Using lenses

1 (a) State **two** advantages of using a camera, rather than the unaided eye, for studying stars.

(2)

1 .....

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2 .....

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(b) Galileo observed the moons of Jupiter.
Explain how these observations helped to change scientists' ideas about the Universe.

(3)

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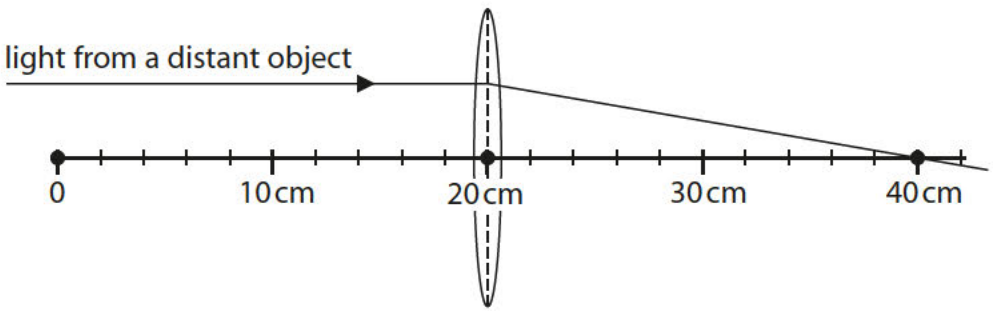
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(c) The diagram shows a thin lens placed at the 20 cm mark of a metre rule.



A ray has been drawn from a distant object.
Complete the sentence by putting a cross (☒) in the box next to your answer.

The focal length of the lens is

(1)

☐ **A** 10 cm

☐ **B** 20 cm

☐ **C** 30 cm

(d) The linear magnification of a thin lens is given the symbol *M*.
The following equation for *M* is used for lenses in cameras.

$$M = \frac{f}{(d - f)}$$

where *f* is the focal length of the lens and *d* is the distance between the lens and an object.

A lens has a focal length of 12 cm.

(i) Use the equation to calculate *M* when the distance from an object to the lens is 14 cm

(2)

M = ...

(ii) Use the equation to calculate *M* when the distance from an object to the lens is 11 cm

(1)

M = ...

(iii) The table shows the magnifications produced by this lens for different distances between object and lens.

d / cm	*M*
3.0	–1.3
9.0	–4.0
15	4.0
21	1.3

Suggest what the sign of *M* indicates about the image produced by the lens.

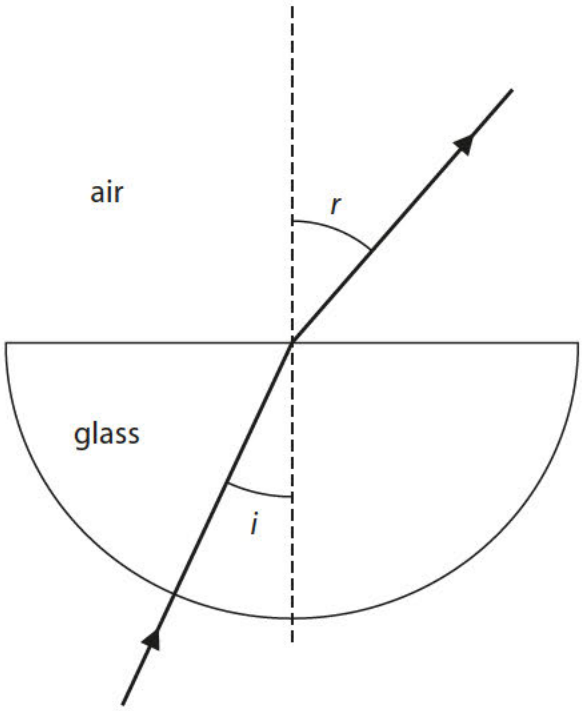
(1)

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.....

(Total for Question 4 = 10 marks)

2 A student investigates the way light passes through glass.
The diagram shows the path of a ray of light through the glass.



(a) State the scientific name for the dotted line in the diagram.

