AQA

GCSE PHYSICS

H

Higher Tier Paper 2H

Specimen 2018 Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a calculator
- a protractor
- the Physics Equation sheet (enclosed).

Instructions

- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- There are 100 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Advice

- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname

Forename(s)

Candidate signature _____

0 1 In 1929, the astronomer Edwin Hubble observed that the light from galaxies moving away from the Earth had longer wavelengths than expected.

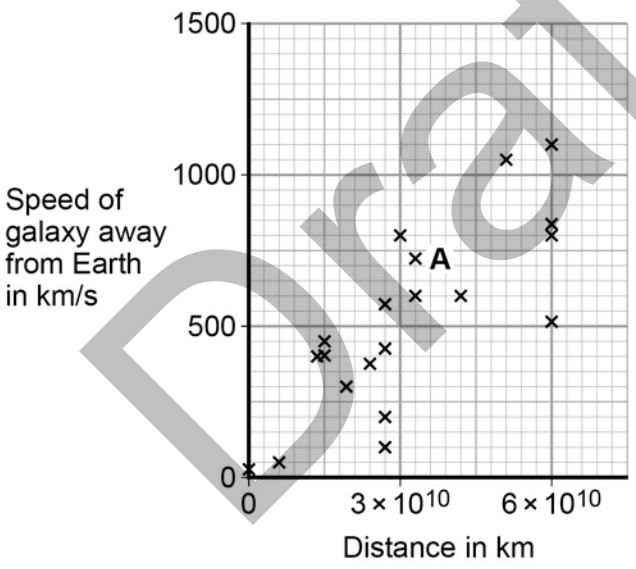
0 1 . 1 What name is given to this effect?

[1 mark]

0 1 . 2 From his observations Hubble was able to calculate the speed of a galaxy and the distance of the galaxy from the Earth.

Figure 1 shows the results of Hubble's calculations.

Figure 1



What relationship between the speed of a galaxy and the distance is suggested by Hubble's results?

[1 mark]

0 1 . 3 One of the galaxies in **Figure 1** has been labelled **A**.

Identify a galaxy in **Figure 1** for which the observed wavelengths of light would be longer than the equivalent wavelengths of light observed from galaxy **A**.

Label this galaxy **B**.

[1 mark]

The observations made by Hubble support the idea that the Universe is expanding. This means that galaxies are continually moving away from each other and from the Earth.

Figure 2 shows a student using a balloon to model the idea of an expanding Universe.

Some dots, which represent galaxies, were marked on the balloon.
The balloon was then inflated.

Figure 2

0 1 . 4 Give **one** strength and **one** weakness of this model in representing the idea of an expanding Universe.

[2 marks]

strength

weakness

In the 1950s there were two main theories to explain how the Universe began.

Theory 1	The Universe has always existed, it is continually expanding. New galaxies are formed as older galaxies die out.
Theory 2	The Universe began from a very small region that was extremely hot and dense. The Universe has been expanding ever since.

0 1 . 5 What is the name is given to Theory 2?

[1 mark]

0 1 . 6 In what way do the observations made by Hubble support both Theory 1 and Theory 2?

[1 mark]

0 1 . 7 Most scientists now believe that Theory 2 is correct.

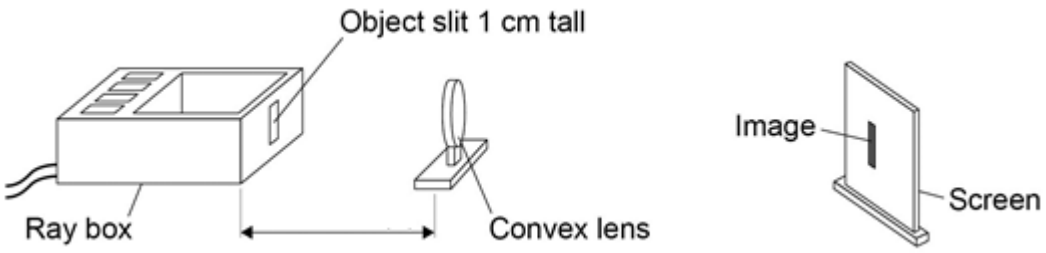
Suggest what is likely to have caused scientists to start thinking Theory 1 is wrong.

