

---

**PHYSICS**

**9702/22**

Paper 2 AS Level Structured Questions

**October/November 2017**

MARK SCHEME

Maximum Mark: 60

---

**Published**

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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2017 series for most Cambridge IGCSE<sup>®</sup>, Cambridge International A and AS Level components and some Cambridge O Level components.

Question	Answer	Marks
1(a)(i)	micrometer (screw gauge)/digital calipers	<b>B1</b>
1(a)(ii)	take several readings (and average)	<b>M1</b>
	along the wire <b>or</b> around the circumference	<b>A1</b>
1(b)(i)	$\sigma = 4 \times 25 / [\pi \times (0.40 \times 10^{-3})^2] = 1.99 \times 10^8 \text{ Nm}^{-2}$ <b>or</b> $\sigma = 25 / [\pi \times (0.20 \times 10^{-3})^2] = 1.99 \times 10^8 \text{ Nm}^{-2}$	<b>A1</b>
1(b)(ii)	$\%F = 2\%$ <b>and</b> $\%d = 5\%$  <b>or</b> $\Delta F / F = \frac{0.5}{25}$ <b>and</b> $\Delta d / d = \frac{0.02}{0.4}$	<b>C1</b>
	$\%\sigma = 2\% + (2 \times 5\%)$ <b>or</b> $\%\sigma = [0.02 + (2 \times 0.05)] \times 100$  $\%\sigma = 12\%$	<b>A1</b>
1(b)(iii)	absolute uncertainty = $(12/100) \times 1.99 \times 10^8$  = $2.4 \times 10^7$	<b>C1</b>
	$\sigma = 2.0 \times 10^8 \pm 0.2 \times 10^8 \text{ Nm}^{-2}$ <b>or</b> $2.0 \pm 0.2 \times 10^8 \text{ Nm}^{-2}$	<b>A1</b>

Question	Answer	Marks
2(a)	force $\times$ <u>perpendicular</u> distance (of line of action of force) to/from a point	<b>B1</b>
2(b)(i)	$2.4r$ <b>or</b> $(1.2 \times 2r)$ <b>or</b> $(1.2r + 1.2r)$	<b>A1</b>
2(b)(ii)	(anticlockwise moment $=$ ) $6.0 \times r/2 \times \sin \theta$	<b>C1</b>
	$6.0 \times r/2 \times \sin \theta = 2.4r$ $\theta = 53^\circ$	<b>A1</b>
2(b)(iii)	6.0 N	<b>A1</b>

Question	Answer	Marks
3(a)	$p = 1000 \times 9.81 \times 7.0 \times 10^{-2}$ <b>or</b> $1000 \times 9.81 \times 1.9 \times 10^{-2}$	<b>C1</b>
	$\Delta p = 1000 \times 9.81 \times (7.0 \times 10^{-2} - 1.9 \times 10^{-2})$ <b>or</b> $686 - 186$ $= 500 \text{ Pa}$	<b>A1</b>
3(b)	$F = pA$ <b>or</b> $(\Delta)F = \Delta p \times A$	<b>C1</b>
	upthrust $= 500 \times (5.1 \times 10^{-2})^2 = 1.3 \text{ N}$ <b>or</b> upthrust $= (686 - 186) \times (5.1 \times 10^{-2})^2 = 1.3 \text{ N}$ <b>or</b> upthrust $= 1000 \times 9.81 \times 5.1 \times 10^{-2} \times (5.1 \times 10^{-2})^2 = 1.3 \text{ N}$	<b>A1</b>
3(c)	force $= 4.0 - 1.3$ $= 2.7 \text{ N}$	<b>A1</b>

Question	Answer	Marks
3(d)	extension/ $x/e$ = $2.7/30$	<b>C1</b>
	= 0.09 (m) <b>or</b> 9 (cm)	<b>C1</b>
	height above surface = $9 - 7$ = 2 cm	<b>A1</b>
3(e)(i)	mass = $4.0/9.81$	<b>C1</b>
	acceleration = $2.7/(4.0/9.81)$ = $6.6 \text{ m s}^{-2}$	<b>A1</b>
3(e)(ii)	viscous force <u>increases</u> (and then becomes constant)	<b>M1</b>
	(weight and upthrust constant so) acceleration decreases (to zero)	<b>A1</b>

