

NOTICE TO CUSTOMER:

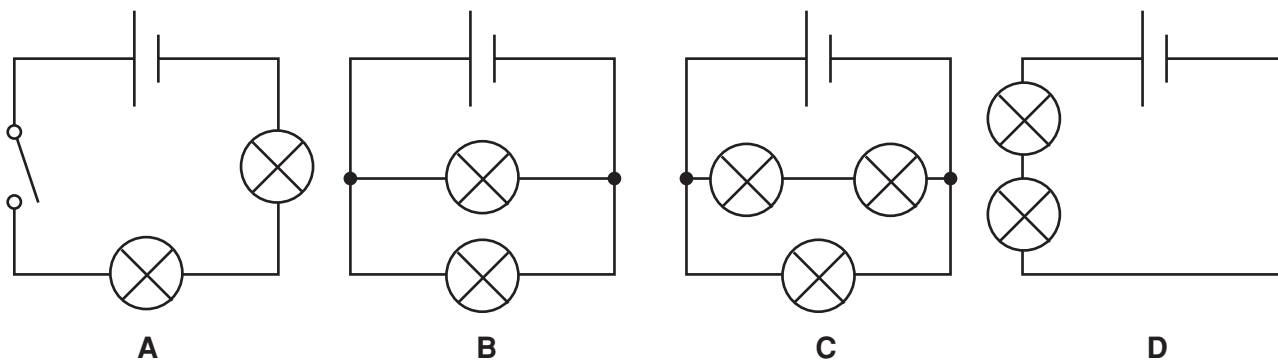
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1 This question is about electric circuits.

(a) Look at the electric circuits.



The bulbs in **one** of the circuits are not lit.

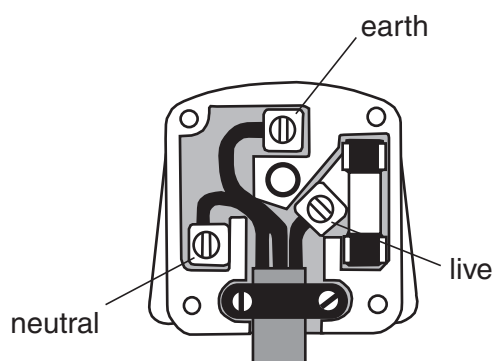
Which one?

Choose from: **A** **B** **C** **D**

answer

[1]

(b) Look at the diagram of a mains electric plug.



The table shows the terminals and colours of the wires.

	live	neutral	earth
A	red	black	green
B	brown	blue	green/yellow
C	green/yellow	blue	brown
D	blue	brown	green/yellow

Which line shows the correct colours for the wires?

Choose from: **A** **B** **C** **D**

answer [1]

(c) Most electrical circuits have either a fuse or a circuit breaker.

Write down a reason for having either a fuse or circuit breaker in a circuit.

.....

..... [1]

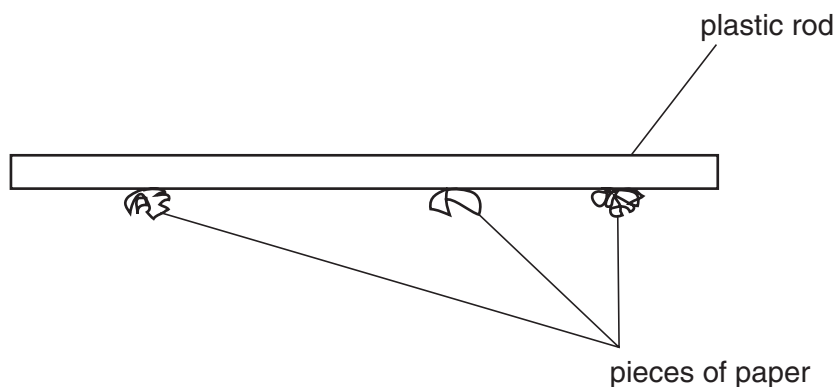
[Total: 3]

[Turn over

3

- 2 (a) Vincent rubs a plastic rod with a duster.

Look at the diagram.



The rod attracts the small pieces of paper.

Suggest why.

.....
..... [1]

- (b) Wayne has a pair of trainers.

They have plastic soles.

He plays football on an artificial grass pitch.

He touches a metal goal post and gets an electric shock.

Describe:

how he gets charged

.....
.....

why he gets a shock.

.....
.....
.....

[3]

(c) Static electricity is useful in spray-painting cars.

Explain how.

In your answer write about

- electrostatic charge
- electrostatic force
- why it is used.

.....

.....

.....

.....

..... [3]

[Total: 7]

[Turn over

3 This question is about **longitudinal** waves.

(a) Look at the list of words.

amplitude

compression

frequency

rarefaction

Complete the following sentences.

Use words from the list.

(i) The number of vibrations each second is called the [1]

(ii) When particles in a wave move apart, they produce a [1]

(b) Ultrasound and sound are examples of longitudinal waves.

Describe how ultrasound is different from sound.

.....
.....
..... [2]

[Total: 4]

4 Radiation is used in hospitals.

(a) Specially trained people take X-ray pictures.

What do we call the people who take these pictures?

..... [1]

(b) There are three types of nuclear radiation.

One type is stopped by skin.

Which type of nuclear radiation is stopped by skin?

..... [1]

(c) Radioisotopes are used in hospitals.

Write down two **uses** of radioisotopes in hospitals.

use 1

.....

use 2

..... [2]

[Total: 4]

5 (a) In a nuclear power station, uranium atoms split. This releases neutrons.

These neutrons make other uranium atoms split.

What do we call this sort of reaction?

..... [1]

(b) What would happen if this reaction went out of control?

.....

..... [1]

[Total: 2]

[Turn over]

6 This question is about static electricity.

(a) Sam rubs a balloon on his sweater.

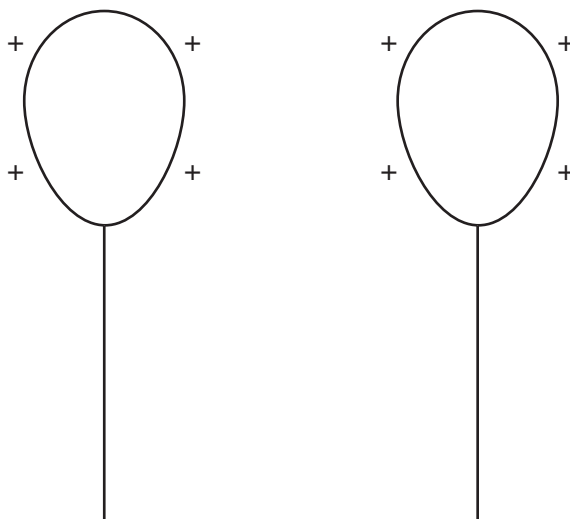
The balloon becomes charged.

(i) Write down the name of the charged particles that move between his jumper and the balloon.

..... [1]

(ii) He charges a second balloon the same way.

Look at the diagram.



What happens to the balloons when he tries to put them together?

.....
..... [1]

(b) Static electricity is useful in spray-painting cars.

Explain how.

In your answer write about

- electrostatic charge
- electrostatic force
- why it is used.

.....

.....

.....

.....

..... [3]

[Total: 5]

[Turn over

- 7 Electrostatic charges can be dangerous in hospitals.

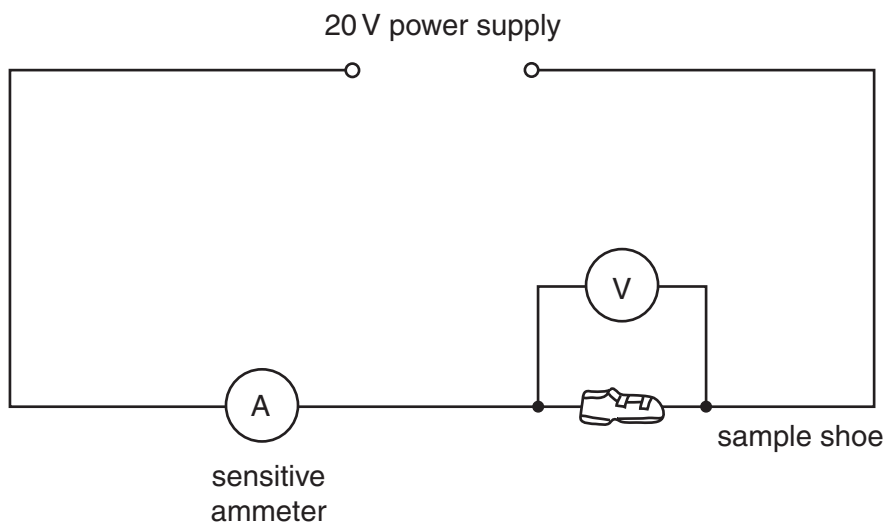
Doctors in operating theatres have to be careful not to become charged.

They wear shoes that conduct electricity.

The shoe manufacturer says that the resistance of the shoe is 15 000 ohms.

Tracey checks this in the laboratory.

She uses this circuit.



- (a) The voltage is 20 volts.

What does she expect the current in the shoe to be?

Choose from: **0.0007 A** **0.0010 A** **0.0013 A** **0.0015 A**

You **must** show your working to gain full marks.

.....

.....

.....

answer A [2]

- (b) All the metal surfaces and electrical equipment in an operating theatre are earthed.

Suggest a reason why.

.....

..... [1]

[Total: 3]

8 This question is about **longitudinal** waves.

(a) Ultrasound and sound are examples of longitudinal waves.

Describe how ultrasound is different from sound.

.....

.....

..... [2]

(b) Doctors often use ultrasound rather than X-rays to get images of the inside of the body.

Give two reasons why.

1

.....

2

..... [2]

[Total: 4]

[Turn over

9 Nuclear radiation is used in hospitals.

(a) There are three types of nuclear radiation.

One type is stopped by skin.

Which type of nuclear radiation is stopped by skin?

..... [1]

(b) Uranium is used as a fuel in a nuclear reactor.

When the reactor is working there is a **chain reaction**.

What is a chain reaction?

.....
.....
..... [2]

(c) Radioactive substances that emit gamma rays are used as tracers to find blockages in underground pipes.

(i) Alpha or beta sources are not used.

Why are **only** gamma sources used?

.....
..... [1]

(ii) How does the gamma source show where the blockage is?

.....
..... [1]

[Total: 5]

10 Strontium-90 is radioactive and gives out beta particles from its nucleus.

(a) What is a beta particle?

.....
..... [2]

(b) The nucleus of strontium-90 contains 38 protons and 52 neutrons.

It emits a beta particle when it decays.

How many neutrons and protons are there in the nucleus of the **new** atom?

number of neutrons

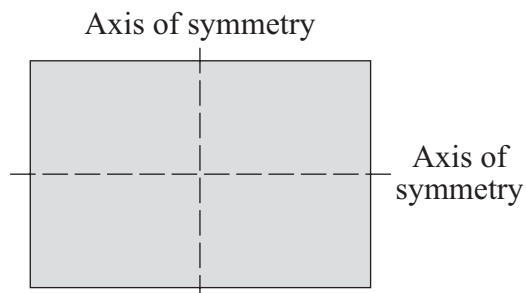
number of protons [1]

[Total: 3]

END OF QUESTION PAPER

Answer **all** questions in the spaces provided.

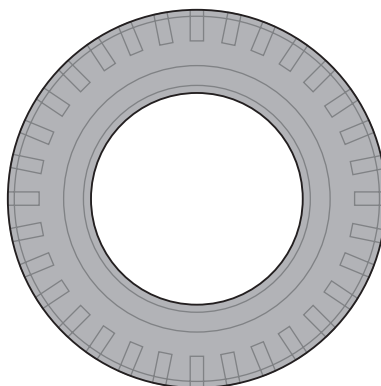
- 1 (a) The diagram shows a rectangle made out of a sheet of cardboard.



Draw an **X** on the diagram so that the centre of the **X** is at the centre of mass of the rectangle.

(1 mark)

- (b) The drawing shows a car tyre.



- (i) Where is the centre of mass of the tyre?

.....
(1 mark)

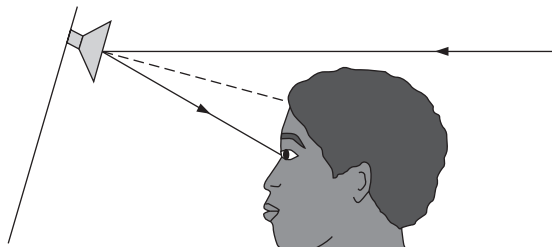
- (ii) Explain your answer to (b)(i).

