MAYFLOWER SECONDARY SCHOOL

YEAR 2024 TERM 1 ASSESSMENT
SEC 4EX PURE PHYSICS 6091

/ 40

Duration: 50minutes

Name _____ ( )

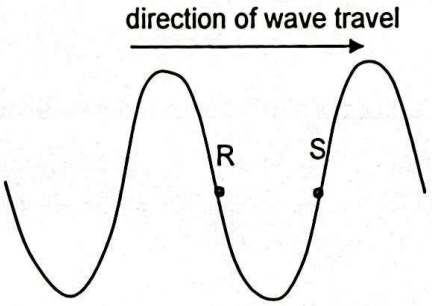
Class _____ **Date:** _____ **Parent's Signature:** _____

Instructions

1. Answer **all** questions.
2. Answer multiple choice questions in the boxes provided at the end of **Section A**.
3. Answer **Sections B and C** in the spaces provided after each question.
4. Use of approved calculator and mathematical sets allowed.
5. This paper consists of **13** pages.

Section A: Multiple Choice Questions

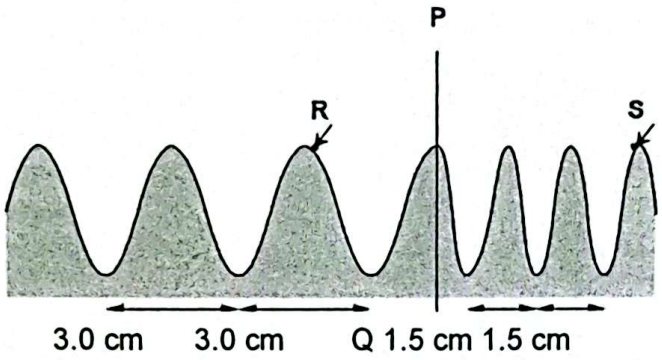
1 A transverse wave travels steadily from left to right as shown below.



Which row correctly shows the directions of the movement of the particles R and S?

	R	S
A	downwards	upwards
B	to the left	to the right
C	to the right	to the left
D	upwards	downwards

2 The diagram shows a water wave in a ripple tank.



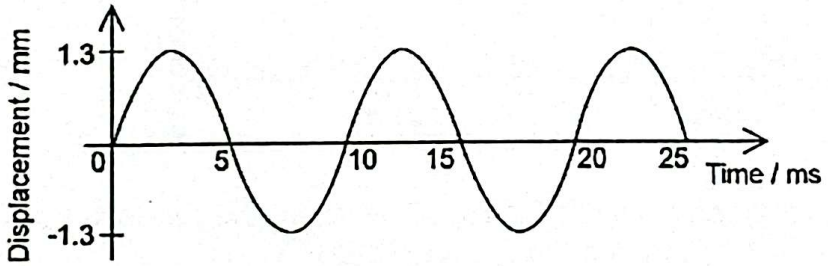
The wave has a speed of 0.15 m/s at R.

The wave crosses a boundary PQ where the distance between crests changes from 3.0 cm to 1.5 cm.

What is the velocity of the wave at point S?

A 0.075 m/s **B** 0.15 m/s **C** 0.30 m/s **D** 0.45 m/s

3 Sound travels with a speed of 330 m/s in air.
The variation of displacement with time of an air particle due to a passing sound wave is shown below.



Which statement about the wave is true?

A The frequency of the sound wave is 200 Hz.

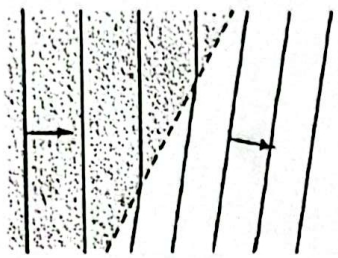
B The graph shows that this sound wave is a transverse wave.

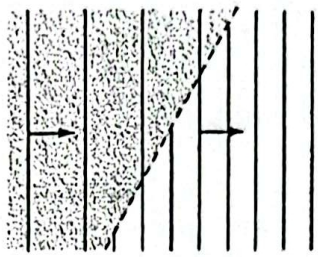
C The wavelength of the sound wave is 3.3 m.

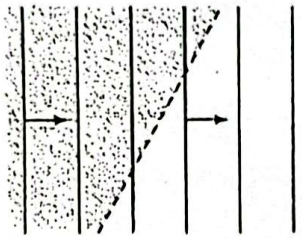
D The wavelength of the sound wave is 10 m.

