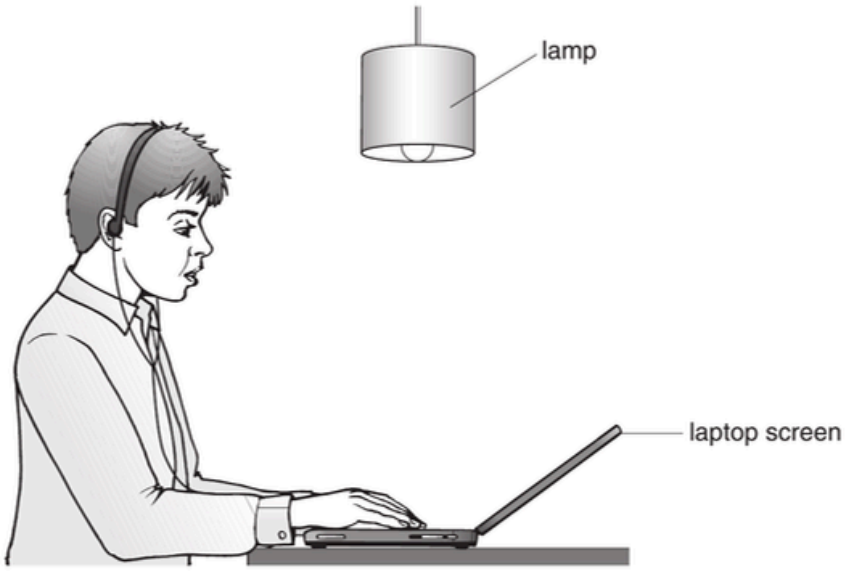
Waves

Sound and light both travel as waves — understanding how waves behave is a key KS3 physics topic that underpins GCSE Science.

10. (a) The diagram below shows George using his laptop.
Light from the lamp is reflected by the laptop screen.



10ai
1 mark

10ai
1 mark

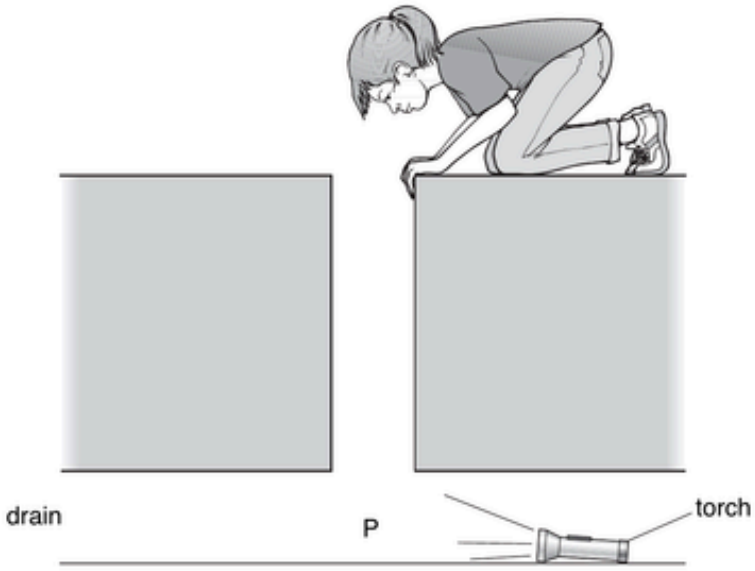
10ai
1 mark

(i) **On the diagram above** draw a ray of light to show how George sees the light from the lamp reflected by the laptop screen. Use a ruler.

Draw arrows to show the direction of light.

KS3 Science SATs, Tier 3-6, Paper 1 (2009) - Q10(a)(i)

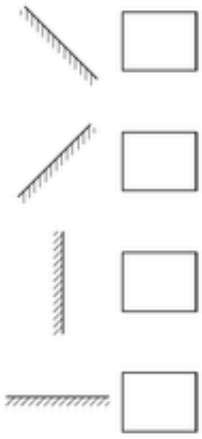
6. Jenny dropped her torch down a drain.
The torch was still switched on but Jenny could **not** see it.



not to scale

(a) (i) Jenny lowered a mirror into the drain and placed it at position P.

At which angle should Jenny put the mirror to see the torch?
Tick the correct box.



6ai
1 mark

(ii) What happens to the light from the torch when it hits the mirror?

Modern Tuition

7. Three pupils watched a firework display.

(a) A man lit the fireworks. He wore ear defenders.



Why should he wear ear defenders when he is close to loud fireworks?

_____

_____

7a

1 mark

(b) A rocket exploded making a loud sound and a bright flash.
Peter, Sabrina and Jan were standing at different distances from the rocket.




Jan


Sabrina


Peter



When the rocket exploded, Jan heard the quietest sound.
Why did Jan hear the quietest sound?

_____

_____

7b

(c) Jan saw the flash before she heard the sound.

