1)

Ultrasound waves are used to produce images of a fetus inside a womb.

(a) Explain what is meant by the frequency of a wave.

[1 mark]

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(b) Ultrasound is a longitudinal wave. Describe the nature of a longitudinal wave.

[2 marks]

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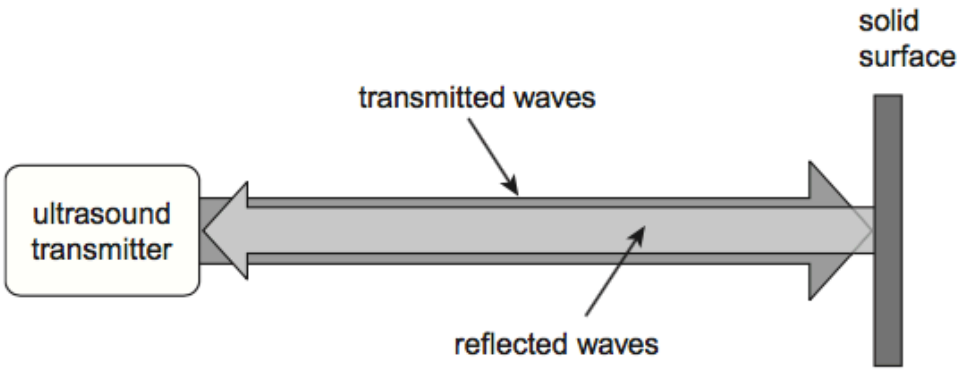
(c) In order to produce an image with sufficient detail, the wavelength of the ultrasound must be $0.50\,\text{mm}$. The speed of the ultrasound in body tissue is $1540\,\text{m s}^{-1}$. Calculate the frequency of the ultrasound at this wavelength.
Give your answer to an appropriate number of significant figures.

[2 marks]

frequency ..... Hz

(d) A continuous ultrasound wave of constant frequency is reflected from a solid surface and returns in the direction it came from.

Figure 7



Assuming there is no significant loss in amplitude upon reflection, describe and explain the effect the waves have on the particles in the medium between the transmitter and the solid surface.

[3 marks]

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3)

(a) Define the amplitude of a wave.

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(1 mark)

(b) (i) Other than electromagnetic radiation, give **one** example of a wave that is transverse.

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(1 mark)

(b) (ii) State **one** difference between a transverse wave and a longitudinal wave.

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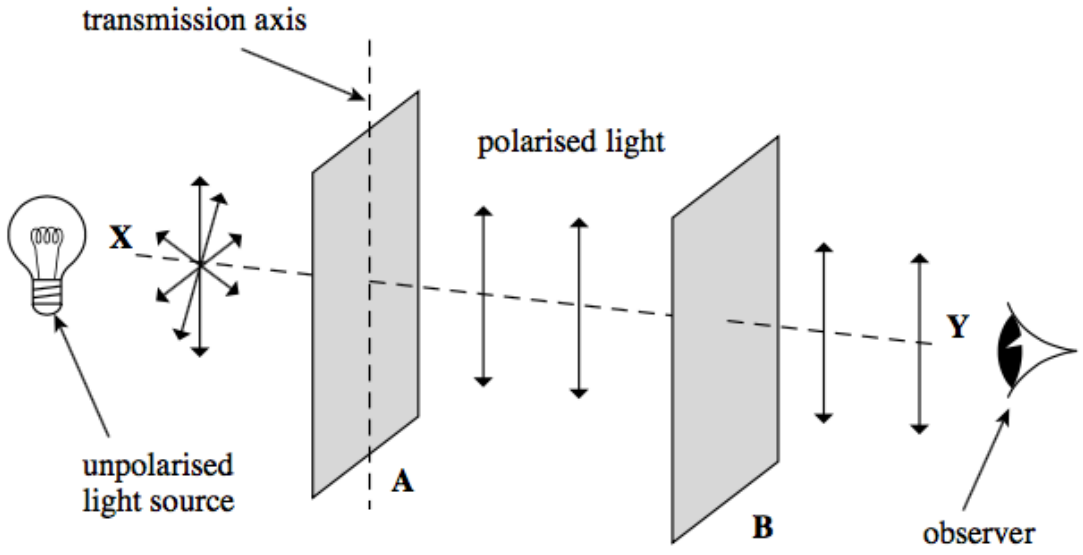
.....

(1 mark)

(c) **Figure 3** shows two identical polarising filters, **A** and **B**, and an unpolarised light source. The arrows indicate the plane in which the electric field of the wave oscillates.