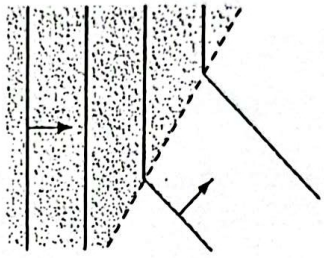
4 A ripple tank is used to demonstrate how the directions of plane wavefronts change as they move from shallow to deep water.

Which diagram shows this change correctly?

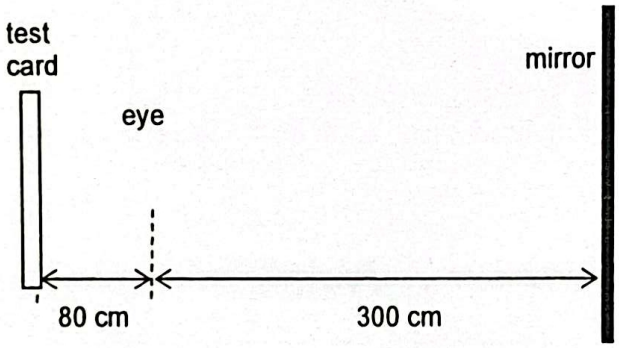
A 

B 

C 

D 

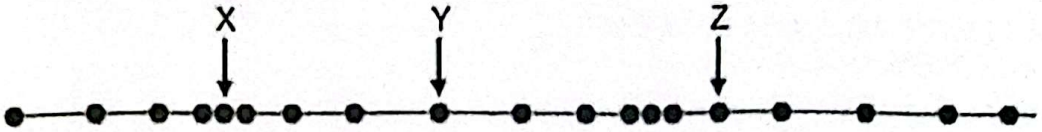
5 The diagram shows a plane mirror placed at distance of 300 cm in front of the patient.



If the optician's test card is fixed at 80 cm behind the eyes of the patient, what is the distance from his eyes to the image of the card?

A 300 cm B 380 cm C 760 cm D 680 cm

6 A sound wave travels through air. The dots on the figure below represent the air particles along the sound wave at one instant.
Three particles are labelled X, Y and Z.



Which statement is true about the particles?

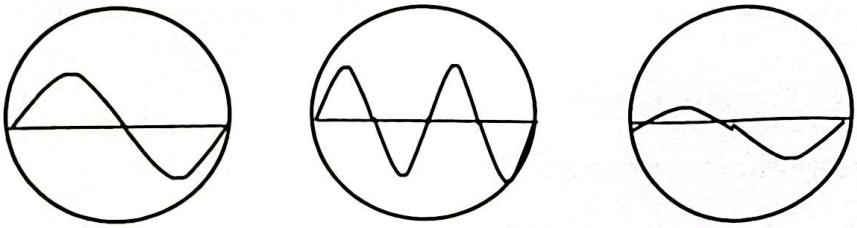
A Particle X is the center of rarefaction.

B Particle Z has a lower speed than particle Y at this instant.

C The distance between particles X and Y is one wavelength.

D The pressure in the region around particle Y is lower than around particle X.

7 Diagrams 1, 2 and 3 represent sound waves displayed on the screen of an oscilloscope.



1 2 3

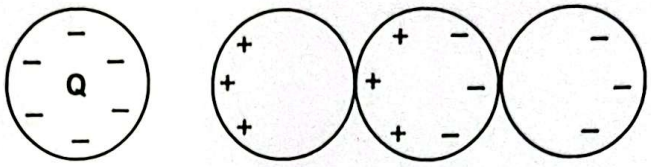
Which diagrams represent sound almost with the same loudness?

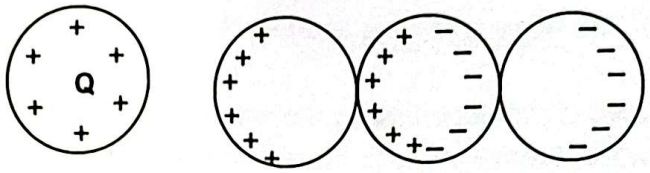
A 1 and 2 B 1 and 3

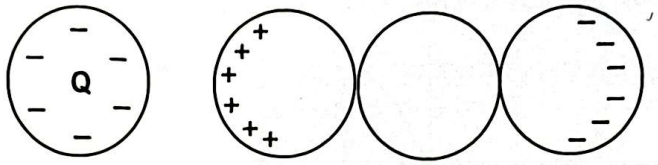
C 2 and 3 D 1, 2 and 3

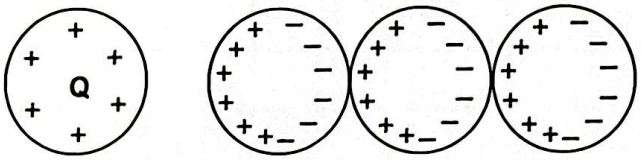
8 A charged sphere Q is brought close to three similar size uncharged metal spheres.

