

**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

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	Cambridge International AS/A Level – May/June 2015	9702	21
1	(a) power = work/time or energy/time or (force × distance)/time = $\text{kg m s}^{-2} \times \text{m s}^{-1} = \text{kg m}^2 \text{s}^{-3}$		B1 A1 [2]
	(b) power = $VI$ [or $V^2/R$ and $V = IR$ or $I^2R$ and $V = IR$ ] (units of $V$ ): $\text{kg m}^2 \text{s}^{-3} \text{A}^{-1}$		B1 B1 [2]
2	(a) speed = distance/time and velocity = displacement/time  speed is a scalar as distance has no direction <b>and</b> velocity is a vector as displacement has direction		B1 B1 [2]
	(b) (i) <u>constant</u> acceleration or linear/uniform increase in velocity until 1.1 s  rebounds or bounces or changes direction  decelerates to zero velocity at the same acceleration as initial value		B1 B1 B1 [3]
	(ii) $a = (v - u)/t$ or use of gradient implied  $= (8.8 + 8.8)/1.8$ or appropriate values from line or $= (8.6 + 8.6)/1.8$  $= 9.8 (9.78) \text{ms}^{-2}$ or $= 9.6 \text{ms}^{-2}$		C1 B1 A1 [3]
	(iii) 1. distance = first area above graph + second area below graph  $= (1.1 \times 10.8)/2 + (0.9 \times 8.8)/2 (= 5.94 + 3.96)$  $= 9.9 \text{m}$		C1 C1 A1 [3]
	2. displacement = first area above graph – second area below graph  $= (1.1 \times 10.8)/2 - (0.9 \times 8.8)/2$  $= 2.0 (1.98) \text{m}$		C1 A1 [2]
	(iv) correct shape with straight lines and all lines above the time axis or all below  correct times for zero speeds (0.0, 1.15 s, 2.1 s) and peak speeds ( $10.8 \text{ms}^{-1}$ at 1.1 s and $8.8 \text{ms}^{-1}$ at 1.2 s and 3.0 s)		M1 A1 [2]
3	(a) $4.5 \times 50 - 2.8 \times M (= \dots)$  $(\dots) = -1.8 \times 50 + 1.4 \times M$  ( $M =$ ) 75g		C1 C1 A1 [3]

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- (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  
( $k =$ )  $250 \text{ N m}^{-1}$  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)  $\text{m s}^{-1}$  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]

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- (ii) lost volts =  $0.5 \times 2.8 = 1.4$  (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  $\theta = 90^\circ$
- 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
- $q = 3.2 \times 10^{-19}$  (C)      C1
- $W = 28\,125 \times 3.2 \times 10^{-19} \times 16 \times 10^{-3}$  or  $450 \times 3.2 \times 10^{-19}$
- $= 1.4(4) \times 10^{-16}$  J      A1 [3]
- (iv) ratio =  $\frac{450 \times 3.2 \times 10^{-19}}{450 \times -1.6 \times 10^{-19}}$  (evidence of working required)
- $= (-) 2$       A1 [1]