S3 Final Examination (2023–2024)

Physics

(1 hour)

Date: 14th June 2024 Name: _____

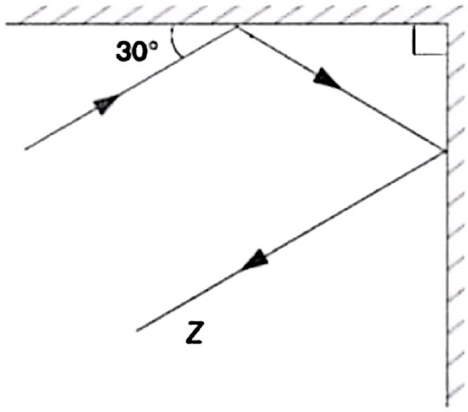
Time: 8:30 a.m. – 9:30 a.m. Class: _____ No.: _____

Instructions to students:

1. Write your name, class and class number on both the question paper and the answer sheets.
2. Answer ALL questions.
3. Write down all the answers on the answer sheets.
4. Hand in the question paper and the answer sheets at the end of the examination.
5. The total mark of the paper is 60.
6. The paper consists of two sections: Section A Multiple Choice Questions (20 marks) and Section B Structured Questions (40 marks).
7. The numerical answers should be either exact or correct to 3 significant figures.

Section A: Multiple Choice Questions (20 marks)

1. The figure below shows a ray of light reflected by two mirrors successively.



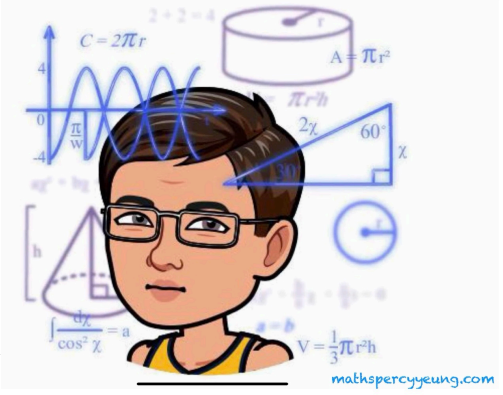
What is the angle of reflection of the final ray *Z*?

A. 30°

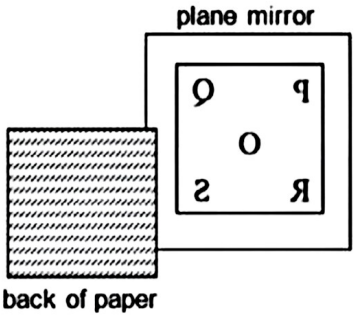
B. 40°

C. 60°

D. 70°



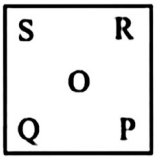
2. A paper printed with letters 'O', 'P', 'Q', 'R' and 'S' is placed in front of a mirror. The figure below shows the image in the mirror.



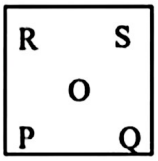
Which of the following best represents the positions of the letters printed on the paper?

A.

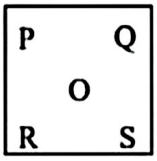
B.



C.

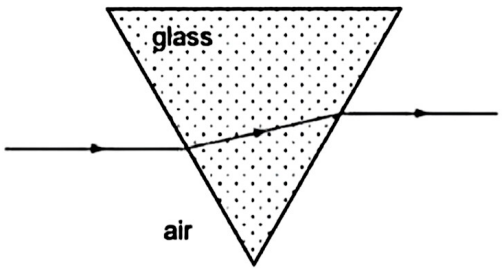


D.

