Hwa Chong Institution

H1 Physics Prelim Exam

Suggested Solutions

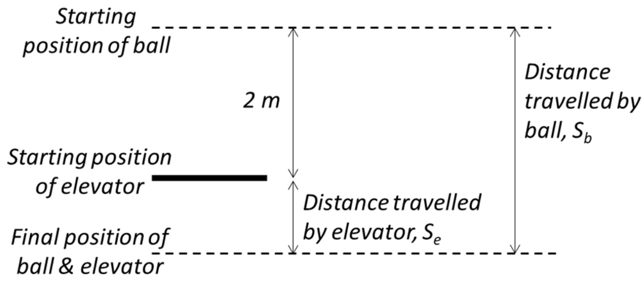
Paper 1

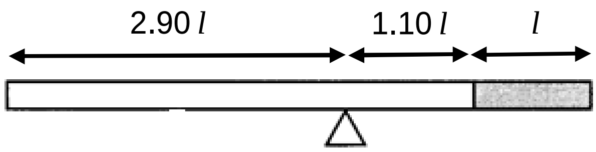
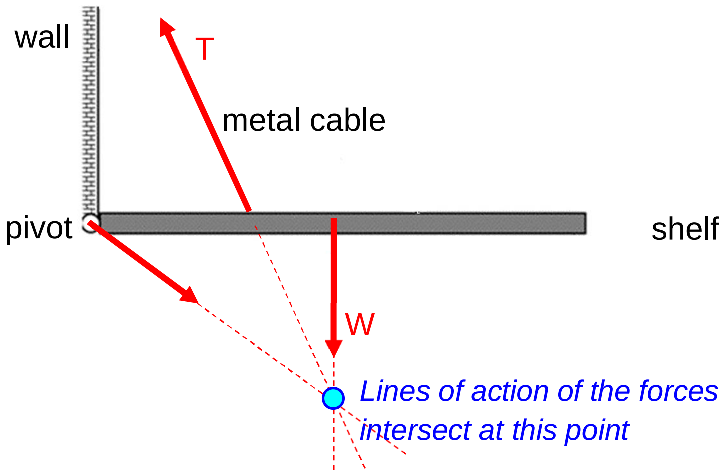
1	2	3	4	5	6	7	8	9	10
D	D	B	D	D	D	C	D	C	B

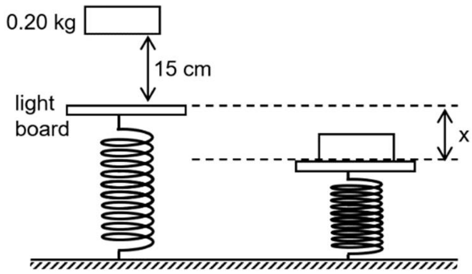
11	12	13	14	15	16	17	18	19	20
D	C	D	C	D	A	C	B	D	B

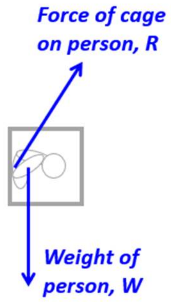
21	22	23	24	25	26	27	28	29	30
D	C	B	B	D	A	D	C	A	B

1	**D**	Temperature difference $= \theta_f - \theta_i = 80 - 20 = 60$ °C Absolute uncertainty, $= \Delta\theta_f + \Delta\theta_i = 1$ °C Percentage uncertainty = $\dfrac{1°\text{C}}{60°\text{C}} \times 100\% = 1.7\%$
2	**D**	Let [*x*] denote the units of *x*. [intensity] = [power] / [area] = [energy] / [time x area] = J s^{-1} m^{-2} = N m s^{-1} m^{-2} = kg m s^{-2} m s^{-1} m^{-2} Hence, the unit of intensity expressed in SI base units is kg s^{-3}.
3	**B**	A is incorrect, as energy is a scalar. **B** is correct. C is incorrect, as power is a scalar. D is incorrect, as energy is a scalar.
4	**D**	The object starts from rest and moves along a straight line. Area under the *a-t* graph represent <u>change</u> in velocity. The triangle below the time axis shows that the change in velocity is in the negative direction. Since the <u>initial velocity is zero</u>, that triangle represents the increasing velocity (in the negative direction). This happens up to the time at B. Beyond B, the acceleration changes direction (from negative to positive direction) However, the velocity still points in the negative direction after B i.e. object continues to travel in the same direction (still getting further away from the starting point). Since acceleration and velocity point in opposite direction, this object is slowing down. The upper triangle BCD represents the change in velocity from B onward, i.e., the velocity is decreasing in magnitude. Since the area of BCD is smaller than the area of the other triangle, the velocity of the object still points in the same direction up to the time at D.

