1 (a) Scientists no longer accept the geocentric model of the universe but it was the accepted theory for hundreds of years.

Explain why the evidence available at the time supported the geocentric model.

(3)

(b) The Big Bang theory and the Steady State theory are two theories about the origin of the universe.

The discovery of CMB led scientists to accept only one of the theories.

Explain why redshift supports both theories but CMB supports only one of them.

(3)

(c) (i) A star with a mass very much larger than the Sun

(1)

- ☒ **A** has a longer main sequence than the Sun and ends as a white dwarf
- ☒ **B** has a longer main sequence than the Sun and ends as a black hole
- ☒ **C** has a shorter main sequence than the Sun and ends as a white dwarf
- ☒ **D** has a shorter main sequence than the Sun and ends as a black hole

(ii) Which row has two correct statements about black holes?

(1)

	the gravitational field of a black hole	a black hole is formed when
☒ **A**	allows only electromagnetic radiation to escape	a nebula collapses
☒ **B**	allows nothing to escape	a very large star collapses
☒ **C**	allows nothing to escape	a nebula collapses
☒ **D**	allows only electromagnetic radiation to escape	a very large star collapses

(d) Figure 9 shows some lines in the absorption spectra from four different galaxies (A, B, C, and D) and from a laboratory source.

All the spectra are aligned and to the same scale.

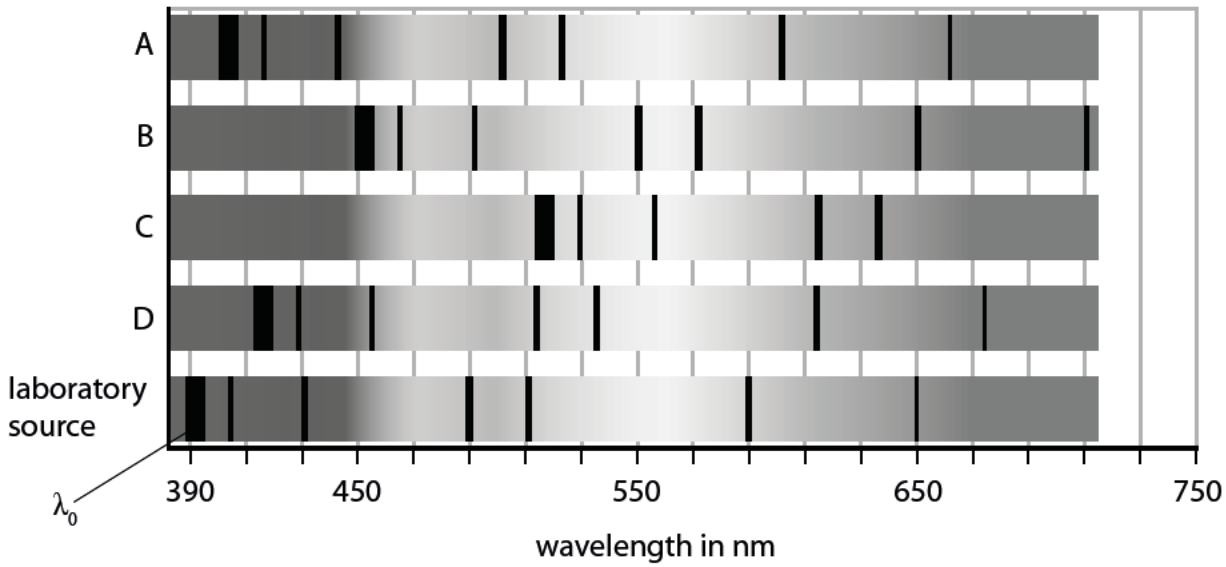


Figure 9

Explain, using Figure 9, which galaxy is furthest away from us.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 7 = 11 marks)

2 (a) Scientists no longer accept the geocentric model of the universe but it was the accepted theory for hundreds of years.

Explain why the evidence available at the time supported the geocentric model.

(3)

(b) The Big Bang theory and the Steady State theory are two theories about the origin of the universe.

The discovery of CMB led scientists to accept only one of the theories.

Explain why red shift supports both theories but CMB supports only one of them.

(3)

(c) (i) A star with a mass very much larger than the Sun

(1)

- ☒ **A** has a longer main sequence than the Sun and ends as a white dwarf
- ☒ **B** has a longer main sequence than the Sun and ends as a black hole
- ☒ **C** has a shorter main sequence than the Sun and ends as a white dwarf
- ☒ **D** has a shorter main sequence than the Sun and ends as a black hole

(ii) Which row has two correct statements about black holes?