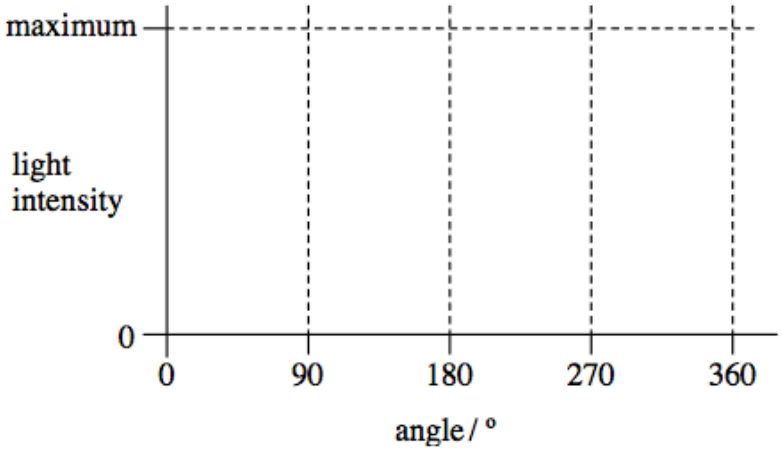
(c) (i) If polarised light is reaching the observer, draw the direction of the transmission axis on filter **B** in **Figure 3**.

Figure 3



(1 mark)

(c) (ii) The polarising filter **B** is rotated clockwise through 360° about line **XY** from the position shown in **Figure 3**. On the axes below, sketch how the light intensity reaching the observer varies as this is done.



(2 marks)

(d) State **one** application, other than in education, of a polarising filter and give a reason for its use.

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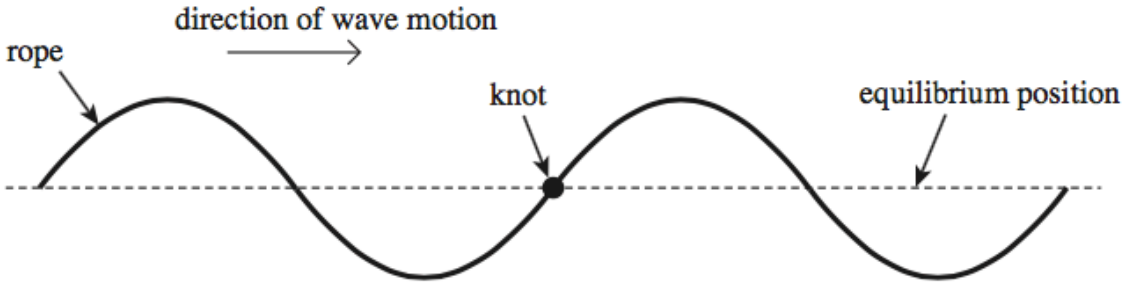
(2 marks)

4)

Figure 7 shows a continuous progressive wave on a rope. There is a knot in the rope.

Figure 7



(a) Define the amplitude of a wave.

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(2 marks)

(b) The wave travels to the right.
Describe how the **vertical** displacement of the knot varies over the next complete cycle.

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(3 marks)

(c) A continuous wave of the same amplitude and frequency moves along the rope from the right and passes through the first wave. The knot becomes motionless.
Explain how this could happen.

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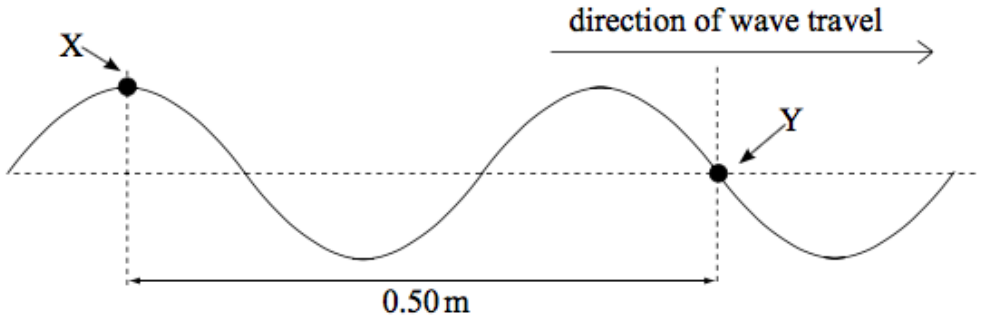
(3 marks)

5)

(a) **Figure 6** represents a progressive wave travelling from left to right on a stretched string.

Figure 6



(a) (i) Calculate the wavelength of the wave.

answer.....m
(1 mark)

(a) (ii) The frequency of the wave is 22 Hz. Calculate the speed of the wave.

answer.....$m\,s^{-1}$
(2 marks)

(a) (iii) State the phase difference between points X and Y on the string, giving an appropriate unit.

answer.....
(2 marks)

(b) Describe how the displacement of point **Y** on the string varies in the next half-period.