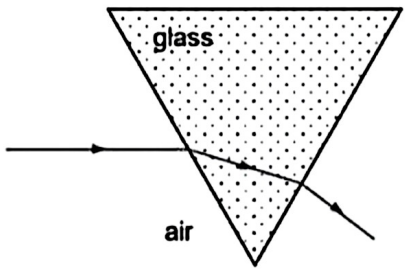


3. A horizontal light ray is incident on a glass prism. Which of the following ray diagrams is correct?

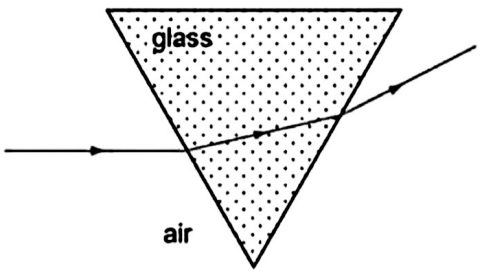
A



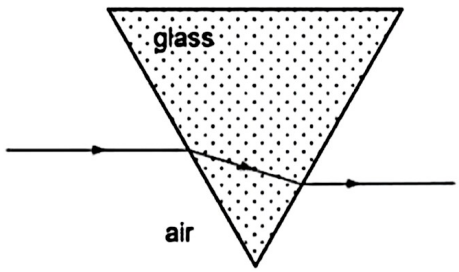
B.



C.



D



4. A ray of light enters a transparent block from air (Figure *a*). The angle of incidence *i* is varied and the corresponding angle of refraction *r* is measured. A graph of sin *i* against sin *r* is obtained (Figure *b*). What is the critical angle for the interface between the block and air?

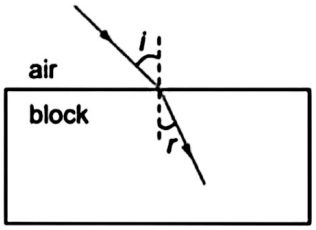


Figure *a*

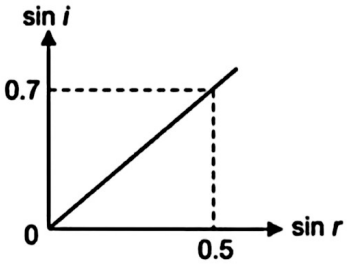
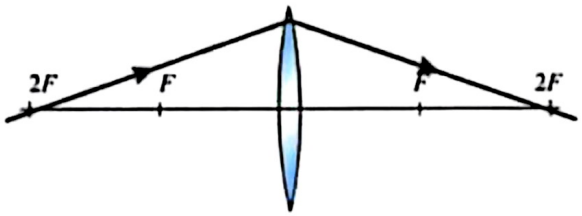


Figure *b*

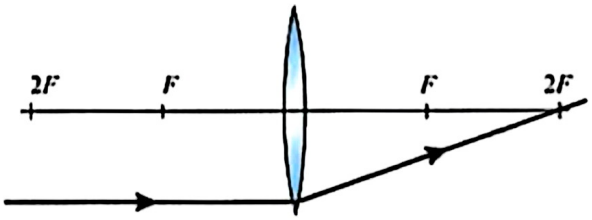
A. 20.5°
B. 30.0°
C. 44.2°
D. 45.6°

5. A ray of light passes through a convex lens with principal foci *F*. Which of the following ray diagrams correctly shows the refracted ray?

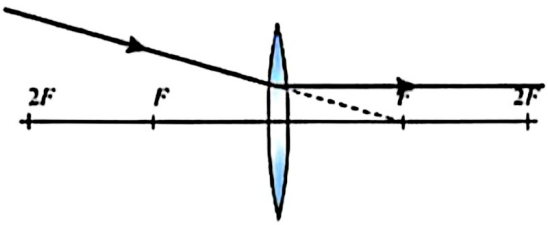
A.



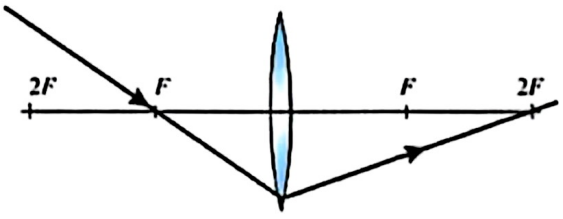
B.



