Radioactive Emissions (H)

1. When an electron in an atom changes energy level, it emits electromagnetic radiation.

Which row in the table is correct?

	Energy level of the electron	Type of radiation emitted
A	Decreases	Almost any electromagnetic radiation.
B	Decreases	Visible light only.
C	Increases	Almost any electromagnetic radiation.
D	Increases	Visible light only.

Your answer ☐ **[1]**

2. Which statement is **true** for isotopes of the same element?

N_p = number of protons and N_n = number of neutrons.

A $N_p = N_n$
B N_p is the same but N_n is different
C N_p is always greater than N_n
D The total ($N_p + N_n$) is always the same

Your answer ☐ **[1]**

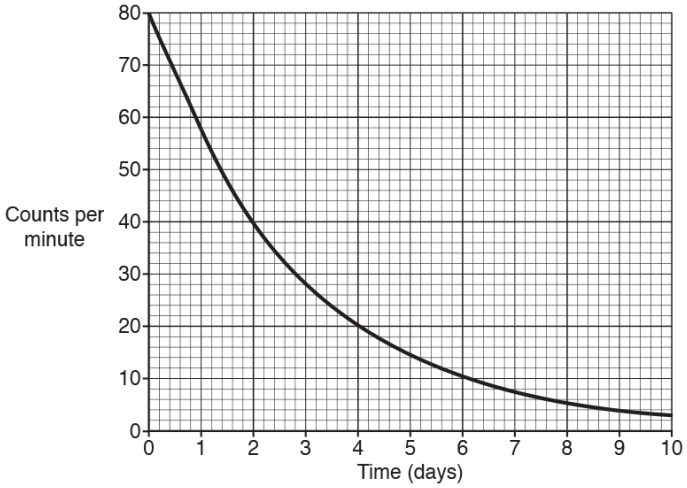
3. The table gives some information about four radioactive isotopes.

Which isotope is the best to use as a medical tracer?

	Half life	Radiation emitted
A	6 hours	alpha
B	6 hours	gamma
C	6 minutes	gamma
D	6 years	beta

Your answer ☐ **[1]**

4. A teacher measures the radiation from a radioactive source for 10 days.



What is the half-life of this radioactive source?

A 1 day
B 2 days
C 4 days
D 5 days

Your answer ☐ **[1]**

5. An alpha particle collides with an atom to produce a positive ion.

What happens to the atom for it to become a positive ion?

A It loses an electron from inside the nucleus.
B It loses an electron from outside the nucleus.
C It loses a neutron from inside the nucleus.
D It loses a proton from outside the nucleus.

Your answer ☐ **[1]**

6. Beta radiation is used to check the thickness of thin aluminium foil at a factory.

Why is beta radiation used?

A All electromagnetic radiation is reflected by aluminium foil.
B Beta radiation will **not** pass through aluminium foil.
C Beta radiation will partially pass through aluminium foil.
D Beta radiation is reflected by aluminium foil.

Your answer ☐ **[1]**

7. The information below shows information on radioactive isotopes.

Radioactive isotope	Type of radiation	Half-life	Penetration through human flesh
A	alpha	300 years	2mm
B	beta	7 hours	60mm
C	gamma	7 hours	> 10m
D	alpha	9 seconds	2mm
E	gamma	3 years	> 10m

A doctor injects a patient with isotope **C** to track blood flow through the body.

Use the data to suggest why the doctor uses isotope **C**.

[1]

8. A radioactive source has a half-life of 80 s.

How long will it take for $^{7}/_{8}$ of the source to decay?

A. 10 s
B. 70 s
C. 240 s
D. 640 s

Your answer ☐

[1]

9. Radium-226, $^{226}_{88}Ra$, decays to become radon-222, $^{222}_{86}Rn$.

What is emitted when a nucleus of radium-226 decays?

A. a beta particle
B. an alpha particle
C. four neutrons
D. four protons

Your answer ☐

[1]

10. An element has more than one isotope.

Which correctly describes the atoms of all isotopes of this element?

	Numbers of electrons	Numbers of protons	Numbers of neutrons
A	different	different	different
B	same	different	different
C	same	same	different
D	same	different	same

Your answer

[1]

11. The most abundant form of radium is radium-226.

Its nuclear mass is 226 and its nucleus contains 138 neutrons.

Which is an **isotope** of radium?

