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**PHYSICS**

**5054/22**

Paper 2 Theory

**May/June 2017**

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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Question	Answer	Marks
1(a)(i)	(a=) $v(-u) / t$ <b>or</b> 25 / 14	<b>C1</b>
	1.8 m / s <sup>2</sup>	<b>A1</b>
1(a)(ii)	initial straight line from (0,0) to (14,25)	<b>B1</b>
	gradient of line decreases after 14 s <b>and</b> flat from (70,55) to (80,55)	<b>B1</b>
1(b)	force backwards on driver / car B1	<b>any 3</b>    <b>B3</b>
	force produced by seat belt / steering wheel <b>or</b> friction <u>with seat</u> / friction <u>between tyres and road</u> B1	
	no / small (backward) force / friction on bag B1	
	(mass of bag) resists change (from state of motion) <b>or</b> carries on in straight line <b>or</b> has constant velocity <b>or</b> (bag) has inertia B1	

Question	Answer	Marks
2(a)	use of stopwatch or electronic timer	<b>B1</b>
	time at least 5 swings <b>and</b> divide by number of swings <b>or</b> use of fiducial mark <b>or</b> definition of one swing clear e.g. A to C to A or from A and back to A	<b>B1</b>
2(b)(i)	(m=) P.E. / gh <b>or</b> $240 / 10 \times 0.6$	<b>C1</b>
	40 kg	<b>A1</b>
2(b)(ii)	air resistance <b>or</b> friction (with air or rope and tree)	<b>B1</b>
	heat produced / work done (in / against air or friction) <b>or</b> effect of wind <b>or</b> work done by arms / legs	<b>B1</b>

Question	Answer	Marks
3(a)	force $\times$ distance <b>ignore</b> force into distance	<b>C1</b>
	force $\times$ <b>perpendicular</b> distance (from line of action to point / pivot)	<b>A1</b>
3(b)	any moment calculation seen, e.g. $F \times 22 = 80 \times 4$	<b>C1</b>
	15 N	<b>A1</b>
3(c)	(P=) force / area <b>or</b> $80 / 0.0012$	<b>C1</b>
	$6.7 \times 10^4$ Pa	<b>A1</b>

Question	Answer	Marks
4(a)	(c= ) E / mT <b>or</b> 17000 / (22 × 850)	<b>C1</b>
	0.91 J / (g °C)	<b>A1</b>
4(b)	765 – 774 J / °C	<b>B1</b>
4(c)	molecules colliding against molecules <b>or</b> movement / diffusion / collision of (free) electrons	<b>B1</b>

Question	Answer	Marks
5(a)	irregular arrangement of at least 8 molecules with at least one molecule touching other	<b>B1</b>
5(b)	solid – vibrate (about fixed positions)	<b>B1</b>
	liquid – change position / slide (over each other) <b>or</b> move / translate throughout (liquid) <b>or</b> move in clusters	<b>B1</b>
	gas – random movement <b>or</b> move in all directions <b>or</b> high speed / <u>kinetic</u> energy <b>or</b> have range of speeds <b>or</b> move throughout container <b>or</b> move in a straight line (between collisions) <b>or</b> move freely	<b>B1</b>
5(c)	no / weak force between molecules in gases <b>or</b> molecules not held together in gases	<b>B1</b>
	speed / K.E of gas molecules fast(er) than solids	<b>B1</b>

Question	Answer	Marks
6(a)	longitudinal - vibration / oscillation / movement to and fro <b>and</b> in direction of wave <b>or</b> has compressions and rarefactions	<b>B1</b>
	transverse – vibration / oscillation / movement up and down <b>and</b> at right angles to wave <b>or</b> has crests and troughs	<b>B1</b>
6(b)(i)	$(\lambda = ) v / f$ or 330 / 3800	<b>B1</b>
	0.087 m <b>or</b> 8.7 cm	<b>B1</b>
6(b)(ii)	not heard <b>and</b> because below the range of audible frequencies <b>or</b> audible range is 20 – 20 000 Hz <b>or</b> too low a pitch / frequency	<b>B1</b>

Question	Answer	Marks
7(a)(i)	current in coil (at right angles) in a magnetic field (of magnet) <b>or</b> left-hand rule mentioned	<b>B1</b>
7(a)(ii)	reverses / changes direction of current (in coil)	<b>B1</b>
	reverses current every half turn / when coil is vertical <b>or</b> reverses forces (on side AB / CD) <b>or</b> keeps forces in same direction for wire on one side	<b>B1</b>
7(b)(i)	$(E = )VIt$ or $2 \times 12 \times 8$ <b>or</b> $E = Pt$ <b>and</b> $P = VI$ <b>or</b> $E = VQ$ <b>and</b> $Q = It$	<b>C1</b>
	190 <b>or</b> 192 J	<b>A1</b>
7(b)(ii)	73% <b>or</b> 0.73	<b>B1</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
8(a)	equal (numbers of) positive and negative charges	<b>B1</b>
8(b)(i)	negative charge moves from cloth to rod	<b>C1</b>
	electrons move from cloth to rod	<b>A1</b>
8(b)(ii)	apparatus needed, e.g. (small) pieces of paper / water stream / (gold leaf) electroscope / suspended or pivoted other <u>charged</u> rod / charged object / conducting object	<b>B1</b>
	correct statement of what is seen / felt with apparatus	<b>B1</b>

