Optics

Questions

Name: _____

Class: _____

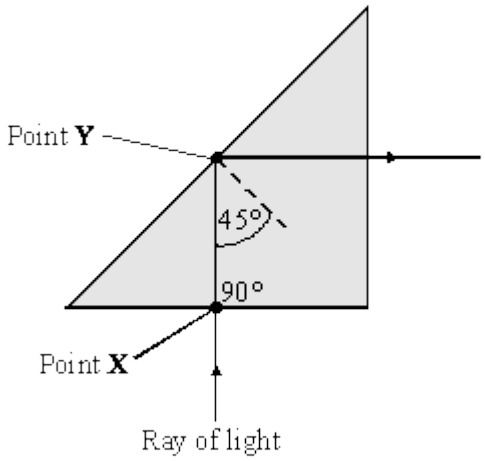
Date: _____

Time: **71 minutes**

Marks: **71 marks**

Comments:

1 The diagram shows a glass prism.



(i) Explain why refraction has **not** occurred at point **X**.

_____

_____

(1)

(ii) (A) Give the full name for the process which has occurred at point **Y**.

_____

(1)

(B) Explain why this process has occurred.

_____

_____

_____

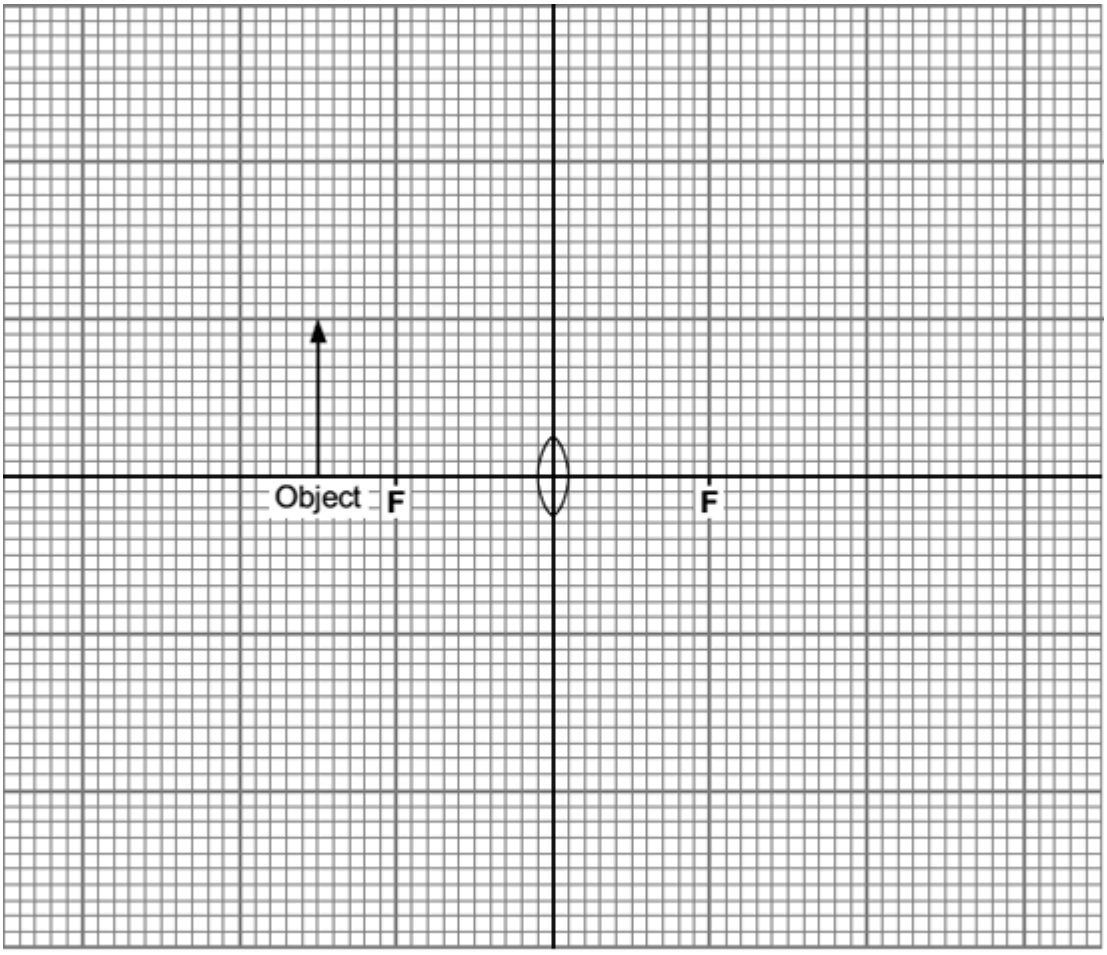
(2)