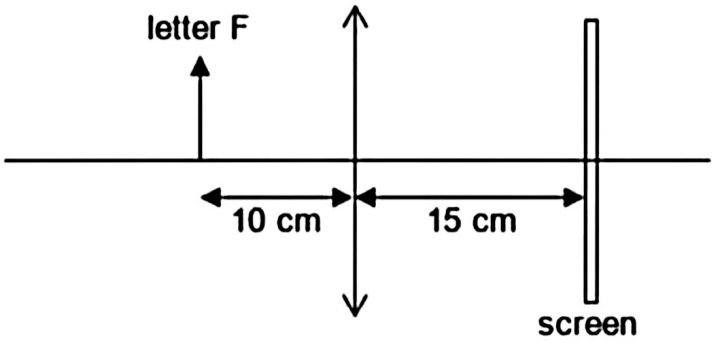
C.



D.



6. A letter 'F' is placed at 10 cm in front of a convex lens as shown in the figure. A sharp image is captured by the screen placed 15 cm behind the lens.



If the screen is moved towards the lens, which of the following adjustments may allow a sharp image to be captured on the screen again?

(1) Replace the lens with a convex lens of longer focal length.
(2) Move the letter 'F' away from the lens.
(3) Replace the lens with a concave lens of the same focal length.

A. (1) only
B. (2) only
C. (1) and (2) only
D. (1), (2) and (3)

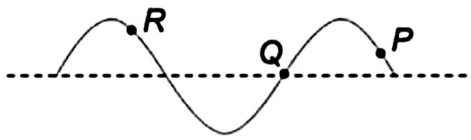
7. When an object is placed 18 cm away from a lens of a focal length 6 cm, a diminished and erect image is formed. What is the nature of the image if the object is placed 7 cm away from the lens?

A. Real, inverted and diminished
B. Real, inverted and magnified
C. Virtual, erect and magnified
D. Virtual, erect and diminished

8. A student uses a vibrator to generate a transverse wave on a string. Suppose the period of the wave is doubled. How would the wavelength of the wave change?

A. reduces by half
B. doubles
C. remains unchanged
D. cannot be determined

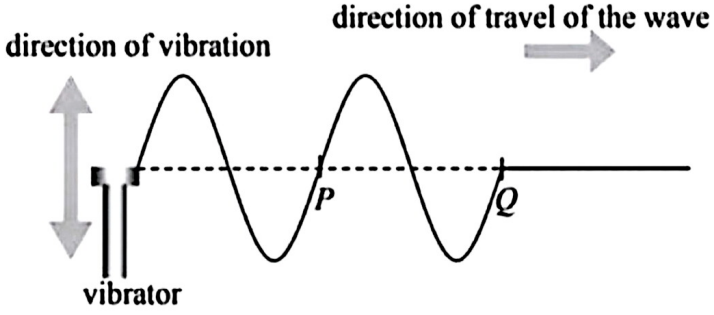
9. The figure below shows a transverse wave travelling along a string. At this instant, particle R is moving downwards.



Which of the following statements is correct?

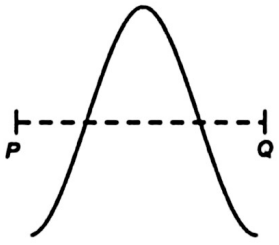
A. Particle Q is momentarily at rest.
B. The wave is travelling to the right.
C. Particle R has a larger amplitude than particle Q.
D. Particle P is moving downwards.

10. A student uses a vibrator to generate a travelling transverse wave on a string. The figure below shows the shape of the string at a certain instant.

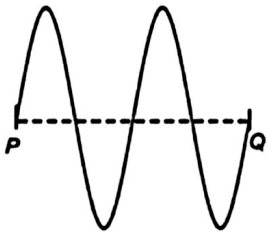


Which of the following figure best shows the shape between P and Q after $\frac{3}{4}$ period?

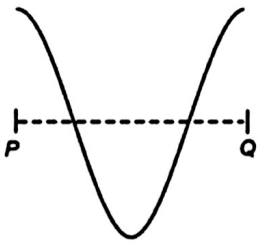
A.



