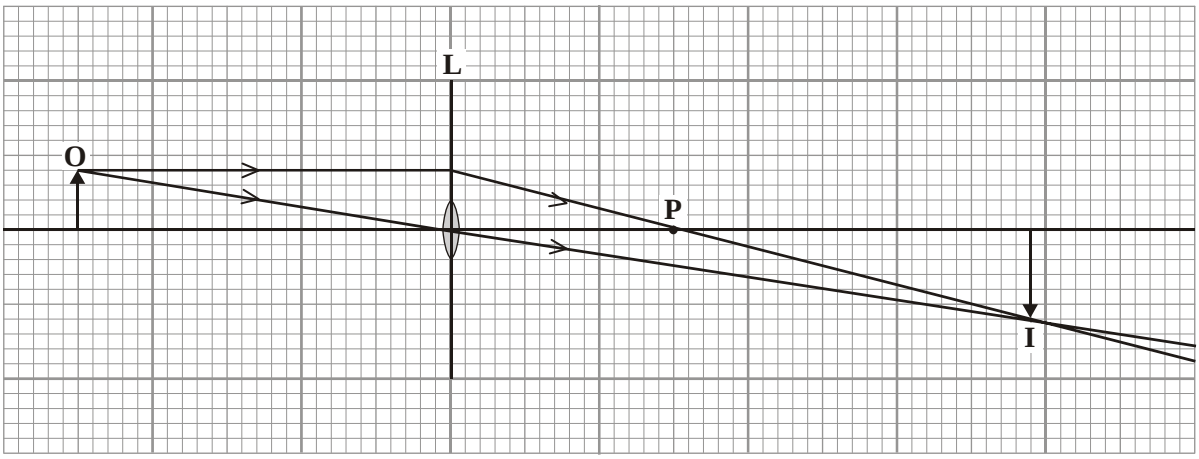
Medical applications of physics

1. The ray diagram shows the position and size of the image, **I**, of an object, **O**, formed by a lens, **L**.



(a) What type of lens is shown in the ray diagram?

.....

(1)

(b) Name the point labelled **P**.

.....

(1)

(c) The ray diagram has been drawn to scale.

Use the equation in the box to calculate the magnification.

$$\text{magnification} = \frac{\text{image height}}{\text{object height}}$$

Show clearly how you work out your answer.

.....

.....

Magnification = ...

(2)

(d) How can you tell from this ray diagram that the image is a real image?

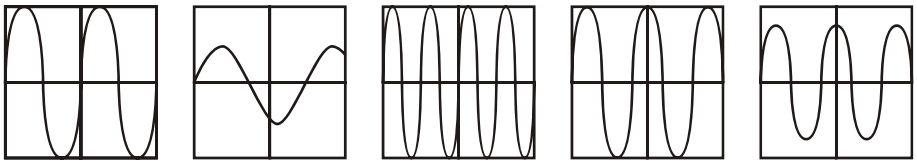
.....

.....

(1)

(Total 5 marks)

2. (a) A student uses a microphone to send different sounds to an oscilloscope. The diagrams show five traces, **A**, **B**, **C**, **D** and **E**, on the oscilloscope. All the traces are drawn to the same scale.



A **B** **C** **D** **E**

(i) Which **three** diagrams show traces with the same amplitude?

Diagrams ..... , ... and ..... .

