WJEC
CBAC

GCE MARKING SCHEME

PHYSICS
AS/Advanced

JANUARY 2012

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2012 examination in GCE PHYSICS. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

PH1

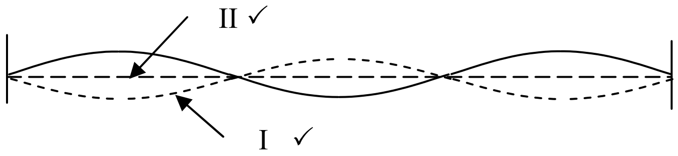
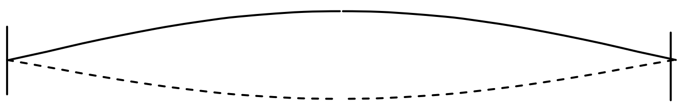
Question			Marking details	Marks Available
1	(a)	(i)	[For a metallic conductor] the potential difference and current are [directly] proportional/ I α V (1), provided the temperature remains constant / all physical factors remain constant (1) V = IR only no marks	2
		(ii)	It is constant / stays the same /increases as the temperature increases	1
	(b)	(i)	$A = 1.5(3) \times 10^{-8}$ [m^2](1) $R = \frac{\rho l}{A} = \frac{95 \times 10^{-8} \times 3.2}{1.5(3) \times 10^{-8}}$ (1) = 199 [Ω] (1)	3
		(ii)	$\frac{230^2}{200}$ = 265 [W] allow e.c.f. from (b)(i)	1
		(iii)	$\frac{1}{66.7(1)} = \frac{1}{200} + \frac{1}{R_2}$ (1) R_2 = 100 [Ω] (1)	3
		(iv)	R_2 (1) **either** reference to $\frac{V^2}{R}$ so lower R / same V across lower R **or** reference to I^2R so greater I **or** reference to IV so I increased [for constant V] **or** correct calculation of R_2 (1)	2
		(v)	$\frac{230}{66.7}$ = 3.5 [A] allow e.c.f. from (b)(iii)	1
			Question 1 total	**[13]**
2	(a)	(i)	Diagram to include • Correct electric circuit with ohmmeter **or** power supply with ammeter + voltmeter with correct symbols and positioning (1) • Method of heating shown (1) • Method of recording temperature shown (1)	3
		(ii)	Linear [or approximately linear] graph with positive gradient (1) and positive intercept on R axis (1).	2
	(b)	(i)	Conducting / delocalised / free electrons (1) collide (1) with metal lattice / atoms / ions (1) [not with other free electrons]	3
		(ii)	The greater the temperature the greater the vibrational energy of the lattice / metal ions (1) producing a greater chance [or rate] of collisions/ collisions more often / greater frequency of collisions (1) [not harder] .	2
			Question 2 total	**[10]**

Question			Marking details	Marks Available
3	(a)	(i)	Rate of change of velocity or $\frac{v-u}{t}$ or change in velocity / time taken	1
		(ii)	(u = 0) (1) [or by impl.] Acceleration = $\frac{6.0}{0.8}$ = 7.5 m s^{-2} (1) UNIT mark	2
	(b)		After release there are no [horizontal] forces acting [on the trolley] (1) so it travels with constant speed [to the left] (1). When Nigel catches it there is a force on the trolley to the right / towards Nigel (1) which causes the trolley to decelerate/ slow down/ stop moving [to rest] (1)	4
			Question 3 total	**[7]**
4	(a)		$E_P = (7.0 \times 10^6 \times 1000)(1) \times 9.81 \times 600$ (1) [= 4.1×10^{13}] 1st mark – use of density equation to get 7.0 x 10^9 kg 2nd mark – use of mgh	2
	(b)		Energy available per second = $0.9 \times 4.1 \times 10^{13}$ [= 3.6×10^{13}] J (1) allow e.c.f. from (a) Time = $\frac{3.6\times10^{13}}{6\times300\times10^6(1)}$ [= 2×10^4 [s] / 5.6 [hour]] (1)	3
	(c)	(i)	$\frac{7.0\times10^9}{2\times10^4\text{e.c.f.}}$ = 3.5×10^5 [kg s^{-1}] allow e.c.f from (a) and (b)	1
		(ii)	E_k per second [= ½ × $3.5 \times 10^5 \times 20^2$] = 7×10^7 [J s^{-1}] allow e.c.f from (c)(i)	1
		(iii)	Energy wasted per second = $\frac{10\%\times4\times10^{13}\text{ J}}{2\times10^4\text{ s}}$ (1) allow e.c.f. from (a) and (b) [or equiv, or by impl.] = 2×10^8 [W] (1)	2
		(iv)	% lost in E_k = $\frac{7\times10^7}{2\times10^8}$ [e.c.f. on (ii) and (iii)] = 35%	1
		(v)	Any sensible answer, e.g. [k.e. in] water turbulence, [work against] friction in turbines, drag/friction between water and pipes not just heat or sound or refilling the high level reservoir.	1
			Question 4 Total	**[11]**

