This is a Class 1 exam

Lebanon Evangelical School for Boys and Girls

Lebanon Evangelical School

for Boys and Girls — Loueizeh - Baabda

Stage Exam 05

12MAY2023

Do NOT write in this box. Your MARK will be placed here.

Subject :	Physics	
Class :	9A	
Teacher :	Dr Ruth Brett	
Duration :	1 hour	
Answer all questions in the spaces provided on the exam paper.		
Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Q1. Recall questions. Seven questions worth one mark each.

a) Define wavelength.

.....

.....

b) Give the equation linking wave speed, frequency and wavelength.

.....

.....

c) Define the time period of a wave.

.....

.....

d) Give the equation linking the refractive index, angle of incidence and the angle of refraction. **(Note: you will need to use this in a later question).**

.....

.....

e) Why do small objects produce higher pitched notes?

.....

.....

f) Give a danger of infrared radiation.

.....

.....

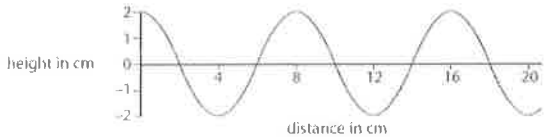
g) Give a danger of ultraviolet radiation.

.....

.....

Q2.

The diagram shows a water wave.



(a) (i) The amplitude of the wave is

(1)

- ☐ **A** 1 cm
- ☐ **B** 2 cm
- ☐ **C** 4 cm
- ☐ **D** 8 cm

(ii) The wavelength of the wave is

(1)

- ☐ **A** 2 cm
- ☐ **B** 4 cm
- ☐ **C** 8 cm
- ☐ **D** 20 cm

(b) Describe one difference between transverse and longitudinal waves.
Draw a labelled diagram to help your answer. (There is space to write at the top of the next page).

(3)

.....

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.....

.....

(c) State two properties that are the same for all electromagnetic waves.

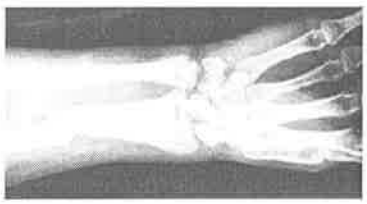
(2)

1.....

2.....

(d) Some types of wave are used in hospitals.

(i) A scanner uses one type of wave to check for broken bones.



The type of wave emitted by the scanner is

(1)

- ☐ **A** infrared
- ☐ **B** microwaves
- ☐ **C** sound
- ☐ **D** X rays

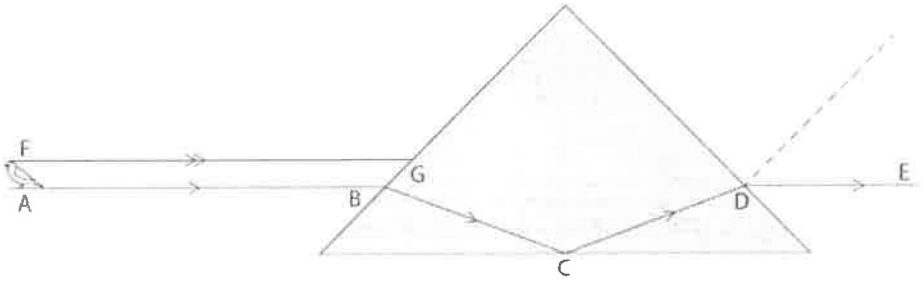
(ii) An image of the bone is seen because the waves from the scanner are

(1)

- ☐ **A** absorbed by the bone
- ☐ **B** reflected by the bone
- ☐ **C** refracted by the bone
- ☐ **D** transmitted by the bone

(Total for question = 9 marks)

Q3. The diagram shows two parallel rays of light, AB and FG, from a distant bird, incident on a right-angled prism.



(a) (i) On the diagram, draw the normal at B.

(1)

(ii) Measure the angle of incidence at B and the angle of refraction at B.