.....
.....
(1 mark)

- 2 (a) The diagram shows a motorist looking into her driving mirror.

- (i) Mark on the diagram:

I to show the incident ray
r to show the angle of reflection.



(2 marks)

- (ii) Name the dashed line shown in the diagram.

.....
 (1 mark)

- (b) List **A** gives the names of two types of mirror. List **B** shows how three types of mirror are represented in diagrams.

Draw a line from each type of mirror in list **A** to the correct mirror in list **B**.

List **A**

Concave mirror

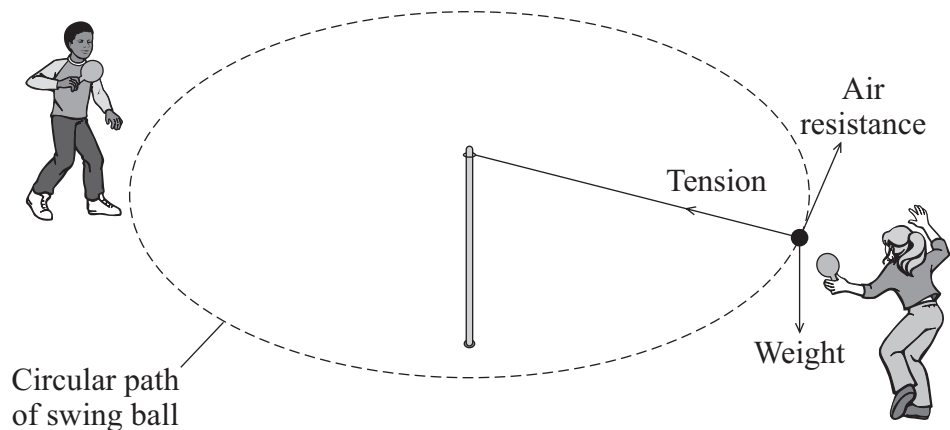
Plane mirror

List **B**



(2 marks)

- 3 The diagram shows two children playing with a toy called a swing ball. The ball is joined to a pole by a strong string. The children hit the ball so that it goes round in a circular path.



- (a) Which force causes the ball to move in a circle?

Draw a ring around your answer.

air resistance

tension

weight

(1 mark)

- (b) Complete the sentences by ticking (✓) the correct ending.

- (i) The force needed to make the ball move in a circular path is larger if

the speed of the ball is increased. ☐

the speed of the ball is decreased. ☐

the string is made longer. ☐

(1 mark)

- (ii) The continuous acceleration of a ball moving in a circular path changes

the speed of the ball. ☐

the direction of the ball. ☐

the weight of the ball. ☐

(1 mark)

- (c) Which of the following words is used to describe any force that causes an object to move in a circular path?

Draw a ring around your answer.

centripetal

frictional

gravitational

universal

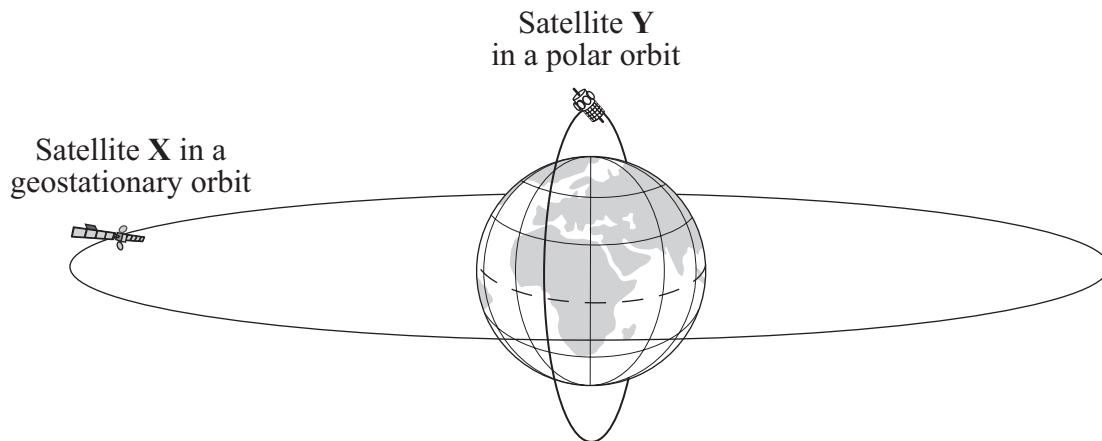
(1 mark)

4

Turn over for the next question

Turn over ►

- 4 The diagram shows two satellites orbiting the Earth.



These satellites have the same mass.

- (a) Complete the following sentences by drawing a ring around the correct words in each box.

- (i) The time taken for one orbit by satellite X is
the time for one orbit by satellite Y.

less than
the same as
more than

(1 mark)

- (ii) The force between the Earth and satellite X is
the force between the Earth and satellite Y.

less than
the same as
more than

(1 mark)

- (b) A communication satellite is put into a geostationary orbit.

What is a geostationary orbit?

.....

.....

.....

.....

(2 marks)

- (c) A company plans to launch a satellite to monitor the weather.

Which type of orbit is usually used for this purpose?

Draw a ring around your answer.

geostationary

high polar

low polar

(1 mark)

5

Turn over for the next question

Turn over ►

- 5 Two students collect data from the Internet about planets in the Solar System.

The table shows the data that they collect about the first six planets.

Name of planet	Distance from the Sun in arbitrary units	Time for one orbit of the Sun in years	Mean surface temperature of the planet in °C
Mercury	0.4	0.2	+ 125
Venus	0.7	0.6	+ 465
Earth	1.0	1.0	+ 22
Mars	1.5	1.9	– 48
Jupiter	5.2	11.9	
Saturn	9.6	29.5	– 180

- (a) One student says that the mean surface temperature of planets gets less the further they are from the Sun. The other student agrees but says that one planet does not fit the pattern.

Which planet does not fit the pattern ?

.....
(1 mark)

- (b) Estimate a value for the mean surface temperature of Jupiter.

Mean surface temperature of Jupiter = °C
(1 mark)

- (c) Use words from the box to complete the following conclusion reached using the data in the table.

You can use the words once, more than once or not at all.

decreases	increases	stays the same
------------------	------------------	-----------------------

As the distance from the Sun to a planet.....

the time taken for the planet to orbit the Sun.....
(1 mark)

- (d) Hundreds of years ago, some scientists thought that Mars was a hot planet because it has a reddish colour.

Which **one** of the following statements gives the reason why scientists no longer think this?

Put a tick (✓) in the box next to your answer.

Hundreds of years ago, scientists got everything wrong.

☐

Today's scientists have new evidence about Mars.

☐

All scientific ideas change every one hundred years.

☐

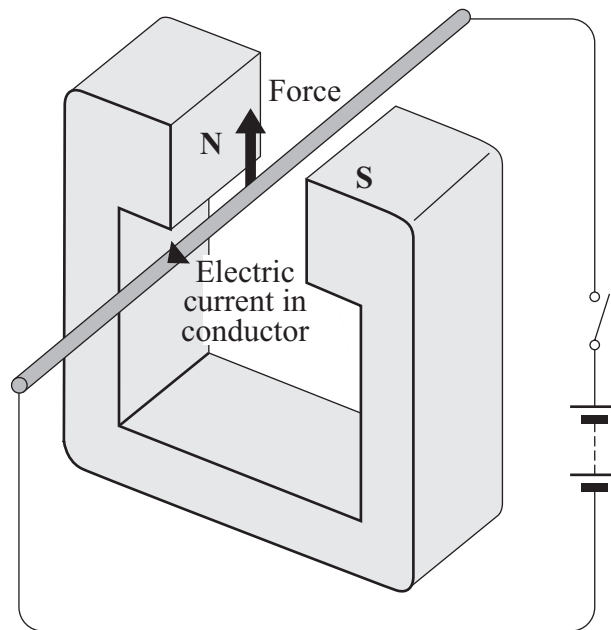
(1 mark)

4

Turn over for the next question

Turn over ►

- 6 When a conductor carrying an electric current is placed in a magnetic field a force may act on it.



- (a) State **two** ways in which this force can be increased.

1

2 (2 marks)

- (b) State **two** ways in which this force can be made to act in the opposite direction.

1

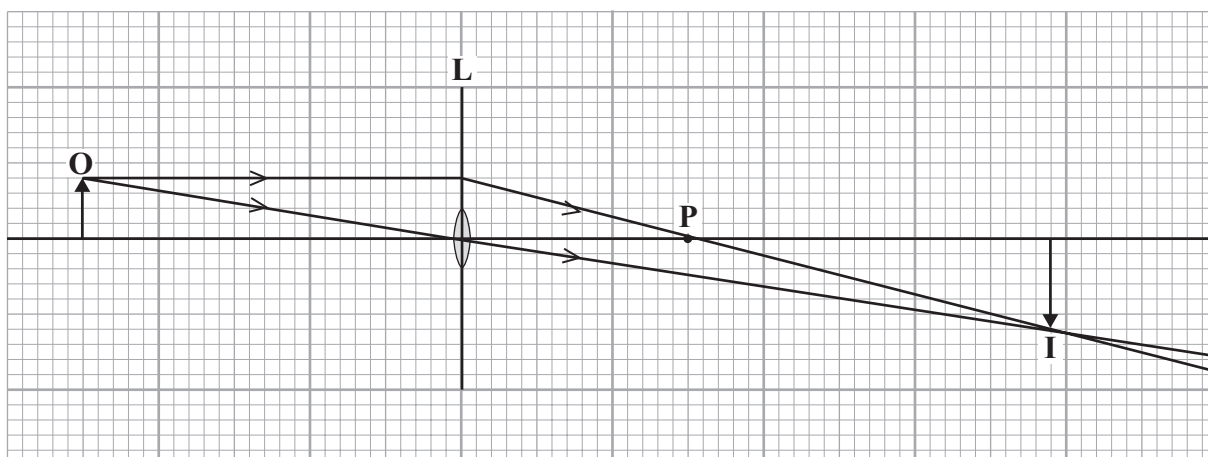
2 (2 marks)

- (c) In what circumstance will **no** force act on a conductor carrying an electric current and in a magnetic field?

.....

..... (1 mark)

- 7 The ray diagram shows the position and size of the image, **I**, of an object, **O**, formed by a lens, **L**.



- (a) What type of lens is shown in the ray diagram?

.....
(1 mark)

- (b) Name the point labelled **P**.

.....
(1 mark)

- (c) The ray diagram has been drawn to scale.

Use the equation in the box to calculate the magnification.

$\text{magnification} = \frac{\text{image height}}{\text{object height}}$

Show clearly how you work out your answer.

.....
.....

Magnification =
(2 marks)

- (d) How can you tell from this ray diagram that the image is a real image?

.....
.....
(1 mark)

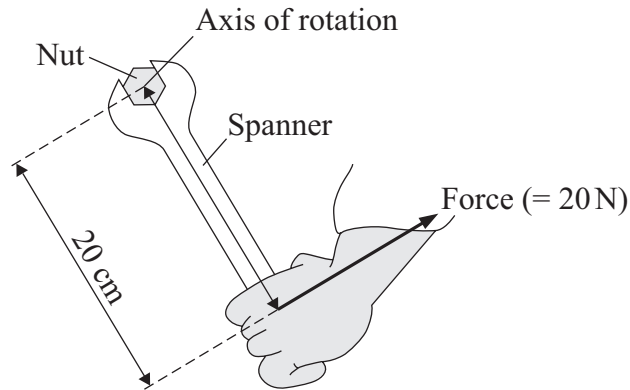
Turn over ►

8 A spanner gives a turning effect to undo a nut.

(a) Complete the sentence.

The turning effect of a force is called the of the force.
(1 mark)

(b) The diagram shows a spanner being used.



Use the equation in the box to calculate the spanner's turning effect in newton metres.

$\text{turning effect} = \text{force} \times \text{perpendicular distance from the line of action of the force to the axis of rotation}$
--

Show clearly how you work out your answer.

.....
.....

Turning effect = Nm
(2 marks)

(c) Give **two** ways in which you can increase the spanner's turning effect.

