

**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)  $\text{ms}^{-1}$  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 ( <i>ignore sign in answer</i> )	A1	
	down	A1	[2]
(c)	straight line from positive value of $v$ to $t$ axis	M1	
	same straight line <u>crosses</u> $t$ 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	
	$\Delta p (= -6.64 \times 10^{-27} \times 1250 - 6.64 \times 10^{-27} \times 1250) = 1.66 \times 10^{-23}$ N s	A1	[2]
	(b) (i) molecule collides with wall/container <b>and</b> there is a change in momentum	B1	
	change in momentum / time is force or $\Delta p = Ft$	B1	
	<u>many/all/sum of</u> 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/ $\gamma$  (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]