JURONG JUNIOR COLLEGE
PHYSICS DEPARTMENT
2016 JC2 Preliminary Examination
8866 H1 Physics Paper 2
Suggested Solutions with Markers' Comments

Qn	Suggested solution	Remarks
1(a)	$t = \frac{1.2}{8.0} = 0.15$ s	[1] - Sub
(b)	$h = 0 + \frac{1}{2}(9.81)(0.15)^2 = 0.11$ m	[1] – Sub [1] – Ans
(c)	$v_x = 8.0$ m s^{-1} $v_y = 0 + (9.81)(0.15) = 1.472$ m s^{-1} $v = \sqrt{8.0^2 + 1.472^2} = 8.13$ m s^{-1}	[1] – v_y [1] – Ans
(d)	Both of them have the **same vertical acceleration**. OR the **ball must be targeted at the block.**	[1]
2(a)	As the mass moves upwards at constant speed**, the upward force, *F*, must be equal to the weight of the object, *mg*.** Hence **work done on object = *Fh*** **= *(mg)h*** By conservation of energy, **since *Fh* is the work done on the object and is equal to the increase in gravitational potential energy, E_p = *mgh*** since its kinetic energy is constant	[1] [1] [1]
(b)(i)	By conservation of energy, $(0.100)(9.81)h - (0.100)(9.81)(0.50) = \frac{1}{2}(0.100)(1.6)^2 - 0$ $0.100(9.81)h - 0.4905 = 0.128$ $h = 0.63$ m	[1] – Sub [1] – Ans
(ii)	By conservation of momentum, $(0.100)(3.5) + 0 = (0.180)v$ $v = 1.94$ m s^{-1} By conservation of energy, $\frac{1}{2}(0.180)(1.94)^2 - 0 = \frac{1}{2}(120)x^2$ $x = 0.0751$ m	[1] - *v* [1] – Sub [1] – Ans
3(a)(i)	$R = \frac{V}{I} = \frac{1.0\times10^3}{56\times10^3} = 0.0179\ \Omega$	[1]
(ii)	**Into the page/into the plane**	[1]
(b)(i)	$F = BIL\sin 90^\circ = 1.12(56\times10^3)(0.04)$ $= 2508.8$ $= 2510$ N	[1] – Sub [1] – Ans
(ii)	As the projectile travels along the rail, resistance increases and **current *I* decreases**. Therefore **force decreases.**	[1] [1]
(iii)	**To the right.**	[1]

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(iv)	OR Use stronger voltage/ power supply OR Decrease resistance of track (includes increasing the cross-sectional area of the track).	**[1]**
4(a)(i)	The photoelectric current reaches a maximum because it is **limited by the rate of emission of photoelectrons** which is **dependent on the intensity of illumination.** **Increase in *V* only increases the acceleration** of the photoelectrons but not the rate of emissions of photoelectrons from the metal.	**[1]** **[1]**
(ii)	The **intensity of radiation is dependent on the rate of incidence of photons**. **The greater the rate of incidence of photons, the greater the rate of emission of photoelectrons**. Since the maximum photoelectric **current is dependent on the rate of emission of photoelectrons,** increasing the intensity of illumination increases the maximum photoelectric current.	**Any 2 out of 3 points**
(b)(i)	The current, $I = ne$ where n = number of photoelectrons emitted per second → $n = \frac{I}{e} = \frac{4.8 \times 10^{-10}}{1.6 \times 10^{-19}} = \mathbf{3.0 \times 10^{9}\ s^{-1}}$	**[1]** – Ans
(ii)	Number of photons incident per second $N = 2500(3.0 \times 10^{9}) = \mathbf{7.5 \times 10^{12}}$ The intensity, $i = \frac{Nhf}{A}$ → $i = \frac{Nhc}{A\lambda} = \frac{(7.5 \times 10^{12})(6.63 \times 10^{-34})(3.0 \times 10^{8})}{(24 \times 10^{-6})(410 \times 10^{-9})}$ $= \mathbf{0.152\ W\ m^{-2}}$	**[1]** – *N* **[1]** - Sub **[1]** - Ans
5(a)(i)	(see table below)	**1 mark for two correctly filled blanks**

