

CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series**9702 PHYSICS****9702/22**

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

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- 1 (a) stress = Young modulus \times strain
- $$= 1.8 \times 10^{11} \times 8.2 \times 10^{-4} \text{ or } 1.476 \times 10^8 \quad \text{C1}$$
- $$= 0.15 \text{ (0.148) GPa} \quad \text{A1 [2]}$$
- (b) (i) wavelength = $3 \times 10^8 / 12 \times 10^{12}$ C1
 $= 25 \mu\text{m}$ A1 [2]
- (ii) infra-red / IR B1 [1]
- (c) (i) arrow drawn up to the left of 7.5 N force
approximately 5° to 40° to west of north A1 [1]
- (ii) 1. correct vector triangle or working to show
magnitude of resultant force = 6.6 N
allow 6.5 to 6.7 N if scale diagram M1 [1]
2. magnitude of acceleration = $6.6 / 0.75$
[scale diagram: (6.5 to 6.7) / 0.75] C1
- $$= 8.8 \text{ ms}^{-2} \text{ [scale diagram: } 8.7 - 8.9 \text{ ms}^{-2}] \quad \text{A1 [2]}$$
- (iii) 19° [use of scale diagram allow 17° to 21° (a diagram must be seen)] B1 [1]
- 2 (a) (i) straight line from $t = 0.60 \text{ s}$ to $t = 1.2 \text{ s}$ and $|V_v| = 5.9$ at $t = 1.2 \text{ s}$ M1
 $V_v = -5.9$ at $t = 1.2 \text{ s}$ i.e. line is for negative values of V_v A1 [2]
- (ii) $s = 0 + \frac{1}{2} \times 9.81 \times (0.6)^2$ or area of graph = $(5.9 \times 0.6) / 2$ C1
 $= 1.8 \text{ (1.77) m} \quad \quad \quad = 1.8 \text{ (1.77) m} \quad \text{A1 [2]}$
- (iii) $V_h = V \cos 60^\circ$ and $V_v = V \sin 60^\circ$ or $V_h = 5.9 / \tan 60^\circ$ or $V_h = 5.9 \tan 30^\circ$ C1
 $V_h = 3.4 \text{ ms}^{-1}$ A1 [2]
- (iv) horizontal line at 3.4 from $t = 0$ to $t = 1.2 \text{ s}$ [to half a small square] B1 [1]
- (b) (i) $\text{KE} = \frac{1}{2}mv^2$ C1
 $= \frac{1}{2} \times 0.65 \times (6.81)^2$ [allow if valid method to find v] C1
 $= 15 \text{ (15.1) J} \quad \text{A1 [3]}$
- (ii) $\text{PE} = 0.65 \times 9.81 \times 1.77$ C1
 $= 11 \text{ (11.3) J} \quad \text{A1 [2]}$

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- 3 (a) electric field strength is force per unit positive charge B1 [1]
- (b) mass = volume \times density (any subject, allow usual symbols or defined symbols) C1
- $$= \frac{4}{3} \times \pi \times (1.2 \times 10^{-6})^3 \times 930 (= 6.73 \times 10^{-15})$$
- weight = $\frac{4}{3} \times \pi \times (1.2 \times 10^{-6})^3 \times 930 \times 9.81 = 6.6 \times 10^{-14} \text{ N}$ M1 [2]
- (c) (i) $E = 1.9 \times 10^3 / 14 \times 10^{-3}$ C1
 $= 1.4 (1.36) \times 10^5 \text{ V m}^{-1}$ A1 [2]
- (ii) $F = QE$
- $$Q = 6.6 \times 10^{-14} / 1.36 \times 10^5$$
- $$= 4.9 (4.86) \times 10^{-19} \text{ C [allow } 4.7 \times 10^{-19} \text{ C if } 1.4 \times 10^5 \text{ used]}$$
- C1 A1 [2]
- (iii) electric force increases/is greater (than weight) B1
charge (on S) is negative to give resultant/net/sum/total force up B1 [2]
- 4 (a) (i) solid: (molecules) vibrate B1
no translational motion/fixed position, liquid: translational motion B1 [2]
- (ii) gas: molecules have random (and translational) motion B1 [1]
- (b) (i) ductile: straight line through origin then curving towards x-axis B1 [1]
- (ii) brittle: straight line through origin with no or negligible curved region B1 [1]
- (c) similarity: obey Hooke's law / $F \propto x$ or have elastic regions B1
- difference: brittle no or (very) little plastic region
ductile has (large(r)) plastic region B1 [2]
- 5 (a) (i) in series $2X$ or in parallel $X/2$ M1
other relationship given and $4\times$ greater in series (than in parallel) A1 [2]
- (ii) due to the internal resistance B1
- total resistance for series circuit is not four times greater than resistance for parallel circuit B1 [2]
- (iii) 1. $E = I_1(2X + r)$ or $12 = 1.2(2X + r)$ A1
2. $E = I_2(X/2 + r)$ or $12 = 3.0(X/2 + r)$ A1 [2]
- (iv) $2X + r = 10$ and $X/2 + r = 4$
 $X = 4.0 \Omega$ A1 [1]

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- (b) $P = I^2 R$ or V^2 / R or VI C1
- ratio = $[(1.2)^2 \times 4] / [(1.5)^2 \times 4]$
= 0.64 A1 [2]
- (c) the resistance (of a lamp) changes with V or I B1
- V or I is greater in parallel circuit or circuit 2
or V or I is less in series circuit or circuit 1 B1 [2]
- 6 (a) difference: vibration / oscillation (of particles) / displacement of particles is parallel to energy transfer / wavefronts in longitudinal and perpendicular for transverse B1
or
transverse can be polarised, longitudinal cannot be polarised
- similarity: both transfer / propagate energy B1 [2]
- (b) (i) waves from slits are coherent / constant phase relationship (B1)
waves overlap (at screen) with a phase difference or have a path difference (B1)
maxima where phase difference is integer $\times 360^\circ$ (or $\times 2\pi$ rad)
or path difference is integer $\times \lambda$
or equivalent explanation of minima e.g. $(n + \frac{1}{2}) \times 360^\circ$ (B1)
max. 2 [2]
- (ii) maxima spacing = $\lambda D / a$ C1
= $(6.3 \times 10^{-7} \times 2.5) / 0.35 \times 10^{-3}$
= $4.5 \times 10^{-3} \text{ m}$ A1 [2]
- (c) (ultra-violet has) shorter wavelength, hence smaller separation / distance A1 [1]
- 7 (a) (i) A: 206, nucleon(s) or neutron(s) and proton(s) }
B: 82, proton(s) } all correct A1 [1]
- (ii) kinetic / E_K / KE B1 [1]
- (b) energy = $5.3 \times 1.6 \times 10^{-13} \text{ (J)}$ [= $8.48 \times 10^{-13} \text{ (J)}$] C1
- power = $(7.1 \times 10^{18} \times 5.3 \times 1.6 \times 10^{-13}) / (3600 \times 24)$
= 70 (69.7) W A1 [2]