Diffraction 2
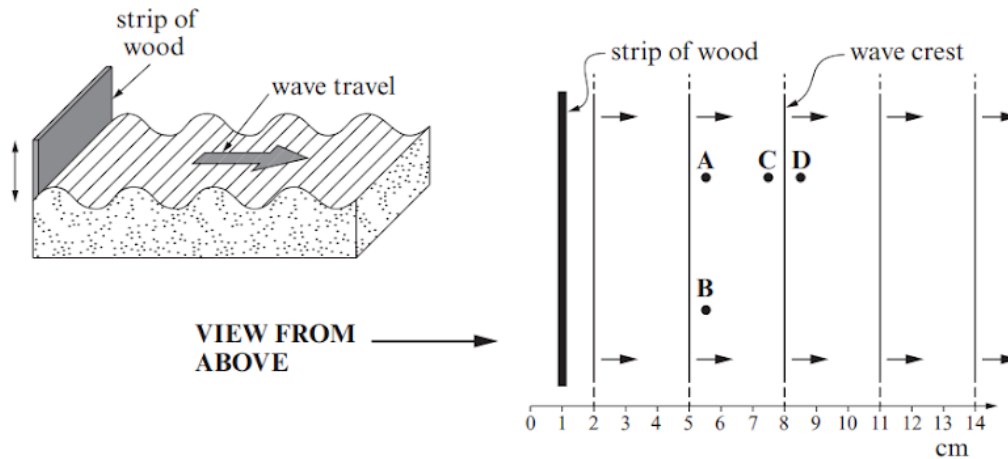
Have a go at the following exam questions.

1. (a) A strip of wood, in contact with the surface of water in a tank, oscillates up and down at a frequency of 5.0 Hz. The view from above shows the positions of wave crests (where the water height is a maximum) at one instant.

(i)   Determine the wavelength of the wave.   [1]

....

(ii) Calculate the time it takes for a wave crest to travel a distance of 10.5 cm.   [3]

....

....

....

....

....

(iii) State whether or not the oscillations at points **B**, **C** and **D** are *in phase* with the oscillations at **A**. Justify your answers.   [3]

Point **B** ....

....

Point **C** ....

....

Point **D** ....

....
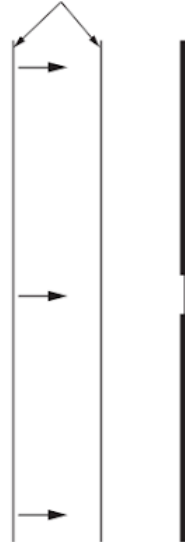
(b)   The waves of frequency 5.0 Hz approach a barrier with a gap in it (see diagram below). The waves that pass through the gap spread out.

   (i)   What name is given to the spreading of the waves? .... [1]

   (ii)   Carefully sketch the **two** wave crests to the right of, and nearest to, the gap.   [2]

wave crests

   (iii) What changes would occur to the diagram above if the **frequency** of the wave were increased by a factor of 4? No calculations are needed.   [2]

   ....

   ....

   ....

13 The diagram shows a diffraction pattern.
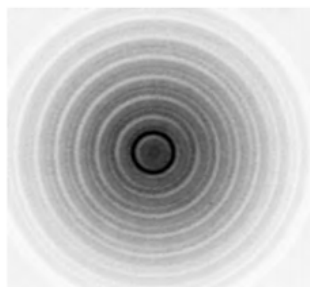
(a) Explain what is meant by diffraction.

(2)

....

....

....

....

(b) This diffraction pattern is produced by electrons passing through a thin sheet of graphite.

(i)   State what this suggests about the behaviour of electrons.

(1)

....

....

(ii) Suggest why substantial diffraction occurs.

(1)

....

....

(Total for Question 13 = 4 marks)

8   In 1927 it was shown by experiment that electrons can produce a diffraction pattern.

(a) (i) Explain the meaning of the term *diffraction*.

....

....

.... [1]

(ii) State the condition necessary for electrons to produce observable diffraction when passing through matter, e.g. a thin sheet of graphite in an evacuated chamber.

....

....

....

.... [2]

(b) Show that the speed of an electron with a de Broglie wavelength of 1.2×10^{-10} m is 6.0×10^{6} ms^{-1}.

[3]

(c) The electrons in (b) are accelerated to a speed of 6.0×10^{6} ms^{-1} using an electron gun shown diagrammatically in Fig. 8.1.
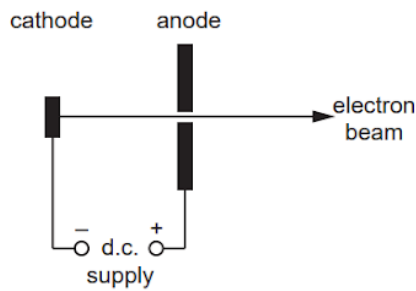
Fig. 8.1

(i) Calculate the potential difference *V* across the d.c. supply between the cathode and the anode.

V = ... V [3]

(ii) Suggest why, in an electron gun, the cathode is connected to the negative terminal of the supply rather than the positive terminal.
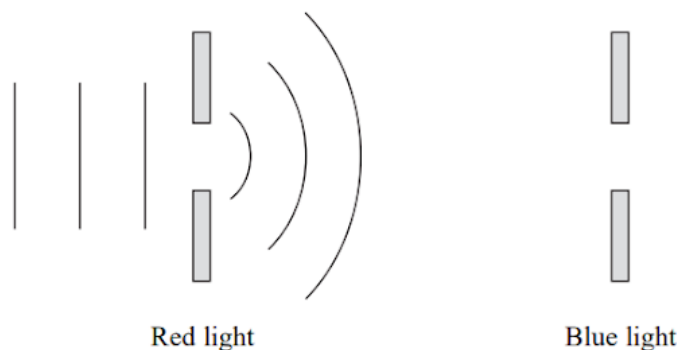
....

....

.... **[1]**

[Total: 10]

EDEXCEL, 6PH02/01, JANUARY 2010

19 Wavefronts of light change shape when they pass around an edge or through a slit. This means that the light bends and the effect is called diffraction. The longer the wavelength of light, the more the light bends.

(a) The diagram on the left shows red light passing through a slit and undergoing diffraction.

Red light   Blue light

On the diagram on the right, show the same effect for blue light.

(2)

(b) If the red light passes through two slits that are close together, the waves spread out, overlap and add together to produce a pattern of light and dark bands.

Complete the diagram below to show how two overlapping waves produce the pattern of light and dark bands.

(4)
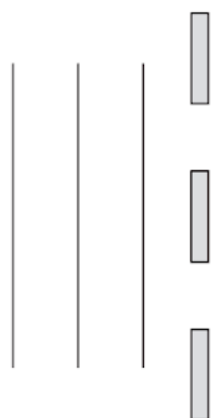
(c) (i) The spacing between two dark bands in the pattern produced is inversely proportional to the distance between the two slits. Red light is shone through two slits that are separated by 1.2 mm and the dark bands in the pattern are 0.60 mm apart.

Calculate how far apart the dark bands will be if the distance between the two slits is reduced to 0.40 mm.

(2)

Distance between dark bands = ...

(ii) Describe the effect on the pattern if the distance between the two slits is gradually increased to 1 cm.

(2)

(Total for Question 19 = 10 marks)

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