

Name of the Student: _____

Max. Marks : 24 Marks

Time : 24 Minutes

Mark Schemes

Q1.

- (a) resultant/overall/sum of force = 0 OR forces up equal forces down AND forces left equal forces right ✓
(sum of) anticlockwise moments (about any point) = (sum of) clockwise moments/zero resultant moment/torque ✓

1
1

- (b) EITHER
the point through which (the line of action of) a force has no turning effect/causes no rotation/ no torque ✓
OR
where the mass of the body can be considered to be concentrated OR where the weight can be considered to act ✓

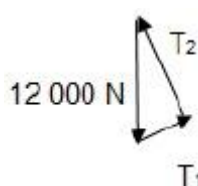
*NOT where mass can be considered to act
Ignore reference to force of gravity*

1

- (c) so there is not a resultant moment/turning effect / turning force OR moments do not balance OR (beam) does not rotate / oscillate / swing ✓
about A / because A is pivot ✓

Allow moments balanced for no resultant moment

1
1



- (d)
 $T_1 = 12\,000 \cos 53$ ✓
 $T_1 = 7200$ (7221) (N) ✓
 $T_2 = 12\,000 \sin 53$ ✓
 $T_2 = 9600$ (9583) (N) ✓

OR

$$T_1 \cos 53 + T_2 \cos 37 = 12\,000 \quad \checkmark$$

$$T_1 \sin 53 = T_2 \sin 37 \quad \checkmark$$

$$T_2 = T_1 \sin 53 / \sin 37$$

hence

$$T_1 \cos 53 + T_1 \sin 53 \cos 37 / \sin 37 = 12\,000$$

$$T_1 = 7200$$
 (7221) (N) ✓

$$T_2 = 7221 \sin 53 / \sin 37 = 9600 \text{ (9583) (N) } \checkmark$$

If T_1 and T_2 are the wrong way round get 3 out of 4

If scale drawing 2 max +/- 300(N)

If values out by a factor of 10 then -1 (i.e. confusion over g)

1
1
1
1

(e) (use of $\Delta l = F/AE$)

$$A = \pi \times (0.75 \times 10^{-2})^2 \checkmark (= 1.767 \times 10^{-4})$$

$$\Delta l = 12\,000 \times 12 / (1.767 \times 10^{-4} \times 200 \times 10^9) \checkmark$$

$$\Delta l = 4.1 \times 10^{-3} \text{ (m) } \checkmark$$

No attempt to calculate area scores zero

Wrong area (e.g. d^2 or $2\pi r$ or $2\pi rl$) maximum 1 mark unless diameter used for radius in πr^2 then maximum 2 marks

Accept 4.0×10^{-3}

If 4×10^{-3} then -1 as 1 sig. fig.

1
1
1

[12]

Q2.

- (a) Mass of alpha particle = $\frac{2 \times 1.6 \times 10^{-19}}{4.81 \times 10^7} = 6.6(53) \times 10^{-27} \text{ (kg)}$
 Allow mass = $2 \times m_p + 2 \times m_n = 6.696 \times 10^{-27} \text{ kg}$
 Allow mass = $4 \times 1.66 \times 10^{-27} \text{ kg} = 6.64 \times 10^{-27} \text{ kg}$
 Allow mass = $4 \times 1.67 \times 10^{-27} \text{ kg} = 6.68 \times 10^{-27} \text{ kg}$
 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 $8.1 \times 10^{-13} \text{ (J)}$ substituted correctly₁ ✓

$$1.56 \times 10^7 \text{ seen } \checkmark_2$$

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 $W = Fs$, $F = 8.1 \times 10^{-13} \div 3.5 \times 10^{-2}$ ✓₁

$$(F=) 2.3 \times 10^{-11} \text{ (N) } \checkmark_2$$

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) $_1\checkmark$

Condone POT error

(F=) 2.3×10^{-11} (N) $_2\checkmark$

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) $_1\checkmark$

(F=) 2.3×10^{-11} (N) $_2\checkmark$

[answer is

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

Using $2 \times 10^7 \text{ m s}^{-1}$ yields ($5.71 \times 10^{15} \times \text{their } m_\alpha$) – 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 $_1\checkmark$

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

OR

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

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) $_3\checkmark$

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

$$n = (\text{their } Q) \div 1.6 \times 10^{-19} \quad 1 \checkmark$$

$$n = 6.4 \times 10^6 \text{ (c.a.o.)} \quad 2 \checkmark$$

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]