CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

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.

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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]

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(b) (i) kinetic energy $= \frac{1}{2} mv^2$ C1
$= \frac{1}{2} \times 0.150 \times (25)^2$ C1
$= 46.875 = 47\,\text{J}$ 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 × 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 change in momentum when they collide with the walls 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 kinetic 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
several 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

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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

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

= 8 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° and large angles described as >90° B1 [3]

(b) most of the atom is empty space/nucleus very small compared with atom B1

mass and charge concentrated in (very small) nucleus B1

correct links made with statements in **(a)** B1 [3]

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