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

$= 1.8 \times 10^{11} \times 8.2 \times 10^{-4}$ *or* 1.476×10^8 C1

$= 0.15\ (0.148)$ GPa   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

$= 8.8\ \text{m s}^{-2}$ [scale diagram: $8.7 – 8.9\ \text{m s}^{-2}$]   A1   [2]

(iii) 19°   [<u>use of scale diagram</u> allow 17° to 21° (a diagram must be seen)]   B1   [1]

2 (a) (i) straight line from $t = 0.60$ s to $t = 1.2$ s and $|V_v| = 5.9$ at $t = 1.2$ s   M1
$V_v = -5.9$ at $t = 1.2$ 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

$= 1.8\ (1.77)$ m $= 1.8\ (1.77)$ m   A1   [2]

(iii) $V_h = V \cos 60°$ <u>and</u> $V_v = V \sin 60°$ *or* $V_h = 5.9 / \tan 60°$ *or* $V_h = 5.9 \tan 30°$ C1

$V_h = 3.4\ \text{m s}^{-1}$ A1   [2]

(iv) horizontal line at 3.4 from $t = 0$ to $t = 1.2$ s   [to half a small square]   B1   [1]

(b) (i) KE $= \frac{1}{2}mv^2$ C1

$= \frac{1}{2} \times 0.65 \times (6.81)^2$ [allow if valid method to find v]   C1

$= 15\ (15.1)$ J   A1   [3]

(ii) PE $= 0.65 \times 9.81 \times 1.77$ C1

$= 11(11.3)$ J   A1   [2]

3 (a) electric field strength is force per unit positive charge   B1   [1]

    (b) mass = volume × density (any subject, allow usual symbols or defined symbols)   C1

             $= 4/3 \times \pi \times (1.2 \times 10^{-6})^3 \times 930 \ (= 6.73 \times 10^{-15})$

      weight $= 4/3 \times \pi \times (1.2 \times 10^{-6})^3 \times 930 \times 9.81 = 6.6 \times 10^{-14}\,\text{N}$ M1   [2]

    (c) (i) $E = 1.9 \times 10^3 / 14 \times 10^{-3}$ C1
            $= 1.4 \ (1.36) \times 10^5\,\text{V}\,\text{m}^{-1}$ 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 1.4×10^5 used]   A1   [2]

      (iii) <u>electric</u> 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 2*X* <u>or</u> in parallel *X*/2   M1
           other relationship given <u>and</u> 4× 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 <u>slits</u> 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 $\times 360°$ (or $\times 2\pi$ rad)
or path difference is integer $\times \lambda$
or equivalent explanation of minima e.g. $(n+\frac{1}{2})\times 360°$ (B1)
max. 2   [2]

(ii) maxima spacing $= \lambda D / a$ C1
$= (6.3 \times 10^{-7} \times 2.5) / 0.35 \times 10^{-3}$
$= 4.5 \times 10^{-3}$ m   A1 [2]

(c) (ultra-violet has) shor<u>ter</u> wavelength, hence small<u>er</u> 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 $= 5.3 \times 1.6 \times 10^{-13}$ (J) $[= 8.48 \times 10^{-3}$ (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]