

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2015 series

9702 PHYSICS

9702/21

Paper 2 (AS Structured Questions), maximum raw mark 60

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- 1 (a) temperature B1
current B1 [2]
(allow amount of substance, luminous intensity)
- (b) (i) 1. $E = (\text{stress/strain}) = [\text{force/area}] / [\text{extension/original length}]$
units of stress: $\text{kg m s}^{-2} / \text{m}^2$ and no units for strain B1
units of E : $\text{kg m}^{-1} \text{s}^{-2}$ A0 [1]
2. units for T : s, l : m and M : kg
 $K^2 = T^2 E / M l^3$ hence units: $\text{s}^2 \text{kg m}^{-1} \text{s}^{-2} / \text{kg}^3 (= \text{m}^{-4})$ C1
units of K : m^{-2} A1 [2]
- (ii) % uncertainty in $E = 4\%$ (for T^2) + 0.6% (for l^3) + 0.1% (for M) + 3% (for K^2)
 $= 7.7\%$ B1
- $E = [(1.48 \times 10^5)^2 \times 0.2068 \times (0.892)^3] / (0.45)^2$
 $= 1.588 \times 10^{10}$ C1
- 7.7% of $E = 1.22 \times 10^9$ C1
- $E = (1.6 \pm 0.1) \times 10^{10} \text{ kg m}^{-1} \text{s}^{-2}$ A1 [4]
- 2 (a) $\text{ps} = 10^{-12}(\text{s})$ or $T = 4 \times 50 \times 10^{-12}(\text{s})$ B1
- $v = f\lambda$ or $v = \lambda / T$ C1
- $\lambda = 3.0 \times 10^8 \times 4 \times 50 \times 10^{-12}$ C1
 $= 0.06(0)\text{m}$ A1 [4]
- (b) $1500 = 3.0 \times 10^8 \times 4 \times \text{time-base setting}$ or $T = 5 \times 10^{-6}\text{s}$ C1
time-base setting = $1.3 (1.25) \mu\text{s cm}^{-1}$ A1 [2]
- 3 (a) work done is force $\times$ distance moved in direction of force
or
no work done along PQ as no displacement/distance moved in direction of force B1
work done is same in vertical direction as same distance moved in direction of force B1 [2]

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(b) (i) at maximum height $t = 1.5$ (s) or $s = \frac{1}{2}(u + v)t$, $s = 11$ m and $t = 1.5$ s C1

$$V_v = 0 + 9.81 \times 1.5$$

$$V_v = (11 \times 2) / 1.5$$

$$= 15 \text{ (14.7) ms}^{-1}$$

A1 [2]

(ii) straight line from (0,0) to (3.00, 25.5)

B1 [1]

(iii) at maximum height $V_h = 25.5/3 (= 8.5 \text{ ms}^{-1})$

B1

$$\text{ratio} = mgh / \frac{1}{2}mv^2$$

C1

$$= (2 \times 9.81 \times 11.0) / (8.5)^2$$

$$= 3.0 \text{ (2.99)}$$

A1 [3]

(iv) deceleration is greater/resultant force (weight and friction force) is greater

M1

time is less

A1 [2]

4 (a) density = mass/volume

C1

$$\text{mass} = 7900 \times 4.5 \times 24 \times 10^{-6} = 0.85 \text{ (0.853) kg}$$

M1 [2]

(b) pressure = force/area

C1

$$\text{force} = W \cos 40^\circ$$

C1

$$\text{pressure} = (0.85 \times 9.81 \cos 40^\circ) / 24 \times 10^{-4}$$

$$= 2.7 \text{ (2.66) } \times 10^3 \text{ Pa}$$

A1 [3]

(c) $F = ma$

C1

$$W \sin 40^\circ - f = ma$$

C1

$$0.85 \times 9.81 \times \sin 40^\circ - f = 0.85 \times 3.8$$

$$f (= 5.36 - 3.23) = 2.1 \text{ N [5.38 - 3.242 if 0.8532 kg is used for the mass]}$$

A1 [3]

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- 5 (a) progressive: all particles have same amplitude
stationary: no nodes or antinodes or maximum to minimum/zero amplitude B1
- progressive: adjacent particles are not in phase
stationary: waves particles are in phase (between adjacent nodes) B1 [2]
- (b) (i) wavelength 1.2 m (zero displacement at 0.0, 0.60 m, 1.2 m, 1.8 m, 2.4 m)
either peaks at 0.30 m and 1.5 m and troughs at 0.90 m and 2.1 m
or vice versa (but not both) B1
maximum amplitude 5.0 mm B1 [2]
- (ii) 180° or π rad A1 [1]
- (iii) at $t = 0$ particle has kinetic energy as particle is moving B1
at $t = 5.0$ ms no kinetic energy as particle is stationary
so decrease in kinetic energy (between $t = 0$ and $t = 5.0$ ms) B1 [2]
- 6 (a) energy converted from chemical to electrical per unit charge B1 [1]
- (b) (i) current = $E/(R + r)$ C1
 $= 6.0/(16 + 0.5)$
 $= 0.36$ (0.364) A A1 [2]
- (ii) terminal p.d. = $(0.36 \times 16) = 5.8$ V or $(6 - 0.36 \times 0.5)$
 $= 5.8$ V A1 [1]
- (c) (i) use of $R = \rho l/A$ or proportionality with length and inverse
proportionality with area or d^2 C1
 $d/2$ and $l/2$ gives resistance of $Z = 2R_Y = 24$ (Ω) C1
 R = resistance of parallel combination = $[1/24 + 1/12]^{-1}$
 $= 8$ (0) (Ω) A1 [3]
- (ii) resistance of circuit less therefore current larger B1
lost volts greater therefore terminal p.d. less B1 [2]
- (d) power = $I^2 R$ or VI or V^2/R C1
current in second circuit ($= 6.0/12.5$) = 0.48 (A) B1
ratio = $[(0.36)^2 \times 16] / [(0.48)^2 \times 12] = 0.75$ [0.77 if full s.f. used] B1 [3]

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7 (a) (i) curved path towards negative (–) plate (right-hand side) B1 [1]

(ii) range of α -particle is only few cm in air/loss of energy of the α -particles due to collision with air molecules/ionisation of the air molecules B1 [1]

(iii) $V = E \times d$ C1

$= 140 \times 10^6 \times 12 \times 10^{-3} = 1.7 \text{ (1.68) MV}$ A1 [2]

(b) β have opposite charge to α therefore deflection in opposite direction B1

β has a range of velocities/energies hence number of different deflections B1

β have less mass or q/m is larger hence deflection is greater

or

β with (very) high speed (may) have less deflection B1 [3]

(c)

emitted particle	change in Z	change in A
α -particle	–2	–4
β -particle	+1	0

A1 [1]