5	**D**	$S_b - S_e = 2$ $2.0 = [(0)\,t + (0.5)(9.81)\,t^2]$ $\quad - [(0)\,t + (0.5)(5.8)\,t^2]$ $t = 1.00$ s 
6	**D**	The horizontal velocity is constant at 10.0 cos 30° = 8.6603 m s^{-1}. Hence, the ball takes t = (10.0 m) / (8.6603 m s^{-1}) = 1.1547 s to cover the distance to the wall. For the vertical velocity, $v = u + a\,t$ = (10.0 sin 30°) + (-9.81) (1.1547) = -6.3276 m s^{-1}. This means that, when the ball hits the wall, it is travelling at a downward angle. The speed when the ball hits the wall is $[(8.6603)^2 + (-6.3276)^2]^{1/2}$ = 10.7 m s^{-1}
7	**C**	The thrust must provide an upward force to propel the rocket upward. This force must be least at equal to its weight. Thrust $= v\left(\frac{dm}{dt}\right)$ $v\left(\frac{dm}{dt}\right) = Mg$ $\frac{dm}{dt} = \frac{Mg}{v} = \frac{(500)(9.81)}{1000} = 4.9 \text{ kg s}^{-1}$
8	**D**	Momentum and total energy are always conserved. However, some of the initial kinetic energy of ball X might be converted to other forms of energy, e.g., in the production of sound.
9	**C**	Assume velocity of P and Q immediately after the collision is v_P and v_Q respectively in the direction to the right. Conservation of linear momentum: 2.0 (4.0) + 3.0 (-2.0) = 2.0 (v_P) + 3.0 (v_Q) 8 – 6 = 2 v_p + 3 v_Q 2 v_p + 3 v_Q = 2 --- (1) For elastic collision, relative speed of approach = relative speed of separation: 4.0-(-2.0) = v_Q- v_P v_Q – v_P = 6 3 v_Q – 3 v_P = 18 --- (2) (1) – (2): 5 v_P = -16 v_P = - 3.2 m s^{-1} Speed of v_P = 3.2 m s^{-1}

10	**B**	 Taking moments about the pivot and letting A be the x-sectional area, W_{wood} (distance of center-of-mass of wood from pivot) = W_{rubber} (distance of center-of-mass of rubber from pivot) $A(4.00\ l)\rho_{wood}\,g(0.90\ l) = A(l)\rho_{rubber}\,g(1.10\ l + 0.50\ l)$ $4.00\ \rho_{wood}\,(0.90) = \rho_{rubber}\,(1.60)$ $\frac{\rho_{rubber}}{\rho_{wood}} = 2.25$
11	**D**	 A solid body experiencing three forces, whose lines of action are not parallel is in equilibrium if 1. The lines of action are coplanar 2. The vector sum of the forces is equal to the zero vector **The lines of action intersect at a point**
12	**C**	The force to compress the spring is equal to the weight of the passengers, $F = W = m\,g = (450)\,(9.81) = 4414.5$ N. The compression of the spring is equal to the difference in height, $x = 0.10$ m. Hence, the spring constant is $k = F / x = (4414.5\text{ N}) / (0.10\text{ m}) = 44100\text{ N m}^{-1}$ (to 3 s.f.).

13	**D**	No kinetic energy at drop-point and at maximum compression, *x*. Comparing the total energy at the initial and final positions, gain in elastic potential energy = total loss in gravitational potential energy $\frac{1}{2}kx^2 = mg(0.15 + x)$ $\frac{1}{2}(85)x^2 = (0.20 \times 9.81)(0.15 + x)$ $42.5x^2 - 1.962x - 0.2943 = 0$ $x = 0.109$ m 
14	**C**	At maximum speed, engine force = drag force of *kv*. Power of boat, *P* = (engine force) *v* = kv^2 Hence, $\frac{P_{\text{one engine}}}{P_{\text{two engines}}} = \left(\frac{v_{\text{one engine}}}{v_{\text{two engines}}}\right)^2$ $\frac{32}{64} = \left(\frac{v_{\text{one engine}}}{14}\right)^2$ $v_{\text{one engine}} = 9.9 \text{ m s}^{-1}$
15	**D**	The useful work done by the engine is the increase in kinetic energy, $\Delta\text{KE} = \text{KE}_{\text{final}} - \text{KE}_{\text{initial}} = \frac{1}{2}mv^2 - \frac{1}{2}mu^2 = m\frac{(v^2 - u^2)}{2}$

