6 This question is about astrophysics.

(a) (i) What is a star formed from?

(1)

- ☐ **A** a black dwarf
- ☐ **B** a nebula
- ☐ **C** a planet
- ☐ **D** a white dwarf

(ii) Which of these indicates that the Universe is expanding?

(1)

- ☐ **A** galaxies are moving further away from each other
- ☐ **B** galaxies rotate
- ☐ **C** it takes millions of light years for light to reach us from some stars
- ☐ **D** some stars in the Milky Way are accelerating towards our Sun

(iii) Which of these provides evidence for the Big Bang theory?

(1)

- ☐ **A** cosmic microwave background radiation
- ☐ **B** nebulae
- ☐ **C** neutron stars
- ☐ **D** ultrasound radiation

(iv) Which of these does red-shift provide evidence for?

(1)

- ☐ **A** galaxies are moving away from each other
- ☐ **B** nebulae contract to form stars
- ☐ **C** red giants shrink to red dwarfs
- ☐ **D** white dwarfs expand into red giants

(b) The spectra of stars and galaxies show lines at specific wavelengths that correspond to the spectra of hydrogen, helium and carbon.

Give reasons why lines corresponding to these elements are found in spectra from typical galaxies.

(2)

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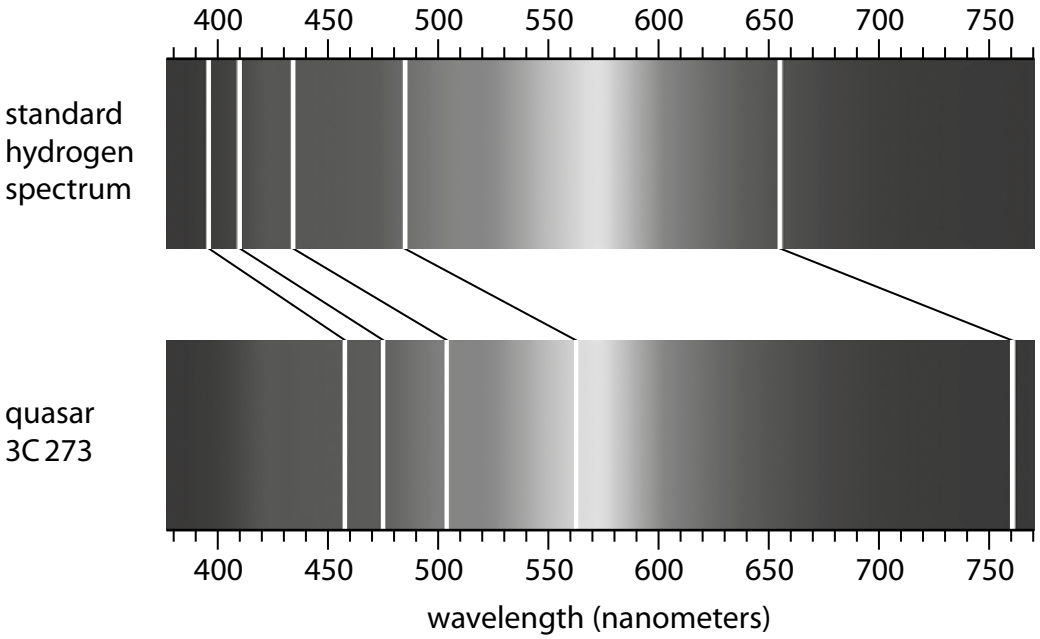
(c) The spectrum of light from an astronomical object called a quasar can be compared to the spectrum of hydrogen on Earth.



(i) Calculate the change in wavelength, $\Delta\lambda$, for the line at the red end of the spectrum.

(2)

$\Delta\lambda$ = ... nm

(ii) Calculate a value for the recessional velocity of the quasar using your value for $\Delta\lambda$.

speed of light in free space, $c = 3.0 \times 10^5$ km/s

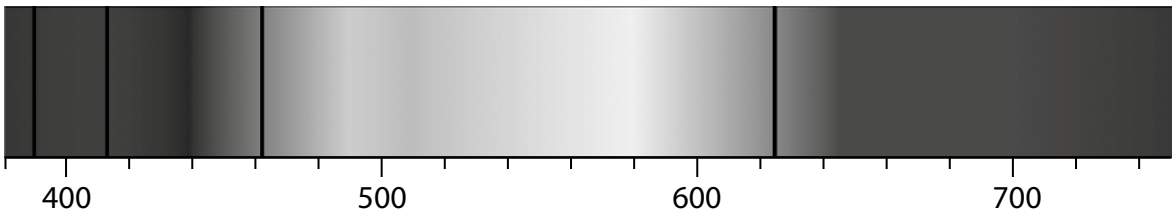
(3)

recessional velocity = ... km/s

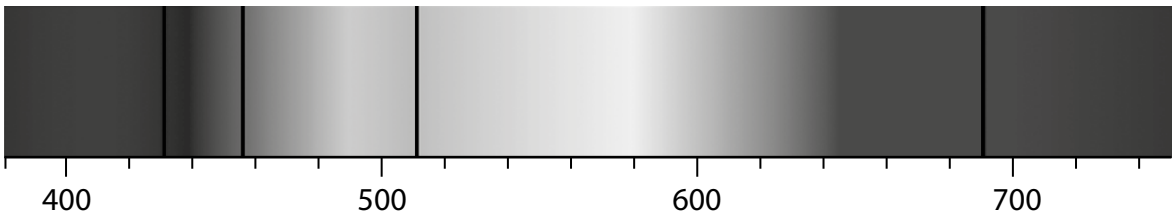
(d) An astronomer observes the light from a nearby galaxy.

She notices that the spectra for hydrogen from the right side and left side of the galaxy are different.

left side of the galaxy

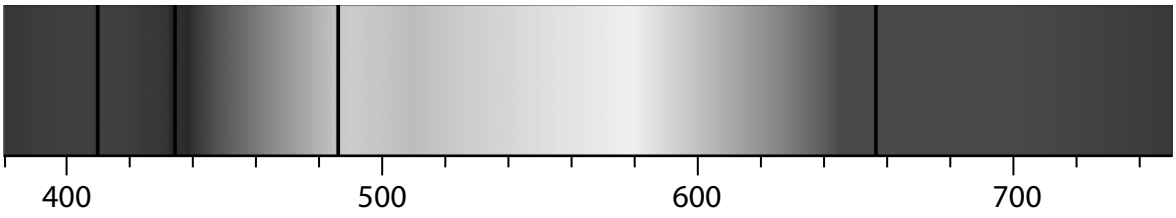


right side of the galaxy



She compares them to the spectrum for hydrogen from the centre of the galaxy.

centre of the galaxy



Explain what information the two spectra give about the movement of the galaxy.

(3)

(Total for Question 6 = 14 marks)

TOTAL FOR PAPER = 70 MARKS