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PHYSICS

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Paper 4 Extended Theory

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MARK SCHEME

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Question	Answer	Marks
1(a)	$\rho = m / V$ in any form OR $(m =) \rho V$ OR $(m =) 9000 \times 7.5 \times 10^{-5}$	C1
	$(m =) 0.68 \text{ kg}$ accept 680 g	A1
1(b)(i)	$W = m g$ in any form or $(W =) m g$ OR $(W =) 0.68 \times 10$	C1
	$(W =) 6.8 \text{ N}$	A1
1(b)(ii)	any one of: weight has direction / mass does not weight is a vector / mass is not weight varies / mass does not mass is amount of matter weight is a force / mass is not	B1
1(c)(i)	$\rho = h \rho g$ in any form OR $(\rho =) \rho / h g$ OR $(\rho =) 560 / (0.027 \times 10)$	C1
	$(\rho =) 2.1 \times 10^3 \text{ kg / m}^3$	A1
1(c)(ii)	explains why there is a resultant downward force	B1

Question	Answer	Marks
2(a)	accelerate / increase speed OR decelerate / decrease speed OR stop	B1
	change direction / move in a curve o.w.t.t.e.	B1
2(b)	change of shape OR size	B1
2(c)(i)	$F = ma$ in any form OR $(a =) F / m$ OR $(a =) 3500 / 1400$	C1
	$(a =) 2.5 \text{ m / s}^2$	A1
2(c)(ii)	$a = (v - u) / t$ in any form OR $(t =) (v - u) / a$ OR $(t =) (30 - 0) / 2.5$ OR $30 / 2.5$	C1
	$(t =) 12 \text{ s}$	A1
2(c)(iii)	friction / air resistance / drag	B1

Question	Answer	Marks
3(a)	suitable fuel for a power station	B1
	any three from five: • thermal energy / heat (from fuel) • water / steam / gas heated OR steam produced • (steam / gas) turns / moves / drives turbine • (turbine) turns / moves / drives generator • 2 correct energy transfers	B3
3(b)	sun is energy source for plants / living matter (to grow) o.w.t.t.e.	B1
	plant / animal (remains compressed) into fuel OR carbon / chemical energy stored / trapped in plant / animal (remains)	B1
3(c)	not renewable (as fuel is consumed)	M1
	could only be replaced over very long time period (e.g. clearly > 50 years)	A1

Question	Answer	Marks
4(a)(i)	any one of these six: • <u>evaporation</u>: at <u>surface</u> OR no bubbles form) pair 1 • <u>boiling</u>: throughout liquid OR bubbles form) • <u>evaporation</u>: at any temperature OR no heat needed) pair 2 • <u>boiling</u>: at specific temperature OR heat needed) • <u>evaporation</u>: affected by draught / surface area) pair 3 • <u>boiling</u>: not affected by draught / surface area)	B1
	any one pair of points	B1
4(a)(ii)	(it / rate) increases AND {more molecules have enough energy to escape OR break bonds}	B1
4(b)(i)	remains constant	B1
4(b)(ii)	$E = m l$ in any form OR $(E =) m l$	C1
	$P = \text{energy} / t$ in any form OR $(P =) \text{energy} / t$	C1
	$(P = 0.095 \times 2.3 \times 10^6 / (12 \times 60) =) 300 \text{ W}$	A1

Question	Answer	Marks
5(a)	any three of these five: • any sensible mention of the sun (as source of energy) • (thermal / heat / IR / electromagnetic) radiation • white (or clearly implied) surfaces absorb less or don't absorb • white (or clearly implied) surfaces reflect more • to keep house cooler OR to reduce thermal energy / heat transferred to house	B3
5(b)	decreases	B1

Question	Answer	Marks
6(a)(i)	diffraction	B1
6(a)(ii)	4 arcs between dashed lines centred vertically at centre of gap	B1
	any 3 wavelengths same as incident wavelengths including wavelength from wavefront in gap	B1
6(b)(i)	wavefronts have smaller angular width OR do not extend as far as dashed lines OR less (angular) spread	B1
6(b)(ii)	increased wavelength OR more spreading	B1
	use of $v=f\lambda$ OR increased wavelength	B1

