UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2010 question paper

for the guidance of teachers

9702 PHYSICS

9702/23 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) 1% of ±2.05 is ±0.02 — A1 [1]

(ii) max. value is 2.08 V — A1 [1]

(b) there may be a zero error/calibration error/systematic error — M1
which makes all readings either higher or lower than true value — A1 [2]

2 (a) no resultant force/sum of forces zero — B1
no resultant moment/torque/sum of moments/torques zero — B1 [2]

(b) (i) each force is represented by the side of a triangle/by an arrow — M1
in magnitude and direction — A1
arrows joined, head to tail — B1 [3]
(*could be shown on a sketch diagram*)

(ii) if the triangle is 'closed' (then the forces are in equilibrium) — B1 [1]

(c) triangle drawn with correct shape (incorrect arrows loses this mark) — B1
$T_1 = 5.4 \pm 0.2\,\text{N}$ — B1
$T_2 = 4.0 \pm 0.2\,\text{N}$ — B1 [3]

(d) forces in strings would be horizontal — B1
(so) no vertical force to support the weight — B1 [2]

3 (a) evidence of use of area below the line — B1
distance = 39 m (*allow ±0.5 m*) — A2 [3]
(*if > ±0.5 m but ≤ 1.0 m, then allow 1 mark*)

(b) (i) 1 $E_K = \frac{1}{2}mv^2$ — C1
$\Delta E_K = \frac{1}{2} \times 92 \times (6^2 - 3^2)$
$= 1240$ J — A1 [2]

2 $E_P = mgh$ — C1
$\Delta E_P = 92 \times 9.8 \times 1.3$
$= 1170$ J — A1 [2]

(ii) $E = Pt$ — C1
$E = 75 \times 8$
$= 600$ J — A1 [2]

(c) (i) energy = (1240 + 600) – 1170 — M1
= 670 J — A0 [1]

(ii) force = 670/39 = 17 N — A1 [1]

(d) frictional forces include air resistance — B1
air resistance decreases with decrease of speed — B1 [2]

4 **(a)** **(i)** solid has fixed volume and fixed shape/incompressible B1 [1]

(ii) gas fills any space into which it is put B1 [1]

(b) atoms/molecules have (elastic) collisions with the walls (of the vessel) B1
momentum of atom/molecule changes B1
so impulse (on wall)/force on wall B1
random motion/many collisions (per unit time) gives rise to
(constant) force/pressure B1 [4]

(c) spacing (much) greater in gases than in liquids/about ten times C1
either spacing depends on $1/\sqrt[3]{\rho}$
or ratio of spacings is about 8.8 A1 [2]

5 **(a)** **(i)** **1** number of oscillations per unit time (not per second) B1 [1]
2 $n\lambda$ A1 [1]

(ii) v = distance / time = $n\lambda/t$ M1
$n/t = f$ hence $v = f\lambda$ A1
or f oscillations per unit time so $f\lambda$ is distance per unit time M1
distance per unit time is v so $v = f\lambda$ A1 [2]

(b) **(i)** 1.0 period is 3 × 2 = 6.0 ms C1
frequency = $1/(6 \times 10^{-3})$ = 170 Hz A1 [2]

(ii) wave (with approx. same amplitude and) with correct phase difference B1 [1]

6 **(a)** **(i)** movement/flow of charged particles B1 [1]

(ii) work done per unit charge (transferred) B1 [1]

(b) straight line through origin B1
resistance = V/I, with values for V and I shown M1
= 20 Ω A0 [2]
(using the gradient loses the last mark)

(c) **(i)** 0.5 A A1 [1]

(ii) *either* resistance of each resistor is 20 Ω *or* total current = 0.8 A C1
either combined resistance = 10 Ω *or* $R = E/I$ = 10 Ω A1 [2]

(d) **(i)** 10 V A1 [1]

(ii) power = EI C1
= 10 × 0.2 = 2.0 W A1 [2]

7 (a) (i) *either* helium nucleus
or particle containing two protons and two neutrons — B1 [1]

(ii) allow any value between 1 cm and 10 cm — B1 [1]

(b) (i) energy = $(8.5 \times 10^{-13})/(1.6 \times 10^{-13})$ — M1
= 5.3 MeV — A0 [1]

(ii) number = $(5.3 \times 10^{6})/31$ — C1
= 1.7×10^{5} (*allow 2 s.f. only*) — A1 [2]

(iii) number per unit length = (1.7×10^{5}) / **(a)(ii)**
correct numerical value — A1
correct unit — B1 [2]