(2)

angle of incidence at B = ...

angle of refraction at B = ...

(ii) Use the equation linking refractive index, angle of incidence and angle of refraction to calculate the refractive index of the material the prism is made from.

(3)

refractive index = ...

(b) Complete the diagram by drawing the path that light ray FG takes through the prism. (You do not need to do any calculations).

(3)

(Total for question = 9 marks)

Q4.

This question is about how light travels in water.

(a) Diagram 1 shows a ray of light from a torch submerged in a swimming pool.
The ray of light does not pass through the water surface.

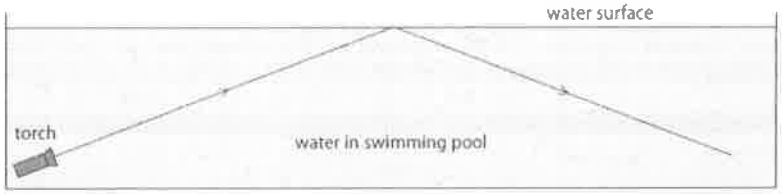


Diagram 1

(i) State the name of this process and explain why it happens.

(3)

.....

.....

.....

.....

.....

.....

(ii) Draw the normal on diagram 1 where the ray of light meets the water surface.

(1)

(iii) Measure the angle of incidence.

(1)

angle of incidence = ...

(iv) State the angle of reflection.

(1)

angle of reflection = ...

(b) The torch is moved, and the ray of light now passes through the water surface.



Diagram 2

(i) Draw a line on diagram 2 to continue the path of the ray of light.

(2)

(ii) State the name of this process.

(1)

.....

(c) (i) State the equation linking critical angle and refractive index.

(1)

(ii) The refractive index of water is 1.33
Calculate the critical angle for the boundary between water and air.
Give your answer to three significant figures.

(3)

critical angle = ...

(iii) The torch is moved again so that the ray of light now meets the water surface at an angle of incidence of 52°.
State what happens to this ray of light.

(1)

.....

.....

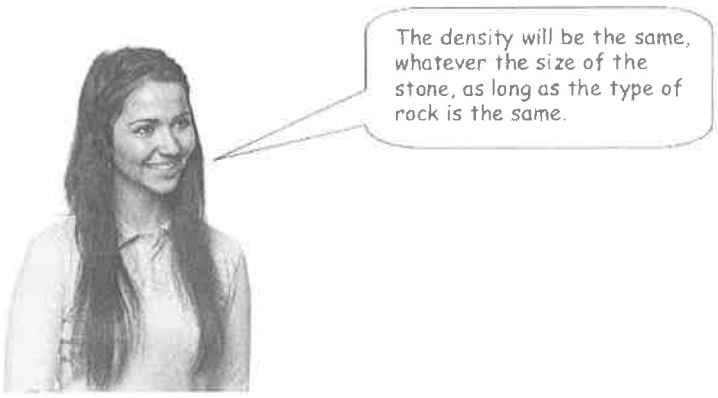
(Total for question = 14 marks)

Q5.

Kalpana finds a small stone.

To help her identify the type of stone, Kalpana decides to find its density.

Kalpana explains why she thinks this will help.



Her friend, Christine, disagrees.



(a) Who is correct – Kalpana or Christine?

(2)

.....

Explain your answer.

.....

.....

.....

.....

(b) The table shows the measurements that Kalpana makes.

Mass of stone in g	Volume of stone in cm^3
54	23

(i) State the equation linking density, mass and volume.

(1)

(ii) Calculate the density of the stone.
State your answer to an appropriate number of significant figures.
Give the unit.

(3)

Density = ... Unit .....

(c) (i) How can Kalpana use her value of density to identify the type of stone?

(2)

.....

.....

.....

.....

(ii) Kalpana may still be unsure about the type of stone.

Suggest why.

(1)

.....

.....

(Total for question = 9 marks)

Q6.