(Total 4 marks)

2 A student investigated how the nature of the image depends on the position of the object in front of a large converging lens.

The diagram shows one position for the object.

(a) Use a ruler to complete a ray diagram to show how the image of the object is formed.



Key: **F** = principal focus

(4)

(b) Describe the nature of this image relative to the object.

_____

_____

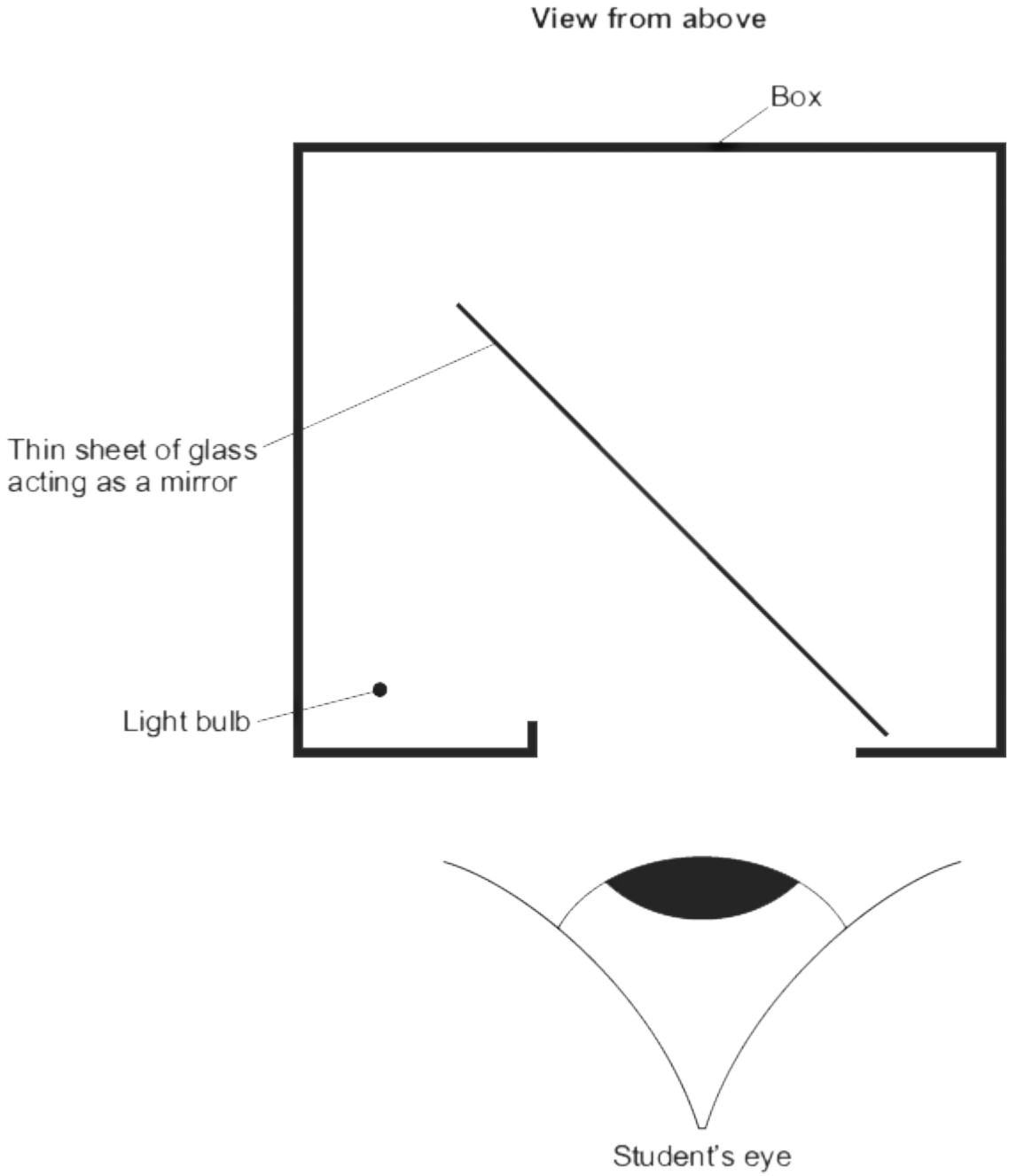
_____

(2)

(Total 6 marks)

3 The diagram shows a model used to demonstrate an illusion known as 'Pepper's Ghost'.

A small light bulb and thin sheet of glass are put inside a box. The thin sheet of glass acts as a mirror. Although the light bulb is switched on, a student looking into the box cannot see the bulb. What the student does see is a virtual image of the bulb.



(a) Use a ruler to complete a ray diagram to show how the image of the light bulb is formed. Mark and label the position of the image.

(4)

(b) The image seen by the student is virtual.

Why?

