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**PHYSICS**

**5054/21**

Paper 2 Theory

**October/November 2017**

MARK SCHEME

Maximum Mark: 75

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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**Section A**

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


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

Question	Answer	Marks
3(a)	any <b>two</b> 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) <b>or</b> positions not fixed <b>or</b> can slide past each other	<b>B2</b>
3(b)(i)	work done <b>or</b> forces overcome	<b>B1</b>
	atoms pulled apart <b>or</b> bonds broken	<b>B1</b>
3(b)(ii)	(Q = )ml <b>or</b> $0.84 \times 64$ <b>or</b> $0.84 \times 64\ 000$	<b>C1</b>
	54 kJ <b>or</b> 54 000 J	<b>A1</b>

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

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

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

Question	Answer	Marks								
6	<b>OR</b>									
6(a)		<b>B1</b>								
6(b)(i)	(the NAND gate has a) power supply / battery <b>or</b> it is an active device	<b>B1</b>								
6(b)(ii)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>inputs</th> <th>output</th> </tr> </thead> <tbody> <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> </tbody> </table>	inputs	output	0 0	1	0 1	1	1 0	1	<b>B1</b>
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Question	Answer	Marks
7(a)	PQ: a force towards the top of the page (second box) ticked	<b>B1</b>
	QR: a force towards the right of the page (bottom box) ticked	<b>B1</b>
7(b)	current reversed	<b>B1</b>
	both forces reversed	<b>B1</b>
7(c)	force(s) decrease <b>or</b> less heat generated	<b>B1</b>

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

**Section B**

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

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



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

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

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
11(b)(iii)	<b>18 <math>\Omega</math> resistor</b> underlined <b>2</b> <b>and 60 <math>\Omega</math> resistor</b> underlined	<b>B1</b>
11(b)(iv)	five cells in series <b>and</b> all in same direction	<b>B1</b>
11(b)(v)	resistance increases <b>and</b> current decreases	<b>B1</b>