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Cambridge International Advanced Subsidiary and Advanced Level

PHYSICS 9702/23

Paper 2 AS Level Structured Questions

October/November 2016

MARK SCHEME
Maximum Mark: 60

Published

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		Cambridge International AS/A Level – October/November 2016 9	702	23	
1	(a) (d	ensity =) mass/volume		B1	[1]
	(b) (i)	$d = [(6 \times 7.5)/(\pi \times 8100)]^{1/3}$			
		= 0.12(1) m		A1	[1]
	(ii)				
		or fractional uncertainty = $(0.04 + 0.05)/3$ (= 0.03)		C1	
		absolute uncertainty (= 0.03×0.121) = 0.0036		C1	
		$d = 0.121 \pm 0.004 \mathrm{m}$		A1	[3]
2	(a) fo	rce per unit positive charge		B1	[1]
	(b) (i)	time = $5.9 \times 10^{-2} / 3.7 \times 10^{7}$ = 1.6×10^{-9} s $(1.59 \times 10^{-9}$ s)		A1	[1]
	(ii)	E = V/d		C1	
		$= 2500 / 4.0 \times 10^{-2}$			
		= $6.3 \times 10^4 \text{N C}^{-1} (6.25 \times 10^4 \text{or} 62500 \text{N C}^{-1})$		A1	[2]
	(iii)	a = Eq/m or F = ma <u>and</u> F = Eq		C1	
		= $(6.3 \times 10^4 \times 1.60 \times 10^{-19})/9.11 \times 10^{-31} = 1.1 \times 10^{16} \mathrm{ms^{-2}}$		A1	[2]
	(iv	$s = ut + \frac{1}{2}at^2$			
		$= \frac{1}{2} \times 1.1 \times 10^{16} \times (1.6 \times 10^{-9})^{2}$		C1	
		$= 1.4 \times 10^{-2} \text{ (m)}$		C1	
		distance from plate = $2.0 - 1.4$ = 0.6 cm (allow 1 or more s.f.)		A1	[3]
	(v)	, , ,			
		 or acceleration due to electric field » acceleration due to gravitational field 	I	B1	[1]
	(vi)	v_X – t graph: horizontal line at a non-zero value of v_X		B1	
		v_Y — t graph: straight line through the origin with positive gradient		B1	[2]

