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PHYSICS **5054/21**

Paper 2 Theory **October/November 2017**

MARK SCHEME

Maximum Mark: 75

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Section A

Question	Answer	Marks
1(a)	(ρ =)m / V **or** 23 / (3.6 × 0.35 × 0.025) **or** 23 / 0.0315	**C1**
	730 kg / m^3	**A1**
1(b)(i)	230 N	**B1**
1(b)(ii)	(Γ =)$Wx_{\perp r}$ **or** 230 × 1.3	**C1**
	300 Nm	**A1**
1(c)	moment of painter / clockwise moment (about support) is greater than / not equal to / different from moment of plank / anticlockwise moment	**B1**

Question	Answer	Marks
2(a)(i)	(pressure =)force / area	**B1**
2(a)(ii)	fewer molecules **or** less gas **or** more space / further apart	**B1**
	less frequent collisions (with walls)	**B1**
	less force exerted on walls	**B1**
2(b)	(p_1 =)p_2V_2 / V_1 **or** $p_1V_1 = p_2V_2$ $1.0 \times 10^5 \times 9.4 \times 10^{-4} / 1.8 \times 10^{-4}$	**C1**
	5.2×10^5 Pa	**A1**

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Question	Answer	Marks
3(a)	any **two** of: irregular arrangement (of molecules) intermolecular forces weak(er) / not held as firmly together intermolecular distances greater / more spaced out move in clusters through the liquid (not just vibrations) **or** positions not fixed **or** can slide past each other	**B2**
3(b)(i)	work done **or** forces overcome	**B1**
	atoms pulled apart **or** bonds broken	**B1**
3(b)(ii)	(Q =)ml **or** 0.84 × 64 **or** 0.84 × 64 000	**C1**
	54 kJ **or** 54 000 J	**A1**

Question	Answer	Marks
4(a)	use of boiling water	**B1**
	thermometer in boiling water or in steam above boiling water	**B1**
	mercury level at 100 °C mark **or** use of pure / distilled water **or** at a pressure of one atmosphere	**B1**
4(b)	(range is) decreased / smaller / reduced	**B1**
	ethanol (thread) reaches the end at a lower temperature	**B1**

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Question	Answer	Marks
5(a)	pressure / vibrational / longitudinal (wave) **or** (wave that consists of) compressions **and** rarefactions **or** sound wave **or** inaudible sound	**B1**
	frequency greater than 15 kHz–25 kHz	**B1**
5(b)	(ultrasound) transmitted into body	**B1**
	echo / reflection from (baby / fetus)	**B1**
	image produced	**B1**

Question	Answer	Marks
6	**EITHER**	
6(a)	(high) positive potential	**B1**
	very low gas pressure **or** heat filament continuously / filament must remain hot	**B1**
6(b)	determine distance / number of squares between pulses	**M1**
	multiply by time-base setting **or** multiply by number of ms / div	**A1**

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Question	Answer	Marks
6	**OR**	
6(a)		**B1**
6(b)(i)	(the NAND gate has a) power supply / battery **or** it is an active device	**B1**
6(b)(ii)	<table><tr><th>inputs</th><th>output</th></tr><tr><td>0 0</td><td>1</td></tr><tr><td>0 1</td><td>1</td></tr><tr><td>1 0</td><td>1</td></tr></table>	**B1**
	<table><tr><th>inputs</th><th>output</th></tr><tr><td>1 1</td><td>0</td></tr></table>	**B1**

Question	Answer	Marks
7(a)	PQ: a force towards the top of the page (second box) ticked	**B1**
	QR: a force towards the right of the page (bottom box) ticked	**B1**
7(b)	current reversed	**B1**
	both forces reversed	**B1**
7(c)	force(s) decrease **or** less heat generated	**B1**

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Question	Answer	Marks
8(a)(i)	2 protons and 2 neutrons (joined together)	**B1**
8(a)(ii)	it is (positively)charged	**B1**
	it pulls electrons from molecules of air **or** knocks electrons from the molecules of air **or** gains electrons from air molecules	**B1**
8(a)(iii)	**1** stronger **and 2** stronger	**B1**
8(b)(i)	idea of halving	**C1**
	(N =)$4.8 \times 10^7 / 1.5 \times 10^6$ **or** 1 / 32 **or** 5 (half-lives)	**C1**
	$1.6 / 1.65 / 1.7 \times 10^6$ s	**A1**
8(b)(ii)	radioactive emission is a **random** process	**B1**

