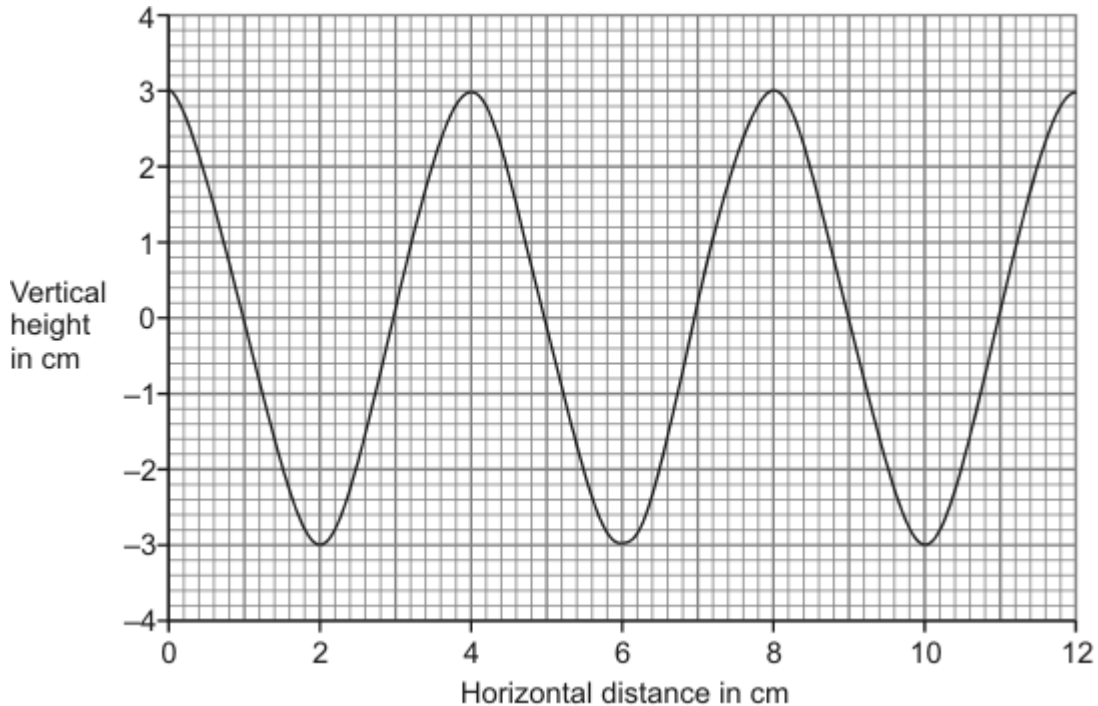


**Waves and their uses**

1. The diagram shows a water wave drawn to scale.



(a) What is the wavelength of this water wave? ..... cm (1)

(b) What is the amplitude? ..... cm (1)

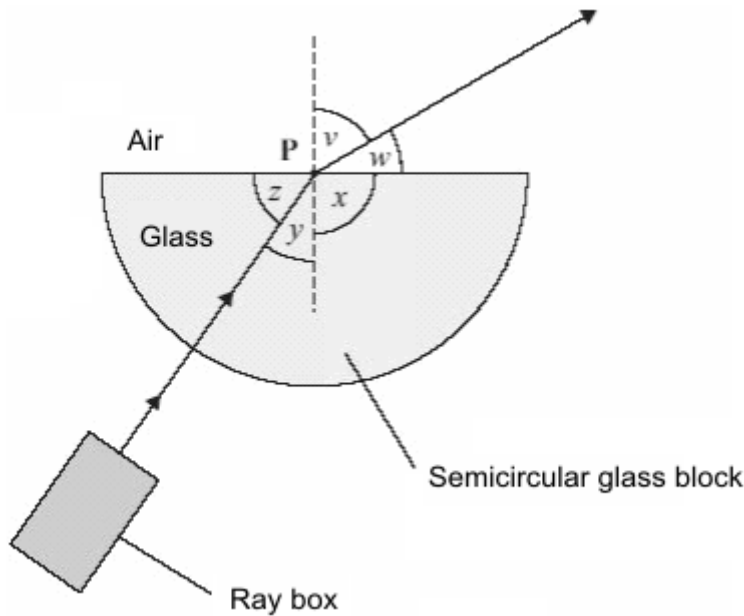
(c) Twelve waves pass an observer in four seconds.  
What is the frequency of the waves? Show clearly how you work out your answer and give the unit.

.....  
.....

Frequency = .....

(3)  
(Total 5 marks)

2. A student uses a ray box and a semicircular glass block to investigate refraction.



(a) What is the vertical dashed line called?

.....

(1)

(b) Which angle,  $v$ ,  $w$ ,  $x$ ,  $y$  or  $z$ , is the angle of refraction?

.....

(1)

(c) Why has refraction taken place?

.....

.....

(1)

(d) In an investigation, a student always aims the light from the ray box at point **P**. She moves the ray box to give different values of angle  $v$ . She records angle  $y$  for each of these values. The table shows her results.

Angle $v$ measured in degrees	Angle $y$ measured in degrees
30	19
40	25
50	31
60	35
70	39
80	41

The student studies the data and comes to the following conclusion.

Angle  $y$  is directly proportional to angle  $v$ .