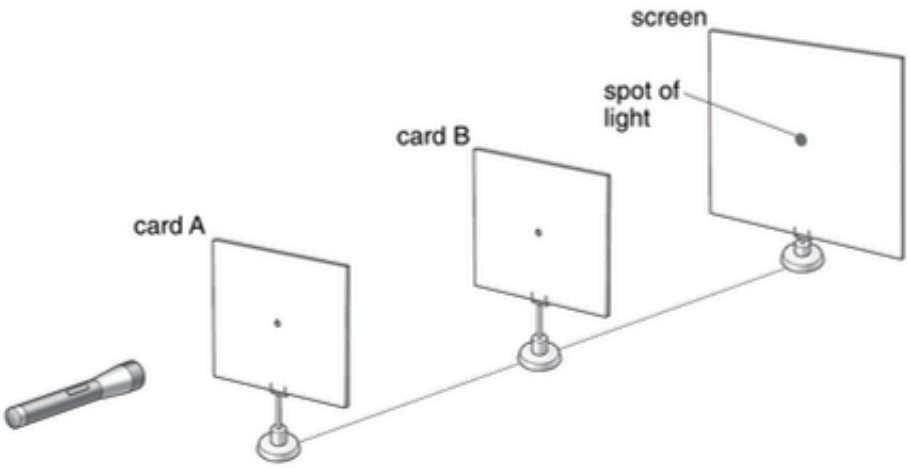
What does this tell you about the speed of light and the speed of sound?

_____

_____

Modern Tuition

8. Gabby arranged a torch, two cards and a screen as shown below.
Light from the torch passed through holes in the cards and onto the screen.



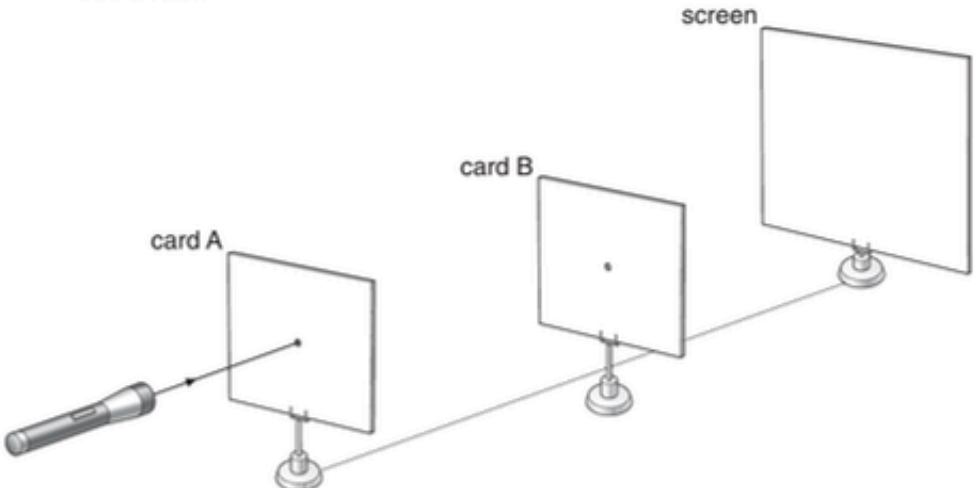
(a) Why did a spot of light appear on the screen? Tick the correct box.

Light can be split up into many colours.	☐	Light can travel through empty space.	☐
Light travels in straight lines.	☐	Light travels very fast.	☐

8a ☐ 1 mark

(b) Gabby moved card B to one side as shown below.
The ray of light passed through the hole in card A and onto card B.

Continue the ray of light from the torch to show where it would hit card B.
Use a ruler.



8b ☐ 1 mark

Modern Tuition

(c) Gabby used a torch to shine a ray of light towards a mirror.
Continue the ray of light to show how it reflects off the mirror.
Add an arrow to show the direction of the reflected ray.
Use a ruler.





8c
1 mark

8c
1 mark

8c
1 mark

Modern Tuition

14. James shone a ray of light at a mirror as shown below.

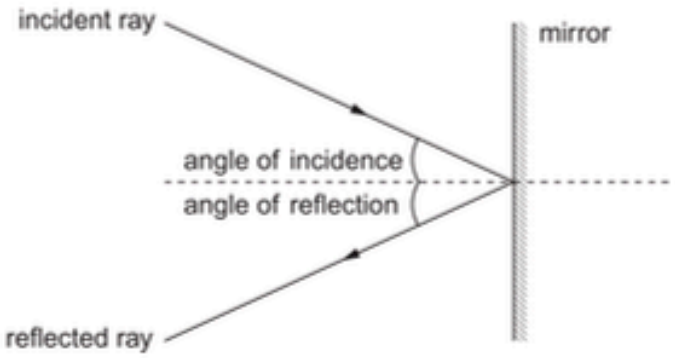


diagram 1

He measured the angle of **reflection** for different angles of incidence.
His results are shown below.

angle of **incidence** (°)	30	40	50	60	70
angle of **reflection** (°)	30	40	50	65	70

(a) Which angle of reflection was **not** measured accurately?

