

## COLLATED QUESTIONS: ELECTROMAGNETIC RADIATION

### 2011(2): WAVES

Doppler radar can determine the speed and direction of a moving car. Pulses of extremely high frequency radio waves are sent out in a narrow beam and the returning echoes from the car are detected by the radar.

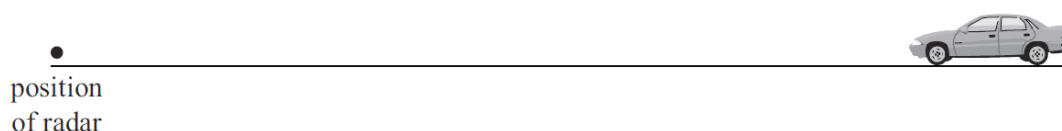
A **fast** moving car is travelling **towards** a Doppler radar.

Complete the diagram below, and use it to explain how and why the Doppler effect can be used to determine the speed of a car approaching a radar.

Your explanation should include:

- how the frequency changes between the transmitted signal and the returning signal when the car is coming **towards** the radar
- how the frequency changes between the transmitted signal and the returning signal when the car is travelling **fast**.

*A diagram may assist your answer.*



### 2010(2): Microwave Ovens



A microwave oven uses a vacuum tube to produce microwaves inside the cooking chamber. These microwaves have a frequency of 2.45 GHz.

Discuss how the microwave oven is used to cook food. Your answer should include:

- The effect on water molecules
- Heating of the food
- Why the walls are made of metal
- The function of mesh in glass door.

### 2009(2): Electromagnetic radiation

Remote controls can work using infrared (ir) or radio frequency (rf). A television remote control uses ir and has to have a direct line of sight to work. The television remote control can work up to a distance of 10 m. A remote control for a garage door uses rf, which can travel through the door and around objects. The garage remote control can work over a larger distance than a television remote control.

Compare and contrast the effectiveness of the television remote control and the garage door remote control in relation to:

- relative wavelengths of ir and rf
- absorption
- transmission.

### 2009(3): X-rays

X-rays are a form of electromagnetic radiation that can be used to produce images of the body. An x-ray machine produces a small burst of x-rays that pass through the body. This is then recorded as an image.

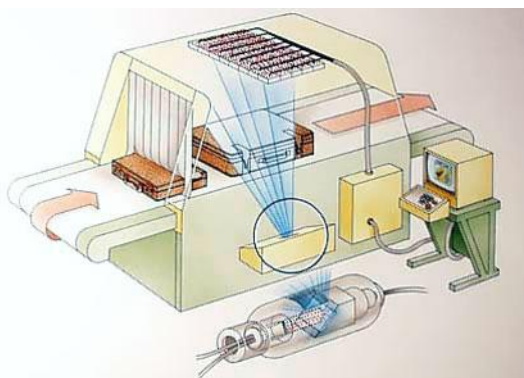


Discuss how the above image is produced, referring to:

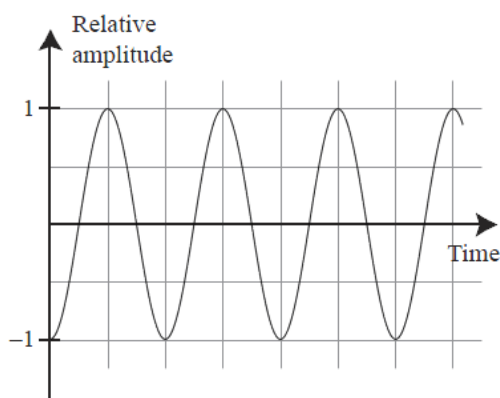
- Properties of x-rays
- relative absorption of x-rays by different parts of the body

### 2008(3): EMR

(a) X-rays are used to make images of luggage at airports to help identify potential weapons. Explain how x-rays can be used to make images of the items within the luggage.

