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Paper 4 Extended Theory

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MARK SCHEME

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This document consists of **10** printed pages.

Question	Answer	Marks
1(a)(i)	Distance = area under graph OR $0.5 \times 20 \times 13$	C1
	130 m	A1
1(a)(ii)	$(a =) (v - u) / t$ OR $(a =) v / t$ OR $13 / 20$	C1
	0.65 m / s^2	A1
1(a)(iii)	$(F =) ma$ OR 1200×0.65	C1
	= 780 N	A1
1(b)	Acceleration decreases OR rate of increase of speed decreases OR speed increases at a lower rate	B1

Question	Answer	Marks
2(a)	Extension of a spring is (directly) proportional to load / force / weight OR $F = ke$ where e is extension	B1
2(b)(i)	<u>Straight</u> line drawn from origin to (64 mm, 120 N)	B1
2(b)(ii)	$F = ke$ in any form OR $120 / 64$ OR $120 / 6.4$ OR $120 / 0.064$	C1
	c.a.o. 1.9 N / mm OR 19 N / cm OR 1900 N / m	A1
2(c)	Above 120 N / at 140 N, the spring does not obey Hooke's law OR the extension is not proportional to the load / weight / force	B1
	The elastic limit / limit of proportionality of the spring has been exceeded	B1

Question	Answer	Marks
3(a)	(Measure of) quantity / amount of matter OR (property) that resists change in motion / speed / momentum OR measure of a body's inertia	B1
3(b)(i)	$d = m / V$ OR in words OR $0.44 / 0.080^3$ OR $0.44 / 5.12 \times 10^{-4}$ OR $440 / 8^3$ OR $440 / 512$ OR $0.44 / 8^3$ OR $0.44 / 512$	C1
	0.86 g / cm^3 OR 860 kg / m^3 OR $8.6 \times 10^{-4} \text{ kg / cm}^3$	A1
3(b)(ii)	Sinks OR does not float AND (cube) denser (than oil)	B1
3(c)(i)	$W = mg$ OR ($g =$) W / m OR $0.70 / 0.44$	C1
	1.6 N / kg	A1
3(c)(ii)	($P =$) hdg OR $0.030 \times 850 \times 1.6$	C1
	41 Pa	A1

Question	Answer	Marks
4(a)	Atoms collide with wall (and rebound) OR atoms rebound from wall	B1
	(Atoms) undergo change of momentum	C1
	Force on wall = (total) rate of change of momentum (of atoms) OR = change of momentum (of atoms) per second OR = change of momentum (of atoms) / time	A1
4(b)(i)	Fewer atoms per unit volume OR density of gas less	B1
	Rate of collision (with walls of balloon) decreases OR Fewer collisions per unit area	B1
4(b)(ii)	$PV = \text{constant}$ OR $P_1 V_1 = P_2 V_2$ OR ($P_2 =$) $P_1 V_1 / V_2$ OR $1.0 \times 10^5 \times 9.6 / 12$	C1
	$8.0 \times 10^4 \text{ Pa}$	A1

Question	Answer	Marks
5(a)	Tick 2nd box only	B1
5(b)(i)	At least 3 parallel wavefronts in shallow water sloping upwards from left to right	B1
	Wavefronts in shallow water meet wavefronts in deep water	B1
5(b)(ii)	Indication that frequency is same in deep and shallow water	C1
	In deep water $v = f\lambda$ in any form OR $(f =) v / \lambda$ OR $80 / 1.4$	C1
	$= 57.1$ (Hz)	C1
	Wavelength in shallow water $= v / f$ OR $60 / 57.1 = 1.05$ cm	A1
	OR	
	speed in deep water / speed in shallow water $= 0.80 / 0.60$	(C1)
	$= 1.33$	(C1)
	(f is constant so) λ in deep water / λ in shallow water $= 1.33$	(C1)
	λ in shallow water $= 1.4 / 1.33 = 1.05$ cm	(A1)

Question	Answer	Marks
6(a)	1500 m / s liquid 5000 m / s solid 300 m / s gas	B2
6(b)(i)	X and Y marked at centres of any two rarefactions	B1
6(b)(ii)	Area of low pressure or low density (of atoms) or where atoms / molecules far apart	B1
6(c)	$v = d / t$ or $2 d / t$ in any form	C1
	$d = vt / 2$ OR $3.0 \times 10^8 \times 2.56 / 2$	C1
	3.84×10^8 m OR 3.84×10^5 km	A1