_____ °

How can you tell this from the table?

_____

_____

14a

1 mark

(b) James set up a different experiment as shown below.

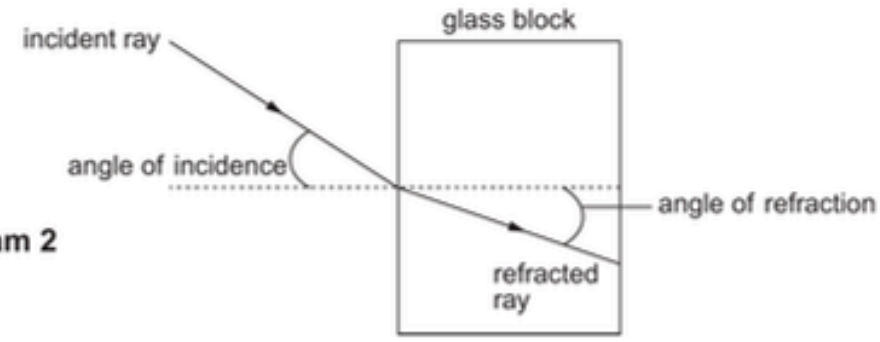
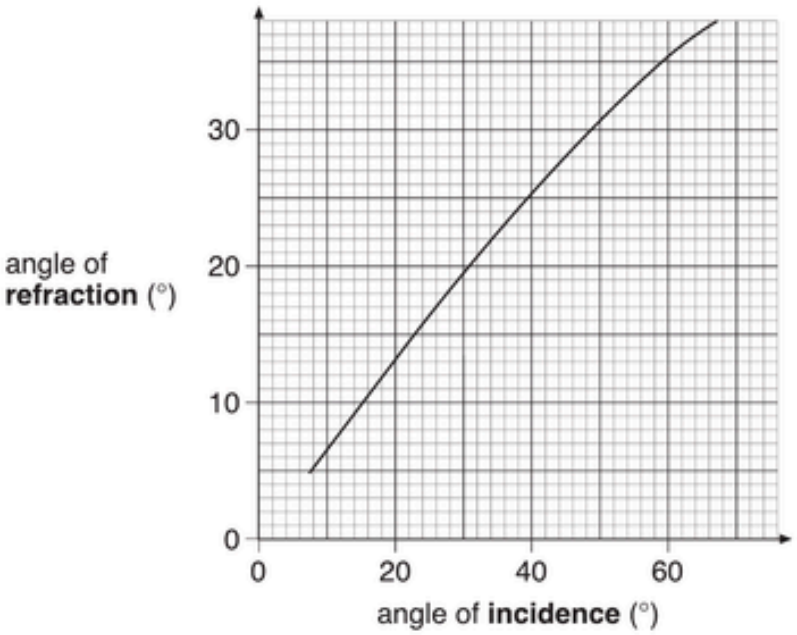


diagram 2

Modern Tuition

He measured the angle of **refraction** for different angles of incidence.
His results are shown in the graph.



Use the graph to answer the questions below.

(i) When the angle of **refraction** is 20°, what is the angle of **incidence**?

_____ °

14bi
1 mark

(ii) What conclusion could James draw from his graph?
Complete the sentence below.

When light passes from air into glass, the angle of **incidence** is

always _____ the angle of **refraction**.

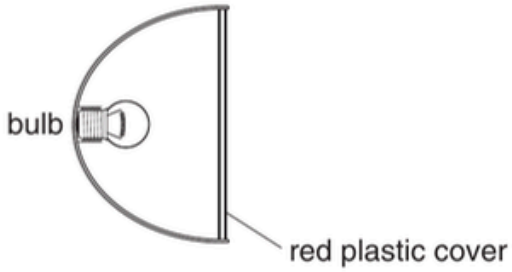
14bii
1 mark

(c) **On diagram 2, on the opposite page**, draw a line to continue the refracted ray as it leaves the glass block.

14c
1 mark

Modern Tuition

(b) The bulb in the rear lamp gives out white light.
White light is a mixture of all the colours of light.



The plastic cover acts as a red filter.
Red light passes through the filter.

What happens to the other colours that do **not** pass through?

