**1.** Ultrasonic waves can be safely used to examine a developing baby inside its mother's womb.

(a) What are ultrasonic waves?

.....

.....

**(2)**

(b) Describe how ultrasound is used to produce an image of the developing baby.

.....

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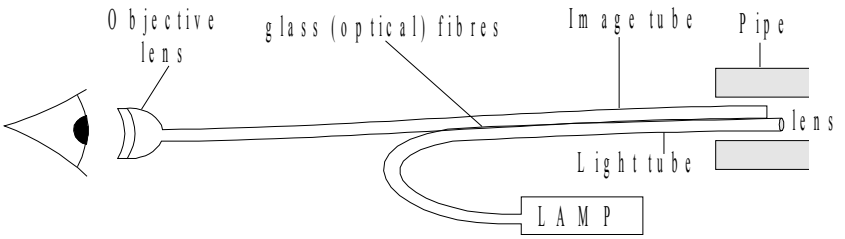
.....

.....

**(3)**
**(Total 5 marks)**

**2.** The diagram shows an endoscope which can be used to examine the inside of narrow tubes or pipes.




Explain, in as much detail as you can, how an engineer is able to see the inside of the pipe.

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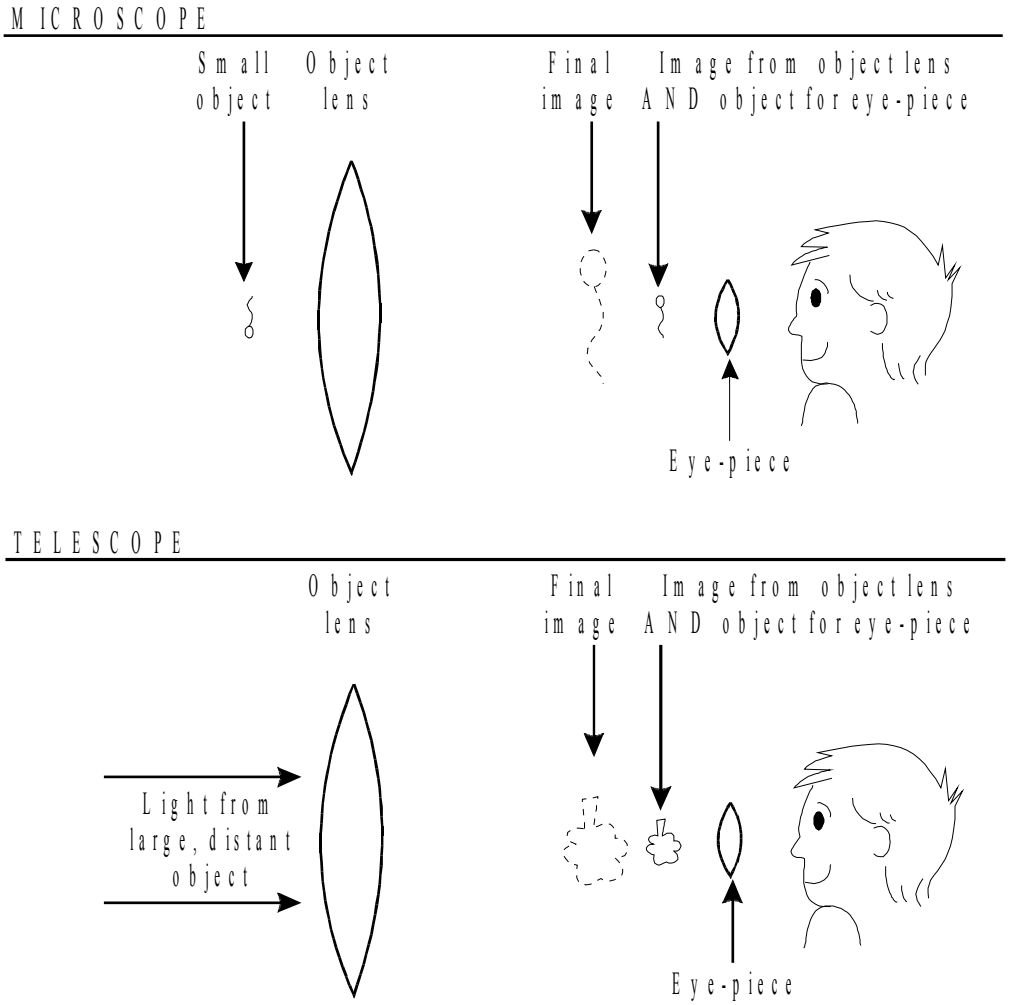
**(Total 6 marks)**