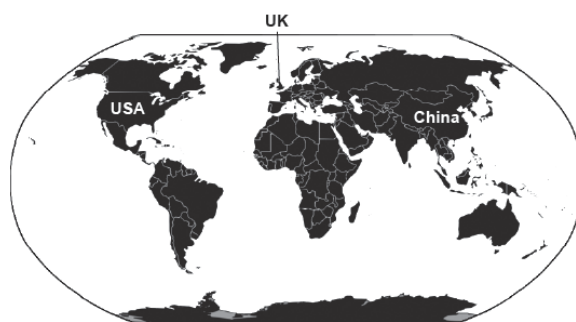


(b) The following diagram shows a typical electromagnetic radiation (EMR) wave.



Complete the diagram above by clearly labelling the: (i) amplitude of the wave (ii) wavelength of the wave.

(c) One property of electromagnetic radiation is that it normally travels in straight lines. Short-wave radio waves are an example of electromagnetic radiation that can be used to transmit radio signals from one country to another. Discuss how short-wave radio waves transmitted in the UK can be heard as far away as the USA and also in China. A labelled diagram may assist your answer.

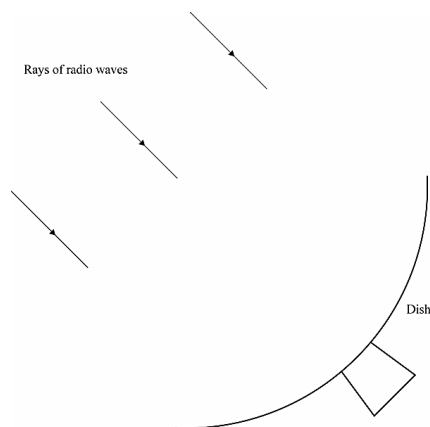


(d) An aerial is built with a length equal to half of the wavelength of the radio wave it is trying to receive. One short-wave radio frequency commonly used is 6 195 kHz ( $6.195 \times 10^6$  Hz). Given that radio waves travel at  $3.0 \times 10^8 \text{ ms}^{-1}$ , calculate the length of the aerial that needs to be used to receive the signal broadcast at a frequency of 6195 kHz. Give your answer to an appropriate number of significant figures and with an appropriate unit.

### 2007(3): ELECTROMAGNETIC RADIATION

Radio telescopes are used to observe radio waves emitted from outer space.

- (a) The diagram below shows the dish of a radio telescope and three incoming rays of radio waves.
- Complete the path of the three rays to show what would happen to the rays before **and** after they hit the dish.
  - Clearly indicate on the diagram the position of the radio receiver.



- (b) The planet Venus is  $4.2 \times 10^{10}$  m away from the Earth. Calculate how long it would take a radio wave to travel from Venus to Earth. Give a unit with your answer (the speed of electromagnetic waves in space is  $3.0 \times 10^8$  ms<sup>-1</sup>).

The following diagram shows two images of the planet Venus.



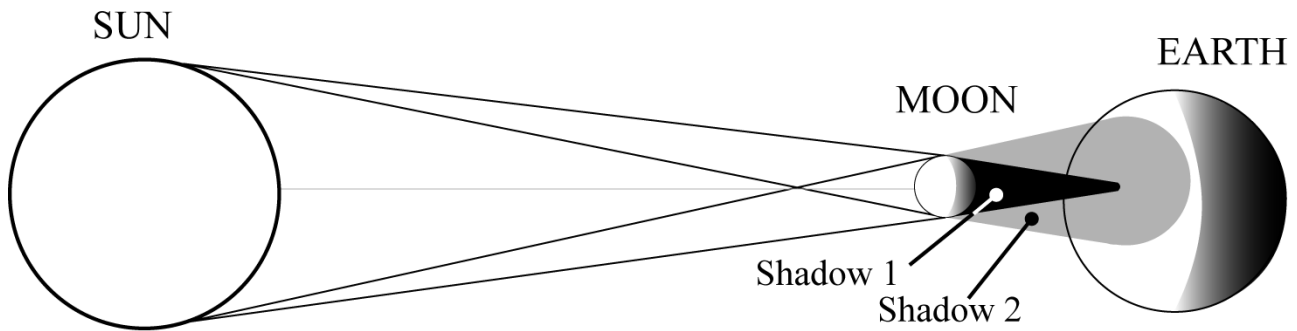
The left-hand image shows the planet with its surrounding dense atmosphere as taken with visible light. The right-hand image shows the planet's surface as taken with radar.

