5 The isotope radon-222 is radioactive.

(a) Radioactive decay is random and spontaneous.

Explain the terms random and spontaneous in the context of radioactive decay.

random .....

.....

spontaneous .....

.....

[2]

(b) A student is investigating the amount of radiation reaching a detector from a sample of radon-222.

The student places the radiation detector near to the source.

The student uses a stop-watch to measure the time and records the reading on the radiation detector after 100 seconds.

The data is shown in Table 5.1.

Table 5.1

time	radiation detector reading
100	62

Describe how to improve the student's method and presentation of data in the table.

.....

.....

.....

..... [3]

(c) Another student uses an improved method to collect data from the radon-222 sample.

The student produces a graph showing the variation of activity with time.

Fig. 5.1 shows the graph the student obtains.

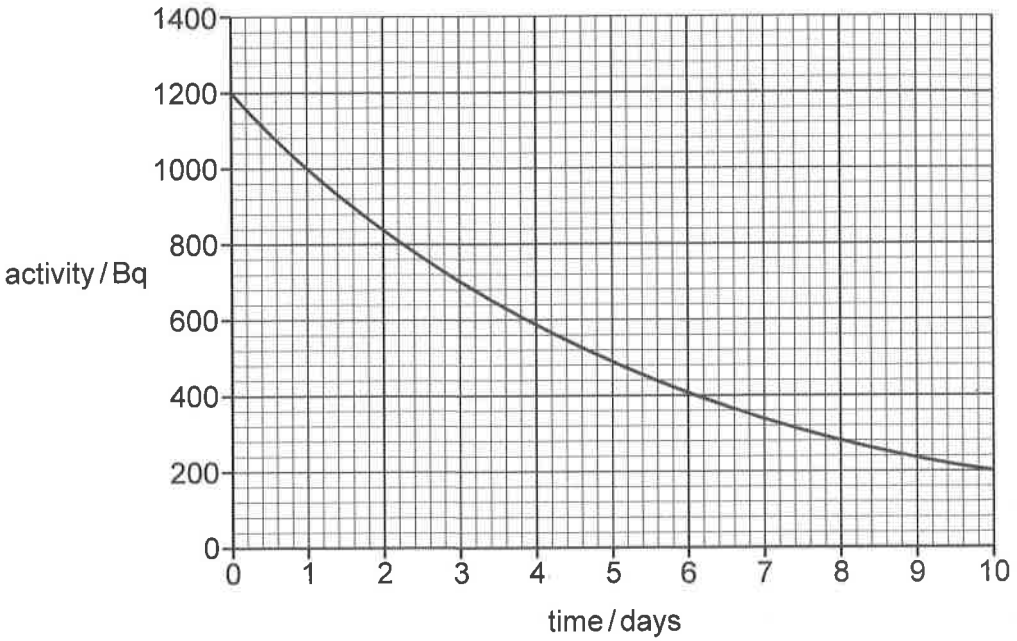

Fig. 5.1

(i) State what is meant by the term activity.

.....

..... [1]

(ii) It is suggested that the relationship between activity and time is exponential.

If the activity decreases exponentially then:

$$\frac{A_1}{A_0} = \frac{A_2}{A_1} = \frac{A_3}{A_2} = \ldots$$

where A_n represents the activity recorded at equally spaced time intervals.

Use Fig. 5.1 to determine whether the activity decreases exponentially with time.

.....

..... [3]

(iii) It is suggested that the data in Fig. 5.1 follow the equation

$$A = A_0 e^{-\frac{0.693t}{\tau}}$$

where A_0 is the activity at time = 0, A is the activity at time t and τ is the half-life.

The data used to produce Fig. 5.1 are now used to plot a logarithmic graph to verify the exponential nature of the decay and to determine the half-life.

State and explain:

- the quantities plotted on each axis
- how the graph verifies the exponential nature of the decay
- how the graph is used to determine the half-life.

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..... [4]

(d) An alternative method to determine the half-life is to calculate 0.693 multiplied by the intercept on the time axis of the tangent to the line drawn at time = 0.

On Fig. 5.1 draw this tangent and use it to determine the half-life in days.

half-life = ... days [2]

[Total: 15]