Question Number	Answer		Mark
21(a)(i)	λ_{max} read from graph	**(1)**	**3**
	Use of $T = \frac{2.898 \times 10^{-3}\ \text{m K}}{\lambda_{\text{max}}}$	**(1)**	
	T = 3400 (K) (accept 3350K – 3450K) [min 2 sf]	**(1)**	
	Example of calculation λ_{max} = 850 nm $T = \frac{2.898\ \times 10^{-3}\ \text{m K}}{850\ \times 10^{-9}\ \text{m}} = 3410\ \text{K}$		
21(a)(ii)	Use of $A = 4\pi r^2$	**(1)**	**5**
	Use of $L = \sigma A T^4$	**(1)**	
	Use of $L_{\text{Sun}} = 3.83 \times 10^{26}$ W	**(1)**	
	$\frac{L}{L_{\text{Sun}}} = 0.35\%$ (allow ecf from(a)(i))	**(1)**	
	Calculated value of ratio compared with 0.5% and conclusion made	**(1)**	
	Or		
	Use of $A = 4\pi r^2$	**(1)**	
	Use of $L = \sigma A T^4$	**(1)**	
	Use of $L_{\text{Sun}} = 3.83 \times 10^{26}$ W	**(1)**	
	$L_{\text{Ross}} = 1.34 \times 10^{24}$ W **and** 0.5% $L_{\text{Sun}} = 1.92 \times 10^{24}$ W	**(1)**	
	Calculated values of L_{Ross} and 0.5% L_{Sun} compared and conclusion made	**(1)**	
	[Use of show that value of T gives $L_{Ross} = 8.04 \times 10^{23}\ \text{W m}^{-2}$ Use of show that value gives ratio = 0.0021]		
	Example of calculation $L = 4\pi(1.18 \times 10^{8})^2 \times 5.67 \times 10^{-8}\ \text{W m}^{-2}\ \text{K}^{-4} \times (3400)^4 = 1.33 \times 10^{24}\ \text{W m}^{-2}$ $\frac{L}{L_{\text{Sun}}} = \frac{1.33 \times 10^{24}\ \text{W}}{3.83 \times 10^{26}\ \text{W}} = 0.00346$ $\therefore L = 0.35\%$ of L_{Sun} which is less than 0.5%, so statement is correct		

21(b)	Equate $F = \frac{GMm}{r^2}$ and $F = m\omega^2 r$	**(1)**	
	Use of $\omega = \frac{2\pi}{T}$	**(1)**	
	$T = 2.29 \times 10^6$ s	**(1)**	
	OR		
	Use of $F = \frac{GMm}{r^2}$ **with** $F = \frac{mv^2}{r}$	**(1)**	
	Use of $v = \frac{2\pi r}{T}$	**(1)**	
	$T = 2.29 \times 10^6$ s	**(1)**	**3**
	Example of calculation $\frac{GMm}{r^2} = m\omega^2 r$ $\therefore \omega = \sqrt{\frac{GM}{r^3}} = \sqrt{\frac{6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2} \times 3.38 \times 10^{29}\ \text{kg}}{(0.096 \times 1.50 \times 10^{11}\ \text{m})^3}} = 2.75 \times 10^{-6}\ \text{rad s}^{-1}$ $T = \frac{2\pi}{\omega} = \frac{2\pi}{2.75 \times 10^{-6}\ \text{s}^{-1}} = 2.29 \times 10^6$ s		
	Total for question 21		**11**