Which row of diagrams correctly shows the resulting distribution of charges?

A 

B 

C 

D 

9 An electrostatic precipitator is is used in an incineration plant. The waste gases go through the electrostatic precipitator to remove unwanted particles before the gases are released into the atmosphere. The following steps are the steps of the process.

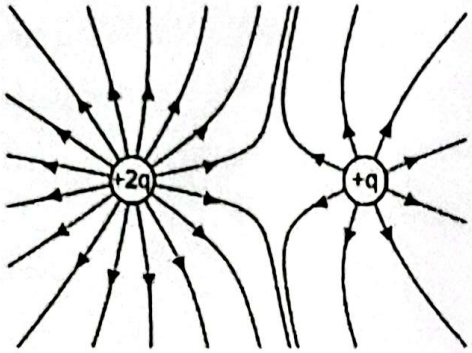
P Negatively charged particles are attracted to the positive plates.
Q The clean gas, where unwanted particles are removed, exits the electrostatic precipitator.
R Unwanted particles are charged by free moving electrons and negative ions.

What is the correct order for these steps?

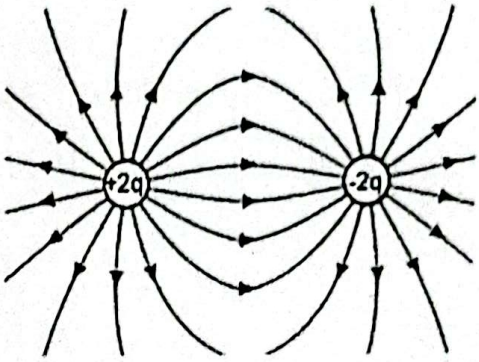
A P → R → Q
B Q → P → R
C R → P → Q
D R → Q → P

10 Which diagram shows an incorrect electric field pattern?

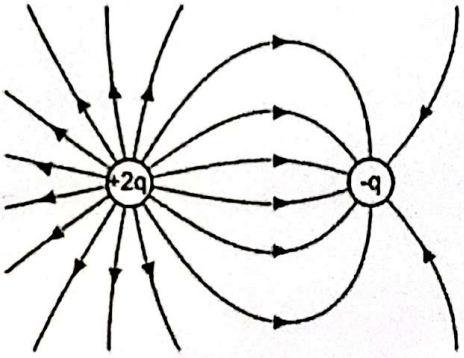
A



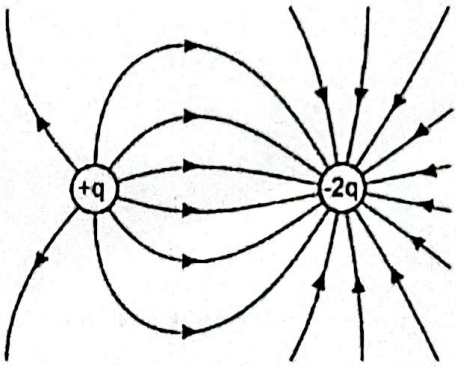
B



C



D



Section A MCQ Answers				
Q1	Q2	Q3	Q4	Q5
Q6	Q7	Q8	Q9	Q10

- - - - - End of Section A - - - - -

Section B: Structured Questions

Answer **all** questions in this section. Write your answers on the space provided.

1. Fig. 1.1 shows a ship sending sound signal to the bottom of the sea to determine the distance of the seabed to the sea level d.