[1 mark]

0 2 A student investigated how the magnification produced by a convex lens varies with the distance (*d*) between the object and the lens.

The student used the apparatus shown in **Figure 3**.

Figure 3



The student placed the lens at a measured distance in front of the object.

The student then moved the screen until a sharp image of the object was focused on the screen.

The student repeated this for different values of distance.

0 2 . 1 To measure the magnification produced by the lens, the student measured the height of the image in centimetres.

Explain why in this particular investigation the height of the image in centimetres equals the magnification.

[2 marks]

The data recorded by the student is given in **Table 1**.

Table 1

Distance between the object and the lens in cm	Magnification
25	4.0
30	2.0
40	1.0
50	0.7
60	0.5

0 2 . 2 What does it mean when an image has a magnification value of 0.5?

[1 mark]

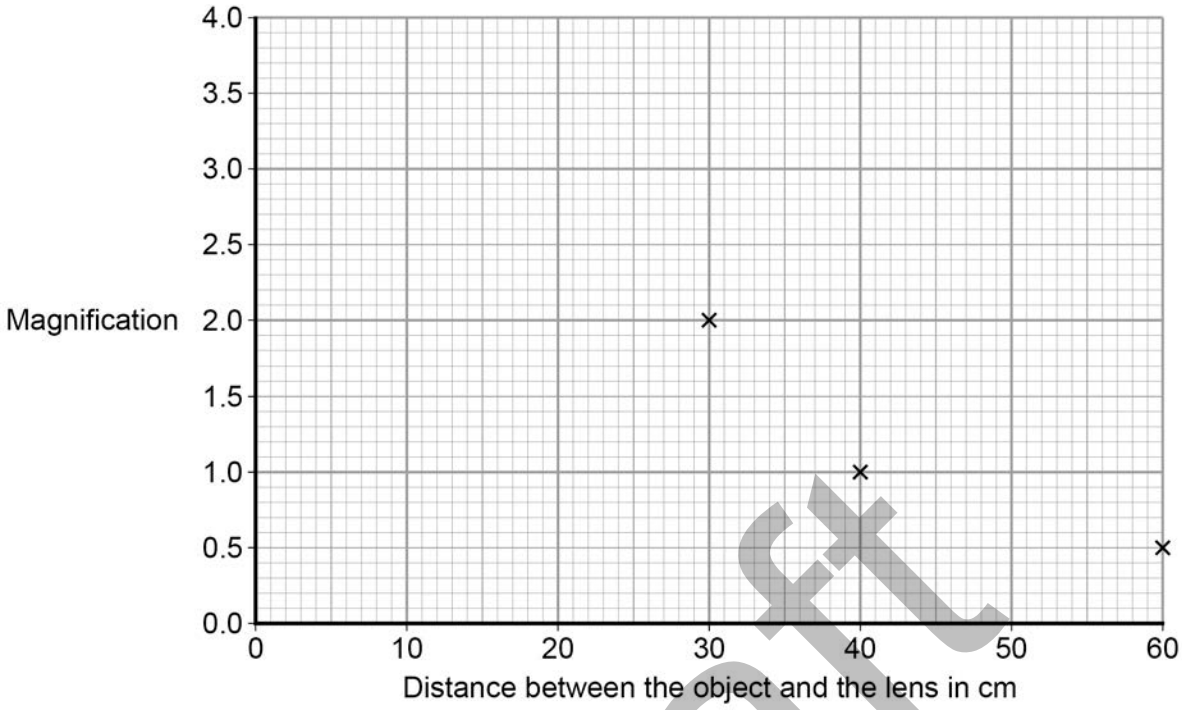
0 2 . 3 It would be difficult to obtain accurate magnification values for distances greater than 60 cm as the image is very small.