Question			Marking details	Marks Available
5	(a)	(i)	Electron	1
		(ii)	Negative charges repelled [by rod] (1) and move from A to B/ to the right (1) leaving A with a net positive charge (1)	3
		(iii)	Diagram with A shown as positive and B as negative (1) and the charges shown on the sides of the sphere which are nearly touching.(1)	2
	(b)	(i)	[$1.6 \times 10^{-19} \times 300 \times 10^{9}$ =] 4.8×10^{-8} C UNIT mark	1
		(ii)	$I = \frac{4.8\times10^{-8}}{20\times10^{-12}}$ (1) = 2.4×10^{3} [A] (1) allow e.c.f from (b)(i)	2
			Question 5 Total	**[9]**
6	(a)	(i)	$\frac{\text{[Total] distance}}{\text{time}}$ not rate of change of distance	1
		(ii)	$\frac{\text{displacement}}{\text{time}}$ not rate of change of displacement	1
	(b)	(i)	$\frac{6.0}{25}$ = 0.24[m s^{-1}]	1
		(ii)	$\frac{\sqrt{3.5^2+2.5^2}\,(1)}{25}$ = 0.17 [m s^{-1}](1)	2
	(c)	(i)	$E = IVt$ <u>used</u> [i.e. relevant numbers substituted] (1) Energy stored = 2.5 × (60 × 60) or 1.25 x 2 x (60 x 60) (1) × 15.0 i.e. conversion to seconds $E = 1.35 \times 10^{5}$ [J] or 37.5 Watt hours (1) Watt hours unit needed	3
		(ii)	$\frac{1.35\times10^{5}}{30}$ (1) = 4.5×10^{3} s [= 1¼ hour] (1) allow e.c.f. from (c)(i)	2
	(d)	(i)	Power = $\frac{\text{Work [or energy]}}{\text{time}} = \frac{F\times d}{t}$ Identification of work as $F \times d$ in context of power equation (1) Identification of velocity as d/t (1)	2
		(ii)	9 = F × 0.24 (1) [or by impl. – use of 0.24 m s^{-1}, i.e. identification of relevant v] allow e.c.f. from (b)(i) F = 37.5 [N] (1)	2
			Question 6 Total	**[14]**

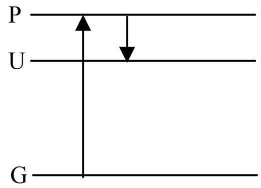
Question			Marking details	Marks Available
7	(a)		Relevant pairs of values chosen (1) [e.g. 10 m $s^{-1} \rightarrow$ 8 m and 20 m $s^{-1} \rightarrow$ 32 m] Method / strategy, e.g compare $\frac{\text{distance}}{\text{speed}^2}$ for the pairs of values. (1) Conclusion clearly linked to calculation (1) Allow e.c.f for values of pairs if marking points 2 and 3 completed correctly.	3
	(b)	(i)	Identification of relevant equation: e.g. $v^2 = u^2 + 2ax$ (1) Identification of x = 18 m (1) deceleration = 6.3 [m s^{-2}] or a = -6.3 [m s^{-2}] (1)	3
		(ii)	$F = 800 \times 6.3 = 5000$ [N] allow e.c.f. from (b)(i)	1
	(c)		Reaction time is independent of speed / doesn't change (1) Then $v \propto d$ [from $d = vt$] (1)	2
	(d)	(i)	21 + 72 = 93 [m]	1
		(ii)	No change to thinking distance (1) [Reduced acc/deceleration would] increase braking distance (1)	2
	(e)		Time required = $\frac{\text{total distance}}{\text{speed}} = \frac{10}{50}$ [= 0.2 hour] (1) Time for first 6.0 km = $\frac{6.0}{80}$ [= 0.075 hour] (1) remaining time = 0.2 – 0.075 = 0.125 hour (1) Speed for remaining 4 km = $\frac{4}{0.125}$ = 32 [km / h] or 8.9 [m s^{-1}] (1)	4
			Question 7 Total	**[16]**

