



Cambridge International AS & A Level

PHYSICS**9702/21**

Paper 2 AS Level Structured Questions

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This document consists of **12** printed pages.

Question	Answer	Marks
1(a)(i)	force $\times$ <u>perpendicular</u> distance (of line of action of force to the point)	B1
1(a)(ii)	units: $\text{kg m s}^{-2} \text{ m}$ $= \text{kg m}^2 \text{ s}^{-2}$	A1
1(b)	$W = \rho Vg$ or $W = \rho ALg$	C1
	$A = 5.2 / (790 \times 2.4 \times 9.81)$ $(= 2.8 \times 10^{-4} \text{ (m}^2\text{)})$	C1
	$= 2.8 \times 10^2 \text{ mm}^2$	A1
1(c)(i)	(component $=$) $5.2 \sin 56^\circ = 4.3 \text{ (N)}$ or $5.2 \cos 34^\circ = 4.3 \text{ (N)}$	A1
1(c)(ii)	$(T \times 2.4)$ or (4.3×1.2) or (4.6×1.8)	C1
	$(T \times 2.4) + (4.3 \times 1.2) = (4.6 \times 1.8)$	C1
	$T = 1.3 \text{ N}$	A1

Question	Answer	Marks
2(a)	constant gradient	B1
2(b)	(displacement until 0.20 s =) $\frac{1}{2} \times 1.96 \times 0.20$ (= 0.196 m) or (displacement after 0.20 s =) $\frac{1}{2} \times 6.86 \times 0.70$ (= 2.401 m)	C1
	height = 2.401 – 0.196	C1
	= 2.2 m	A1
	<i>(alternative methods are possible using equations of uniformly accelerated motion)</i>	
2(c)	$(\Delta)E = mg(\Delta)h$ or $W(\Delta)h$	C1
	$(\Delta)E = 0.86 \times 2.2$ = 1.9 J	A1
2(d)	curved line from the origin	M1
	gradient of curved line decreases and is zero at $t = 0.20$ s only	A1
2(e)	acceleration (of free fall) is unchanged/is not dependent on mass <u>and</u> (so) no effect	B1

Question	Answer	Marks
3(a)	(force =) rate of change of momentum	B1
3(b)(i)	$E = \frac{1}{2}mv^2$ or $\frac{1}{2} \times 0.062 \times 3.8^2$ or $\frac{1}{2} \times 0.062 \times 1.7^2$	C1
	loss of KE = $\frac{1}{2} \times 0.062 \times (3.8^2 - 1.7^2)$ = 0.36 J	A1
3(b)(ii)	$p = mv$ or 0.062×3.8 or 0.062×1.7	C1
	change in momentum = $0.062 \times (1.7 + 3.8)$ = 0.34 N s	A1
3(b)(iii)	(average resultant force =) $0.34 / 0.081 = 4.2$ (N) or (average resultant force =) $0.062 \times (1.7 + 3.8) / 0.081 = 4.2$ (N)	A1
3(b)(iv)	1. average force = $4.2 + (0.062 \times 9.81)$ = 4.8 N	A1
	2. average force = 4.8 N	A1

Question	Answer	Marks
4(a)(i)	(stress =) force / cross-sectional area	B1
4(a)(ii)	(strain =) extension / original length	B1
4(b)(i)	$E = FL / Ax$	C1
	$= GL / A$	A1
4(b)(ii)	straight line from origin above the original line	M1
	line ends at point (4 small squares, F_1).	A1
4(b)(iii)	1. shaded area below the graph line and between the two vertical dashed lines	B1
	2. remove the force/ F/F_2 and the wire goes back to original length/zero extension	B1
4(b)(iv)	values have a large range	B1

Question	Answer	Marks
5(a)	$v = \lambda / T$ or $v = f\lambda$ and $f = 1 / T$	C1
	$v = 8.0 \times 10^{-2} / 0.40$ $= 0.20 \text{ m s}^{-1}$	A1
5(b)	$I \propto A^2$	C1
	ratio $= 2^2 / 4^2$	C1
	$= 0.25$	A1

Question	Answer	Marks
6(a)	the waves (of the same type) move in opposite directions and overlap	B1
	the waves have the same (speed and) frequency/wavelength	B1
6(b)(i)	zero amplitude	B1
6(b)(ii)	distance = 6.0×4 = 24 cm	A1
6(b)(iii)	180°	A1

Question	Answer	Marks
7(a)	volt / ampere	B1
7(b)	$R = \rho L / A$	C1
	$A = 460 \times 10^{-9} \times 2.5 / 3.2$	C1
	= $3.6 \times 10^{-7} \text{ m}^2$	A1
7(c)(i)	energy is dissipated in the internal resistance/ r	B1
7(c)(ii)	$E = IR + Ir$ or $E = I(R + r)$	B1
7(c)(iii)	$P = I^2 R$ or $P = I^2 r$	C1
	$I = E / 2r$	A1
	(so) $P = E^2 / 4r$	

Question	Answer	Marks
8(a)	similarity: same/equal mass or same/equal (magnitude of) charge or both fundamental (particles) difference: opposite (sign of) charge or one is matter and the other is antimatter	B1
8(b)(i)	number of protons = 13 and number of neutrons = 12	A1
8(b)(ii)	(charge =) $13 \times 1.60 \times 10^{-19} \text{ (C)} = 2.1 \times 10^{-18} \text{ (C)}$	A1
8(c)	force = $11 \times 10^3 \times 2.1 \times 10^{-18}$	C1
	work done = $11 \times 10^3 \times 2.1 \times 10^{-18} \times 0.04$	C1
	= $9.2 \times 10^{-16} \text{ J}$	A1