Question	Answer	Marks
7(a)	real (answers in any order for 7(a))	B1
	enlarged OR magnified	B1
	Inverted OR upside down	B1
7(b)(i)	1st straight incident ray from close to point object to mirror correctly reflected, $i = r$	M1
	2nd straight incident ray <u>from point object</u> to mirror correctly reflected, $i = r$	A1
7(b)(ii)	BOTH reflected rays extended back to intersect behind mirror	M1
	BOTH reflected rays extended back <u>in straight lines</u> AND I in correct position AND {labelled OR clearly indicated}	A1

Question	Answer	Marks
8(a)	$R_S = R_A + R_B$ in any form OR $(R_S =) R_A + R_B$ OR $(R_S =) 4 + 8$	C1
	$(R_S =) 12\ (\Omega)$	C1
	$(R_P =) 1 / (1 / R_S + 1 / R_C)$ in any form OR $(R_P =) R_S R_C / (R_S + R_C)$ OR $(R_P =) 1 / (1 / 12 + 1 / 6)$ OR $(R_P =) (6 \times 12) / 18$	C1
	$(R_P =) 4.0\ \Omega$	A1
8(b)	$V_8 = \text{supply } V \times (8 / 12)$ OR $= 24 \times (8 / 12)$	C1
	$(V_8 =) 16\ \text{V}$	A1
	OR alternative route	
	$I_8 = \text{supply } V / 12$ OR $= 24 / 12$ OR $= 2\ (\text{A})$	(C1)
	$(V_8 = 2 \times 8 =) 16\ \text{V}$	(A1)

Question	Answer						Marks
9(a)(i)	A (fixed)resistor B thermistor C L.E.D. OR light emitting diode						
	2 correct						B1
	3 correct						B1
9(a)(ii)	any four from six: • if cold / hot resistance of thermistor high / low • if cold / hot voltage (across) thermistor high / low • if cold / hot voltage of input to LED high / low • if cold / hot there is current / no current in LED • if cold LED lights / brighter • if hot LED does not light / dimmer						B1
9(b)	Row	A	B	C	(output of AND)	X	
	1	0	0	0	0	0	
	2	0	1	0	0	0	
	3	1	0	0	0	0	
	4	1	1	0	1	1	
	5	0	0	1	0	1	
	6	0	1	1	0	1	
	7	1	0	1	0	1	
	8	1	1	1	1	1	
	row 1 of X correct – answer 0						B1
rows 2 AND 3 of X correct – both answers 0						B1	
rows 4–8 of X correct – all answers 1						B1	

Question	Answer	Marks
10(a)(i)	clockwise arrows on <u>at least 3</u> circles	B1
10(a)(ii)	(magnetic) field becomes weaker / decreases (as distance from wire increases)	B1
10(b)(i)	any four from these six: • charge flows OR current in solenoid / wire / circuit • solenoid becomes magnet / magnetised • bolt becomes magnet / magnetised • (such that) unlike poles (of solenoid and bolt are) facing o.w.t.t.e. • bolt is attracted • bolt moves / (door) locks / spring stretched	B4
10(b)(ii)	solenoid OR bolt no longer magnetised OR bolt no longer attracted	B1
	(spring contracts and pulls) bolt back / bolt returns (to original position) / (door) unlocked	B1

Question	Answer	Marks
11(a)	nucleon numbers balance each side of equation	B1
	proton numbers balance each side of equation	B1
	${}^0_{-1}\beta$	B1
11(b)(i)	background radiation OR radiation from the environment	B1
	rocks / ground / buildings / food / space / weapons testing / nuclear accidents or waste / sun / air / radon / argon	B1
11(b)(ii)	random (variation)	B1
11(b)(iii)	clear evidence of subtracting 23 from (original) count	C1
	clear evidence of dividing original / corrected count by 4	A1
	clear evidence of adding <u>23</u> correctly to result after division	A1