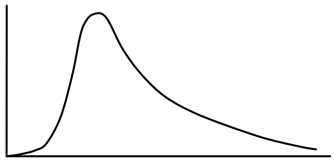
PH2

Question			Marking details	Marks Available
1	(a)	(i)		2
		(ii)	Either $\lambda = 1.16$ [m] (1) $f = 50$ [Hz] (1) $v = 58$ [m s^{-1}](1) Or $\lambda = 1.16$ [m] (1) $v = \frac{\lambda}{T}$ **or** $v = \frac{1.16}{0.02}$ (1) $v = 58$ [m s^{-1}](1) [1 mark only if either 1.2m used or 1.74/0.03 used]	3
		(iii)	All 4 nodes labelled	1
		(iv)	Any crosses placed in first **and** last loops	1
	(b)	(i)	 Either line drawn ✓	1
		(ii)	$f = 17$ Hz (1) UNIT mark New wavelength = 3.48 m **or** 3 × previous λ **or** appeal to $f = [n]\frac{v}{2L}$ (1) (Allow 1 mark only if $f = 34$ Hz) Allow e.c.f. from (b)(i)	2
	(c)	(i)	The displacement at any point is the [vector] sum of the displacements of the individual waves.	1
		(ii)	$t = 1.0$ s: horizontal line shown (1) $t = 2.0$ s: inversion of $t = 0$ shown (1)	2
			Question 1 total	**[13]**

Question			Marking details	Marks Available
2	(a)	(i)	I. Vibrations / oscillations / displacements [accept particle displacements] are perpendicular / at right angles / 90° to the propagation directions [or equiv.]	1
			II. Vibrations / oscillations / displacements [accept particle displacements] are in one direction [accept in one plane]	1
		(ii)	Alternates [gradually] between light and dark (1) 2 extinctions / dark places in 360°/ or equivalent (1) [Accept an answer which assumes initially bright or initially dark]	2
	(b)	(i)	I. Light spreads out [round edge of each slit] [or equiv.]	1
			II. So light from the two slits overlaps [or equiv.]	1
		(ii)	I. $\lambda = \frac{2.0\text{ mm} \times 0.50\text{ mm}}{1.5\text{ m}}$ (1) = 670 n[m] (1) [667 nm, accept 700 nm]	2
			II. Fringe separation increased (1); [bright] fringes dimmer (1)	2
	(c)		$3\lambda = d \sin 77°$ [or by impl.] (1) $d = \frac{1}{5.00 \times 10^5}$ m [= 2.00×10^{-6} m] [or by impl.] (1) λ = 650 n[m] (1)	3
			Question 2 total	**[13]**

Question			Marking details	Marks Available
3	(a)	(i)	Smooth curve drawn through all the points	1
		(ii)	46° [or as appropriate from drawn line]	1
		(iii)	Reflected ray drawn with angle of reflection equal to θ_P **by eye**.	1
		(iv)	Any of: $\frac{\sin 14^\circ}{\sin 10^\circ}$ ✓ 1.39 [±0.05]✓ or by implication; $\frac{\sin 28.5^\circ}{\sin 20^\circ}$ 1.40[±0.05]; $\frac{\sin 44^\circ}{\sin 30^\circ}$ 1.40[±0.05]; $\frac{\sin 64^\circ}{\sin 40^\circ}$ 1.40[±0.05]; $\frac{\sin 82^\circ}{\sin 45^\circ}$ 1.40[±0.05]	2
		(v)	I. Any 2 × (1) from • Straight ✓ • Through the origin ✓ • Gradient > 1 ✓	2
			II. [*n* is the] gradient	1
	(b)	(i)	1.530 sin *c* = 1.520 [sin 90°] (1) [or by impl.] *c* = 83° (1)	2
		(ii)	θ = 7° [accept 6.5°] e.c.f. from (b)(i)	1
		(iii)	Smaller <u>differences</u> in distances travelled or times taken [by light travelling different paths] (1), so less blurring / smearing / overlap of data / pulses (1) [**or** data can be transmitted at a greater rate] Less multimode dispersion only award 2nd mark	2
			Question 3 Total	**[13]**
4	(a)		$f_{\text{Thresh}} = \frac{\phi}{h}$ (1) [or by impl.] = 5.1[3] × 10^{14} [Hz] (1)	2
	(b)	(i)	Photon $E = 6.63 \times 10^{-34} \times 7.4 \times 10^{14}$ [= 4.91×10^{-19}J][or by impl.](1) $E_{\text{k max}}$ [= $4.91 \times 10^{-19} - 3.4 \times 10^{-19}$] = 1.5×10^{-19} [J] (1)	2
		(ii)	[A single] photon gives its energy to an electron (1) Some of the energy used to escape from the metal (1).	2
	(c)	(i)	Points plotted at (5.1×10^{14}Hz, 0) and (7.4×10^{14} Hz, 1.5×10^{-19} J) (1) Allow e.c.f. from (a) and (b)(i) Straight line drawn through points (1) (One correct point only and a positive slope line = 1 mark)	2
		(ii)	*h* / the Planck constant	1
		(iii)	Straight line drawn with same gradient as (i) and to the right	1
			Question 4 Total	**[10]**

