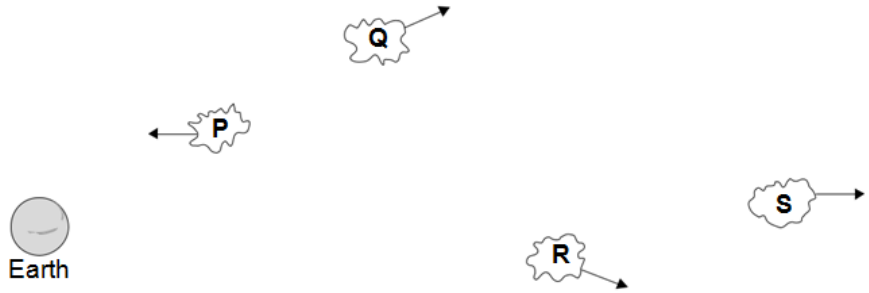
Red Shift and Big Bang 2

Q:1 In the same way as the sound from the car engine changes, the light from most galaxies also seems to have a change in observed frequency. This is called red-shift.

(a) The diagram shows four galaxies, P, Q, R and S. The arrows show the direction the galaxies are moving relative to the Earth.



Which one of the galaxies is moving the fastest?

Write the correct answer in the box. ☐

Which one of the galaxies will produce the biggest red-shift?

Write the correct answer in the box. ☐

(2 marks)

(c) Most scientists support a theory that the Universe began from a very small initial point. Red-shift can be used as evidence for this theory.

What name is given to the theory that the Universe began from a very small initial point?

_____

(1 mark)

(c) Cosmic microwave background radiation (CMBR) provides more evidence for this theory. CMBR is detected coming from space.Where does CMBR come from?

Tick (⍰) one box.

CMBR only comes from near the Sun. ☐

CMBR comes from all parts of the Universe. ☐

CMBR only comes from the Moon. ☐

(1 mark)

(d) Which statement gives the reason why most scientists support the theory that the Universe began from a very small initial point?

Tick (⍰) one box.

The evidence proves it happened. ☐

There is no other way of explaining how the Universe began. ☐

At the moment it is the best way of explaining our scientific knowledge. ☐

(1 mark)

Q:2 In 2005 a space telescope detected a star that exploded 13 billion years ago. The light from the star shows the biggest red-shift ever measured.

(a)(i) What is red-shift?

_____

(1 mark)

(ii) What does the measurement of its red-shift tell scientists about this star?

_____

_____

(1 mark)

(b) Red-shift provides evidence for the 'big bang' theory.

(i) Describe the 'big bang' theory.

_____

(2 marks)

(ii) Suggest what scientists should do if new evidence were found that did not support the 'big bang' theory.

(1 mark)

Q3 Read the passage.

> In the Solar System, the inner planets, such as the Earth, contain elements which are heavier than the elements hydrogen and helium.
>
> Our star, the Sun, is a medium sized star.
>
> If a star is much more massive than the Sun it will eventually swell into a red giant, start to contract, continue to contract and finally explode.

(a) What is the explosion called?

(1 mark)

(b) Explain why scientists believe that the Solar System was formed from the material produced when earlier stars exploded.

(3 marks)

Q 4. Read this statement from a website.

> Immediately after the 'big bang', at the start of the Universe, there were only atoms of the element hydrogen (H).
>
> Now the Universe contains atoms of over one hundred elements.

(a) Explain how atoms of the element helium (He) are formed in a star

(2 marks)

(b) Explain how, and when, atoms of different elements may be distributed throughout the Universe.

(2 marks)

Q5 (a) Our star, the Sun, is stable.Explain what the conditions need to be for a star to remain stable.

(2 marks)

b) Shortly after the 'big bang', hydrogen was the only element in the Universe. Explain how the other elements came to be formed.

