1 **(a)** Fig. 6.1 shows the position of layers of air, at one moment, as a sound wave of constant frequency passes through the air. Compressions are labelled C. Rarefactions are labelled R.

Fig. 6.1

(i) State how Fig. 6.1 would change if

1. the sound had a higher frequency,

....[1]

2. the sound were louder.

....

....

....[2]

(ii) On Fig. 6.1, draw a line marked with arrows at each end to show the wavelength of the sound. [1]

(b) In an experiment to measure the speed of sound in steel, a steel pipe of length 200 m is struck at one end with a hammer. A microphone at the other end of the pipe is connected to an accurate timer. The timer records a delay of 0.544 s between the arrival of the sound transmitted by the steel pipe and the sound transmitted by the air in the pipe.

The speed of sound in air is 343 m / s. Calculate the speed of sound in steel.

speed of sound in steel = ...[3]

[Total: 7]

2 Some plane waves travel on the surface of water in a tank. They pass from a region of deep water into a region of shallow water. Fig. 6.1 shows what the waves look like from above.

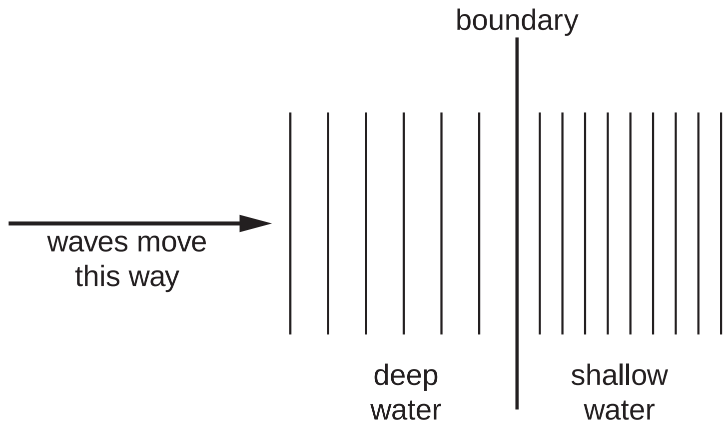

Fig. 6.1

(a) State what happens at the boundary, if anything, to

(i) the frequency of the waves,

.... [1]

(ii) the speed of the waves,

.... [1]

(iii) the wavelength of the waves.

.... [1]

(b) The waves have a speed of 0.12 m/s in the deep water. Wave crests are 0.08 m apart in the deep water.

Calculate the frequency of the source producing the waves. State the equation that you use.

frequency = ... [3]

(c) Fig. 6.2 shows identical waves moving towards the boundary at an angle.

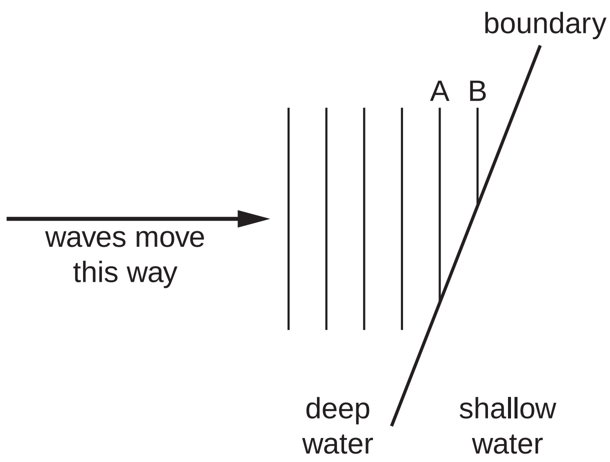

Fig. 6.2

On Fig. 6.2, draw carefully the remainder of waves A and B, plus the two previous waves which reached the shallow water. You will need to use your ruler to do this. [3]

[Total: 9]

3 **(a)** A small object S is dipped repeatedly into water near a flat reflecting surface.

Fig. 10.1 gives an instantaneous view from above of the position of part of the waves produced.

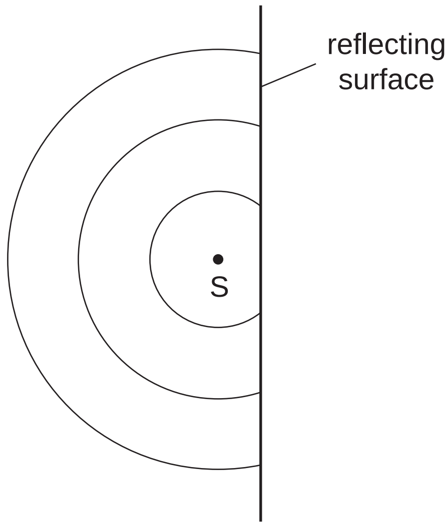

Fig. 10.1

On Fig. 10.1,

(i) put a clear dot at the point from which the reflected waves appear to come (label the dot R),

(ii) draw the reflected portion of each of the three waves shown. [3]

(b) Fig. 10.2 shows a small object P in front of a plane mirror M.