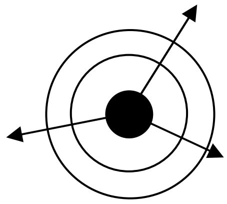
Question			Marking details	Marks Available
5	(a)		$E = \frac{hc}{\lambda}$ [or equiv. eg. $E = hf$ and $\lambda = \frac{c}{f}$ or by impl] (1) $\lambda_{UG} = 6.95 \times 10^{-7}$ [m] (1)	2
	(b)	(i)	More electrons in level U than in level G	1
		(ii)	They / the photons would be absorbed [accept ‘disappear’] (1). The energy would be used to excite ions [accept atoms] / raise electrons from G to U [or equiv.] (1)	2
		(iii)	 **Both** transitions shown	1
		(iv)	Any 2 x (1) from • Passing / incident photon ✓ • Excited ion ✓ • Electron drops to lower level ✓ • The incident photon must have wavelength = λ_{UG} [or 695 nm] **or** must have energy 2.86×10^{-19} J ✓ 3rd mark • 2 photons where there was one previously. Accept by implication e.g. in phase with the incident photon.	3
	(c)		Any 2 → (1); any third →(2) from • [plane] polarised ✓ • Coherent✓ • Monochromatic✓ • Parallel beam✓	2
			Question 5 Total	**[11]**

Question			Marking details	Marks Available
6	(a)	(i)	$\lambda_{\text{Peak}} = \dfrac{2.90\times10^{-3}\text{ K m}}{2.5\times10^{7}\text{ K}}$ (1) = 1.16 × 10^{-10} [m] (1)	2
		(ii)	X-ray / γ-ray	1
		(iii)		1
		(iv)	Spectral intensity low <u>in high λ 'tail'</u> but not zero.	1
	(b)		$P = \sigma A \times (2.5 \times 10^{7}\text{ K})^{4}$ [or by impl.] (1) $A = 4\pi \times 11000^{2}$ [or by impl.] (1) [= 1.52×10^{9} m^{2}] $P = 3.4 \times 10^{31}$ W (1) UNIT mark	3
	(c)		$A_2T_2^{\,4} = A_1T_1^{\,4}$ (1) or $T_2^{\,4} = \dfrac{3.4\times10^{31}}{5.67\times10^{-8}\times3.04\times10^{9}}\text{K}^4$ e.c.f from (b) $T_2 = 2.1 \times 10^{7}$ K (1)	2
			Question 6 Total	**[10]**
7	(a)	(i)	Any 3 × (1) from • d have $^{1}/_{3}$ electronic charge / $-^{1}/_{3}e$ charge✓ • ds have greater mass than e s✓ • ds feel strong force [or interact with gluons]; e don't✓ • ds cannot be isolated; e can [**or** d can only be found in specific groupings; e can be by itself] ✓ • ds have lepton number 0, es have lepton number 1 ✓	3
		(ii)	[3 × ($-^{1}/_{3}e$)] = $-e$ [accept e or −1 or 1.6 × 10^{-19} C with some justification]	1
	(b)		Any 2 × (1) from • Very short decay time ✓ • Individual quark flavours conserved ✓ • Accept: no neutrino [and no γ] emission	2
	(c)	(i)	x is an electron (1) y is an antineutrino (1) clear logical reasoning based on the laws of conservation of charge and of lepton number (1)	3
		(ii)	Weak	1
			Question 7 Total	**[10]**

