1 The Astra satellite is in an orbit around the Earth.

(a) The satellite uses microwave signals for communication.

Microwaves are part of the electromagnetic spectrum.

(i) Which part of the electromagnetic spectrum has longer wavelengths than microwaves?

(1)

- ☐ **A** gamma rays
- ☐ **B** radio waves
- ☐ **C** ultraviolet light
- ☐ **D** visible light

(ii) Which of these statements is correct?

(1)

- ☐ **A** Microwaves always travel faster than radio waves.
- ☐ **B** Microwaves always travel slower than radio waves.
- ☐ **C** Microwaves and radio waves travel at the same speed in a vacuum.
- ☐ **D** Microwaves and radio waves travel at the same speed in all materials.

(iii) State one property of electromagnetic waves that makes microwaves suitable for communications with a satellite in space.

(1)

.....

.....

(b) The Astra satellite takes 24 hours to orbit the Earth once.

It travels at a speed of 3.1 km/s.

Calculate the orbital radius of the satellite and give the unit.

(4)

orbital radius = ... unit .....

(c) The Astra satellite orbits above the equator and travels in the same direction as the rotation of the Earth.

Suggest why this type of 24-hour orbit is an advantage for communications.

(1)

.....

.....

.....

(Total for Question 1 = 8 marks)

2 A student is listening to a radio.



(a) The radio is powered by batteries that provide a direct current (d.c.).

What is **direct current**?

(1)

.....

(b) Radio waves are part of the electromagnetic spectrum.

(i) Suggest a property of radio waves that makes them suitable for use in communication.

(1)

.....

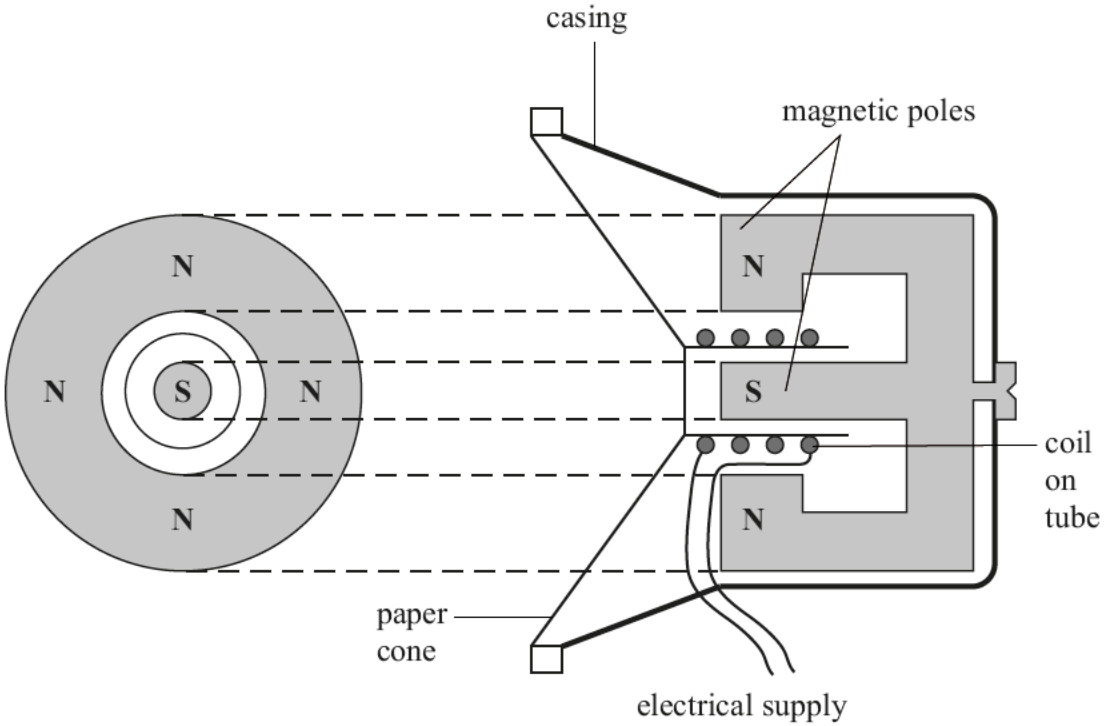
(ii) Complete the table to show uses and possible harmful effects of some other parts of the electromagnetic spectrum.

(4)

Part of electromagnetic spectrum	Use	Possible harmful effect on people
microwaves		
ultraviolet		

(c) In the radio, sound is produced by a loudspeaker.

The diagram shows the construction of a loudspeaker.



Describe how a loudspeaker uses an electrical supply to produce sound waves.

(5)

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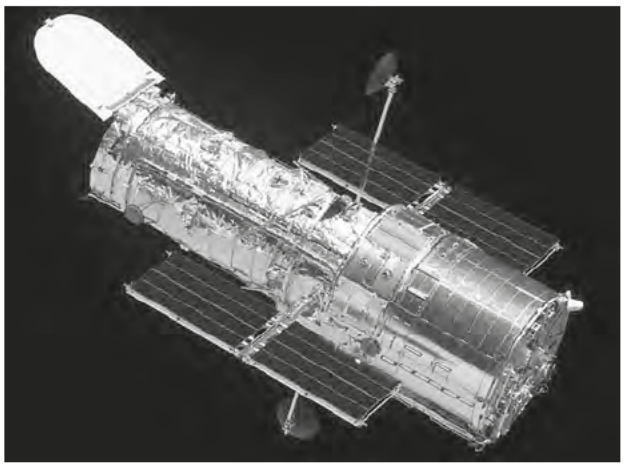
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(Total for Question 2 11 marks)

3 The Hubble Space Telescope is in orbit around the Earth.

It detects visible light from distant objects.