1

2

(2 marks)

- 9 When sound waves reach a material, some of the energy of the sound is reflected and some is transmitted through the material.

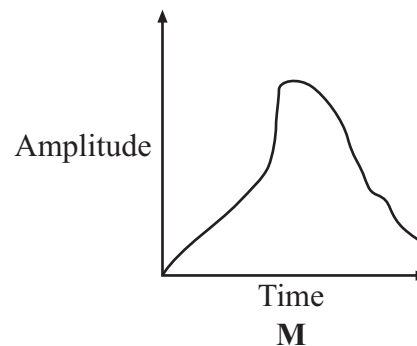
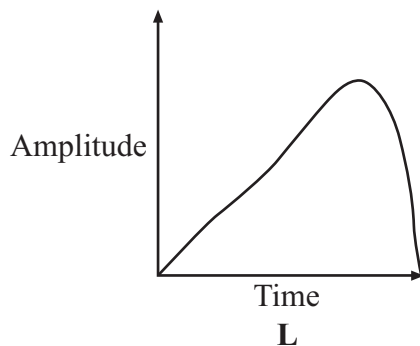
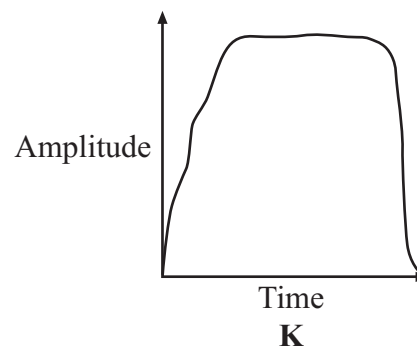
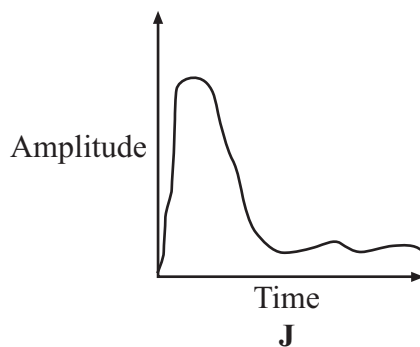
(a) Complete the sentence.

Sound waves are caused by
(1 mark)

(b) The graphs **J**, **K**, **L** and **M** represent the sound energy reflected from a surface.

The graphs are all drawn to the same scale.

Which graph shows the greatest total sound energy output from the surface?



Graph
(1 mark)

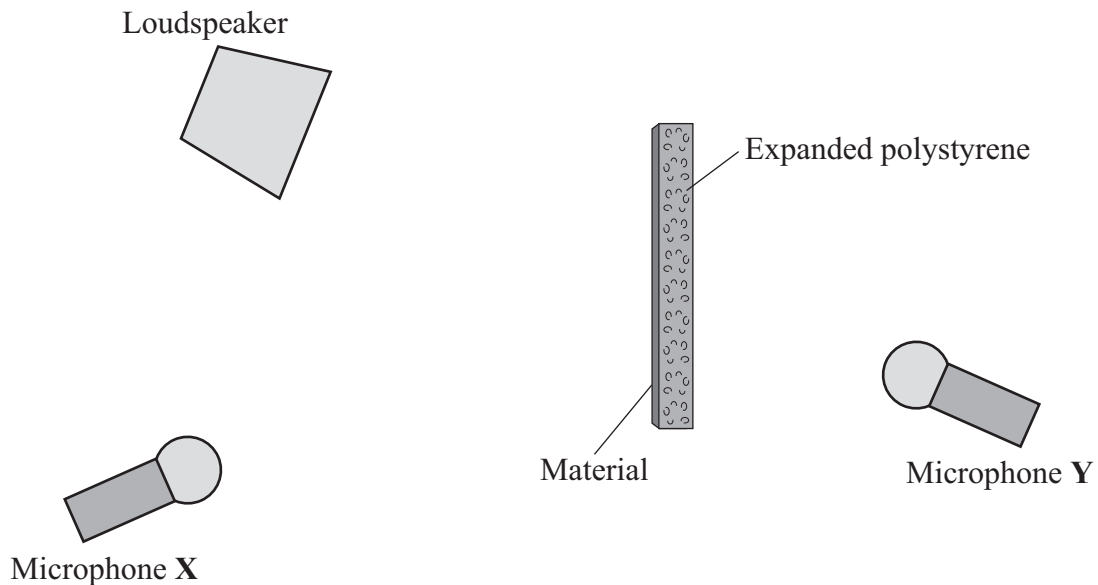
Turn over ►

- (c) The proportion of the sound energy which is reflected or transmitted depends on the material which receives the sound.

A student investigates different materials.

The diagram shows how a student sets up her equipment.

- (i) Using a pencil and ruler to draw on the diagram, show how microphone X receives reflected sound.



(2 marks)

- (ii) The student tests four materials. Each sheet of material is 1 mm thick. This has been glued onto a block of expanded polystyrene.

Why does the student use the same size of expanded polystyrene block and the same sound level for each test?

.....

.....

(1 mark)

- (iii) The table shows the readings for the sound level transmitted to microphone Y.

Sound level from loudspeaker in arbitrary units	Surface material	Sound level transmitted to microphone Y in arbitrary units
60	paper	39
60	plaster	18
60	cloth	31
60	wood	15

- [A] Which surface material transmits the smallest proportion of the sound?

.....
(1 mark)

- [B] What proportion is this?

.....
(1 mark)

- (d) People living in a flat have very noisy neighbours who are always playing loud music.

Suggest **one** practical idea to reduce the amount of noise transmitted into the flat through the walls and explain how your idea will work.

.....

.....

.....

.....

.....

.....

(2 marks)

END OF QUESTIONS

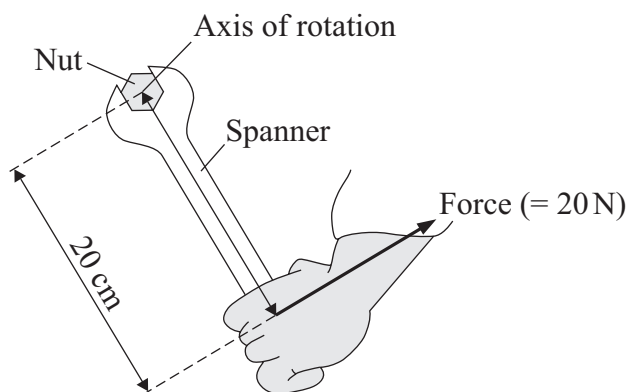
Answer **all** questions in the spaces provided.

1 A spanner gives a turning effect to undo a nut.

(a) Complete the sentence.

The turning effect of a force is called the of the force.
(1 mark)

(b) The diagram shows a spanner being used.



Use the equation in the box to calculate the spanner's turning effect in newton metres.

$\text{turning effect} = \text{force} \times \text{perpendicular distance from the line of action of the force to the axis of rotation}$
--

Show clearly how you work out your answer.

.....
.....

Turning effect = Nm
(2 marks)

(c) Give **two** ways in which you can increase the spanner's turning effect.

1

2

(2 marks)

- 2 When sound waves reach a material, some of the energy of the sound is reflected and some is transmitted through the material.

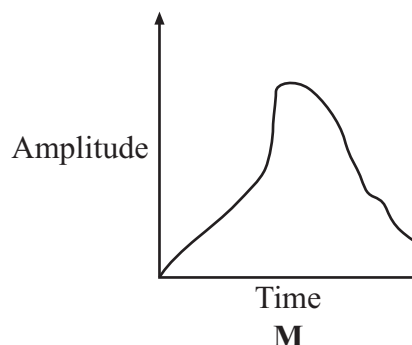
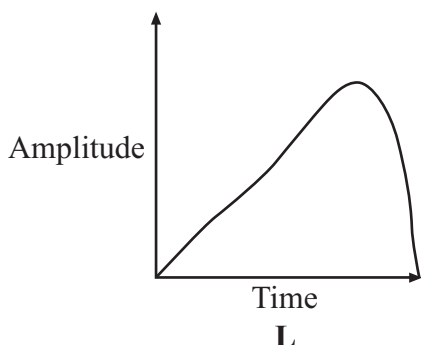
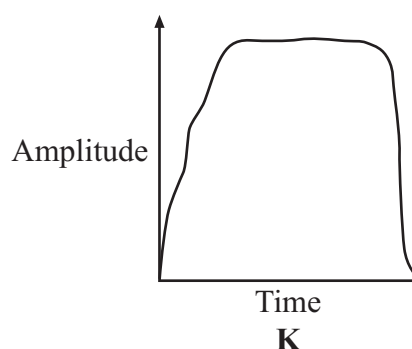
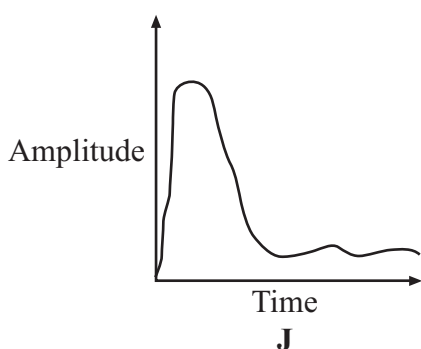
(a) Complete the sentence.

Sound waves are caused by
(1 mark)

(b) The graphs **J**, **K**, **L** and **M** represent the sound energy reflected from a surface.

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Graph
(1 mark)

Question 2 continues on the next page

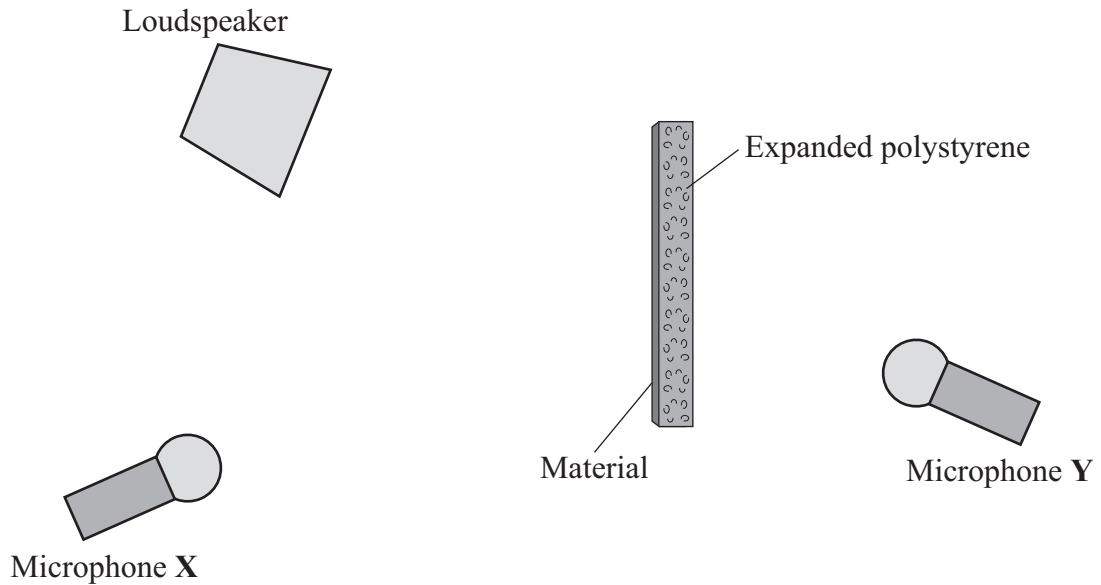
Turn over ►

- (c) The proportion of the sound energy which is reflected or transmitted or absorbed depends on the material which receives the sound.

A student investigates different materials.

The diagram shows how a student sets up her equipment.

- (i) Using a pencil and ruler to draw on the diagram, show how microphone X receives reflected sound.



(2 marks)

- (ii) The student tests four materials. Each sheet of material is 1 mm thick. This has been glued onto a block of expanded polystyrene.

Why does the student use the same size of expanded polystyrene block and the same sound level for each test?

.....

.....

(1 mark)

- (iii) The table shows the readings for the sound level transmitted to microphone Y.

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- [A] Which surface material transmits the smallest proportion of the sound?

.....
(1 mark)

- [B] What proportion is this?

.....
(1 mark)

- (d) People living in a flat have very noisy neighbours who are always playing loud music.

Suggest **one** practical idea to reduce the amount of noise transmitted into the flat through the walls and explain how your idea will work.

.....

.....

