W-16

11 PHYSICS ATAR
TEST 6: NUCLEAR PHYSICS

NAME: _____ MARK: ___/33

1. Copy and complete these reaction equations.

(a) $^{141}_{57}La \longrightarrow {}^{141}_{58}Ce +$ _____

(b) $^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn +$ _____

(c) $^{1}_{0}n + {}^{239}_{94}Pu \longrightarrow$ _____ $+ {}^{106}_{40}Zr + 4\,{}^{1}_{0}n$ (3)

2. Consider three beams of α, β and γ radiations of ***equal energy***. When passing through matter, they have differing ***ionising power*** and ***penetrating ability***.

(a) Arrange them in decreasing order (i.e. highest mentioned first) of:

(i) ionising power.

(ii) penetrating ability.

(2)

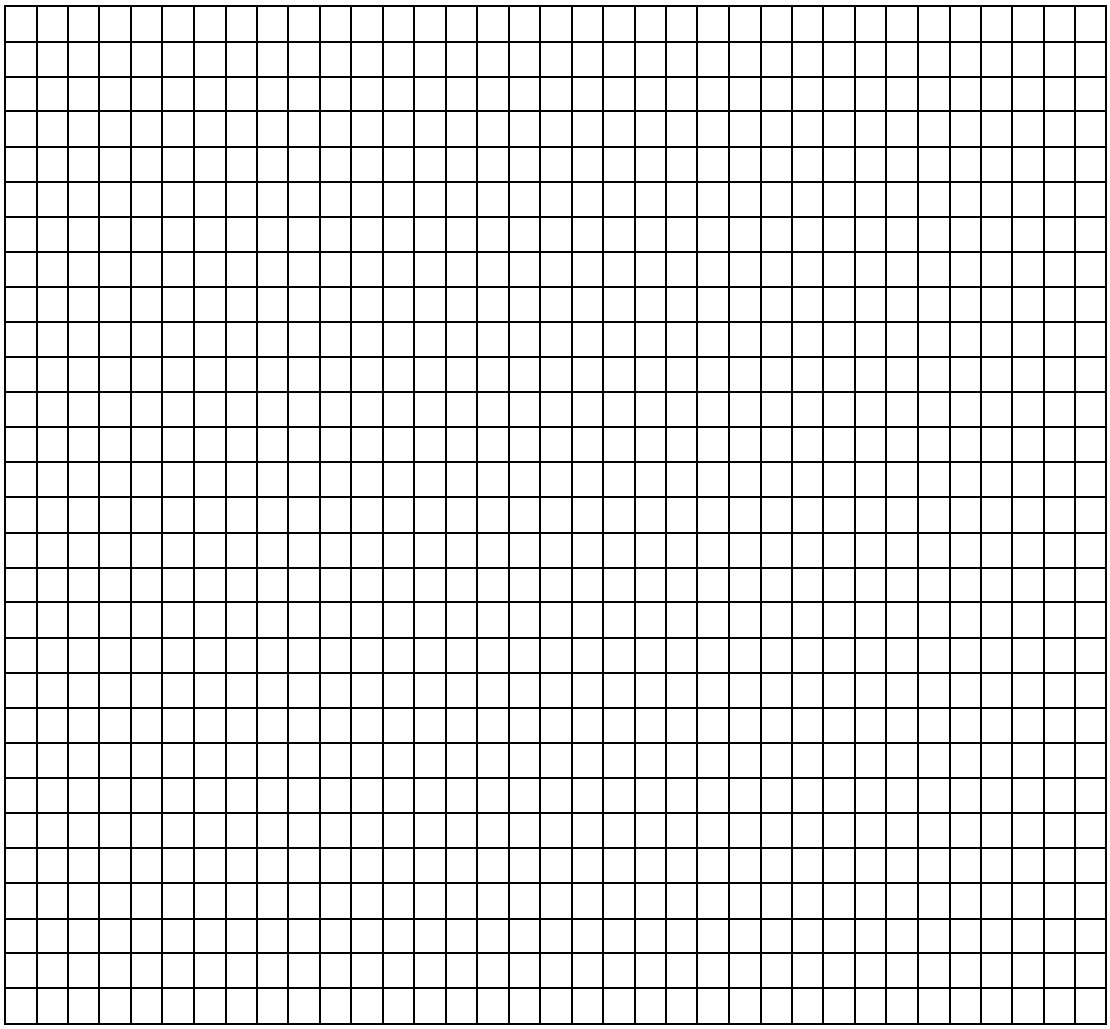
(b) Look at the α particle rankings in part (a) above. Explain why you have rated this radiation as you have.

