6 **(a)** **(i)** Define *decay constant*.

....

...............[1]

(ii) Suggest why the determination of decay constant by measuring the mass and activity of a sample can be used only for nuclides that have relatively *small* decay constant.

....

...............[1]

(iii) Explain why the random nature of radioactive decay makes it difficult to measure the decay constant to a high degree of accuracy.

....

....

....

...............[2]

(b) A stationary radon nucleus may undergo alpha decay to form the daughter nuclide X.

The masses of the nuclei and of the alpha particle are given in the Fig. 6.1.

nucleus or particle	mass / u
radon	222.0176
X	218.0090
alpha particle	4.0026

Fig. 6.1

(i) Complete the nuclear decay equation, including all the decay products.

$^{222}_{86}\text{Rn} \longrightarrow$ [1]

(ii) Calculate the total kinetic energy of the products.

total kinetic energy = ... J [2]

(iii) Alpha particles can be stopped by tissue paper.

Suggest if this implies that alpha-emitters present no health hazards in a school laboratory.

....

....

.........................[1]

(c) A theory of nuclear astrophysics proposes that all the elements heavier than iron ore are formed in supernova explosions ending the lives of massive stars. Assume equal amounts of ^{235}U and ^{238}U were created at the same time and the present $\frac{^{235}U}{^{238}U}$ ratio is 0.00725. Calculate how long ago the explosion of the star that released the elements that formed our Earth occurred.

Half-lives of ^{235}U and ^{238}U are 0.704×10^9 years and 4.47×10^9 years respectively.

time = ... years [2]

[Total: 10]

Section B

Answer **one** question from this Section in the spaces provided.