21 During their life cycle, stars go through a number of stages.

(a) Betelgeuse is a red giant star with a luminosity of 4.49×10^{31} W.

The peak intensity of radiation from Betelgeuse occurs at a wavelength of 850 nm.

(i) A website claims that the radius of Betelgeuse is 1000 times the radius of the Sun.

Assess the accuracy of this claim.

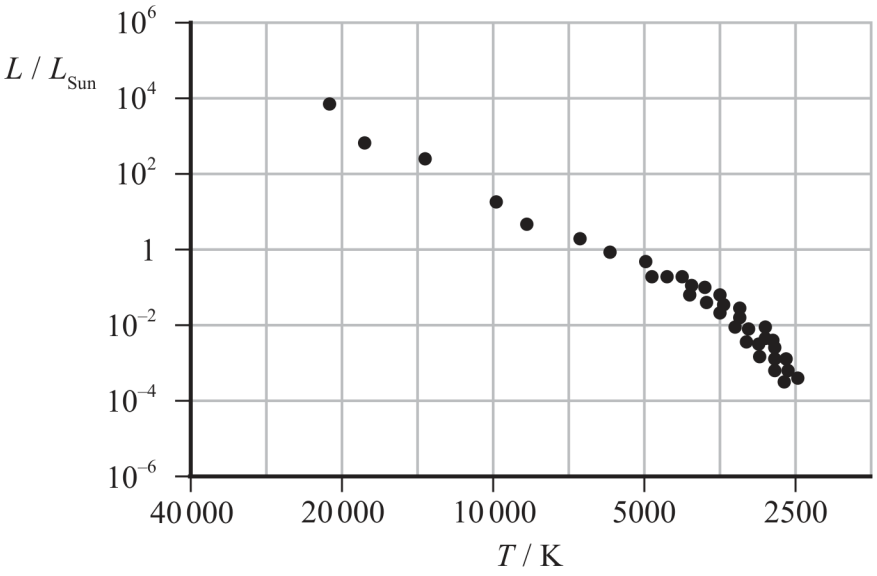
surface temperature of Sun = 5800 K
luminosity of Sun = 3.83×10^{26} W

(4)

(ii) The Hertzsprung-Russell diagram shows the positions of some main sequence stars.

Add the approximate positions of the Sun and Betelgeuse to the diagram. Mark the positions with labelled crosses.

(2)



(iii) State what is meant by a main sequence star.

(1)

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(b) The final stage of evolution for a massive star may be a rotating neutron star.

One neutron star rotates with a period of 33.5 ms.

As this star rotates, one side of the star moves towards the Earth while the other side of the star moves away from the Earth. This causes a range of wavelengths to be received by an observer.

Ultraviolet radiation of wavelength 91.2 nm is emitted by the star.

Calculate the maximum and minimum wavelengths observed.

diameter of star = 20.5 km

(6)

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Maximum wavelength observed = ...

Minimum wavelength observed = ...

(Total for Question 21 = 13 marks)