16	**A**	There are two forces acting on the person, the force by cage on him, ***R***, and his weight, ***W***. Since the man is in uniform (constant speed) circular motion, the net force on him is directed toward the centre of the circle, i.e., towards the right. Hence, the vector sum of ***R*** and ***W*** must also point towards the right. 
17	**C**	Option A: Satellites can only remain vertically above fixed points on the equator. Option B: Geostationary satellites have to remain vertically above a fixed point on the Earth. Hence, the *angular* speed ω is equal to the speed of a point on the Earth's equator. Since $v = r\,\omega$, this means that the linear speed v cannot be equal to the speed of a point on the Earth's equator. Option C: This is correct. Option D: The satellite's motion has to match that of the Earth. Since the Earth is rotating from west to east (which is why the Sun is "rising" in the east: the Earth is rotating in that direction to meet it), geostationary satellites must be travelling from west to east.
18	**B**	The gravitational force between the Sun and the Earth provides the centripetal force. $F_g = F_c$ $G\dfrac{Mm}{r^2} = m\left(\dfrac{2\pi}{T}\right)^2 r$ $M = \dfrac{4\pi^2 r^3}{GT^2} = \dfrac{4\pi^2(1.50\times10^{11})^3}{(6.67\times10^{-11})(365\times24\times3600)^2} = 2.01\times10^{30}\text{ kg}$ where G is the gravitational constant, M is the mass of the Sun, m is the mass of the Earth, r is the distance between the Sun and the Earth, and T is the period of rotation.
19	**D**	Volume V is constant, express cross-sectional area A in terms of L : $AL = V \Rightarrow A = V/L$ Hence, the resistance variation with L is given by : $R = \dfrac{\rho L}{A} = \dfrac{\rho L^2}{V} \propto L^2$
20	**B**	Resistance of each of the lamp : $R = \dfrac{V^2{}_{rating}}{P_{rating}} \propto \dfrac{1}{P_{rating}}$ since, both of them have the same voltage rating: $\dfrac{R_A}{R_B} = \dfrac{P_{rating,B}}{P_{rating,A}} = \dfrac{40}{10} = \dfrac{4}{1}$ Since, both lamps are connected in series, the same current passes both lamps and power emitted by each lamp : $P_{emitted} = I^2R$. $\dfrac{P_{emitted,A}}{P_{emitted,R}} = \dfrac{R_A}{R_B} = \dfrac{4}{1} \Rightarrow P_A = 4P_B$

21	**D**	e,m,f, E is defined as the work done per unit charge in driving it through the entire circuit, including the cell and external circuit. Electrical energy is converted to other forms of energy. EQ therefore represents the energy dissipated to other forms of energy in the cell and external circuit.
22	**C**	When no current is flowing, the potential at point Z is equal to the potential at the negative terminal of the source. Hence, the voltmeter will measure zero potential difference between point Z and the negative terminal. Similarly, when no current is flowing, the potentials at X and Y are equal to the potential at the positive terminal of the source. Hence, when connected at X or Y, the voltmeter will measure the potential difference over the sources, which is equal to its e.m.f. of 12 V.
23	**B**	The effective resistance of the parallel part is 10 / 2 = 5 Ω. The effective resistance of the whole circuit is 10 + 5 = 15 Ω. The voltmeter will measure the potential difference over the parallel part. By the potential-divider principle, this is (5 / 15) x 12 V = 4 V.
24	**B**	As the resistance of the variable resistor is decreased, the effective resistance of the parallel part becomes less. By the potential-divider principle, lamp Y will receive a smaller fraction of the battery's e.m.f. and become less bright. Equivalently, lamp X will receive a larger fraction of the battery's e.m.f. and become brighter.
25	**D**	Ignoring the weight of the electron, The vertical acceleration of electron $a_y = \frac{\Sigma F}{m} = \frac{qE}{m}$ $a_y = \frac{(1.60\times10^{-19})(1500)}{9.11\times10^{-31}} = 2.63 \times 10^{14}$ m s^{-2} The vertical displacement, $s_y = u_y t + \frac{1}{2}a_y t^2$ $s_y = u_y t + \frac{1}{2}a_y t^2 = 0 + \frac{1}{2}(2.63 \times 10^{14})\left(\frac{0.060}{8.0 \times 10^6}\right)^2 = 7.41 \times 10^{-3}$ m