**PUBLISHED****SECTION B**

Question	Answer	Marks
9(a)(i)	ray from right-hand corner of mirror to eye	<b>B1</b>
	any incident and corresponding reflected ray correct by eye	<b>B1</b>
9(a)(ii)	normal drawn at any intersection of incident and reflected ray	<b>C1</b>
	both $r$ and $i$ labelled correctly with normal	<b>A1</b>
9(a)(iii)1	cannot be formed on a screen <b>or</b> nothing at the image (position)	<b>B1</b>
	rays do not come (all the way) from the image <b>or</b> rays only appear to come from image	<b>B1</b>
9(a)(iii)2	(same distance) behind the mirror <b>or</b> same size (as object) <b>or</b> upright / erect <b>or laterally</b> inverted	<b>B1</b>
9(b)(i)	reflection in mirror occurs at any angle <b>or</b> total internal reflection (TIR) only occurs for $i >$ critical angle <b>or</b> there is no critical angle for the mirror B1	<b>any 2</b>
	TIR occurs from dense to less dense medium <b>or</b> in the dense( $r$ ) medium <b>or</b> from glass to air <b>or</b> inside / does not escape glass <b>or</b> from slow to fast (media) <b>or</b> mirror reflection from air to glass B1	<b>B2</b>
	(mirror) reflection is not total, e.g., not all reflected <b>or</b> better quality of image <b>or</b> multiple images from a mirror B1	

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
9(b)(ii)	(n=) $1 / \sin C$ <b>or</b> $1 / \sin 44$	<b>C1</b>
	1.4	<b>A1</b>
9(b)(iii)	$n = \sin i / \sin r$ in any form, e.g. $\sin r = \sin 50 / n$	<b>C1</b>
	$32^\circ - 33^\circ$	<b>A1</b>
9(b)(iv)	ANY 2 lines from <ul style="list-style-type: none"> <li>• more data per second <b>or</b> per unit time</li> <li>• less decrease in strength / amplitude / attenuation</li> <li>• less heat / power produced / wasted</li> <li>• less need for repeating or amplification stations</li> <li>• less interference / noise</li> <li>• more secure / less chance of cross-talk</li> <li>• lighter / less heavy</li> </ul>	<b>B1</b> <b>B1</b>



Question	Answer	Marks
10(a)(i)	directly proportional	<b>B1</b>
10(a)(ii)	straight line <b>or</b> does not curve <b>or</b> constant gradient	<b>B1</b>
10(a)(iii)1	greater <b>or</b> twice as large	<b>B1</b>
10(a)(iii)2	straight line with half the gradient	<b>B1</b>
10(b)(i)1	$1/R_t = 1/R_1 + 1/R_2$ in any form e.g. $1/R = 1/20 + 1/80$ <b>or</b> 16 ( $\Omega$ ) seen	<b>C1</b>
	40 $\Omega$	<b>A1</b>
10(b)(i)2	$(I=)V/R$ in any form e.g. 6/40	<b>C1</b>
	0.15 A	<b>A1</b>
10(b)(i)3	0.15 $\times$ 16 <b>or</b> 0.15 $\times$ 24 <b>or</b> 3.6 (V) seen <b>or</b> current split in ratio 1:4, e.g. 0.03 A and 0.12 A seen <b>or</b> clear attempt at potential divider formula	<b>C1</b>
	2.4 V	<b>A1</b>
10(b)(ii)1	work done $\div$ charge	<b>B1</b>
10(b)(ii)2	correct circuit symbol for a cell and positive correct	<b>B1</b>
	four cells, correct symbol, correctly in series	<b>B1</b>
10(b)(ii)3	four cells in series and another four in parallel <b>or</b> any other series and parallel arrangement of 8 cells with connections to and from battery	<b>B1</b>
10(c)	lasts longer <b>or</b> if one cell fails it still works <b>or</b> contains more energy	<b>B1</b>

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
11(a)(i)	rocks / soil / Earth's surface / building materials / radon (gas) / waste from a nuclear power station / weapons testing	<b>B1</b>
11(a)(ii)	cancer / mutation / cell damage / gene damage <b>or</b> adds to / affects experimental readings / count rate <b>or</b> causes ionisation	<b>B1</b>
11(a)(iii)	protons 2	<b>B1</b>
	neutrons 2	<b>B1</b>
11(a)(iv)	alpha-particles absorbed / stopped by / cannot penetrate air / atmosphere <b>or</b> scattered (by air) <b>or</b> cause ionisation (and slow down)	<b>B1</b>
11(a)(v)	continuous curve deflected either clockwise <b>or</b> anticlockwise within shaded area	<b>B1</b>
	arrow or other indication to show anticlockwise deviation within shaded area	<b>B1</b>
11(b)(i)	time taken to halve	<b>C1</b>
	time taken for the activity / count (rate) / number of atoms / number of nuclei to halve	<b>A1</b>
11(b)(ii)	any halving seen, e.g. 200–100 <b>or</b> 3 half lives	<b>B1</b>
	17 100 years	<b>B1</b>
11(b)(iii)	too little carbon-14 left <b>or</b> all decayed <b>or</b> shows large reduction	<b>B1</b>
11(c)(i)	different number of neutrons <b>or</b> different mass <b>or</b> different nucleon number	<b>C1</b>
	carbon-14 has two more neutrons	<b>A1</b>
11(c)(ii)	same number of protons	<b>B1</b>