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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)(i)	$(x =)\frac{1}{2} v_i t$ or $\frac{1}{2} \times 12 \times 30$ or $(x =)\frac{1}{2} a t^2$ or $\frac{1}{2} \times 0.40 \times 30^2$	C1
	180 m	A1
1(a)(ii)	$(a =)\Delta v / t$ or $12 / 30$	C1
	$0.40 \text{ (m/s}^2\text{)}$ or $12 / 30$	C1
	$(F =)ma$ or $2.0 \times 10^4 \times 0.40$ or $2.0 \times 10^4 \times 0.40 \times 12 / 30$	C1
	8000 N	A1
1(b)	drag / friction / air resistance mentioned	C1
	drag / friction / air resistance increases (as speed increases)	A1

Question	Answer	Marks
2(a)	$(m =)\rho V$ or $950 \times 8.2 \times 10^{-5}$ or 0.95×82	C1
	$7.8 / 7.79 \times 10^N$ (where N is a integer)	C1
	0.078 / 0.0779 kg or 78 / 77.9 g	A1
2(b)(i)	$(p =)h\rho g$ or $0.094 \times 950 \times 10$	C1
	890 / 893 Pa	A1
2(b)(ii)	atmospheric pressure (is acting)	B1
2(c)(i)	steel is denser (than liquid) or denser than 950 kg/m^3	B1
2(c)(ii)	take new reading and subtract $82 \text{ (cm}^3\text{)}$ / original reading	B1

Question	Answer	Marks
3(a)(i)	nuclear <u>fusion</u>	B1
3(a)(ii)	<u>nuclei</u> combine / join together	B1
	small <u>nuclei</u> to larger nuclei or hydrogen to helium (in some way) or loss of mass	B1
3(b)	any suitable resource e.g. fossil fuels; hydroelectric; wave; wind	M1
	renewable or not (according answer) and matching explanation	A1
3(c)	two advantages from: no polluting gases / quiet / low maintenance / can be placed on roofs / clean / cheap <u>to run</u>	B2
	two disadvantages from: intermittent supply / unattractive / takes up space / uses land / d.c. output	B2

Question	Answer	Marks
4(a)	molecules of solid arranged in lattice / in organised pattern / without gaps / orderly / fixed structure	B1
4(b)(i)	glass heated first or at first liquid not heated / does not expand / takes time (to heat up) or glass poor conductor	B1
	glass expands	B1
	capacity / volume of flask increases	B1
4(b)(ii)	liquid (starts to) warms up	B1
	liquid expands more than the solid / glass	B1

Question	Answer	Marks
5(a)	(quantity of internal) energy that raises temperature	M1
	per degree Celsius / per unit temperature change	A1
5(b)(i)	560 / 562 / 561.6 J	B1
5(b)(ii)	kinetic energy / potential energy / total energy (of atoms / molecules / particles)	B1
	kinetic <u>added to</u> potential energy (of atoms / molecules / particles)	B1
5(c)	line from 100 °C and falling	B1
	falls at decreasing rate	B1
	levels off at labelled / approximate 22 °C	B1

Question	Answer	Marks
6(a)(i)	box next to 3.0×10^8 (second box down) ticked	B1
6(a)(ii)	$(\lambda =)c/f$ or $3.0 \times 10^8 / 4.8 \times 10^{14}$	C1
	6.2 / 6.25 / 6.3×10^{-7} m	A1
6(b)(i)	1. <u>sines</u> have no unit or sines are ratio of two lengths or ratio of two speeds (whose units cancel) or units cancel	B1
	2. $(v =) c/n$ or $3.0 \times 10^8 / 1.5$	C1
	2.0×10^8 m/s	A1
6(b)(ii)	information / message / music / sound / signal / data (encoded as pulses of light) sent	B1
	light (travels along fibre) or infra-red (radiation)	B1
	light detected (at far end) or message decoded or total internal reflection mentioned	B1

Question	Answer	Marks
7(a)(i)	any two rays that start at the top of the image from: • seems to come from F_1 to lens and emerges paraxially • passes through centre of lens undeviated • paraxial to the lens and passes through F_2	M2
	two correct rays traced back and image indicated	A1
7(a)(ii)	any two of enlarged; inverted; real underlined	B1
	enlarged and inverted and real underlined	B1
7(b)	refracted ray in prism below yellow ray and above normal	B1
	emergent ray diverging away from the yellow ray and above side of prism	B1

Question	Answer	Marks
8(a)	touch the sphere with the earth wire	B1
	negatively charged and electrons flow to sphere	B1
	remove earth wire or electrons / negative charges attracted (by rod)	B1
8(b)	four or more straight, radial lines and uniformly spaced	B1
	at least one arrow outwards and no wrong arrows	B1
8(c)	$(I =) Q/t$ or $7.0/(5.0 \times 60)$ or $7.0/5.0$ or 1.4 (A)	C1
	$0.023(3333)$ A	A1

Question	Answer	Marks
9(a)(i)	cosine or sine curve and maximum value equal to minimum value	B1
	two complete cycles of 0.02 s between 0 and 0.040 s	B1
9(a)(ii)	point marked A where output voltage is zero	B1
9(b)(i)	<u>magnetic</u> field (due to a.c.) mentioned	B1
	changing / alternating (magnetic) field or field lines cut solenoid	B1
	e.m.f. / voltage <u>induced</u> (in coil)	B1
9(b)(ii)	diode	B1
	prevents / stops the backward current or allows only one direction of current	B1

Question	Answer	Marks
10(a)	electromagnetic (waves / rays / radiation)	M1
	high frequency / energy or short wavelength	A1
10(b)(i)	no change or (stays at) 43	B1
10(b)(ii)	no change or (stays at) 99	B1
10(c)(i)	(radiation) always present / due to environment / in absence of radioactive sample / natural (radiation)	B1
10(c)(ii)	112 – 16 or 96 or 112/28 or $\frac{1}{4}$ or 18/2	C1
	28 – 16 or 12 or $\frac{1}{8}$ or 18/3 or 9.0 (hours)	C1
	6.0 hours	A1
10(d)	any two of: (distance): tongs / manipulator / centre of cardboard box (absorption): lead gloves / suit / lead glass screen / goggles / glasses (time): limit exposure time / keep in box until needed / film badge	B2