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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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 = ρgh*)   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 <u>change</u> 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
$= \frac{1}{2} \times [(0.4 \times 9.8) / 15 \times 10^{-2}] \times (15 \times 10^{-2})^2$ C1
$= 0.294 \, J$ (*allow 2 s.f.*)   A1   [3]

4 (a) (i) $R = V^2 / P$ *or* $P = IV$ and $V = IR$ C1
$= (220)^2 / 2500$
$= 19.4 \, \Omega$ (*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) $R = [0.90 / 1.0] \times 4 \ (= 3.6)$ C1
$V = I R = 0.286 \times 3.6 = 1.03 \, V$ 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* $(n + \frac{1}{2})\lambda$
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 <u>dark</u> fringes   B1
no change to separation/fringe width   B1
<u>bright</u> 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*)
<u>highly</u> ionizing
deflected in electric/magnetic fields
(*One mark for each property, max 2*)   B2   [2]

(b) <u>mass-energy</u> 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]