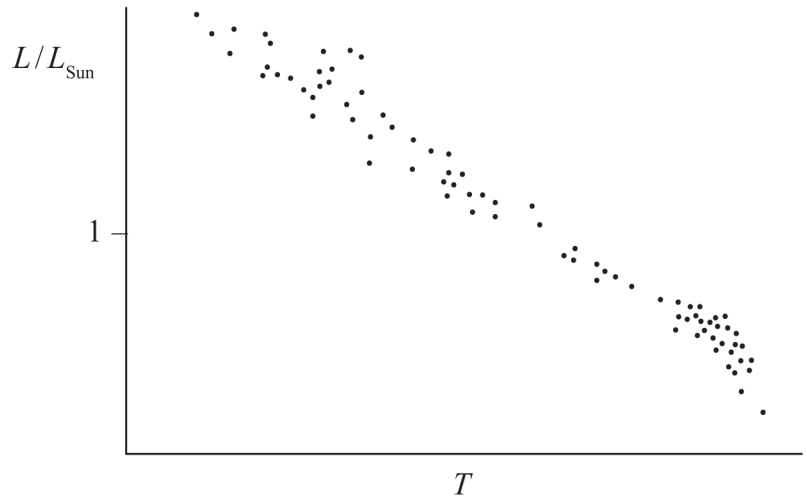
20 (a) The Hertzsprung-Russell (HR) diagram shows the relationship between luminosity L and surface temperature T for a range of stars.

The HR diagram below is for a young star cluster.



(i) Mark on the diagram the position of a star similar to the Sun.

(1)

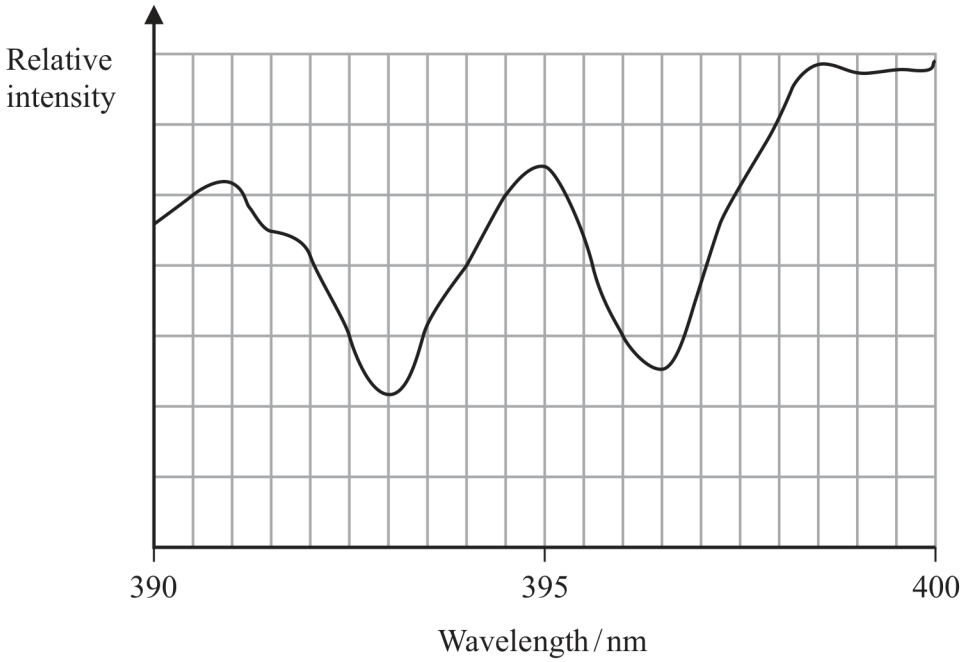
*(ii) The appearance of the HR diagram changes as stars in the cluster evolve.

Explain the changes in the appearance of the HR diagram as the star cluster gets older.

(6)

(b) One hundred years ago the Andromeda Galaxy was thought to be a group of stars within our own galaxy. In 1923, Edwin Hubble made observations on a standard candle within this group of stars. He concluded from these observations that Andromeda must be outside our own galaxy.

(i) The graph shows part of the spectrum of radiation received from Andromeda.



(Source: © Nasa)

The two intensity minima represent lines in the absorption spectrum of calcium. In the laboratory these two lines have a wavelength of 393.4 nm and 396.9 nm.

Determine the velocity of Andromeda relative to the Earth.

(4)

Velocity of Andromeda relative to the Earth = ...

(ii) Dust in space around a star may affect how bright the star appears to be.

It is claimed that dust around a standard candle would lead to the conclusion that the standard candle is a greater distance from Earth than the actual distance.

Assess the validity of this claim.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 20 = 14 marks)