Mark Scheme

Syllabus

Paper

Page 2

Cambridge International AS/A Level – October/November 2016 9702 23 3 (a) force/load is proportional to extension/compression (provided proportionality limit is not exceeded) B1 [1] (b) (i) $k = F/x$ or $k =$ gradient $k = 600 \text{Nm}^{-1}$ (ii) $(W =) \% kx^2$ or $(W =) \% x^2$ or $(W =) \% x^2$ or $(W =) \% x^2$ or $(W =) 30.5 \times 24 \times 0.040 = 0.48 \text{J}$ A1 [2] C1 (iii) $(M =) \% xx^2$ or $(M =) \% x^2$ or $(W =) 30.5 \times 24 \times 0.040 = 0.48 \text{J}$ A1 [2] A1 [2] (iii) $(M =) \% xx^2$ or $(M =) \% x^2$ or $(M =) 0.5 \times 24 \times 0.040 = 0.48 \text{J}$ A1 [2] A1 [2] 2. (work done against resistive force = $0.48 - 0.45 = 0.03(0) \text{J}$ C1 average resistive force = $0.030/0.040$ C1 C1 = $0.45/0.48 \text{J} \times 1000$ C1 = $0.45/0.4$	P	age 3	Mark Scheme	Syllabus	Раре	
is not exceeded) (b) (i) $k = F/x$ or $k = \text{gradient}$ $k = 600 \text{Nm}^{-1}$ (ii) $(W =) \frac{1}{2} \frac{1}{2} \frac{1}{2} x$ or $(W =) \frac{1}{2} \frac{1}{2} x$ or $(W =) \text{ area under graph}$ (1ii) $(W =) \frac{1}{2} \frac{1}{2} x^2$ or $(W =) \frac{1}{2} \frac{1}{2} x$ or $(W =) 0.5 \times 24 \times 0.040 = 0.48 \text{J}$ A1 [2] (iii) 1. $(E_K =) \frac{1}{2} \frac{1}{2} x$ A1 [2] 2. $(\text{work done against resistive force} =) 0.48 - 0.45 [= 0.03(0) \text{J}]$ C1 $= 0.45 \text{J}$ A1 [3] 2. $(\text{work done against resistive force} =) 0.48 - 0.45 [= 0.03(0) \text{J}]$ C1 $= 0.75 \text{N}$ A1 [3] (iv) efficiency = [useful energy out/total energy in] (×100) C1 $= [0.45/0.48] (\times 100)$ $= 0.94 \text{ or } 94\%$ A1 [2] 4. (a) the number of oscillations per unit time of the source/of a point on the wavel/of a particle (in the medium) A1 [2] or the number of wavelengths/wavefronts per unit time of the source/of a point on the wavel/of a particle (in the medium) A1 [2] or the number of wavelengths/wavefronts per unit time (M1) (A1) (b) T or period = $2.5 \times 250 (\mu \text{s}) (= 625 \mu \text{s})$ M1 frequency = $1/(6.25 \times 10^{-4}) \text{or } 1/(2.5 \times 250 \times 10^{-6}) = 1600 \text{Hz}$ A1 [2] (c) (i) for maximum frequency: $f_0 = f_0 \text{y}/(v - v_0)$ $1640 = (1600 \times 330) / (330 - v_0)$ C1 $v_0 = 8(.0) \text{ms}^{-1} (8.049 \text{ms}^{-1})$ A1 [2] (ii) loudspeaker moving towards observer causes rise in/higher frequency or repeated rise and fall/higher and then lower frequency (M1)			Cambridge International AS/A Level – October/November 2016	9702	23	
$k = 600 \mathrm{Nm}^{-1}$ A1 [2] (ii) $(W =) \frac{1}{2}kx^2$ or $(W =) \frac{1}{2}Fx$ or $(W =)$ area under graph C1 $(W =) 0.5 \times 600 \times (0.040)^2 = 0.48 \mathrm{J}$ or $(W =) 0.5 \times 24 \times 0.040 = 0.48 \mathrm{J}$ A1 [2] (iii) 1. $(E_K =) \frac{1}{2}mv^2$ C1 $= \frac{1}{2} \times 0.025 \times 6.0^2$ $= 0.45 \mathrm{J}$ A1 [2] 2. (work done against resistive force =) 0.48 - 0.45 [= 0.03(0) J] C1 average resistive force = 0.030/0.040 C1 $= 0.75 \mathrm{N}$ A1 [3] (iv) efficiency = [useful energy out/total energy in] (×100) C1 $= [0.45/0.48] (\times 100)$ $= 0.94 \text{ or } 94\%$ A1 [2] 4 (a) the number of oscillations per unit time of the source/of a point on the wave/of a particle (in the medium) A1 [2] or the number of wavelengths/wavefronts per unit time passing a (fixed) point (M1) (A1) (b) T or period = $2.5 \times 250 (\mu \mathrm{s}) (= 625 \mu \mathrm{s})$ M1 frequency = $1/(6.25 \times 10^{-4}) \text{ or } 1/(2.5 \times 250 \times 10^{-6}) = 1600 \mathrm{Hz}$ A1 [2] (c) (i) for maximum frequency: $f_0 = f_8 V / (V - V_8)$ 1640 = $(1600 \times 330) / (330 - V_8)$ C1 $V_8 = 8(.0) \mathrm{ms}^{-1} (8.049 \mathrm{ms}^{-1})$ A1 [2] (ii) loudspeaker moving towards observer causes rise in/higher frequency loudspeaker moving away from observer causes fall in/lower frequency or repeated rise and fall/higher and then lower frequency (M1)	3			nality limit	B1	[1]