A student uses a dog whistle to produce a high frequency sound wave that cannot be heard by humans.

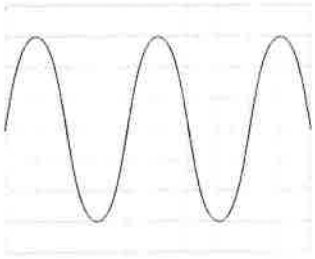
(a) State the frequency range for human hearing.

(2)

.....

(b) The student uses an oscilloscope to display the sound wave.

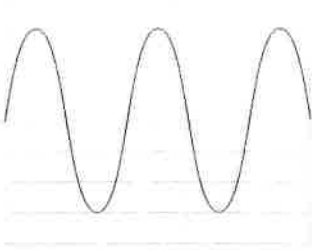
The student obtains this trace on the oscilloscope.



On the grid above, draw a trace of a quieter sound with double the frequency.

(2)

(c) The scale on the grid below is 2 ms per division.



(i) Determine the time period of the wave.

(2)

(ii) Calculate the frequency of the wave using the equation given below:

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

(2)

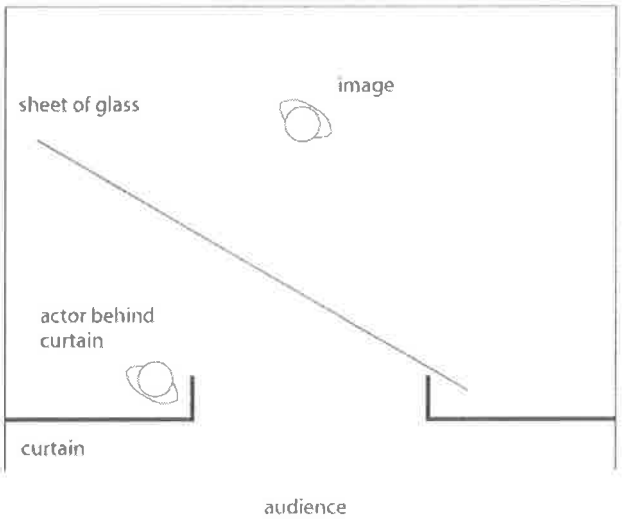
(Total for question = 8 marks)

Q7. Pepper's Ghost is a theatre effect used to make it appear that there is an image on stage.

The diagram shows a theatre viewed from above.

A sheet of glass is placed on the stage. A brightly lit actor stands behind a curtain at the side of the stage.

The audience sees the reflection of this actor in the glass.



(a) Add a ray diagram to show how light from the actor appears to come from the image.

(3)

(b) The image formed by the glass is a virtual image.

State what is meant by the term **virtual image**.

(1)

.....

.....

(Total for Question = 4 marks)

WORKED SOLUTION

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Q1. Recall questions. Seven questions worth one mark each.

a) Define wavelength.

The distance between identical points on adjacent waves (1)

b) Give the equation linking wave speed, frequency and wavelength.

Wave speed = frequency x Wavelength (1)

c) Define the time period of a wave.

The time taken for one complete wave to be produced (1)

d) Give the equation linking the refractive index, angle of incidence and the angle of refraction. **(Note: you will need to use this in a later question).**

$$\text{refractive index} = \frac{\sin(i)}{\sin(r)}$$ (1)

e) Why do small objects produce higher pitched notes?

Small objects vibrate faster (1)

f) Give a danger of infrared radiation.

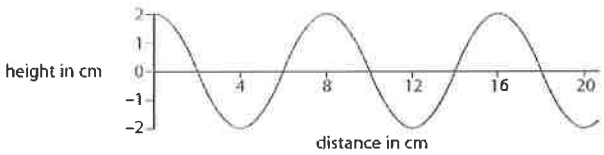
Skin burns (1)

g) Give a danger of ultraviolet radiation.

Skin cancer (1)

Q2.