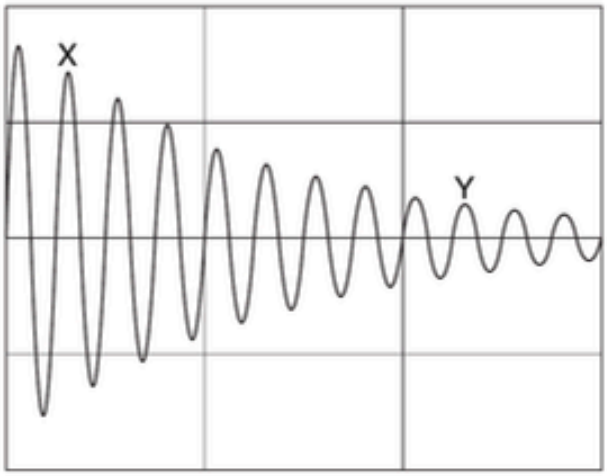
_____

15b
1 mark

Modern Tuition

(c) Zeena pushes the lid down and nitrogen gas escapes through the diaphragm.
The diaphragm vibrates and produces a sound.

The pattern on the oscilloscope screen below represents the soundwave produced by the alarm.



(i) The loudness of the sound produced by the alarm decreases between X and Y.

How can you tell this from the graph?

_____

_____

10ci
1 mark

(ii) The pitch of the sound produced by the alarm stays the same between X and Y.

How can you tell this from the graph?

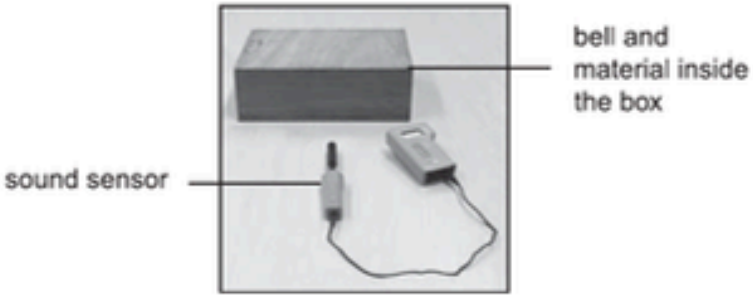
_____

_____

10cii
1 mark

Modern Tuition

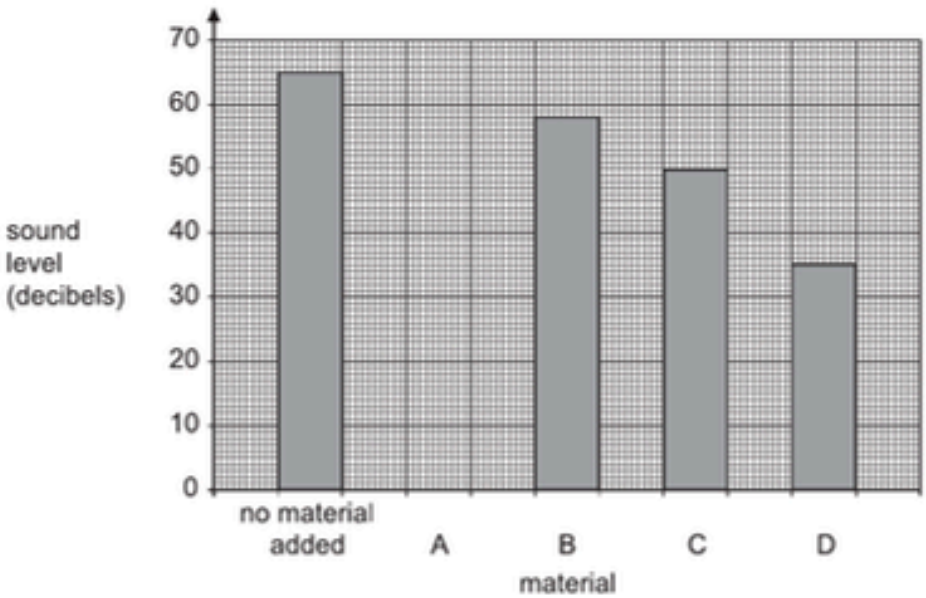
2. John investigated which material would be best for sound-proofing.
He put a bell inside a box.
He covered the bell with each material in turn.
He put a sound sensor outside the box to record the sound level.



He tested different materials and got the following results.

material	sound level (decibels)
no material added	65
A	40
B	58
C	50
D	35

(a) On the chart below, draw the bar for **material A**.



2a
1 mark

Modern Tuition

(b) How many types of material did John test?

_____

2b
1 mark

(c) Which material was best at stopping the sound going through?
Give the correct letter.

_____

2c
1 mark

(d) Which **two** things should John have done to make his test fair?
Tick the **two** correct boxes.

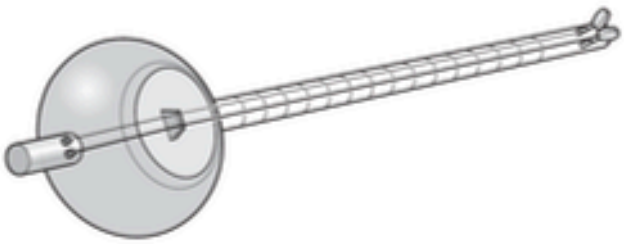
Use the same box each time.	☐
Make sure a different person recorded the results each time.	☐
Use the same material each time.	☐
Keep the distance between the sound sensor and the bell the same each time.	☐
Test each material in a different room.	☐

2d
1 mark

2d
1 mark

Modern Tuition

10. The dotar is a musical instrument with two strings.



(a) Aftal plays the dotar very quietly.