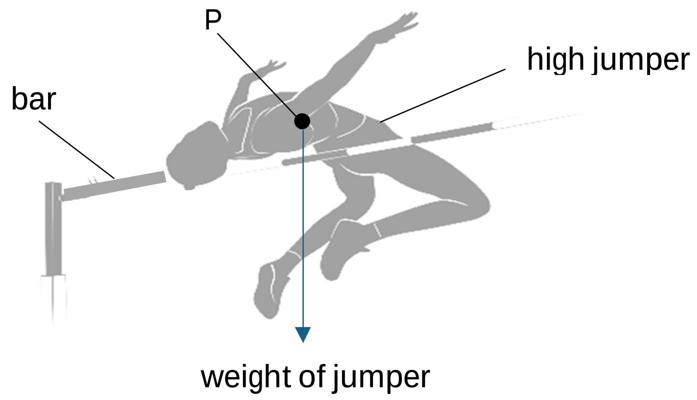
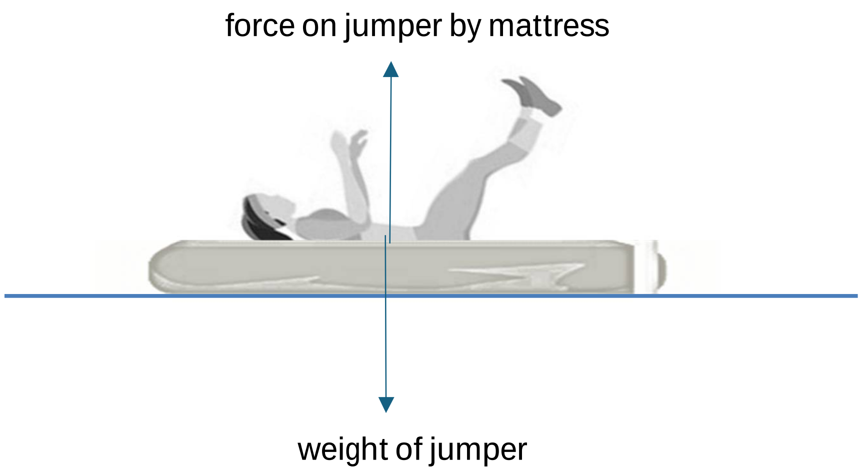
26	**A**	Current I_1 causes a magnetic field *out of the paper* in region 1 and *into the paper* in regions 2 and 3. Current I_2 causes a magnetic field *out of the paper* in regions 1 and 2 and *into the paper* in region 3. Hence, the magnetic fields are in opposite directions in region 2 only and may cause neutral points there.
27	**D**	The force on the wire is given by $F = B\,I\,L = (3.7 \times 10^{-2})\,(2.7)\,(0.040)\sin 70° = 3.8 \times 10^{-3}$ N. Using Fleming's Left-Hand Rule, the magnetic force is into the paper. (Can consider changing one or two of the answers: ignoring the angle gives 4.0×10^{-3} N.)
28	**C**	The initial count rate due to the sample only would be 532 – 24 = 508 counts per minute. The count rate due to the sample only after two half-lives would be 508 / 4 = 127 counts per minute. Hence, the count rate after two half-lives including the background is 127 + 24 = 151 counts per minute. (Can consider changing one or two of the answers: careless calculation gives 201 counts per minute.)
29	**A**	Binding energy released when helium is formed = (binding energy per nucleon of helium) (number of nucleons) = (2.54)(4) = 10.16 MeV Minimum energy absorbed by the 2 deuterium nuclei to separate into individual nucleons = 10.16 – 3.26 = 6.90 MeV Binding energy of each deuterium nucleus = $\frac{1}{2}(6.90) = 3.45$ MeV $\therefore$ binding energy per nucleon of deuterium nucleus = 3.45 / (number of nucleons) = $\frac{3.45}{2} = 1.725$ MeV =1.73 MeV
30	**B**	For each alpha decay, the number of protons will decrease by two, and the number of neutrons will also decrease by two, as an alpha particle emitted has two protons and two neutrons. For each beta decay, the number of protons will increase by 1 and the number of neutrons will decrease by 1, each the proton is converted to a neutron by emitting the beta particle (electron). To achieve a reduction of two protons and two neutrons in the first decay, it would be an alpha decay. Subsequently, to achieve an increase of two protons and a reduction of two neutrons, it would be two beta decays.

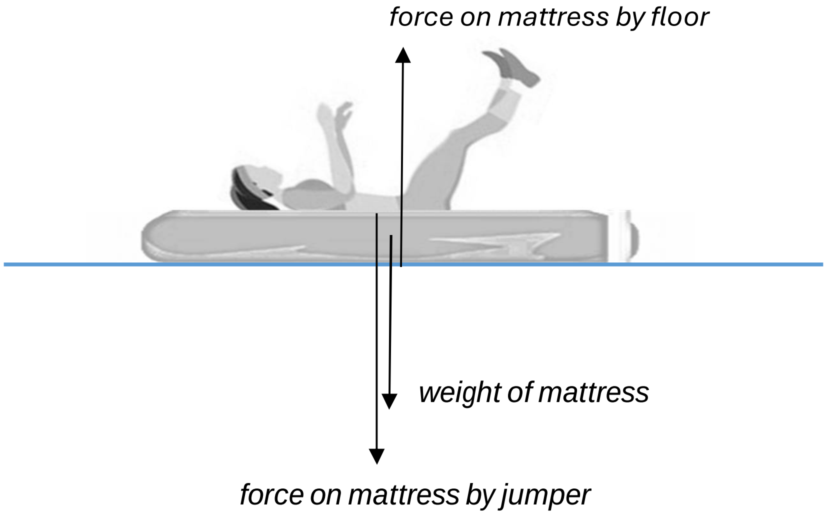
Paper 2

Question 1

(a)			The body must have constant acceleration (same magnitude and direction).	1
(b)	**(i)**		$v_y = v \sin\theta = 11.7 \sin(59.0) = 10.0\ \text{m s}^{-1}$	1
	(ii)	**1.**	Both the mass and balloon have the same horizontal displacement, as they have the same horizontal velocity.	1
		2.	$s_{mass} = 10.0\,(3.0) + \frac{1}{2}(-9.81)(3.0)^2$ $= -14.1$ m $s_{balloon} = 10.0\,(3.0) = 30.0$ m Distance = 30.0 – (-14.1) = 44.1 ≈ 44 m	 1 1 1
			Total	6

