

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9702 PHYSICS

9702/22

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

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- 1 (a) (work =) force \times distance or force \times displacement or ($W =$) $F \times d$ M1
units of work: $\text{kg m s}^{-2} \times \text{m} = \text{kg m}^2 \text{s}^{-2}$ A1 [2]
- (b) (p.d. =) $\frac{\text{work (done) or energy (transformed) (from electrical to other forms)}}{\text{charge}}$ B1 [1]
- (c) $R = V/I$ B1
units of V : $\text{kg m}^2 \text{s}^{-2} / \text{As}$ and units of I : A C1
- or
 $R = P/I^2$ [or $P = VI$ and $V = IR$] (B1)
units of P : $\text{kg m}^2 \text{s}^{-3}$ and units of I : A (C1)
- or
 $R = V^2/P$ (B1)
units of V : $\text{kg m}^2 \text{s}^{-2} / \text{As}$ and units of P : $\text{kg m}^2 \text{s}^{-3}$ (C1)
- units of R : $(\text{kg m}^2 \text{s}^{-2} / \text{A}^2 \text{s}) = \text{kg m}^2 \text{s}^{-3} \text{A}^{-2}$ A1 [3]
- 2 (a) speed decreases/stone decelerates to rest/zero at 1.25 s B1
speed then increases/stone accelerates (in opposite direction) B1 [2]
- (b) (i) $v = u + at$ (or $s = ut + \frac{1}{2}at^2$ and $v^2 = u^2 + 2as$) C1
 $= 0 + (3.00 - 1.25) \times 9.81$ C1
 $= 17.2$ (17.17) ms^{-1} A1 [3]
- (ii) $s = ut + \frac{1}{2}at^2$
- $s = \frac{1}{2} \times 9.81 \times (1.25)^2$ [= 7.66] C1
 $s = \frac{1}{2} \times 9.81 \times (1.75)^2$ [= 15.02] C1
- (distance = 7.66 + 15.02)
- $[v = u + at = 0 + 9.81 \times (2.50 - 1.25) = 12.26 \text{ ms}^{-1}]$
- or
 $s = \frac{1}{2} \times 9.81 \times (1.25)^2$ [= 7.66] (C1)
 $s = 12.26 \times 0.50 + \frac{1}{2} \times 9.81 \times (3.00 - 2.50)^2$ [= 7.36] (C1)
- (distance = 2 \times 7.66 + 7.36)
- Example alternative method:*
- $s = (v^2 - u^2) / 2a = (12.26^2 - 0) / 2 \times 9.81$ [= 7.66] (C1)
 $s = (v^2 - u^2) / 2a = (17.17^2 - 12.26^2) / 2 \times 9.81$ [= 7.36] (C1)
- (distance = 2 \times 7.66 + 7.36)

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- 22.7 (22.69 or 23)m A1 [3]
- (iii) ($s = 15.02 - 7.66 =$) 7.4 (7.36)m (*ignore sign in answer*) A1
- down A1 [2]
- (c) straight line from positive value of v to t axis M1
- same straight line crosses t axis at $t = 1.25$ s A1
- same straight line continues with same gradient to $t = 3.0$ s A1 [3]
- 3 (a) (i) (vertical component = $44 \sin 30^\circ =$) 22 N A1 [1]
- (ii) (horizontal component = $44 \cos 30^\circ =$) 38(.1)N A1 [1]
- (b) $W \times 0.64 = 22 \times 1.60$ C1
- ($W =$) 55 N A1 [2]
- (c) F has a horizontal component (not balanced by W)
 or F has 38 N acting horizontally
 or 38 N acts on wall
 or vertical component of F does not balance W
 or F and W do not make a closed triangle of forces B1 [1]
- (d) line from P in direction towards point on wire vertically above W and direction up B1 [1]
- 4 (a) ($p =$) mv C1
- $\Delta p (= -6.64 \times 10^{-27} \times 1250 - 6.64 \times 10^{-27} \times 1250) = 1.66 \times 10^{-23}$ Ns A1 [2]
- (b) (i) molecule collides with wall/container **and** there is a change in momentum B1
- change in momentum / time is force or $\Delta p = Ft$ B1
- many/all/sum of molecular collisions over surface/area of container produces pressure B1 [3]
- (ii) more collisions per unit time so greater pressure B1 [1]
- 5 (a) curved line showing decreasing gradient with temperature rise M1
- smooth line not touching temperature axis, not horizontal or vertical anywhere A1 [2]
- (b) (i) (no energy lost in battery because) no/negligible internal resistance B1 [1]

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- (ii) $I = V/R$
 $= 8/15 \times 10^3$ or $1.6/3.0 \times 10^3$ or $2.4/4.5 \times 10^3$ or $12/22.5 \times 10^3$ C1
 $= 0.53 \times 10^{-3} \text{ A}$ A1 [2]
- (iii) p.d. across X = $12 - 8.0 - 3.0 \times 10^3 \times 0.53 \times 10^{-3}$ (= 2.4 V) C1
 $R_X = 2.4/(0.53 \times 10^{-3})$ C1
or
 $R_{\text{tot}} = 12/0.53 \times 10^{-3}$ (= $22.5 \times 10^3 \Omega$) (C1)
 $R_X = (22.5 - 15.0 - 3.0) \times 10^3$ (C1)
 $4.5(2) \times 10^3 \Omega$ A1 [3]
- (iv) resistance decreases hence current (in circuit) is greater M1
p.d. across X and Y is greater hence p.d across Z decreases A1
or explanation in terms of potential divider:
 R_Z decreases so $R_Z/(R_X + R_Y + R_Z)$ is less (M1)
therefore p.d. across Z decreases (A1) [2]
- 6 (a) progressive waves transfer/propagate energy **and** stationary waves do not B1
amplitude constant for progressive wave **and** varies (from max/antinode to min/zero/node) for stationary wave B1
adjacent particles in phase for stationary wave **and** out of phase for progressive wave (B1) [2]
- (b) (i) wave / microwave from source/S reflects at reflector/R B1
reflected and (further) incident waves overlap/meet/superpose B1
waves have same frequency/wavelength/period **and** speed (so stationary waves formed) B1 [3]
- (ii) detector/D is moved between reflector/R and source/S (or v.v.) B1
maximum, minimum/zero, (maximum... etc.) observed on meter/deflections/readings/measurements/recordings B1 [2]
- (iii) determine/measure the distance between adjacent minima/nodes or maxima/antinodes **or** across specific number of nodes/antinodes B1
wavelength is twice distance between adjacent nodes/minima or maxima/antinodes (or other correct method of calculation of wavelength from measurement) B1 [2]

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- (c) $v = f\lambda$ C1
- $f = 3.0 \times 10^8 / (2.8 \times 10^{-2}) [= 1.07 \times 10^{10} \text{ Hz}]$ C1
- 11 (10.7)GHz A1 [3]

- 7 (a) 92 protons and 143 neutrons B1 [1]

(b)

	value
a	1
b	0
c	141
d	55

(a and b both required)

B1
B1
B1 [3]

- (c) kinetic energy (of products) or gamma/ γ (radiation or photon) B1 [1]

- (d) (total) mass on left-hand side/reactants is greater than (total) mass on right-hand side/products M1

difference in mass is (converted to) energy A1 [2]