- Compare the use of visible light with radar to view the surface of Venus.
- The radio waves that the radar telescope sends have a frequency of  $9.5 \times 10^9$  Hz. Calculate the wavelength of the wave. Show your working clearly and round your answer sensibly. The speed of electromagnetic waves in space is  $3.0 \times 10^8$  m s<sup>-1</sup>.



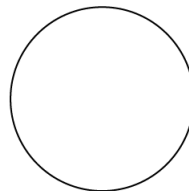
### 2006(3): ECLIPSES AND SHADOWS

Total solar eclipses are observed somewhere in the world nearly every year. Below is a diagram of a solar eclipse.



- (a) (i) Name the TWO types of shadow shown on the diagram above.
- (ii) Describe the property of light that causes an eclipse to be formed.
- (b) Explain why there are two types of shadow produced in an eclipse.
- (c) On the diagram below, show the **shadow** produced when the source of light is very tiny. Label your diagram.

•  
Dot shows size  
of light source.



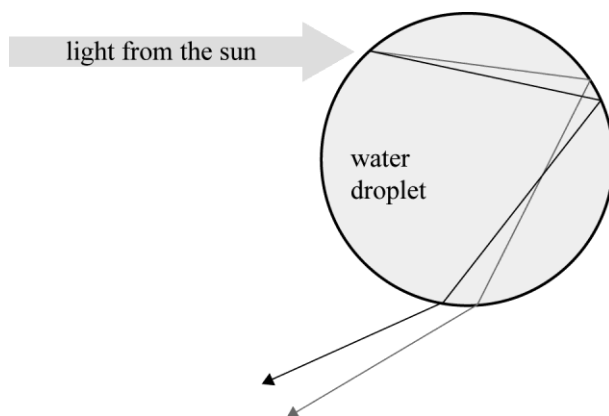
Object

Screen

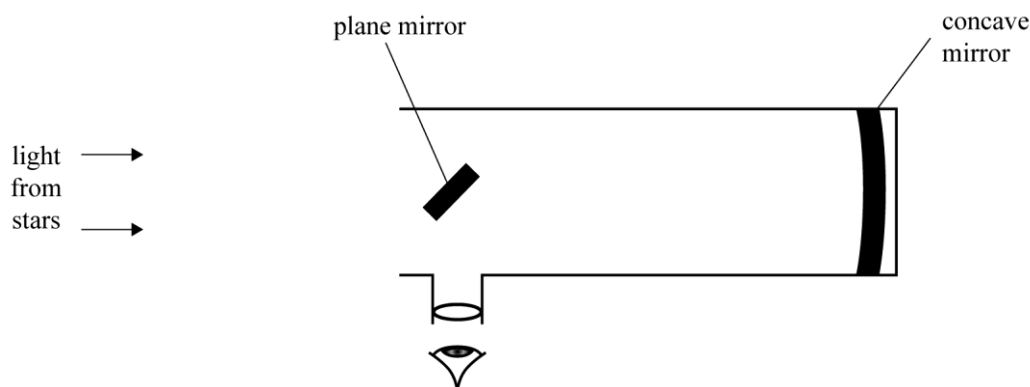


## 2005(1): ELECTROMAGNETIC RADIATION

- (a) Name the type of electromagnetic radiation that:
- is used to measure the velocity of a moving vehicle
  - is used for heating rooms
  - causes sunburn
- (b) Name at least five colours of the rainbow, in order of **increasing** wavelength.
- (c) The diagram of **a drop of water in a rainbow** shows reflected and refracted rays. Label the reflected rays.