The diagram shows a water wave.



(a) (i) The amplitude of the wave is

(1)

- ☐ **A** 1 cm
- ☒ **B** 2 cm (1)
- ☐ **C** 4 cm
- ☐ **D** 8 cm

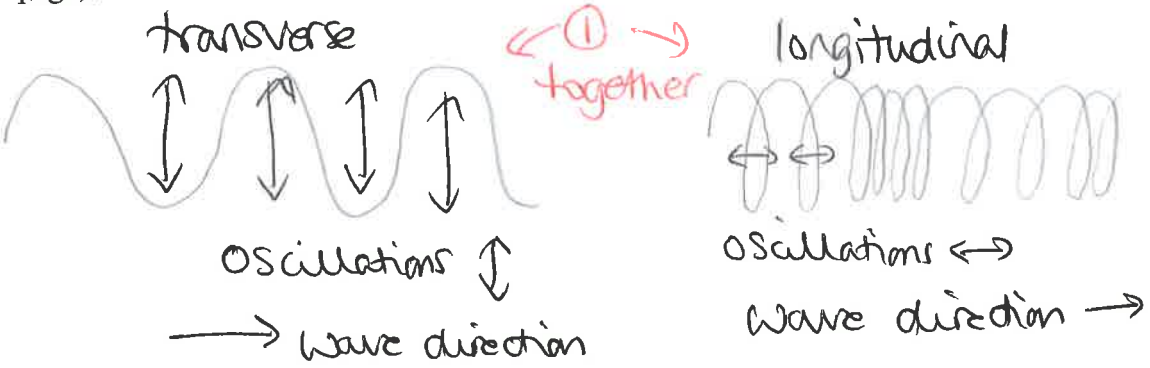
(ii) The wavelength of the wave is

(1)

- ☐ **A** 2 cm
- ☐ **B** 4 cm
- ☒ **C** 8 cm (1)
- ☐ **D** 20 cm

(b) Describe one difference between transverse and longitudinal waves.
Draw a labelled diagram to help your answer. ~~(There is space to write at the top of the next page).~~

(3)



In a transverse wave, the vibrations are perpendicular (1) to the direction of travel of the wave. In a ~~the~~ longitudinal wave, the oscillations are parallel (1) to the direction of motion of the wave.

(c) State two properties that are the same for all electromagnetic waves.

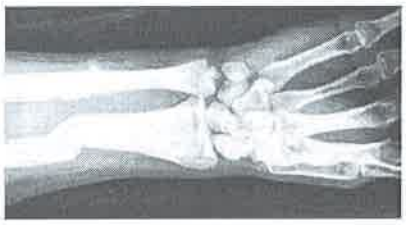
(2)

1 All electromagnetic waves are transverse (1)

2 They all travel at the same speed in a vacuum (1)

(d) Some types of wave are used in hospitals.

(i) A scanner uses one type of wave to check for broken bones.



The type of wave emitted by the scanner is

(1)

