Radioactive Emissions (F)

1. Which statement about alpha particles is correct?

A They are fast moving electrons.
B They are less penetrating than beta particles.
C They can pass through lead.
D They have less mass than beta particles.

Your answer ☐ **[1]**

2. A radioactive isotope has a half-life of 6 hours.

50 g of the isotope are put in a container.

What mass of the isotope is left after 6 hours?

Mass = ... g **[1]**

3. Which radioactive decay equation is correct?

A $^{14}_{6}C \rightarrow {}^{10}_{4}Be + {}^{0}_{-1}e$

B $^{14}_{6}C \rightarrow {}^{10}_{4}Be + {}^{0}_{0}\gamma$

C $^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{4}_{2}He$

D $^{14}_{6}C \rightarrow {}^{14}_{7}N + {}^{0}_{-1}e$

Your answer ☐ **[1]**

4. Which equation shows a correct alpha decay?

A $^{241}_{95}Am \rightarrow {}^{239}_{91}Np + {}^{2}_{4}He$

B $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{0}_{2}He$

C $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$

D $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{0}_{1}He$

Your answer ☐ **[1]**

5. Which statement is true about the **nucleus** of an atom?

A It contains neutrons and ions and has a negative charge.

B It contains neutrons and ions and has a neutral charge.

C It contains neutrons and protons and has a neutral charge.

D It contains neutrons and protons and has a positive charge.

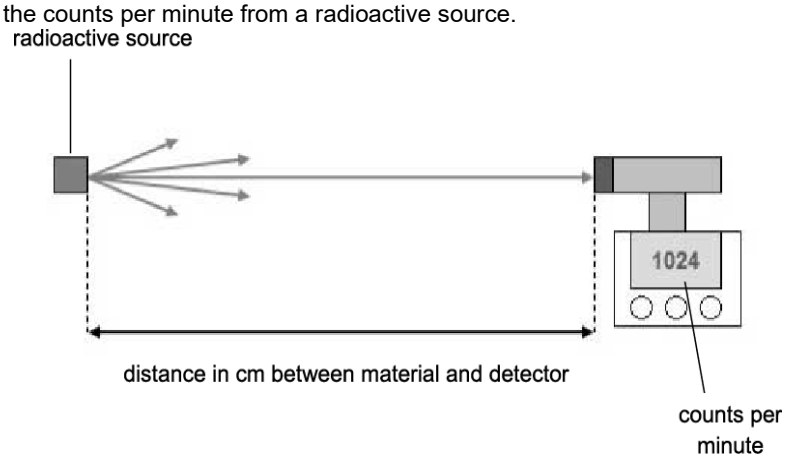
Your answer ☐ **[1]**

6. Matt experiments with radioactive materials.

He investigates how the activity of radiation changes with distance.

The radiation moves from the source to a detector.

He measures the counts per minute from a radioactive source.



The table shows the results from the experiment.

Distance between the source and the detector (cm)	Count rate (counts per minute)
10	1000
20	240
40	60
80	20

Matt could **not** take an accurate reading at 0 cm.

Suggest a reason why.

_____ **[1]**

7. All radioactive sources have a half-life.

Which statement about the half-life of a source is correct?

A. It is half the time for the radioactive source to become safe.

B. It is half the time it takes for an atom to decay.

C. It is half the time it takes the activity of the source to decrease to zero.

D. It is the time it takes the activity of the source to decrease by half.

Your answer ☐

[1]

8. What is the number of neutrons in this isotope of uranium?

$$^{238}_{92}U$$

A. 92
B. 119
C. 146
D. 238

Your answer ☐

[1]

9 (a). Matt experiments with radioactive materials.

He investigates how the activity of radiation changes with distance.

