Question Number	Answer		Mark
21(a)(i)	Use of $\lambda_{\max}T = 2.898 \times 10^{-3}\text{m K}$ T = 3570 (K) <u>Example of calculation</u> $T = \dfrac{2.898 \times 10^{-3}\text{ m K}}{8.12 \times 10^{-7}\text{ m}} = 3569\text{ K}$	**(1)** **(1)**	**2**
21(a)(ii)	Use of $L = \sigma A T^4$ and $A = 4\pi r^2$ Use of $I = \frac{L}{4\pi d^2}$ Use of intensity of radiation at the Earth Intensity = 0.42 I_E (ecf from (a)(i)) **Or** 552 (Wm^{-2}) ≈ 583.0 (W m^{-2}) [Using the 'show that' value of T gives I = 604 W and I = 0.44 I_E] <u>Example of calculation</u> $L = 5.67 \times 10^{-8}\text{ W m}^{-2}\text{ K}^4 \times 4\pi \times (2.03 \times 10^8\text{ m})^2 \times (3570\text{ K})^4$ $\therefore L = 4.76 \times 10^{24}\text{ W}$ $I = \dfrac{4.76 \times 10^{24}\text{ W}}{4\pi \times (2.55 \times 10^{10}\text{ m})^2} = 583.0\text{ W m}^{-2}$ Intensity = $\dfrac{583\ W\ m^{-2}}{1380\ W\ m^{-2}} I_E = 0.422\ I_E$ $I = 0.4 \times 1380\text{ Wm}^{-2} = 552\text{ Wm}^{-2}$	**(1)** **(1)** **(1)** **(1)**	**4**

Question Number	Answer		Mark
21(b)	Use of $V = \frac{4}{3}\pi r^3$	**(1)**	
	Use of $\rho = \frac{m}{V}$	**(1)**	
	Use of $g = \frac{GM}{r^2}$	**(1)**	
	$g = 18.4\ \mathrm{N\ kg^{-1}}$ [Intermediate rounding gives $g = 18.3\ \mathrm{N\ kg^{-1}}$]	**(1)**	
	Conclusion consistent with calculated value for g compared with $4g$ <u>Example of calculation</u> $V = \frac{4}{3}\pi \times (1.02 \times 10^7)^3 = 4.45 \times 10^{21}\ \mathrm{m^3}$ $m = 6.44 \times 10^3\ \mathrm{kg\ m^{-3}} \times 4.45 \times 10^{21}\ \mathrm{m^3} = 2.86 \times 10^{25}\ \mathrm{kg}$ $g = \frac{6.67 \times 10^{-11}\ \mathrm{N\ m^2\ kg^{-2}} \times 2.86 \times 10^{25}\ \mathrm{kg}}{(1.02 \times 10^7\ \mathrm{m})^2} = 18.4\ \mathrm{N\ kg^{-1}}$ Ratio $= \frac{18.4\ \mathrm{N\ kg^{-1}}}{9.81\mathrm{N\ kg^{-1}}} = 1.87$ which is less than 4, so humans could survive the gravitational field strength	**(1)**	**5**
	Total for question 21		**11**