movement of the same electron if it had absorbed radiation with more energy?

Your answer ☐ **[1]**

2. Atoms can emit or absorb electromagnetic radiation when electrons move between energy levels.

The diagram shows electron transitions **Y** and **Z** between energy levels in an atom.



i. Draw an arrow on the diagram showing the transition of an electron in the **lowest** energy level when it is lost from the atom.

[2]

ii. Complete each sentence about the electron transitions in the diagram.

Use the words in the list.

absorbed	**emitted**	**excited**	**ionised**
higher than	**lower than**	**the same as**	

When an electron is ....., as shown by arrow **Y**, electromagnetic radiation is ..... by the atom.
The frequency of electromagnetic radiation involved in transition **Z** is ..... the frequency of the electromagnetic radiation involved in transition **Y**.

[2]

3(a).

i. Complete **Table 18.1** to show the composition of an **alpha particle**.

Table 18.1

Number of protons	
Number of neutrons	
Number of electrons	

[2]

ii. A person swallows a small amount of polonium-210. Doctors examine the person using a Geiger-Müller tube outside the body.

Explain why the doctors do **not** detect the polonium-210 inside the body.

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[1]

(b). Polonium-210, $^{210}_{84}Po$, can be made in a nuclear reactor in two steps.

i. In the first step, bismuth-209, $^{209}_{83}Bi$ is bombarded with neutrons to make $^{210}_{83}Bi$.

State the name given to these different forms of the element bismuth.

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[1]

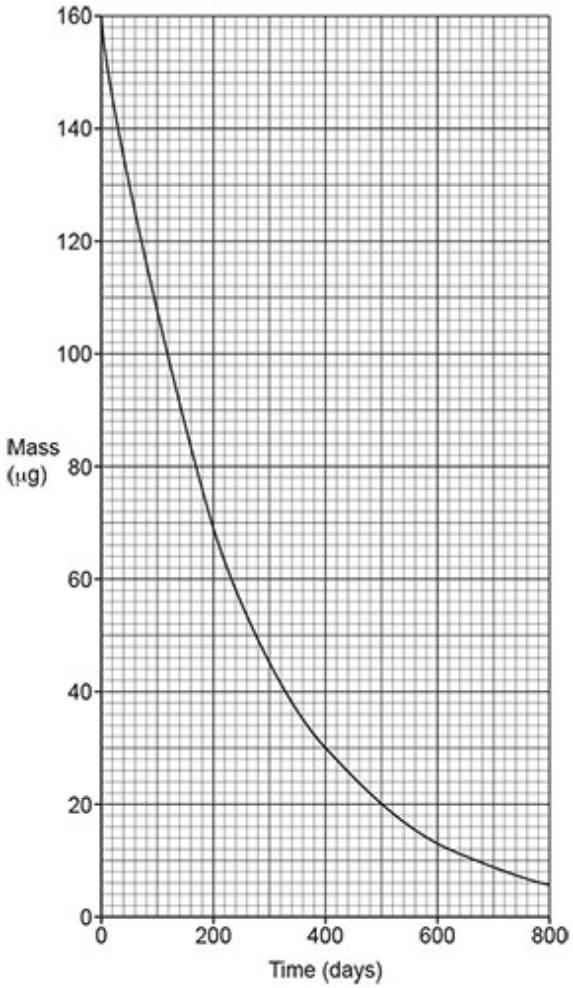
ii. In the second step, $^{210}_{83}Bi$ decays to form $^{210}_{84}Po$.

Complete the **balanced nuclear** equation for this decay.

$$^{210}_{83}Bi \rightarrow {}^{210}_{84}Po + \text{.....}$$

[2]

(c). The graph shows how the mass of a sample of polonium-210 changes with time.



i. Use the graph to complete **Table 18.2.** Two answers have been filled in for you.

Table 18.2

Time (days)	Mass (μg)
0	160
200	
400	30
600	

[1]

ii. A teacher explains half-life and radioactive decay to their class.

The teacher says,
'For equal time periods, the ratio:

$$\frac{\text{mass at the start of the time period}}{\text{mass at the end of that time period}}$$

is constant.'

Use this ratio and your answers in **Table 18.2** to determine if the teacher is correct for the sample of polonium-210.

[2]

4. A radioactive source has a count-rate of 64 counts per minute (cpm).
The half-life of the radioactive source is 10 minutes.

What is the count-rate of the radioactive source after 20 minutes?

A 8 cpm
B 16 cpm
C 32 cpm
D 48 cpm

Your answer ☐ **[1]**

END OF QUESTION PAPER