(a) Name the force that keeps the telescope in orbit around the Earth.

(1)

.....

(b) The Hubble Space Telescope moves in a circular orbit.

Its distance above the Earth's surface is 560 km.

(i) The radius of the Earth is 6400 km.

Calculate the radius of the orbit of the Hubble Space Telescope.

(1)

Radius = ... km

(ii) The Hubble Space Telescope completes one orbit in 96 minutes.

Calculate its orbital speed in m/s.

(3)

Orbital speed = ... m/s

(c) The Chandra Telescope also orbits the Earth, but does not move in a circular orbit.

Its distance from the Earth and its speed change as it orbits the Earth.

It travels fastest when it is closest to the Earth.

Use ideas about energy to explain why.

(3)

(d) The Chandra Telescope detects X-rays from distant objects.

(i) State the name of the type of wave that includes X-rays and visible light.

(1)

(ii) Describe **two** differences between X-rays and visible light.

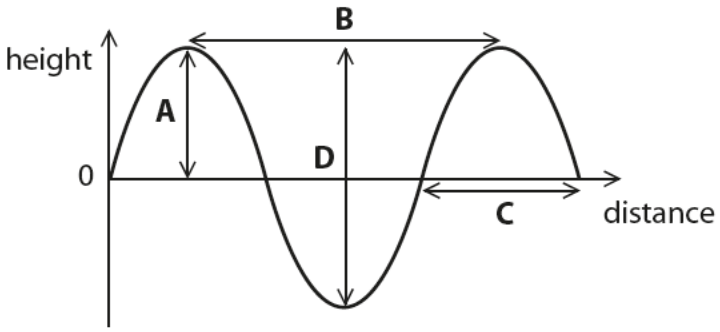
(2)

1

2

(Total for Question 3 = 11 marks)

4 The diagram shows part of a water wave.



(a) (i) Which letter represents the wavelength?

(1)

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

(ii) Which letter represents the amplitude?

(1)

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

(iii) This water wave is transverse. Other waves can be longitudinal.

State a similarity and a difference between a transverse wave and a longitudinal wave.

(2)

similarity .....

.....

difference .....

.....

(b) A student writes some sentences about electromagnetic waves.

His teacher circles a mistake in each sentence.

In the table, write a suitable correction for each mistake.

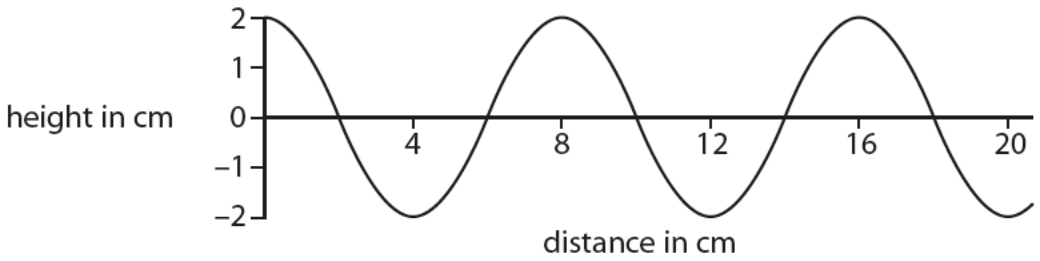
The first one has been done for you.

(5)

Sentence	Correction
Electromagnetic waves travel at $3 \times (10^2)$ m/s in a vacuum.	10^8
(Sound) waves are electromagnetic.	
(Infra-red) waves are the most harmful to people.	
(Gamma) waves are used for heating up food.	
(Radio) waves have the highest frequency.	
(Gamma) waves have a very long wavelength.	

(Total for Question 4 = 9 marks)

5 The diagram shows a water wave.



(a) (i) The amplitude of the wave is

(1)

- ☒ **A** 1 cm
- ☒ **B** 2 cm
- ☒ **C** 4 cm
- ☒ **D** 8 cm

(ii) The wavelength of the wave is

(1)

- ☒ **A** 2 cm
- ☒ **B** 4 cm
- ☒ **C** 8 cm
- ☒ **D** 20 cm

(b) Describe one difference between transverse and longitudinal waves.

Draw a labelled diagram to help your answer.

(3)

(c) State two properties that are the same for all electromagnetic waves.

(2)

1 .....

2 .....

(d) Some types of wave are used in hospitals.

(i) A scanner uses one type of wave to check for broken bones.



The type of wave emitted by the scanner is

(1)

☒ **A** infrared

☒ **B** microwaves

☒ **C** sound

☒ **D** X rays

(ii) An image of the bone is seen because the waves from the scanner are

(1)

☒ **A** absorbed by the bone

☒ **B** reflected by the bone

☒ **C** refracted by the bone

☒ **D** transmitted by the bone

(iii) Name one type of wave that is used in cancer treatment and explain what it does during the treatment.

(2)

Type of wave .....

Explanation of what it does .....

.....

.....

(Total for Question 5 = 11 marks)