Question 2

(a)		Newton's third law of motion states that if body A exerts a force on body B, body B will exert the same type of force of equal magnitude but opposite in direction on body A.	1
(b)	**(i)**		1
	(ii)		1

	(ii)		2
(c)		Area under $F-t$ graph gives change in momentum. $\lvert\Delta p\rvert = \frac{1}{2}(1.2)(375)$ $\lvert 0-(50)(u)\rvert = 225$ $u = 4.5 \text{ m s}^{-1}$	1 1

Question 3

(a)			resultant force (in any direction) is zero resultant moment / torque (about any axis) is zero	1 1
(b)	**(i)**		Using principle of moment and taking moment about the bottom of ladder: clockwise moment = anticlockwise moment $N \times L \sin 60° = W \times \frac{L}{2} \cos 60°$ $N \times L \sin 60° = 80 \times \frac{L}{2} \cos 60°$ N = 23 N	1 1
	(ii)		Resolve vertically: ↑ Y = W = 80 N Resolve horizontally ← X = N = 23 N force R = $\sqrt{X^2 + Y^2} = \sqrt{23^2 + 80^2}$ = 83 N angle R makes with floor = $\tan^{-1}\left(\frac{Y}{X}\right) = \tan^{-1}\left(\frac{80}{23}\right) = 74°$ OR Use vector triangle, obtain R and angle.	1 1 1 1
	(iii)	**1.**	(Due to the person's weight) there is now greater downward force on the ladder, and so (to maintain equilibrium) the floor exerts a larger upward vertical force on the ladder.	1 1
		2.	(Due to the person's weight) there is now a greater anticlockwise moment about the ladder bottom, and so (to maintain equilibrium) the wall exerts a greater clockwise moment and hence greater horizontal force.	1 1
			Total	12

Question 4

(a)	**(i)**	Force is in the direction of the motion / field. The particle accelerates.	1
	(ii)	Force is in the opposite direction to the motion / field. The particle decelerates.	1
	(iii)	There is no force on the particle. Its velocity remains constant.	1
(b)	**(i)**	$F = BIL$ $= 0.080 \times 4.0 \times 5.0 \times 10^{-2}$ $= 0.016$ N	 1 1
	(ii)	reading on balance = 2.500 – 0.016 = 2.484 N Magnetic force on rod (by magnet) acts downwards (by Fleming's Left Hand Rule). By Newton's Third Law, an equal and opposite force acts on the magnet (by rod). Thus force on magnet is upwards and reading on balance decreases.	1 1 1
		Total	8

Question 5

(a)	**(i)**		Isotopes are nuclides with the <u>same number of protons but different number of neutrons</u>.	1
	(ii)		The binding energy of a nucleus <u>is the minimum amount of energy required to break the nucleus into its constituent particles.</u> or The binding energy of a nucleus <u>is the energy released when a nucleus is formed from its constituent particles.</u>	1
(b)	**(i)**		Binding energy of tritium = 3(2.83) = 8.49 MeV	 1 1
	(ii)		$8.49 \times 10^{6}(1.6 \times 10^{-19})$ $= (1.00783u + 2 \times 1.00867u - m)(3 \times 10^{8})^{2}$ $m = 3.01608\ u$	 1 1
(c)	**(i)**		${}^{2}_{1}\mathrm{H} + {}^{2}_{1}\mathrm{H} \rightarrow {}^{3}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H}$	1

	(ii)	**1.**	BE of tritium – 2 × BE of deuterium = 4.03 MeV 8.49 – 2 × BE of deuterium = 4.03 MeV BE of deuterium = 2.23 MeV	1 1
		2.	No. of reactions required per unit time $= \frac{2.86 \times 10^9}{4.03 \times 10^6 (1.6 \times 10^{-19})}$ Mass of deuterium required per unit time $= \left[\frac{2.86 \times 10^9}{4.03 \times 10^6 (1.60 \times 10^{-19})}\right](2 \times 2 \times 1.66 \times 10^{-27})$ $= 2.95 \times 10^{-5}$ kg	1 1 1
			Total	12

Question 6

<table>
<tr><td>(a)</td><td>(i)</td><td>$F = G\frac{Mm}{r^2}$
where
<u>F is the gravitational force</u> between <u>two point masses of masses M and m</u>, separated by <u>distance r</u>, and <u>G is the gravitational constant</u>.</td><td>1

1</td></tr>
<tr><td></td><td>(ii)</td><td>Since the gravitational force F_G by the Sun on a planet provides the centripetal force F_C for the planet’s circular orbit around the Sun,
$F_G = F_C$
$G\frac{Mm}{r^2} = mr\omega^2$
$GM = r^3\left(\frac{2\pi}{T}\right)^2$
$T^2 = \frac{4\pi^2 r^3}{GM}$
Since $\underline{\frac{4\pi^2}{GM}}$ <u>is a constant</u> this implies that $T \propto r^{\frac{3}{2}}$</td><td>