**3.** The diagrams show how the same two lenses can be used to make a microscope **or** a telescope.



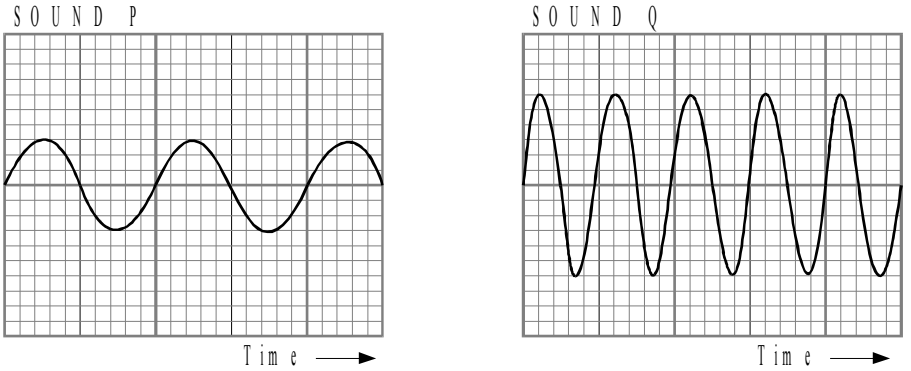

The microscope and the telescope made from the two lenses are similar in some ways but different in others.

Complete the table to show these **similarities** and **differences**.

| | Similarities | Differences |
|---|---|---|
| What the micro-scope and telescope are used for | | |
| The job done by the eye-piece | | |
| How the final image compares with the **original** object | | |

**(Total 7 marks)**

**4.** The diagram shows the oscilloscope traces of two different sounds P and Q. The oscilloscope setting is exactly the same in both cases.




P and Q **sound** different.
Write down **two** differences in the way they sound.
Explain your answers as fully as you can.

1 .....

.....

.....

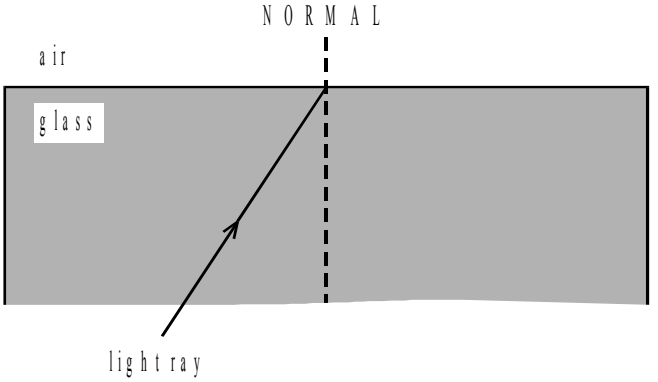
2 .....

.....

.....

**(Total 5 marks)**

**5.** The diagram shows a ray of light travelling through a glass block.




(a) Complete the diagram to show what happens to the ray of light when it comes out of the glass.

**(2)**

(b) Explain why this happens to the ray of light.

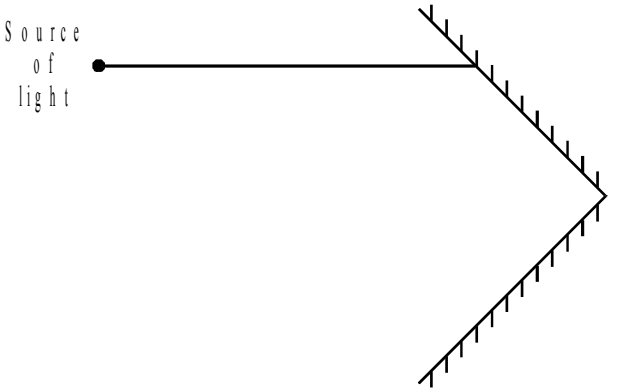
.....

