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Student number

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Name _____

Date _____

Attempt/Time taken _____

GCSE PHYSICS

Topic Paper: 8.2 Red-shift & The Big Bang theory
Part 1

Time allowed: 35 minutes

Materials

For this paper you must have:

- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
 - is clear, logical, sensibly structured
 - fully meets the requirements of the question
 - shows that each separate point or step supports the overall answer.



33 Marks



Q1. (a) Observation of the spectra from distant galaxies provides evidence to support the 'Big Bang' theory.

(i) Complete the following sentence.

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

.....

(1)

(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.

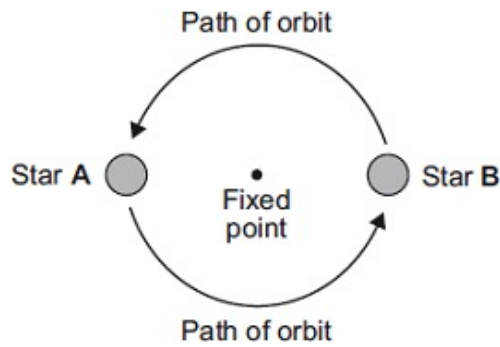
provided more evidence to support the 'Big Bang' theory.

proved the Universe will continue to expand forever.

(1)

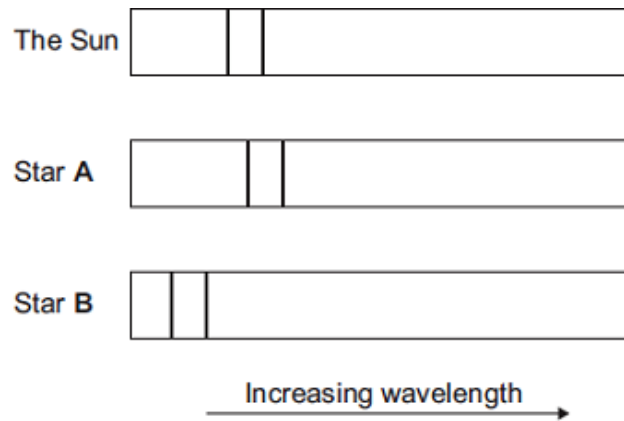


- (b) Many stars are part of a binary star system. Binary star systems have two stars.



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.



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

.....

(1)



- (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.

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(3)
(Total 6 marks)

Q2. Galaxies emit all types of electromagnetic wave.

- (a) (i) Which type of electromagnetic wave has the shortest wavelength?

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(1)

- (ii) State **one** difference between an ultraviolet wave and a visible light wave.

.....

.....

(1)

- (b) Electromagnetic waves travel through space at a speed of 3.0×10^8 m/s.

The radio waves emitted from a distant galaxy have a wavelength of 25 metres.

Calculate the frequency of the radio waves emitted from the galaxy and give the unit.

Use the correct equation from the Physics Equations Sheet.

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Frequency =

(3)



(c) Scientists use a radio telescope to measure the wavelength of the radio waves emitted from the galaxy in part (b) as the waves reach the Earth. The scientists measure the wavelength as 25.2 metres. The effect causing this observed increase in wavelength is called red-shift.

(i) The waves emitted from most galaxies show red-shift.

What does red-shift tell scientists about the direction most galaxies are moving?

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(1)

(ii) The size of the red-shift is **not** the same for all galaxies.

What information can scientists find out about a galaxy when they measure the size of the red-shift the galaxy produces?

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(2)

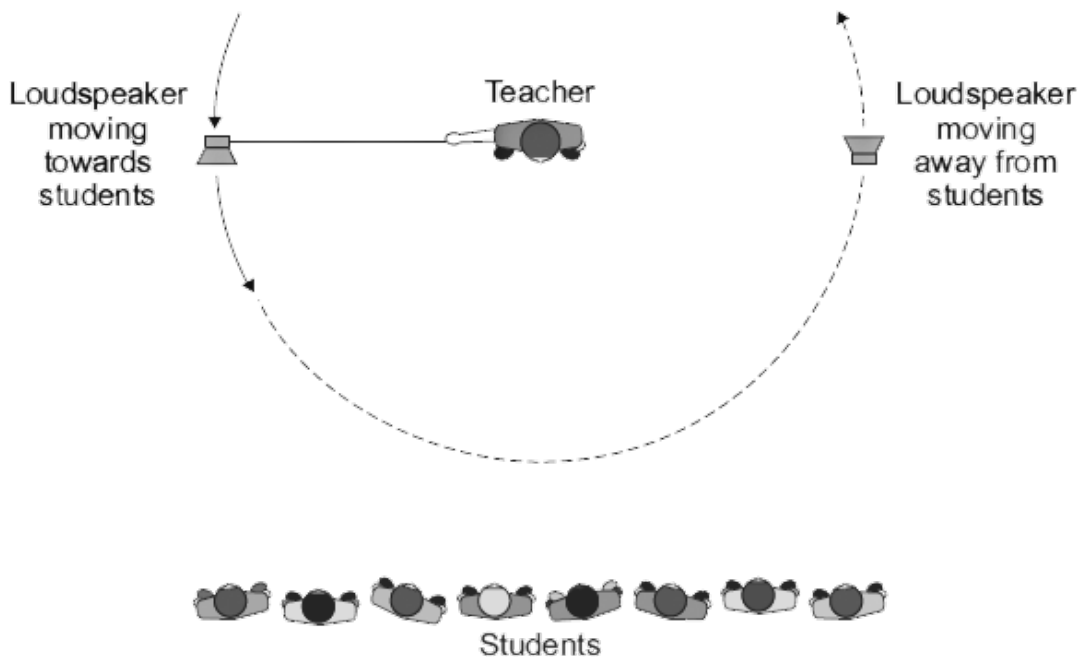
(iii) What does the observation of red-shift suggest is happening to the Universe?

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(1)

(Total 9 marks)

Q3. The diagram shows a teacher using a loudspeaker to demonstrate the Doppler effect. The loudspeaker, which produces a note of constant frequency, is swung around in a circle.





(a) What is the Doppler effect?

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(2)

(b) This demonstration of the Doppler effect can be used as a model for the *red-shift* observed in the light spectra from distant galaxies.

What is red-shift and what does the size of the red-shift tell us about distant galaxies?

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(3)

(Total 5 marks)

Q4. The Big Bang theory attempts to explain the origin of the Universe.

(i) What is the Big Bang theory?

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.....

(1)

(ii) What can be predicted from the Big Bang theory about the size of the Universe?

.....

(1)

(Total 2 marks)



Q5. (a) The light spectrum from a distant galaxy shows a red shift.

What is meant by *red shift* and what does it tell us about distant galaxies?

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(2)

(b) What name is given to the theory that the Universe started with a massive explosion?

.....

(1)

(Total 3 marks)

Q6. (a) A student listens to the sound waves produced by a car siren. When the car is stationary, the student hears a constant frequency sound.

Describe how the wavelength and frequency of the sound waves heard by the student change when the car is driven away from the student.

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(2)

(b) Satellites fitted with various telescopes orbit the Earth. These telescopes detect different types of electromagnetic radiation.

Why are telescopes that detect different types of electromagnetic waves used to observe the Universe?

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(1)

(c) 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.

(i) What is *red-shift*?

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(1)



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

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(1)

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

(i) Describe the 'big bang' theory.

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(2)

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

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(1)

(Total 8 marks)