(1)

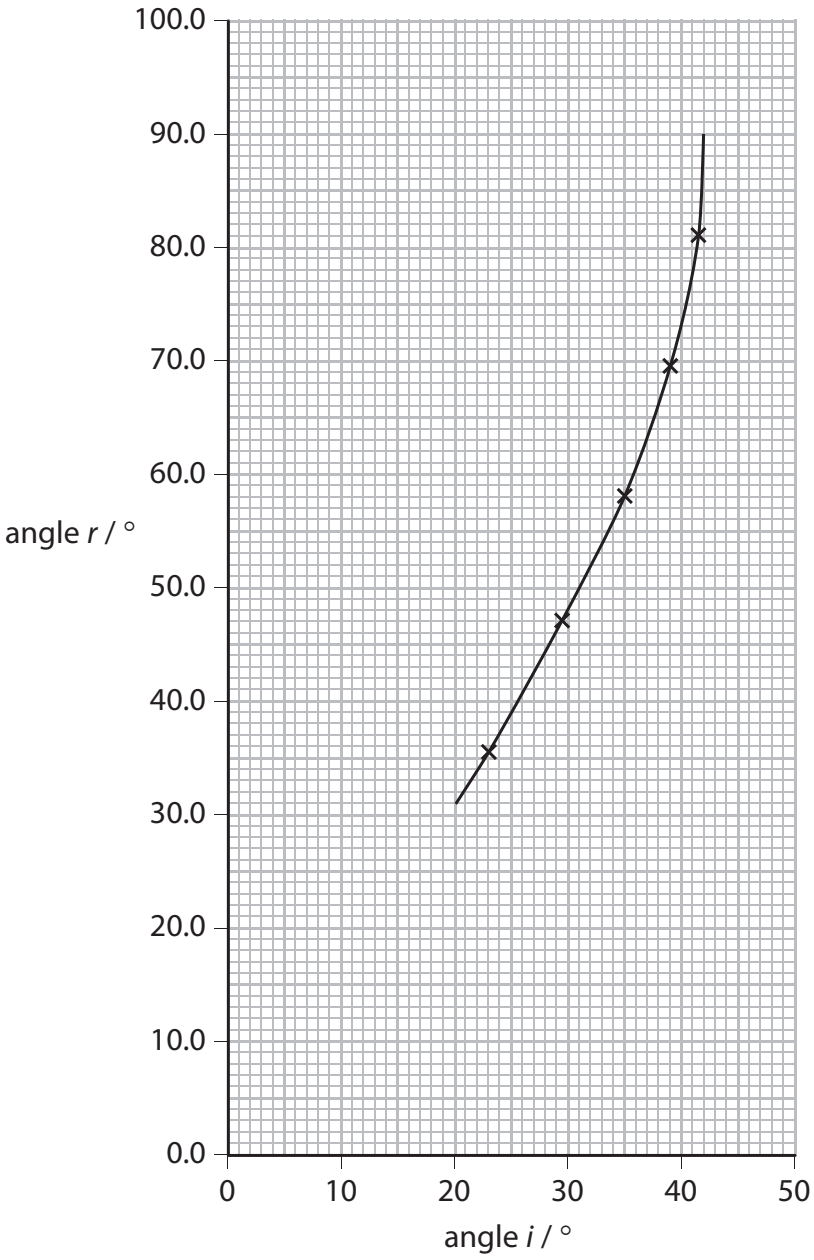
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(b) The student measu
She plots some of her results on the graph.
The table shows results that she has not plotted.

angle *i*	angle *r*
0°	0°
6°	9°

(i) Plot these results on the graph.

(2)



(ii) Continue the line on the graph through the results you have plotted.

(1)

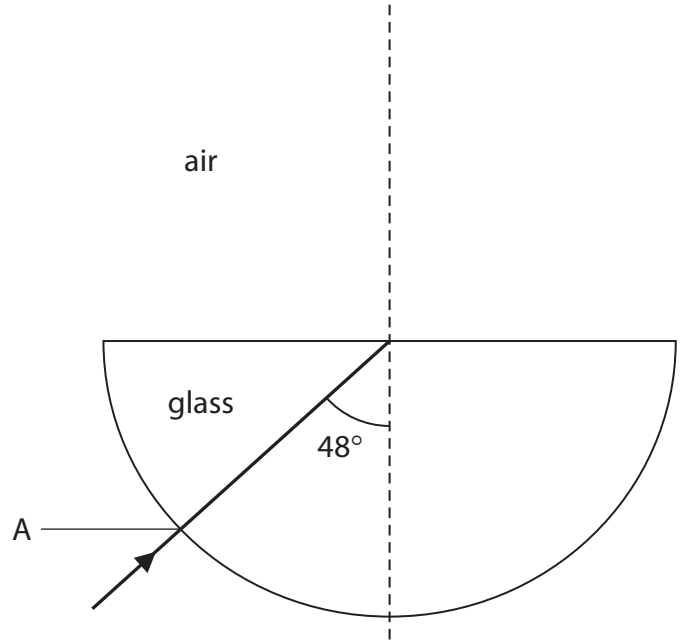
(iii) Write down the value of angle *i* when angle *r* = 90°.

