

## **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
- $$= 1.8 \times 10^{11} \times 8.2 \times 10^{-4} \text{ or } 1.476 \times 10^8$$
- C1
- $$= 0.15 \text{ (0.148) GPa}$$
- A1 [2]
- (b) (i) wavelength =  $3 \times 10^8 / 12 \times 10^{12}$
- $$= 25 \mu\text{m}$$
- C1  
A1 [2]
- (ii) infra-red/IR
- B1 [1]
- (c) (i) arrow drawn up to the left of 7.5 N force  
approximately  $5^\circ$  to  $40^\circ$  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:  $(6.5 \text{ to } 6.7) / 0.75$ ]
- C1
- $$= 8.8 \text{ m s}^{-2} \text{ [scale diagram: } 8.7 - 8.9 \text{ m s}^{-2}\text{]}$$
- A1 [2]
- (iii)  $19^\circ$  [use of scale diagram allow  $17^\circ$  to  $21^\circ$  (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  $t = 1.2 \text{ s}$   
 $V_v = -5.9$  at  $t = 1.2 \text{ s}$  i.e. line is for negative values of  $V_v$
- M1  
A1 [2]
- (ii)  $s = 0 + \frac{1}{2} \times 9.81 \times (0.6)^2$  or area of graph =  $(5.9 \times 0.6) / 2$
- $$= 1.8 \text{ (1.77) m} \qquad \qquad \qquad = 1.8 \text{ (1.77) m}$$
- C1  
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  $V_h = 5.9 \tan 30^\circ$
- $$V_h = 3.4 \text{ m s}^{-1}$$
- C1  
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) KE =  $\frac{1}{2}mv^2$
- C1
- $$= \frac{1}{2} \times 0.65 \times (6.81)^2 \text{ [allow if valid method to find } v\text{]}$$
- C1
- $$= 15 \text{ (15.1) J}$$
- A1 [3]
- (ii) PE =  $0.65 \times 9.81 \times 1.77$
- C1
- $$= 11 \text{ (11.3) J}$$
- 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)  $F = QE$   
 $Q = 6.6 \times 10^{-14} / 1.36 \times 10^5$  C1  
 $= 4.9 (4.86) \times 10^{-19} \text{ C}$  [allow  $4.7 \times 10^{-19} \text{ C}$  if  $1.4 \times 10^5$  used] 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)  $P = I^2R$  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.  $(n+1/2) \times 360^\circ$  (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 =  $5.3 \times 1.6 \times 10^{-13} \text{ (J)}$  [=  $8.48 \times 10^{-3} \text{ (J)}$ ] C1
- power =  $(7.1 \times 10^{18} \times 5.3 \times 1.6 \times 10^{-13}) / (3600 \times 24)$   
 $= 70 \text{ (69.7) W}$  A1 [2]