Suggest **one** change that could be made so that accurate magnification values could be obtained for distances greater than 60 cm.

[1 mark]

The graph in **Figure 4** is incomplete.

Figure 4



0 2 . 4 Complete the graph in **Figure 4** by plotting the missing data and then drawing a line of best fit.

[2 marks]

0 2 . 5 What conclusion can be made from the student's data?

[2 marks]

Question 2 continues on the next page

0 2 . 6 During the investigation the student also measured the distance between the lens and the image.

Table 2 gives both of the distances measured and the magnification.

Table 2

Distance between the lens and the image in cm	Distance between the lens and the object in cm	Magnification
100	25	4.0
60	30	2.0
40	40	1.0
33	50	0.7
30	60	0.5

Consider the data in **Table 2**.

Give a second way that the student could have determined the magnification of the object.

Justify your answer with a calculation.

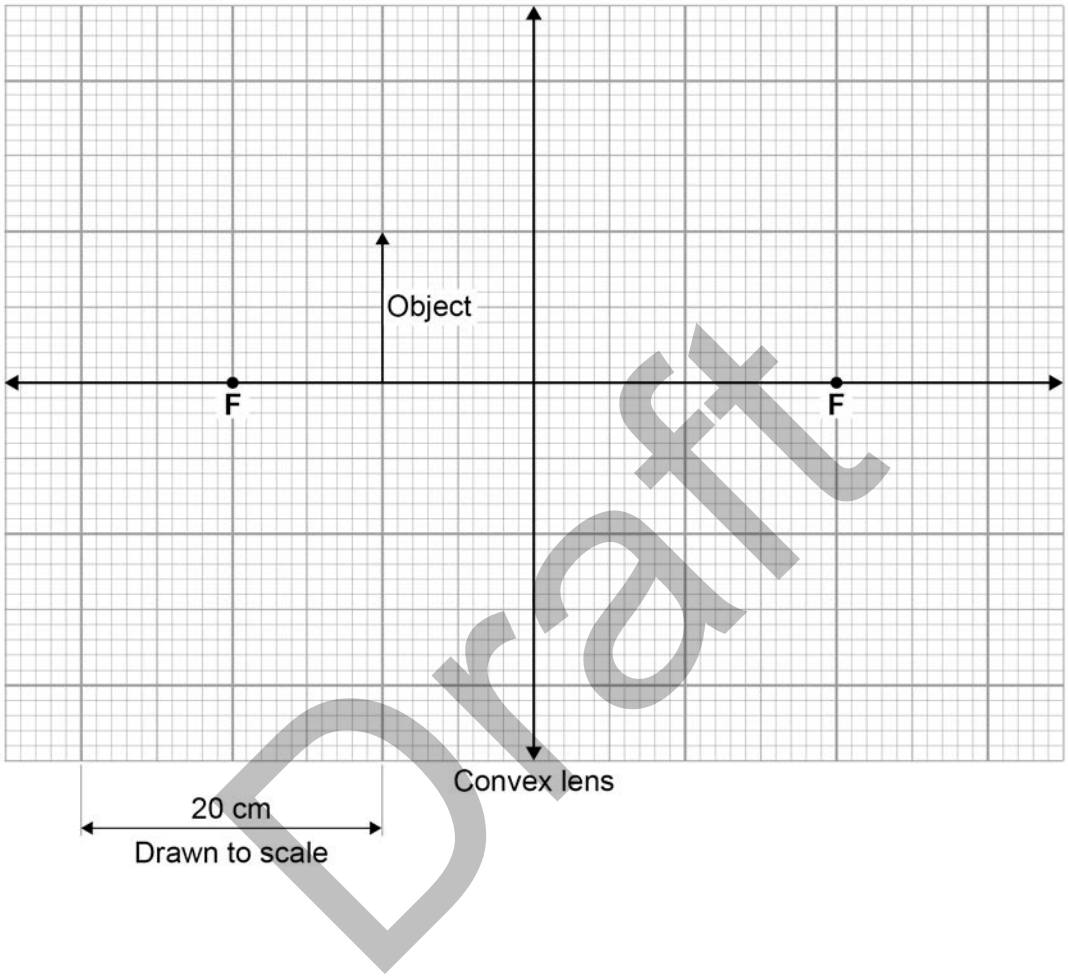
[2 marks]

