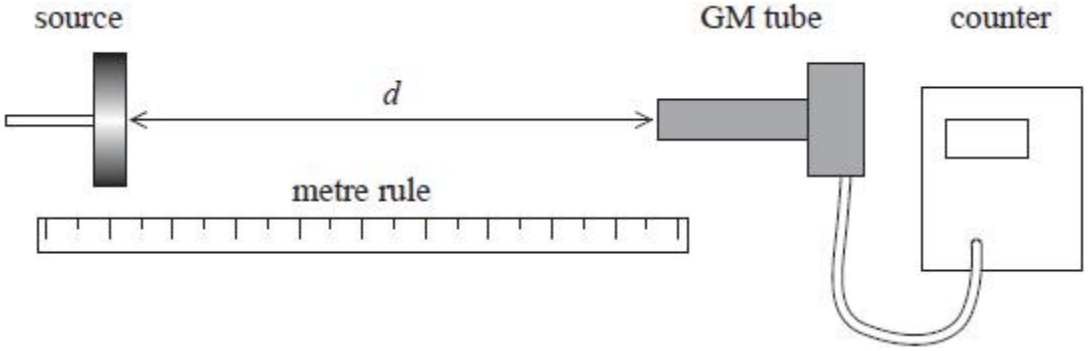
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Exam Preparation and Free Resources

Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

A student investigated the way in which gamma radiation spreads out from a source.
He placed a cobalt-60 source in a source holder and set up a Geiger-Müller (GM) tube a short distance *d* away.
He connected the GM tube to a counter as shown.



The student recorded the count for 2 minutes.

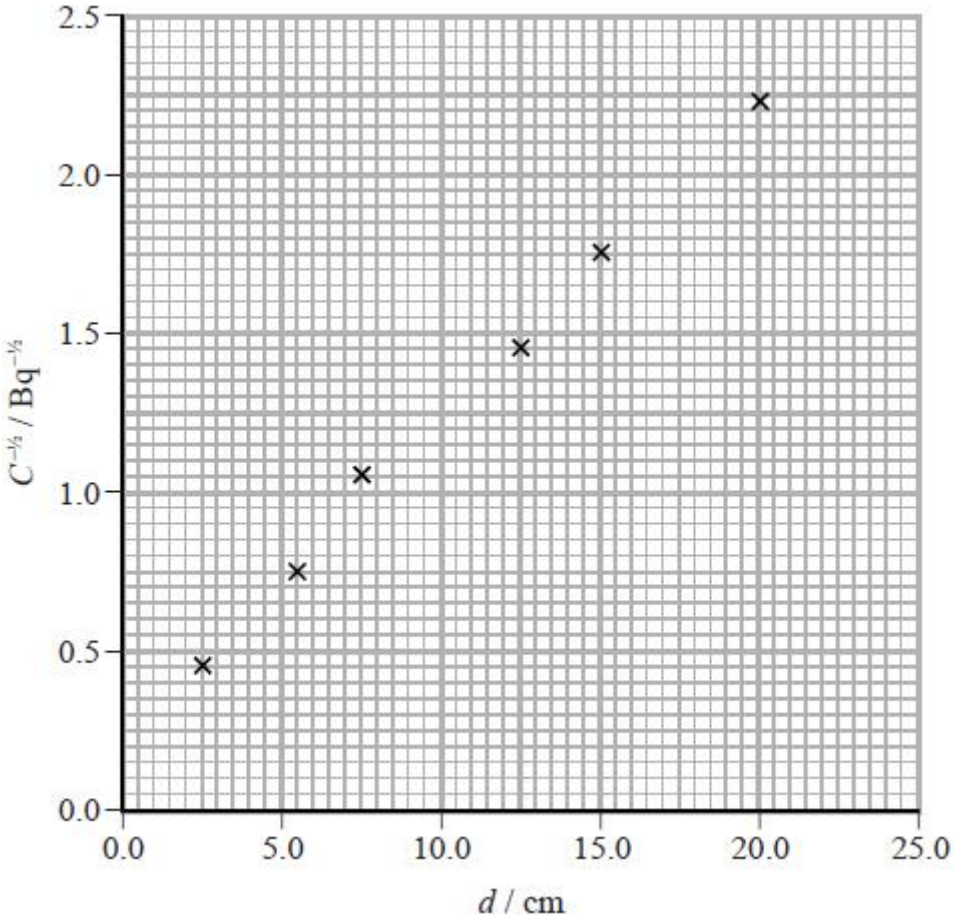
The variation in the intensity of gamma radiation with distance from a point source should obey an inverse square law. If this is the case, then the count rate *C* should vary with *d* according to the equation

$$C = \frac{K}{4\pi d^2}$$

where *K* is a constant.