_____

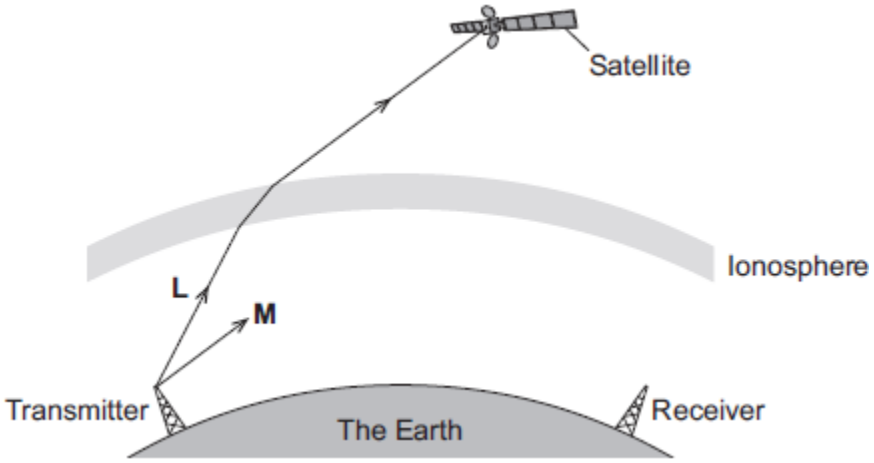
_____

(1)

(Total 5 marks)

4 Different parts of the electromagnetic spectrum are useful for different methods of communication.

The diagram shows a transmitter emitting two electromagnetic waves, **L** and **M**.



(a) (i) Wave **L** is used to send a signal to a satellite.
Which part of the electromagnetic spectrum does wave **L** belong to?

_____

(1)

(ii) What name is given to the process that occurs as wave **L** passes into the ionosphere?

_____

(1)

(b) Wave **M** is **reflected** by the ionosphere.

(i) On the diagram above, draw the path of wave **M** until it reaches the receiver.

(2)

(ii) On the daigram above, draw a line to show the normal where wave **M** meets the ionosphere. Label the line **N**.

(1)

(c) Give **two** properties of all electromagnetic waves.

1. _____

_____

2. _____

_____

(2)

(Total 7 marks)

5 The data given in the table below was obtained from an investigation into the refraction of light at an air to glass boundary.

