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Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9702 PHYSICS

9702/23   Paper 2 (AS Structured Questions), maximum raw mark 60

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CAMBRIDGE
International Examinations

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1 **(a)** ampere   B1
           kelvin   B1   [2]
           (allow mole and candela)

       (b) **(i)** stress: N m^{-2} C1
                  kg m s^{-2}/m^2 = kg m^{-1} s^{-2} A1   [2]

               (ii) Young modulus = stress/strain and <u>strain has no units</u>
                   hence units: kg m^{-1} s^{-2} B1   [1]

2 **(a)** **(i)** amplitude scale reading 2.2 (cm)   C1
                  amplitude = 2.2 × 2.5 = 5.5 mV   A1   [2]

               (ii) time period scale reading = 3.8 (cm)   C1
                   time period = 3.8 × 0.5 × 10^{-3} = 0.0019 (s)   C1

                   frequency *f* = 1 / 0.0019 = 530 (526) Hz   A1   [3]

               (iii) uncertainty in reading = ± 0.2 in 3.8 (cm) or 5.3% or 0.2 in 7.6 (cm)
                   or 2.6% [allow other variations of the distance on the *x*-axis]   M1

                   actual uncertainty = 5.3% of 526 = 27.7 or 28 Hz
                   or 2.6% of 526 = 13 or 14   A1   [2]

       (b) frequency = 530 ± 30 Hz or 530 ± 10 Hz   A1   [1]

3 **(a)** displacement/velocity/acceleration/momentum/etc.
           three correct (none wrong) 2, two correct (none or one wrong) 1   A2   [2]

       (b) **(i)** *Y* = 70 N [allow 71 N as +½ small square on graph]   A1   [1]

               (ii) θ = 90°   M1

                   (for equilibrium) the direction of *Y* must be <u>opposite</u> to *Z*

                   or using *Y* sin θ = *Z*, hence sin θ = 70 / 70 = 1, θ = 90°   A1   [2]

               (iii) **1.** *Y* cos θ = 160 and *Y* sin θ = 70   C1

                       tan θ = 70/160 hence θ = 23.6° (24°)   A1   [2]

                     2. *Y* = 160 / cos 23.6° or 70 / sin 23.6°   C1
                           = 174.6 or 175 or 170 N   A1   [2]

                     or:

                     160^2 + 70^2 = *Y*^{2} (C1)
                     Y = 174.6 or 175 or 170 N   (A1)

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    (c) (equilibrium not possible as) there is no vertical component from Y to balance Z B1   [1]

4   **(a)** for a system (of interacting bodies) the <u>total</u> momentum remains constant   M1
         provided there is no <u>resultant</u> force acting (on the system)   A1   [2]

     (b) (i) total momentum $= m_1 v_1 + m_2 v_2$ C1
                         $= 0.4 \times 0.65 + 0.6 \times 0.45$ C1
                         $= 0.26 + 0.27 = 0.53\,N\,s$ A1   [3]

       (ii) $0.53 = 0.4 \times 0.41 + 0.6 \times v$ C1

           $v = 0.366 / 0.6 = 0.61\,m\,s^{-1}$ A1   [2]

       (iii) $KE = \frac{1}{2}mv^2$ C1
           total initial $KE = \frac{1}{2} \times 0.4 \times (0.65)^2 + \frac{1}{2} \times 0.6 \times (0.45)^2$ C1
                         $= 0.0845 + 0.06075 = 0.15\,(0.145)\,J$ A1   [3]

     (c) check relative speed of approach equals relative speed of separation
         or:
         total final kinetic energy equals the total initial kinetic energy   B1   [1]

     (d) the forces on the two bodies (or on X and Y) are equal and opposite   B1
         time same for both forces <u>and</u> force is change in momentum / time   B1   [2]

5   evaporation: molecules escape from the surface   B1
               at all temperatures   B1

     boiling: takes place throughout / in the liquid   B1
               at the boiling point / at specific temperatures   B1   [4]

6   **(a)** $R = \rho l / A$ C1

        $A = [\pi \times (0.38 \times 10^{-3})^2] / 4 \quad (= 0.113 \times 10^{-6}\,m^2)$ C1

        $R = (4.5 \times 10^{-7} \times 1.00) / ([\pi \times (0.38 \times 10^{-3})^2] / 4) = 4.0\,(3.97)\,\Omega$ M1   [3]

     (b) (i) $I = V / R$ C1
                $= 2.0 / 5.0 = 0.4(0)\,A$ A1   [2]

       (ii) p.d. across BD $= 4 \times 0.4 = 1.6\,V$ A1   [1]

       (iii) p.d. across BC $(l) = 1.5\,(V)$ C1

            BC $(l) = (1.5 / 1.6) \times 100 = 94\,(93.75)\,cm$ A1   [2]

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(c) p.d. across wire not balancing e.m.f. of cell OR cell Y has current   B1
     energy lost or lost volts due to internal resistance   B1   [2]

7 (a) (i) progressive: energy is moved / transferred / propagated from one place to
     another (without the bulk movement of the medium)   B1

     transverse: (particles) oscillate / vibrate at right angles to the direction of
     travel of the energy / wavefront   B1   [2]

     (ii) number of oscillations per unit time / number of wavefronts passing a point
     per unit time   B1   [1]

(b) (i) P and T   B1   [1]

     (ii) P and S <u>or</u> Q and T   B1   [1]

(c) $\lambda = 1.2 \times 10^{-2}$ (m)   C1

     $v = f\lambda$
        $= 15 \times 1.2 \times 10^{-2}$ C1
        $= 0.18\,\mathrm{m\,s^{-1}}$ A1   [3]

(d) ratio $= (1.4)^2 / (2.1)^2$ C1
        $= 0.44$ A1   [2]