(3 marks)

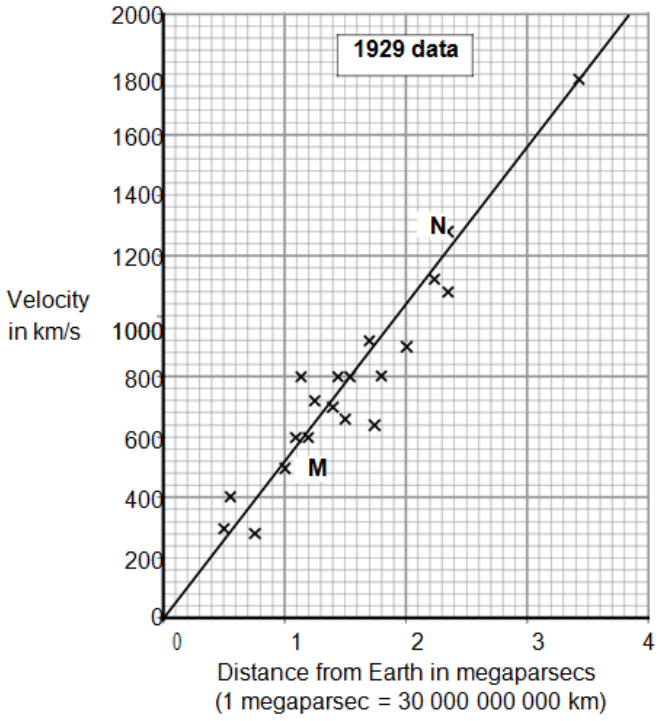
Q:6 (a) In 1929, the astronomer Edwin Hubble observed that the light from galaxies that are moving away from the Earth showed a red-shift.

What is red-shift ?

(1 mark)

(b) By measuring the red-shift, Hubble was able to calculate the speed at which the galaxies are moving away from the Earth. He was also able to calculate the distance of these galaxies from the Earth.

The graph shows some of the data calculated by Hubble.



(b) (i) The data from two galaxies, M and N, has been included in the graph. The light from galaxy M has a smaller red-shift than the light from galaxy N.

What does the difference in red-shift tell scientists about the two galaxies, M and N?

_____

_____

_____

_____

(2 marks)

(b) (ii) The gradient of the line drawn on the graph gives a number known as the Hubble constant. The Hubble constant can be used to estimate when the universe began.

Use the graph to calculate the value of the Hubble constant.

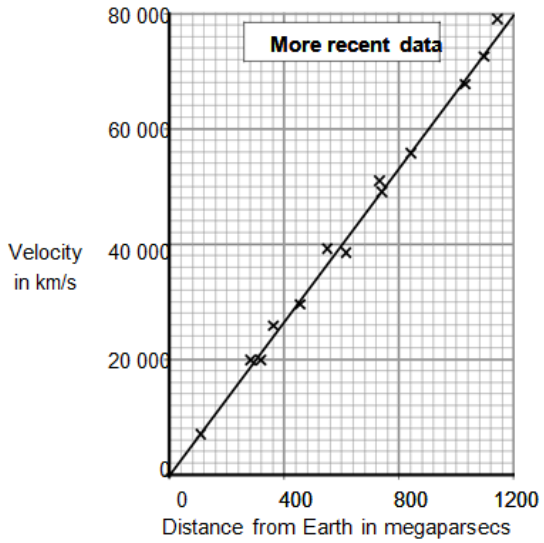
Show clearly how you obtained your answer.

_____

_____

Hubble constant = _____ . km/s per megaparsec (2 marks)

(b) (iii) More recently, data has been obtained from more distant galaxies.



The results from the more recent data give a totally different value for the Hubble constant to the one calculated from the 1929 data.

Which set of data, the 1929 or the more recent, is most likely to give the value closest to the true value for the Hubble constant?

Draw a ring around your answer.

1929 more recent

Give a reason for your answer.

_____

_____

(1 mark)

(c) The Andromeda galaxy is not moving away from the Earth. It is actually moving towards the Earth. This means that the light from Andromeda shows a blue-shift.

How do the wavelength and frequency of the light from Andromeda seem to have changed when viewed from the Earth?

(2 marks)

Q:7 (a) The 'Big Bang' theory uses red-shift as evidence to explain the beginning of the Universe.

How does the red-shift from distant galaxies provide evidence for the beginning of the Universe?

(3 marks)

(b) Cosmic microwave background radiation (CMBR) is a type of electromagnetic radiation. CMBR fills the Universe. It was first discovered in 1965 by two astronomers called Penzias and Wilson.

(b) (i) What do scientists believe is the origin of CMBR?

(1 mark)

(b) (ii) Why was the discovery of CMBR so important to the scientists believing the 'Big Bang' theory to be correct?

(1 mark)

(b) (iii) How is the wavelength of CMBR likely to change, if at all, over the next billion years?

_____

Give a reason for your answer.

_____

_____

(2 marks)

Q:8 (a) Observation of the spectra from distant galaxies provides evidence to support the 'Big Bang' theory.

(a) (i) Complete the following sentence.