Angle of incidence	Angle of refraction
20°	13°
30°	19°
40°	25°
50°	30°

(a) Describe an investigation a student could complete in order to obtain similar data to that given in the table above.

Your answer should consider any cause of inaccuracy in the data.

A labelled diagram may be drawn as part of your answer.

_____

_____

_____

_____

_____

_____

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_____

_____

_____

(6)

(b) State the reason why light is refracted as it crosses from air into glass.

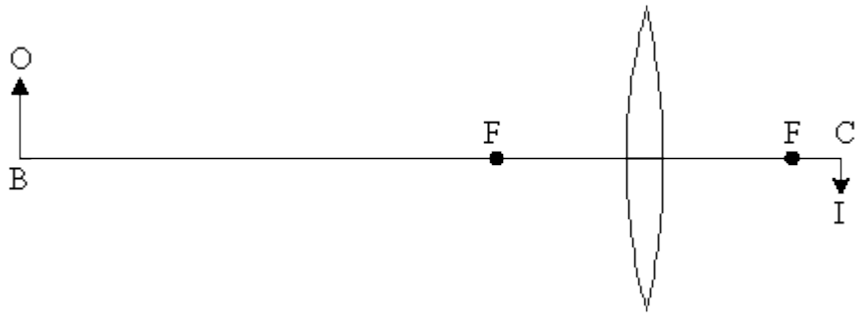
_____

_____

(1)

(Total 7 marks)

6 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.

_____

_____

_____

_____

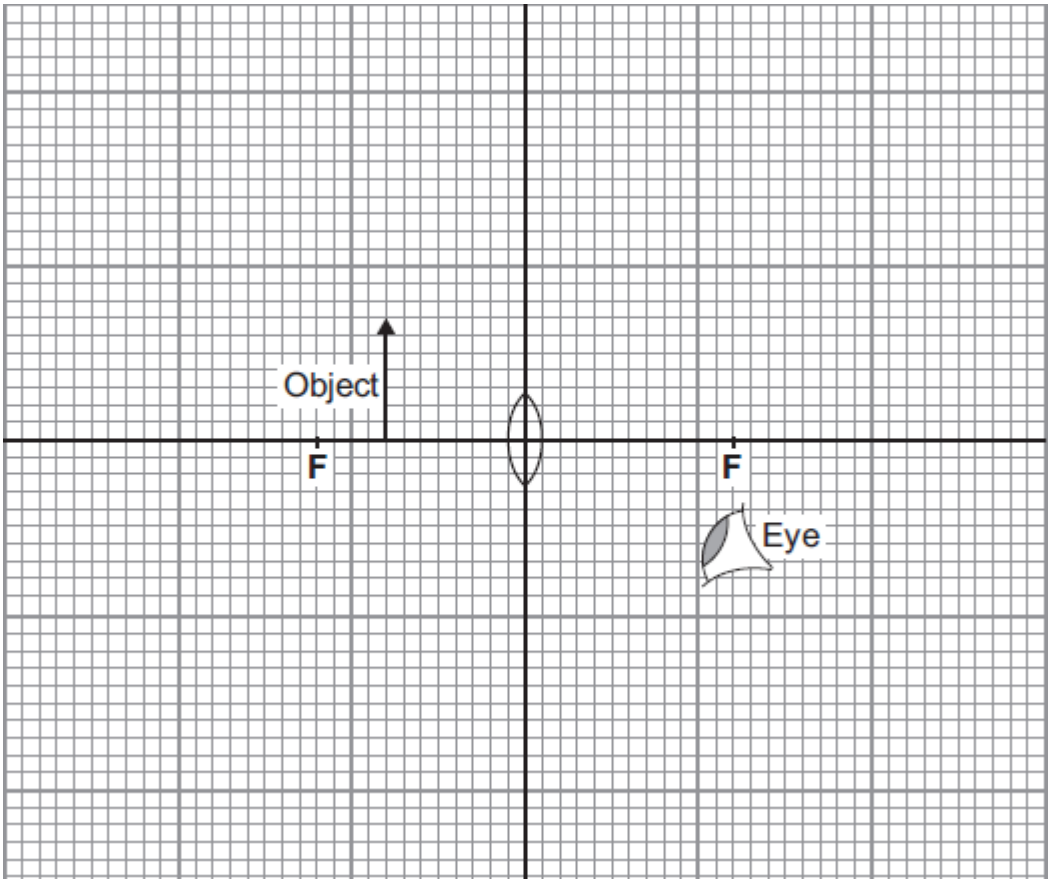
_____

(3)

