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**PHYSICS**

**5054/21**

Paper 2 Theory

**May/June 2016**

MARK SCHEME

Maximum Mark: 75

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**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.

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Page 2	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	5054	21

- 1 (a) air resistance is zero B1  
**or** no air resistance acts (at first)  
**or** weight much larger than air resistance
- (a=)  $F/m$  **or** weight/mass **or** 600/60 B1  
**or** weight is 10 times mass
- (b) air resistance / upwards force is larger than weight / 600 N / downwards force B1
- (c) (i) 5(.0)m/s B1  
(ii) 120 N B1
- 2 (a) (i) limit of proportionality B1  
(ii) 250 g B1  
(iii) 2.5 N B1
- (b) half the extension / 10 cm B1  
each / both / another spring shares / distributes the weight / mass B1  
**or** both springs bear / carry the load
- 3 (a) (i) amount of matter / substance / material B1  
**or** the ability of an object to resist a change in its state of motion  
(when a force is applied)
- (ii)  $(V=) M/D$  in any form numerical or algebraic C1  
0.13(19) cm<sup>3</sup> A1
- (iii)  $V/(l \times w)$  in any form numerical or algebraic C1  
0.022 cm A1
- (b) micrometer (screw gauge) **or** calipers B1
- 4 (a) **greatest** air; **least** copper B1

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	5054	21

- (b) (i) 1 difference between smallest and largest temperature  
or from 0 to 100 °C B1
- (i) 2 small/moderate distance between (thermometer) marks B1  
or for a given temperature change there is a small expansion of liquid / distance  
(along scale) / change in thermometric property  
or cannot measure small temperature difference / change
- (ii) • use liquid that expands more B1  
• smaller bore / thinner tube  
• more mercury (in bulb) or use larger bulb
- 5 (a) *sound*: along or parallel (to transfer of energy or wave) **and** longitudinal B1  
*water*: perpendicular **and** transverse B1
- (b) (i) 0.29 – 0.28 m B1
- (ii) time / period for one wave (length) / cycle constant B1  
or each oscillation / cycle takes one second
- 6 (a) angle of incidence B1  
smallest angle for light to be totally internally reflected B1  
or largest angle (of incidence) for ray to be refracted / emerge  
or when light emerges along surface  
or when angle of refraction is 90°
- (b) (i)  $n = 1 / \sin C$  algebraic or numerical B1  
2.5 or 2.46 or 2.458(59) A1
- (ii) *left hand diagram* ray refracts away from normal and emerges into air at bottom left surface B1  
*right hand diagram* reflected horizontal ray (by eye) B1  
*right hand diagram* rest of ray completely correct to emerge into air at top face without refraction (by eye) B1
- 7 (a) (current in coil) creates magnetic field C1  
or current is at right angles to magnetic field (of permanent / cylindrical magnets)
- (b) into and out of magnet B1  
or left and right  
or backwards and forwards  
current is one way then reverses (so reverses force) B1

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	Cambridge O Level – May/June 2016	5054	21

- (c) ( $\lambda =$ )  $v/f$  numerically or algebraic in any form  
0.64 m C1  
A1
- 8 (a) (i) same/equal **or**  $I_B = I_1 = I_2$  B1
- (ii) (p.d. of) battery is sum of (p.d. across) fixed resistor and (p.d. across) the variable resistor  
**or**  $V_B = V_1 + V_2$  B1
- (b) ( $I =$ )  $V/R$  numerical or algebraic in any form  
0.006(0)A C1  
A1
- 9 E (a) 2 squares  
10V C1  
A1
- (b) measure/find horizontal distance/number of divisions (between points)  
distance  $\times$  no (m)s/division C1  
A1
- OR (a) transistor B1
- (b) (in dark) resistance of LDR large/increases  
large voltage across base (and emitter) B1  
switches transistor on B1  
**or** current in collector increases B1
- 10 (a) (i) temperature  
when solid turns to liquid B1  
B1
- (ii) molecules escape (surface)  
fastest molecules/most energetic molecules C1  
escape/break bonds A1  
leaving behind slower molecules/colder molecules B1  
**or** temperature falls
- (b) (i) at the surface/top of liquid B1
- (ii) less heat/energy enters (liquid nitrogen)/transfers  
**or** less nitrogen evaporates/boils B1  
reduces/stops conduction **and** convection B1  
explanation of no conduction or convection, e.g. no molecules/no medium B1

Page 5	Mark Scheme	Syllabus	Paper
	Cambridge O Level – May/June 2016	5054	21

(c) (i)	nitrogen gas <b>or</b> nitrogen vapour	B1
(ii) 1	(Q=) $mcT$ numerical or algebraic 216 (°C) seen 4200 J	C1 C1 A1
(ii) 2	(m=) $Q/L$ numerical or algebraic 21 g	C1 A1
11 (a) (i)	<p>diagram showing coil of wire and either</p> <ul style="list-style-type: none"> <li>magnet <b>or</b></li> <li>another coil and supply (dc and switch <b>or</b> ac)</li> </ul> <p>coil of wire connected to an ammeter or voltmeter or cro or other method of detection, e.g. lamp</p> <p>magnet <b>or</b> coil moved <b>or</b> <u>change in current</u> mentioned if another coil used</p>	B1     B1 B1
(ii)	<p>ANY 2 from</p> <ul style="list-style-type: none"> <li>move magnet (or coil) faster</li> <li>larger current in primary (if transformer drawn)</li> <li>more turns in coil</li> <li>stronger magnet (if magnet drawn)</li> <li>soft iron core</li> </ul>	B2
(iii) 1	direction of <u>induced</u> current/ <u>induced</u> emf opposes the change (that produces it)	B1 B1
(iii) 2	(magnetic) flux/field/poles in coil caused by movement/(induced) current in coil	B1
	statement of how opposition occurs, e.g. repulsion as magnet moves in; N pole created (by induction) at end of coil as N pole approaches	B1
(b) (i) 1	(I=) $P/V$ numerical or algebraic 15(.15) A	C1 A1
2	(E=) $Pt$ <b>or</b> $VIt$ <b>or</b> $500(000) \times 60 \times 60$ $1.8 \times 10^9$ J <b>or</b> 500 kWh	C1 A1
(ii)	<p>low current</p> <p><math>P = I^2R</math> <b>or</b> <math>E = I^2Rt</math> explained</p>	B1 B1

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<b>12 (a)</b>	kinetic energy at start thermal energy/ heat energy/ internal energy at end	B1 B1
<b>(b) (i)</b>	0.4(0)s	B1
<b>(ii)</b>	(d=) $s \times t$ numerical or algebraic 2.8 m	C1 A1
<b>(iii)</b>	area under graph (between 0.4 and 2.4 s) <b>or</b> time (difference) $\times$ <u>average</u> speed <b>or</b> $\frac{1}{2} \times$ time (difference) $\times$ initial speed	B1
<b>(iv)</b>	horizontal line from (0,5) to (0.4,5) line showing braking with same gradient as original line	B1 B1
<b>(v)</b>	less friction less deceleration <b>or</b> graph less steep <b>or</b> less <u>force backwards</u> /less <u>force opposing motion</u> <b>or</b> same KE lost/work done by friction	B1 B1
	longer time to stop <b>or</b> larger area under (speed-time) graph <b>or</b> work = force $\times$ distance applied correctly	B1
<b>(c) (i)</b>	(F=) $P \times A$ numerical or algebraic 60 N	C1 A1
<b>(ii)</b>	same pressure larger area (of S/brake pads)	B1 B1