.....

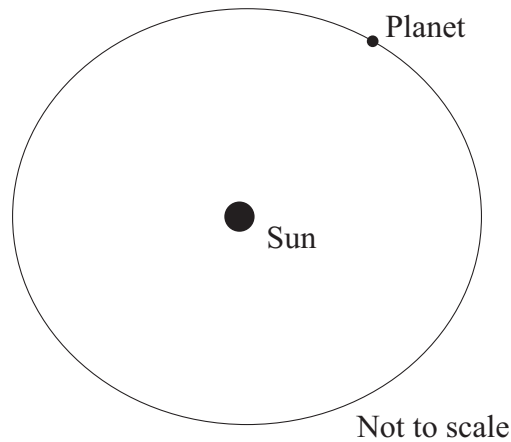
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.....

.....

(2 marks)

- 3 (a) The diagram shows the orbit of a planet in the Solar System. The orbit is in the shape of a slightly squashed circle.



- (i) What is the name of this orbit shape?

.....
(1 mark)

- (ii) Complete the sentence.

The Sun is at one of this shape.
(1 mark)

- (iii) What provides the centripetal force which allows the planet to maintain its nearly circular orbit?

.....
(1 mark)

- (iv) What is the relationship between the time it takes each planet in the Solar System to complete its orbit and the planet's average distance from the Sun?

.....
.....
(1 mark)

- (b) Scientists have detected an object orbiting the Sun at a distance of about 17 billion kilometres. Some scientists think that the object, named Sedna, should be classified as a planet. However, some other scientists disagree.

What do you think scientists should do?

Put a tick (✓) in the box next to your answer.

Scientists should decide by voting.

☐

Scientists should wait until they have more evidence.

☐

Give a reason for your answer.

.....

.....

.....

(1 mark)

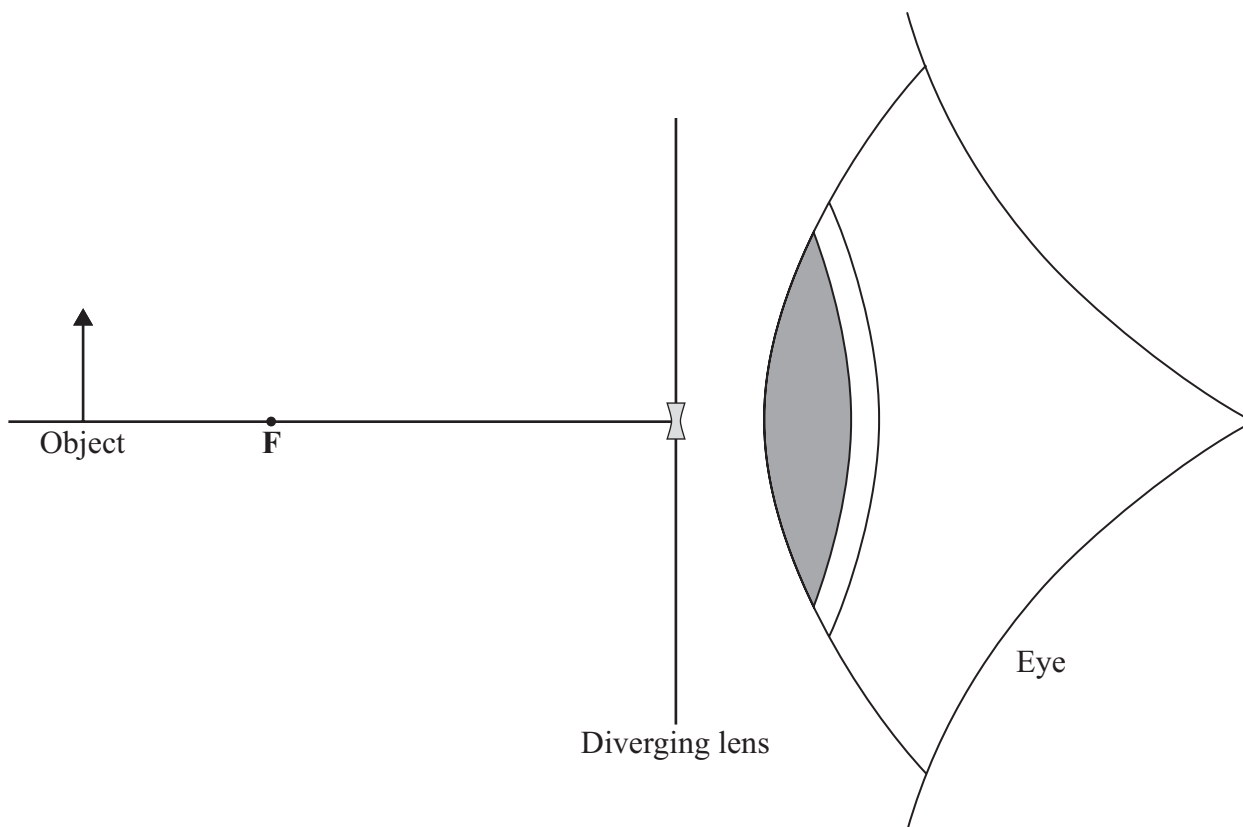
5

Turn over for the next question

Turn over ►

- 4 The diagram shows an object located vertically on the principal axis of a diverging lens. A student looks through the lens and can see an image of the object.

- (a) Using a pencil and ruler to draw construction lines on the diagram, show how light from the object enters the student's eye and the size and position of the image.



(3 marks)

- (b) Describe the nature of the image by comparing it to the object.

.....

.....

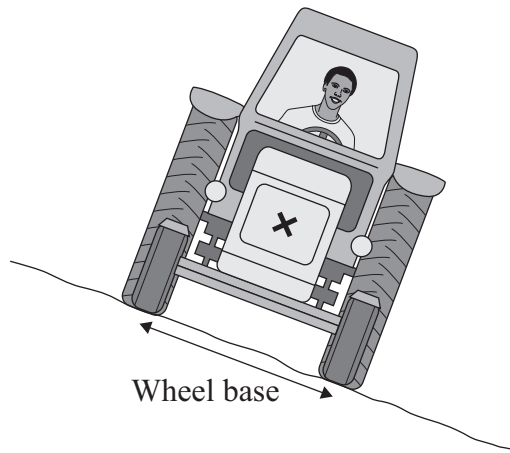
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(2 marks)

- 5 Tractors are often used on sloping fields, so stability is important in their design.

On the diagram, the centre of the **X** marks the centre of mass of the tractor.



- (a) Explain why the tractor has **not** toppled over. You may add to the diagram to help you to explain.

.....

.....

.....

.....

.....

.....

(3 marks)

- (b) Give **two** features of the tractor which affect its stability and state how each feature could be changed to increase the tractor's stability.

Feature 1

.....

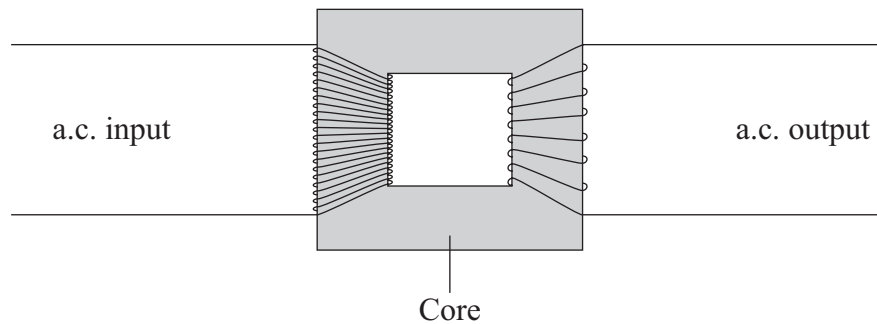
Feature 2

.....

(2 marks)

Turn over ►

- 6 (a) The diagram shows a transformer.



- (i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

Put a tick (✓) in the box next to your answer.

a step-up transformer

☐

a step-down transformer

☐

Explain your answer.

.....
.....
(1 mark)

- (ii) Why is insulated wire, and not uninsulated wire, used to make the coils?

.....
.....
(1 mark)

- (iii) Why is the core made of iron?

.....
.....
(1 mark)

- (b) A transformer has 500 turns on its primary coil and 7500 turns on its secondary coil. The potential difference across the primary coil is 150 volts.

Use the equation in the box to calculate the potential difference across the secondary coil.

$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$

Show clearly how you work out your answer.

.....

.....

.....

Potential difference across the secondary coil = volts
(2 marks)

- (c) Step-down transformers are used between power lines and people's houses.

Explain why.

.....

.....

.....

(2 marks)

- (d) Before 1926, large towns had their own local power stations. After 1926, these power stations were connected to form the National Grid.

Explain the advantage of having a National Grid system.

.....

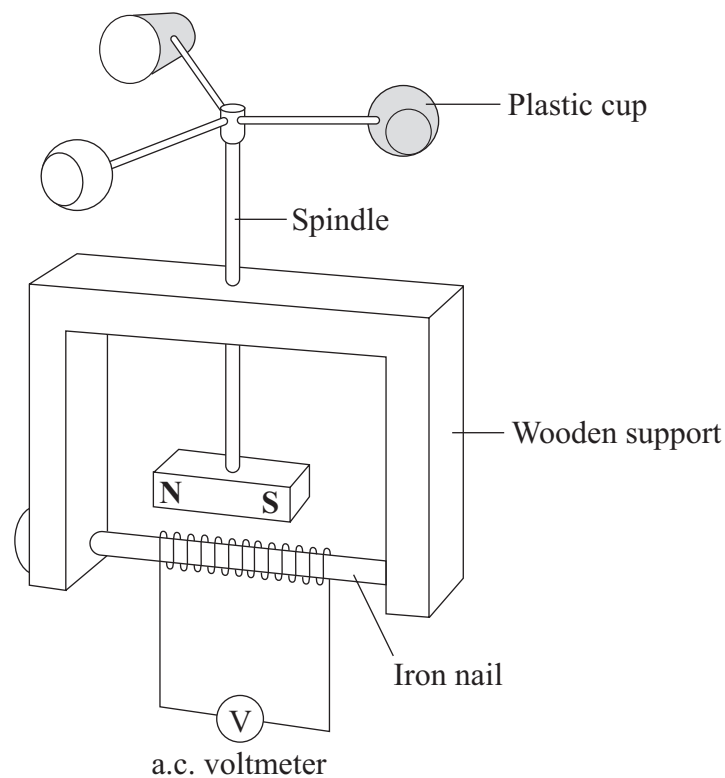
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.....

(2 marks)

- 7 The diagram shows a student's design for a simple wind speed gauge.



- (a) Explain why the wind causes the a.c. voltmeter to give a reading. The explanation has been started for you.

The wind causes the plastic cups to turn. This causes the spindle and magnet to turn.

.....

.....

.....

.....

(2 marks)

- (b) The gauge is not sensitive enough to measure light winds.

Suggest **one** way that the design can be modified to make the gauge more sensitive.

.....

.....

(1 mark)

8 Read the passage.

In the Solar System, the inner planets, such as the Earth, contain elements which are heavier than the elements hydrogen and helium.

Our star, the Sun, is a medium sized star.

If a star is much more massive than the Sun it will eventually swell into a red giant, start to contract, continue to contract and finally explode.

- (a) What is the explosion called?

.....
(1 mark)

- (b) Explain why scientists believe that the Solar System was formed from the material produced when earlier stars exploded.

.....
.....
.....
.....
.....
.....
(3 marks)

4

END OF QUESTIONS

Answer **all** questions in the spaces provided.

1 Electricity is generated in power stations. It is then sent to all parts of the country through a network of cables.

1 (a) Complete the following sentence by using **one** of the words in the box.