The student plotted $\frac{1}{\sqrt{C}}$ against *d* and obtained the following graph.

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(i) Draw a line of best fit on the graph.

(1)

(ii) The student concluded that the graph was consistent with the gamma radiation intensity obeying an inverse square law.

Discuss the extent to which the data obtained supports the student's conclusion.

(4)

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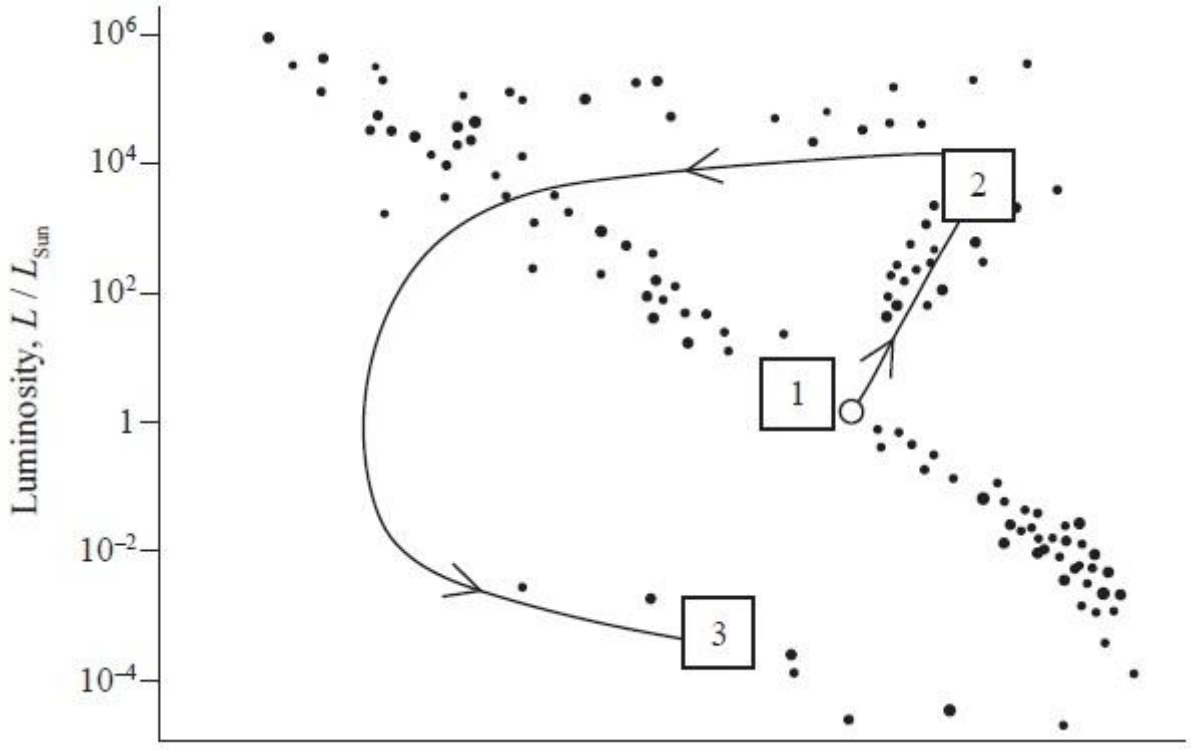
(Total for question = 5 marks)

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Q2.

The Sun has a surface temperature of 5800 K and is approximately 4.5 billion years old.

The Hertzsprung-Russell diagram maps the future evolution of the Sun, from its current position in area 1 of the diagram, through to its final position in area 3 of the diagram.



(a) (i) Complete a suitable temperature scale on the x-axis.

(2)

*(ii) Use the diagram to describe the lifecycle of the Sun starting from its present position in area 1 and concluding in area 3.

(6)

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(b) The energy source for the Sun is the fusion of light nuclei to heavy nuclei. In its present stage of evolution hydrogen is being converted into helium in the core of the Sun.

(i) State and explain the conditions necessary for fusion to occur in a star.

(3)

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(ii) In a star the fusion of hydrogen into helium takes place in a number of stages. The final stage is:

$$^{3}_{2}\mathrm{He} + {}^{3}_{2}\mathrm{He} \rightarrow {}^{4}_{2}\mathrm{He} + 2 \times {}^{1}_{1}\mathrm{H}$$

Calculate the energy released in MeV when one nucleus of the normal isotope of helium is produced.

(4)

Isotope	Mass / 10^{-27} kg
^{3}He	5.008238
^{4}He	6.646483
^{1}H	1.673534

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Energy released = ... MeV

(Total for Question = 15 marks)

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