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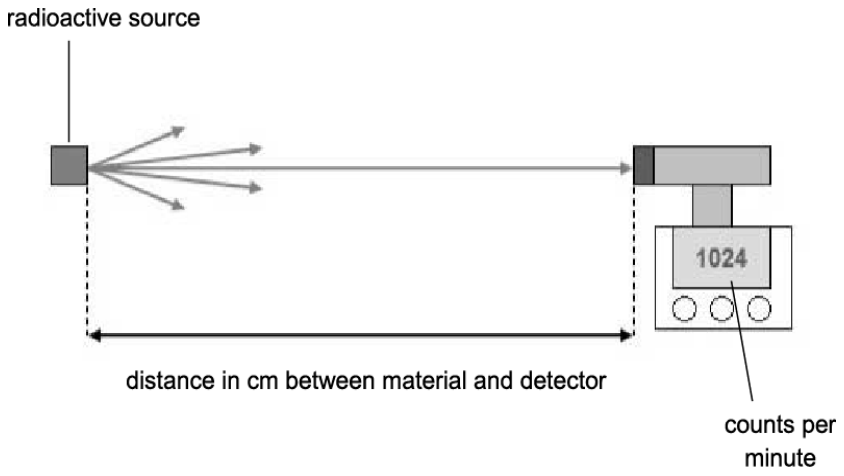
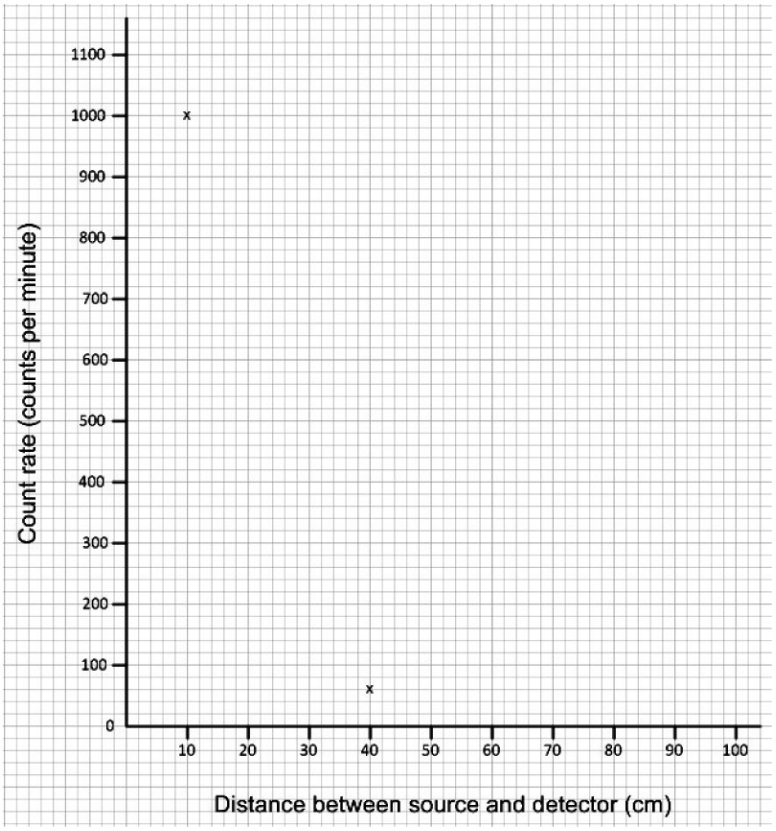


The table shows the results from the experiment.

Distance between the source and the detector (cm)	Count rate (counts per minute)
10	1000
20	240
40	60
80	20

i. Two points for 10 cm and 40 cm have been plotted on the graph below.

Plot the rest of Matt's results and join the points with a smooth curve.



[2]

ii. Use the graph to estimate the reading at **30 cm**.

answer: …… counts per minute **[1]**

(b).

i. What pattern is shown by the results as the distance is increased from **20** cm to **40** cm?