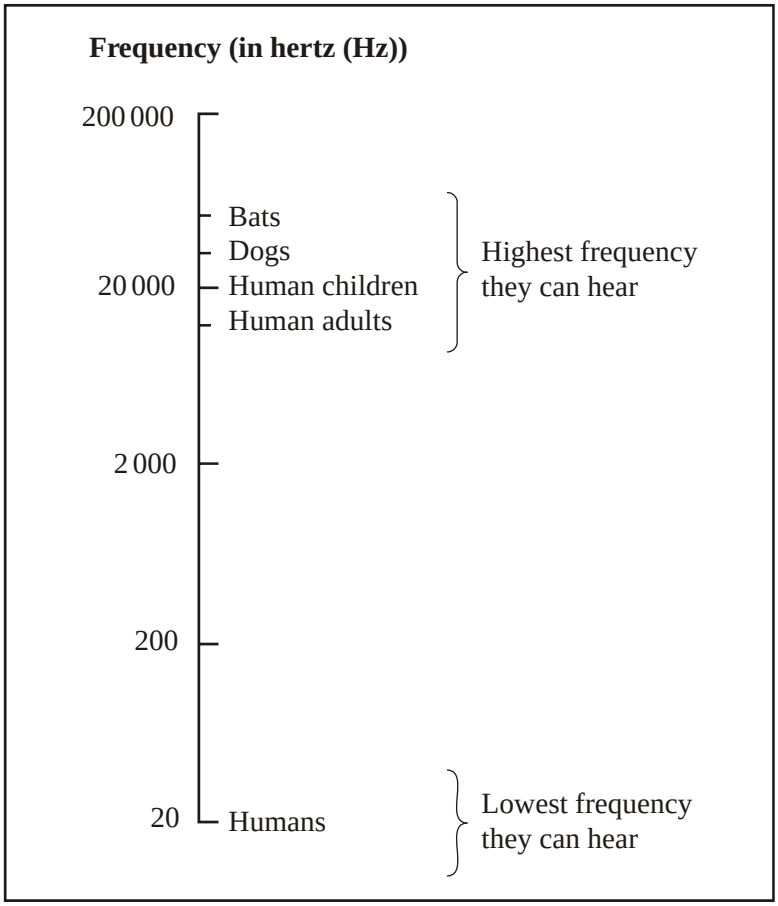
(1)

(ii) Which **two** diagrams show traces with the same frequency?

Diagrams ……..... and ..... .

(1)

(b) The diagram shows the sound frequencies which some living things can hear.



(i) What is the widest range of frequencies that a human child can hear?

.....

(1)

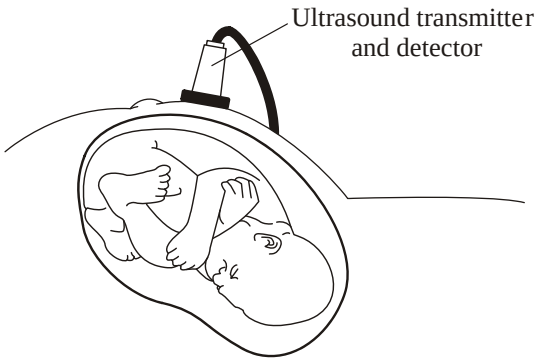
(ii) Why can some dog whistles be heard by dogs but not by humans?

.....

.....

(1)

(c) An ultrasound scan can be used to make a picture of a baby in its mother's womb. An ultrasound transmitter and detector are placed above the mother's womb. Ultrasound goes into the body of the mother and into the body of the baby.



Use the correct words from the box to complete the sentences.

detector	reflection	refraction	sound	substance	transmitter

(i) When the ultrasound crosses from one ..... to another, some ultrasound becomes an echo caused by ..... .

(ii) This information is collected by the ultrasound ..... and made into a picture on a screen.

(3)
(Total 7 marks)

3. Ultrasound can be used in industry for detecting internal cracks in metals.

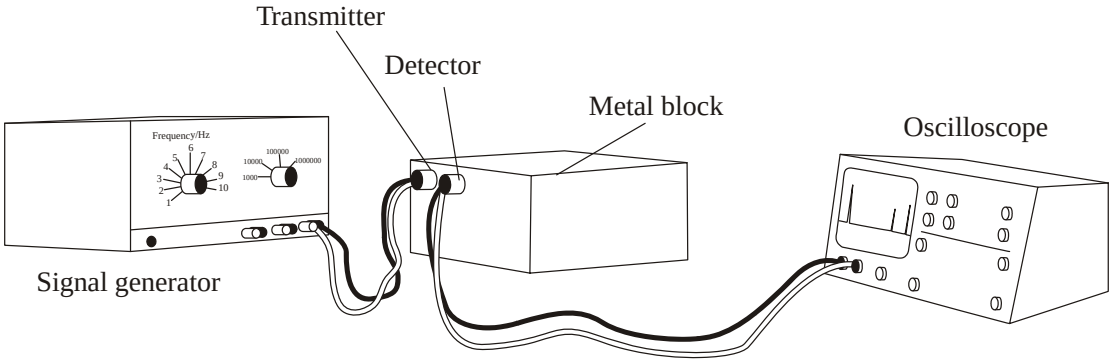
(a) State **two** features of ultrasound.

1 .....