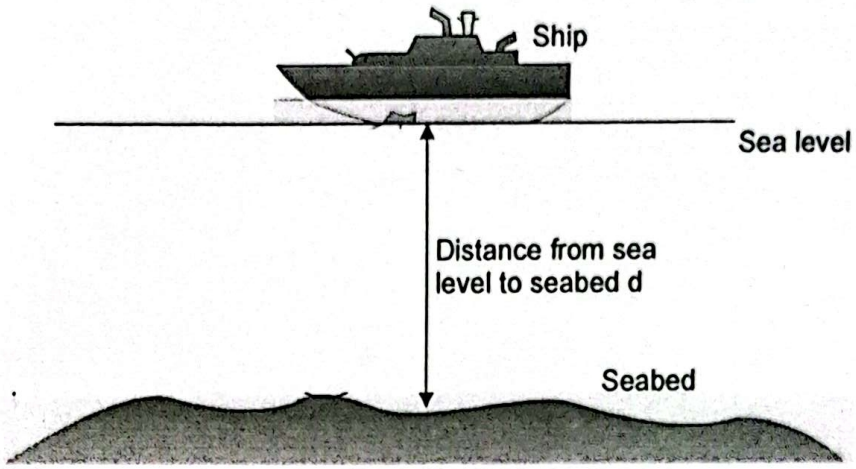


Fig. 1.1

(a) The signal sent is a longitudinal wave.

Explain what is meant by a *longitudinal wave*.

.....

..... [1]

(b) Describe how the sound is transmitted from the ship to the seabed.

.....

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.....

..... [2]

(c) Calculate the distance d, given that the echo sent from the ship takes 3.48 s to be received by the ship.

Take the speed of sound transmission in the sea to be 1500 m/s.

d = ... [2]

2. As a water wave moves along the calm surface of a lake and passes a piece of floating debris, a boy observed that the debris bobbed up and down 30 times in 1 minute. He also noted that the wavelength of the water wave remained unchanged as it moves over the water surface.

(a) Explain what is meant by *wavelength*.

.....

..... [1]

(b) Fig. 2.1 shows the water wave and P, the position of the floating debris on the wave at time t. The wave is moving towards the right.

In Fig. 2.2, draw the position of the water wave at time, t + ¾ T, where T is the period of the wave. Clearly indicate the new position P. [2]

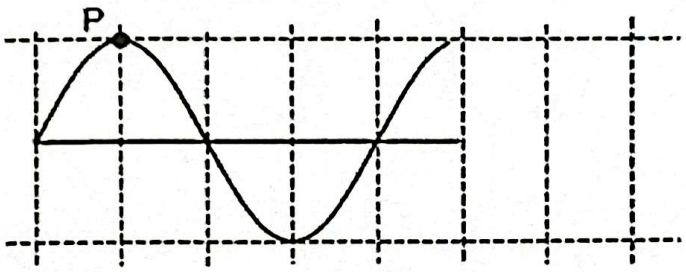

Fig. 2.1

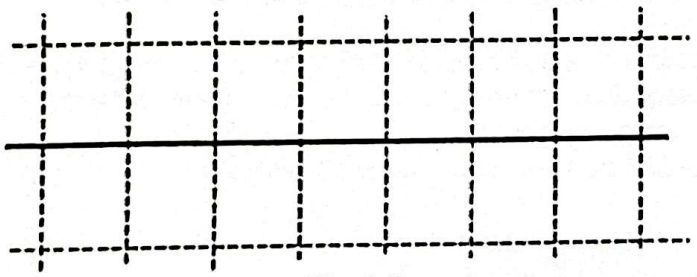

Fig. 2.2

3. Fig. 3.1 shows light entering a transparent block.

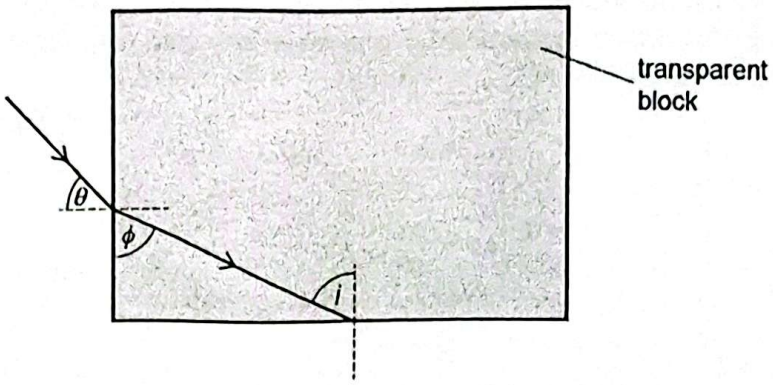

Fig. 3.1 (not to scale)

The light enters the block at an angle θ to the normal and travels through the block until it meets the bottom surface.