**(2)**
**(Total 4 marks)**

**6.** (a) The diagram shows two mirrors at right angles to each other. A ray of light shines onto one mirror as shown.

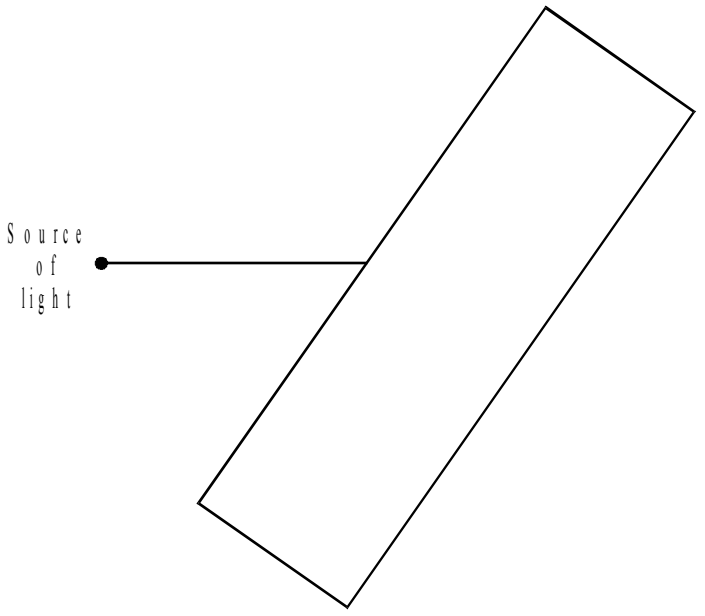
Carefully draw the path of the ray which is reflected from both mirrors.

Draw an arrow on the ray to show the direction of the light.



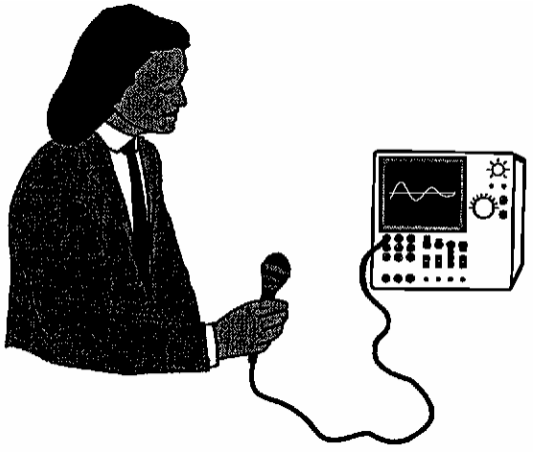

**(3)**

(b) Light can also be made to change direction as it passes into and out from a block of glass. Complete the ray diagram below.




**(2)**
**(Total 5 marks)**

**7.** (a) The student is using a microphone connected to a cathode ray oscilloscope (CRO).



The CRO displays the sound waves as waves on its screen. What does the microphone do?

.....

.....

.....

**(2)**

(b) The amplitude, the frequency and the wavelength of a sound wave can each be either increased or decreased.

(i) What change, or changes, would make the sound quieter?

.....

**(1)**

(ii) What change, or changes, would make the sound higher in pitch?

.....

**(1)**

(c) People can generally hear sounds in the frequency range 20 Hz to 20 000 Hz.

(i) What are very high frequency, and inaudible, sounds with frequencies **greater** than 20 000 Hz called?

.....

**(1)**

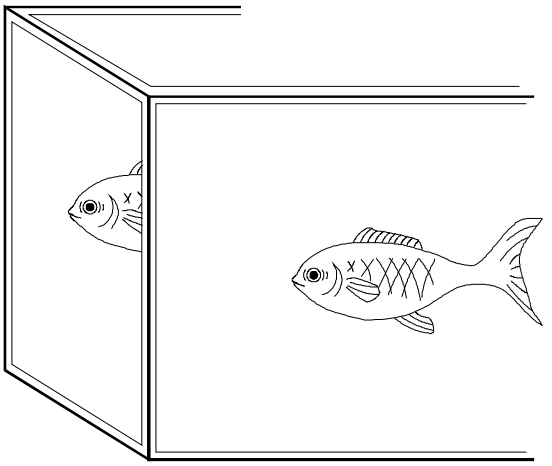
(ii) Give **two** uses for very high frequency sounds.

1. .....

2. .....