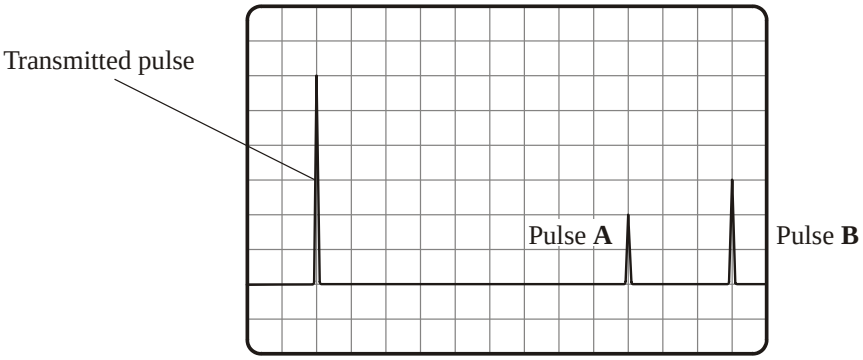
2 .....

(2)

(b) The diagram shows an ultrasound transmitter and detector fixed to the front of a metal block. The block has an internal crack.



The diagram below shows the screen of the oscilloscope connected to the detector.



(i) Explain why pulse **A** and pulse **B** occur.

.....

.....

(2)

(ii) The metal block is 120 mm from front to back. What is the distance, in mm, from the front of the block to the internal crack?

Distance = ... mm

(1)

(Total 5 marks)

4. (a) The diagram shows a lens used as a magnifying glass. The position of the eye is shown and the size and position of an object standing at point **O**.

(i) What type of lens is shown in the diagram?

.....

(1)

(ii) Two points are marked as **F**. What are these points?

.....

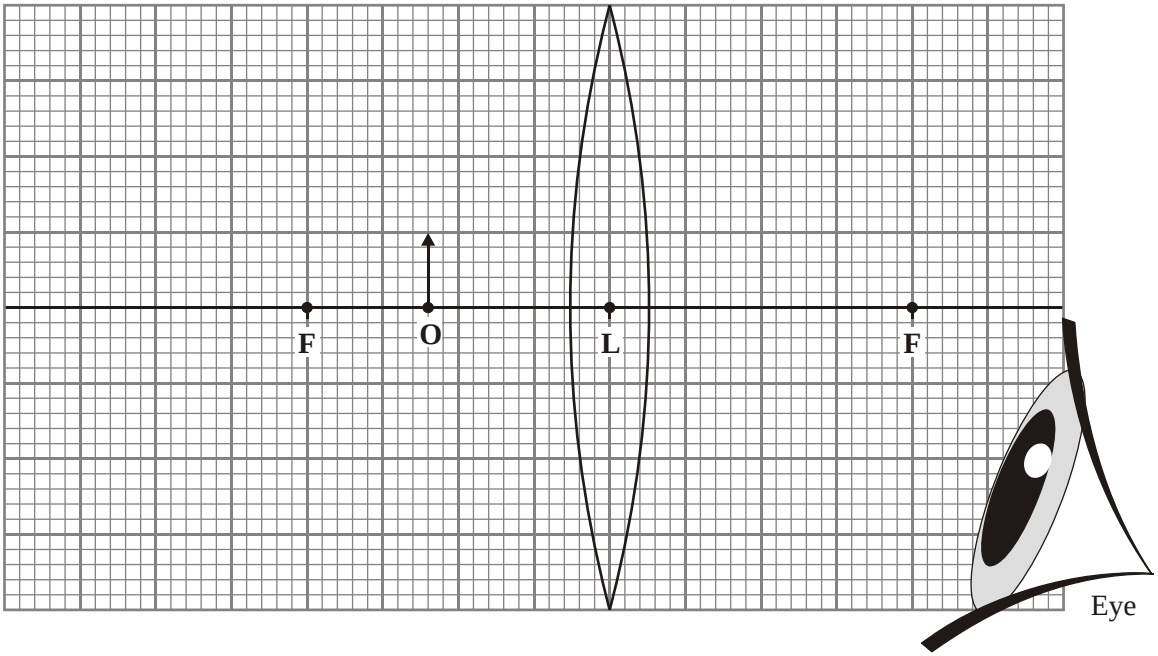
(1)

(iii) What is the name of the straight line which goes through the point **F**, through the point **L** at the centre of the lens, and through the point **F** on the other side?

