CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9702 PHYSICS

9702/21 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)** power = work / time or energy / time or (force × distance) / time B1

= $kg\,m\,s^{-2} \times m\,s^{-1} = kg\,m^2\,s^{-3}$ A1 [2]

(b) power = VI [or V^2/R **and** $V = IR$ or I^2R **and** $V = IR$] B1

(units of V:) $kg\,m^2\,s^{-3}\,A^{-1}$ B1 [2]

2 **(a)** speed = distance / time and velocity = displacement / time B1

speed is a scalar as distance has no direction **and**
velocity is a vector as displacement has direction B1 [2]

(b) **(i)** constant acceleration or linear/uniform increase in velocity until 1.1 s B1

rebounds or bounces or changes direction B1

decelerates to zero velocity at the same acceleration as initial value B1 [3]

(ii) $a = (v - u)/t$ or use of gradient implied C1

= (8.8 + 8.8) / 1.8 or appropriate values from line or = (8.6 + 8.6) / 1.8 B1

= 9.8 (9.78) $m\,s^{-2}$ or = 9.6 $m\,s^{-2}$ A1 [3]

(iii) **1.** distance = first area above graph + second area below graph C1

= (1.1 × 10.8) / 2 + (0.9 × 8.8) / 2 (= 5.94 + 3.96) C1

= 9.9 m A1 [3]

2. displacement = first area above graph – second area below graph C1

= (1.1 × 10.8) / 2 – (0.9 × 8.8) / 2

= 2.0 (1.98) m A1 [2]

(iv) correct shape with straight lines and all lines above the time axis or all below M1

correct times for zero speeds (0.0, 1.15 s, 2.1 s) and peak speeds
(10.8 $m\,s^{-1}$ at 1.1 s and 8.8 $m\,s^{-1}$ at 1.2 s and 3.0 s) A1 [2]

3 **(a)** $4.5 \times 50 - 2.8 \times M$ (= ...) C1

(...) = $-1.8 \times 50 + 1.4 \times M$ C1

(M =) 75 g A1 [3]

© Cambridge International Examinations 2015

(b) total initial kinetic energy/KE not equal to the total final kinetic energy/KE

or relative speed of approach is not equal to relative speed of separation

so not elastic or is inelastic B1 [1]

(c) force on X is equal and opposite to force on Y (Newton III) M1

force equals/is proportional to rate of change of momentum (Newton II) M1

time of collision same for both balls hence change in momentum is the same A1 [3]

4 (a) (i) two sets of co-ordinates taken to determine a constant value (F/x) M1

F/x constant hence obeys Hooke's law A1 [2]

or
gradient calculated and one point on line used (M1)
to show no intercept hence obeys Hooke's law (A1)

(ii) gradient or one point on line used e.g. $4.5/1.8 \times 10^{-2}$ C1

(k =) 250 N m^{-1} A1 [2]

(iii) work done or E_P = area under graph or $\frac{1}{2}Fx$ or $\frac{1}{2}kx^2$ C1

$= 0.5 \times 4.5 \times 1.8 \times 10^{-2}$ or $0.5 \times 250 \times (1.8 \times 10^{-2})^2$ C1

= 0.041 (0.0405) J A1 [3]

(b) KE = $\frac{1}{2}mv^2$

$\frac{1}{2}mv^2$ = 0.0405 or KE = 0.0405 (J) C1

(v = $[2 \times 0.0405/1.7]^{1/2}$ =) 0.22 (0.218) m s^{-1} A1 [2]

5 (a) very high/infinite resistance for negative voltages up to about 0.4 V B1

resistance decreases from 0.4 V B1 [2]

(b) initial straight line from (0,0) into curve with decreasing gradient but not to horizontal M1

repeated in negative quadrant A1 [2]

(c) (i) $R = 12^2/36 = 4.0\,\Omega$ A1

or
$I = P/V = 36/12 = 3.0$ A and $R = 12/3.0 = 4.0\,\Omega$ (A1) [1]

© Cambridge International Examinations 2015

(ii) lost volts = $0.5 \times 2.8 = 1.4\,(\text{V})$ or $E = 12 = 2.8 \times (R + r)$ C1

$R = V/I = (12 - 1.4)/2.8$ or $(R + r) = 4.29\,\Omega$ C1

$= 3.8\,(3.79)\,\Omega$ or $R = 3.8\,\Omega$ A1 [3]

(d) resistance of the lamp increases with increase of V or I B1 [1]

6 **(a)** diffraction is the spreading of a wave as it passes through a slit or past an edge B1

when two (or more) waves superpose/meet/overlap M1
resultant displacement is the sum of the displacement of each wave A1 [3]

(b) $n\lambda = d \sin\theta$ and $v = f\lambda$ C1

max order number for $\theta = 90°$
hence $n\,(= f/vN) = 7.06 \times 10^{14}/(3 \times 10^8 \times 650 \times 10^3)$ M1

$n = 3.6$
hence number of orders = 3 A1 [3]

(c) greater wavelength so fewer orders seen A1 [1]

7 **(a)** a region/space/area where a (stationary) charge experiences an (electric) force B1 [1]

(b) **(i)** at least four parallel equally spaced straight lines perpendicular to plates B1

consistent direction of an arrow on line(s) from left to right B1 [2]

(ii) electric field strength $E = V/d$ C1

$E = (450/16 \times 10^{-3})$
$= 28 \times 10^3\,(28\,125)\,\text{V m}^{-1}$ A1 [2]

(iii) $W = Eqd$ or Vq C1

$q = 3.2 \times 10^{-19}\,(\text{C})$ C1

$W = 28\,125 \times 3.2 \times 10^{-19} \times 16 \times 10^{-3}$ or $450 \times 3.2 \times 10^{-19}$

$= 1.4(4) \times 10^{-16}\,\text{J}$ A1 [3]

(iv) $\text{ratio} = \dfrac{450 \times 3.2 \times 10^{-19}}{450 \times -1.6 \times 10^{-19}}$ *(evidence of working required)*

$= (-)\,2$ A1 [1]

© Cambridge International Examinations 2015