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

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(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_α) – 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

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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

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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]

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