(1)

angle *i* = ... °

(c) (i) Complete the diagram to show what happens to the ray of light when angle *i* is 48°.

(2)



(ii) State why the ray of light does not change direction when it enters the glass at A.

(1)

.....

.....

(Total for Question 1 = 8 marks)

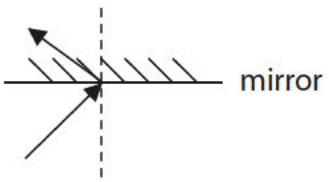
Visible light

3 Mirrors and lenses can be used in telescopes.

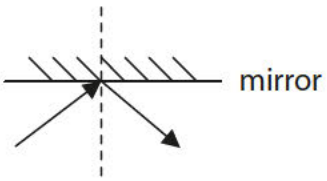
(a) Which diagram best shows what happens to a ray of light when it hits a plane mirror?

Put a cross (☒) in the box next to your answer.

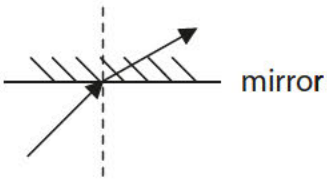
(1)



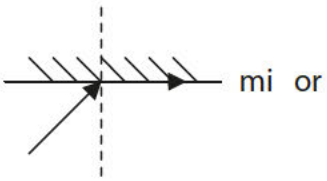
☐ **A**



☐ **B**

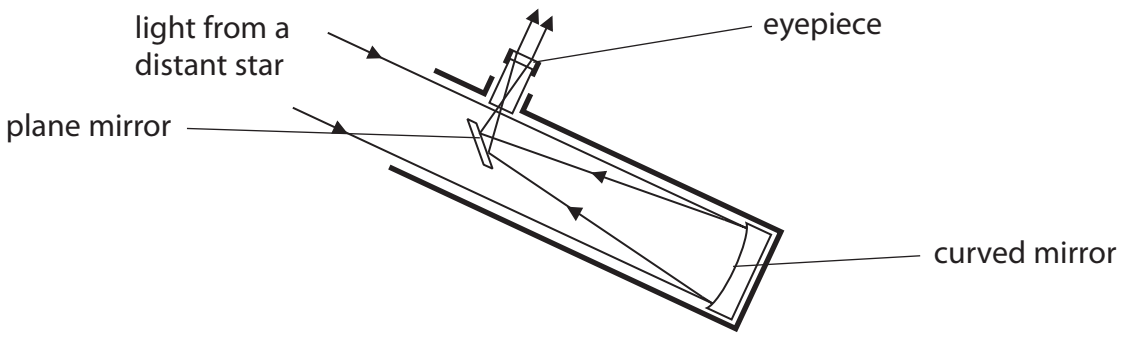


☐ **C**



☐ **D**

(b) The diagram shows light rays in a reflecting telescope.



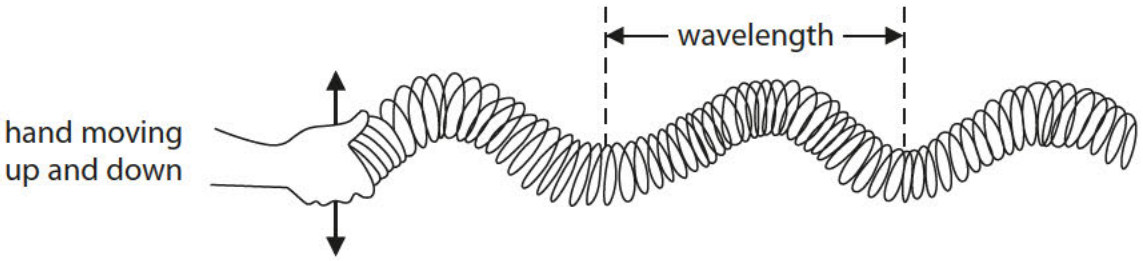
(i) Describe what the mirrors and the eyepiece do to the light rays to form an image of a distant star.

(3)

(ii) Explain an advantage of using a telescope instead of the naked eye to look at stars.

(2)

(c) Light travels through space as a wave.
A model of this type of wave can be made using a Slinky spring.
A Slinky spring is a long coil of wire like the one shown in the diagram.



(i) State the name of this type of wave.

(1)

.....

(ii) How could the movement of the hand be changed to make the amplitude of this wave bigger?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** move up and down a smaller distance

☐ **B** move up and down at a faster rate

☐ **C** move up and down a bigger distance

☐ **D** move up and down at a slower rate

(iii) The wave shown in the model has a wavelength of 0.5 m and the frequency is 4 Hz.