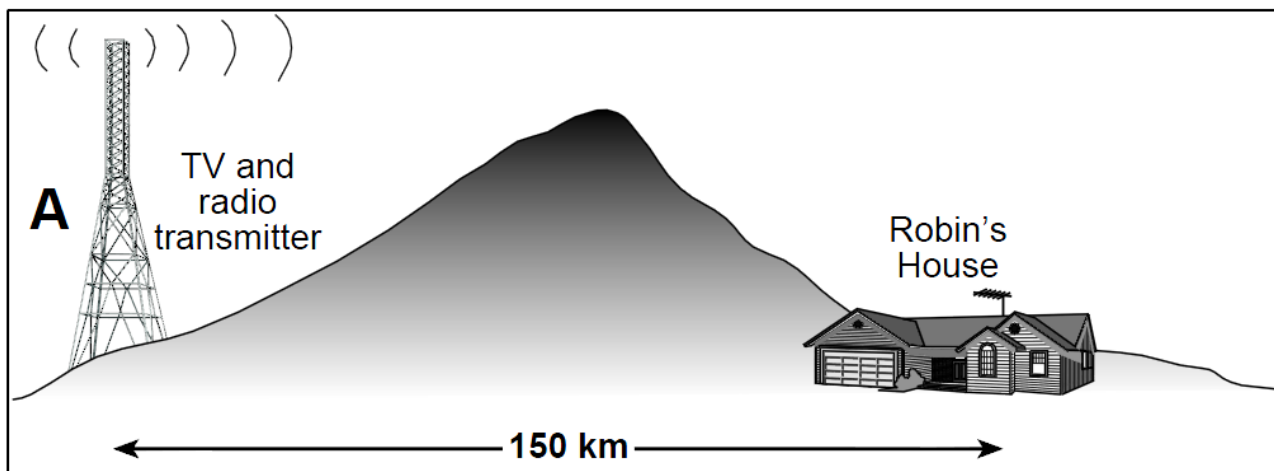
Below is the diagram of a common form of reflecting telescope. The telescope has two mirrors, a plane and a concave one, as part of its optics.



- (d) Explain how the light rays are gathered and reflected in a reflecting telescope. **Draw** light rays on the diagram to help your answer.
- (e) The Hubble Space Telescope (HST) takes photographs in the visible, ultra-violet and infra-red regions of the electromagnetic spectrum. The HST orbits the Earth above the atmosphere and obtains clearer photographs than telescopes on Earth. Discuss why the Hubble Space Telescope is placed outside the Earth's atmosphere.

## 2004(1): ELECTROMAGNETIC RADIATION

The diagram (not to scale) shows a radio transmitter (**A**) situated on the opposite side of a hill from a small town. The transmitter broadcasts AM radio programmes on a frequency of 935 kHz ( $1 \text{ kHz} = 1 \times 10^3 \text{ Hz}$ ). The radio waves are picked up by Robin's stereo in his house. The house is 150 km away from the transmitter (the speed of radio waves in air is  $3.0 \times 10^8 \text{ ms}^{-1}$ ).



- Describe what is meant by the term **wavelength**. Draw a diagram if this will help your answer.
- Calculate the wavelength of the radio waves emitted by the transmitter. State your answer with **appropriate units** and **rounded** to a sensible number of significant figures.
- To boost the signal, another transmitter is placed beside transmitter **A**. Both transmitters are exactly the same distance from Robin's house. The waves from each transmitter have the same amplitude, frequency and phase. Explain why the aerial in Robin's house detects a radio wave that has twice the amplitude of each transmitted wave. Draw a diagram if this will help your answer.
- The transmitter at **A** also transmits FM waves. These waves typically have a wavelength of 3.0 m. Robin gets poor reception of these FM waves. Discuss why Robin's house can receive the AM radio waves from the transmitter better than the higher frequency FM waves.