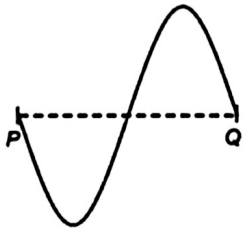
B.



C.



D.



End of Section A

Section B: Structured Questions (40 marks)

1. John is looking at a plane mirror that is hung on the wall. He can see a clock of 20 cm behind him through the mirror. His eye level is 1.5 m from the ground. Figure 1 shows the situation of his room.

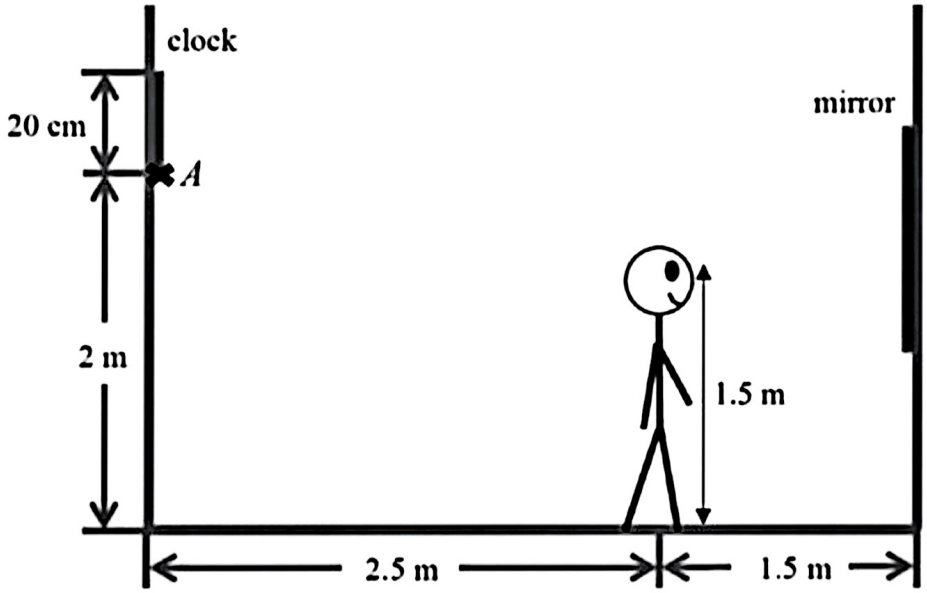


Figure 1

(a) If the time now is 10:00 pm, draw the image of the clock seen by John. (1 mark)

(b) Mark the position of the image of the clock. (1 mark)

(c) Draw a light ray from the bottom of the clock (point *A*) which is reflected by the mirror to John's eye. (2 marks)

(d) What is the minimum length of the mirror so that John can just see the whole clock? (2 marks)

(e) Find the height of bottom of the mirror in (d) from the ground. (2 marks)

2. A well-cut diamond sparkles when light entering from its top is totally reflected and emerges from the top. Figure 2 shows a piece of diamond-shaped glass block. A beam of light ray *p* enters the glass block from air and emerges along the opposite face as shown in Figure 2.

