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 × 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 × 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 × 9.81 × 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 $\times$ 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$\times$ 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]

(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 = $\lambda D / a$ 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) short<u>er</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) [= 8.48×10^{-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]