What must he do to the strings to make a louder sound?

_____

_____

10a

1 mark

(b) Aftal makes the strings tighter so they vibrate more quickly.

How does this affect the sound produced by the strings?
Tick the correct box.

The sound has a lower pitch.	☐
The sound is louder.	☐
The sound has a higher pitch.	☐
The sound is quieter.	☐

10b

1 mark

Modern Tuition

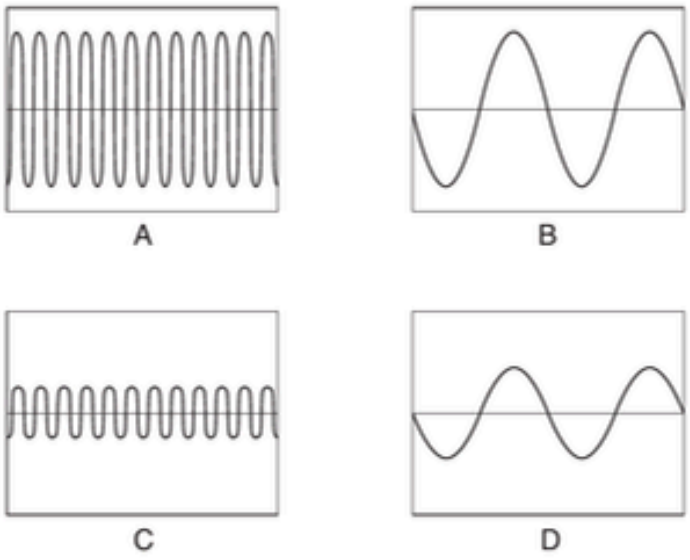
(c) One of the strings is thicker than the other, so it vibrates more slowly.

In what way is the sound made by the thicker string different from the sound made by the thinner string?

_____

10c
1 mark

(d) Aftal played the dotar near a microphone connected to an oscilloscope. The diagrams below show the patterns made by four sounds.



(i) How does the sound shown in trace A differ from the sound in trace B?

_____

_____

10di
1 mark

(ii) How does the sound shown in trace A differ from the sound in trace C?

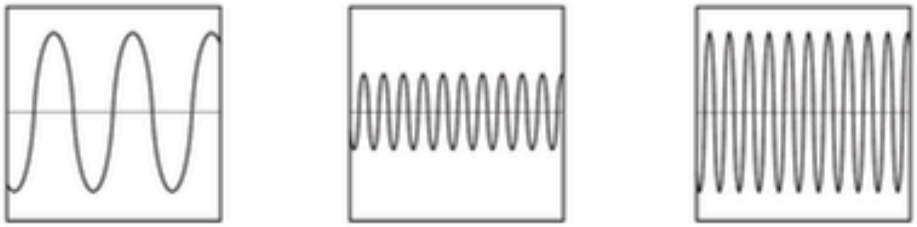
_____

_____

10dii
1 mark

Modern Tuition

8. (a) The diagrams below show the patterns produced on an oscilloscope by three different sound waves.



(i) Which **two** waves have the same loudness?
Write the letters.

_____ and _____

How do the diagrams show this?

_____

_____

8ai
1 mark

(ii) Which **two** waves have the same pitch?
Write the letters.

_____ and _____

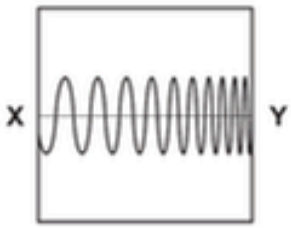
How do the diagrams show this?

_____

_____

8aii
1 mark

(iii) Shuli is listening to a sound that produces the pattern below.



Describe how the sound that Shuli **hears** changes between X and Y.

_____

8aiii
1 mark

Modern Tuition

(b) The table below shows the maximum time a person can listen to music at different sound levels without damage to the ear.

sound level (decibels)	maximum time (hours)
86	8
88	4
90	2
92	1
94	0.5

Estimate the maximum time a person could listen to a sound of 87 decibels.

_____ hours

8b

1 mark

(c) The diagram below shows part of the human ear.



What happens to the ear drum as a sound gets louder?