The angle between the ray in the block and the vertical side of the block is Φ.

(a) State and explain what happens to the wavelength of the light and the frequency of the light as it enters the block.

.....

.....

..... [2]

(b) The refractive index of the transparent block is 1.6. Angle θ is 45°.

(i) Calculate angle Φ.

angle Φ = ...[2]

(ii) The angle *i* at the bottom surface is equal to angle Φ and the critical angle for the material of the block in air is 39°.

State and explain what happens to the light after it meets the bottom surface.

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..... [3]

4. Fig. 4.1 shows a negatively charged rod suspended by an insulating thread. A neutral metal sphere is mounted on an insulating stand.

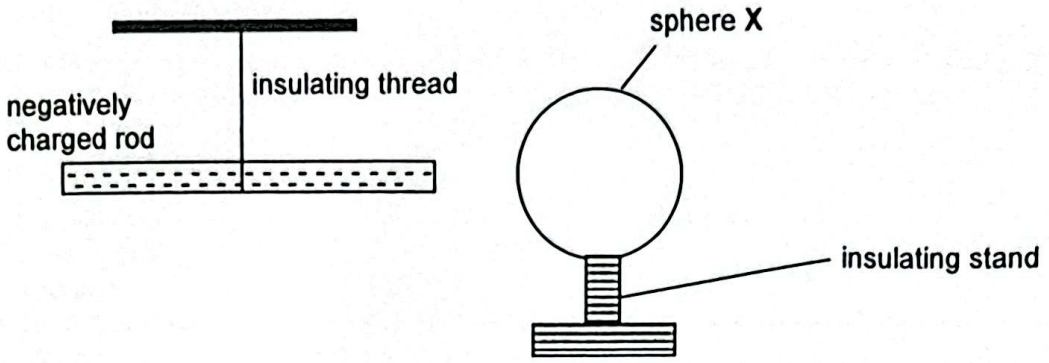

Fig. 4.1

(a) Describe and explain what happens to the charges in sphere **X** when it is brought close to the rod without touching it.

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.....

.....

..... [2]

(b) A second identical metal sphere, Y, which is neutral is brought close to and in contact with sphere X. Sphere Y is earthed as shown in Fig. 4.2.

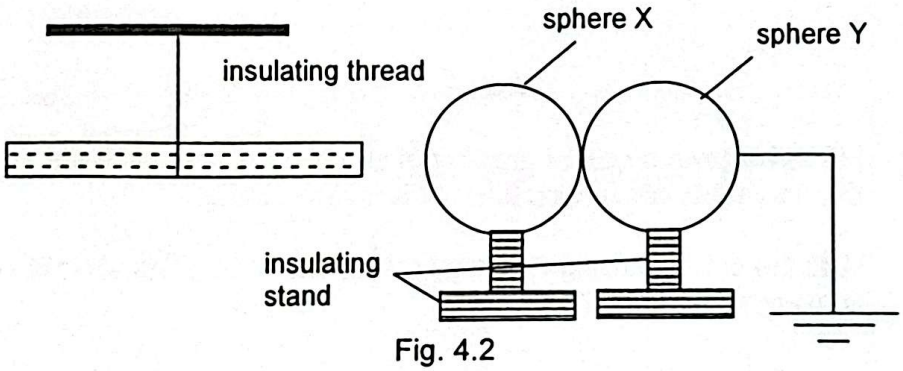

Fig. 4.2

(i) Draw on Fig. 4.2 the distribution of charges on sphere X. [1]

(ii) Explain your answer in **(b)(i)**.

.....

.....

..... [2]

- - - - - End of Section B - - - - -

Section C: Long Questions

Answer **all** questions in this section. Write your answers on the space provided.

5. **(a)** Fig. 5.1 shows an object XY near a thin converging lens. The focal points of the lens are at F and F'.

