Cambridge
O Level

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PHYSICS **5054/21**

Paper 2 Theory **May/June 2016**

MARK SCHEME

Maximum Mark: 75

Published

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1 **(a)** air resistance is zero B1
or no air resistance acts (at first)
or weight <u>much larger</u> 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^3 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

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(b) (i) 1 difference between smallest and largest temperature B1
or from 0 to 100 °C

(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 / sinC algebraic or numerical C1
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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(c) (λ=) v / f numerically or algebraic in any form C1
0.64 m 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 B1
or $V_B = V_1 + V_2$

(b) (I=) V / R numerical or algebraic in any form C1
0.006(0) A A1

9 **E** **(a)** 2 squares C1
10 V A1

(b) measure / find horizontal distance / number of divisions (between points) C1
distance × no (m)s / division A1

OR **(a)** transistor B1

(b) (in dark) resistance of LDR large / increases B1
large voltage across base (and emitter) B1
switches transistor on B1
or current in collector increases

10 **(a)** **(i)** temperature B1
when solid turns to liquid B1

(ii) molecules escape (surface) C1
fastest molecules / most energetic molecules A1
escape / break bonds
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

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(c) (i) nitrogen gas **or** nitrogen vapour B1

(ii) 1 (Q=) mcT numerical or algebraic C1
216 (°C) seen C1
4200 J A1

(ii) 2 (m=) Q / L numerical or algebraic C1
21 g A1

11 (a) (i) diagram showing coil of wire and either B1
- magnet or
- another coil and supply (dc and switch or ac)

coil of wire connected to an ammeter or voltmeter or cro or other method of detection, e.g. lamp B1

magnet or coil moved B1
or change in current mentioned if another coil used

(ii) ANY 2 from B2
- move magnet (or coil) faster
- larger current in primary (if transformer drawn)
- more turns in coil
- stronger magnet (if magnet drawn)
- soft iron core

(iii) 1 direction of induced current / induced emf B1
opposes the change (that produces it) 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 C1
15(.15) A A1

2 (E=) Pt **or** VIt **or** 500(000) × 60 × 60 C1
1.8×10^9 J **or** 500 kWh A1

(ii) low current B1
P = I^2R **or** E = I^2Rt explained B1

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12 (a) kinetic energy at start B1
thermal energy / heat energy / internal energy at end B1

(b) (i) 0.4(0) s B1

(ii) (d=) s × t numerical or algebraic C1
2.8 m A1

(iii) area under graph (between 0.4 and 2.4 s) B1
or time (difference) × <u>average</u> speed
or ½ × time (difference) × initial speed

(iv) horizontal line from (0,5) to (0.4,5) B1
line showing braking with same gradient as original line B1

(v) less friction B1
less deceleration **or** graph less steep B1
or less <u>force</u> <u>backwards</u> / less <u>force</u> <u>opposing motion</u>
or same KE lost / work done by friction

longer time to stop B1
or larger area under (speed-time) graph
or work = force x distance applied correctly

(c) (i) (F=) P × A numerical or algebraic C1
60 N A1

(ii) same pressure B1
larger area (of S / brake pads) B1

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