UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of CAMBRIDGE
International Examinations

1 (a) (i) V units: m^3 (*allow metres cubed or cubic metres*) A1 [1]

(ii) Pressure units: $kg\,m\,s^{-2}$ / m^2 (*allow use of* $P = \rho gh$) M1
Units: $kg\,m^{-1}\,s^{-2}$ A0 [1]

(b) V / t units: $m^3\,s^{-1}$ B1
Clear substitution of units for P, r^4 and l M1

$$C = \frac{\pi P r^4}{8 V t^{-1} l} = \frac{kg\,m^{-1}\,s^{-2}\,m^4}{m^3\,s^{-1}\,m}$$

Units: $kg\,m^{-1}\,s^{-1}$ 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
$= 19.0(4)\ m\,s^{-1}$ (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 $s = ut + ½\,at^2$ (or $v^2 = u^2 + 2as$ etc.)
$= 4.23 \times 1.51 + 0.5 \times 9.81 \times (1.51)^2$ C1
$= 17.6\,m$ (*or 17.5 m*) A1 [2]
(*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
$= 140\,N$ A1
(*Use of – sign max 2/4. Ignore –ve sign in answer*)
Direction: upwards B1 [4]

(ii) $h = ½ \times (18.6)^2 / 9.81$ C1
$= 17.6\ m$ *(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]

(c) (i) Hooke's law: extension is proportional to the force (*not mass*) B1
Linear/straight line graph hence obeys Hooke's law B1 [2]

(ii) Use of the gradient (*not just F = kx*) C1
K = $(0.4 \times 9.8) / 15 \times 10^{-2}$ M1
= 26(.1) N m^{-1} A0 [2]

(iii) *either* energy = area to left of line *or* energy = ½ ke^2 C1
= ½ × $[(0.4 \times 9.8) / 15 \times 10^{-2}] \times (15 \times 10^{-2})^2$ C1
= 0.294 J (*allow 2 s.f.*) A1 [3]

4 (a) (i) $R = V^2 / P$ *or* $P = IV$ and $V = IR$ C1
= $(220)^2 / 2500$
= 19.4 Ω (*allow 2 s.f.*) A1 [2]

(ii) $R = \rho l / A$ C1
l = $[19.4 \times 2.0 \times 10^{-7}] / 1.1 \times 10^{-6}$ C1
= 3.53 m (*allow 2 s.f.*) A1 [3]

(b) (i) P = 625, 620 or 630 W A1 [1]

(ii) R needs to be reduced C1
Either length ¼ of original length
or area 4× greater
or diameter 2× greater 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) $2.0 = I \times (4.0 + 2.5 + 0.5)$ C1
I = 0.286 A (*allow 2 s.f.*) A1 [2]
(*If total resistance is not 7 Ω, 0/2 marks*)

(ii) R = [0.90 / 1.0] × 4 (= 3.6) C1
$V = I R$ = 0.286 × 3.6 = 1.03 V A1 [2]
(*If factor of 0.9 not used, then 0/2 marks*)

(iii) E = 1.03 V A1 [1]

(iv) *either* no current through cell B
or p.d. across r is zero B1 [1]

6 (a) (i) coherence: constant phase difference M1
between (two) waves A1 [2]

(ii) path difference is *either* λ *or* $n\lambda$
or phase difference is 360° *or* $n \times 360°$ *or* $n2\pi$ rad B1 [1]

(iii) path difference is *either* $\lambda/2$ *or* $(n + ½)\ \lambda$
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
$= 2.1 \times 10^{-3}$ 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 2*e*
mass 4u
constant energy
absorbed by thin paper *or* few cm of air (3 cm → 8 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]