1
1
1</td></tr>
<tr><td>(b)</td><td>(i)</td><td>
<table>
<tr><th>Moon</th><th>Period, T/days</th><th>Orbital radii, r /10^8 m</th><th>lg (r / m)</th><th>lg (T / days) 3 dp</th></tr>
<tr><td>Miranda</td><td>1.41</td><td>1.3</td><td>8.11</td><td>0.149</td></tr>
<tr><td>Ariel</td><td>2.52</td><td>1.9</td><td>8.28</td><td>0.401</td></tr>
<tr><td>Umbriel</td><td>4.14</td><td>2.7</td><td>8.43</td><td>0.617</td></tr>
<tr><td>Titania</td><td>8.71</td><td>4.4</td><td>8.64</td><td>0.940</td></tr>
<tr><td>Oberon</td><td>13.46</td><td>5.8</td><td>8.76</td><td>1.129</td></tr>
</table>
Deduct one mark for each error</td><td>2</td></tr>
<tr><td></td><td>(ii)</td><td>Correctly plotted points
Best fit line</td><td>1
1</td></tr>
</table>

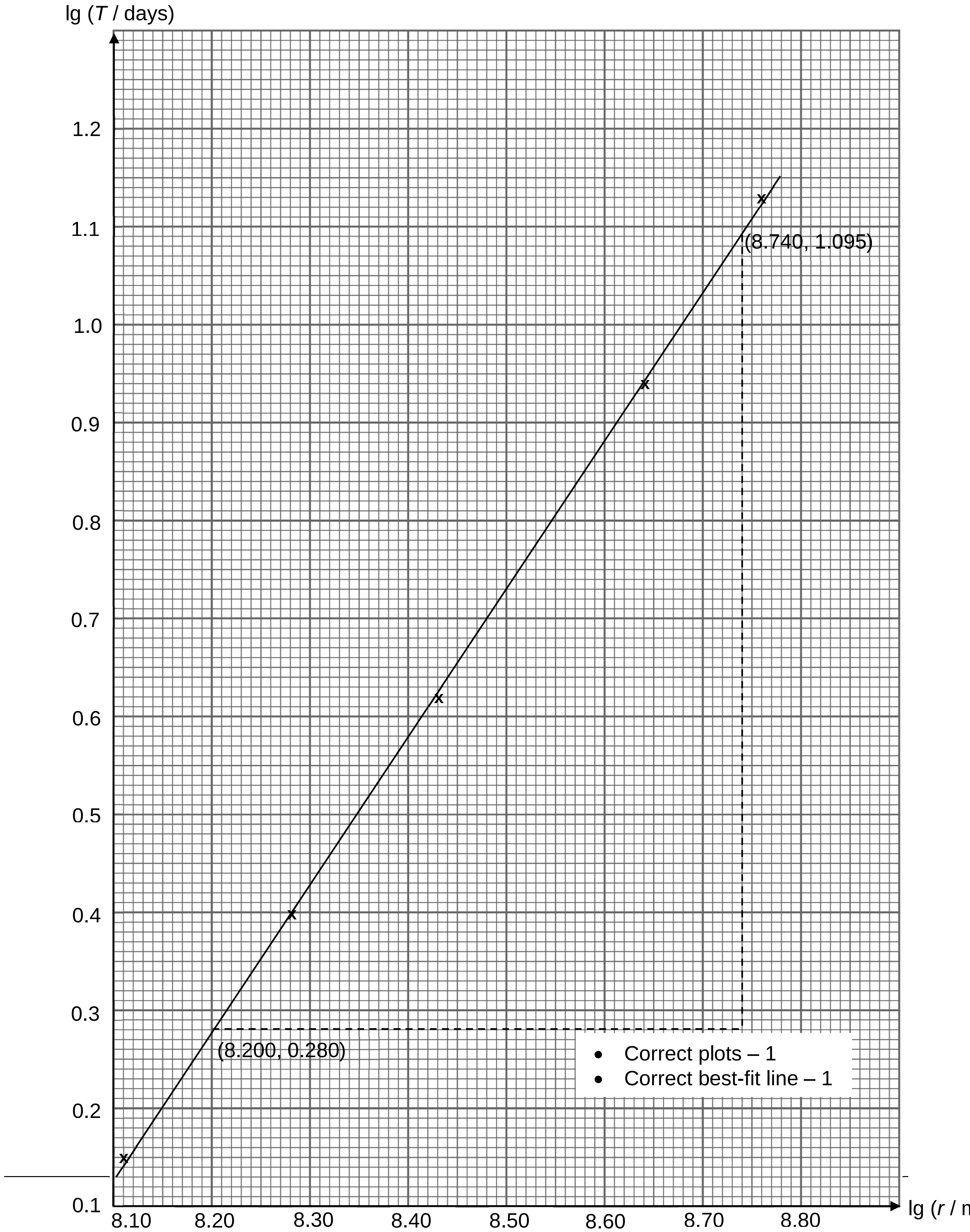
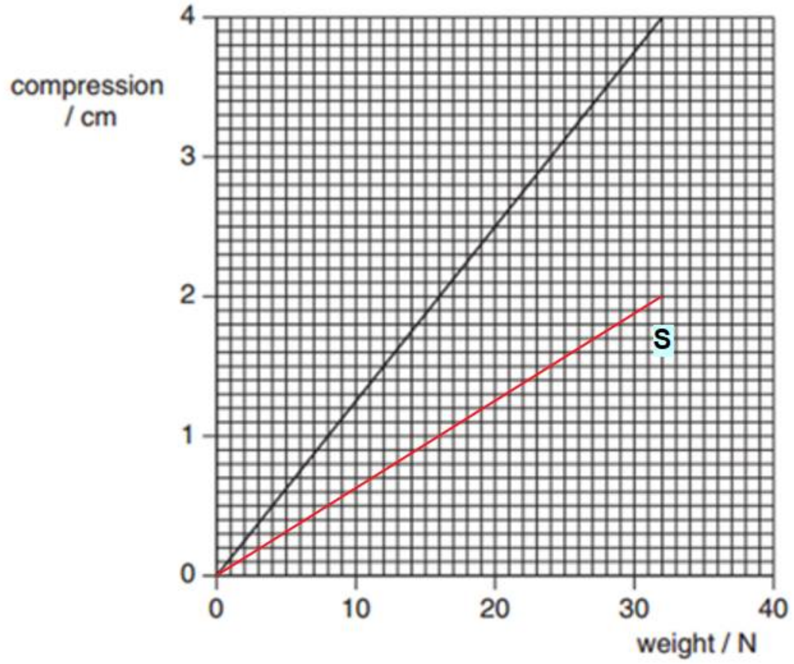

