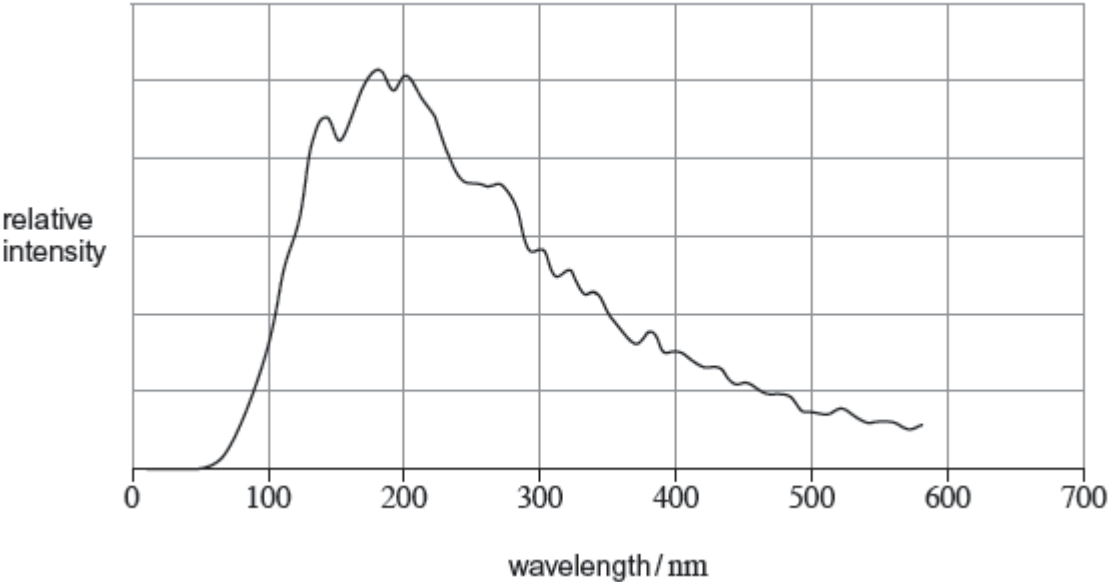**Q1.** The graph shows the variation of intensity with wavelength for the star 40 Eridani B.

(a) (i) Calculate the black body temperature of 40 Eridani B.

State an appropriate unit for your answer.

temperature = ... unit ....

(3)

(ii) 40 Eridani B has a total power output of 4.2×10^{24} W.

Calculate its radius.

radius = ... m

(2)

(b) (i) Which of the following regions of the Hertzsprung-Russell diagram does 40 Eridani B belong to?
Tick (✓) the correct answer.

main sequence	
dwarf star	
giant star	

(1)

(ii) Give reasons for your answer to part (i).

....

....

....

....

....

....

(2)
(Total 8 marks)

Q2.(a) Define the term absolute magnitude.

....

....

(1)

(b) The figure below shows the axes of a Hertzsprung-Russell diagram.

Mark suitable scales on the absolute magnitude and temperature axes.

absolute magnitude
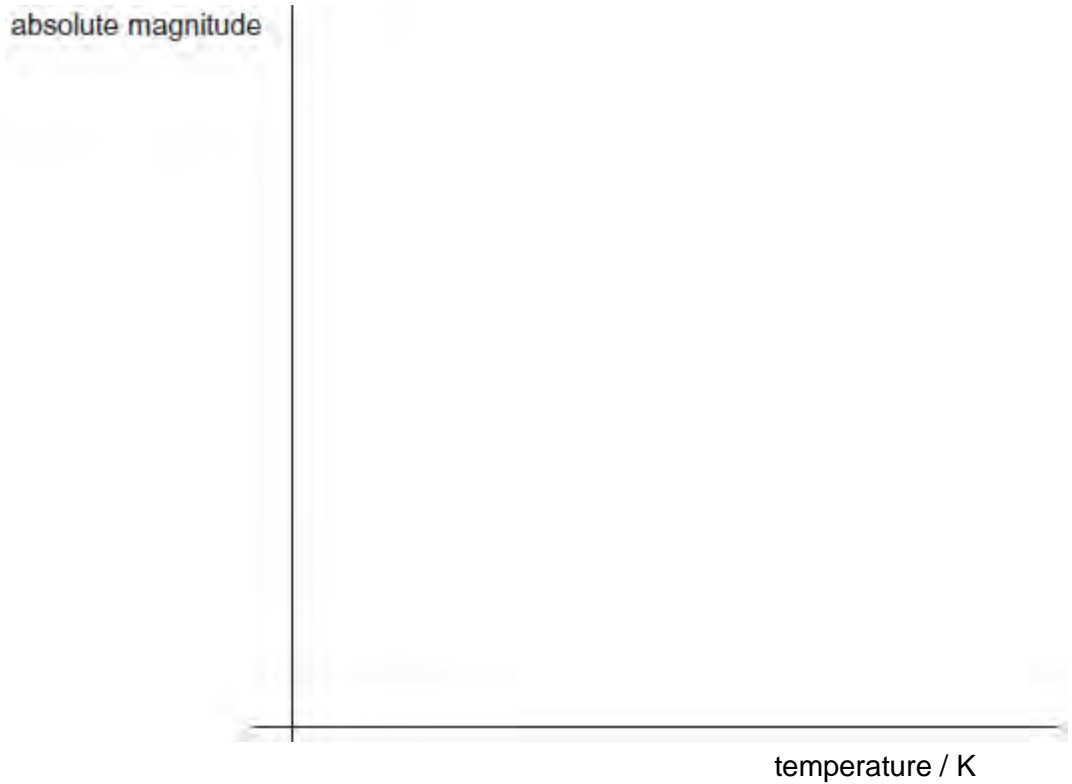
temperature / K

(2)