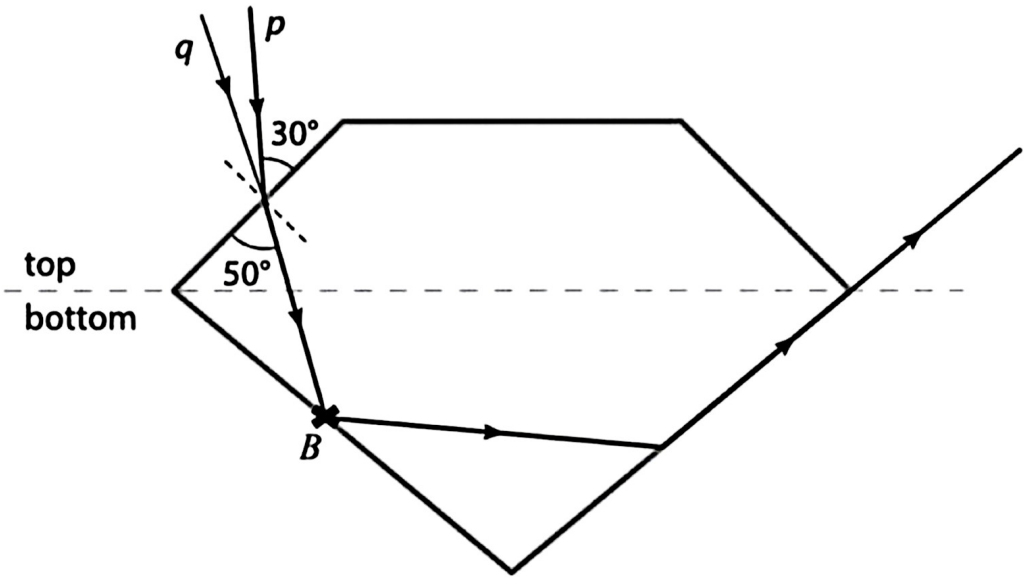


Figure 2

(a) Find the refractive index of the glass. (2 marks)

(b) Find the speed of light in the glass. (2 marks)

(c) Label the angle of incidence at point *B* as *i*. (1 mark)

(d) What is the minimum value of *i* such that total internal reflection occurs at point *B*? (2 marks)

(e) Another light ray *q* enters the glass block at the same point as *p* as shown in Figure 2. Sketch the path of *q* in the answer sheet. (2 marks)

3. (a) As shown in Figure 3a on the answer sheet, an object *O* is placed in front of a lens *L*.

(i) Label the image formed with *I*. (2 marks)

(ii) What kind of lens, convex or concave, is used? Explain. (2 marks)

(b) As shown in Figure 3b on the answer sheet, an object *O* and its image *I* formed by a lens *L*. The horizontal line represents the principal axis of the lens.

(i) By drawing a suitable light ray, locate the principal focus *F* of lens *L*. (2 marks)

(ii) Complete the path for the ray *p* from point *A*. (1 mark)

4. (a) An object is placed 20 cm in front of a lens and forms an erect image at a position 30 cm from the lens.
   (i) What is the linear magnification of the image? (1 mark)
   (ii) What is the focal length of the lens? (2 marks)
   (b) An object is placed 20 cm from a convex lens. The linear magnification of the image is 1. What is the linear magnification of the image if the object distance is doubled? (3 marks)

5. A train of water waves passes 7 balls floating on the water surface. The balls are equally spaced and the separation between two adjacent balls is 10 cm. Figure 5 shows the positions of the balls at different time.

