

Name of the Student: \_\_\_\_\_

Max. Marks : 22 Marks

Time : 22 Minutes

**Q1.**

- (a) Brown dwarf stars are thought to have been formed in the same way as other stars. They are too small for nuclear fusion reactions to take place in them. Brown dwarf stars emit infrared radiation but are not hot enough to emit visible light.

- (i) Describe how a star is formed.

---

---

---

---

(2)

- (ii) Describe the process of nuclear fusion.

---

---

---

(1)

- (iii) Scientists predicted that brown dwarf stars existed before the first one was discovered in 1995.

Suggest **one** reason why scientists are now able to observe and identify brown dwarf stars.

---

---

---

(1)

- (b) In the 18th century some scientists suggested a theory about how the planets formed in the Solar System. The theory was that after the Sun formed, there were cool discs of matter rotating around the Sun. These cool discs of matter formed the planets. The scientists thought this must have happened around other stars too.

- (i) Thinking about this theory, what would the scientists have predicted to have been formed in other parts of the Universe?

---

---

(1)

- (ii) Since the 1980s scientists studying young stars have shown the stars to be surrounded by cool discs of rotating matter.

What was the importance of these observations to the theory the scientists suggested in the 18th century?

---

---

(1)

- (c) The Earth contains elements heavier than iron.

Why is the presence of elements heavier than iron in the Earth evidence that the Solar System was formed from material produced after a massive star exploded?

---

---

(1)

(Total 7 marks)

## Q2.

Galaxies emit all types of electromagnetic wave.

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

---

(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  $3.0 \times 10^8$  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.

---

---

---

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?

---

---

(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?

---

---

---

---

(2)

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

---

---

(1)

(Total 9 marks)

### Q3.

- (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.

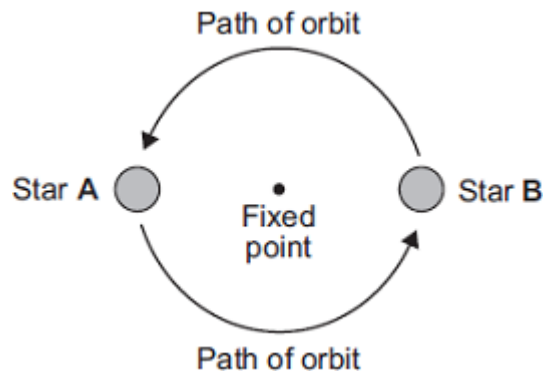
provided more evidence to support the 'Big Bang' theory.

proved the Universe will continue to expand forever.



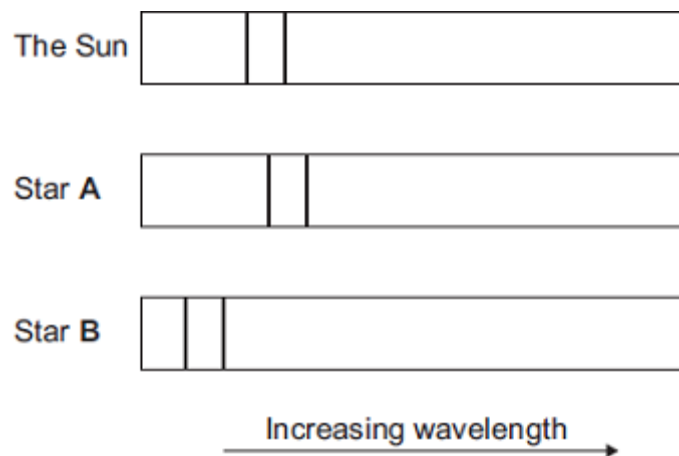
(1)

(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.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

---

---

---

---

**(3)**  
**(Total 6 marks)**