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

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2014 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

CAMBRIDGE
International Examinations

1 **(a)** stress = Young modulus × 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 μm 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 m s^{-2} [scale diagram: 8.7 – 8.9 m s^{-2}] 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 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) $s = 0 + ½ \times 9.81 \times (0.6)^2$ *or* area of graph = $(5.9 \times 0.6) / 2$ C1

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

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

V_h = 3.4 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 = $½mv^2$ C1

= $½ \times 0.65 \times (6.81)^2$ [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

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

weight = $4/3 \times \pi \times (1.2 \times 10^{-6})^3 \times 930 \times 9.81 = 6.6 \times 10^{-14}$ 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

$= 4.9\ (4.86) \times 10^{-19}$ C [allow 4.7×10^{-19} C if 1.4×10^5 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× 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]

(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 $\times 360°$ (or $\times 2\pi$ rad)
or path difference is integer $\times \lambda$
or equivalent explanation of minima e.g. $(n+½)\times 360°$ (B1)
max. 2 [2]

(ii) maxima spacing = λD / a C1
= $(6.3 \times 10^{-7} \times 2.5) / 0.35 \times 10^{-3}$
= 4.5×10^{-3} 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 = $5.3 \times 1.6 \times 10^{-13}$ (J) [= 8.48×10^{-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]