Her friend says that this conclusion is **not** correct.

- (i) Use data from the table to explain why the conclusion is **not** correct.

.....  
 .....

(2)

- (ii) Write a correct conclusion for the experiment.

.....  
 .....

(1)

- (iii) Why is your conclusion only valid when angle  $v$  is between  $30^\circ$  and  $80^\circ$ ?

.....  
 .....

(1)

(Total 7 marks)

3. (a) Read the following information, then answer the questions.

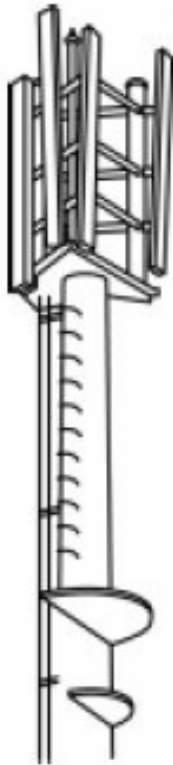
A newspaper article had the heading:  
**‘Are mobiles putting our children at risk?’**

A recent report said that children under the age of nine should not use mobile phones because of potential health risks. Although there is no direct evidence that mobile phones are a health danger, the advice is that young children should use mobiles in emergencies only.

Currently there are over 30 000 mobile phone masts in the UK. The masts transmit microwave signals between mobile phone users.

Objects containing water absorb microwave radiation. This is why humans can absorb microwave radiation. When microwaves are absorbed they produce a heating effect; this is not thought to be a significant health risk.

Some scientists worry that long term exposure to microwave radiation may cause genetic damage and cancer. Other scientists think there is no evidence of this.



(i) Below which age is it recommended that children use a mobile phone in emergencies only?

..... (1)

(ii) Why does the human body absorb microwaves?

..... (1)

(iii) What are the possible effects on a person's body of living too close to a mobile phone mast?

.....  
..... (2)

(iv) Have these effects been proven?

.....  
..... (1)

(b) The microwaves used in microwave ovens have a frequency of 2400 million hertz and a wavelength of 0.125 metres.

(i) Write down the equation that links frequency, wavelength and wave speed.

..... (1)

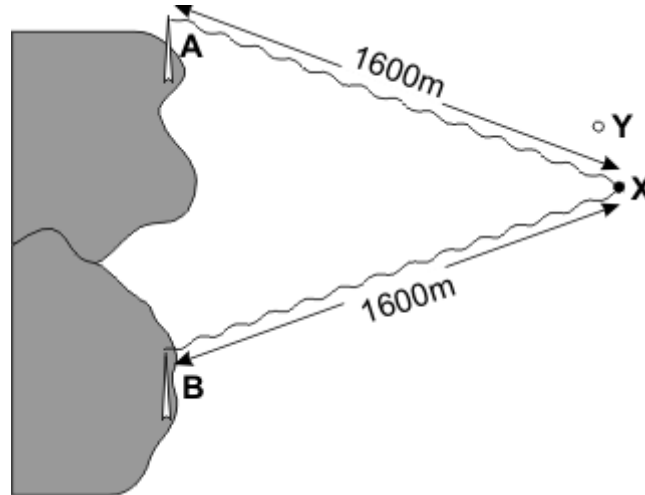
(ii) Calculate the speed of microwaves. Show clearly how you work out your answer.

.....  
.....

speed of microwaves = ..... m/s

(2)  
**(Total 8 marks)**

4. In the diagram below A and B are two radio navigation beacons. They both transmit at 1.5 MHz. The waves from both A and B have the same amplitude and they are in phase with each other. A ship is at point X, 1600 m away from each beacon.



- (i) Calculate the wavelength of the radio waves.  
(The speed of radio waves is  $3 \times 10^8$  m/s.)

.....  
 .....  
 .....

(3)

- (ii) Calculate the number of wavelengths which is equal to the distance between A and X.

.....  
 .....

(1)

(Total 4 marks)

5. The 'steady state' theory was once a popular alternative to the 'big bang' theory.

The 'steady state' theory suggested that the universe, although expanding, had no origin and it has always existed. As the universe expands, a small amount of matter is created to keep the universe looking exactly the same all of the time.

- (a) When considering the origin of the universe, what is the difference between the 'big bang' theory and the 'steady state' theory?

.....  
 .....  
 .....  
 .....

(2)

(b) The light from distant galaxies shows a *red-shift*.

(i) What is *red-shift*?

.....  
.....

(1)

(ii) Why does red-shift provide evidence to support both the 'big-bang' theory and the 'steady state' theory?

.....  
.....  
.....  
.....

(2)

(c) The 'steady state' theory was important in encouraging new research into the universe. Suggest a reason why scientists were keen to carry out new research.

.....  
.....

(1)

(d) Scientists can answer many questions about the universe, but not the question: 'Why was the universe created?'

Suggest a reason why this question cannot be answered by scientists.

.....  
.....

(1)

(Total 7 marks)

6. (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.

.....  
.....  
.....  
.....

(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?

.....  
.....

(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*?

.....  
.....

(1)

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

.....  
.....

(1)

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

- (i) Describe the 'big bang' theory.

.....  
.....  
.....  
.....

(2)

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

.....  
.....

(Total 8 marks)