0 2 . 7 Complete the ray diagram in **Figure 5** to show how the convex lens produces the image of a close object.

Use an arrow to represent the image.

[3 marks]

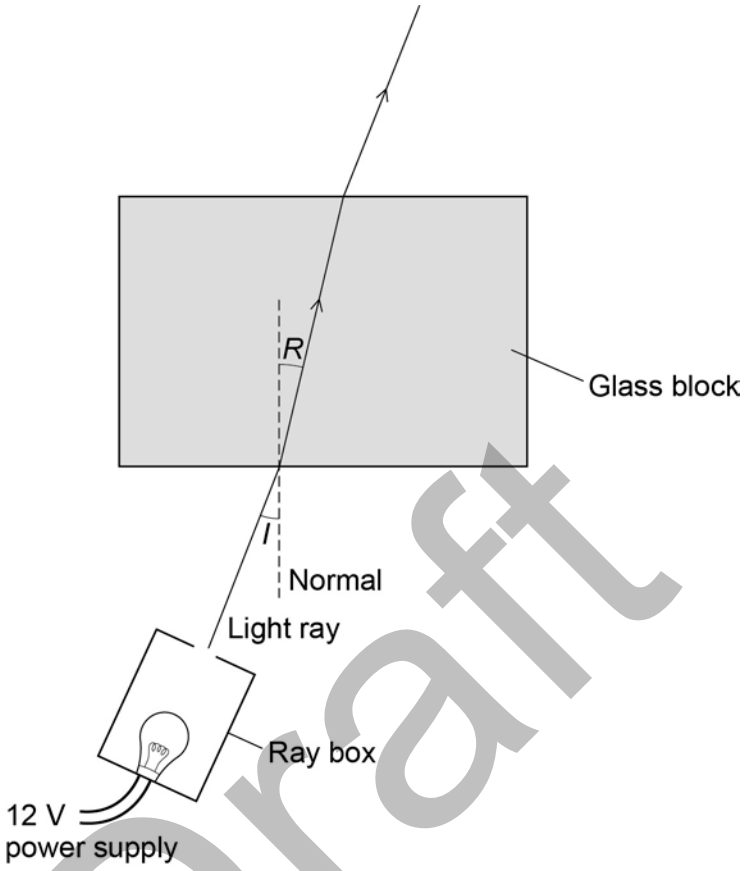
Figure 5



Turn over for the next question

0 3 **Figure 6** shows the apparatus used to investigate how light changes direction when it enters a glass block.

Figure 6



The data given in **Table 3** was obtained by varying the angle ***I***.

Table 3

Angle *I*	**Angle *R***
20^o	13^o
30^o	19^o
40^o	25^o
50^o	30^o

0 3 . 1 Describe how the apparatus shown in **Figure 6** would be used to obtain the data given in **Table 3**.

[6 marks]

0 3 . 2 The ray of light from the ray box is often quite wide.

Suggest **one** reason why the width of the light ray may cause an error in the values recorded for angle ***I*** and angle ***R***.

[1 mark]

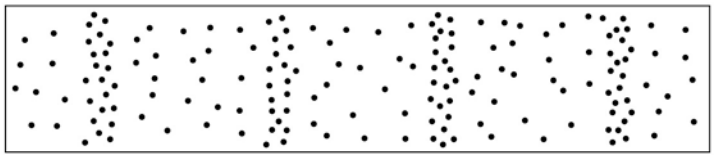
0 3 . 3 State why the light changes direction when it enters the glass block.