.....

(1)

(iv) On the diagram, use a ruler to construct accurately the position of the image. You should show how you construct your ray diagram and how light appears to come from this image to enter the eye.



(5)

(v) The image is *virtual*. What is a *virtual* image?

.....

.....

(1)

(b) The lens shown in the diagram in part (a)(iv) can be used in a camera to produce a *real* image.

Explain why a *real* image must be produced in a camera and how the object and the lens are positioned to produce a *real* image which is **smaller** than the object.

Do **not** draw a ray diagram as part of your answer.

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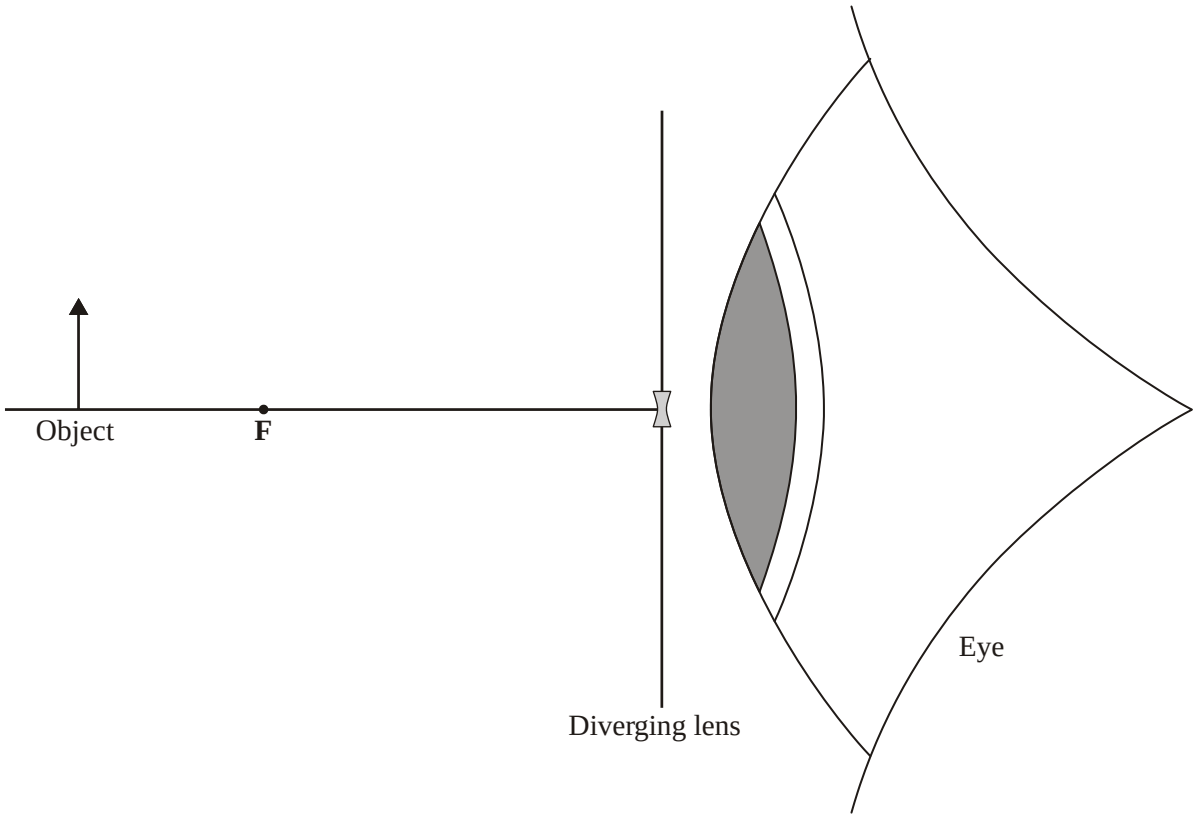
.....

.....

(3)
(Total 12 marks)

5. The diagram shows an object located vertically on the principal axis of a diverging lens. A student looks through the lens and can see an image of the object.

(a) Using a pencil and ruler to draw construction lines on the diagram, show how light from the object enters the student's eye and the size and position of the image.



(3)

(b) Describe the nature of the image by comparing it to the object.

.....

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.....

.....

(2)

(Total 5 marks)

6. Explain fully why pregnant women should not normally have X-rays of the lower body.

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(Total 4 marks)