PH4

Question			Marking details	Marks Available
1	(a)		$p = \frac{1}{3}\rho\overline{c^2}$ rearranged e.g. $\overline{c^2} = \frac{3p}{\rho}$ (1) $c_{rms} = 514$ [m s^{-1}] (1)	2
	(b)	(i)	Mass of particle = $\frac{3.75}{8.06\times10^{22}}$ g (1) [4.63 × 10^{-26} kg] = 27.9u (1) [so molar mass = 27.9 [g mol^{-1}] [~ 28 g mol^{-1}] **Or:** Amount of gas = $\frac{8.06\times10^{22}}{6.02\times10^{23}}$ mol (1) [= 0.134 mol] So molar mass = $\frac{3.75\text{ g}}{0.134\text{ mol}}$ [=28 g mol^{-1}]	2
	(c)	(i)	$p = mv$ used , e.g. $p = 460m$ (1) p = 2.14 × 10^{-23} kg m s^{-1} / N s ((**UNIT mark**)) (1)	2
		(ii)	$\lambda = \frac{h}{p}$ (1)[manipulation: $p = \frac{h}{\lambda}$ by itself is not enough] [or by impl.] λ = 3.1 × 10^{-11}[m] (1) Allow e.c.f.	2
			Question 1 total	**[8]**
2	(a)	(i)	(20.0, 1.00) labelled A and (23.0, 1.00) labelled B	1
		(ii)	(23.0, 0.80) labelled C	1
	(b)	(i)	$n = \frac{pV}{RT}$ (1) [manipulation – or by impl.] = 0.745 [mol] (1)	2
		(ii)	[$N = nN_A$ =] 4.5 × 10^{23} Allow e.c.f.	1
		(iii)	$T = \frac{pV}{nR}$ [or by impl.]; (or V/T = constant or P/T = constant) T_B = 371 [K] **and** T_C = 297 [K] (1) e.c.f.	2
	(c)		at least two values substituted into $E = mc\Delta\theta$ (1) $\Delta\theta$= 1.36 [K or °C] (1)	2
	(d)		Area under graph = work or by clear implication (1) detail, e.g. ½ × 0.21×10^5 × 3 × 10^{-3} (1) [square counting ok] 31.5 [J] or 30 [J] (ans) (1)	3
	(e)		$\Delta U = Q - W$ quoted or by clear implication or 1st law quoted (1); and $\Delta U = 0$ (1)	2
			Question 2 total	**[14]**

Question			Marking details	Marks Available
3	(a)		$A = \pi \times 1.8^2$ or implied in numbers (1) Volume per second = $\pi r^2 v$ [or by some method e.g. $m = \rho v$] (1) Mass flow rate = $\pi \times 1.8^2 \times 250 \times 0.4$ [= 1018 kg s^{-1}] (1)	3
	(b)		Thrust = Mass / sec $\times \Delta v$ (1) [or equiv.][i.e. *(a)* $\times \Delta v$] [or by impl.] = 40 [kN] (1)	2
	(c)		Aeroplane momentum is constant (1) [this mark is implied if the candidates imply or state that the exhaust air speed = 250 m s^{-1}] No (overall) change in air momentum (1) **Or** (Δ) momentum of air forwards (due to drag etc.) (1) is balanced by (Δ) momentum of exhaust air backwards (1) **Or** equivalents if candidate states momentum of aeroplane is decreasing (due to small decrease in mass i.e. kerosene loss) e.g. momentum of aeroplane is decreasing <u>due to decreasing mass</u> (1) so overall transfer of momentum to air to the right (1)	2
			Question 3 Total	**[7]**
4	(a)		m_1 Earth's mass (1) m_2 satellite mass (1) r radius of <u>orbit</u> or distance between masses (1) ω angular velocity or angular speed [accept: pulsatance] [of satellite] (1)	4
	(b)		m_2 clearly cancelled and r collected or by implication (1) e.g. $\frac{Gm_1m_2}{r^3} = m_2\omega^2$ $\omega = \frac{2\pi}{T}$ substituted or quoted (1) clear algebra leading to $r = \sqrt[3]{\frac{Gm_1T^2}{4\pi^2}}$ (1) but $r = h + R_E$ (1)	4
	(c)		period of orbit, $T = 24 \times 60 \times 60$ s or 86400 s (1) $h = 35.9 \times 10^6$ m (1)	2
	(d)		$\Delta V = \pm\frac{Gm}{r} \pm \frac{Gm}{r}$ (i.e. attempt at combining potentials) P.E. = $m\Delta V$ used (1) i.e. 850× any change in potential [N.B. $\Delta PE = \pm\frac{Gm}{r} \pm \frac{Gm}{r}$ ✓✓] $\Delta PE = 4.51\times10^{10}$ J (**UNIT mark**) (1) Allow e.c.f.	3
			Question 4 Total	**[13]**

