OCR
Oxford Cambridge and RSA

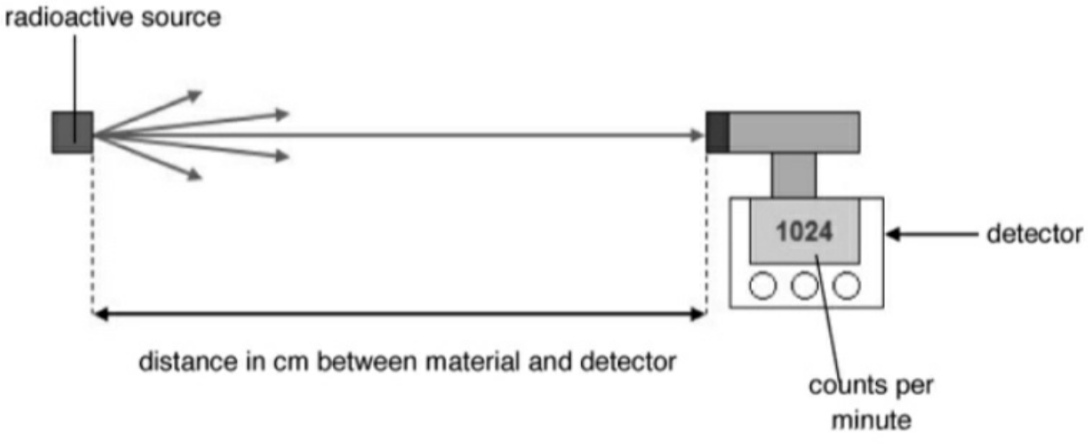
GCSE Physics A (Gateway)

J249/04 Physics A P5-P8 and P9 (Higher Tier)

Question Set 23

23 A student does an experiment with radioactive materials.

- He investigates how the activity of radiation changes with distance.
- The radiation moves from the radioactive source to a detector.
- He measures the counts per minute at the detector.



The table shows the results.

Distance between source and detector (cm)	Count rate (counts per minute)
10	1024
20	256
40	64
80	16

(a) Describe, using these results, how the count rate changes as the detector is moved away from the source.

That count rate (intensity) decreases as distance increases. This shows that countrate (intensity of the radiation) follows inverse square law

$I \propto \frac{1}{r^2}$ (where r is distance).

As distance doubles, count rate is $\times \frac{1}{4}$.

(following $I \propto \frac{1}{r^2}$)

e.g. $10 \times 2 = 20$ cm

$1024 \times \frac{1}{4} = 256$ countrate

[2]

(b) The student takes two further readings at 160 and 320 cm.

He adds these further readings to his table.

Distance between source and 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 and 320 cm, the results do **not** follow the same pattern as the other results.

Predict what these last two results should have been and explain the anomalies in the last two results.

[3]

At 160 cm, the count rate should be 4 counts per minute.

At 320 cm, the count rate should be 1 count per minute.

The anomalies in the last 2 results do not follow the same pattern, as it is 6 counts per minute instead of 4 and 0 counts per minute instead of 1.

This may because of a random error or the experiment being inconsistent (eg. another interferring source added).

(c) Gamma radiation is used to irradiate cancers in the brain.

Treatment is given for 15 minutes every 4 days.

Each patient receives a certain dose of radiation.

Explain how this treatment reduces damage to healthy cells.

Cancer cells grow and divide much faster than most normal cells. This treatment works by targetting the cancer cells for a short period, in order to kill them. Healthy cells aren't affected as much by the radiation due to the short period of exposure and the fact they mostly do not divide as fast. This treatment reduces damage to healthy cells due to the gamma source rotating ∴ evenly spreading out the exposure, instead of concentrating the radiation at one point. The 15 minute exposure also reduces damage to healthy cells, as it is too short of a period to cause any serious damage. **[4]**

Total Marks for Question Set 23: 9