A. nuclear mass 226; 137 neutrons
B. nuclear mass 226; 139 neutrons
C. nuclear mass 227; 138 neutrons
D. nuclear mass 227; 139 neutrons

Your answer

[1]

12. The information below shows information on radioactive isotopes.

Radioactive isotope	Type of radiation	Half-life	Penetration through human flesh
A	alpha	300 years	2mm
B	beta	7 hours	60mm
C	gamma	7 hours	> 10m
D	alpha	9 seconds	2mm
E	gamma	3 years	> 10m

A doctor implants radioactive isotope **A** into a patient to treat a localised cancer which is a few mm in size.

She intends to remove the isotope in a few weeks.

Use the data to suggest **two** reasons why the doctor uses isotope **A**.

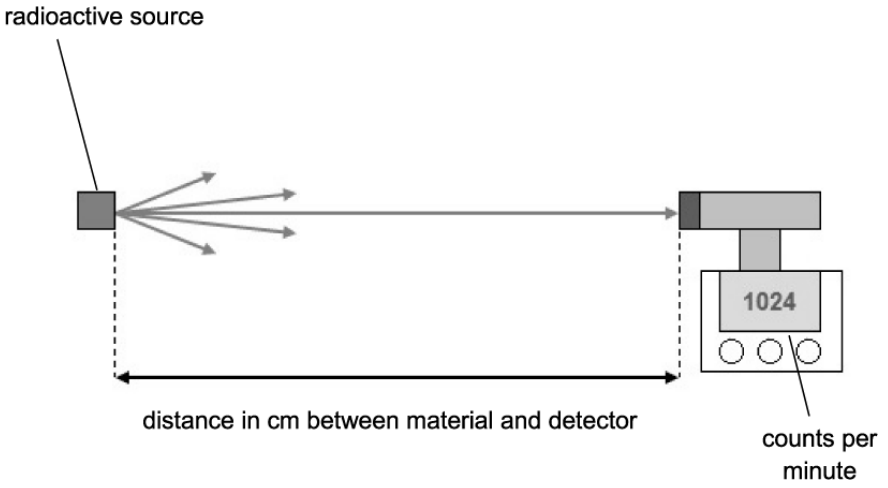
[2]

13(a). Matt experiments with radioactive materials.

He investigates how the activity of radiation changes with distance.

The radiation moves from the source to the 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	1024
20	256
40	64
80	16
160	**6**
320	**0**

As the distance is increased to 160 cm and 320 cm the results do not follow the same pattern as the other results.

What do you think these results should have been?

Explain the anomalies in the last two results.

[3]

(b). Describe using the data in the table how the count rate changes as the detector is moved away from the source.

[2]

14(a). Decay equations are used to show the type of emission from different radioactive elements.

i. Complete the decay equation for **alpha** emission.

$^{230}_{92}U \rightarrow {}^{4}_{2}He + {}^{.....}_{.....}Th$ **[2]**

ii. Complete the decay equation for **beta** emission.

$^{214}_{83}Bi \rightarrow {}^{.....}_{.....}\beta + {}^{214}_{84}Po$ **[2]**

iii. Complete the decay equation for **gamma** emission.

$$^{235}_{\ldots\ldots}U \rightarrow {}^{0}_{0}\gamma + {}^{\ldots\ldots}_{92}U$$ **[2]**

(b). Carbon is a common element. Carbon has two different isotopes called carbon-12 and carbon-14. Both of these isotopes have six protons in the nucleus.

i. Carbon-14 is radioactive and carbon-12 is **not** radioactive.

Explain why some isotopes are radioactive.

[1]

ii. Describe how the nucleus of carbon-12 is different to the nucleus of carbon-14.

[1]

15 (a). The teacher measures the activity of isotope **B**.

She starts taking activity measurements after 20 minutes.

Table 23.1 shows her results for isotope **B**.

Time (minutes)	Activity (counts per minute)
0	
10	
20	84
30	64
40	52
50	40
60	32
70	25
80	20
90	16

Table 23.1

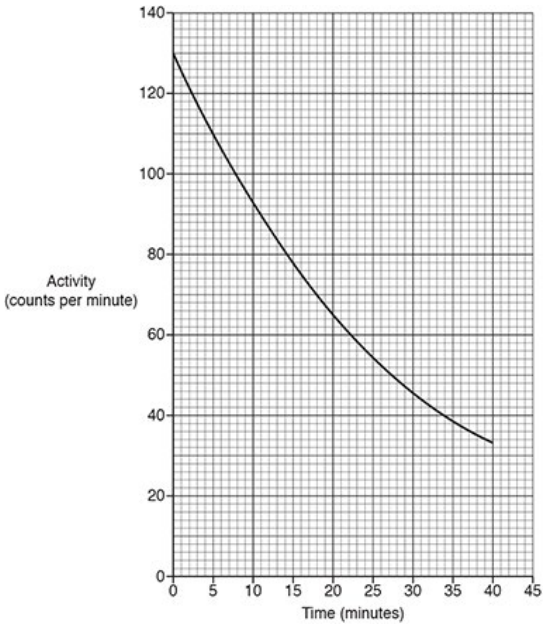
Predict the activity of isotope **B** at 0 minutes.