_____

_____

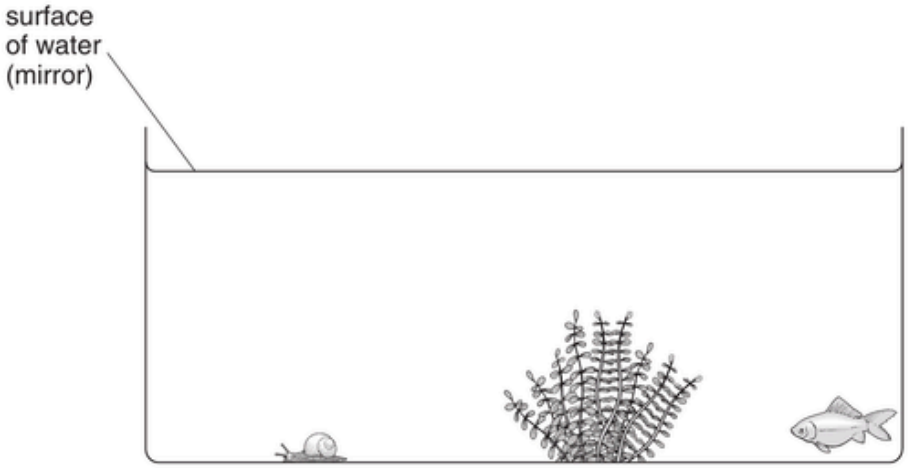
8c

1 mark

Modern Tuition

10. (a) The diagram below shows a fish tank.

The surface of the water acts like a mirror.
The fish can see the snail reflected in the surface of the water.



10a
1 mark

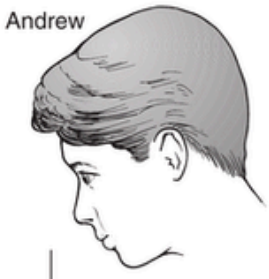
Draw a ray of light which passes from the snail, and reflects from the surface, to show how the fish can see the snail. Use a ruler.

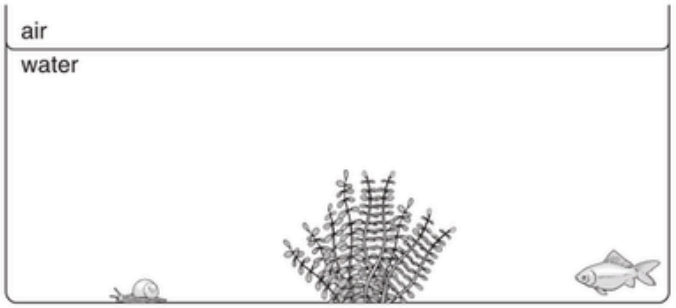
10a
1 mark

Put arrows on the ray of light.

10a
1 mark

(b) Andrew is looking at the snail.





When a ray of light passes from water to air it changes direction.

(i) Draw a ray of light from the snail to Andrew to show how Andrew can see the snail. Use a ruler.

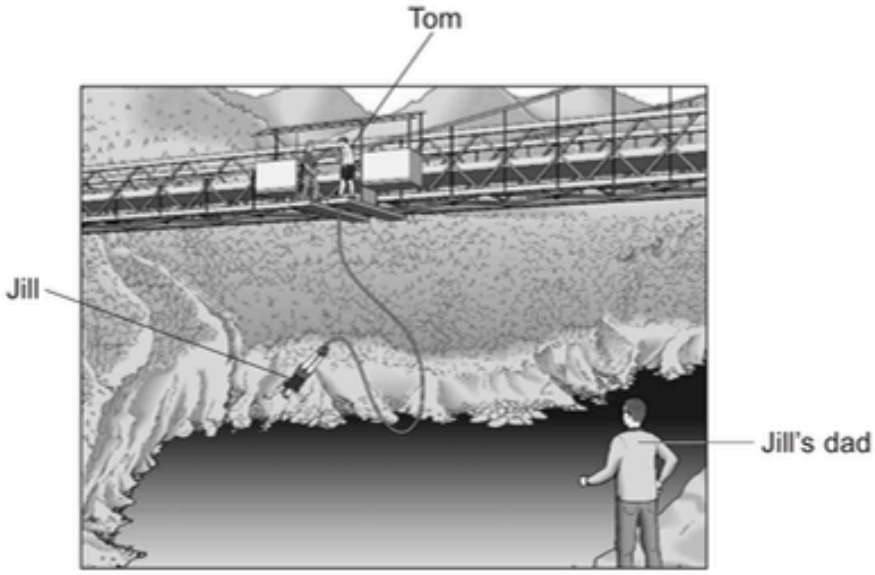
Put arrows on the ray of light.

(ii) What is the name given to this change in the direction of a ray of light?

_____

Modern Tuition

(c) Jill's dad watches her doing the bungee jump.
He is standing a long way from the bridge.
Jill shouts 'bungee' at the same time as she jumps off the bridge.
Jill's dad sees her jump before he hears her shout.



(i) Why does Jill's dad **see** her jump before he **hears** her shout?

_____

_____

6ci
1 mark

(ii) Tom is near Jill when she shouts. Her dad is far away.

Complete the sentence to describe how the shout will sound to Tom compared with Jill's dad. Use one word from the box.

louder	higher	lower	quieter

The shout will sound _____ to Tom.

