Selected Questions – Set 5 (OCR)

1.

Sirius A and B are binary stars in our galaxy at a distance of 8.6 ly from the Sun. Sirius B is a white dwarf of diameter 12 km and mass 2.0×10^{30} kg.

(a) Calculate the density of Sirius B.

density = ... unit ..... **[3]**

(b) The mass of the Sun is the same as Sirius B. The Sun has a diameter of 1.4×10^{9} m.

Calculate the ratio

$$\frac{\text{gravitational field strength on the surface of Sirius B}}{\text{gravitational field strength on the surface of the Sun}}.$$

ratio = ... **[2]**

(c) Calculate the parallax angle in arc seconds for Sirius B.

1 pc = 3.1×10^{16} m

parallax angle = ... arc seconds **[2]**

(d) Sirius A is moving towards the Earth at a relative velocity of $7600\,m\,s^{-1}$. Calculate the percentage change in the wavelength of a spectral line observed from this star compared with an identical spectral line observed in the laboratory.

percentage change = ... % **[2]**

(e) A student suggests that the distance of Sirius A can be calculated using Hubble's law and the speed given in **(d)**. Discuss whether this suggestion is correct or incorrect.

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..... **[1]**

2.

(a) In the universe there are about 10^{11} galaxies, each with about 10^{11} stars with each star having a mass of about 10^{30}kg. Estimate the attractive gravitational force between two galaxies separated by a distance of 4×10^{22} m.

force = ... N **[3]**

(b) Explain why the galaxies do not collapse on each other.

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..... **[1]**

(c)

Fig. 10.1 shows some absorption spectral lines of the spectrum of calcium as observed from a source on the Earth and from a distant galaxy.

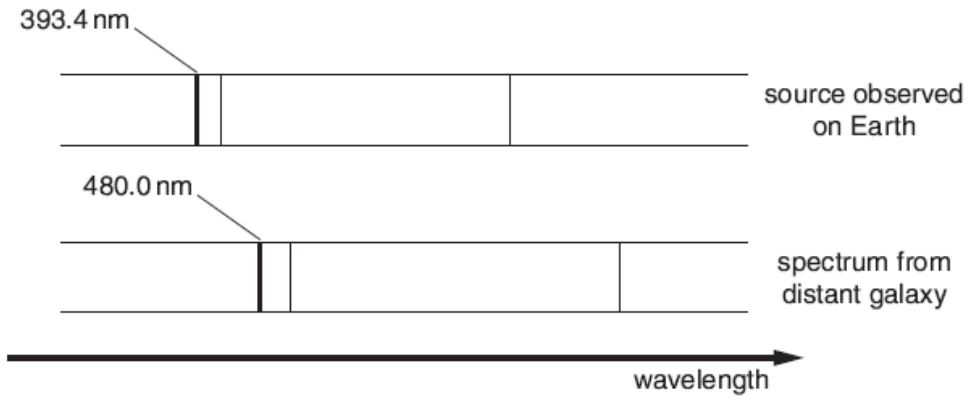

Fig. 10.1

(i) Describe an absorption spectrum.

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..... **[2]**

(ii) Use Fig. 10.1 to calculate the distance of the galaxy in Mpc. The Hubble constant has a value of $50\,km\,s^{-1}\,Mpc^{-1}$.

distance = ... Mpc **[3]**