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

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2015 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

® IGCSE is the registered trademark of Cambridge International Examinations.

CAMBRIDGE
International Examinations

1 **(a)** (work =) force × distance or force × displacement or (W =) $F \times d$ M1

units of work: $kg\,m\,s^{-2} \times m = kg\,m^2\,s^{-2}$ A1 [2]

(b) (p.d. =) $\dfrac{\text{work (done) or energy (transformed) (from electrical to other forms)}}{\text{charge}}$ B1 [1]

(c) $R = V/I$ B1
units of V: $kg\,m^2\,s^{-2}/A\,s$ **and** units of I: A C1

or
$R = P/I^2$ [or $P = VI$ **and** $V = IR$] (B1)
units of P: $kg\,m^2\,s^{-3}$ **and** units of I: A (C1)

or
$R = V^2/P$ (B1)
units of V: $kg\,m^2\,s^{-2}/A\,s$ **and** units of P: $kg\,m^2\,s^{-3}$ (C1)

units of R: $(kg\,m^2\,s^{-2}/A^2\,s =)\,kg\,m^2\,s^{-3}\,A^{-2}$ A1 [3]

2 **(a)** speed decreases/stone decelerates <u>to rest/zero</u> at 1.25 s B1

speed then increases/stone accelerates (in opposite direction) B1 [2]

(b) **(i)** $v = u + at$ (or $s = ut + ½at^2$ **and** $v^2 = u^2 + 2as$) C1

$= 0 + (3.00 - 1.25) \times 9.81$ C1

$= 17.2\ (17.17)\,m\,s^{-1}$ A1 [3]

(ii) $s = ut + ½at^2$

$s = ½ \times 9.81 \times (1.25)^2$ [= 7.66] C1
$s = ½ \times 9.81 \times (1.75)^2$ [= 15.02] C1

(distance = 7.66 + 15.02)

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

or
$s = ½ \times 9.81 \times (1.25)^2$ [= 7.66] (C1)
$s = 12.26 \times 0.50 + ½ \times 9.81 \times (3.00 - 2.50)^2$ [= 7.36] (C1)

(distance = 2 × 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 × 7.66 + 7.36)

© Cambridge International Examinations 2015

			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 <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° =) 22 N	A1	[1]
		(ii)	(horizontal component = 44 cos 30° =) 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	
			Δp (= $-6.64 \times 10^{-27} \times 1250 - 6.64 \times 10^{-27} \times 1250$) = 1.66×10^{-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]

© Cambridge International Examinations 2015

(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

$= 0.53 \times 10^{-3}$ 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
$R_{tot} = 12/0.53 \times 10^{-3}$ (= $22.5 \times 10^3\ \Omega$) (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]

© Cambridge International Examinations 2015

(c) $v = f\lambda$ C1

$f = 3.0 \times 10^8 / (2.8 \times 10^{-2})$ [$= 1.07 \times 10^{10}$ 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 <u>greater</u> than (total) mass on right-hand side/products M1

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

© Cambridge International Examinations 2015