**(2)**
**(Total 7 marks)**

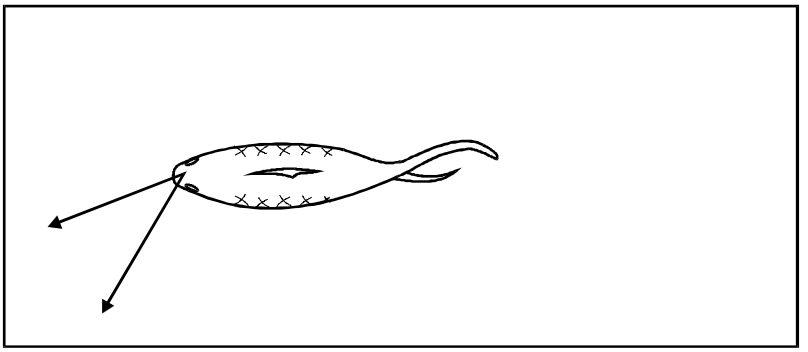
**8.** An aquarium contains only one fish. But if you look at the comer of the aquarium, there seem to be two fish.



The diagram below shows the top of the aquarium.

Two light waves have been drawn from the fish.

(a) Complete the diagram to show how the light waves reach the eye.




**(2)**

(b) Complete each sentence by using the correct words from the box.

| | | | |
|---|---|---|---|
| colour | diffraction | longitudinal | reflection |
| refraction | speed | transverse | |

When the light waves pass from glass into the air they change .....

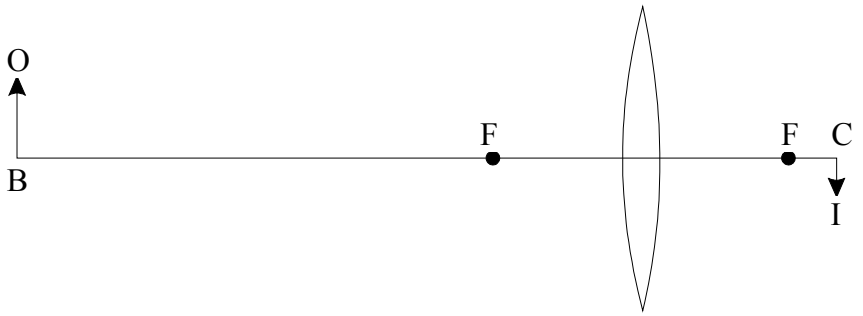
This causes a change in direction called .....

Light waves are ..... waves.

**(3)**

**(Total 5 marks)**

**9.** The diagram shows the image IC formed by a lens, of an object OB a long way from it. The points F mark the focal points of the lens.




(a) Describe, either by writing below or drawing on the diagram, how the size and position of the image changes:

(i) when the object OB is moved towards the focal point F.

.....

.....

(ii) when the object OB is moved past F to a point nearer the lens than the focal point.

.....

.....

**(4)**

(b) Explain how a converging lens in a camera is used to produce sharp images on the film when the object is a long distance away from the camera, and when it is close to the camera.

.....

.....

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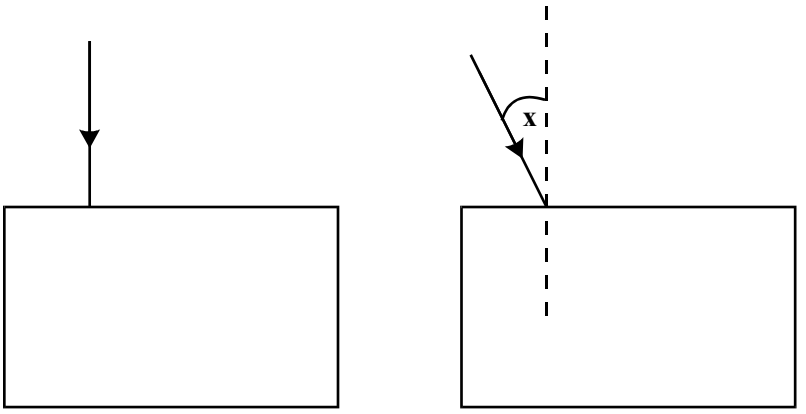
.....

.....

**(3)**
**(Total 7 marks)**

**10.** (a) The diagrams show rays of light. Each ray strikes a surface of a glass block.

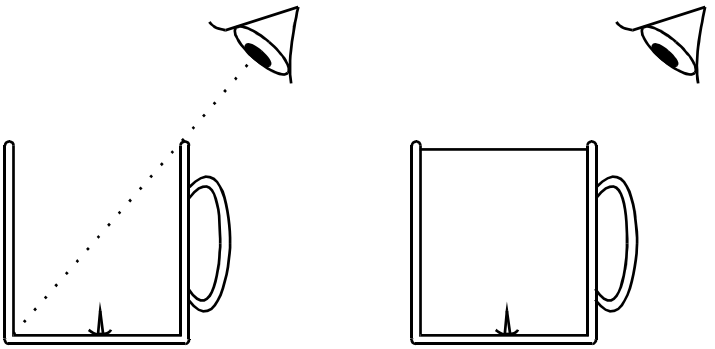



(i) On the diagram draw the path of each ray through the glass block and out into the air again.