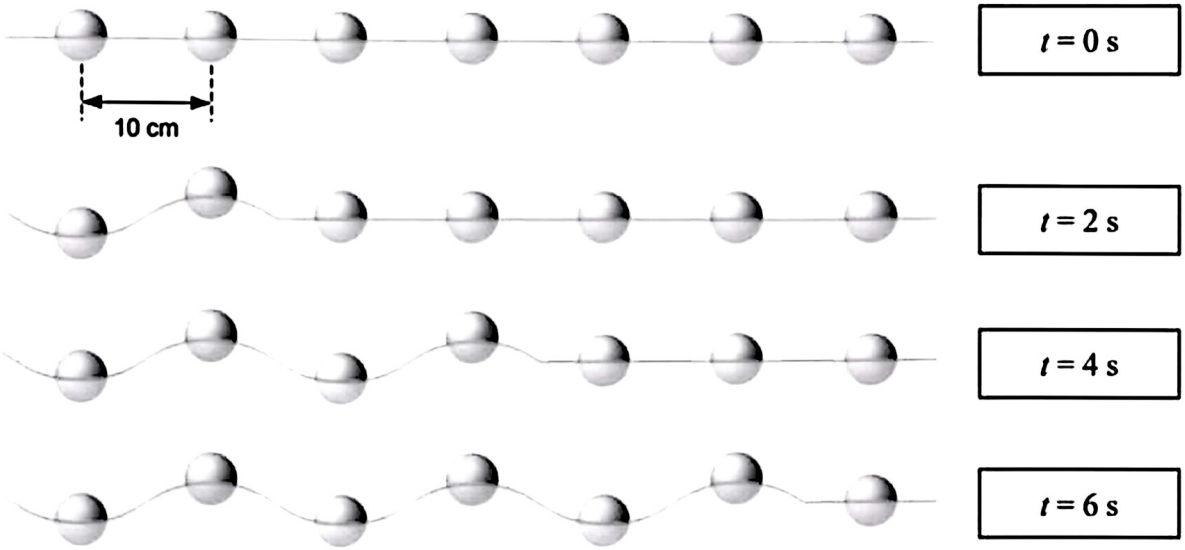


Figure 5

   (a) Find the frequency, wavelength and speed of the wave. (3 marks)
   (b) Draw the positions of the seven balls at $t = 5$ s. (2 marks)

6. In Figure 6, electromagnetic waves are classified into seven categories based on their frequencies. It is given that *D* is visible light.

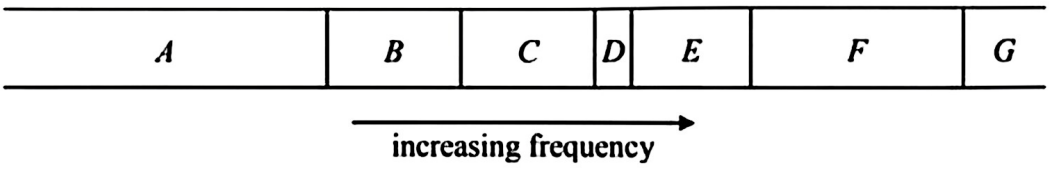


Figure 6

   (a) Name *C* and *G*. (2 marks)
   (b) List one application of *E* and *F* respectively. (2 marks)
   (c) What are the three primary colours of light? (1 mark)

End of Section B

END OF PAPER

S3 Final Examination (2023–2024)

Physics

Answer Sheet

(1 hour)

Date: 14th June 2024 Name: _____

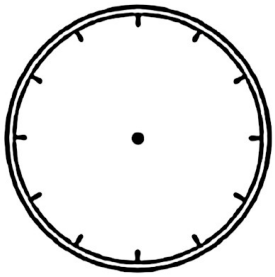
Time: 8:30 a.m. – 9:30 a.m. Class: _____ No.: _____

Section A: Multiple Choice Questions (20 marks)

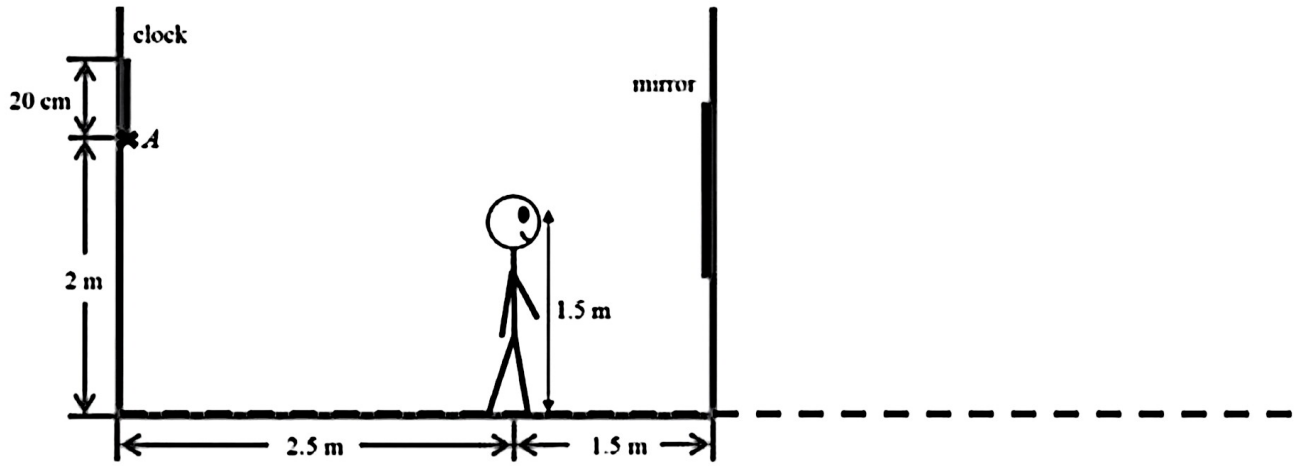
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