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Section B

Question	Answer	Marks
9(a)(i)	(*WD*) = *Fx* **or** $2.8 \times 10^6 \times 9.7$	**C1**
	2.7×10^7 J	**A1**
9(a)(ii)	from chemical (potential energy)	**B1**
	to thermal (energy) / heat	**B1**
9(b)(i)	(*a* =)*F* / *m* **or** $2.8 \times 10^6 / 2.2 \times 10^8$	**C1**
	0.013 m / s^2	**A1**
9(b)(ii)	**1** deceleration / it decreases	**B1**
	resistive force decreases **or** resistive force depends on speed	**B1**
	2 curve/line from 9.7 to zero **and** gradient negative (**allow** zero at end)	**B1**
	magnitude of gradient decreasing	**B1**
	3 area mentioned	**B1**
	area <u>under</u> line / curve **or** convert cm^2 (of graph paper) to distance **or** in terms of the scales	**B1**
9(c)(i)	(efficiency =) useful energy output / total energy input **or** useful power output / total power input	**B1**
9(c)(ii)	33×0.64 **or** 12 MJ / s	**C1**
	21 MJ / s	**A1**

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Question	Answer	Marks
10(a)	P - gamma(-rays) **or** γ(-rays)	
	Q - ultraviolet (radiation)	
	R - microwaves	
	any one correct	**C1**
	all three correct	**A1**
10(b)	P **and** X-rays **and** Q ticked	**B1**
10(c)(i)	(f =)c / λ **or** 3.0×10^{8} / 9.4×10^{-7}	**C1**
	3.2×10^{N}	**C1**
	3.2×10^{14} Hz	**A1**
10(c)(ii)	infra-red / radiation / signal / wave emitted by control **and** received at set	**B1**
	infra-red / radiation / signal / wave is encoded **or** is decoded	**B1**
10(d)(i)	normal indicated **and** angle of incidence indicated	**B1**
10(d)(ii)	n = sin i / sin r **or** 1.5 = sin 57(°) / sin r **or** (r =)$\sin^{-1}$(sin 57(°) / n) **or** $\sin^{-1}$(sin 57(°) / 1.5)	**C1**
	34°	**A1**
10(d)(iii)	**1** no change	**B1**
	2 **3** decreases **and** decreases	**B1**

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Question	Answer	Marks
10(d)(iv)	ray in glass between normal and continuation of the incident ray	**B1**
	ray in air between continuation of the refracted ray and side of prism	**B1**

Question	Answer	Marks
11(a)(i)	any suitable solid insulator (e.g. nylon, plastic, glass, rubber, polystyrene)	**B1**
11(a)(ii)	positive charges near to rod	**B1**
	negative charges opposite rod **and** equal in number **and** 7 or fewer	**B1**
11(a)(iii)	**1** electrons / negative charges flow towards earth	**B1**
	repelled (by negative charge on rod)	**B1**
	(sphere) becomes positive	**B1**
	2 flow of electrons / negative charge **and** (in direction) earth to sphere	**B1**
11(b)(i)	$1 / R = 1 / R_1 + 1 / R_2$ **or** $R_1 R_2 / (R_1 + R_2)$ **or** 1 / R = 1 / 15 + 1 / 60 **or** $15 \times 60 / 75$ **or** $15 \times 60 / (15 + 60)$	**C1**
	12 (Ω) **or** 0.083 (Ω)	**C1**
	30 Ω	**A1**
11(b)(ii)	($I =$)V / R **or** 7.5 / 30	**C1**
	0.25 A	**A1**

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Question	Answer	Marks
11(b)(iii)	**18 Ω resistor** underlined **2** **and 60 Ω resistor** underlined	**B1**
11(b)(iv)	five cells in series **and** all in same direction	**B1**
11(b)(v)	resistance increases **and** current decreases	**B1**

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