

---

**PHYSICS****5054/21**

Paper 2 Theory

**October/November 2016**

MARK SCHEME

Maximum Mark: 75

---

**Published**

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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2016 series for most Cambridge IGCSE<sup>®</sup>, Cambridge International A and AS Level components and some Cambridge O Level components.

Page 2	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2016	5054	21

### Section A

- 1 (a) velocity/it has a direction/is a vector B1
- (b) (i)  $(F = )ma$  or  $800 \times 1.5$  C1  
1200 N A1
- (ii) friction/air resistance acts on car B1  
opposes force due to engine B1
- (iii)  $(\Delta v = )at$  or  $1.5 \times 4.0$  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  $260 \times 0.35$  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<sub>2</sub> **or** warms lakes/rivers/sea **or** global warming **or** greenhouse effect B1
- (c) (i) useful 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  
 $5.0 \times 10^9$  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  
 $2.2 \times 10^{13}$  J A1 [8]
- 4 (a) smallest angle for total internal reflection **or** angle for refraction along surface B1  
angle of incidence in (optically) denser 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]

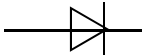
Page 3	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2016	5054	21

- 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 vibration / oscillation / energy passed on B1  
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]

Page 4	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2016	5054	21

### 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  
 ${}^{24}_{\dots}(\text{Mg})$  B1  
 ${}^{12}_{\dots}(\text{Mg})$  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

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge O Level – October/November 2016	5054	21

- (ii) 1 1.3V B1  
2  $(I = )V/R$  or 1.3/5.2 C1  
0.25 A A1  
3  $(Q = )It$  or  $0.25 \times 1.5 \times 3600$  or  $0.25 \times 1.5$  C1  
 $0.25 \times 1.5 \times 3600$  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)  $(V = )m/\rho$  or 680/0.85 C1  
 $800 \text{ cm}^3$  or  $8.0 \times 10^{-4} \text{ m}^3$  A1
- (ii) 1 molecules vibrate molecules vibrate 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) temperature at which (liquid) vaporises / becomes gas / steam B1  
(ii)  $(Q = )mc \Delta T$  or  $680 \times 2.0 \times (260 - 20)$  or  $680 \times 2.0 \times 240$  C1  
 $3.3 \times 10^5 \text{ J}$  A1  
(iii) heat supplied to pan or heat lost to air / surroundings B1 [4]  
[15]