MARK SCHEME for the May/June 2013 series

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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

1 (a) the wire returns to its original length   (*not 'shape'*)   M1
when the load is removed   A1 [2]

(b) energy: N m / kg m^2 s^{-2} and volume m^3 C1
energy / volume: kg m^{2}s^{-2} / m^3 M1
energy / volume: kg m^{-1}s^{-2} A0 [2]

(c) ε has no units   B1
E: kg m s^{-2} m^{-2} M1
units of RHS: kg m^{-1}s^{-2} = LHS units / satisfactory conclusion to show *C* has
no units   A1 [3]

2 (a) mass is the property of a body resisting changes in motion / quantity of
matter in a body / measure of inertia to changes in motion   B1

weight is the force due to the gravitational field/force due to gravity
or gravitational force   B1 [2]

Allow 1/2 for *'mass is scalar weight is vector'*

(b) (i) arrow vertically down through O   B1
tension forces in correct direction on rope   B1 [2]

(ii) 1. weight = *mg* = 4.9 × 9.81 (= 48.07)   C1
69 sin θ = *mg*   C1
θ = 44.(1)°   *scale drawing allow ± 2°*   A1 [3]
use of cos or tan 1/3 only

2. *T* = 69 cos θ C1
= 49.6 / 50 N   *scale drawing 50 ±2 (2/2)   50 ±4 (1/2)*   A1 [2]

correct answers obtained using scale diagram or triangle of forces will score
full marks
cos in **1.** *then sin in* **2.** *(2/2)*

3 (a) loss in potential energy due to decrease in height (as P.E. = *mgh*)   (B1)
gain in kinetic energy due to increase in speed (as K.E. = ½ *mv*^{2})   (B1)
   special case 'as PE decreases KE increases' (1/2)
increase in thermal energy due to work done against air resistance   (B1)
loss in P.E. equals gain in K.E. and thermal energy   (B1)
                                                     max. 3 [3]

(b) (i) kinetic energy $= \frac{1}{2} mv^2$ C1
$= \frac{1}{2} \times 0.150 \times (25)^2$ C1
$= 46.875 = 47\,$J   A1   [3]

(ii) 1. potential energy $(= mgh) = 0.150 \times 9.81 \times 21$ C1
loss $=$ KE $- mgh = 46.875 - (30.9)$ C1
$= 15.97 = 16\,$J   A1   [3]

2. work done $= 16\,$J
work done $=$ force $\times$ distance   C1
$F = 16 \, / \, 21 = 0.76\,$N   A1   [2]

4 (a) pressure $=$ force / area (normal to force)   A1   [1]

(b) molecules/atoms/particles in (constant) random/haphazard motion   B1
molecules have a <u>change</u> in momentum when they collide with <u>the walls</u>   M1
(force exerted on molecules) therefore force on the walls   A1
reference to average force from many molecules/many collisions   A1   [4]

(c) elastic collision when <u>kinetic</u> energy conserved   B1
temperature constant for gas   B1   [2]

5 (a) waves overlap / meet / superpose   (B1)
coherence / constant phase difference (*not constant λ or frequency*)   (B1)
path difference $= 0$, λ, 2λ or phase difference $= 0$, 2π, 4π (B1)
same direction of polarisation/unpolarised   (B1)
     max. 3   [3]

(b) $\lambda = v \, / \, f$ C1
$f = 12 \times 10^9\,$Hz   C1
$\lambda = 3 \times 10^8 \, / \, 12 \times 10^9$ (*any subject*)   M1
$= 0.025\,$m   A0   [3]

(c) maximum at P   B1
<u>several</u> minima or maxima between O and P   B1
5 maxima / 6 minima between O and P
or 7 maxima / 6 minima including O and P   B1   [3]

(d) slits made narrower   B1
slits put closer together   B1   [2]
  (*not just 'make slits smaller'*)
Allow tilting the slits M1 and explanation of axes of rotation A1

6 (a) (i) chemical to electrical   B1   [1]

      (ii) electrical to thermal / heat or heat and light   B1   [1]

   (b) (i) $(P_B =) EI$ or $I^2(R_1 + R_2)$ A1   [1]

      (ii) $(P_R =) I^2R_1$ A1   [1]

   (c) $R = \rho l / A$ or clear from the following equation   B1

$$\text{ratio} = I^2R_1 / I^2R_2 = \frac{\rho l / \pi d^2}{\rho(2l)/\pi(2d)^2} \text{ or } R_1 \text{ has } 8\times \text{ resistance of } R_2$$ C1

$$= 8 \text{ or } 8{:}1$$ A1   [3]

   (d) $P = V^2 / R$ or E^2 / R C1
(V or E the same) hence ratio is 1/8 or 1:8 = 0.125 (*allow ecf from (c)*)   A1   [2]

7 (a) the majority/most went straight through
or were deviated by small angles   B1

a very small proportion/a few were deviated by large angles   B1
small angles described as < 10° <u>and</u> large angles described as >90°   B1   [3]

   (b) most of the atom is empty space/nucleus very small compared with atom   B1
mass <u>and</u> charge concentrated in (very small) nucleus   B1
correct links made with statements in **(a)**   B1   [3]