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PHYSICS

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Paper 4 Extended Theory

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MARK SCHEME

Maximum Mark: 80

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This document consists of **11** printed pages.

Question	Answer	Marks
1(a)	decrease of velocity / speed OR slows / slowing down	B1
1(b)(i)	Area under graph OR $\frac{1}{2}(u+v)t$ OR $\frac{1}{2} \times (11 + 5) \times 3$ OR $\frac{1}{2}(6 \times 3)$ OR (3×5)	C1
	24 m	A1
1(b)(ii)	$(a =) \Delta v / \Delta t$ OR $(v - u) / t$ OR $(5 - 11) / (6 - 3)$	C1
	2.0 m/s ²	A1
1(c)(i)	(deceleration) decreases	B1
1(c)(ii)	(Resultant force) decreases	B1
	Total:	7

Question	Answer	Marks
2(a)(i)	Ft OR 180×0.050	C1
	9.0 Ns OR 9.0 kg m/s	A1
2(a)(ii)	$Ft = m(v - u)$ OR $Ft = mv - mu$ OR $Ft = mv$ OR ($m =$) Ft/v OR $9.0/20$	C1
	0.45 kg	A1
2(a)(iii)	$mgh = \frac{1}{2}mv^2$ OR ($h =$) $v^2/2g$	C1
	($h =$) $20^2/(2 \times 10)$	C1
	20 m	A1
	OR $t = v/g = 2$	(C1)
	$h = \text{average speed} \times \text{time}$	(C1)
	20 m	(A1)
2(b)	Elastic (energy) OR strain (energy)	B1
	Total:	8

Question	Answer	Marks
3(a)(i)	(Weight is) force/pull of gravity (acting on an object)	B1
3(a)(ii)	Mass $\times$ acceleration due to gravity OR mg OR 350×7.5	C1
	2600 N	A1
3(b)	($\rho =$) m / V in any form	C1
	0.27 (kg / m ³) OR 270 (g / m ³)	A1
	Balloon moves/floats <u>up</u>	B1
	(Floats when) density of balloon less than density of atmosphere OR (sinks when) density of balloon greater than atmosphere	B1
	OR ($\rho =$) m / V in any form	(C1)
	110 g	(A1)
	Balloon rises	(B1)
	(Floats when) mass/weight of balloon less than mass/weight of atmosphere (of same volume as balloon) (Sinks when) mass/weight of balloon greater than mass/weight of atmosphere (of same volume as balloon)	(B1)
	Total:	7

Question	Answer	Marks
4(a)(i)	60 W	B1
4(a)(ii)	<u>Radiation</u> <u>and</u> either conduction or convection	B1
4(b)(i)	Radiation mentioned	B1
	Higher reading or rises faster on thermometer A	B1
	Black (surface) is a good/better emitter (than polished surface) OR polished (surface) is a poor/bad/worse emitter (than black surface)	B1
4(b)(ii)	(Compared with black bulb thermometer) readings rise more slowly OR readings are low(er)	B1
	Shiny (bulb) surfaces are good/better reflectors (of radiation) OR Shiny (bulb) surfaces are poor/bad/worse absorbers (of radiation)	B1
4(c)	Firefighter does not get too hot/burned (from radiation)	B1
	Total:	8

Question	Answer	Marks
5(a)	Pressure increases	B1
	Molecules (of gas) move faster/their <u>kinetic</u> energy increases/their momentum increases	B1
	(Molecules) collide with walls/piston more often/more frequently OR greater (rate of) change of momentum	B1
	(Molecules) exert greater/more force (on wall)/hit (walls) <u>harder</u>	B1
5(b)	Pressure (of gas) falls and volume (of gas) increases	B1
	Initially there is a larger pressure inside than outside/atmospheric pressure OR (Piston stops when) pressure (of gas) = external/outside/atmospheric pressure	B1
	Total:	6

Question	Answer	Marks
6(a)(i)	(Ray passes into the air and) refracts / changes direction / bends	B1
6(a)(ii)	Total internal reflection (takes place)	B1
6(b)(i)	Total internal reflection at B with angle of incidence equal to angle of reflection (by eye)	B1
	Refraction into air at right-hand face with angle of refraction greater than angle of incidence	B1
6(b)(ii)	(n =) $1/\sin c$ OR $1/\sin 41$	M1
	1.5	A1
	Total:	6

