Question Number	Answer		Mark
20(a)	A main sequence star is fusing hydrogen (into helium) in the core of the star	**(1)**	**1**
20(b)(i)	Use of $L = A\sigma T^4$ **and** $A = 4\pi r^2$	**(1)**	**2**
	$r = 6.94 \times 10^8$ (m)	**(1)**	
	Example of calculation $r = \sqrt{\frac{L}{4\pi\sigma T^4}} = \sqrt{\frac{3.83 \times 10^{26}\ \text{W}}{4\pi \times 5.67 \times 10^{-8}\ \text{W m}^{-2}\ \text{K}^{-4}\ (5780\ \text{K})^4}} = 6.94 \times 10^8\ \text{m}$		
20(b)(ii)	Use of $L = A\sigma T^4$ **and** $A = 4\pi r^2$	**(1)**	**3**
	Use of $\lambda_{max} T = 2.898 \times 10^{-3}$ m K	**(1)**	
	$\lambda_{max} = 9.8 \times 10^{-7}$ (m) (ecf value of r from (i))	**(1)**	
	Example of calculation $T = \sqrt[4]{\frac{L}{4\pi r^2 \sigma}} = \sqrt[4]{\frac{1600 \times 3.83 \times 10^{26}\ \text{W}}{4\pi\ (150 \times 7.0 \times 10^8\ \text{m})^2 \times 5.67 \times 10^{-8}\ \text{W m}^{-2}\ \text{K}^{-4}}}$ $= 2972$ K $\lambda_{max} = \frac{2.898 \times 10^{-3}\ \text{m K}}{2972\ \text{K}} = 9.75 \times 10^{-7}$ m		
20(b)(iii)	λ_{max} is not in the wavelength range for red light **Or** λ_{max} is in the infrared wavelength range	**(1)**	**3**
	There is a range of wavelengths emitted around the value of λ_{max}	**(1)**	
	The most intense region of the visible spectrum will be red light (dependent upon MP2)	**(1)**	
	[Accept annotated sketches of the black body curve]		
20(c)	(The mass of the Sun decreases and so) the gravitational force exerted on the planet decreases	**(1)**	**3**
	The gravitational force provides a centripetal force	**(1)**	
	$F = m\omega^2 r$, ω decreases and so T must increase	**(1)**	
	OR		
	(The mass of the Sun decreases and so) the gravitational force exerted on the planet decreases	**(1)**	
	The gravitational force provides a centripetal force	**(1)**	
	$F = \frac{mv^2}{r}$, v will decrease and so T must increase	**(1)**	
	OR		
	Equate $F = \frac{GMm}{r^2}$ with $F = m\omega^2 r$	**(1)**	
	Derive expression for T	**(1)**	
	Deduce that T will increase	**(1)**	
	Total for question 20		**12**