lg (T / days)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
(8.740, 1.095)
(8.200, 0.280)
• Correct plots – 1
• Correct best-fit line – 1
8.10
8.20
8.30
8.40
8.50
8.60
8.70
8.80
lg (r / m

Fig. 7.2

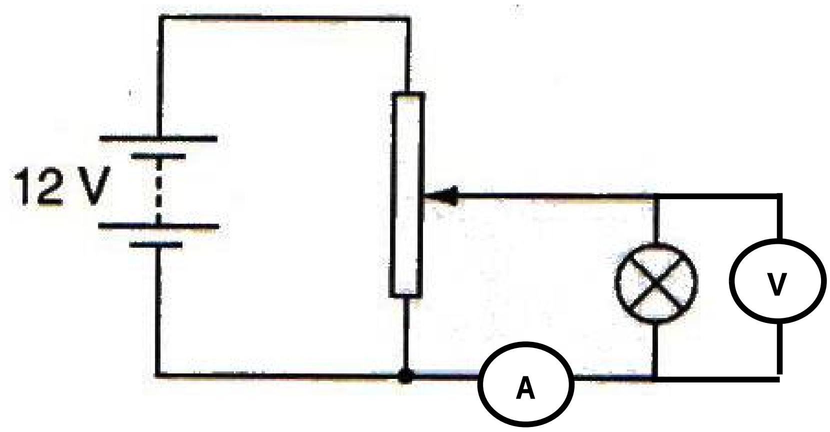
(c)	**(i)**	$\text{Gradient} = \dfrac{1.095 - 0.280}{8.740 - 8.200}$ $= \dfrac{0.815}{0.540}$ $= 1.51$ (3 s.f.)	1 1
	(ii)	$T^2 = \dfrac{4\pi^2 r^3}{GM}$ $2\lg T = 3\lg(r) + \lg\left(\dfrac{4\pi^2}{GM}\right)$ $\lg T = \dfrac{3}{2}\lg(r) + \dfrac{1}{2}\lg\left(\dfrac{4\pi^2}{GM}\right)$ This suggests that the gradient should be 1.5. Since the graph of lg*T*-vs-lg*r* is a straight line of gradient of about 1.5, the data supports the relation given.	1 1
(d)		The graph can be used for the moons of any planet with the same mass as Jupiter, regardless of size. This is because from (a)(ii), $T = \dfrac{2\pi}{\sqrt{GM}} r^{\frac{3}{2}} \rightarrow \lg T = \dfrac{3}{2}\lg r + \lg\left(\dfrac{2\pi}{\sqrt{GM}}\right)$, the gradient is independent of mass and y-intercept will be the same with the same mass of planet, hence the graph will be identical.	1 1
		Total	15

Question 7

(a)	**(i)**	k is the reciprocal of the gradient of the graph or By Hooke's Law, $F = k\,x$, where F is the force exerted on the spring, and x is the compression. $k = F / x = (32.0) / (4.00 \times 10^{-2}) = 800\ \text{N m}^{-1}$	1 1
	(ii)	Elastic potential energy = average force × compression or Elastic potential energy = ½ kx^2 or Elastic potential energy = area to the <u>left</u> of the graph EPE = ½ $k\,x^2$ = ½ (800) $(3.5 \times 10^{-2})^2$ = 0.49 J	 1 1 0
(b)	**(i)**	The initial linear momentum is zero (the trolleys are at rest). Hence, by the principle of conservation of linear momentum, the *magnitudes* of the momenta of the two trolleys must be equal after the thread is cut. Letting V be the speed of the heavier trolley and v the speed of the lighter trolley, this gives $(2400 \times V) = (800 \times v)$ $v/V = 3.0$ (shown)	 1 1 0

