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.

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Page 2		Mark Scheme Syllabus		Paper	
		Cambridge International AS/A Level – October/November 2014 9702	22)	
1 (a	a) str	ess = 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]	
(1	b) (i)	wavelength = $3 \times 10^8 / 12 \times 10^{12}$ = $25 \mu\text{m}$	C1 A1	[2]	
	(ii)	infra-red/IR	B1	[1]	
(0	c) (i)	arrow drawn up to the left of 7.5 N force approximately 5° to 40° to west of north	A1	[1]	
	(ii)	 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: $8.7 - 8.9 \text{ m s}^{-2}$]	A1	[2]	
	(iii)	19° [use of scale diagram allow 17° to 21° (a diagram must be seen)]	B1	[1]	
2 (a	a) (i)	straight line from $t = 0.60 \text{s}$ to $t = 1.2 \text{s}$ and $ V_v = 5.9 \text{at}$ $t = 1.2 \text{s}$ $V_v = -5.9 \text{at}$ $t = 1.2 \text{s}$ 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 = $(5.9 \times 0.6) / 2$	C1		
		= 1.8 (1.77) m = 1.8 (1.77) m	A1	[2]	
	(iii)	$V_h = V \cos 60^\circ \text{ and } V_v = V \sin 60^\circ \text{ or } V_h = 5.9 \text{ / } \tan 60^\circ \text{ or } V_h = 5.9 \text{ tan } 30^\circ \text{ or } V_h = 5.9 \text{ fan } 60^\circ \text{ or } V_h = 5.9$)° C1		
		$V_{\rm h} = 3.4 \rm m s^{-1}$	A1	[2]	
	(iv)	horizontal line at 3.4 from $t = 0$ to $t = 1.2$ s [to half a small square]	B1	[1]	

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

C1

C1

Α1

C1

Α1

[3]

[2]

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

= 15 (15.1) J

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

= 11(11.3) J

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

(c) (i)
$$E = 1.9 \times 10^3 / 14 \times 10^{-3}$$
 C1
= 1.4 (1.36) × 10⁵ 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 $4.7 \times 10^{-19} C$ 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
 - 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 $12 = 1.2(2X + r)$

2.
$$E = I_2(X/2 + r)$$
 or $12 = 3.0(X/2 + r)$

(iv)
$$2X + r = 10$$
 and $X/2 + r = 4$
 $X = 4.0 \Omega$ A1 [1]

Pa	age 4		Mark Scheme	Syllabus	Paper	
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	(b)	P =	I^2R or V^2/R or VI		C1	
		rati	$0 = [(1.2)^2 \times 4] / [(1.5)^2 \times 4]$ = 0.64		A1	[2]
	(c)	the	resistance (of a lamp) changes with \emph{V} or \emph{I}		B1	
			or I is greater in parallel circuit or circuit 2 V or I is less in series circuit or circuit 1		B1	[2]
6	(a)		erence: vibration/oscillation (of particles)/displacement of particles energy transfer/wavefronts in longitudinal and perpendicular for tran		B1	
		trai	nsverse can be polarised, longitudinal cannot be polarised			
		sim	nilarity: both transfer/propagate energy		B1	[2]
	(b)	(i)	waves from <u>slits</u> are coherent/constant phase relationship waves overlap (at screen) with a phase difference or have a path of maxima where phase difference is integer $\times 360^\circ$ (or $\times 2\pi$ rad) or path difference is integer $\times \lambda$	lifference	(B1) (B1)	
			or equivalent explanation of minima e.g. (n+½)×360° max. 2		(B1)	[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)	(ult	ra-violet has) short <u>er</u> wavelength, hence small <u>er</u> separation/distanc	e	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)	ene	ergy = $5.3 \times 1.6 \times 10^{-13}$ (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]