6cii
1 mark

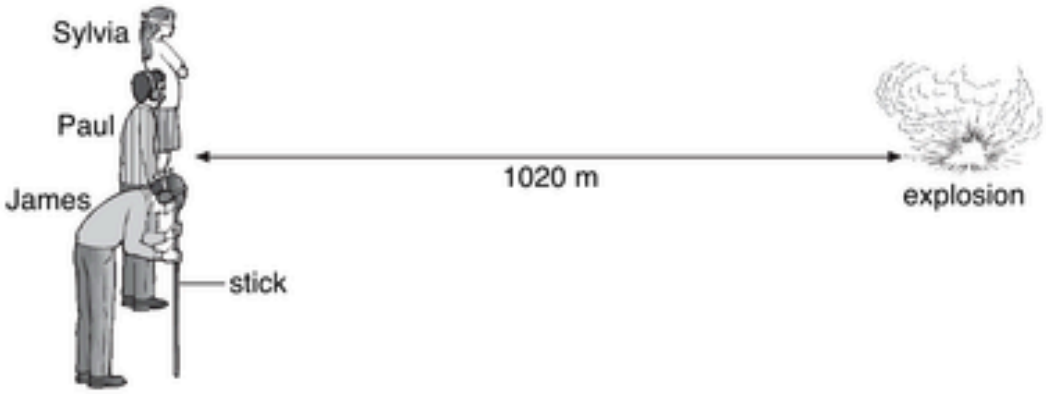
(iii) What part of Tom's ear vibrates when he hears Jill shout?

_____

6ciii
1 mark

Modern Tuition

13. Three pupils took part in an investigation into the speed of sound.
All three pupils stood 1020 m from an explosion.



- Sylvia wore a blindfold.
- Paul wore ear defenders.
- James wore a blindfold **and** ear defenders. He rested his head on a wooden stick pushed into the ground so that he could feel vibrations.

The explosion produced sound and light at the same time.
The table shows the speed of sound in two different materials.

material	speed of sound (m/s)
air	340
soil	3200

(a) Use all the information above to help you answer parts (i) and (ii) below.

(i) In which order would the pupils notice the explosion?

first _____

second _____

third _____

13ai
1 mark

Modern Tuition

(ii) From the information given opposite, calculate the time it would take for the sound to travel through the air to Sylvia.

_____

_____ s

13aii
1 mark

(b) Another pupil, Nasah, stood 2000 m away from the explosion.

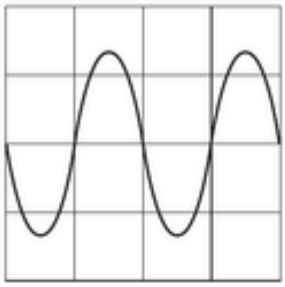
(i) The sound heard by Nasah was quieter than the sound heard by Sylvia.
The further sound travels the quieter it becomes.
Give the reason for this.

_____

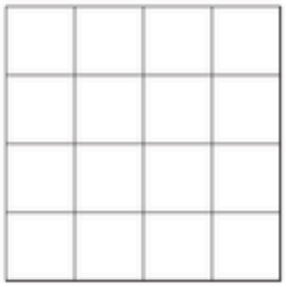
_____

13bi
1 mark

(ii) The oscilloscope trace below represents the sound Sylvia heard.



Sylvia



Nasah

The sound Nasah heard was quieter but the pitch was the same.

On the right-hand grid, draw the trace to show the pattern of the sound Nasah heard.

13bii
1 mark

13bii
1 mark

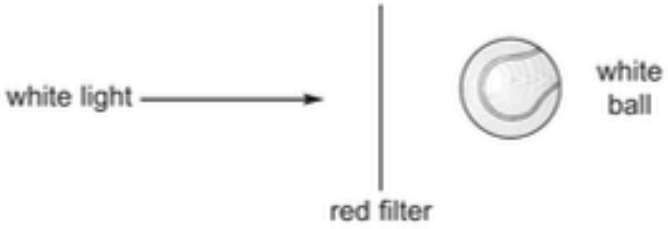
Modern Tuition

9. (a) Peter had two different coloured tennis balls as shown below.



He shone white light through a red filter onto each ball.

(i) **experiment 1**



The white ball appeared red.
Explain why this ball appeared red.

_____

_____

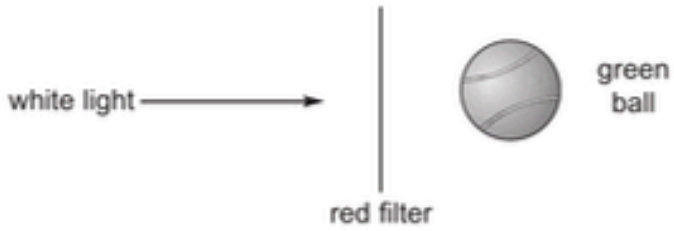
_____

_____

1 mark

1 mark

(ii) **experiment 2**



What colour did this ball appear?