(Total 7 marks)

7 (a) The diagram shows a converging lens being used as a magnifying glass.

(i) On the diagram, use a ruler to draw two rays from the top of the object which show how and where the image is formed. Represent the image by an arrow drawn at the correct position.



(3)

(ii) Use the equation in the box to calculate the magnification produced by the lens.

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

Show clearly how you work out your answer.

_____

_____

Magnification = _____

(2)

(b) A camera also uses a converging lens to form an image.

Describe how the image formed by the lens in a camera is different from the image formed by a lens used as a magnifying glass.

_____

_____

_____

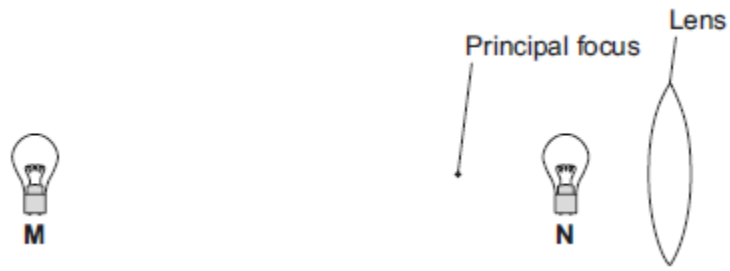
_____

(2)

(Total 7 marks)

8 (a) A light bulb is placed between a convex lens and the principle focus of this lens, at position **N** shown in **Figure 1**. The light bulb is then moved to position **M**, a large distance from the lens.

Figure 1



Describe how the nature of the image formed changes as the light bulb is moved from position **N** to position **M**.