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[2]

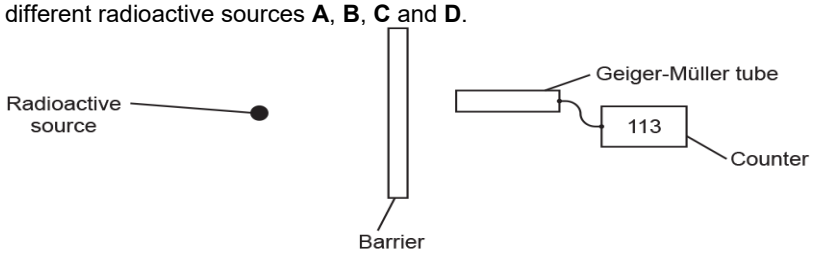
ii. Matt wants to find the count rate at 5 cm.

Estimate the count rate at a distance of 5 cm.

answer: …… counts per minute **[1]**

10 (a). A teacher demonstrates an experiment about radioactivity. He demonstrates how different types of radiation can be absorbed.

He puts different barriers between the source and the Geiger-Müller tube. He uses four different radioactive sources **A**, **B**, **C** and **D**.



The teacher chooses source **A** and uses the Geiger-Müller tube to measure the count rate (counts per minute) for different barriers. He repeats the experiment with source **B**, source **C** and then source **D**.

Look at his results.

Source	Count rate using different barriers			
	Paper	**Aluminium**	**Lead**	**No barrier**
A	113	112	22	112
B	20	21	20	182
C	162	23	21	164
D	282	78	24	280

He also finds that the **average count rate** with no sources and no barriers is 20.

i. Which source **A**, **B**, **C** or **D** emits **gamma** radiation only?

Explain your answer.

Source _____ because _____

_____

_____ **[2]**

ii. Which source **A**, **B**, **C** or **D** emits **alpha** radiation only?

Explain your answer.

Source _____ because _____

_____

_____ **[2]**

iii. Which source **A**, **B**, **C** or **D** could emit both **beta and gamma** radiation?

Explain your answer.

Source _____ because _____

_____

_____ **[2]**

(b). The teacher notices that the count rate behind the lead barrier ranges from 20 to 24.

Give **two** reasons why there are a wide range of results around 22 counts per minute.

1. _____

_____

2. _____

_____

[2]

(c). The teacher decides to repeat the experiment.

This time he records the number of counts for a much longer time interval for each source.

Explain why this is an improvement to the experiment.

_____

_____

_____ **[2]**

(d). Suggest two safety **precautions** that the teacher should use when demonstrating this experiment.

1. _____

_____

2. _____

_____

[2]

11. Fig. 20.1 shows thinking, braking and stopping distances for the same car travelling at different speeds.

Speed (m/s)	Thinking distance (m)	Braking distance (m)	Stopping distance (m)
8	6	6	12
16	12	24	36
32	24	96	120

Fig. 20.1

* Explain why the stopping distances are different for each speed in **Fig. 20.1.**

_____

_____

_____

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_____

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_____

_____ **[6]**

12 (a). Atoms can absorb and emit electromagnetic radiation.

Describe **two** possible effects on an electron in an atom when it absorbs electromagnetic radiation.

1

2

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[2]

(b). Alpha radiation is **not** emitted in the processes in part **(a)**.

Explain why.

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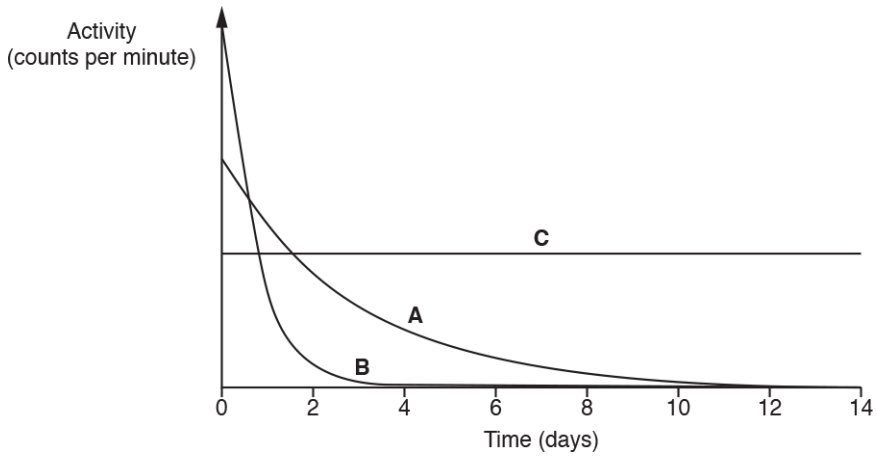
[2]