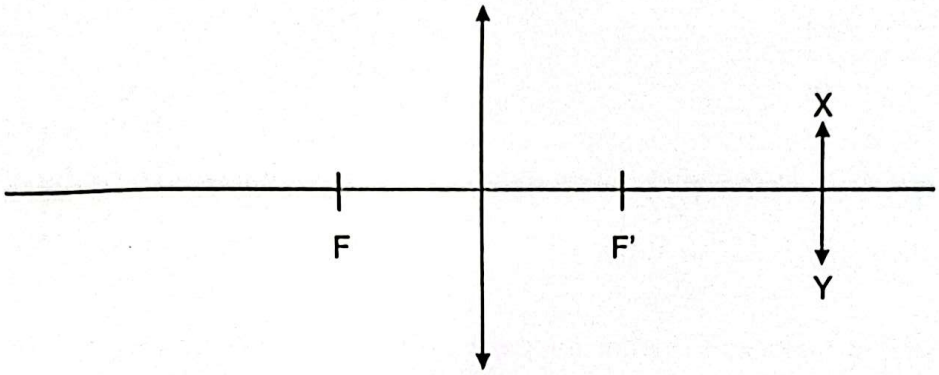

Fig. 5.1

(i) By means of an accurate drawing on Fig. 5.1, draw rays to find the positions of the images of the points X and Y. [2]

(ii) If object XY is gradually brought closer to the converging lens until a distance less than one focal length, clearly describe the changes to the image of XY.

.....

.....

..... [2]

(c) Fig. 5.2 shows a scaled drawing of an object A and its image A' after passing through a thin converging lens. A' is a virtual image.

With the aid of drawing light rays on Fig 5.2, find the focal length of the converging lens.

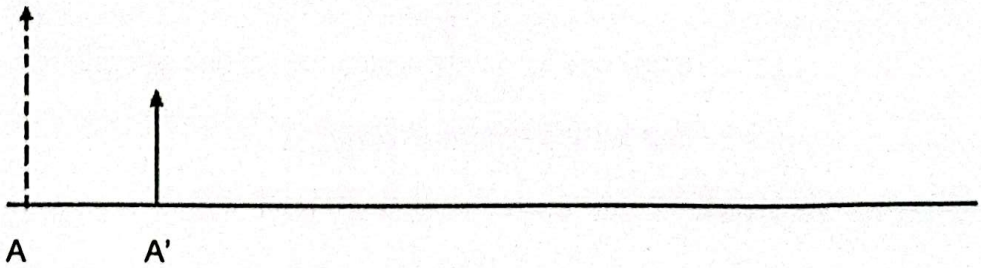

Fig. 5.2

focal length = ... [2]

(c) Light rays passing into an eyeball undergo two refractions; once as they pass through the cornea and another as they pass through the lens of the eye. Fig. 5.3 shows how light rays pass through the eyeball in a normal eye and Fig. 5.4 shows the eye of an individual with short-sightedness where the image of an object is formed in front of the retina.

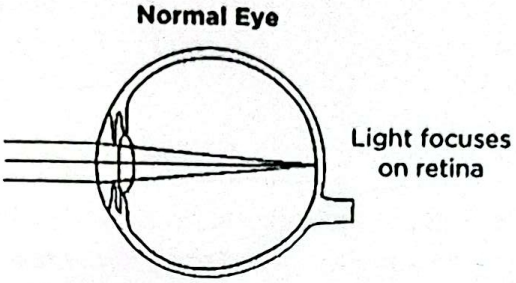

Fig. 5.3

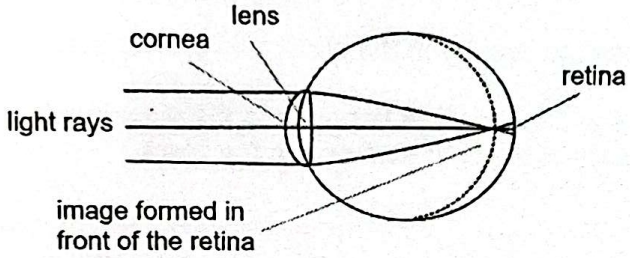

Fig. 5.4

(i) One way to correct short-sightedness is to use a pair of spectacles.

Which type of spectacle lens (converging or diverging) would be suitable for correcting short-sightedness?

Explain your answer clearly.

.....

.....

.....

..... [2]

(ii) Another method to correct short-sightedness is by performing a 'Lasik surgery' which removes a small portion of tissue in the cornea to make the cornea less rounded. Fig. 5.5 shows a cornea after Lasik surgery.

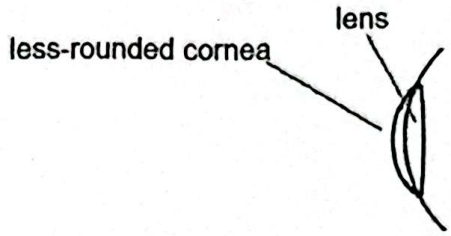

Fig. 5.5

Suggest how the less-rounded cornea in front of the eye's lens can help to correct short-sightedness.