_____

_____

_____

_____

_____

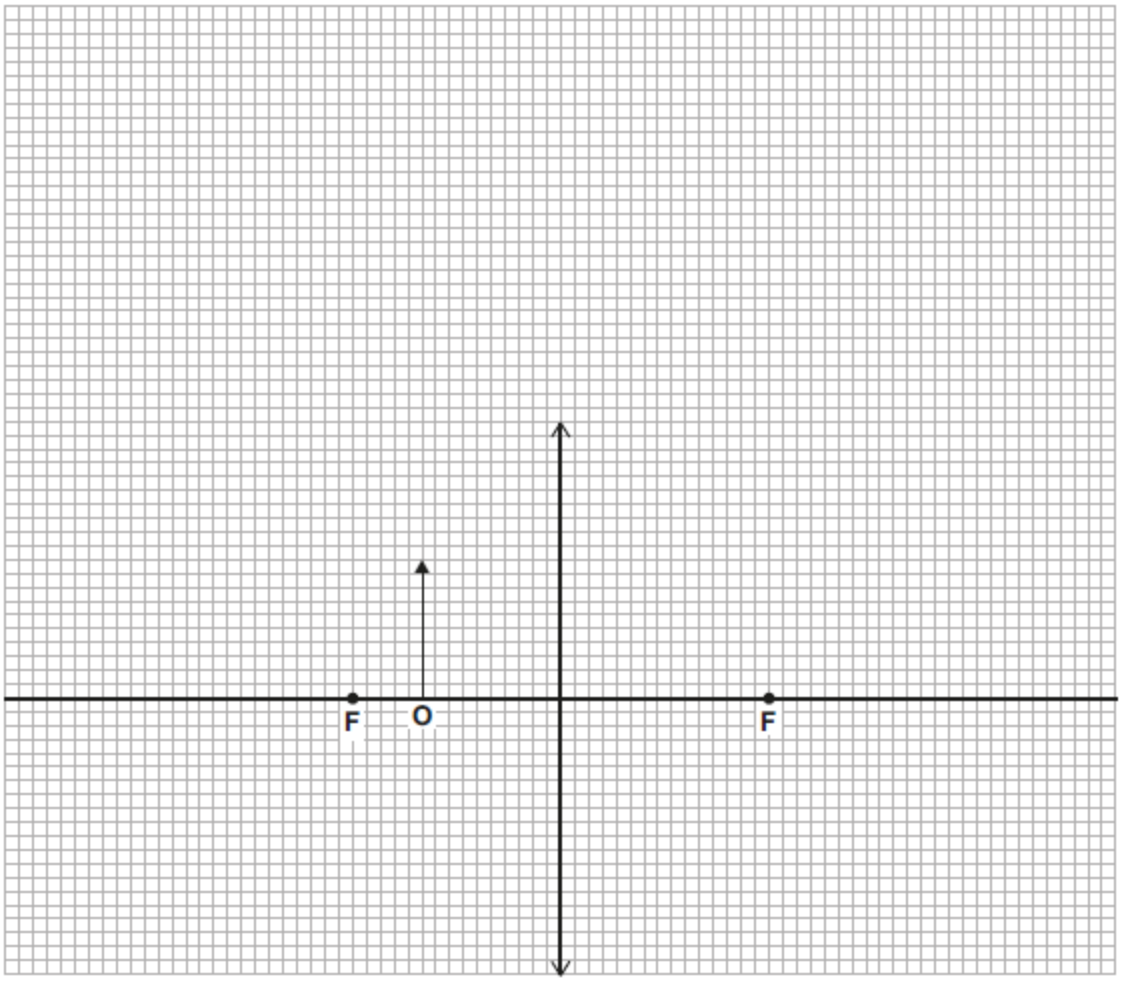
_____

(3)

(b) An object, **O**, is very near to a convex lens, as shown in **Figure 2**.

Complete **Figure 2** to show how rays of light from the object form an image.

Figure 2

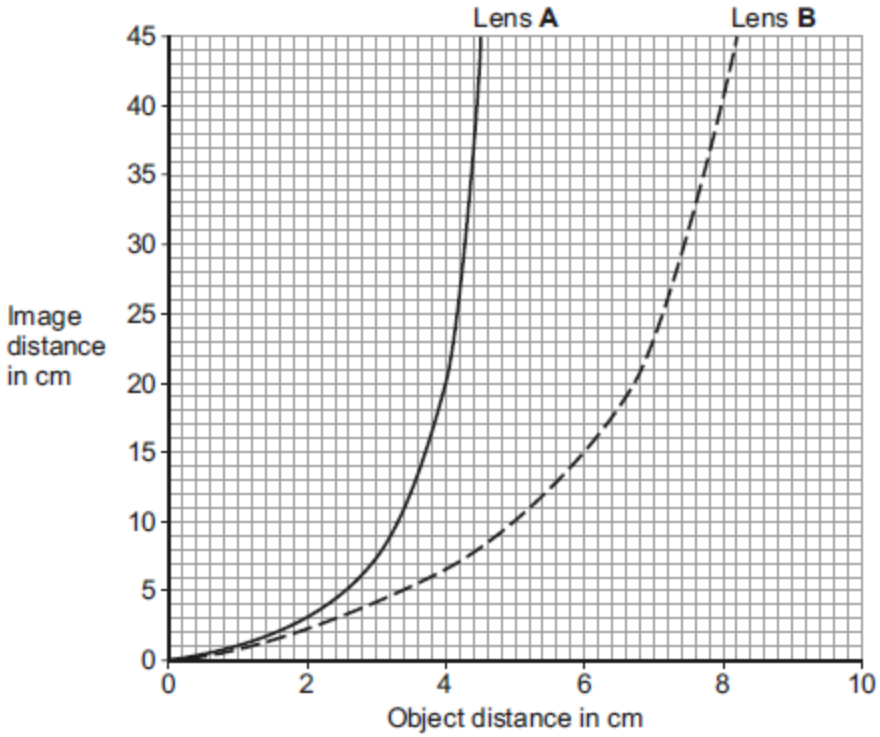


(3)

(c) The object distance is the distance from an object to the lens. The image distance is the distance from the lens to the image.