Question	Answer	Marks
7(a)	One ray with correct path through lens	B1
	Another ray with correct path through lens Rays intersect to right of F and below axis, inverted image	B1
	drawn <u>and</u> labelled I	B1
7(b)	enlarged, upright and virtual <u>only</u> underlined or ringed	B2
	Two of above descriptions underlined	B1
7(c)	On entering prism: green ray deflection more than red ray and above normal	B1
	On leaving prism: diverging downwards from red ray and not along surface of prism	B1

Question	Answer	Marks
8	Hydroelectric	
8(a)	Hydroelectric named OR water from behind dam	B1
	K.E. of (falling) water used / P.E. of stored water	B1
	Turbine / waterwheel / paddle wheel operated	B1
	(Turbine) turns / drives a generator (that produces electricity)	B1
8(b)	Rain (fills lakes in high places)	B1
	Cause of rain is the Sun, so renewable	B1
8(c)	Sun evaporates water from sea etc. to fall (later) as rain	B1
	Sun is the source of energy.	B1
8	Tidal flow	
8(a)	Tides / tidal flow named	B1
	K.E. of water used	B1
	Turbine / waterwheel / paddle wheel operated	B1
	(Turbine) turns / drives a generator (that produces electricity)	B1
8(b)	Moon (and Sun) causes tides	B1
	Moon (and Sun) permanently in place, so renewable	B1
8(c)	Attraction due to Moon's (and Sun's) gravity causes tides	B1
	Sun is a source of (part of) the energy OR Sun is not the primary source of energy	B1

Question	Answer	Marks
8 Waves		
8(a)	Waves on surface of sea	B1
	K.E. of water used to oscillate a floating mechanism	B1
	Turbine / waterwheel / paddle wheel operated	B1
	(Turbine) turns / drives a generator (that produces electricity)	B1
8(b)	Wind causes waves	B1
	Sun causes wind, so renewable	B1
8(c)	Winds are air currents caused by thermal energy / heat from the Sun	B1
	Sun is the source of energy	B1

Question	Answer	Marks
9(a)(i)	$(3 \times 1.5 =) 4.5 \text{ V}$	B1
9(a)(ii)	$1/R = 1/R_1 + 1/R_2$ OR $R = 1/(1/R_1 + 1/R_2)$ OR $(R =) R_1 R_2 / (R_1 + R_2)$	C1
	Correct substitution of 3 and 6	C1
	$(R =) 2.0 \Omega$	A1
9(a)(iii)	$V = IR$ in any form OR $(I =) V/R$ OR $4.5/3$	C1
	1.5 A	A1
	OR	
	$I_{\text{total}} = 4.5/2 = 2.25 \text{ A}$	(C1)
	For 3Ω , $I = 2.25 \times 6/9 = 1.5 \text{ A}$	(A1)
9(b)(i)	Connect ammeter (in wire) from A to B OR from H to G	B1
9(b)(ii)	Connect voltmeter (terminals) to A and H OR B and G OR C and D OR E and F	B1

Question	Answer	Marks
10(a)(i)		B1
10(a)(ii)	To allow flow (of current) in one direction	B1
10(b)(i)	Wire from B to + or – terminal of battery and wire from A to other terminal of battery	B1
	Diode to allow current in at + terminal or out at – terminal	B1
10(b)(ii)	Alternating current in coil Y sets up alternating magnetic field OR causes change in magnetic flux	B1
	Alternating field / change in flux cuts coil X OR Alternating field links with coil X	B1
	(Alternating) voltage / current is <u>induced</u> in coil X OR (Alternating) voltage / current is produced in coil X by electromagnetic induction	B1

Question	Answer	Marks
11(a)(i)	An electron	M1
	In / from / by the nucleus	A1
11(a)(ii)	Proton numbers balance on left and right sides of equation	B1
	Nucleons numbers balance on left and right sides of equation	B1
	${}^0_{-1}\beta$	B1
11(b)	Time for activity / count rate / number of nuclei / number of atoms to halve	B1
11(c)(i)	α -particles would be stopped / absorbed by <u>the plastic</u> / <u>bottle</u>	B1
11(c)(ii)	γ -rays would not be absorbed by the liquid / bottle OR reading not reduced (in passing through liquid / bottle) OR very penetrative so no change in detector reading	B1