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.....

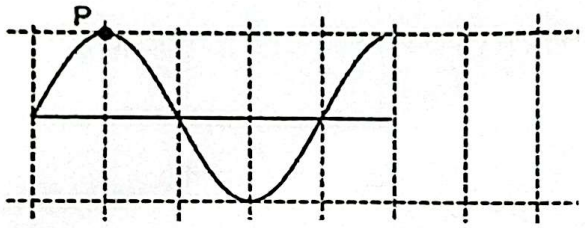
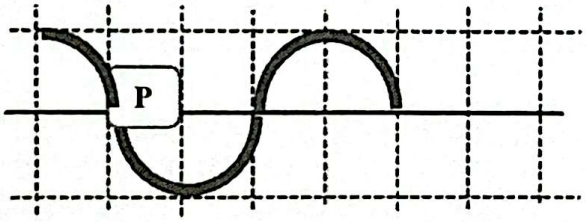
.....

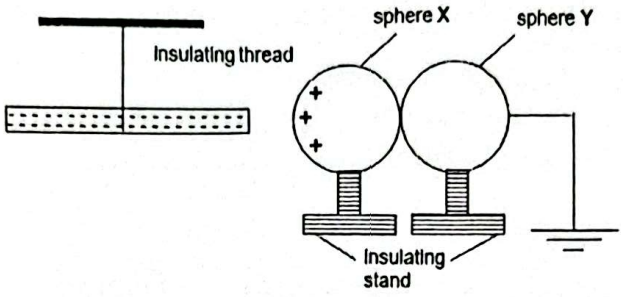
..... [2]

- - - - - End of Section C - - - - -

- - - - - End of Paper - - - - -

1	2	3	4	5	6	7	8	9	10
D	A	C	D	D	D	A	C	C	B

1(a)	Longitudinal wave is a wave where the direction of vibration is parallel to the direction of wave travel.	[1]
(b)	The signal vibrates the particles in the water. The water particles collide and undergo a series of compressions and rarefactions until it reaches the sea bed.	[1] [1]
(c)	v = 2d / t 1500 = 2d / 3.48 d = 2610 m	[1] [1]
2(a)	Wavelength is the shortest distance between two points which are in phase along the wave's direction. **OR** Wavelength refers to the horizontal distance between 2 successive crests (or troughs)	[1]
(b)	 time = *t* **Fig. 8.1**  time = *t* + ¾ *T* **Fig. 8.2** Correct waveform Correct Label of P	[1] [1]
3(a)	Wavelength decreases as velocity decreases since v = fλ. Frequency remains the same as the light is from the same source. (Reason needs to be provided)	[1] [1]
(b)(i)	n = sin i / sin r 1.6 = sin 45° / sin (90 – Φ) Φ = 63.8°	[1] [1]

(ii)	• The light ray undergoes <u>total internal reflection</u>, • Since the light travels <u>from an optically denser medium</u> to an optically less dense medium and • the angle of incidence in the optically denser medium is larger than the critical angle.	[1] [1] [1]
4(a)	• The negatively charged rod <u>induced</u> the electrons in the metal sphere to be repelled to the extreme right since like charges repel. • <u>Positive charges</u> will be left behind on the <u>left side</u> of the metal sphere.	[1] [1]
(b)(i)		[1]
(b)(ii)	• The <u>electrons</u> in spheres **X** and **Y** are <u>repelled to the right side</u> of sphere **Y** which is connected to the earth. • Earthing occurs and the <u>excess electrons flow to the ground</u>.	[1] [1]
5(a)(i)	For each position of the object (X & Y), the two principal rays drawn must be accurate with direction indicated.	[1] [1]
(a)(ii)	Any of the 2 below, • new image formed is magnified but current is diminished. **OR** image decreases in size • new image formed is virtual but current is real. • new image is formed on the same side of the object but current is form on the opposite side of the lens.	[2]
b	two principal rays draw accurately with direction accept f = 5.0 cm +/- 0.3 cm	[1] [1]
(c)(i)	Diverging lens Diverging lens will spread or diverge the incoming rays before reaching the cornea and lens of eye. Thus, allow light ray to converge on the wall of retina.	[1] [1]
(c)(ii)	When the cornea is less rounded, light will <u>bend less</u> Hence <u>focal length</u> will <u>increase</u>.	[1] [1]