

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

Cambridge International Advanced Subsidiary and Advanced Level

## **MARK SCHEME for the March 2016 series**

### **9702 PHYSICS**

**9702/22**

Paper 2 (AS Level Structured Questions),  
maximum raw mark 60

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- 1 (a) metre rule/tape measure B1
- (b) (i)  $v = [(1.8 \times 126 \times 10^{-2}) / 5.1 \times 10^{-3}]^{1/2}$   
 $= 21.1 \text{ (ms}^{-1}\text{)}$  C1  
A1
- (ii) percentage uncertainty = 4% **or** fractional uncertainty = 0.04  
 $\Delta v = 0.04 \times 21.1$   
 $= 0.84$  C1  
 $v = 21.1 \pm 0.8 \text{ (ms}^{-1}\text{)}$  A1
- 2 (a) change in velocity/time (taken) **or** rate of change of velocity B1
- (b) (i)  $v_x = (24 / 1.5) = 16 \text{ (ms}^{-1}\text{)}$  A1
- (ii)  $\tan 28^\circ = v_y / v_x$  **or**  $v_x = v \cos 28^\circ$  **and**  $v_y = v \sin 28^\circ$  C1  
 $v_y = 16 \tan 28^\circ$  **or**  $v_y = 16 \times (\sin 28^\circ / \cos 28^\circ)$  **so**  $v_y = 8.5 \text{ (ms}^{-1}\text{)}$  A1
- (iii)  $v = u + at$  C1  
 $t = (0 - 8.5) / (-9.81)$   
 $= 0.87 \text{ (s)}$  A1
- (iv) straight line from positive  $v_y$  at  $t = 0$  to negative  $v_y$  at  $t = 1.5 \text{ s}$  M1  
line starts at  $(0, 8.5)$  and crosses  $t$ -axis at  $(0.87, 0)$  and does not go beyond  $t = 1.5 \text{ s}$ . A1
- (c) (i)  $(v^2 = u^2 + 2as)$   $0 = 8.5^2 + 2(-9.81)s$   
**or**  $(s = ut + \frac{1}{2}at^2)$   $s = 8.5 \times 0.87 + \frac{1}{2} \times (-9.81) \times 0.87^2$   
**or**  $(s = vt - \frac{1}{2}at^2)$   $s = 0 - \frac{1}{2} \times (-9.81) \times 0.87^2$   
**or**  $(s = \frac{1}{2}(u + v)t$  **or** area under graph)  $s = 0.5 \times 8.5 \times 0.87$  C1  
 $s = 3.7 \text{ (m)}$  A1
- (ii)  $\Delta E_p = mg\Delta h$  (allow  $E = mgh$ ) C1  
 $m = 22 / (9.81 \times 3.7)$   
 $= 0.61 \text{ (kg)}$  A1
- (d) acceleration (of freefall) is unchanged/ not dependent on mass, and so no effect (on maximum height)  
**or explanation in terms of energy:**  
(initial) KE  $\propto$  mass,  $(\Delta)\text{KE} = (\Delta)\text{PE}$ , (max) PE  $\propto$  mass, and so no effect (on maximum height) B1
- 3 (a) (i) (work = ) force  $\times$  distance moved in the direction of the force. B1
- (ii) the energy stored (in an object) due to extension/compression/change of shape B1
- (b) (i)  $E_k = \frac{1}{2}mv^2$  C1  
 $= 0.5 \times 0.40 \times 0.30^2$   
 $= 1.8 \times 10^{-2} \text{ (J)}$  A1

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- (ii) (change in) kinetic energy = work done on spring / (change in) elastic potential energy C1  
 $1.8 \times 10^{-2} = \frac{1}{2} \times F \times 0.080$  C1  
 $F_{\text{MAX}} = 0.45 \text{ (N)}$  A1
- (iii)  $a = F/m = 0.45/0.40$   
 $= 1.1 \text{ (ms}^{-2}\text{)}$  A1
- (iv) 1. constant velocity / resultant force is zero, so in equilibrium B1  
2. decelerating / resultant force is not zero, so not in equilibrium B1
- (c) curved line from the origin  
with decreasing gradient M1  
A1
- 4 (a) (i) Displacement of particles perpendicular to direction of energy propagation B1  
(ii) waves meet / overlap (at a point) B1  
(resultant) displacement is sum of the individual displacements B1
- (b) (i)  $\lambda = vT$  or  $\lambda = v/f$  and  $f = 1/T$  C1  
 $\lambda = 4.0 \times 1.5$   
 $\lambda = 6.0 \text{ (cm)}$  A1
- (ii) path difference  $[= (44 \text{ cm} - 29 \text{ cm})/6 \text{ cm}] = 2.5\lambda$  M1  
**either** waves have path difference  $= (n + \frac{1}{2})\lambda$   
**or** waves have phase difference  $= 180^\circ$  M1  
so destructive interference A1
- (c) (i) intensity  $\propto (\text{amplitude})^2$  C1  
ratio  $= (0.60^2/0.90^2) = 0.44$  A1
- (ii) phase difference  $= 90^\circ$  A1
- 5 (a) (i) movement / flow of charge carriers B1  
(ii)  $\frac{\text{work (done) or energy (transformed) (from electrical to other forms)}}{\text{charge}}$  B1
- (b) (i) p.d. across one lamp  $= 2.5 \text{ V}$  C1  
resistance  $= [(8.7 - 7.5)/0.3]/2 = 2.0 \text{ (}\Omega\text{)}$  A1
- (ii) straight line through the origin  
with gradient of 0.5 M1  
A1

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- (iii)  $P = I^2R$       or  $P = VI$  and  $V = IR$       or  $P = V^2 / R$  and  $V = IR$       C1  
 $= 0.30^2 \times 2.0$        $= 0.60 \times 0.30$        $= 0.60^2 / 2.0$   
 $= 0.18 \text{ (W)}$       A1
- (iv) 1  $R = \rho l / A$       C1  
 $l = (2.0 \times 0.40 \times 10^{-6}) / 1.7 \times 10^{-8}$   
 $= 47 \text{ (m)}$       A1
- 2  $I = Anvq$   
 $v = 0.30 / (0.40 \times 10^{-6} \times 8.5 \times 10^{28} \times 1.6 \times 10^{-19})$       C1  
 $= 5.5 \times 10^{-5} \text{ (m s}^{-1}\text{)}$       A1
- 6 (a)  ${}^1_1\text{p}$       B1  
 ${}^0_{-1}\beta^-$  and  ${}^0_0\bar{\nu}$       B1
- (b) an (electron) antineutrino      B1
- (c) lepton(s)      B1
- (d) (i) down, down, up/ddu      B1  
(ii) a down/d (quark) changes to an up/u (quark) or ddu  $\rightarrow$  uud      B1