_____

1 mark

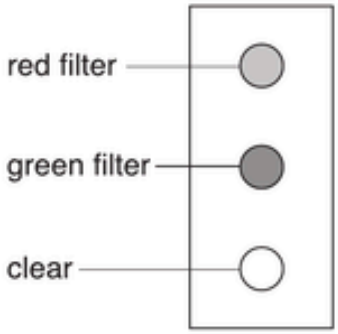
Explain your answer.

_____

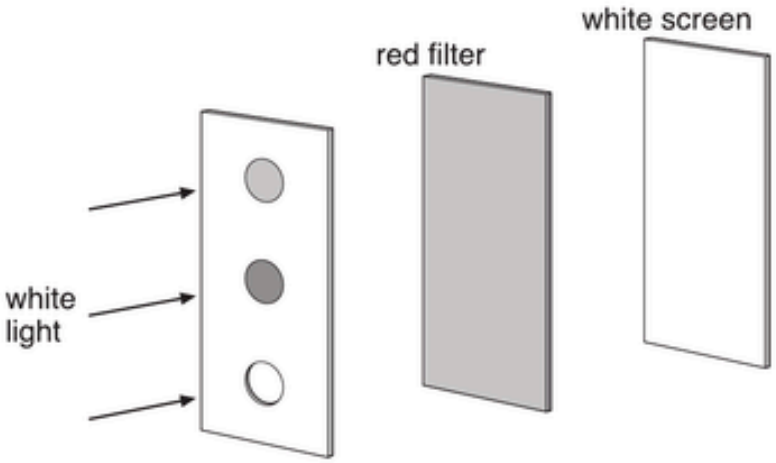
_____

Modern Tuition

(b) Peter set up a different experiment.
He cut three holes in a piece of card.
Two of the holes were covered by coloured filters as shown below.



Peter placed a red filter between the piece of card and a white screen.
He shone white light at the piece of card with three holes in it.



What would Peter see on the screen?

_____

_____

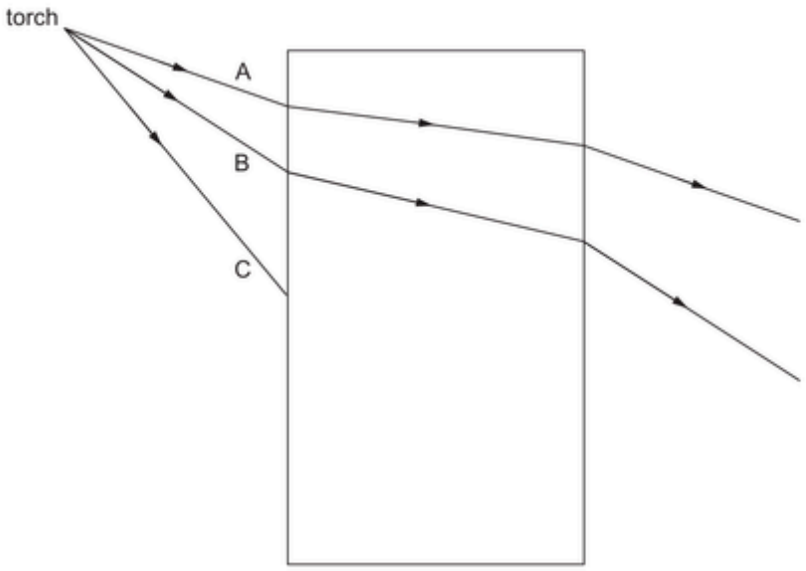
9b
1 mark

Modern Tuition

10. (a) When light travels from air to glass, it changes direction.
What is the name of this effect?

10a
1 mark

(b) The diagram below shows three rays of light A, B and C striking a glass block.



10b
1 mark

The paths of A and B have been drawn.

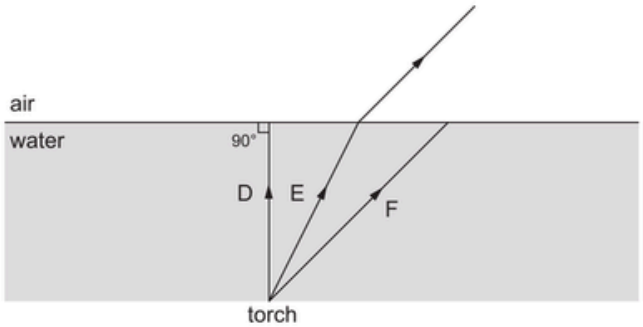
10b
1 mark

Continue ray C to show its path through the block and out the other side.
Use a ruler.

(c) The diagram below shows three rays of light, D, E and F, from a torch placed under water.

The path of ray E is shown as it leaves the water and enters the air.

Continue the paths of D and F as they pass through the air.
Use a ruler.



Modern Tuition