(1)

	the gravitational field of a black hole	**a black hole is formed when**
☒ **A**	allows only electromagnetic radiation to escape	a nebula collapses
☒ **B**	allows nothing to escape	a very large star collapses
☒ **C**	allows nothing to escape	a nebula collapses
☒ **D**	allows only electromagnetic radiation to escape	a very large star collapses

(Total for Question 2 = 8 marks)

3 (a) Figure 2 shows some lines in the absorption spectra from four different galaxies (A, B, C, and D) and from a laboratory source.

All the spectra are aligned and to the same scale.

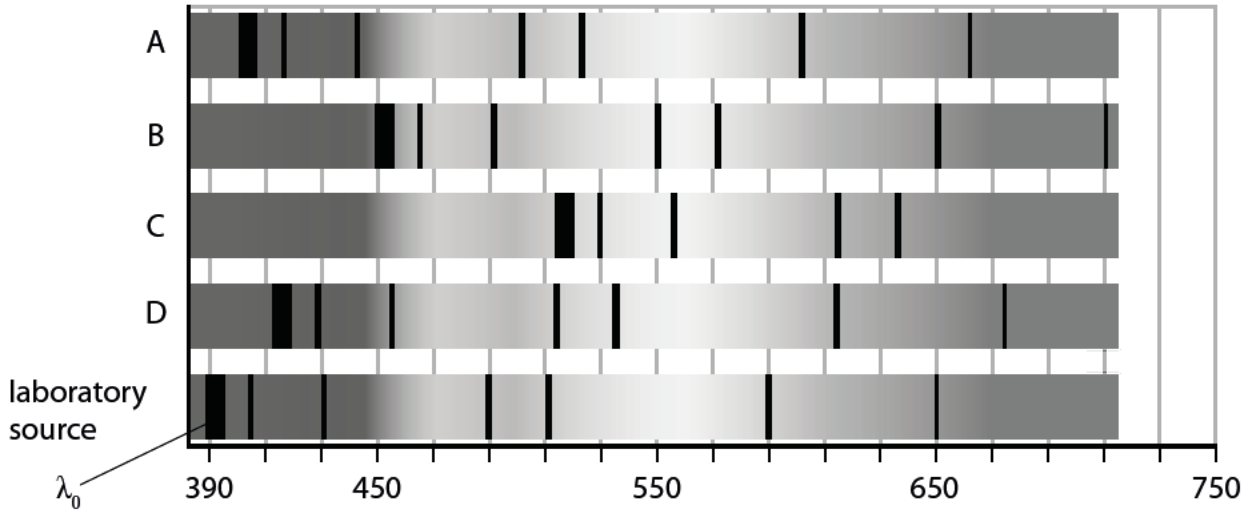


Figure 2

(i) Explain, using Figure 2, which galaxy is furthest away from us.

(3)

.....

.....

.....

.....

.....

.....

(ii) In Figure 2, the reference wavelength, λ_0, is shown at 390 nm.

Estimate the change in the reference wavelength, $\Delta\lambda$, for the light from galaxy D.

(1)

$\Delta\lambda$ = ... nm

(iii) Calculate the speed, *v*, of galaxy D.

Use the equation

$$v = c\frac{\Delta\lambda}{\lambda_0}$$

[c = speed of light = 3×10^8 m/s]

(2)

v = ... m/s

(b) Figure 3 shows a photograph of galaxy D.

This photograph was taken by a student at his home.



(Source: Paul Curtis)

Figure 3

State **two** ways that the student can improve the observational techniques so that the quality of the image is improved.

(2)

1 .....

.....

2 .....

.....

(Total for Question 3 = 8 marks)

Waves and the Solar System

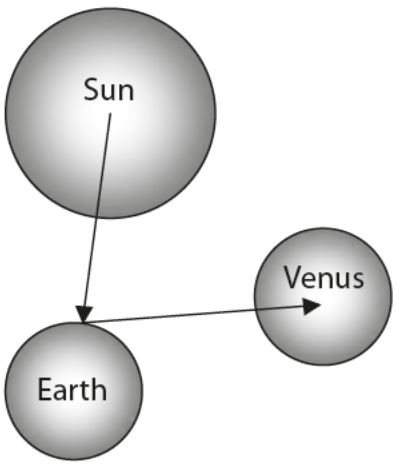
4 (a) Galileo was one of the first scientists to use a telescope to study Venus.

(i) Which of these diagrams best shows how light waves enable us to see Venus?

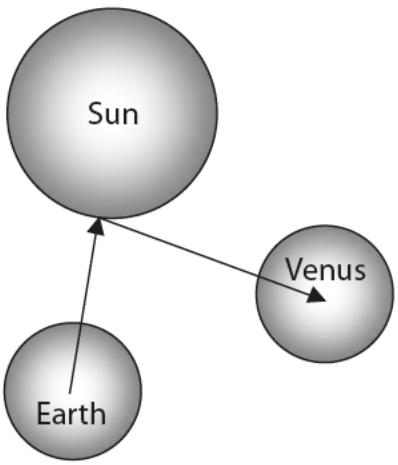
Put a cross (☒) in the box next to your answer.