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(iii) 1. $(E_K =) \frac{1}{2}mv^2$ C1 = $\frac{1}{2} \times 0.025 \times 6.0^2$ = 0.45 J A1 [2] 2. (work done against resistive force =) 0.48 – 0.45 [= 0.03(0) J] C1 average resistive force = 0.030 / 0.040 C1 = 0.75 N A1 [3] (iv) efficiency = [useful energy out/total energy in] (×100) C1 = [0.45 / 0.48] (×100) = 0.94 or 94% A1 [2] 4 (a) the number of oscillations per unit time of the source/of a point on the wave/of a particle (in the medium) A1 [2] or the number of wavelengths/wavefronts per unit time passing a (fixed) point (M1) (b) T or period = $2.5 \times 250 \text{ (µs)}$ (= 625 µs) M1 frequency = $1/(6.25 \times 10^{-4})$ or $1/(2.5 \times 250 \times 10^{-6})$ = 1600 Hz A1 [2] (c) (i) for maximum frequency: $f_0 = f_5 v/(v - v_6)$ $v_5 = 8(.0) \text{ ms}^{-1}$ (8.049 ms $^{-1}$) A1 [2] (ii) loudspeaker moving towards observer causes rise in/higher frequency loudspeaker moving away from observer causes fall in/lower frequency or repeated rise and fall/higher and then lower frequency (M1)		(ii)	$(W=) \frac{1}{2}kx^2$ or $(W=) \frac{1}{2}Fx$ or $(W=)$ area under graph		C1	
$= \frac{1}{2} \times 0.025 \times 6.0^2$ $= 0.45 \text{ J} \qquad \text{A1} \qquad [2]$ 2. (work done against resistive force =) $0.48 - 0.45 = 0.03(0) \text{ J}$ C1 $= 0.75 \text{ N} \qquad \text{A1} \qquad [3]$ (iv) efficiency = [useful energy out/total energy in] (×100) C1 $= [0.45/0.48] \text{ (×100)}$ $= 0.94 \text{or} 94\% \qquad \text{A1} [2]$ 4 (a) the number of oscillations per unit time of the source/of a point on the wave/of a particle (in the medium) or the number of wavelengths/wavefronts per unit time passing a (fixed) point (A1) (b) T or period = $2.5 \times 250 \text{ (µs)} = 625 \text{ µs}$ M1 $\text{frequency} = \frac{1}{6.25 \times 10^{-4}} \text{ or } \frac{1}{2.5 \times 250 \times 10^{-6}} = 1600 \text{ Hz} \qquad \text{A1} [2]$ (c) (i) for maximum frequency: $f_0 = f_8 v/(v - v_8)$ $1640 = (1600 \times 330) / (330 - v_8) \qquad \text{C1}$ $v_s = 8.0 \text{ ms}^{-1} (8.049 \text{ ms}^{-1}) \qquad \text{A1} [2]$ (ii) loudspeaker moving towards observer causes rise in/higher frequency loudspeaker moving away from observer causes fall in/lower frequency or repeated rise and fall/higher and then lower frequency (M1)			$(W =) 0.5 \times 600 \times (0.040)^2 = 0.48 \text{J}$ or $(W =) 0.5 \times 24 \times 0.040 = 0.040$.48 J	A1	[2]
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(c) (i) for maximum frequency: $f_0 = f_s v / (v - v_s)$ $1640 = (1600 \times 330) / (330 - v_s)$ $V_s = 8(.0) \text{m s}^{-1} (8.049 \text{m s}^{-1})$ (ii) loudspeaker moving towards observer causes rise in/higher frequency loudspeaker moving away from observer causes fall in/lower frequency or repeated rise and fall/higher and then lower frequency (M1)		(b) T	or period = $2.5 \times 250 \; (\mu s) \; (= 625 \; \mu s)$		M1	
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$v_{\rm s} = 8(.0){\rm ms^{-1}}~(8.049{\rm ms^{-1}})$ A1 [2] (ii) loudspeaker moving towards observer causes rise in/high <u>er</u> frequency loudspeaker moving away from observer causes fall in/low <u>er</u> frequency or repeated rise and fall/higher and then lower frequency (M1)		(c) (i)	for maximum frequency: $f_0 = f_s v / (v - v_s)$			
(ii) loudspeaker moving towards observer causes rise in/high <u>er</u> frequency B1 loudspeaker moving away from observer causes fall in/low <u>er</u> frequency B1 [2] or repeated rise and fall/higher and then lower frequency (M1)			$1640 = (1600 \times 330) / (330 - v_s)$		C1	
loudspeaker moving away from observer causes fall in/lower frequency B1 [2] or repeated rise and fall/higher and then lower frequency (M1)			$v_s = 8(.0) \mathrm{m}\mathrm{s}^{-1} (8.049 \mathrm{m}\mathrm{s}^{-1})$		A1	[2]
repeated rise and fall/higher and then lower frequency (M1)		(ii)	loudspeaker moving away from observer causes fall in/lower freque			[2]
			repeated rise and fall/higher and then lower frequency		` '	