[1 mark]

Turn over for the next question

0 4 **Figure 7** shows the pattern of compressions and rarefactions formed by air molecules as a sound wave passes through the air.

Figure 7



0 4 . 1 Mark with the letter **R**, one part of the pattern that shows a rarefaction.

[1 mark]

0 4 . 2 What, approximately, is the speed of sound through air?

Tick **one** box.

[1 mark]

330 m/s ☐

33 000 m/s ☐

300 000 m/s ☐

300 000 000 m/s ☐

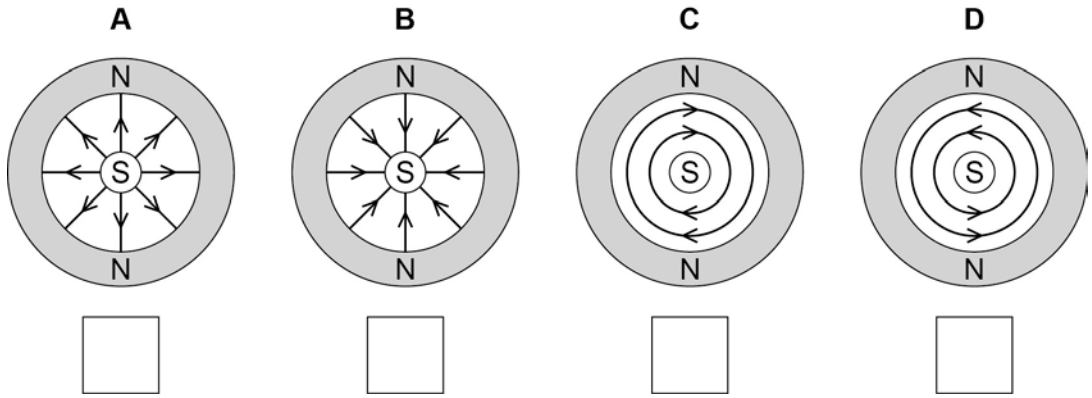
0 4 . 3 A loudspeaker contains a cylindrical magnet.

Which one of the diagrams in **Figure 8**, **A**, **B**, **C** or **D**, shows the magnetic field pattern of the magnet?

Tick **one** box.

[1 mark]

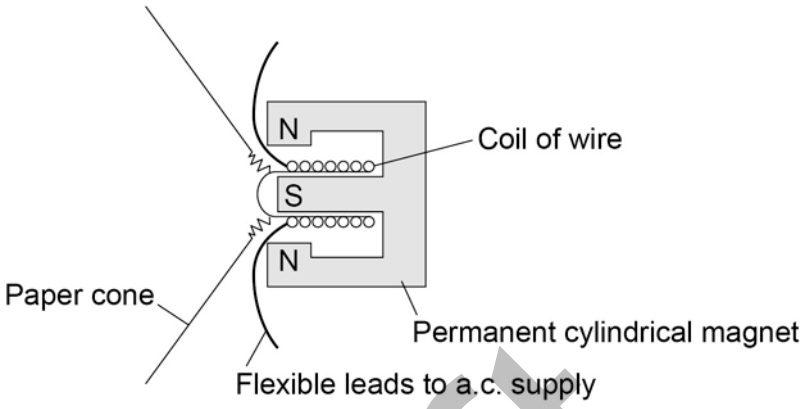
Figure 8



0 4 . 4 **Figure 9** shows the parts of a loudspeaker.

A coil of wire is positioned in the gap between the north and south poles of the cylindrical magnet.