(2)

3. A sample of Ra-233 is delivered to a research laboratory and found to give an α particle count rate of 92 per second. However, over the next month, the count rate diminishes as follows.

TIME (days)	0	5	10	15	20	25	30
COUNT RATE (s^{-1})	92	67	51	38	27	20	15

Plot the data on the graph paper below and determine the half-life.



Half-life: _____ (5)

4. Iodine-131, used in destroying malignant tumours of the thyroid, has a half-life of 8.07 days. If the initial activity (count rate) is 3.20×10^6 Bq at the time of injection, what would be the activity after 3.50 days?

(4)

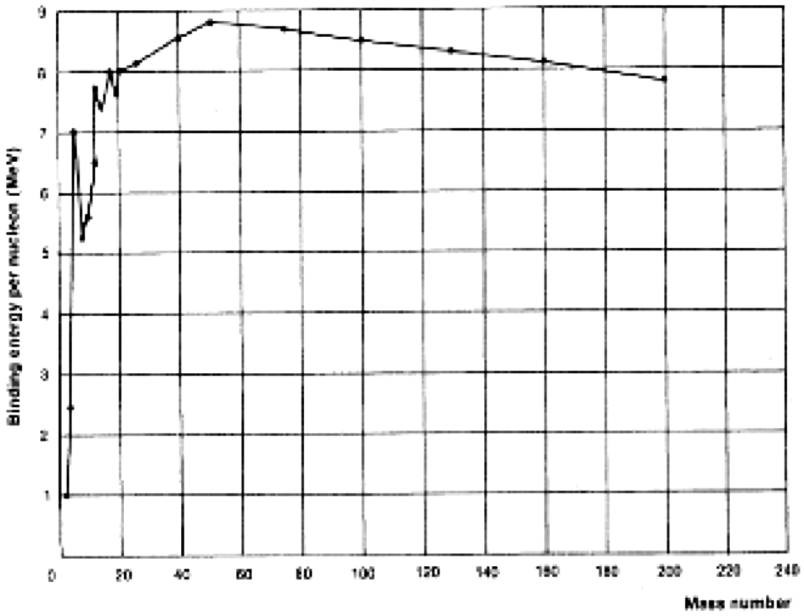
5. (a) Determine the binding energy per nucleon of a $^{218}_{84}\mathrm{Po}$ atom. Show all of your working clearly. (Po-218 = 218.10215u)

(4)

(b) Which element has the highest binding energy per nucleon?

(1)

(c) On the diagram below, indicate which elements along the curve undergo ***fission***, and explain why they do.



(3)

7. (a) When irradiating a food sample, a scientist uses an absorbed dose of 11.0 kGy of gamma radiation. How much energy would a 245 g sample absorb?

(2)

(b) What dose equivalent would this be if alpha particles were used instead of gamma rays?

(2)

8. Two deuterium nuclei ($^{2}_{1}\mathrm{H}$) fuse to make helium ($^{3}_{2}\mathrm{He}$) and a neutron.

(a) Write a nuclear equation for this fusion reaction.

(1)

(b) Determine the amount of energy liberated by one such fusion reaction.
(Mass $^{2}_{1}\mathrm{H}$ = 3.34354 x 10^{-27} kg, mass $^{3}_{2}\mathrm{He}$ = 5.00742 x 10^{-27} kg)

(4)