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 ± 0.2 N   B1
      T_2 = 4.0 ± 0.2 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
       <u>so</u> 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 $1/^3\sqrt{\rho}$
       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* $R = E/I = 10\,\Omega$ 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]