

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) $v = [(1.8 \times 126 \times 10^{-2}) / 5.1 \times 10^{-3}]^{1/2}$ C1
 $= 21.1 \text{ (ms}^{-1}\text{)}$ A1
- (ii) percentage uncertainty = 4% **or** fractional uncertainty = 0.04 C1
 $\Delta v = 0.04 \times 21.1$
 $= 0.84$ 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 $(s = \frac{1}{2}(u + v)t \text{ or area under graph})$ $s = 0.5 \times 8.5 \times 0.87$ 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) $\frac{\text{work (done) or energy (transformed)}(\text{from electrical to other forms})}{\text{charge}}$ 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 M1
with gradient of 0.5 A1

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(iii) $P = I^2 R$ **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