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PHYSICS

5054/22

Paper 2 Theory

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MARK SCHEME

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Question	Answer	Marks
1(a)(i)	(a=) $v(-u) / t$ or 25 / 14	C1
	1.8 m / s ²	A1
1(a)(ii)	initial straight line from (0,0) to (14,25)	B1
	gradient of line decreases after 14 s and flat from (70,55) to (80,55)	B1
1(b)	force backwards on driver / car B1	any 3 B3
	force produced by seat belt / steering wheel or 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) or carries on in straight line or has constant velocity or (bag) has inertia B1	

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

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

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

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

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

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

Question	Answer	Marks
8(a)	equal (numbers of) positive and negative charges	B1
8(b)(i)	negative charge moves from cloth to rod	C1
	electrons move from cloth to rod	A1
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	B1
	correct statement of what is seen / felt with apparatus	B1

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

Question	Answer	Marks
9(b)(ii)	(n=) $1 / \sin C$ or $1 / \sin 44$	C1
	1.4	A1
9(b)(iii)	$n = \sin i / \sin r$ in any form, e.g. $\sin r = \sin 50 / n$	C1
	$32^\circ - 33^\circ$	A1
9(b)(iv)	ANY 2 lines from • more data per second or per unit time • less decrease in strength / amplitude / attenuation • less heat / power produced / wasted • less need for repeating or amplification stations • less interference / noise • more secure / less chance of cross-talk • lighter / less heavy	B1 B1

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

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