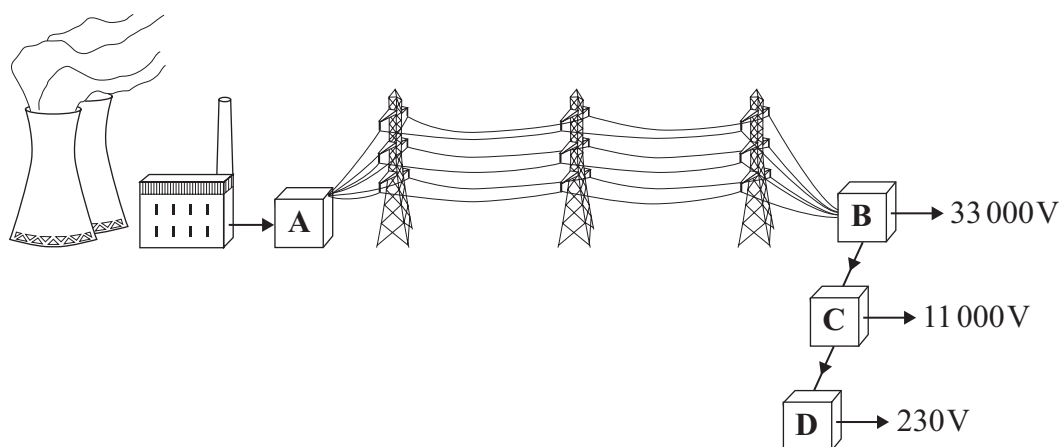
Grid

Power

Supply

The network is called the National
(1 mark)

1 (b) In the diagram, **A**, **B**, **C** and **D** are transformers.



1 (b) (i) Which transformer, **A**, **B**, **C** or **D**, is a step-up transformer?

Transformer (1 mark)

1 (b) (ii) Which transformer, **A**, **B**, **C** or **D**, will supply homes, offices and shops?

Transformer (1 mark)

- 1 (c) Complete the following sentence by drawing a ring around the correct line in the box.

In a step-down transformer, the potential difference (p.d.) across the

primary coil is

less than
the same as
more than

 the p.d. across the secondary coil.

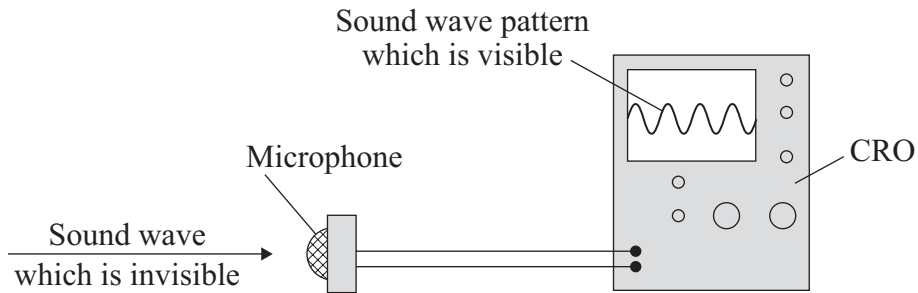
(1 mark)

4

Turn over for the next question

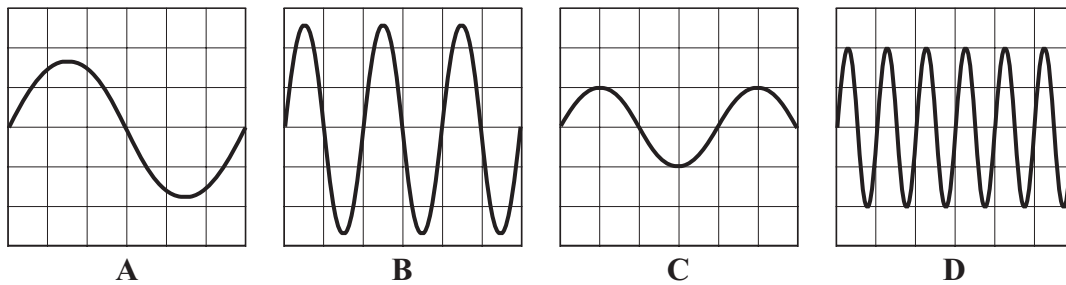
Turn over ►

- 2 A microphone and a cathode ray oscilloscope (CRO) can be used to show the pattern of a sound wave.



Four sound wave patterns, **A**, **B**, **C** and **D**, are shown.

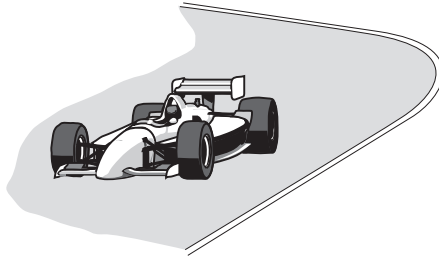
They are all drawn to the same scale.



- 2 (a) Which **one** of the patterns has the smallest amplitude?
- 2 (b) Which **one** of the patterns has the lowest frequency?

(2 marks)

- 3 (a) Complete the following sentence by drawing a ring around the correct line in the box.



A racing car can accelerate by changing

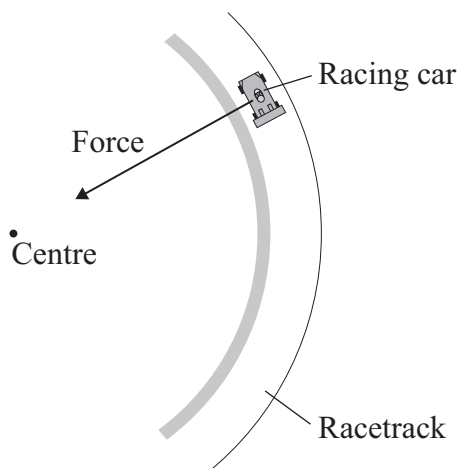
its direction only

its speed only

either its direction or its speed

(1 mark)

- 3 (b) A racing car moves round a circular part of a racetrack.



A force acts on the racing car. The force is towards the centre of the circular part of the racetrack.

Complete the following sentences by drawing a ring around the correct line in each of the boxes.

- 3 (b) (i) The force is caused by

electrostatics
friction
gravity

 .

(1 mark)

- 3 (b) (ii) The force is a

centripetal force
circular force
perpendicular force

 .

(1 mark)

- 3 (b) (iii) If another racing car has a greater mass and travels at the same speed

around the same racetrack, then the force will need to

- | |
|---------------|
| decrease |
| stay the same |
| increase |
- .

(1 mark)

- 3 (b) (iv) When the racing car goes faster, the force will need to

- | |
|---------------|
| decrease |
| stay the same |
| increase |
- .

(1 mark)

Question 3 continues on the next page

Turn over ►

- 3 (c) This is an item from a newspaper.

No to racetrack plan

At last night's meeting, one local resident said, "The racetrack will be noisy but motor racing leads to safety improvements in all our cars."

"We'll need better brakes. Motor racing encourages speeding and leads to more accidents", said another.

Most of the residents were against the plan to build a racetrack.

Do you agree with most of the residents?

Put a tick (✓) in the box next to your answer and explain.

Yes ☐ No ☐ Not sure ☐

.....

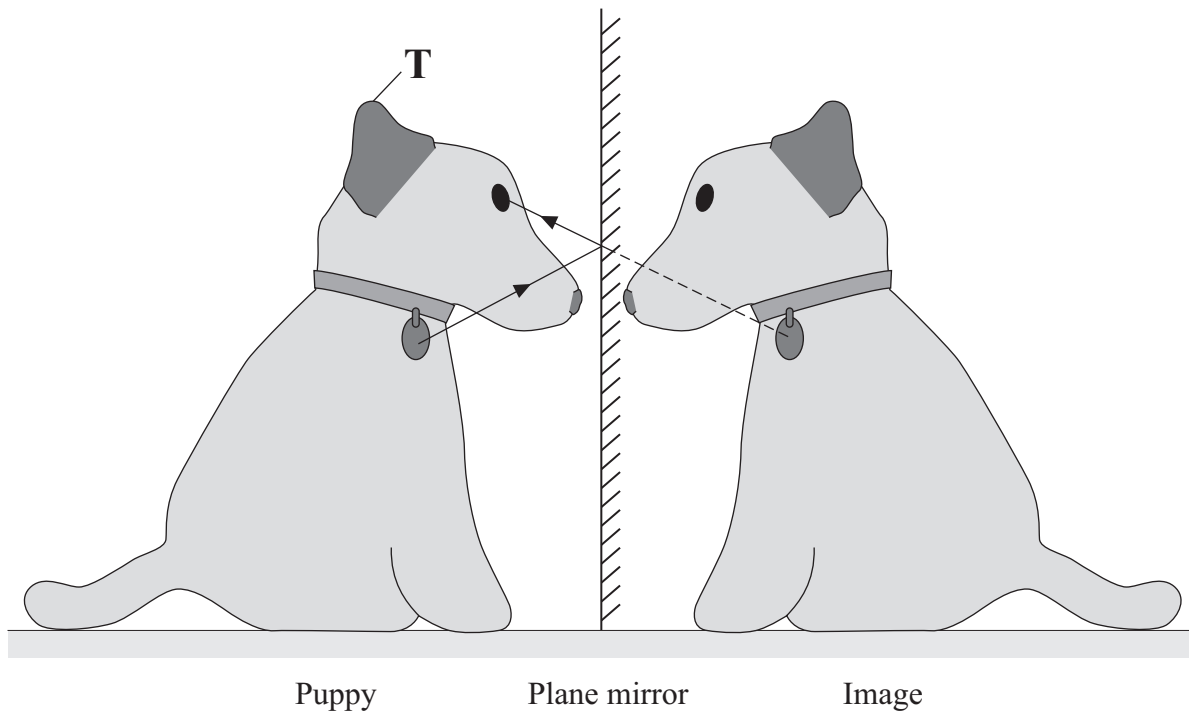
.....

.....

.....

(2 marks)

- 4 A puppy can see an image of himself in a plane mirror.



The diagram shows how the puppy can see his disc.

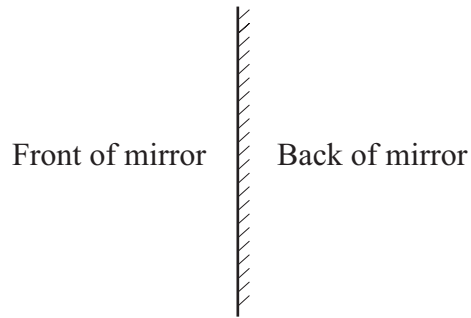
- 4 (a) On the diagram, use a ruler to draw a ray to show how the puppy can see the top of his ear, which is marked as **T**. (3 marks)

- 4 (b) What is a plane mirror?

.....

(1 mark)

- 4 (c) In the puppy diagram, a plane mirror is shown as follows.



Name the type of mirror shown in each of the following diagrams.

- 4 (c) (i)



This is a mirror.

(1 mark)

- 4 (c) (ii)



This is a mirror.

(1 mark)

- 5 (a) Choose the best words from the box to complete the following sentences.

billions	fission	friction	fusion	gases
gravity	liquids	millions	thousands	

- 5 (a) (i) Stars form when enough dust and from space are pulled together by
(2 marks)

- 5 (a) (ii) Stars are able to give out energy for millions of years by the process of
(1 mark)

- 5 (a) (iii) The Sun is one of many of stars in our galaxy.
(1 mark)

- 5 (b) What is the name of our galaxy?

.....
(1 mark)

6 Many electrical appliances use the circular motion produced by their electric motor.

6 (a) Put ticks (✓) in the boxes next to **all** the appliances in the list which have an electric motor.

electric drill

☐

electric fan

☐

electric food mixer

☐

electric iron

☐

electric kettle

☐

electric screwdriver

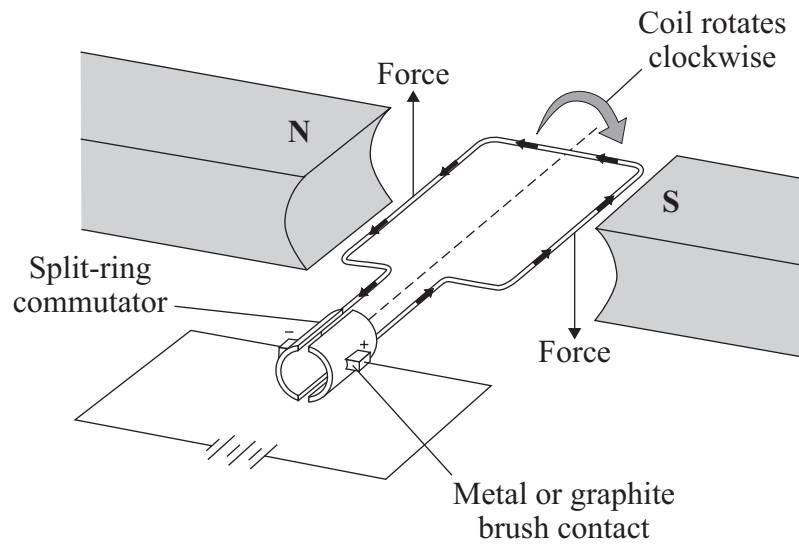
☐

(2 marks)

Question 6 continues on the next page

Turn over ►

- 6 (b) One simple design of an electric motor is shown in the diagram. It has a coil which spins between the ends of a magnet.