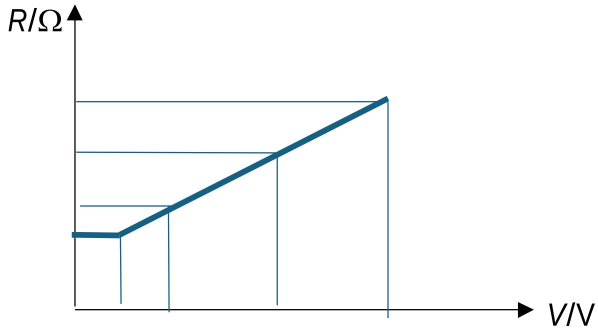
		(ii)	Assuming no energy is transferred from the spring to the surroundings or to other forms of energy, the elastic energy stored in the spring is converted to kinetic energy of the trolleys. EPE = $KE_{\text{heavy trolley}} + KE_{\text{light trolley}}$ $0.49 = ½ (2.4) (1/3\ v)^2 + ½ (0.8) (v)^2$ $v = 0.96\ \text{m s}^{-1}$	1 1 1
	(c)	**(i)**	 (Line with half the gradient of the original)	1
		(ii)	Since a half spring undergoes half the compression when subjected to the same force as in (a), k is doubled. Hence, $k' = 2k = 2 \times 800 = 1600\ \text{N m}^{-1}$	1 1
	(d)	**(i)**	E_1 is the net energy supplied to the system. or E_1 is the net work done by external forces on the system. E_2 is the net energy lost by the system due to dissipative forces. or E_2 is the energy lost due to work against resistive forces.	1 1
		(ii)	1. Kinetic energy is constant with time, since the velocity of the trolley is constant. 2. Gravitational potential energy decreases (linearly) with time, since $\frac{\Delta GPE}{t} = \frac{mg\Delta h}{t} = mgv$ and m, g and v are constant.	1 1 1 1 1

			3. Work done against water resistance force = $mg\Delta h$. In equal time intervals, the trolley moves equal distances of Δh. Thus, work done is constant with time.	1
			Total	20

8	**(a)**		$Q = I\,t$ (Also accept $I = Q / t$)	**1**
	(b)	**(i)**	The charge is $Q = I\,t$ = (6.0)(200) = 1200 C.	**1**
		(ii)	The number of electrons is Q / e = (1200) / (1.6 x 10^{-19}) = 7.5 x 10^{21}	 **1** **1**
	(c)		The resistance **of a device** (or **conductor**) is the **ratio** of the **potential difference across the device** to the **current flowing through** it. (Learning outcome 7e) The ohm is defined as the electrical resistance of a device when a constant potential difference of **one volt** across the device produces a current of **one ampere** to flow through the device. (Not a learning outcome)	**1** **1**
	(d)	**(i)**	 Correct location and symbol for ammeter Correct location and symbol for voltmeter	 **1** **1**
		(ii)	**1.** From the graph, when the potential difference V = 12.0 V, the current I = 3.00 A (must be given to 3 s.f.). Hence, the resistance $R = V / I$ = (12.0) / (3.00) = **4.00 Ω** (to 3 or 4 s.f.). **2.** The power supplied is $P = V\,I$ = (12.0) (3.00) = **36.0 W** (to 3 or 4 s.f.)	**1** **1** **1** **1**
		(iii)	From the graph, when the potential difference V = 6.0 V, the current is I = 2.40 A. Hence, the resistance $R = V / I$ = 6.0 / 2.40 = **2.50 Ω** (to 2 or 3 s.f.). (Learning outcome 7b)	 **1**
		(iv)	As the potential difference in **(iii)** is smaller, the electrons in the wire experience a smaller electric force and therefore a **smaller acceleration**. The electrons will therefore hit the lattice ions in the wire with a smaller speed. Less energy will be transferred to the lattice ions, and they will **vibrate less vigorously**. As such, it is less likely for the moving electrons to hit a lattice ion. Thus, there will be **less collisions** between the electrons and the lattice ions: the resistance is less in **(iii)** than in **(ii)**.	**1** **1** **1**

		(v)		

V/V	R/Ω
2	2/1.4 = 1.4
4	4/2.05 = 2.0
6	2.5 (part iii)
8	8/2.7 = 3.0
12	4.0 (part ii)



The first part of the graph should show a constant resistance. **1**

As the first part of the graph in Fig. 8.2 is a straight line passing through the origin, the current is constant for small values of V. **1**

The resistance should increase beyond $V \approx 2$ V (from Fig. 6.2). **1**

Since the graph in Fig. 8.2 beyond $V \approx 2$ V shows a decreasing **ratio** (not gradient!) of I/V, the ratio of V/I must be increasing. Hence, the resistance goes up. **1**

Total	**20**