Figure 9



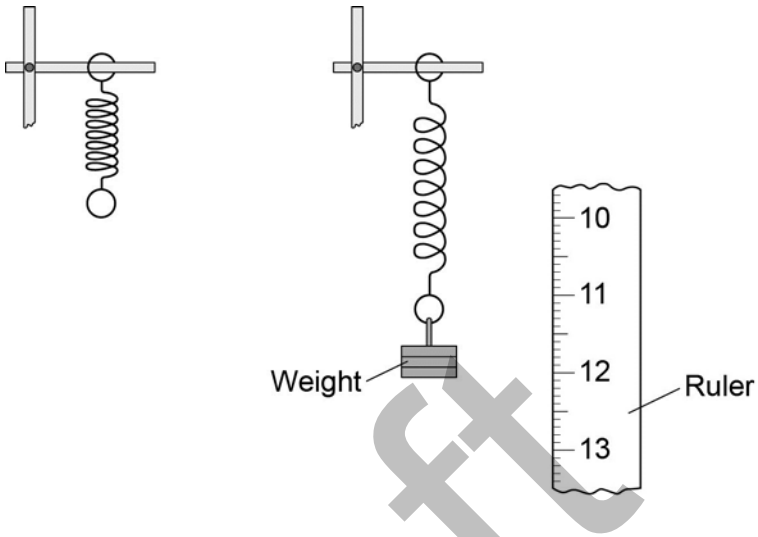
Explain how passing an alternating current through the coil creates a sound wave.

[4 marks]

0 5 A student suspended a spring from a laboratory stand and then hung a weight from the spring.

Figure 10 shows the spring before and after the weight is added.

Figure 10



0 5 . 1 Measure the extension of the spring shown in **Figure 10**.

[1 mark]

Extension = _____ mm

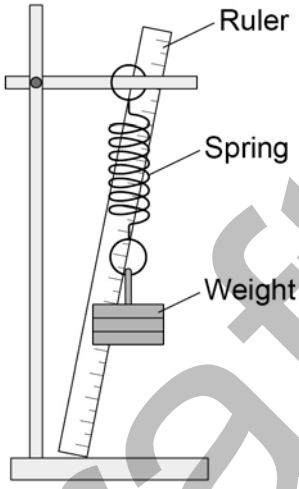
The student used the spring, a set of weights and a ruler to investigate how the extension of the spring depended on the weight hanging from the spring.

Before starting the investigation the student wrote the following prediction:

The extension of the spring will be directly proportional to the weight hanging from the spring.

Figure 11 shows how the student arranged the apparatus.

Figure 11



0 5 . 2 Before taking any measurements, the student adjusted the ruler to make it vertical.

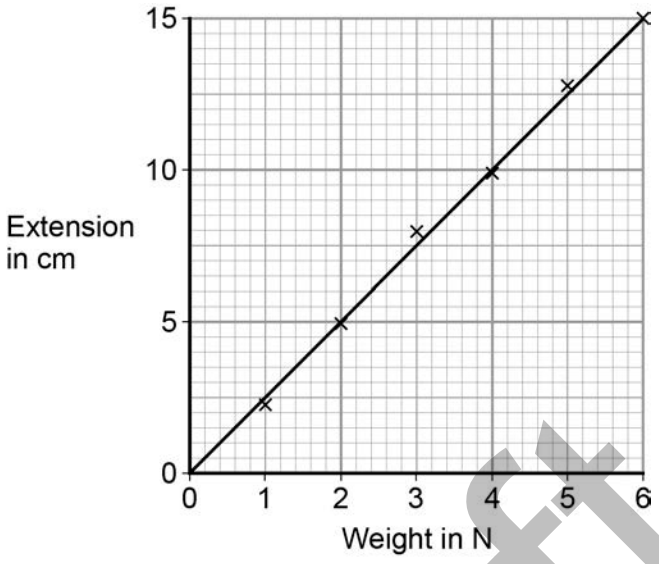
Explain why adjusting the ruler was important.

[2 marks]

The student measured the extension of the spring using a range of weights.

The student's data is shown plotted as a graph in **Figure 12**.

Figure 12



0 5 . 3 What range of weight did the student use?

[1 mark]

0 5 . 4 Why does the data plotted in **Figure 12** support the student's prediction?

