Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

(a) Mass of alpha particle = $\frac{2\times1.6\times10^{-19}}{4.81\times10^{7}}$ =6.6(53) × 10^{-27} (kg)

Allow mass = 2 × m_p + 2 × m_n = 6.696 × 10^{-27} kg
Allow mass = 4 × 1.66 × 10^{-27} kg = 6.64 × 10^{-27} kg
Allow mass = 4 × 1.67 × 10^{-27} kg = 6.68 × 10^{-27} kg
Allow slight rounding on mass (must be correct to 2 sf)

OR

Correctly re-arranged k.e. equation (with v^2 or v as subject) with 8.1 × 10^{-13} (J) substituted correctly$_1$✔

1.56 × 10^7 seen $_2$✔

*Condone **incorrect mass** in otherwise correct substitution **with v or v^2** **recognisable** as subject .*
Alternative approaches are:

$$v=\sqrt{\frac{E_k\times\text{specific charge}}{e}}$$

$$v=\sqrt{\frac{2\times E_k}{m_\alpha}}$$

Must see answer to at least 2 sf
Must see attempt to use one of the alternative approaches to support correct answer

2

(b) Use of $W = Fs$, F = 8.1 × 10^{-13} ÷ 3.5 × 10^{-2} $_1$✔

(F=) 2.3 × 10^{-11} (N) $_2$✔

Condone POT error
Correct answers gets 2 marks

OR

Use of an appropriate equation of motion to find a **and** $F = ma$

(allow their mass and their velocity in this sub) $_1$✔

Condone POT error

(F=) 2.3 × 10^{-11} (N) $_2$✔

Condone POT

OR

Use of an appropriate equation of motion to find t **and** $F = \Delta mv/t$

(allow their mass and their velocity in this sub) $_1$✔

(F=) 2.3×10^{-11} (N) $_2$✔

[answer is

$$\frac{(\text{their speed})^2 \times (\text{their } m_\alpha)}{0.070}$$

Using 2×10^7 m s^{-1} yields(5.71×10^{15} × their m_∞) – allow 1 sf answer in this case

Expect to see 3.8×10^{-11} (N) or 4×10^{-11} (N)]

2

(c) (Number of ions formed over range =)

$5.1 \times 10^4 \times 3.5$ seen **or** 1.785×10^5 (ions) seen

OR

8.1×10^{-13} converted to eV seen $_1$✔

$8.1 \times 10^{-13} \div 1.785 \times 10^5$

OR

$5.06 \times 10^6 \div 1.785 \times 10^5$ seen $_2$✔

Condone POT error in first mark

Ignore units

$8.1 \times 10^{-13} \div (5.1 \times 10^4 \times 3.5)$ is worth 1st and 2nd marks

Condone POT errors in second mark

Correct answer obtains 3 marks

28 (.4) (eV) $_3$✔

99(.3) (eV) scores 1 mark

3

(d) (Q =) $0.85 \times 10^{-3} \times 1.2 \times 10^{-9} = 1.02 \times 10^{-12}$

OR

n = (their Q) $\div 1.6 \times 10^{-19}$ $_1$✔

$n = 6.4 \times 10^6$ (c.a.o.) $_2$✔

Condone one POT error for one mark

2

(e) At 3.5 cm the pd drops / the current begins

OR

When the source is 10 cm away no ionisation occurs in the air gap (because the alpha particles have insufficient range to reach the air gap)

OR

When the radioactive source is close enough (approx. 5 cm) ionisation occurs ✔

OR

When beyond 3.5 cm no change in pd / current equals zero

Must be sense of abrupt change

MAX 3

When ionisation occurs / charge carriers are liberated in the air gap:

Allow more ionisation for second mark

resistance has decreased

OR

current increases (from zero)

OR

the potential difference decreases (with a maximum current) (to its minimum value) (across the air gap)✔

From 10 cm separation until 5 cm (approx) separation nothing changes / appreciates that pd is 4500 V / pd across gap = 4500 V until ionisation occurs ✔

Current is produced: the pd across 5 MΩ resistor is 4250 V / most pd is across the 5 MΩ resistor / small pd across air gap ✔

Current is produced and the pd across the air gap is 250 V✔

Current is produced and the pd across the air gap is 250 V✔

3

[12]

Q2.

(a) path difference for two waves ✔

Allow 'waves travel different distances'

Condone out of phase

gives rise to a phase difference ✔

if phase and path confused only give 1 for first 2 marks

Destructive interference occurs ✔

allow explanation of interference

3

(b) (Path difference =) 0.056 m ✔

Path difference = 2λ or wavelength = 0.028 m ✔e

Use of $f=c/\lambda$ so f = 11(10.7) × 10^9 Hz ✔

Allow 2 max for 5.4 × 10^9 Hz or 2.7 × 10^9 Hz

Allow ecf

3

(c) Intensity decreases with distance ✔

One wave travels further than the other ✔

Amplitudes/intensities of the waves at the minimum points are not equal ✔

Or "do not cancel out"

max 2

(d) The signal decreases/becomes zero ✔

The waves transmitted are polarised ✔

zero when detector at 90° to the transmitting aerial/direction of polarisation of wave ✔

max 3

[11]