Section B: Structured Questions (40 marks)

1. (a) The image seen by John



(b), (c)



(d) _____

_____

_____

_____

(e) _____

_____

_____

_____

2. (a) _____

_____

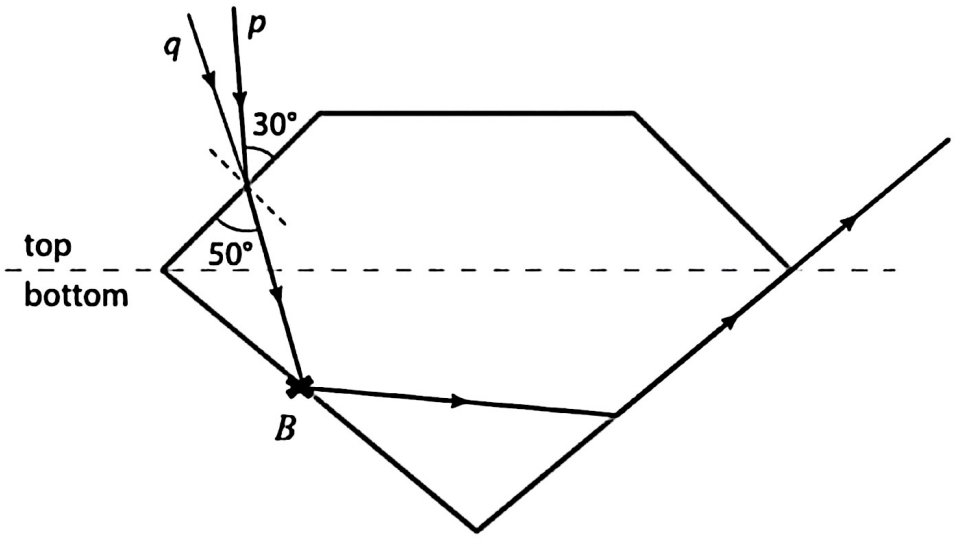
_____

(b) _____

_____

_____

(c), (e)



(d) _____

_____

_____

3. (a) (i)

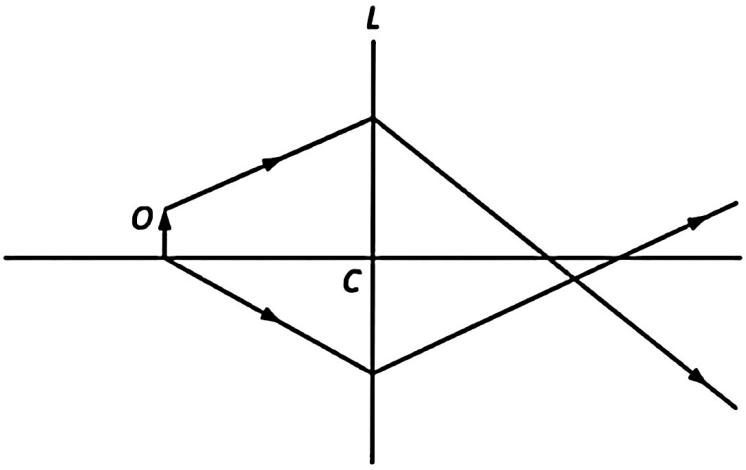


Figure 3a

(ii) _____

_____

_____

(b) (i), (ii)