(1)

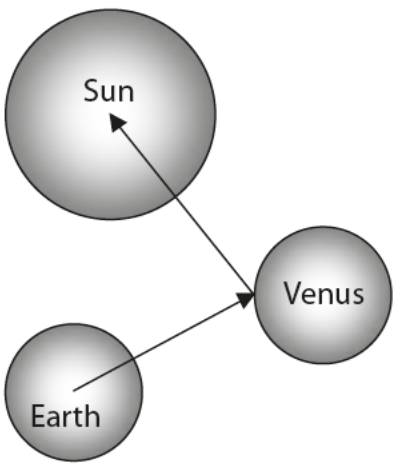
Not to scale



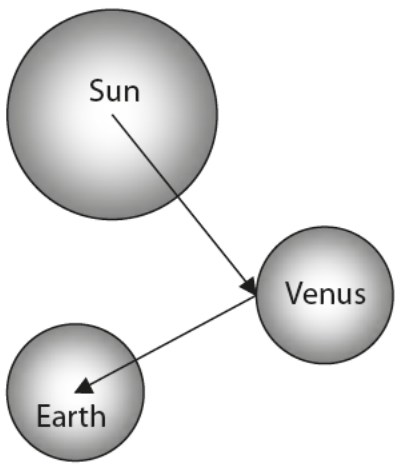
☒ **A**



☒ **B**



☒ **C**



☒ **D**

(ii) Use words from the box to complete the sentences.

(2)

asteroids	comets	geocentric	heliocentric
moons	particle	stars	

Galileo also used his telescope to observe the ..... of Jupiter.

His observations provided evidence to support the ..... model of the Solar System.

(iii) Describe how a reflecting telescope is different from the simple telescope which Galileo used.

(2)

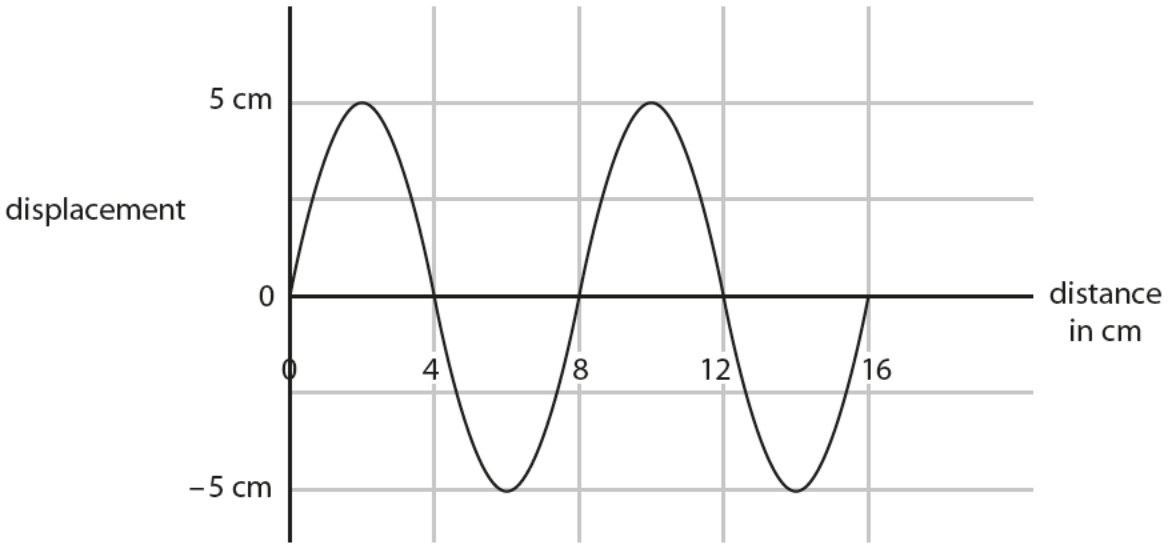
.....

.....

.....

.....

(b) (i) The diagram represents a wave.



State the amplitude and wavelength of the wave.

(2)

amplitude of the wave = ... cm

wavelength of the wave = ... cm

(ii) 20 waves are sent out in 4 seconds.

Complete this sentence by putting a cross (☒) in the box next to your answer.

The frequency of the wave is

(1)

☐ **A** 0.2 Hz

☐ **B** 5 Hz

☐ **C** 20 Hz

☐ **D** 80 Hz

(Total for Question 1 = 8 marks)