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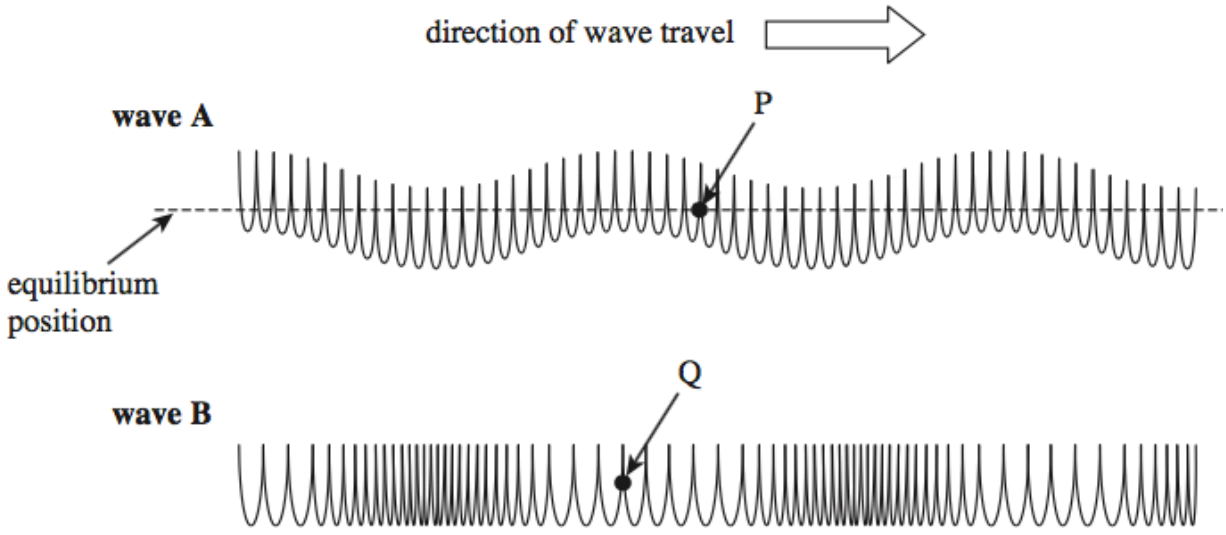
(2 marks)

6)

Figure 10 shows two ways in which a wave can travel along a slinky spring.

Figure 10



(a) State and explain which wave is longitudinal.

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(2 marks)

(b) On **Figure 10**,

(b) (i) clearly indicate and label the wavelength of **wave B**

(1 mark)

(b) (ii) use arrows to show the direction in which the points **P** and **Q** are about to move as each wave moves to the right.

(2 marks)

(c) Electromagnetic waves are similar in nature to **wave A**.

Explain why it is important to correctly align the aerial of a TV in order to receive the strongest signal.

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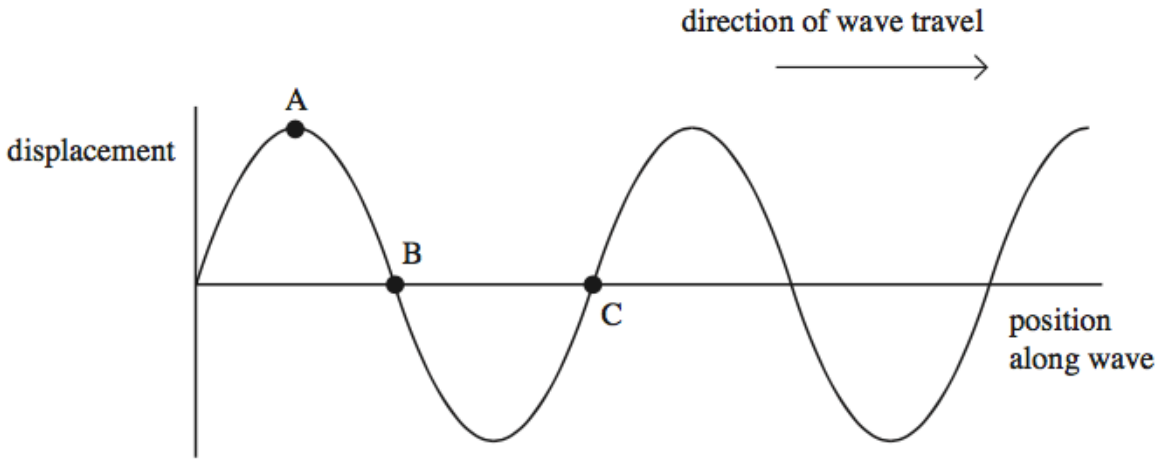
(2 marks)

7)

Earthquakes produce transverse and longitudinal seismic waves that travel through rock. **Figure 8** shows the displacement of the particles of rock at a given instant, for different positions along a transverse wave.

Figure 8



(a) State the phase difference between

(a) (i) points **A** and **B** on the wave .....

(a) (ii) points **A** and **C** on the wave. .....

(2 marks)

(b) Describe the motion of the rock particle at point **B** during the passage of the next complete cycle.

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(2 marks)

(c) A scientist detects a seismic wave that is polarised. State and explain what the scientist can deduce from this information.

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(2 marks)

(d) The *frequency* of the seismic wave is measured to be 6.0 Hz.

(d) (i) Define the frequency of a progressive wave.

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(1 mark)

(d) (ii) Calculate the wavelength of the wave if its speed is $4.5 \times 10^3\,\text{m s}^{-1}$.

wavelength ..... m

(2 marks)