Many scientists think that the 'Big Bang' theory describes the

._____

(1 mark)

(a) (ii) Tick (☒) one box to complete the sentence.

The discovery of cosmic microwave background radiation was important because it …

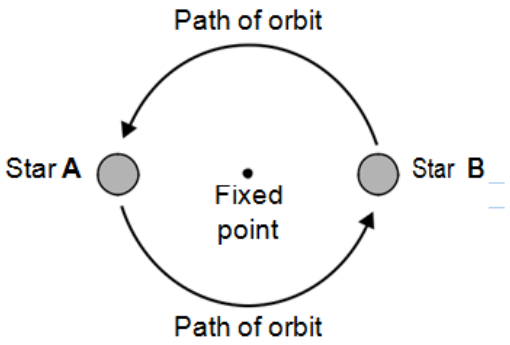
proved the 'Big Bang' theory to be correct. ☐

provided more evidence to support the 'Big Bang' theory. ☐

proved the Universe will continue to expand forever. ☐

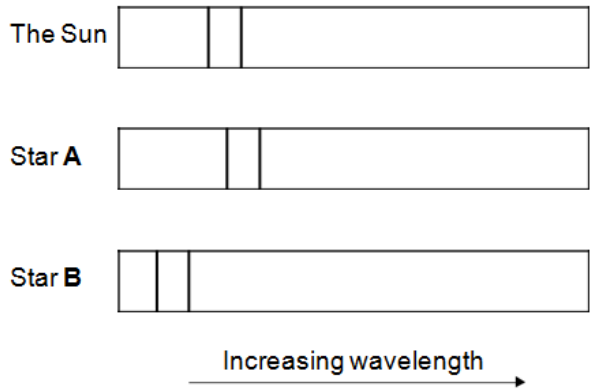
(1 mark)

(b) Many stars are part of a binary star system. Binary star systems have two stars.



The visible spectrum from stars includes dark lines. These lines are at specific wavelengths.

The diagram shows the position of two dark lines in the spectrum from the Sun. It also shows the same lines in the spectra from two stars A and B in a binary star system at the same point in time.



(b) (i) What name is given to the effect shown in the spectrum from star A?

_____

(1 mark)

(b) (ii) Scientists have concluded that the two stars in a binary star system orbit around a fixed point between the two stars.

A comparison of the spectra from the two stars in a binary star system provides evidence to support this conclusion.

Explain how.

_____

_____

_____

_____

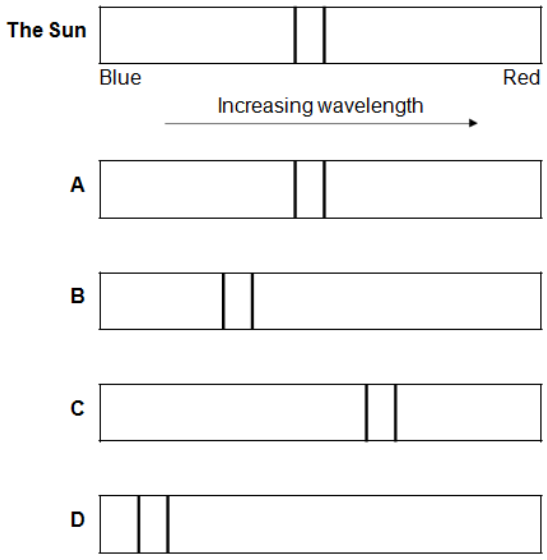
(3 marks)

Q:9 Scientists can use the visible light spectrum from distant stars to determine whether the stars are moving.

The visible light spectrum from stars includes dark lines at specific wavelengths.

(a) Figure 9 shows the visible light spectrum from the Sun and from four other stars, A, B, C and D.

Figure 9



(a) (i) Which star, A, B, C or D, is moving away from the Earth?

[1 mark]

(a) (ii) How does the speed of star B compare with the speed of star D? Tick (☒) one box.

The speed of star B is greater than the speed of star D. ☐

The speed of star B is less than the speed of star D. ☐

The speed of star B is the same as the speed of star D. ☐

[1 mark]

(b) A radio wave is emitted by a star.

The radio wave has a wavelength of 1500 m and a frequency of 200 000 Hz.

Calculate the speed of this radio wave.

Use the correct equation from the Physics Equations Sheet.

Choose the correct unit from the list below.

m m/s m/s2

Speed = _____ unit _____

[3 mark]

TOTAL MARKS=49