Q1. In 1929, the astronomer Edwin Hubble observed that the light from galaxies moving away from the Earth had longer wavelengths than expected.

(a) What name is given to this effect?

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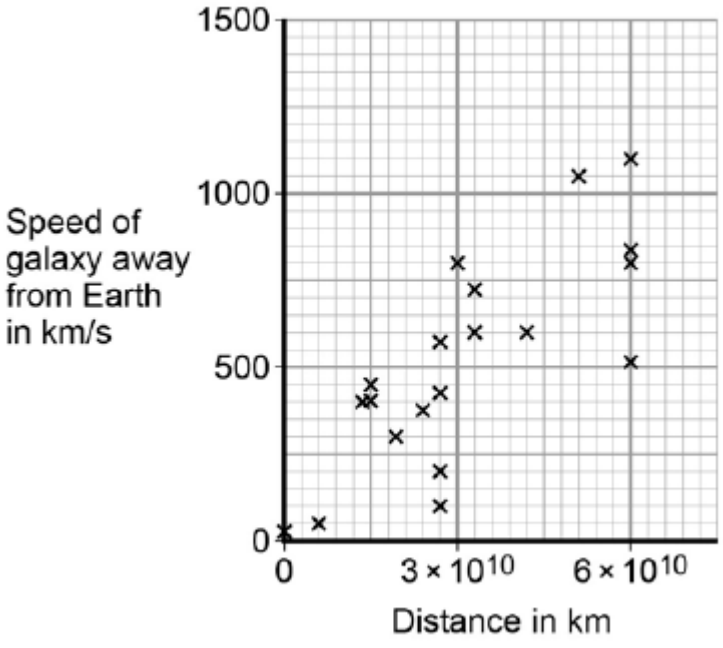
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(1)

(b) From his observations, Hubble was able to calculate the speed of a galaxy and the distance of the galaxy from the Earth.

Figure 1 shows the results of Hubble's calculations.

Figure 1



What relationship between the speed of a galaxy and the distance is suggested by Hubble's results?

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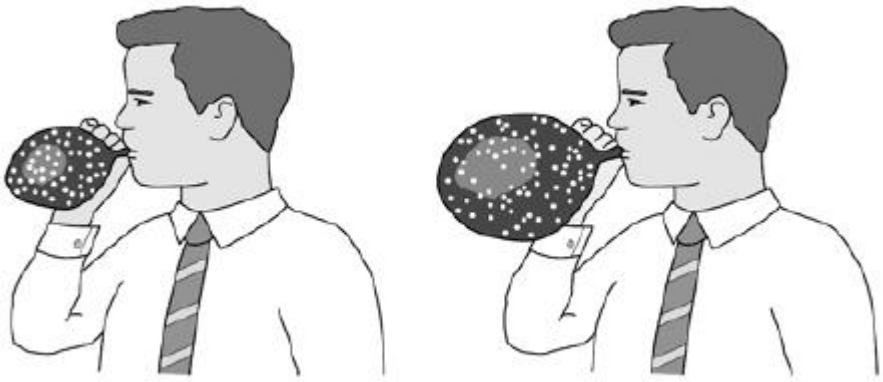
(1)

The observations made by Hubble support the idea that the Universe is expanding. This means that galaxies are continually moving away from each other and from the Earth.

Figure 2 shows a student using a balloon to model the idea of an expanding Universe.

Some dots, which represent galaxies, were marked on the balloon. The balloon was then inflated.

Figure 2



(c) Give **one** strength and **one** weakness of this model in representing the idea of an expanding Universe.

Strength .....

.....

Weakness .....

.....

(2)

In the 1950s there were two main theories to explain how the Universe began.

Theory 1	The Universe has always existed, it is continually expanding. New galaxies are formed as older galaxies die out.
Theory 2	The Universe began from a very small region that was extremely hot and dense. The Universe has been expanding ever since.

(d) In what way do the observations made by Hubble support both Theory 1 and Theory

2?

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(1)

(e) Most scientists now believe that Theory 2 is correct. Suggest what is likely to have caused scientists to start thinking Theory 1 is wrong.

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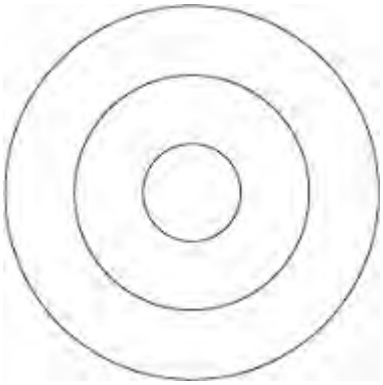
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(1)
(Total 6 marks)

Q2.A teacher demonstrates the production of circular waves in a ripple tank.

Diagram 1 shows the waves at an instant in time.

