PHYSICS **5054/21**

Paper 2 Theory **October/November 2016**

MARK SCHEME

Maximum Mark: 75

Published

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This document consists of **5** printed pages.

Section A

1   **(a)** velocity / it has a direction / is a vector   B1

    (b) (i) ($F = $)$ma$ **or** 800×1.5 C1
             1200 N   A1

       (ii) friction / air resistance acts on car   B1
           opposes force due to engine   B1

     (iii) ($\Delta v = $)$at$ **or** 1.5×4.0 **or** 6.0 C1
           31 m / s   A1   [7]

2   **(a)** 260 N   B1

    (b) (i) for a body in equilibrium   B1
           (total) clockwise moment = (total) anticlockwise moment   B1

       (ii) $F_1d_1 = F_2d_2$ **or** 260×0.35 **or** 91 **or** $F \times 0.65$ C1
           $260 \times 0.35 = F \times 0.65$ **or** $260 \times 0.35/0.65$ **or** $91 = F \times 0.65$ **or** $91/0.65$ C1
           140 N   A1   [6]

3   **(a)** chemical (potential energy)   B1

    (b) (i) non-renewable **and** oil / it is not replaced / will run out   B1

       (ii) acid rain **or** produces CO_2 **or** warms lakes / rivers / sea **or** global warming
           or greenhouse effect   B1

    (c) (i) <u>useful</u> energy output / (total) energy input **or** power for energy twice   B1

       (ii) **1** $1.9 \times 10^9/0.38$ **or** $1.9 \times 10^9 \times 100/38$ C1
                5.0×10^9 W   A1
           2   ($E = $)$Pt$ **or** $0.62 \times 5.0 \times 10^9 \times 2.0$ ($\times 3600$) **or** $(5.0 - 1.9) \times 10^9$ etc.   C1
                2.2×10^{13} J   A1   [8]

4   **(a)** smallest angle for total internal reflection **or** angle for refraction along surface   B1
        angle of <u>incidence</u> in (optically) <u>denser</u> medium   B1

    (b) vertical ray continues undeviated   B1
        second ray (60° to horizontal) refracts away from normal into the air   B1
        third ray reflects internally **and** $i = r$ by eye **not** if any refracted ray   B1   [5]

5 **(a)** number of oscillations / vibrations / wavelengths / compressions / rarefactions / cycles per second / unit time   B1

    (b) (i) $(\lambda =)c/f$ **or** $330/2200$ C1
              0.15 m   A1

        (ii) **1** no change
                     and
            2 increases   B1

    (c) (i) **1** loudspeaker vibrates / oscillates / moves to and fro (and collides with molecules)   B1
            2 compressions **and** rarefactions / molecules vibrate / longitudinal wave   B1
                  vibration / oscillation / energy passed on   B1

        (ii) fewer / no molecules / particles **and** less / no energy / vibration transferred   B1   [8]

6 **(a) (i)** X N-pole   B1
             Y S-pole **and** Z N-pole   B1

        (ii) they touch / move towards each other **and** opposite poles attract   B1

    (b) any sensible use: starting-motor circuit; with a logic gate;
        nuclear power station   B1
        corresponding explanation: current too large for dash-board switch;
        current too small to power device; too dangerous to reach switch   B1   [5]

7 **(a) (i)** supplies the (mains) e.m.f. / voltage   B1

        (ii) to complete the circuit / is at 0 V   B1

    (b) (i) the circuit / supply is cut / broken **or** current stops   B1
               fuse melts / blows / burns   B1

        (ii) live wire   B1
             when it cuts the circuit / melts no part of the appliance is live / no shock   B1   [6]

                                                                           [45]

Section B

8 **(a)** **(i)** 11 protons **and** 11 electrons   B1

13 neutrons   B1

electrons in orbit / surrounding nucleus **or** neutrons **and** protons in nucleus   B1

    (ii) **one** more neutron (in sodium-24) **or** one fewer neutron in sodium-23   B1   [4]

(b) **(i)** electron   B1

    (ii) $_{-1}^{0}(\beta)$ **cao**   B1

$^{24}(Mg)$ B1

$_{12}(Mg)$ B1   [4]

(c) electromagnetic (radiation / rays / waves)   M1

(very) high frequency / energy **or** (very) short wavelength   A1   [2]

(d) **(i)** path curving upwards   B1

    (ii) path continues in straight line   B1

    (iii) beta-particle charged **or** gamma-ray uncharged   B1   [3]

(e) long enough   **or**   short enough   B1

to take measurements   so the body is not irradiated for long   B1   [2]

    [15]

9 **(a)** **(i)** magnetic field mentioned   B1

alternating / changing magnetic field   B1

current / voltage / e.m.f. <u>induced</u> (in secondary coil)   B1
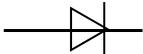
    (ii)   B1

diode   B1   [5]

(b) **(i)** work done / energy transferred per unit charge   M1

electrical energy to other forms **or** for whole circuit **or** property of supply   A1

   (ii) **1**   1.3 V   B1

           2   (I =)V/R **or** 1.3/5.2   C1

               0.25 A   A1

           3   (Q =)It **or** 0.25 × 1.5 × 3600 **or** 0.25 × 1.5   C1

               0.25 × 1.5 × 3600 **or** 0.37/0.375/0.38   C1

               1300 / 1350 / 1400 C   A1   [8]

(c) plastic / casing is an (electrical) insulator   M1

        no shock possible   A1   [2]

                                                        [15]

10 (a) **(i)** molecules / they close together **or** small gaps between molecules   B1

       (ii) molecules / they exert large (repulsive) forces   B1   [2]

  (b) **(i)** (V =)m/ρ **or** 680 / 0.85   C1

                800 cm^3 **or** 8.0 × 10^{-4} m^3 A1

       (ii) **1**   molecules <u>vibrate</u>   molecules <u>vibrate</u>   B1

                    collide with neighbours   **or** collide with electrons   B1

                    transfer vibration / energy   electrons travel through metal   B1

              2   heated / hot oil expands / less dense   B1

                    rises   B1

                    convection current/circulation established   B1

              3   any suitable named insulator **and** it is a poor conductor   B1   [9]

  (c) **(i)** <u>temperature</u> at which (liquid) vaporises / becomes gas / steam   B1

       (ii) (Q =)$mc \Delta T$ **or** 680 × 2.0 × (260 – 20) **or** 680 × 2.0 × 240   C1

             3.3 × 10^5 J   A1

      (iii) heat supplied to <u>pan</u> **or** heat lost to <u>air / surroundings</u>   B1   [4]

                                                          [15]