Moon	Period T/days	mean distance from centre of Jupiter r / 10^9 m	$\log_{10}$ (T/days)	$\log_{10}$ (r/m)
Sinope	758	23.7	2.88	10.37
Leda	239	11.1	2.38	10.05
Callisto	16.7	1.88	**1.22**	**9.27**
Lo	1.77	0.422	**0.25**	**8.63**
Metis	0.295	0.128	-0.53	8.11

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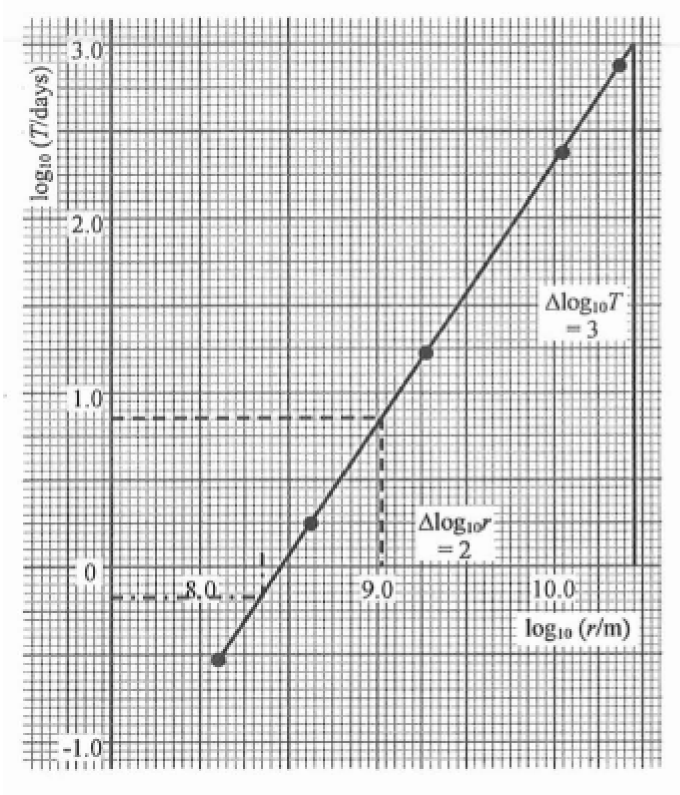
(ii)		**[1] -** **All points plotted correctly.** **[1] -** **best fit line**
(b)(i)	Gradient of the graph = $\dfrac{3.0-0.0}{10.45-8.45}=1.5$	**[1] – Sub** **[1] – Ans**
(ii)	The **data support the relation** in (a). From $T^2=\dfrac{4\pi^2r^3}{GM}$ Let $k=\dfrac{4\pi^2}{GM}$ which is a constant $T^2 = kr^3$ $2\lg T = \lg k + 3\lg r$ $2\lg T = 3\lg r + \lg k$ $\lg T = 1.5\lg r + ½\lg k$ ----- (1) Since a straight line graph is obtained and the **gradient of the graph is equal to 1.5** which is consistent with the equation (1), thus the data support the relation in (a).	**[1] - Ans** **[1] - Expl**
(c)	Given period T = 7.16 days, $\Rightarrow$ lg (7.16) = 0.85. From the graph, lg r = 9.025 Thus the orbital radius of Ganymede = $10^{9.025}$ = 1.06×10^9 m	**[1] – Value** **[1] – Ans**
6(a)	**Rate of change of momentum**	**[1]**