- ☐ **A** infrared
- ☐ **B** microwaves
- ☐ **C** sound
- (1) ☒ **D** X rays

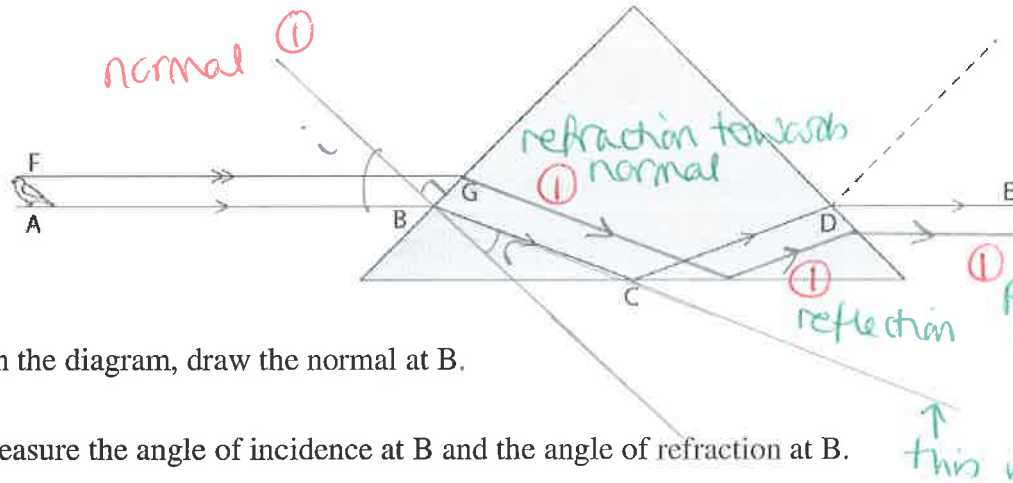
(ii) An image of the bone is seen because the waves from the scanner are

(1)

- (1) ☒ **A** absorbed by the bone
- ☐ **B** reflected by the bone
- ☐ **C** refracted by the bone
- ☐ **D** transmitted by the bone

(Total for question = 9 marks)

Q3. The diagram shows two parallel rays of light, AB and FG, from a distant bird, incident on a right-angled prism.



(a) (i) On the diagram, draw the normal at B.

(1)

(ii) Measure the angle of incidence at B and the angle of refraction at B.

(2)

angle of incidence at B = 44°

angle of refraction at B = 23°

(ii) Use the equation linking refractive index, angle of incidence and angle of refraction to calculate the refractive index of the material the prism is made from.

(3)

$$n = \frac{\sin i}{\sin r} = \frac{\sin 44}{\sin 23} = 1.78$$

refractive index = 1.78 (2 or 3 s.f.)

(b) Complete the diagram by drawing the path that light ray FG takes through the prism. (You do not need to do any calculations).

(3)

(Total for question = 9 marks)

Q4.

This question is about how light travels in water.

(a) Diagram 1 shows a ray of light from a torch submerged in a swimming pool.

The ray of light does not pass through the water surface.

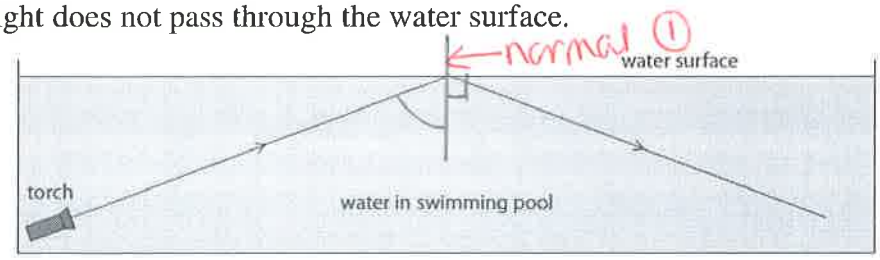


Diagram 1

(i) State the name of this process and explain why it happens.

(3)

This is total internal reflection

It happens if the angle of incidence is greater than the critical angle.

(ii) Draw the normal on diagram 1 where the ray of light meets the water surface.

(1)

(iii) Measure the angle of incidence.

(1)

angle of incidence = 70°

(iv) State the angle of reflection.

(1)

angle of reflection = 70°

(b) The torch is moved, and the ray of light now passes through the water surface.

ray above surface (1)

(1) bends away from normal

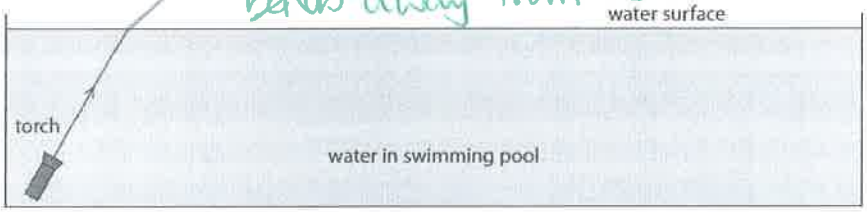


Diagram 2

(i) Draw a line on diagram 2 to continue the path of the ray of light.

