

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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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9702	22

- 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 1.25s 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
 $= 17.2 (17.17) \text{ m s}^{-1}$ 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)
 $[v = u + at = 0 + 9.81 \times (2.50 - 1.25) = 12.26 \text{ m s}^{-1}]$
- 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)

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9702	22

	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 and 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]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9702	22

(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 therefore p.d. across Z decreases	(M1) (A1)	[2]
6	(a) progressive waves transfer/propagate energy and stationary waves do not	B1	
	<u>amplitude</u> 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 <u>from source/S</u> reflects <u>at reflector/R</u>	B1	
	reflected and (further) incident waves overlap/meet/superpose	B1	
	waves have same <u>frequency/wavelength/period</u> and <u>speed</u> (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) <u>determine/measure</u> the distance between adjacent minima/nodes or maxima/antinodes or across <u>specific number</u> of nodes/antinodes	B1	
	wavelength is twice distance between <u>adjacent</u> nodes/minima or maxima/antinodes (or other correct method of calculation of wavelength from measurement)	B1	[2]

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge International AS/A Level – May/June 2015	9702	22

(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]