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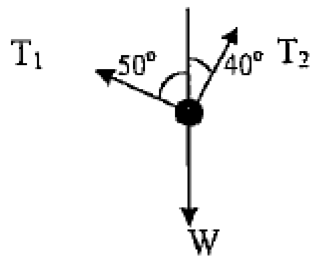
(b)	By definition of force, the body can be **instantaneously** at zero momentum when its **momentum is changing with respect to time.**	[1]
(c)(i)	The high rate of change of momentum of her hand will exert a large force to fracture the bricks.	[1]
(ii)	There will be a **higher rate of change in momentum** and the **force exerted on the bricks on impact would be larger.**	[1] [1]
(d)(i)	$P = Fv = \left(\frac{mv-0}{t}\right)v = \frac{mv^2}{t}$ $= (0.50)(2.0)^2$ $= 2.0$ W	[1] – Sub [1] – Ans
(ii)	$P = \frac{\frac{1}{2}mv^2}{t}$ $= \frac{1}{2}(0.50)(2.0)^2$ $= 1.0$ W	[1] – Sub [1] – Ans
(iii)	Energy lost due to frictional forces acting on the sand.	[1]
(e)(i)		[-1] for any wrong force
(ii)	$T_1 \cos 50^o + T_2 \cos 40^o = W$ (1) $T_1 \sin 50^o = T_2 \sin 40^o$ (2) $W = 125$ N	[2] – Eqn [1] – Ans
(iii)	Tension in shorter rod will **increase** as its **horizontal component acts in the opposite direction to the wind.**	[1] [1]
(iv)	Vertical fall in height = 2.0 – 2.0 cos 50° = 0.71 m By conservation of energy, $\frac{1}{2}mv^2 - 0 = mgh$ $v = \sqrt{2gh} = \sqrt{2(9.81)(0.71)}$ $= 3.74$ m s^{-1}	[1] – h [1] – Ans
(v)	It will be lower as energy is lost to the **drag force due to the surrounding air** OR **Friction at hinge can lead to energy lost.**	[1]

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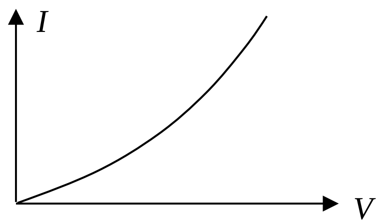
7(a)	**Resistance** of a resistor is defined as the **ratio** of the potential difference across it to the current flowing through it.	[1]
(b)	Volume $V = A \times l$ $\Rightarrow A = \frac{V}{l}$ Resistance, $R = \frac{\rho l}{A} = \frac{\rho l}{V/l} = \frac{\rho l^2}{V} = 6.0\ \Omega$ When the length is 3*l*, new resistance $= \frac{\rho(3l)^2}{A} = \frac{\rho(9l^2)}{A} = 9\frac{\rho l^2}{A} = 9 \times 6.0 = 54\ \Omega$	**[1] – Exp** **[1] – Sub** **[1] – Ans**
(c)(i)	Maximum safe current passing through the 1000 Ω resistor, $I_{1000\Omega} = \sqrt{\frac{P}{R}} = \sqrt{\frac{0.40}{1000}}$ = 0.020 A Maximum safe current passing through the 160 Ω resistor, $I_{160\Omega} = \sqrt{\frac{P}{R}} = \sqrt{\frac{0.40}{160}}$ = 0.050 A Hence maximum safe current flowing through the circuit without damaging any of the resistor is I_{max} = 0.020 + 0.020 = 0.040 A Maximum safe potential difference applied between X and Y *V* = 0.040 x 160 + 0.020 x 1000 = 26.4 V	**[1] – Value** **[1] – Sub** **[1] – Ans**
(c)(ii)	One of the 1000 Ω resistors would be most likely to fail. When the maximum safe potential difference is exceeded, the current flowing in the circuit will be more than the safe current. Thus **the current flowing in the 1000 Ω resistor will be more than 0.020 A** which will result in exceeding the maximum safe power.	**[1]** **[1]**