- 6 (b) (i) Give **two** ways of reversing the direction of the forces on the coil in the electric motor.

1

.....

2

.....

(2 marks)

- 6 (b) (ii) Give **two** ways of increasing the forces on the coil in the electric motor.

1

.....

2

.....

(2 marks)

- 7 (a) This information is from a science magazine.

Electronic systems can be used to produce ultrasonic waves.
These waves have a frequency higher than the upper limit for hearing in humans.

Complete the sentence by choosing the correct number from the box.

20	2000	20 000	200 000
----	------	--------	---------

The upper limit for hearing in humans is a frequency of Hz.
(1 mark)

- 7 (b) An electronic system produces ultrasound with a frequency of 500 kHz.

What does the symbol kHz stand for?

.....
(1 mark)

- 7 (c) (i) State **one** industrial use for ultrasound.

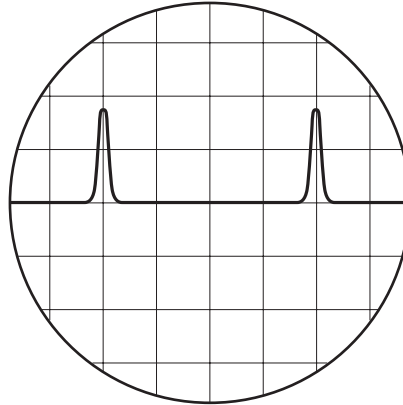
.....
(1 mark)

- 7 (c) (ii) State **one** medical use for ultrasound.

.....
(1 mark)

- 7 (d) An ultrasound detector is connected to an oscilloscope.

The diagram shows centimetre squares on an oscilloscope screen.
Each horizontal division represents 2 microseconds.



Calculate the time, in microseconds, between one peak of one ultrasound pulse and the peak of the next.

.....

Time = microseconds
(1 mark)

- 7 (e) Ultrasounds are partially reflected when they reach a boundary between two different media.

The time taken for the reflection from the boundary to reach the detector can be seen from the screen.

What can be calculated from this time interval?

.....

.....
(2 marks)

- 7 (f) Explain what action scientists should take if they find evidence that ultrasonic waves may be harmful to human health.

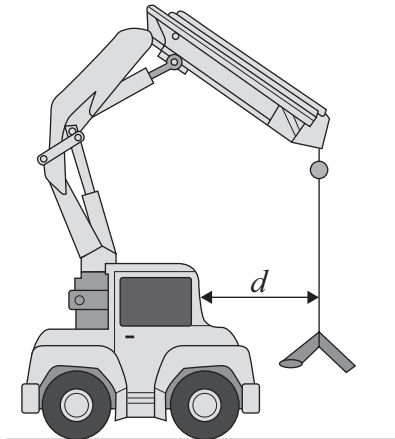
.....

.....

.....

(2 marks)

- 8 The diagram shows a small mobile crane. It is used on a building site.



The distance, d , is measured to the front of the cab.

The table shows information from the crane driver's handbook.

Load in kilonewtons (kN)	Maximum safe distance, d , in metres (m)
10	6.0
15	4.0
24	2.5
40	1.5
60	1.0

- 8 (a) What is the relationship between the load and the maximum safe distance?

.....

.....

.....

(2 marks)

- 8 (b) The crane driver studies the handbook and comes to the conclusion that a load of 30 kN would be safe at a distance, d , of 2.0 metres.

Is the driver correct?

Explain your answer.

.....

.....

.....

.....

(2 marks)

- 8 (c) What is the danger if the driver does not follow the safety instructions?

.....

.....

(1 mark)

- 8 (d) How should the data in the table have been obtained?

Put a tick (✓) in the box next to your answer.

average results from an opinion poll of mobile crane drivers

☐

copied from a handbook for a similar crane

☐

results of experiments on a model mobile crane

☐

results of experiments on this mobile crane

☐

(1 mark)

END OF QUESTIONS

Answer **all** questions in the spaces provided.

- 1 (a) This information is from a science magazine.

Electronic systems can be used to produce ultrasonic waves.
These waves have a frequency higher than the upper limit for hearing in humans.

Complete the sentence by choosing the correct number from the box.

20

2000

20 000

200 000

The upper limit for hearing in humans is a frequency of Hz.
(1 mark)

- 1 (b) An electronic system produces ultrasound with a frequency of 500 kHz.

What does the symbol kHz stand for?

.....
(1 mark)

- 1 (c) (i) State **one** industrial use for ultrasound.

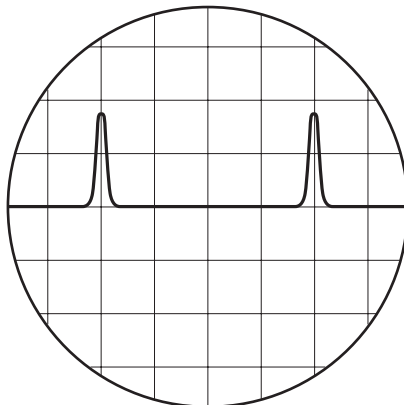
.....
(1 mark)

- 1 (c) (ii) State **one** medical use for ultrasound.

.....
(1 mark)

- 1 (d) An ultrasound detector is connected to an oscilloscope.

The diagram shows centimetre squares on an oscilloscope screen.
Each horizontal division represents 2 microseconds.



Calculate the time, in microseconds, between one peak of one ultrasound pulse and the peak of the next.

.....

Time = microseconds
(1 mark)

- 1 (e) Ultrasounds are partially reflected when they reach a boundary between two different media.

The time taken for the reflection from the boundary to reach the detector can be seen from the screen.

What can be calculated from this time interval?

.....

.....
(2 marks)

- 1 (f) Explain what action scientists should take if they find evidence that ultrasonic waves may be harmful to human health.

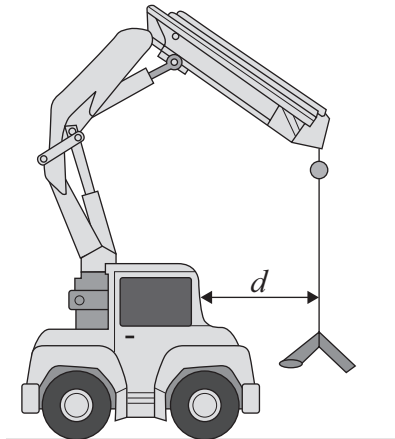
.....

.....

.....
(2 marks)

Turn over ►

- 2 The diagram shows a small mobile crane. It is used on a building site.



The distance, d , is measured to the front of the cab.

The table shows information from the crane driver's handbook.

Load in kilonewtons (kN)	Maximum safe distance, d , in metres (m)
10	6.0
15	4.0
24	2.5
40	1.5
60	1.0

- 2 (a) What is the relationship between the load and the maximum safe distance?

.....

.....

.....

(2 marks)

- 2 (b) The crane driver studies the handbook and comes to the conclusion that a load of 30 kN would be safe at a distance, d , of 2.0 metres.

Is the driver correct?

Explain your answer.

.....

.....

.....

.....

(2 marks)

- 2 (c) What is the danger if the driver does not follow the safety instructions?

.....

.....

(1 mark)

- 2 (d) How should the data in the table have been obtained?

Put a tick (✓) in the box next to your answer.

average results from an opinion poll of mobile crane drivers

☐

copied from a handbook for a similar crane

☐

results of experiments on a model mobile crane

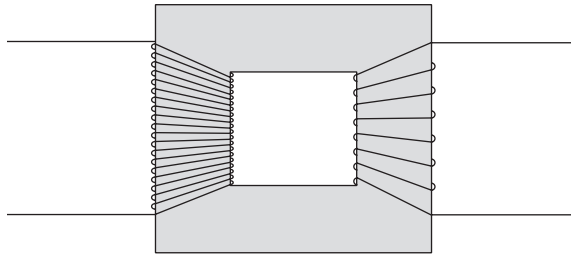
☐

results of experiments on this mobile crane

☐

(1 mark)

- 3 (a) The basic structure of a transformer is a primary coil of insulated wire, an iron core and a secondary coil of insulated wire.



- 3 (a) (i) Why is the core made of iron?

.....
.....
(1 mark)

- 3 (a) (ii) Explain how a transformer works.

.....
.....
.....
.....
.....
.....
.....
.....
(4 marks)

- 3 (b) A small step-down transformer is used in the charger for an electric screwdriver.

The input to the transformer is 230 V a.c. mains supply and the output is 5.75 V a.c.
There are 3200 turns on the primary coil.

Use the equation in the box to calculate the number of turns on the transformer's secondary coil.

$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$

Show clearly how you work out your answer.

.....

Number of turns =
 (2 marks)

7

Turn over for the next question

Turn over ►

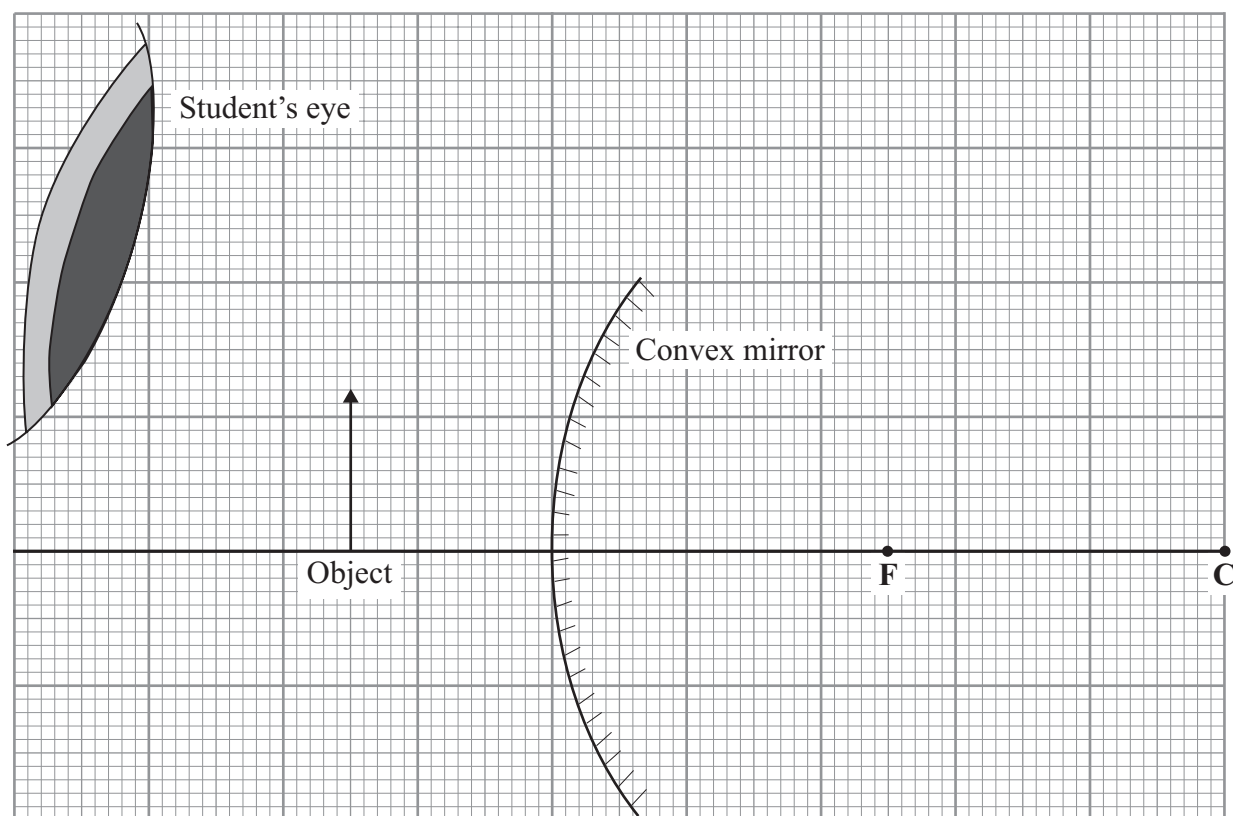
- 4 A student investigates the formation of images by a convex mirror.