Diagram 1



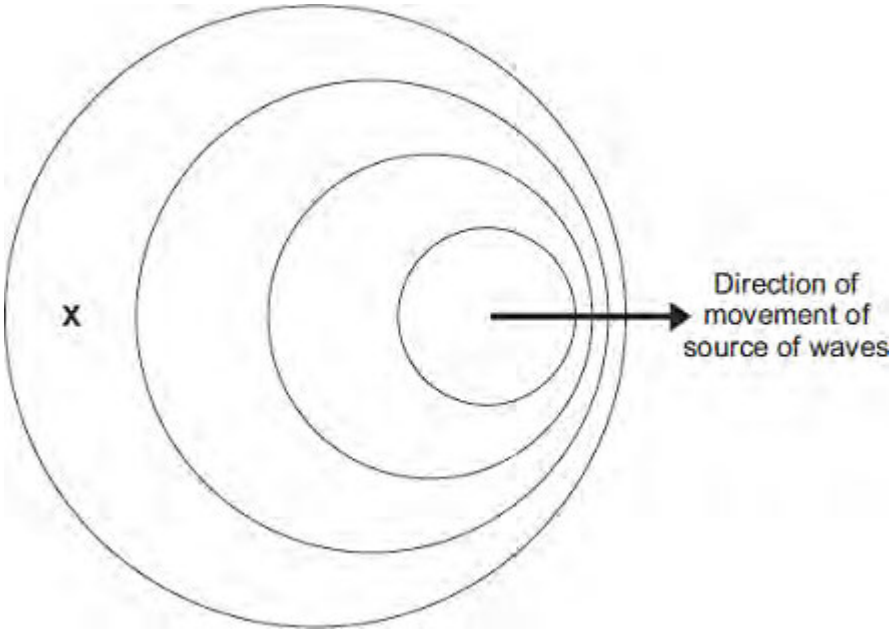
(a) Show on **Diagram 1** the wavelength of the waves.

(1)

(b) The teacher moves the source of the waves across the ripple tank.

Diagram 2 shows the waves at an instant in time.

Diagram 2
(Actual size)



(i) Use the correct answer from the box to complete each sentence.

decreased	**increased**	**stayed the same**

In **Diagram 2**, the observed wavelength of the waves at **X**

has ..... .

In **Diagram 2**, the frequency of the waves at **X**

has ..... .

(2)

(ii) Take measurements from **Diagram 2** to determine the wavelength of the waves received at **X**.

Give the unit.

.....

.....

Wavelength = ...

(3)

(c) The teacher uses the waves in the ripple tank to model the changes in the wavelengths of light observed from distant galaxies.

When observed from the Earth, there is an increase in the wavelength of light from distant galaxies.

(i) State the name of this effect.

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(1)

(ii) What does this increase in wavelength tell us about the movement of most

galaxies?

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(1)

(iii) Explain how this observation supports the Big Bang theory of the formation of the Universe.

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(4)

(iv) State **one** other piece of evidence that supports the Big Bang theory of the formation of the Universe.

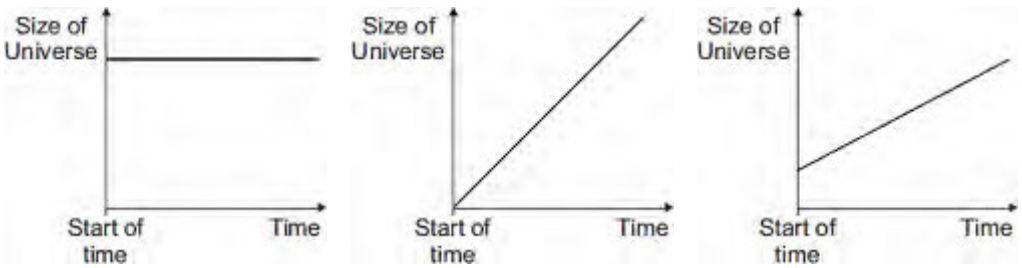
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(1)
(Total 13 marks)

Q3. The 'big bang' theory is one theory explaining the origin of the Universe.

(a) The graphs **X**, **Y** and **Z**, show how the size of the Universe may have changed with time.



Which graph would the 'big bang' theory suggest is correct?

Write your answer, **X**, **Y** or **Z**, in the box. ☐

Explain the reason for your answer.

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.....

.....

(3)

(b) In 1948, an alternative to the 'big bang' theory, called the 'steady state' theory, was developed.
The 'steady state' theory suggested that the Universe, although expanding, has always existed without a beginning in time.

(i) Complete the following sentence by drawing a ring around the correct line in the box.

The measurement of red-shift in the light from distant galaxies provides evidence

only the 'big bang' theory.

to support	only the ‘steady state’ theory.
	both the ‘big bang’ and ‘steady state’ theories.

(1)

(ii) In 1965, scientists rejected the ‘steady state’ theory in favour of the ‘big bang’ theory.

Suggest what might cause scientists to stop supporting one theory and to start supporting an alternative theory.

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(1)
(Total 5 marks)