Question			Marking details	Marks Available
5	(a)		concentric rings: minimum 2 (1) arrows out: minimum 2 (1) correct labelling (1) 	3
	(b)		field inward [or equivalent e.g. opposite]	1
	(c)		values substituted into $E = \dfrac{Q}{4\pi\varepsilon_0 r^2}$ (1) [or by impl.] $E = 2.05 \times 10^7$ V m^{-1} or N C^{-1} [or equivalent] ((**UN IT mark**))(1)	2
	(d)	(i)	values substituted into $V = \dfrac{Q}{4\pi\varepsilon_0 r}$ (1) [or by impl.] $V = 3.24 \times 10^6$ [V] (1)	2
		(ii)	zero	1
	(e)		$\Delta V = 3.24 \times 10^6$ [V] [or by impl.] Allow e.c.f. (1) $\Delta PE = q\Delta V$ (1) $E_k = 7.94$ [J] (1)	3
			Question 5 Total	**[12]**
6	(a)		$f = \dfrac{1}{T}$ (1); $f = 1.23$ [Hz] (1)	2
	(b)		$\omega = 2\pi f$ or $\dfrac{2\pi}{T}$ (1) = 2π x 1.23 (allow e.c.f.) or $2\pi/0.81$ = (7.76 rad s^{-1})	2
	(c)		natural frequency (period) close to walking frequency (period) (1) **resonance** occurs (1) which could break (or damage) bridge (1)	3
	(d)		A and ω subbed into $y = A \sin \omega t$ (1) $y = -10.3$cm (1) [N.B. y ~2.0 cm if calculators set to degrees - 1 mark only]	2
	(e)	(i)	$a = \omega^2 x$ or $\omega^2 A \sin \omega t$ (1) $\omega^2 x = 9.81$ m s^{-2} (1) $x = 16.1$ [cm] [16.3 if ω=7.76 rad s^{-1} used] (1)	3
		(ii)	Point indicated at ~ 0.12 s ecf (1) and 2nd point anywhere > 0.28 s (1)	2
			Question 6 Total	**[14]**

Question			Marking details	Marks Available
7	(a)		$\Delta\lambda = 2.50\ [\pm 0.05] \times 10^{-14}$ m (1) $v = \dfrac{\Delta\lambda}{650\times10^{-9}}\times3.00\times10^{8}$ (1) [= 11.54 m s^{-1} if 2.5 × 10^{-14} m used]	2
	(b)		period = 12.4 - 2.6 [= 9.8 years] allow 9.8 ± 0.1 years (1) $v = \dfrac{2\pi r}{T}$ or equiv [e.g. $v = \omega r$ and $\omega = \dfrac{2\pi}{T}$](1) radius = 5.68 × 10^{8} [m] (1) Allow e.c.f on T [r = 5.90 x 10^{8} m if v = 12 m s^{-1} used]	3
	(c)		$d^3 = \dfrac{T^2G(M_1+M_2)}{4\pi^2}$ [i.e. algebra nearly complete] (1) $M_1 + M_2 \approx M_1$ stated [or in words] (1) $d = \sqrt[3]{\dfrac{(9.81\times24\times365\times3600)^2\times6.67\times10^{-11}\times2\times10^{31}}{4\pi^2}}$ (1) [= 1.48 × 10^{12} m] Allow e.c.f.	3
	(d)		$r_1 \approx \dfrac{M_2}{M_1}d$ or similar (1) M_2 = 7.7 × 10^{27} kg (1) Allow e.c.f.	2
	(e)		The temperature of the planet is greater than that of the Earth [or equiv.] (1) Because of factors of 3000 **and** 10^{2} [or 3000/10^{2} seen] (1) [Accept 30 times hotter]	2
			Question 7 Total	**[12]**

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