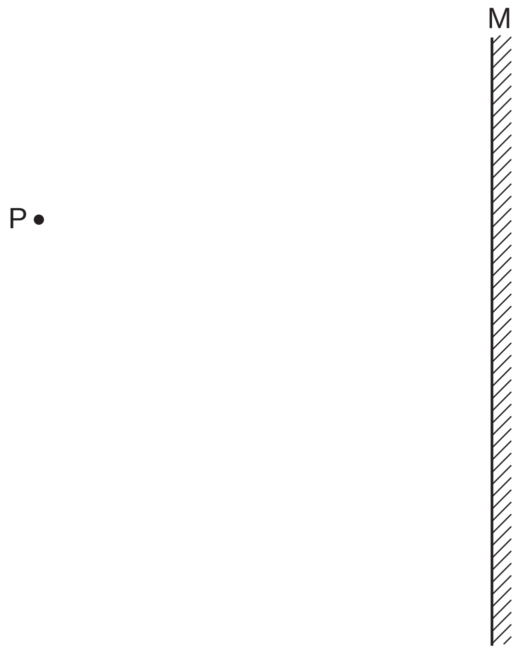

Fig. 10.2

On Fig. 10.2, carefully draw two rays that show how the mirror forms the image of object P. Label the image I. [3]

[Total: 6]

4 Fig. 7.1 shows a scale drawing of plane waves approaching a gap in a barrier.

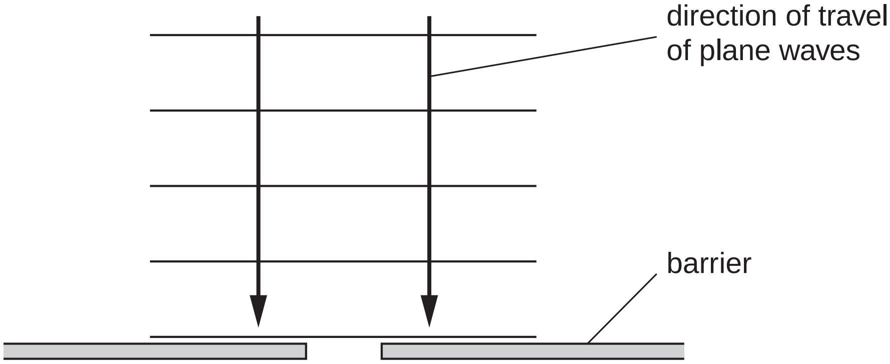

Fig. 7.1

(a) On Fig. 7.1, draw in the pattern of the waves after they have passed the gap. [3]

(b) The waves approaching the barrier have a wavelength of 2.5 cm and a speed of 20 cm/s. Calculate the frequency of the waves.

frequency = ... [2]

(c) State the frequency of the diffracted waves.

.... [1]

[Total: 6]

5 Fig. 7.1 is a drawing of a student's attempt to show the diffraction pattern of water waves that have passed through a narrow gap in a barrier.

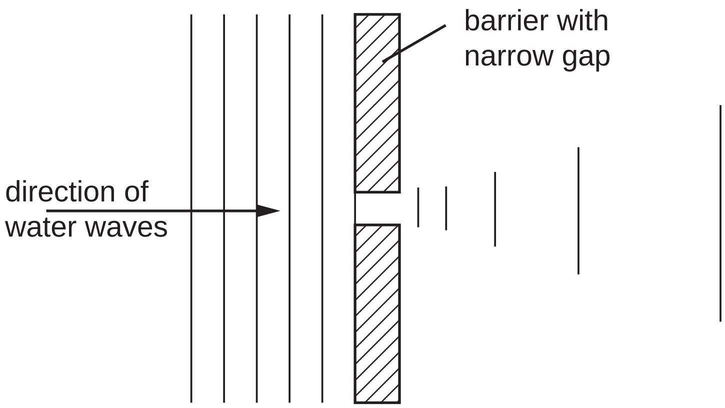

Fig. 7.1

(a) State two things that are wrong with the wave pattern shown to the right of the barrier.

1. ....

2. ....[2]

(b) In the space below, sketch the wave pattern when the gap in the barrier is made five times wider.

[2]

(c) The waves approaching the barrier have a wavelength of 1.2 cm and a frequency of 8.0 Hz.
Calculate the speed of the water waves.

speed =..................................[2]

[Total :6]

6 Fig. 6.1 shows the diffraction of waves by a narrow gap.

P is a wavefront that has passed through the gap.

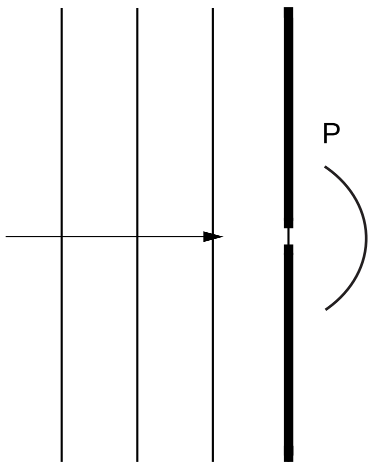

Fig. 6.1

(a) On Fig. 6.1, draw three more wavefronts to the right of the gap. [3]

(b) The waves travel towards the gap at a speed of 3×10^8 m/s and have a frequency of 5×10^{14} Hz. Calculate the wavelength of these waves.

wavelength = ... [3]

[Total : 6]