(c)   Label a possible position of each of the following stars on the diagram above:

(i)   the Sun

(1)

(ii)   star W, which has the same intrinsic brightness as the Sun, but has a significantly higher temperature

(1)

(iii)   star X, which has a similar spectrum to the Sun, but is significantly larger

(1)

(iv)   star Y, which is significantly larger than the Sun and has prominent absorption lines of neutral atoms and titanium oxide (TiO) in its spectrum.

(1)

(d)   How does the diameter of star W, in part (ii), compare with the diameter of the Sun? Explain your answer.

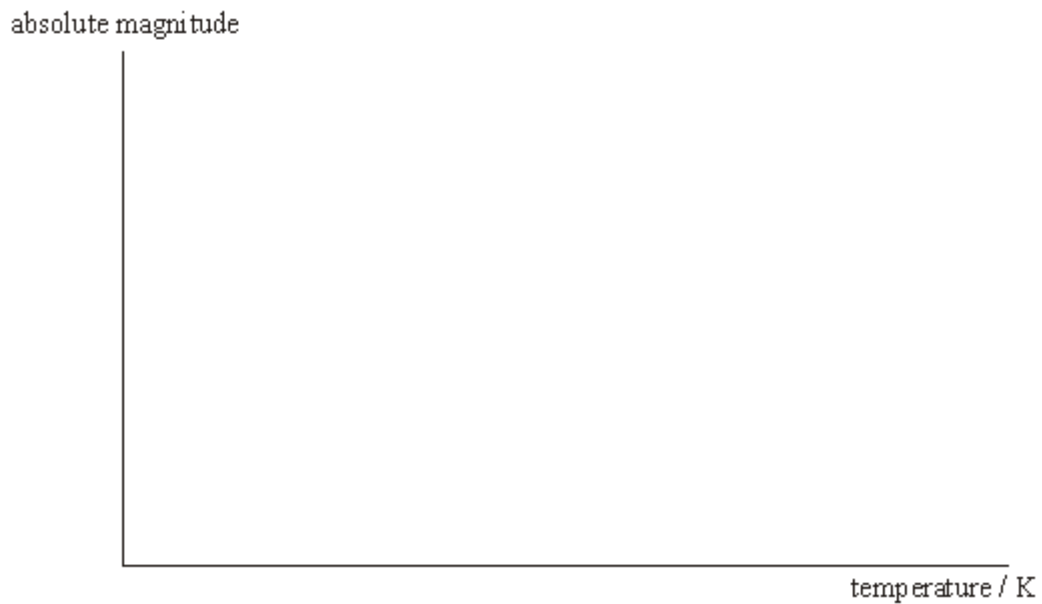...

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(3)
(Total 10 marks)

Q3.   (a)   Define the *absolute magnitude* of a star.

....

....

(1)

(b)   The figure below shows the axes of a Hertzsprung-Russell (H-R) diagram.

absolute magnitude

temperature / K

(i)   On each axis indicate a suitable range of values.

(ii)   Label with an S the current position of the Sun on the H-R diagram.

(iii)   Label the positions of the following stars on the H-R diagram:

   (1)   star W, which is significantly hotter and brighter than the Sun,

   (2)   star X, which is significantly cooler and larger than the Sun,

   (3)   star Y, which is the same size as the Sun, but significantly cooler,

   (4)   star Z, which is much smaller than the Sun, and has molecular bands as an important feature in its spectrum.

(7)
(Total 8 marks)

Q4.   (a)   (i)   On the axes below draw the Hertzsprung-Russell (H-R) diagram labelling the main sequence stars, dwarf stars and giant stars. Complete the horizontal axis by labelling the spectral classes.

absolute magnitude

```
    -10 ┐
        │
        │
     -5 ┤
        │
        │
      0 ┤
        │
        │
      5 ┤
        │
        │
     10 ┤
        │
        │
     15 ┴──────────────────────────────── spectral class
```

(ii)   On the H-R diagram, mark with an **X** the current position of the Sun and draw a line to represent the evolution of the Sun, from its formation to its eventual state as a white dwarf.

(4)

(b)   Matar is a star in the same spectral class as the Sun.

(i)   State **two** properties common to Matar and the Sun.

....

....

(ii)   The distance to Matar is 330 light years. What is this distance in parsec?

....

(iii)   The apparent magnitude of Matar is 2.9. Calculate its absolute magnitude.

....

....

....

....

(iv)   Which is the larger star, Matar or the Sun? Explain your answer.

....

....

....

....

....

(6)
(Total 10 marks)