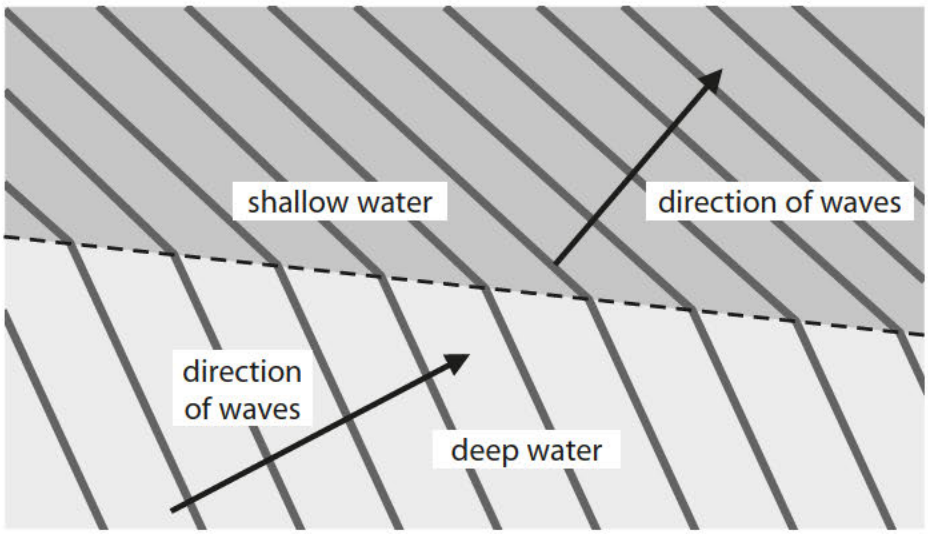
Calculate the speed of the wave.

(2)

speed of wave = ... m/s

(Total for Question 3 = 10 marks)

4 (a) The diagram represents water waves travelling from deep water into an area of much shallower water.



(i) State the name of the effect shown in this diagram.

(1)

.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

When the waves go from deep water to shallow water, the

(1)

☐ **A** frequency decreases

☐ **B** wavelength decreases

☐ **C** frequency increases

☐ **D** wavelength increases

(iii) Explain another change which can be seen from the diagram when the waves go from deep water to shallow water.

(2)

.....

.....

.....

.....

(b) The velocity of the waves in deep water is 25 m/s.
The wavelength is 120 m.

Calculate the frequency of the waves.

(3)

frequency = ... Hz

(c) The photograph shows a floating buoy used to warn boats about shallow water.



The buoy has a lamp and a bell.

Explain the difference between transverse and longitudinal waves by referring to sound from the bell and the light from the lamp.

(3)

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(Total for Question 4 = 10 marks)

5 A student investigates how light behaves as it leaves a clear plastic block.

Figure 4 shows some of her equipment and the path of a ray of light through the block.