(2)

(ii) State the name of this process.

(1)

refraction (1)

(c) (i) State the equation linking critical angle and refractive index.

(1)

$\sin c = \frac{1}{n}$ (1)

(ii) The refractive index of water is 1.33
Calculate the critical angle for the boundary between water and air.
Give your answer to three significant figures.

(3)

$\sin c = \frac{1}{1.33}$ (1) $= 0.752$

$c = \sin^{-1}(0.752) = 48.8$ (1)

must be 3 sf (1)

critical angle = ~~47.5°~~ ~~or~~ 48.8°

(iii) The torch is moved again so that the ray of light now meets the water surface at an angle of incidence of 52°.
State what happens to this ray of light.

(1)

Total internal reflection (1)

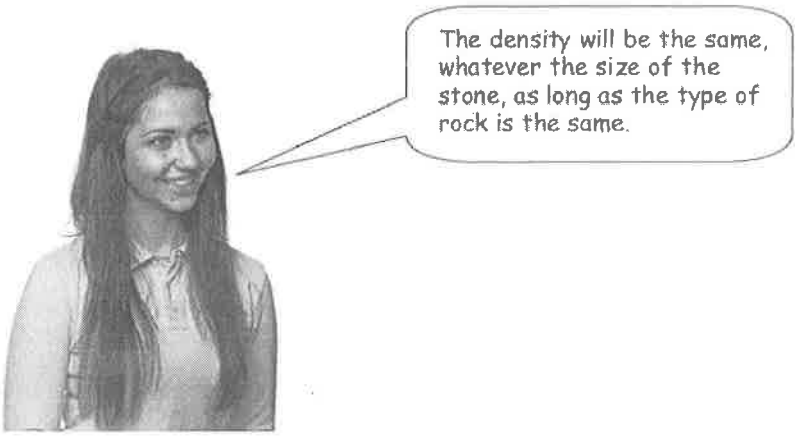
(Total for question = 14 marks)

Q5.

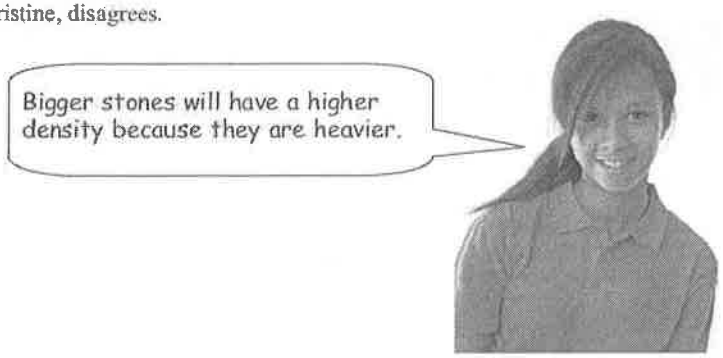
Kalpana finds a small stone.

To help her identify the type of stone, Kalpana decides to find its density.

Kalpana explains why she thinks this will help.



Her friend, Christine, disagrees.



(a) Who is correct – Kalpana or Christine?

(2)

Kalpana

Explain your answer.

Density is calculated using ρ = mass / volume
So if the mass increases, the volume will increase (1) so the density remains constant. Mass and volume are proportional to each other for the same material. (1)

(b) The table shows the measurements that Kalpana makes.

Mass of stone in g	Volume of stone in cm^3
54	23

(i) State the equation linking density, mass and volume.

(1)

$\rho = \frac{m}{V}$ (1)

(ii) Calculate the density of the stone.
State your answer to an appropriate number of significant figures.
Give the unit.

(3)

$\rho = \frac{54}{23} = 2.347$ (1)

No mark if not 2 s.f.