(ii) Label another angle on the diagram which is equal to the angle marked **X**. Label this angle **Y**.

**(4)**

(b) The diagrams show two beakers. Both beakers have a drawing pin inside as shown.



The first beaker is empty. The eye cannot see the drawing pin.
The second beaker is full of water and the eye can see the drawing pin.

Explain how the eye is able to see the drawing pin in the second beaker. You may add to the diagram if it helps your answer.

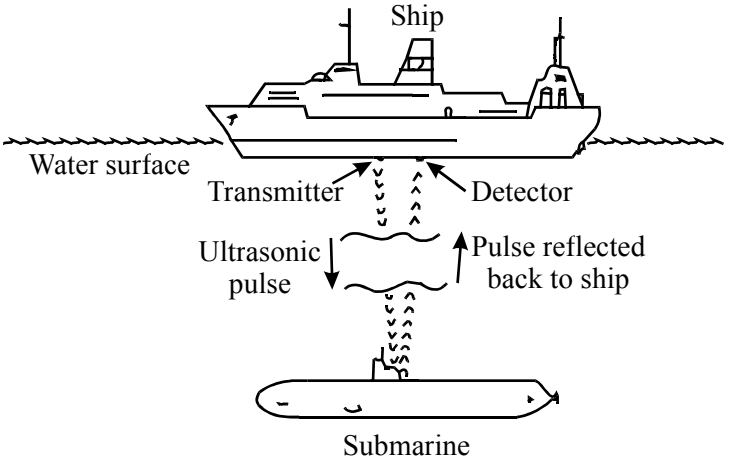
.....

.....

.....

**(3)**
**(Total 7 marks)**

**11.** Echo sounders are used at sea to locate underwater objects, such as submarines.
The diagram below shows how an echo sounder works.




(i) What are ultrasonic waves?

.....

.....

(ii) The pulse travels from the transmitter to the submarine and back to the detector. The time taken is 0.1 s.

Calculate the distance between the submarine and the ship.

.....

.....

.....

.....

Distance ..... m

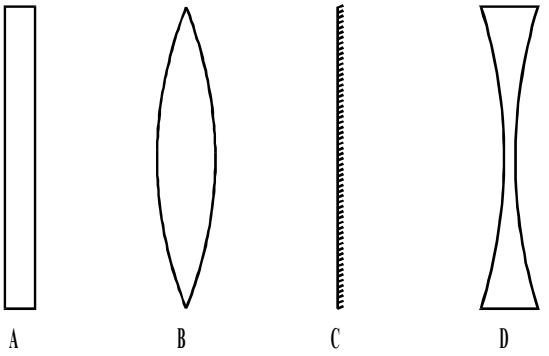
(iii) State **one** other use for ultrasonic waves.

.....

.....

**(Total 7 marks)**

**12.** The diagrams below show some pieces of glass.



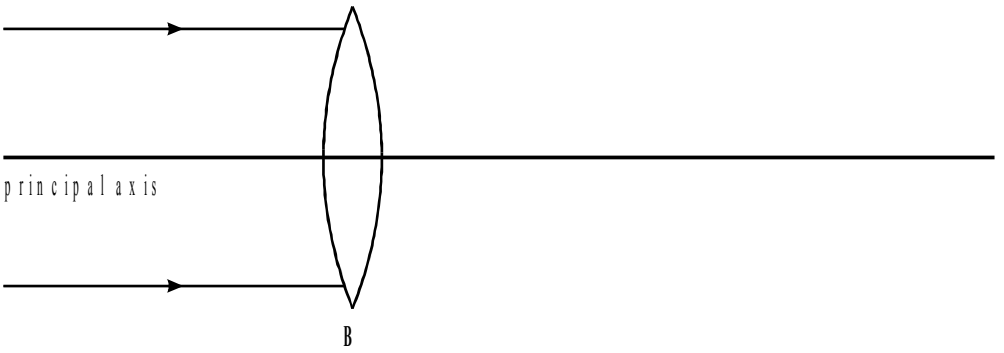

(a) Which of **A, B, C** and **D** is

(i) a converging lens, .....

(ii) a diverging lens? .....

