10 (a) (i) State what is meant by the luminosity of a star.

.....

..... [1]

(ii) Explain how standard candles are used to determine the distance to a galaxy.

.....

.....

.....

.....

.....

..... [3]

(b) The Sun rotates on its axis. Points X, Y and Z are on the equator of the Sun as shown in Fig. 10.1.

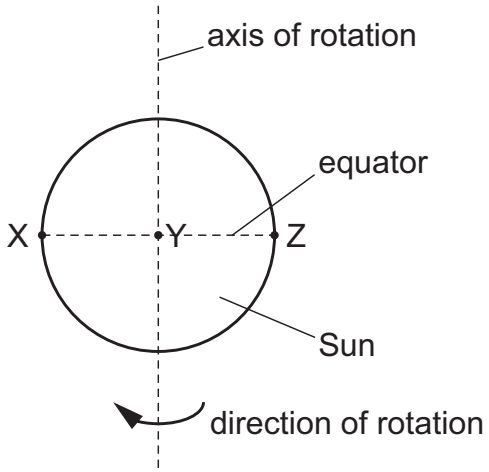

Fig. 10.1

The wavelengths of light from points X and Y are observed and recorded in Table 10.1.

Table 10.1

observed wavelength from X / nm	observed wavelength from Y / nm
656.2877	656.2831

(i) The Sun rotates with a period of 2.07×10^6 s.

Show that the radius of the Sun is 6.93×10^8 m.

[3]

(ii) State and explain how the expected wavelength of the light observed from Z compares with the emitted wavelength.

.....

.....

..... [2]

(iii) The luminosity of the Sun is 3.8×10^{26} W.

Use the information in **(b)(i)** to calculate the surface temperature of the Sun.

temperature = ... K [2]

[Total: 11]

10 (a) (i) State what is meant by the luminosity of a star.

.....

.....

..... [2]

(ii) Explain how a standard candle in a distant galaxy can be used to determine the distance of the galaxy from an observer.

.....

.....

.....

.....

..... [3]

(b) The Sun has a radius of 6.96×10^8 m and a surface temperature of 5780 K.
Light from the Sun is observed to have a peak intensity at a wavelength of 501 nm.

(i) Calculate the luminosity of the Sun. Give a unit with your answer.

luminosity = ... unit ..... [2]

(ii) Another star emits radiation that has a peak intensity at a wavelength of 624 nm.

Determine the surface temperature of this star.

surface temperature = ...K [2]

[Total: 9]

10 **(a)** A student observes different stars from the Earth.
Give **two** reasons why some stars appear brighter than others.

1 .....

.....

2 .....

.....

[2]

(b) State what is meant by a standard candle.

.....

..... [1]

(c) A spectral line from a star within a galaxy is observed to have a wavelength of 660.9 nm. The same spectral line measured in the laboratory is observed to have a wavelength of 656.3 nm.

(i) Show that the speed of the star relative to the Earth is $2.1 \times 10^{6}\,\text{m}\,\text{s}^{-1}$.

[1]

(ii) Calculate the distance to the star.

The Hubble constant is $2.3 \times 10^{-18}\,\text{s}^{-1}$.

distance = ... m [2]

(iii) State and explain what can be concluded about the Universe based on this change in observed wavelength.

.....

.....

.....

.....

..... [3]

[Total: 9]