Mark Scheme

Syllabus

Paper

Page 3

		Cambridge international / to// Love. Cotober to tomber 2010		
5	(a)	wave incident on/passes by or through an aperture/edge wave spreads (into geometrical shadow)	B1 B1	[2]
	(b)	$n\lambda = d\sin\theta$	C1	
		substitution of $\theta = 90^{\circ}$ or $\sin \theta = 1$	C1	
		$4 \times 500 \times 10^{-9} = d \times \sin 90^{\circ}$		
		line spacing = 2.0×10^{-6} m	A1	[3]
	(c)	wavelength of red light is longer (than 500 nm)	M1	
		(each order/fourth order is now at a greater angle so) the fifth-order maximum cannot be formed/not formed	A1	[2]
6	(a)	work done or energy (transformed) (from electrical to other forms) charge	B1	[1]
	(b)	(i) 1. $V = IR$ or $E = IR$	C1	
		I = 14/6.0 = 2.3 (2.33) A	A1	[2]
		2. total resistance of parallel resistors = 8.0Ω	C1	
		current = $14/(6.0 + 8.0)$ = $1.0 A$	A1	[2]
		(ii) $P = EI$ (allow $P = VI$) or $P = V^2/R$ or $P = I^2R$	C1	
		change in power = $(14 \times 2.33) - (14 \times 1.0)$ or $(14^2 / 6.0) - (14^2 / 14)$ or $(2.33^2 \times 6.0) - (1.0^2 \times 14)$		
		= 19W (18W if 2.3 A used)	A1	[2]
	(c)	I = Anvq		
		ratio = $(0.50n/n) \times (1.8A/A)$ or ratio = 0.50×1.8	C1	
		= 0.90	A1	[2]

Mark Scheme
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		(Cambridge International AS/A Level – October/November 2016 9702	23	
7	(a)	or had or	nadron made of quarks/lepton not made of quarks		
		stro			[1]
	(b)	(i)	proton: up, up, down/uud neutron: up, down, down/udd	B1 B1	[2]
		(ii)	composition: 2(uud) + 2(udd) = 6 up, 6 down/6u, 6d	B1	[1]
	(c)	(i)	most of the atom is empty space		
	` ,	• • •	or	D4	[4]
			the nucleus (volume) is (very) small <u>compared to the atom</u>	B1	[1]
		(ii)	nucleus is (positively) charged	B1	
			the mass is concentrated in (very small) nucleus/small region/small volume/small core or		
			the majority of mass in (very small) nucleus/small region/small volume/small core	B1	[2]

Mark Scheme

Syllabus

Paper

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