**(2)**

(b) Complete the diagram below to show what happens to the rays of light when they pass through **B**.

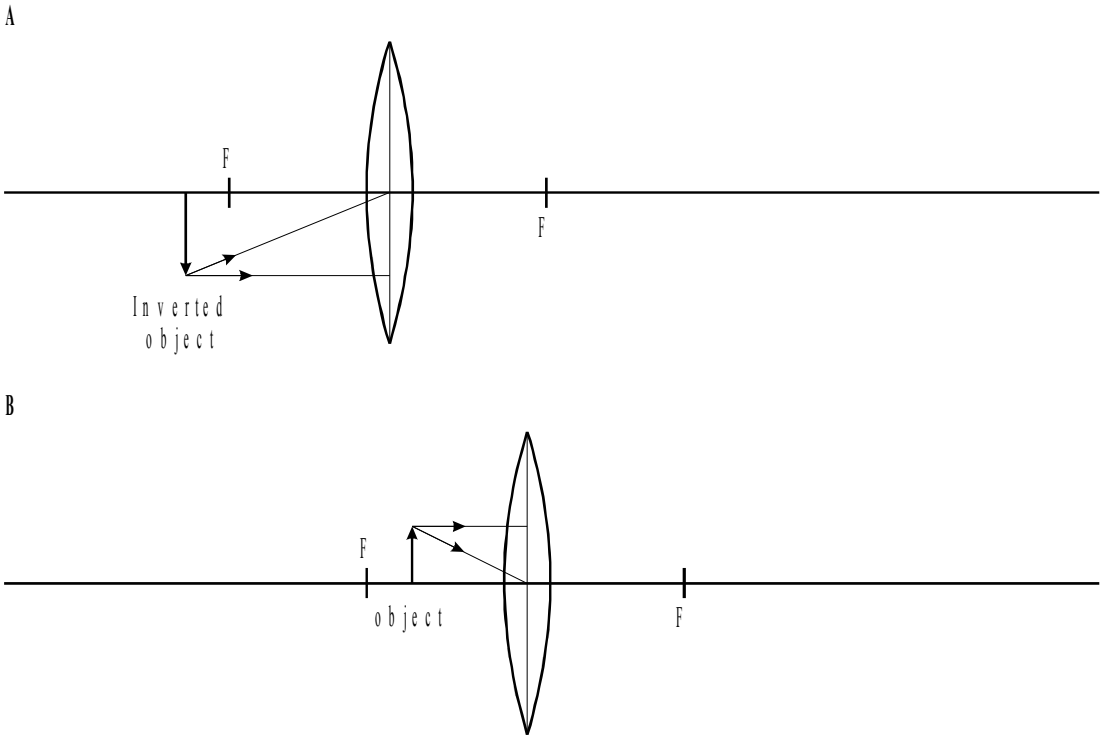



**(4)**
**(Total 6 marks)**

**13.** The ray diagrams show rays from the object to the lens as used in different optical instruments.

(a) Complete both ray diagrams.

On each diagram label the image formed.




**(6)**

(b) Complete the table below to describe the images formed.

| | larger or smaller than object | real or virtual |
|---|---|---|
| **A** | | |
| **B** | | |

**(2)**
**(Total 8 marks)**

**14.** (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?

.....