Density = 2.3 (1) Unit g/cm^3 (1)

(c) (i) How can Kalpana use her value of density to identify the type of stone?

(2)

Compare (1) with data values in a book (1)

(ii) Kalpana may still be unsure about the type of stone.

Suggest why.

(1)

Different types of rock may have similar values of density (1)

(Total for question = 9 marks)

Q6.

A student uses a dog whistle to produce a high frequency sound wave that cannot be heard by humans.

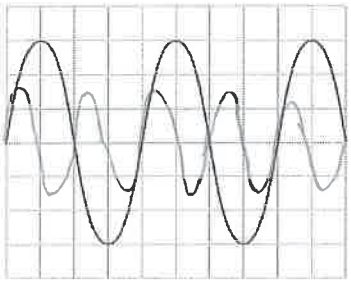
(a) State the frequency range for human hearing.

(1) (1)

20Hz – 20 000Hz (2)

(b) The student uses an oscilloscope to display the sound wave.

The student obtains this trace on the oscilloscope.



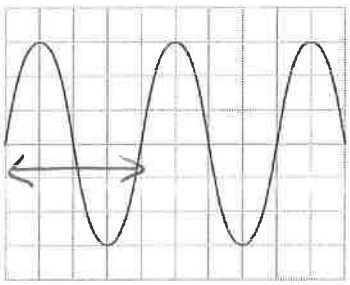
(1) smaller amplitude

(1) double frequency

On the grid above, draw a trace of a quieter sound with double the frequency.

(2)

(c) The scale on the grid below is 2 ms per division.



(i) Determine the time period of the wave.

4 divisions (1) 4 x 2ms = 8ms (1) (2)

(ii) Calculate the frequency of the wave using the equation given below:

$$\text{frequency} = \frac{1}{\text{time period}} \qquad f = \frac{1}{T}$$

$$f = \frac{1}{0.008} = 125\,\text{Hz}$$ (1) (1) (2)

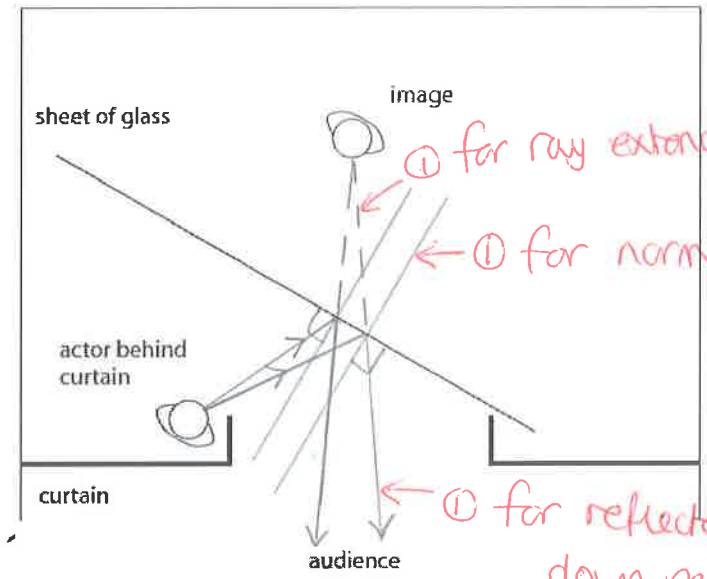
(Total for question = 8 marks)

Q7. Pepper's Ghost is a theatre effect used to make it appear that there is an image on stage.

The diagram shows a theatre viewed from above.

A sheet of glass is placed on the stage. A brightly lit actor stands behind a curtain at the side of the stage.

The audience sees the reflection of this actor in the glass.



(a) Add a ray diagram to show how light from the actor appears to come from the image.

(3)

(b) The image formed by the glass is a virtual image.

State what is meant by the term **virtual image**.

(1)

The image cannot be projected onto a screen ①

(Total for Question = 4 marks)