Question	Answer	Marks
7(a)	Number of wavefronts (generated/produced/passing a point) in 1 sec/per sec/in unit time	B1
7(b)(i)	(Part of wave where) pressure/density is higher OR molecules are closer together	B1
7(b)(ii)	At least 3 wavefronts shown as part semi-circles	B1
	Same separation between wavefronts drawn by candidate as for incident wavefronts	B1
7(b)(iii)	Less spreading out OR less diffraction	B1
7(c)(i)	$(\lambda =) v/f$ OR 340/6800	C1
	0.050 m	A1
7(c)(ii)	In range 900 – 2000 m/s	B1
	Total:	8

Question	Answer	Marks
8(a)	Steel/aluminium/nickel/cobalt/alnico/neodymium/ferrite/alcomax	B1
8(b)(i)	Mention of <u>magnetic</u> field or <u>magnetic</u> flux OR field created by bar magnet	B1
	(Magnetic) field (lines) of magnet cut by coil OR (magnetic) field (lines) linked with/through/in the coil <u>changes</u> OR (magnetic) flux (through coil) <u>changes</u>	B1
	e.m.f. <u>induced</u>	B1
8(b)(ii)	Direction of movement of magnet through the coil OR which pole of magnet enters the coil	B1
	Direction of induced e.m.f. opposes change producing it OR (coil) end near magnet/left-hand end becomes a N-pole OR (coil) repels magnet (when moved in)	B1
8(c)	Hammer the magnet	M1
	repeatedly/until demagnetised/in E/W direction	A1
	OR Heat the magnet	(M1)
	high temperature/red hot/in E-W direction	(A1)
	OR Place magnet in coil carrying A.C.	(M1)
	Remove magnet from coil OR decrease the current (slowly) to zero	(A1)
	Total:	8

Question	Answer	Marks
9(a)(i)	LDR OR light-dependent resistor	B1
9(a)(ii)		B1
9(b)(i)	$I = V / R$	C1
	(total resistance =) 1.2 + 2.4 OR 3.6 seen	C1
	$I = 6.0 / (1.2 + 2.4)$ OR 1.67 or 1.7 (mA)	C1
	(V =) 4.0 V	A1
	OR $(V_1) = [R_1 / (R_1 + R_2)] V$	(C1)
	(total resistance =) 1.2 + 2.4 OR 3.6 seen	(C1)
	$(V_1) = (2.4 / 3.6) 6.0$	(C1)
	= 4.0 V	(A1)
9(b)(ii)	Replace the 1.2 k Ω resistor with one of higher value OR Increase the temperature (of the thermistor or the room)	B1
	Total:	7

Question	Answer	Marks
10(a)	Electrons/negative charges removed from/flow from/lost (from the object)	B1
10(b)(i)	At least 3 plus signs in top half of sphere	B1
	Same number of minus signs in bottom half of sphere	B1
	OR Excess of plus signs over minus signs in top half of sphere	(B1)
	Equal excess of minus signs over plus signs in bottom half of sphere	(B1)
10(b)(ii)	(with rod present) connect earth (to sphere) OR touch (sphere) with conductor/finger	M1
	Remove earth wire and then remove charged rod OR remove conductor/finger and then rod.	A1
	Total:	5

Question	Answer	Marks
11(a)	Background count rate stated as in range 17 – 21 counts/s	B1
	Background used on at least 2 of first 3 readings	C1
	Any halving of corrected or uncorrected reading	C1
	(half-life =) $\frac{1}{2}$ hour	A1
11(b)	${}^3_1\text{H}$ on LHS of an equation	B1
	${}^0_{-1}\beta$ on RHS of equation	B1
	Equation all correct: ${}^3_1\text{H} = {}^0_{-1}\beta + {}^3_2\text{X}$	B1
11(c)	Top: any path to the left within 45° horizontal	B1
	Middle: path to the right and deflected down (ending in a straight line)	B1
	Bottom: path not deflected OR path to the right and deflected up <u>much</u> less than middle path	B1
	Total:	10