Figure 3 shows how the image distance changes with the object distance, for two identically shaped convex lenses, **A** and **B**. Each lens is made from a different type of glass.

Figure 3



(i) When the object distance is 4 cm, the image distance for lens **A** is longer than for lens **B**.

State why.

_____

_____

(1)

(ii) When the object is moved between lens **B** and the principal focus, the image size changes. The table shows the magnification produced by lens **B** for different object distances.

Object distance in cm	Magnification
0.0	1
5.0	2
6.7	3
7.5	4
8.0	5

Using information from **Figure 3** and the table, describe the relationship between the **image** distance and the magnification produced by lens **B**.

_____

_____

_____

(2)

(iii) A third convex lens, lens **C**, is made from the same type of glass as lens **B**, but has a shorter focal length than lens **B**.

Lens **B** is shown in **Figure 4**.

Complete **Figure 4** to show how lens **C** is different from lens **B**.

Figure 4

Lens **B**

Lens **C**

(1)

(Total 10 marks)

9 (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?

_____

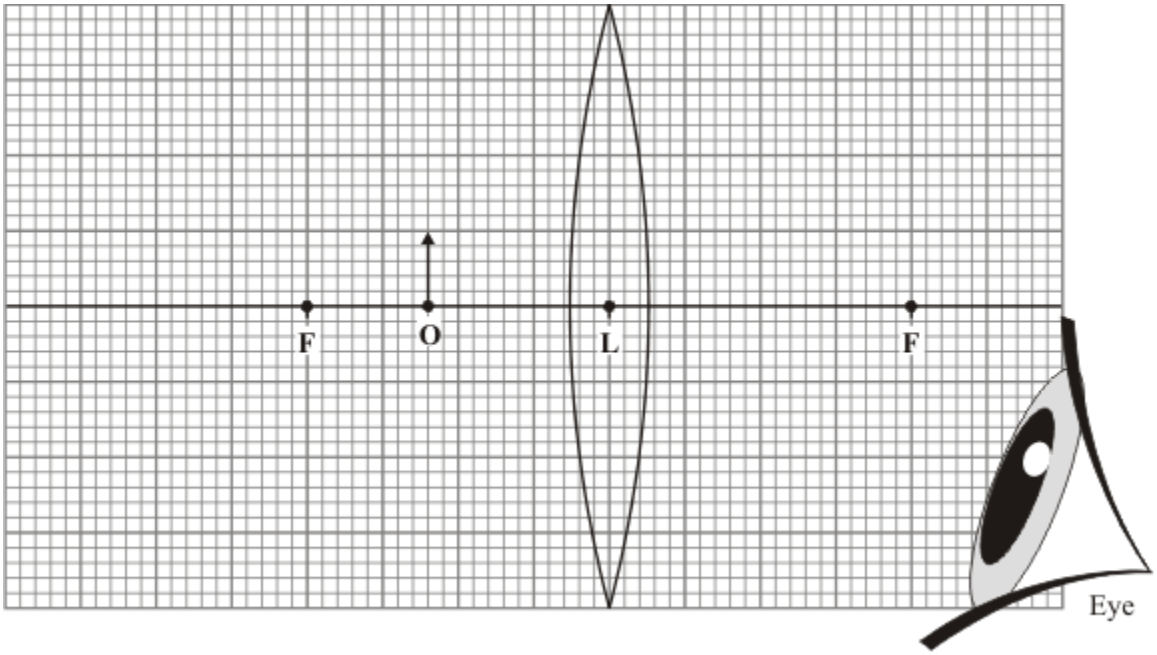
(1)

(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)