In the mirror, she can see the image of an object placed in front of the mirror.

In the diagram, **F** is the principal focus of the mirror and **C** is the centre of curvature of the mirror.

- 4 (a) On the diagram, use a ruler to draw **two** rays from the top of the object which show the position of the image and how the student sees the image.

Mark the direction of the rays at each stage.



(4 marks)

- 4 (b) The image is a virtual image.

How can you tell from the rays you have drawn on the diagram that the image is a virtual image?

.....

.....

(1 mark)

5 The table gives data on the Solar System.

Name of planet	Average distance from the Sun in millions of kilometres	Average orbital speed in kilometres per second
Mercury	60	48
Venus	108	35
Earth	150	30
Mars	228	24
Jupiter	778	13
Saturn	1430	9.6
Uranus	2860	6.8

5 (a) A student studies this data and comes to the following conclusion.

For the planets in the table, the average orbital speed is very nearly inversely proportional to the planet's average distance from the Sun.

5 (a) (i) This conclusion is **not** correct.

Use the data for Saturn and Uranus to explain how the student's conclusion is not correct.

.....

.....

.....

.....

(2 marks)

- 5 (a) (ii) For all the listed planets, write a correct conclusion for the connection between the average distance from the Sun and the orbital speed.

.....

.....

.....

.....

(2 marks)

- 5 (b) The student knows the following:

The planets all move in ellipses (slightly squashed circles).

What is the connection between this statement and the headings in the table?

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

Turn over ►

6 This page is from a science magazine.

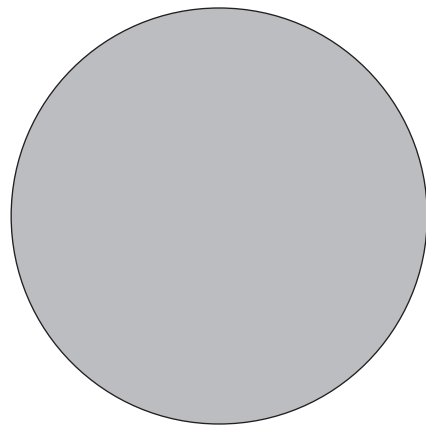
The Red Planet

The two natural satellites, or moons, of Mars are Phobos (fear) and Deimos (terror). They are named after the horses which pulled the chariot of Mars, the god of war in the mythology of Ancient Greece.

Phobos takes less than eight hours to orbit Mars and gets slightly closer every time it does so. Scientists predict that in about 100 million years time it will either be ripped apart by the gravitational force or will crash onto the surface of Mars.

● Deimos

● Phobos



Not to scale

- 6 (a) Suggest how scientists have arrived at their prediction of about 100 million years.

.....

.....

.....

.....

(2 marks)

- 6 (b) The centripetal force on Phobos is gradually changing as it orbits Mars.

Is the force increasing or decreasing?

.....

Explain your answer.

.....

.....

.....

(2 marks)

- 6 (c) Scientists expect that the mass of Mars and the mass of Phobos will not increase.

Explain what will happen to the gravitational force on Phobos as it orbits Mars.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

Turn over ►

- 7 Read this statement from a website.

Immediately after the 'big bang', at the start of the Universe, there were only atoms of the element hydrogen (H).

Now the Universe contains atoms of over one hundred elements.

- 7 (a) Explain how atoms of the element helium (He) are formed in a star.

.....

.....

.....

.....

(2 marks)

- 7 (b) Explain how atoms of very heavy elements, such as gold (Au), were formed.

.....

.....

.....

.....

(2 marks)

- 7 (c) Explain how, and when, atoms of different elements may be distributed throughout the Universe.

.....

.....

.....

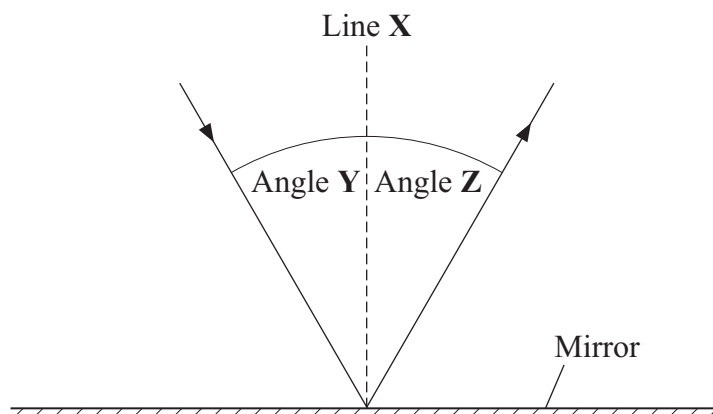
.....

(2 marks)

END OF QUESTIONS

Answer **all** questions in the spaces provided.

- 1 (a) The following diagram shows a ray of light which is reflected by a mirror.



- 1 (a) (i) Use **one** word from the box to complete the sentence.

concave	convex	plane
---------	--------	-------

The mirror is a mirror.
(1 mark)

- 1 (a) (ii) Complete the sentence.

Line X is a vertical line at right angles to the mirror and is called the

.....

(1 mark)

Complete the following sentences by drawing a ring around the correct line in each box.

- 1 (a) (iii) Angle **Y** is called the angle of

incidence
reflection
refraction

.

(1 mark)

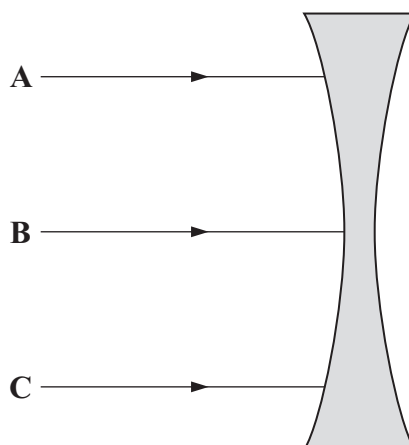
- 1 (a) (iv) If angle **Y** is doubled, then angle **Z** will

be halved
stay the same
be doubled

.

(1 mark)

- 1 (b) The following diagram shows the side view of a lens and three parallel rays of light, **A**, **B** and **C**.



- 1 (b) (i) Use **one** word from the box to complete the sentence.

converging	diverging	plane
------------	-----------	-------

The diagram shows a lens.

(1 mark)

- 1 (b) (ii) Add to the diagram to show what will happen to **each** of the three rays of light, **A**, **B** and **C**.

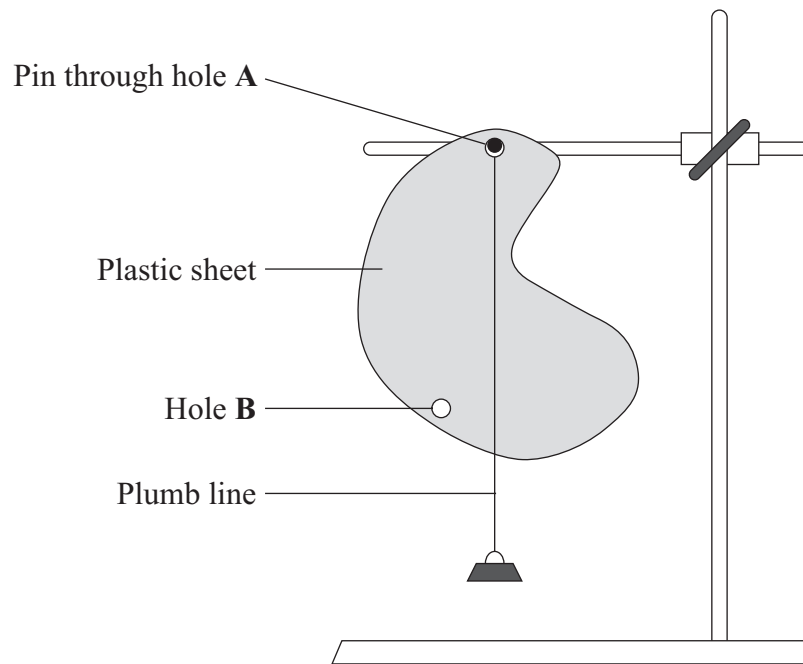
(2 marks)

- 2 The diagram shows how a student can find the centre of mass of a thin flat sheet of plastic.

Part of his equipment is a plumb line. This is a weight fastened to one end of a piece of string.

He hangs the sheet and the plumb line from a pin through hole A.

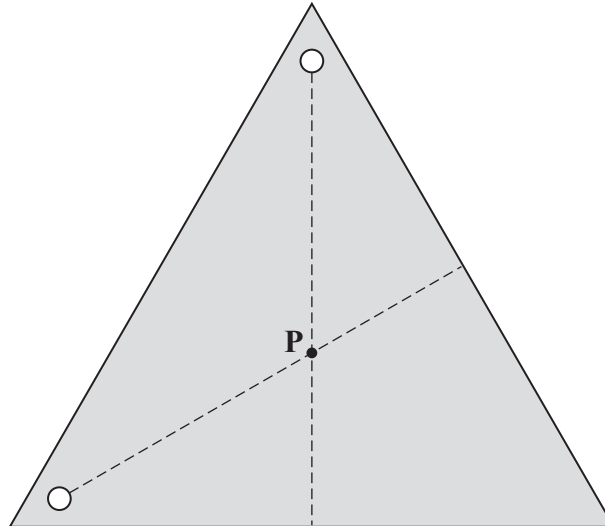
- 2 (a) Mark an **X** on the diagram so that the centre of the **X** marks the likely position of the centre of mass of the plastic sheet.



(1 mark)

- 2 (b) The dashed lines on the diagram below show the position of the plumb line from each hole when the student uses a different plastic sheet.

Point **P** is on both the dashed lines.



Complete the following sentence by drawing a ring around the correct line in the box.

Point **P** shows the

axis
centre of mass
moment
symmetry

of the plastic sheet.

(1 mark)

- 2 (c) Complete the following sentence by drawing a ring around the correct word in the box.

A plumb line always hangs so that it is

curved
horizontal
parallel
vertical

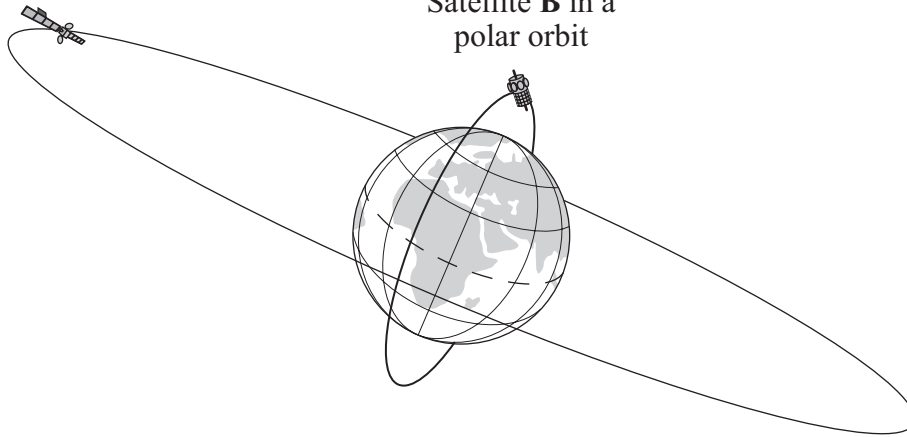
(1 mark)

- 3 The diagram shows two satellites orbiting the Earth.

Both satellites have the same mass.

Satellite **A** in a
geostationary orbit

Satellite **B** in a
polar orbit



- 3 (a) Complete the following sentences by drawing a ring around the correct line in each box.

- 3 (a) (i) The time taken for one orbit by satellite **A** is

less than
the same as
greater than

 the time taken for one orbit by satellite **B**.

(1 mark)

- 3 (a) (ii) The force of attraction between the Earth and satellite **A** is

less than
the same as
greater than

 the force of attraction between the Earth and satellite **B**.

(1 mark)

- 3 (a) (iii) The gravitational force of attraction between the Earth and a satellite

provides a

centripetal
cosmic
friction

force.