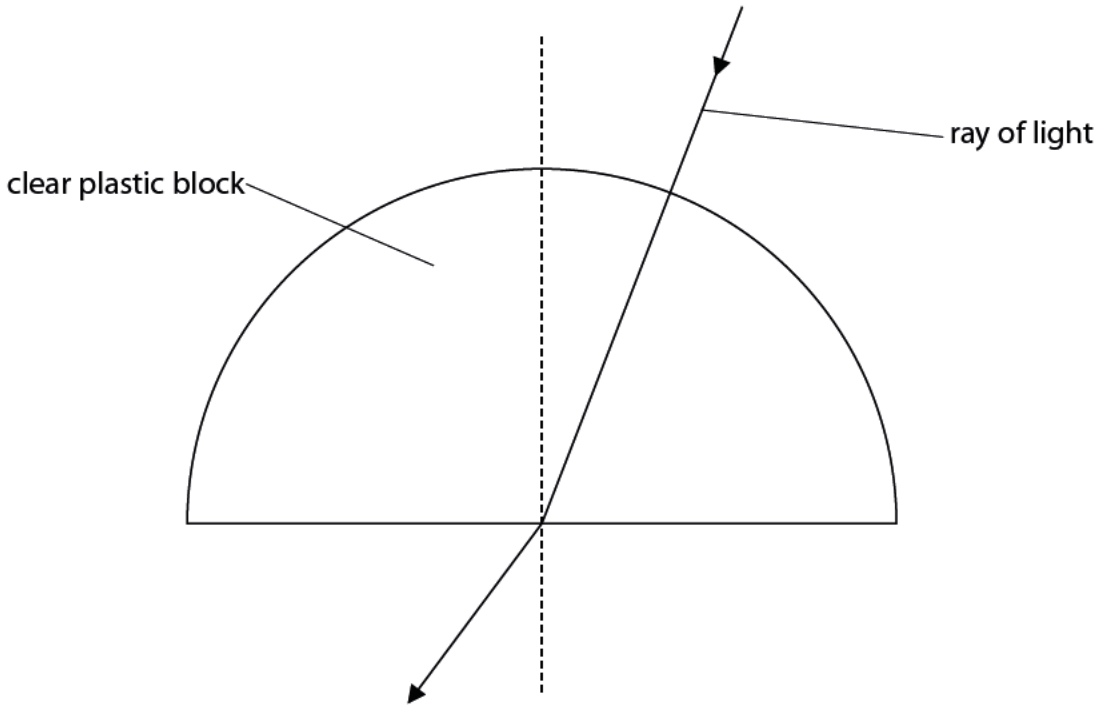


Figure 4

(a) Describe how the student can make sure the light does not change direction as it enters the block.

(2)

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.....

.....

(b) She varies the angle of incidence inside the block and records the angle of refraction.

Figure 5 shows her results.

angle of incidence (°)	angle of refraction (°)
5	7
15	22
30	46
40	69
42	76

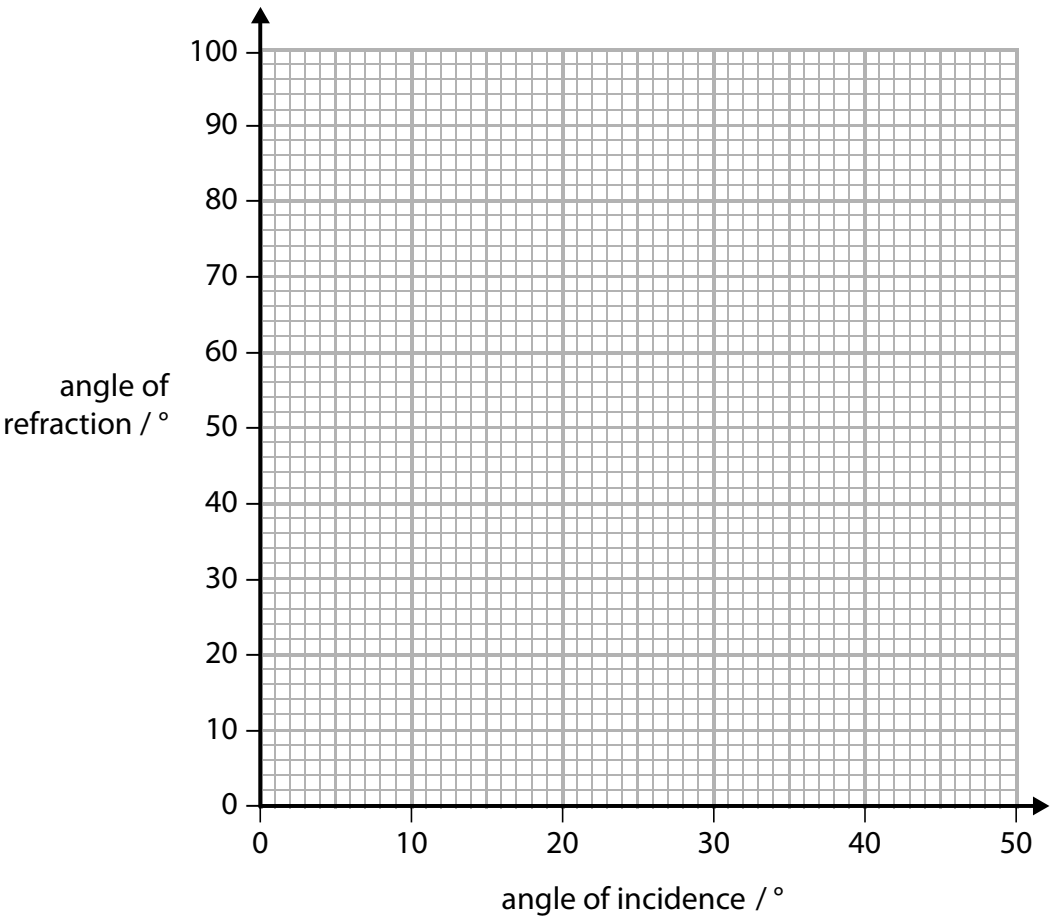
Figure 5

(i) Plot the points on the grid below.

(2)

(ii) Draw the best fit smooth curve through the points.

(1)



(iii) Estimate the angle of incidence which gives an angle of refraction of 90°.

(2)

angle of incidence = ...

(c) Describe what happens to the ray of light when the angle of incidence is increased beyond the critical angle.

(2)

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(Total for Question 4 = 9 marks)