

Name of the Student: _____

Max. Marks : 19 Marks

Time : 19 Minutes

Mark Schemes

Q1.

(a) $1\text{eV} = 1.6 \times 10^{-19} \text{ J}$

kinetic energy = $1.6 \times 10^{-19} \times 4.9 \times 10^6 = 7.8(4) \times 10^{-13} \text{ J}$ ✓

ke lost = pe gained = $7.8(4) \times 10^{-13} \text{ J}$ ✓

2

(b) using $V = Q / 4\pi\epsilon_0 r$ and $E_p = qV$

$r = qQ / 4\pi\epsilon_0 E_p$ ✓

= $(2 \times 1.6 \times 10^{-19}) (79 \times 1.6 \times 10^{-19}) / 4\pi \times 8.85 \times 10^{-12} \times 7.84 \times 10^{-13}$ ✓

$r = 4.67(4.64) \times 10^{-14} \text{ m}$ ✓

3

(c) $A = (R/R_0)^3$ ✓

= $(7.16 \times 10^{-15} / 1.23 \times 10^{-15} \text{ m})^3$ ✓

= 197 placed on the dotted line ✓

3

(d) r gets smaller ✓

less force so needs to travel further to lose same initial ke ✓

Fewer protons means that r will be smaller when alpha particle has the same electrostatic potential energy (as initial kinetic energy)

2

[10]**Q2.**

(a) $(3.0 \times 10^{-10} / 24) \times 6.02 \times 10^{23}$ seen ✓

(7.52×10^{10})

1

(b) Decay constant = $(0.69 / 14.8 \text{ h}^{-1})$ or $1.3 \times 10^{-5} \text{ s}^{-1}$ ✓

$A = 1.30 \times 10^{-5} \times 7.5 \times 10^{10}$ ✓

$9.75 \times 10^5 \text{ Bq}$ ✓

Allow 2 or 3 sf

Allow use of $A = \lambda N$ with an incorrectly calculated decay constant

3

(c) Activity 3.5 h later should be $A = 9.8 \times 10^5 e^{-0.0466 \times 3.5}$ ✓

8.33×10^5 Bq ✓

Volume of liquid = $(8.33 \times 10^5 / 3600) \times 15 = 3470 \text{ cm}^3$ ✓

3

(d) Estimate gives 3700 compared with 3500 ✓

Flask has more mass than average / liquid is not water ✓

2

[9]