Qn	Suggested solution	Remarks
(d)(i)	Given $R = Ae^{\frac{B}{T}} \Rightarrow \ln R = \ln A + \frac{B}{T}$ Temperatures θ = 50 ^{0}C corresponds T = 50 + 273 =323K and 80 ^{0}C correspond to T = 80 + 273 = 353 K From graph, R = 110 Ω at 50 ^{0}C and R = 50 Ω at 80 ^{0}C respectively. $\Rightarrow \ln 110 = \ln A + \frac{B}{323}$ -------- (1) $\ln 50 = \ln A + \frac{B}{353}$ ------- (2) (1) – (2) gives $\ln 110 - \ln 50 = \frac{B}{323} - \frac{B}{353}$ Solving ***B* ≈ 3.0 x 10^3 K** ***A* ≈ 1.03 x 10^{-2} Ω**	**[1] read off values** **[1] working** **[1] ans** **[1] ans**
(ii)	A graph of **ln *R* against** $\frac{1}{T}$ using the equation $\ln R = \ln A + \frac{B}{T}$ is plotted. Gradient of the **graph is equal to *B*** and the ***y*-intercept equals to ln *A***.	**[1]**
(e)		**[1]**
(f)(i)	At 30.0 ^{0}C, the resistance of X is approximately 188 Ω. The current flowing in the circuit, $I = \frac{6.0}{188 + 40.0}$ = 0.0263 A The voltmeter reading $V = IR$ = 0.0263 x 40.0 = 1.05 V	**[1] – Value** **[1] – Ans**

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(ii)	The voltmeter reading will increase. The current flowing in the circuit, $I = \frac{6.0}{R_X + 40.0}$ As temperature rises, the resistance R_X decreases. $\Rightarrow I = \frac{6.0}{R_X + 40.0}$ *will increase* The voltmeter reading $V = IR$ will increase.	**[1] – State** **[1] – Expl**
(iii)	The voltmeter could be replaced by a buzzer. When the temperature rises beyond a certain level, the p.d. across the buzzer rises beyond a trigger value causing the buzzer to be activated.	**[1]**
8(a)(i)	In a longitudinal wave, the **direction of propagation of the wave is parallel to the direction of vibration of the particles** in the wave. In a transverse wave, the **direction of propagation of the wave is perpendicular to the direction of vibration of the particles** in the wave.	**[1]** **[1]**
(ii)	Energy is **transferred in the direction of travel of a progressive wave whereas energy is not transferred in a stationary wave.** All wave particles in a **progressive wave have the same amplitude** whereas **amplitude of neighboring particles of a stationary wave is different.** Every **wave particle within one wavelength of a progressive wave has a different phase** whereas **all particles between two adjacent nodes of a stationary wave have the same phase.**	**[2]** – any two correct statements
(b)	$x = \frac{\phi}{2\pi}(\lambda) = \frac{\pi/6}{2\pi}(1.5)$ $= \mathbf{0.125\ m}$	**[1]** – Sub **[1]** – Ans
(c)(i)	$\lambda = \frac{v}{f}$ $= \frac{330}{1780}$ $= 0.185m$	**[1]** – Ans
(ii)	$S_1D = \sqrt{12^2 + 4^2}$ $= 12.649$ m Path difference = 12.649 – 12 $= \frac{0.649}{0.18539}\lambda$ $= 3.5\lambda$	**[1] –** S_1D **[1]** – Ans
(iii)	Path difference is an **odd multiple of half wavelength implies destructive interference**. For sources in phase, **waves meet at D in antiphase** (phase diff of π rad). Therefore the resultant amplitude is zero and **results in minimum intensity**.	**[1] – expl** **[1] – phase** **[1] – intensity**

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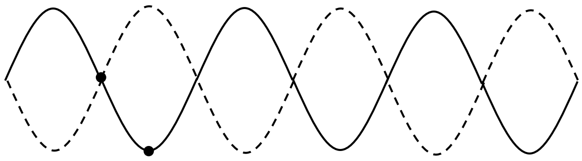
8(d)(i)	**Incident wave** (from magnetron) **and reflected wave from opposite wall superpose** according to Principle of Superposition. Since the **incident and reflected waves travel in opposite direction**, with **same speed**, **amplitude** and **frequency**, stationary waves are formed.	**[1]** **[1]**
(ii)	$v = f\lambda$ $3\times10^{8} = 2.45\times10^{9}\lambda$ $\lambda = 0.122$ m	**[1]** – Sub **[1]** – Ans
(iii)		**[1]** – waveform **[1]** – node and antinode
(iv)	Food placed at **nodes will not be heated** OR those placed at **antinodes may be overcooked**. Constant rotation ensures **even cooking.**	**[1]** **[1]**

~ THE END ~