

**MARK SCHEME for the May/June 2012 question paper
for the guidance of teachers**

9702 PHYSICS

9702/21

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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- 1 (a) (i) V units: m^3 (allow metres cubed or cubic metres) A1 [1]
- (ii) Pressure units: $\text{kgms}^{-2} / \text{m}^2$ (allow use of $P = \rho gh$) M1
Units: $\text{kg m}^{-1} \text{s}^{-2}$ A0 [1]
- (b) V / t units: $\text{m}^3 \text{s}^{-1}$ B1
Clear substitution of units for P , r^4 and l M1
- $$C = \frac{\pi P r^4}{8 V t^{-1} l} = \frac{\text{kgm}^{-1} \text{s}^{-2} \text{m}^4}{\text{m}^3 \text{s}^{-1} \text{m}}$$
- Units: $\text{kg m}^{-1} \text{s}^{-1}$ A1 [3]
(8 or π in final answer –1. Use of dimensions max 2/3)
- 2 (a) (i) $v = u + at$ C1
 $= 4.23 + 9.81 \times 1.51$ M1
 $= 19.0(4) \text{ ms}^{-1}$ (Allow 2 s.f.) A0 [2]
(Use of $-g$ max 1/2. Use of $g = 10$ max 1/2. Allow use of 9.8. Allow 19 m s^{-1})
- (ii) either $s = ut + \frac{1}{2} at^2$ (or $v^2 = u^2 + 2as$ etc.) C1
 $= 4.23 \times 1.51 + 0.5 \times 9.81 \times (1.51)^2$ A1 [2]
 $= 17.6 \text{ m}$ (or 17.5 m)
(Use of $-g$ here wrong physics (0/2))
- (b) (i) $F = \Delta P / \Delta t$ need idea of change in momentum C1
 $= [0.0465 \times (18.6 + 19)] / 12.5 \times 10^{-3}$ C1
 $= 140 \text{ N}$ A1
(Use of $-$ sign max 2/4. Ignore $-ve$ sign in answer)
Direction: upwards B1 [4]
- (ii) $h = \frac{1}{2} \times (18.6)^2 / 9.81$ C1
 $= 17.6 \text{ m}$ (2 s.f. –1) A1 [2]
(Use of 19 m s^{-1} , 0/2 wrong physics)
- (c) either kinetic energy of the ball is not conserved on impact
or speed before impact is not equal to speed after hence inelastic B1 [1]
- 3 (a) Resultant force (and resultant torque) is zero B1
Weight (down) = force from/due to spring (up) B1 [2]
- (b) (i) 0.2, 0.6, 1.0 s (one of these) A1 [1]
- (ii) 0, 0.8 s (one of these) A1 [1]
- (iii) 0.2, 0.6, 1.0 s (one of these) A1 [1]

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(c) (i)	Hooke's law: extension is proportional to the force (<i>not mass</i>) Linear/straight line graph hence obeys Hooke's law	B1 B1	[2]
(ii)	Use of the gradient (<i>not just</i> $F = kx$) $K = (0.4 \times 9.8) / 15 \times 10^{-2}$ $= 26(.1) \text{ Nm}^{-1}$	C1 M1 A0	[2]
(iii)	<i>either</i> energy = area to left of line <i>or</i> energy = $\frac{1}{2} ke^2$ $= \frac{1}{2} \times [(0.4 \times 9.8) / 15 \times 10^{-2}] \times (15 \times 10^{-2})^2$ $= 0.294 \text{ J}$ (<i>allow 2 s.f.</i>)	C1 C1 A1	[3]
4 (a) (i)	$R = V^2 / P$ <i>or</i> $P = IV$ and $V = IR$ $= (220)^2 / 2500$ $= 19.4 \Omega$ (<i>allow 2 s.f.</i>)	C1 A1	[2]
(ii)	$R = \rho l / A$ $l = [19.4 \times 2.0 \times 10^{-7}] / 1.1 \times 10^{-6}$ $= 3.53 \text{ m}$ (<i>allow 2 s.f.</i>)	C1 C1 A1	[3]
(b) (i)	$P = 625, 620$ or 630 W	A1	[1]
(ii)	R needs to be reduced <i>Either</i> length $\frac{1}{4}$ of original length <i>or</i> area $4\times$ greater <i>or</i> diameter $2\times$ greater	C1 A1	[2]
5 (a) (i)	sum of e.m.f.'s = sum of p.d.'s around a loop/circuit	B1	[1]
(ii)	energy	B1	[1]
(b) (i)	$2.0 = I \times (4.0 + 2.5 + 0.5)$ $I = 0.286 \text{ A}$ (<i>allow 2 s.f.</i>) (<i>If total resistance is not 7Ω, 0/2 marks</i>)	C1 A1	[2]
(ii)	$R = [0.90 / 1.0] \times 4 (= 3.6)$ $V = I R = 0.286 \times 3.6 = 1.03 \text{ V}$ (<i>If factor of 0.9 not used, then 0/2 marks</i>)	C1 A1	[2]
(iii)	$E = 1.03 \text{ V}$	A1	[1]
(iv)	<i>either</i> no current through cell B <i>or</i> p.d. across r is zero	B1	[1]
6 (a) (i)	coherence: constant phase difference between (two) waves	M1 A1	[2]
(ii)	path difference is <i>either</i> λ <i>or</i> $n\lambda$ <i>or</i> phase difference is 360° <i>or</i> $n \times 360^\circ$ <i>or</i> $n2\pi$ rad	B1	[1]

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- (iii) path difference is *either* $\lambda/2$ or $(n + \frac{1}{2}) \lambda$
or phase difference is odd multiple of *either* 180° or π rad B1 [1]
- (iv) $w = \lambda D / a$ C1
 $= [630 \times 10^{-9} \times 1.5] / 0.45 \times 10^{-3}$ C1
 $= 2.1 \times 10^{-3} \text{ m}$ A1 [3]
- (b) no change to dark fringes B1
no change to separation/fringe width B1
bright fringes are brighter/lighter/more intense B1 [3]
- 7 (a) (i) 2 protons and 2 neutrons B1 [1]
- (ii) e.g. positively charged $2e$
mass $4u$
constant energy
absorbed by thin paper or few cm of air ($3 \text{ cm} \rightarrow 8 \text{ cm}$)
(not low penetration)
highly ionizing
deflected in electric/magnetic fields
(One mark for each property, max 2) B2 [2]
- (b) mass-energy is conserved B1
difference in mass 'changed' into a form of energy B1
energy in the form of kinetic energy of the products / γ -radiation
photons / e.m. radiation B1 [3]