(1 mark)

- 3 (a) (iv) The time taken for satellite A to complete one orbit is

24 hours
1 week
1 month
1 year

(1 mark)

- 3 (b) Use phrases from the box to complete the sentences.

geostationary orbit

high polar orbit

low polar orbit

- 3 (b) (i) Communications satellites are usually put in a
(1 mark)

- 3 (b) (ii) Monitoring satellites are usually put in a
(1 mark)

Turn over for the next question

Turn over ►

- 4 (a) The table gives information about the frequencies in the hearing ranges of six different mammals.

Name of mammal	Frequencies in hearing range
Bat	20 Hz → 160 kHz
Dog	20 Hz → 30 kHz
Dolphin	40 Hz → 110 kHz
Elephant	5 Hz → 10 kHz
Human	20 Hz → 20 kHz
Tiger	30 Hz → 50 kHz

- 4 (a) (i) Which mammal in the table can hear the highest frequency?

.....
(1 mark)

- 4 (a) (ii) Which mammal in the table, apart from humans, **cannot** hear ultrasound?

.....
(1 mark)

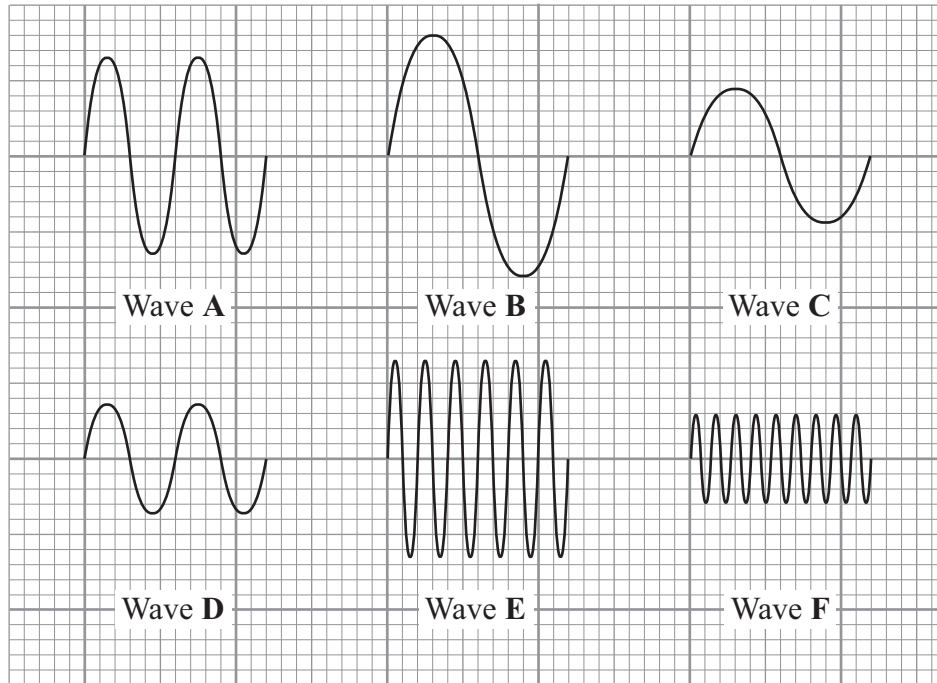
- 4 (a) (iii) Give **one** example of a frequency which an elephant can hear but which a tiger **cannot** hear.

Include the unit in your answer.

Frequency
(1 mark)

- 4 (b) The diagrams show six sound waves, **A**, **B**, **C**, **D**, **E** and **F**, represented on an oscilloscope screen.

They are all drawn to the same scale.



- 4 (b) (i) Which **one** of the waves has the greatest amplitude?

Wave
(1 mark)

- 4 (b) (ii) Which **one** of the waves has the highest frequency?

Wave
(1 mark)

Turn over for the next question

Turn over ►

5 (a) Complete the following sentences by drawing a ring around the correct word in each box.

5 (a) (i) Stars form when enough dust and gas from space is pulled together

by

centripetal
gravitational
magnetic

 attraction.

(1 mark)

5 (a) (ii) Stars give out energy for millions of years by their nuclei

burning
joining
splitting

 .

(1 mark)

5 (a) (iii) When gravitational forces balance radiation pressure, a star is

shrinking
stable
swelling

 .

(1 mark)

5 (b) The Universe is made up of billions of galaxies.

5 (b) (i) What is a galaxy?

.....

.....

(1 mark)

5 (b) (ii) Name the galaxy which contains the Sun.

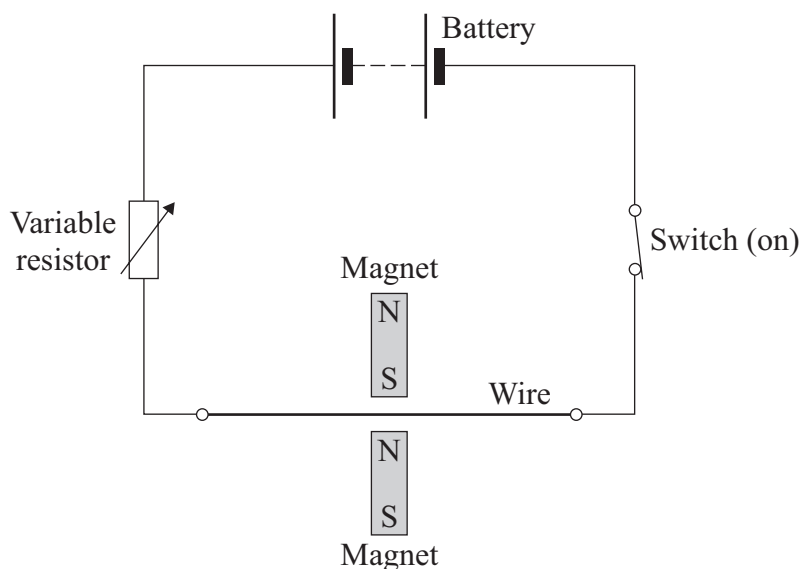
.....

(1 mark)

- 6 A student investigates the electromagnetic force acting on a wire which carries an electric current. The wire is in a magnetic field.

The diagram shows the circuit which the student uses.

- 6 (a) Draw an **X** on the diagram, with the centre of the **X** in the most strongest part of the magnetic field.



(1 mark)

- 6 (b) Give **one** change that she can make to the magnets to **decrease** the electromagnetic force on the wire.

.....

(1 mark)

- 6 (c) The student wants to change the electromagnetic force on the wire without changing the magnets or moving their position.

- 6 (c) (i) Give **one** way in which she can **increase** the electromagnetic force.

.....

(1 mark)

- 6 (c) (ii) Give **one** way in which she can **reverse** the direction of the electromagnetic force.

.....

(1 mark)

- 7 A student collects data from the Internet about planets in the solar system. She arranges the data into a table.

Name of the planet	Distance from the Sun in millions of kilometres	Time taken for one orbit of the Sun in years	Time taken to spin on its axis in hours	Average temperature on the side facing the Sun in °C
Mercury	60	0.24	1400	+430
Venus	110	0.60	5800	+470
Earth	150	1	24	+20
Mars	230	2	25	-20
Jupiter	780	12	10	-150
Saturn	1400	30	10	-180
Uranus	2900	84	17	-220
Neptune	4500	160	16	-230

- 7 (a) Name the **two** variables in the student's table which **always** have the relationship:

As one increases, so does the other.

..... and
(1 mark)

- 7 (b) (i) Give an example of **two** variables in the student's table which **generally** have the relationship:

As one increases, the other decreases.

..... and
(1 mark)

- 7 (b) (ii) Which piece of data does not seem to fit the relationship in (b)(i)?

.....
(1 mark)

- 7 (c) Scientists plan to launch a satellite which will orbit Mars above its equator. It will be a geostationary satellite.

How many hours will it take to orbit Mars?

..... hours
(1 mark)

- 7 (d) Mars has two moons.

Neither of them is in a geostationary orbit and they both take different times to orbit the planet.

Which **one** of these statements is correct.
Put a tick (✓) in the box next to your answer.

The two moons will always be above the same point on the surface of Mars.

☐

The two moons will be in different positions at different times.

☐

You can never see both moons at the same time.

☐

(1 mark)

- 7 (e) Use words from the box to complete the **three** spaces in the passage.

circular	direction	friction	gravitational	speed	universal
----------	-----------	----------	---------------	-------	-----------

The moons of the planet Neptune move in circular paths around the planet.

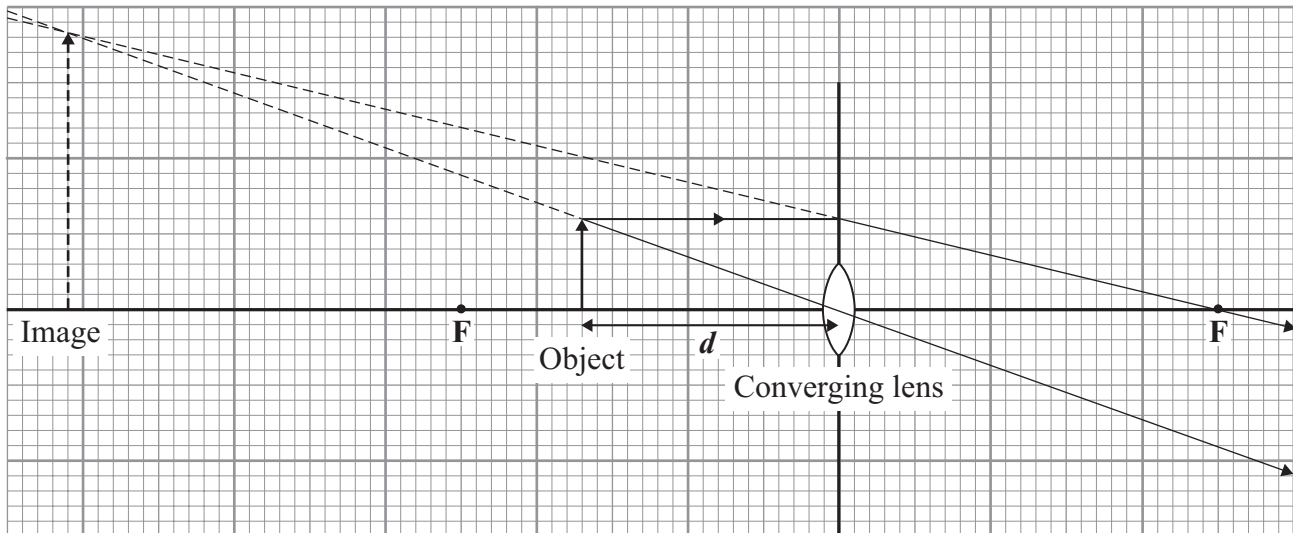
They continuously accelerate towards the centre of Neptune.

The acceleration changes the of each moon but does not change its The force causing the acceleration is a force.

(2 marks)

- 8 A student investigates how the magnification of an object changes at different distances from a converging lens.

The diagram shows an object at distance d from a converging lens.



- 8 (a) (i) The height of the object and the height of its image are drawn to scale.

Use the equation in the box to calculate the magnification produced by the lens shown in the diagram.

$\text{magnification} = \frac{\text{image height}}{\text{object height}}$

Show clearly how you work out your answer.

.....

.....

.....

Magnification =
(2 marks)

- 8 (a) (ii) The points **F** are at equal distances on either side of the centre of the lens.

State the name of these points.

.....
(1 mark)

- 8** (a) (iii) Explain how you can tell, **from the diagram**, that the image is virtual.

.....

.....

(1 mark)

Question 8 continues on the next page

Turn over ►

- 8 (b) The student now uses a different converging lens. He places the object between the lens and point **F** on the left.

The table shows the set of results that he gets for the distance d and for the magnification produced.

Distance d measured in cm	Magnification
5	1.2
10	1.5
15	2.0
20	3.0
25	6.0

His friend looks at the table and observes that when the distance doubles from 10 cm to 20 cm, the magnification doubles from 1.5 to 3.0.

His friend's conclusion is that:

The magnification is directly proportional to the distance of the object from the lens.

His friend's observation is correct but his friend's conclusion is **not** correct.

- 8 (b) (i) Explain, with an example, why his friend's conclusion is **not** correct.

.....

.....

.....

.....

(2 marks)

- 8 (b) (ii) Write a correct conclusion.

.....

.....

(1 mark)

- 8 (b) (iii) The maximum range of measurements for d is from the centre of the lens to **F** on the left.

The student **cannot** make a correct conclusion outside this range.

Explain why.

.....

.....

(1 mark)

8

END OF QUESTIONS