8 **(a)** Describe how two samples, one emitting alpha particles, and the other emitting beta particles can be distinguished through a simple school laboratory experiment, using a Geiger-Muller (GM) tube connected to a ratemeter.

……...……

……..……

……..……

……..……[3]

(b) Radon (Rn) decays spontaneously with a half-life of 52 s to form polonium (Po) and polonium in turn decays spontaneously with a half-life of 0.16 s to form lead (Pb).

$$^{220}_{86}\text{Rn} \xrightarrow[52\text{ s}]{\text{X}} {}^{216}_{84}\text{Po} \xrightarrow[0.16\text{ s}]{} {}^{212}_{82}\text{Pb}$$

(i) Define the terms ***activity*** and ***decay constant***.

……...……...…

……..……

……..……

……..……[2]

(ii) State the identity of the particle labelled **X** and write down the first decay equation in the series in (b).

……..…

……..……[2]

(iii) Suppose the activity of radon, Rn, is determined by measuring the number of particles X emitted. Explain how the decay of $^{216}_{84}Po$ will affect the measurement.

……...……...…

……...……

……...……

……..……[3]

(c) Radioactive isotopes are often introduced into the body through the bloodstream. Their spread through the body can then be monitored by detecting the appearance of radiation in different organs. Iodine-131 (^{131}I), a beta emitter with a half-life of 8.04 days, is one such tracer. Suppose a scientist introduces a sample of ^{131}I with an activity of 375 Bq into the body and watches it spread to the organs.

(i) Discuss the difference between a photoelectron and a beta-particle by making reference to their origin.

……...……...…

……...……

……..…[2]

(ii) Assuming that all of the ^{131}I atoms in the sample went to the thyroid gland, calculate the decay rate in the thyroid 2.5 weeks later. Assume that none of the ^{131}I is eliminated by the body through physiological means.

Decay rate = _____ Bq[3]

(iii) Calculate the mass of ^{131}I required to produce an activity of 375 Bq.

Mass = _____ kg[3]

(d) State one similarity and one difference between radioactive decay and nuclear fission.

……...……...…

……..……

……..……

……..……[2]

******** END OF PAPER