Question	Answer	Marks
4(a)	(two) waves travelling (at same speed) in opposite directions overlap	<b>B1</b>
	waves (are same type and) have same frequency/wavelength	<b>B1</b>
4(b)(i)	5	<b>A1</b>
4(b)(ii)	$T = 1/40 (= 2.5 \times 10^{-2})$	<b>C1</b>
	time taken = $2.5 \times 10^{-2}/2$ $= 1.3 \times 10^{-2} \text{ s } (1.25 \times 10^{-2} \text{ s})$	<b>A1</b>
4(b)(iii)	$180^\circ$	<b>A1</b>
4(b)(iv)	$v = f\lambda$	<b>C1</b>
	$\lambda = 2.0/2.5 (= 0.80 \text{ m})$ $v = 0.80 \times 40$ $= 32 \text{ m s}^{-1}$	<b>A1</b>

Question	Answer	Marks
5(a)	(coulomb is) ampere second	<b>B1</b>
5(b)(i)	$E = V/d$ <b>or</b> $E = F/Q$	<b>C1</b>
	$F = VQ/d$	<b>A1</b>
	$F = (2.0 \times 10^2 \times 8.0 \times 10^{-19})/4.0 \times 10^{-2} = 4.0 \times 10^{-15} \text{ N}$	
5(b)(ii)	arrow pointing to the left labelled 'electric force' <b>and</b> arrow pointing downwards labelled 'weight'	<b>B1</b>
5(b)(iii)	1. resultant force = $\sqrt{[(3.9 \times 10^{-15})^2 + (4.0 \times 10^{-15})^2]}$	<b>C1</b>
	$= 5.6 \times 10^{-15} \text{ N}$	<b>A1</b>
	2. angle = $\tan^{-1} (3.9 \times 10^{-15}/4.0 \times 10^{-15})$ $= 44^\circ$	<b>A1</b>
5(c)	downward sloping line from (0, 2.0)	<b>M1</b>
	magnitude of gradient of line increases with time and line ends at (T, 0)	<b>A1</b>

Question	Answer	Marks
6(a)	flow of charge carriers	<b>B1</b>
6(b)(i)	$nALe$	<b>B1</b>
6(b)(ii)	( $t$ is time taken for electrons to move length $L$ ) $I = Q/t$	<b>B1</b>
	$I = nALe/t$ <b>or</b> $I = nALe/(L/v)$ <b>or</b> $I = nAvte/t$ <b>and</b> $I = nAve$	<b>B1</b>
6(c)(i)	ratio = area at X/area at Y $= [\pi d^2/4]/[\pi(0.69d)^2/4]$ <b>or</b> $d^2/(0.69d)^2$ <b>or</b> $1/0.69^2$	<b>C1</b>
	$= 2.1$	<b>A1</b>
6(c)(ii)	<b>1.</b> $R = \rho L/A$ <b>or</b> $R/L \propto 1/A$	<b>C1</b>
	resistance per unit length = $1.7 \times 10^{-2} \times (\text{area at X/area at Y})$ $= 1.7 \times 10^{-2} \times 2.1$ $= 3.6 \times 10^{-2} \Omega \text{ m}^{-1}$	<b>A1</b>
	<b>2.</b> $P = I^2R$ <b>or</b> $P = V^2/R$	<b>C1</b>
	$R = 3.6 \times 10^{-2} \times 3.0 \times 10^{-3} (= 1.08 \times 10^{-4} \Omega)$ $P = 0.50^2 \times 1.08 \times 10^{-4}$ <b>or</b> $P = (5.4 \times 10^{-5})^2/1.08 \times 10^{-4}$ $= 2.7 \times 10^{-5} \text{ W}$	<b>A1</b>

Question	Answer	Marks
6(c)(iii)	(cross-sectional area decreases so) resistance increases	<b>M1</b>
	$(P = I^2R, \text{ so) power increases}$	<b>A1</b>

Question	Answer	Marks
7(a)	lepton(s)	<b>B1</b>
7(b)	protons: 7 <b>and</b> neutrons: 6	<b>A1</b>
7(c)	$E = \frac{1}{2}mv^2$	<b>C1</b>
	$= 0.80 \times 10^6 \times 1.60 \times 10^{-19}$	<b>C1</b>
	$= 1.28 \times 10^{-13} \text{ (J)}$	<b>A1</b>
	$v^2 = 2 \times 1.28 \times 10^{-13} / 2.2 \times 10^{-26}$ $v = 3.4 \times 10^6 \text{ m s}^{-1}$	
7(d)	an (electron) neutrino/ $\nu_{(e)}$ is also produced (and this has energy)	<b>B1</b>