Name of the Student:_____

Max. Marks : 26 Marks   **Time : 26 Minutes**

Q1.

The age of an ancient boat may be determined by comparing the radioactive decay of $^{14}_{6}C$ from living wood with that of wood taken from the ancient boat.
A sample of 3.00×10^{23} atoms of carbon is removed for investigation from a block of living wood. In living wood one in 10^{12} of the carbon atoms is of the radioactive isotope $^{14}_{6}C$, which has a *decay constant* of 3.84×10^{-12} s^{-1}.

(a)   What is meant by the decay constant?

_____

_____

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                                                                                                    (1)

(b)   Calculate the half-life of $^{14}_{6}C$ in years, giving your answer to an appropriate number of significant figures.

         1 year = 3.15×10^{7} s

                                         answer = _____ years

                                                                                                    (3)

(c)   Show that the rate of decay of the $^{14}_{6}C$ atoms in the living wood sample is 1.15 Bq.

                                                                                                    (2)

(d)   A sample of 3.00×10^{23} atoms of carbon is removed from a piece of wood taken

from the ancient boat. The rate of decay due to the $^{14}_{6}C$ atoms in this sample is 0.65 Bq. Calculate the age of the ancient boat in years.

answer = _____ years

(3)

(e) Give **two** reasons why it is difficult to obtain a reliable age of the ancient boat from the carbon dating described.

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(2)

(Total 11 marks)

Q2.

(a) $^{212}_{83}$ Bi can decay into $^{208}_{82}$ Pb by a β⁻ followed by an α decay, or by an α followed by a β⁻ decay. One or more of the following elements is involved in these decays:

$$_{80}Hg , _{81}Tl , _{84}Po , _{85}At .$$

Write out decay equations showing each stage in both of these decays.

First decay path	**Second decay path**

(b) (i)   Describe how you would perform an experiment that demonstrates that gamma radiation obeys an inverse square law.

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(ii)   Explain why gamma radiation obeys an inverse square law but alpha and beta radiation do not.

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(9)
(Total 15 marks)