13. This is a graph showing the radiation emitted from samples of three different isotopes **A**, **B** and **C**.



i. Which isotope, **A**, **B** or **C**, takes the longest time to decay?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

[1]

ii. Two scientists discuss the isotopes in the graph.

Scientist 1	Scientist 2
'I think isotope **A** is more hazardous than **B**. **A** has a higher activity than **B**.'	'I think isotope **B** is more hazardous than **A**. **B** has a longer half-life than **A**.'

Do you agree with the views of scientist 1 and scientist 2?

Use the graph and ideas about radioactivity and half-life to explain your answer.

Scientist 1

Scientist 2

---

[4]

iii. **Scientist 1** wants to identify the type of radiation emitted by isotope **A**.

This is a list of equipment **Scientist 1** has in his laboratory**:**

- radiation detector
- piece of thick lead
- piece of cardboard
- piece of aluminium.

Describe how **Scientist 1** does the experiment and explain how they can work out the type of radiation emitted.

You may include a diagram in your answer.

_____

_____

_____

_____

_____

_____

_____

_____ **[4]**

14 (a).

i. Explain what is meant by the half-life of a radioactive isotope.

_____

_____ **[1]**

ii. The half-life of Co-60 is 5 years.

The count-rate of a sample of Co-60 is 160 counts per minute.

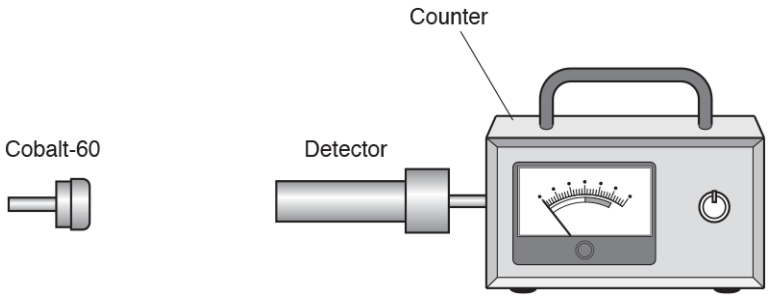
Calculate the count-rate of the Co-60 after 10 years.

Count-rate = ... counts per minute **[3]**

(b). Some isotopes of cobalt are radioactive.

A teacher measures the radiation emitted by Co-60.

She uses this equipment:



The teacher's results are shown in **Table 18.1**.

	Count-rate (counts per minute)
Measurement 1	191
Measurement 2	224
Measurement 3	212

Table 18.1

i. Explain why the teacher's three measurements are **not** the same.

_____

_____ **[1]**

ii. Use the teacher's results in **Table 18.1** to calculate the mean count-rate for Co-60.

Count-rate = ... counts per minute **[2]**

iii. Co-60 emits gamma radiation.

The teacher puts thin aluminium foil between Co-60 and the detector.

State what happens to the count-rate.

_____ **[1]**

(c). The isotope cobalt-60 (Co-60) has the symbol:

$^{60}_{27}Co$

The isotope cobalt-57 (Co-57) has the symbol:

$^{57}_{27}Co$

i. State the number of protons in a nucleus of Co-60.

Number of protons = ... **[2]**

ii. Give **one** similarity and **one** difference between the nucleus of Co-57 and the nucleus of Co-60.

Similarity

_____

Difference

_____

[2]

END OF QUESTION PAPER