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O Level

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PHYSICS **5054/21**

Paper 2 Theory **October/November 2016**

MARK SCHEME

Maximum Mark: 75

Published

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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) (Δ*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 × 0.65 — C1
260 × 0.35 = F × 0.65 **or** 260 × 0.35/0.65 **or** 91 = F × 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** $0.62 \times 5.0 \times 10^9 \times 2.0$ (× 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]

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

(b) **(i)** (λ =)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]

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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) $^{0}_{-1}(\beta)$ **cao** — B1
$^{24}_{\ldots\ldots}(\mathrm{Mg})$ — B1
$^{\ldots\ldots}_{12}(\mathrm{Mg})$ — B1 [4]

(c) electromagnetic (radiation / rays / waves) — M1
(very) high frequency / energy **or** (very) short wavelength — A1 [2]

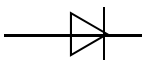
(d) (i) path curving upwards — B1

(ii) path continues in straight line — B1

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

(e) long enough to take measurements **or** short enough so the body is not irradiated for long — B1 B1 [2]
[15]

9 (a) (i) magnetic field mentioned — B1
alternating / changing magnetic field — B1
current / voltage / e.m.f. induced (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

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(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]

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