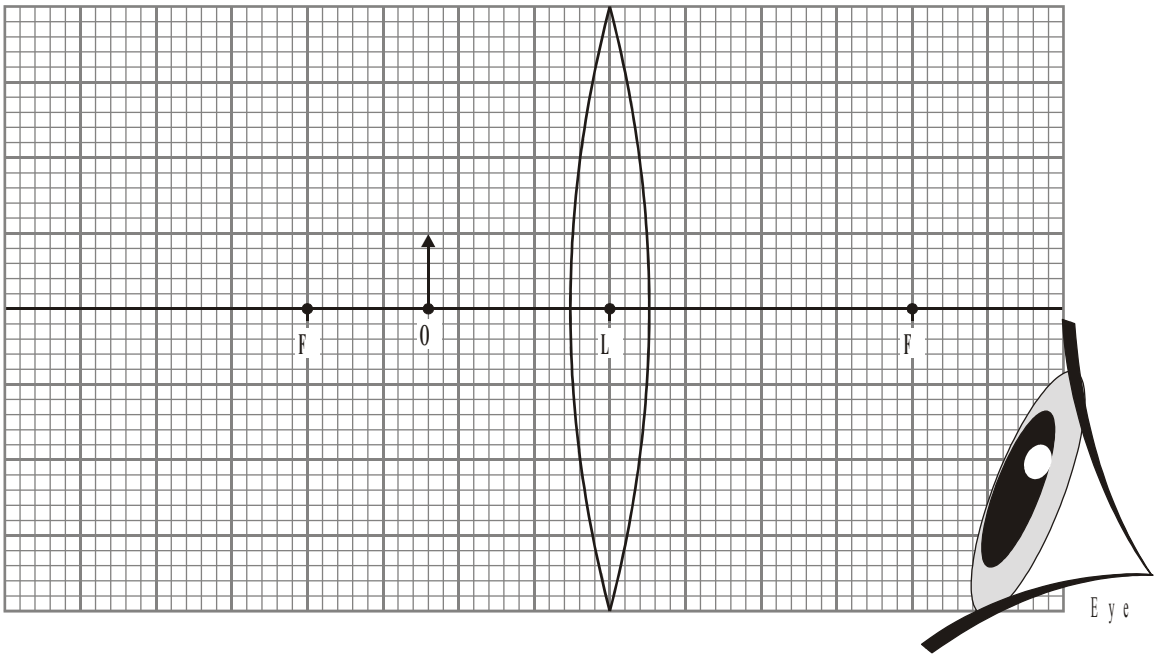
**(1)**

(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.

.....

.....

.....

.....

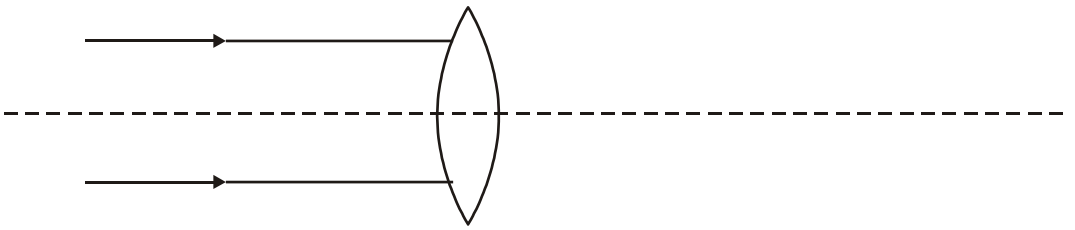
.....

.....

**(3)**
**(Total 12 marks)**

**15.** (a) The diagram shows two parallel rays of light, a lens and its axis.

(i) Complete the diagram to show what happens to the rays.



**(2)**

(ii) Name the point where the rays come together.

.....

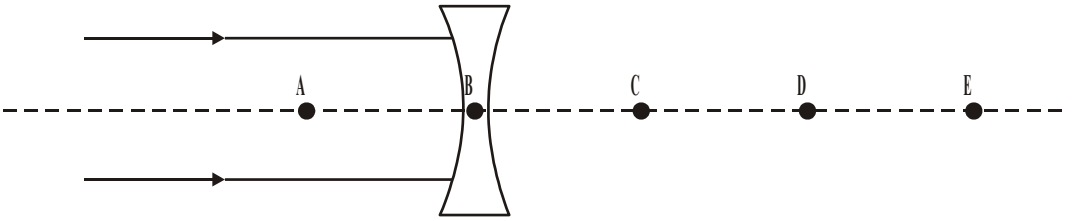
**(1)**

(iii) What word can be used to describe this type of lens?

.....

**(1)**

(b) The diagram shows two parallel rays of light, a lens and its axis.


A
B
C
D
E

(i) Which point **A**, **B**, **C**, **D** or **E** shows the focal point for this diagram?

Point .....

**(1)**

(ii) Explain your answer to part (b)(i).

.....

.....

**(1)**

(iii) What word can be used to describe this type of lens?

.....

**(1)**

(c) Complete the following **three** sentences by crossing out the **two** lines in each box which are wrong

In a camera a converging lens is used to produce an image on a

| |
|---|
| film |
| lens |
| screen |

The image is

| |
|---|
| larger than |
| smaller than |
| the same size as |

the object.

Compared to the distance of the image from the lens, the object is

| |
|---|
| further away from |
| nearer to |
| the same distance from |

the lens.

**(3)**

(d) Explain the difference between a *real* image and a *virtual* image.

.....

.....

.....

.....

.....

.....

**(3)**
**(Total 13 marks)**