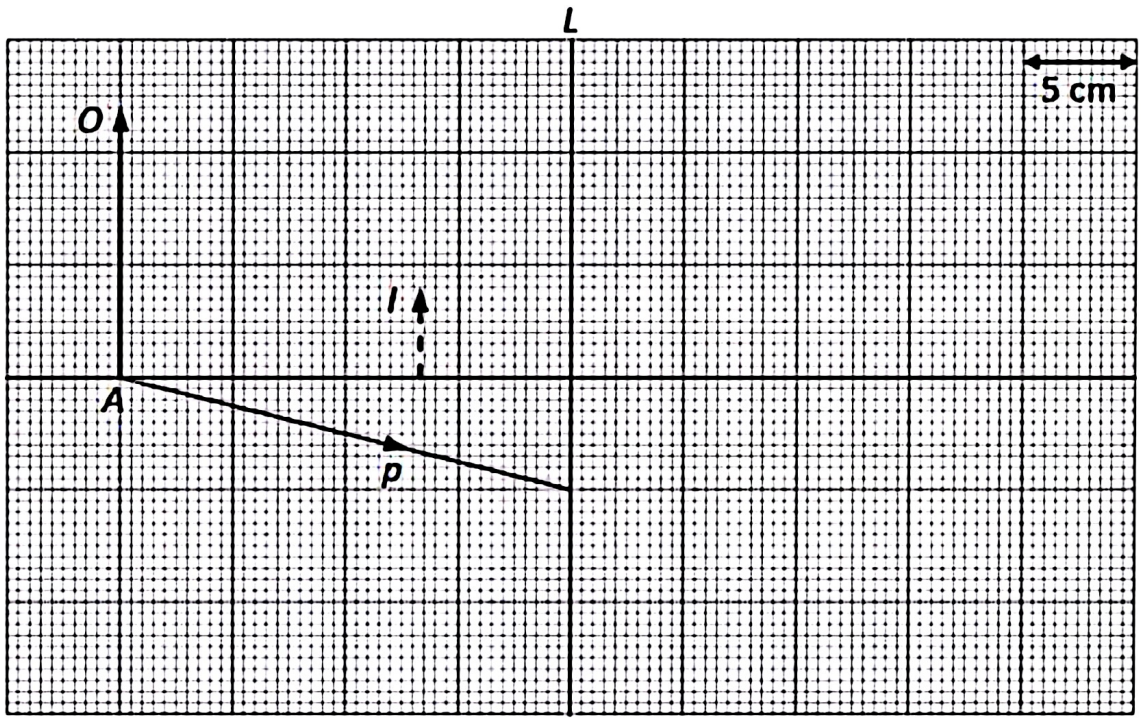


Figure 3b

4. (a) (i) _____

_____

(ii) _____

_____

_____

(b) _____

_____

_____

_____

_____

5. (a) _____

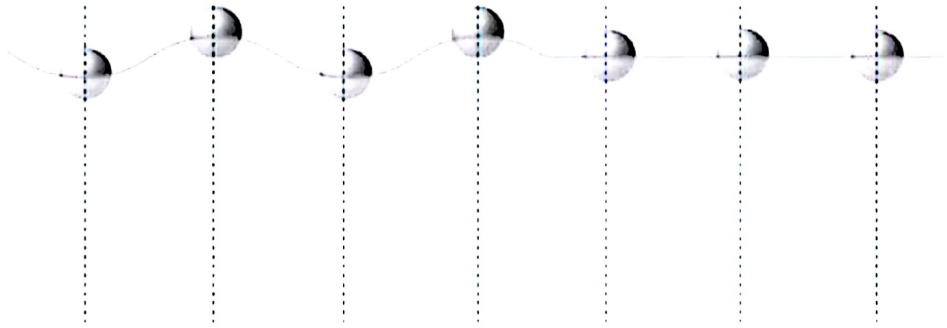
_____

_____

_____

_____

(b)



6. (a) *C:* _____ *G:* _____

(b) *E:* _____

F: _____

(c) _____

_____

END OF ANSWER SHEET