Use the information in **Table 23.1** to help you.

Activity = ... counts per minute **[2]**

(b). A teacher measures the activity of different radioactive isotopes.

Fig. 23.1 is a graph of her results for isotope **A**.



Use **Fig. 23.1** to calculate the half-life of isotope **A**.

Show your working on the graph in **Fig. 23.1**.

Half-life = ... minutes **[2]**

16. The half-life of americium-241 is 432 years.

i. Explain what is meant by **half-life**.

[1]

ii. Explain why the half-life of americium-241 is suitable for a smoke detector.

[1]

iii. The table shows some data for two radioactive sources.

Source	Half-life (years)	Radiation emitted
Americium-241 (Am-241)	432	Alpha
Thorium-228 (Th-228)	2	Alpha

Both sources start with the same number of radioactive nuclei.

Which source is a greater health risk? Explain your answer.

[2]

17. A teacher measures the activity of isotope **C**.

Fig. 23.2 is a graph which shows how activity varies with time for isotope **C**.

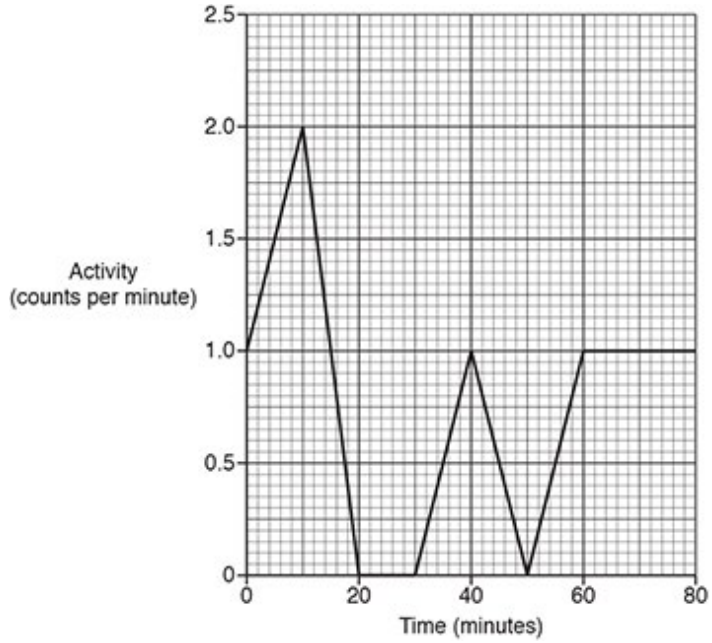


Fig. 23.2

A student makes two conclusions from the graph in **Fig. 23.2**:

Conclusion 1:	I think the results are very inaccurate. The isotope stops being radioactive and then gets more radioactive again.
Conclusion 2:	I do **not** think the isotope has a half-life.

Is the student correct?

Evaluate **each** conclusion and explain your answer.

Conclusion 1

Conclusion 2

[2]

18(a). Americium-241 decays by emitting alpha radiation to form neptunium (Np).

Complete the balanced symbol equation for the decay.

$$^{241}_{95}\text{Am} \longrightarrow \,^{\ldots\ldots}_{\ldots\ldots}\text{Np} + \,^{4}_{2}\ldots\ldots$$

[3]

(b). Americium-241 is a radioactive source that is used in smoke detectors.

This is the symbol for americium-241:

$^{241}_{95}\mathbf{Am}$

Describe the structure of an americium-241 **nucleus**.

[2]

(c). Read the information below about smoke detectors.

In smoke detectors, fine particles of americium-241 are rolled into a metallic foil. The americium-241 cannot be inhaled or move around.

The amount of radiation emitted is very small compared with the natural radioactivity in 1 m^3 of soil.

Americium-241 also emits a small amount of gamma rays.

A scientist says, '**There is no risk from the disposal of smoke detectors in household waste**.'

Do you agree with this statement? Give **two** reasons for your answer.

Yes ☐

No ☐

1

2

[2]

END OF QUESTION PAPER