[1 mark]

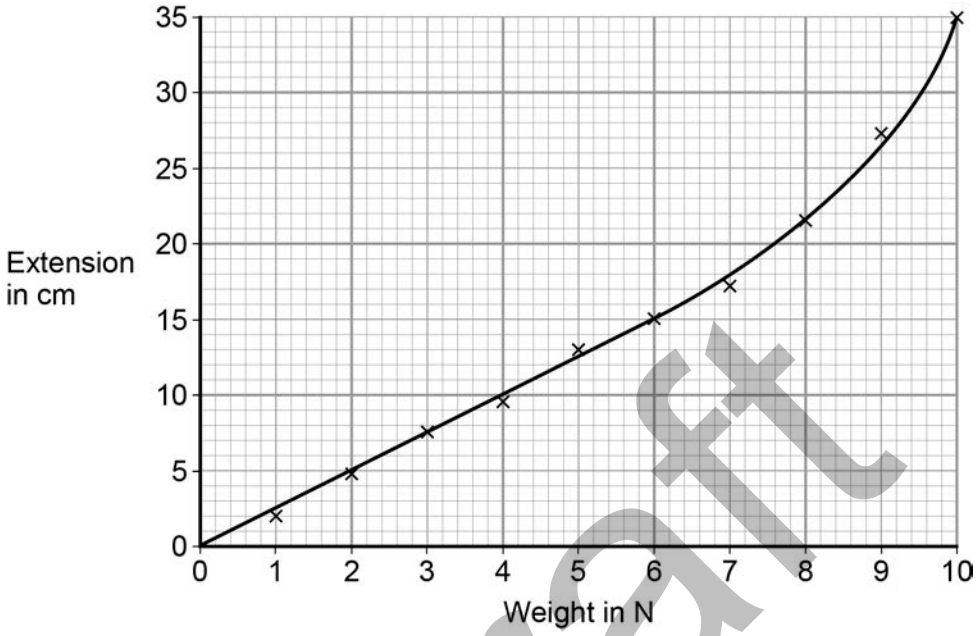
0 5 . 5 Describe **one** technique that you could have used to improve the accuracy of the measurements taken by the student.

[2 marks]

0 5 . 6 The student continued the investigation by increasing the range of weights added to the spring.

All of the data is shown plotted as a graph in **Figure 13**.

Figure 13



At the end of the investigation all of the weights were removed from the spring.

What can you conclude from **Figure 13** about the length of the spring after all of the weights were removed, compared to the length of the spring before the investigation started?

[2 marks]

Give the reason for your conclusion.

0 6 In 2011 some of the scientists working at the CERN particle laboratory published the results of experiments they had conducted over the previous three years.

The scientists said that the results had shown that a particle, called a neutrino, was able to travel faster than the speed of light.

These unexpected results challenged the physics theory that nothing can travel faster than the speed of light.

0 6 . 1 Suggest why most other scientists thought that the experimental results were unbelievable.

[1 mark]

0 6 . 2 The scientists at CERN believed their results were correct but could not explain them.

Suggest **two** reasons why the scientists decided to publish their results.

[2 marks]

1

2

0 6 . 3 The experiments conducted by the scientists involved measuring the time it took neutrinos to travel from CERN to another laboratory 730 km away.

Using the data, the speed of the neutrinos was calculated to be 300 007 400 m/s.

Write down the equation which links distance, speed and time.

Calculate the time it would take the neutrinos to travel 730 km at a speed of 300 007 400 m/s.

[4 marks]

Time = _____ s

In 2012 the scientists found that the unexpected results were caused by a timing error.

The error meant that the time recorded was always 60 nanoseconds less than the actual time.

0 6 . 4 Which **one** of the following is the same as 60 nanoseconds?

Tick **one** box.

[1 mark]

60×10^{-3} s ☐

60×10^{-6} s ☐

60×10^{-9} s ☐

0 6 . 5 What name is given to the type of error made by the scientists?

[1 mark]

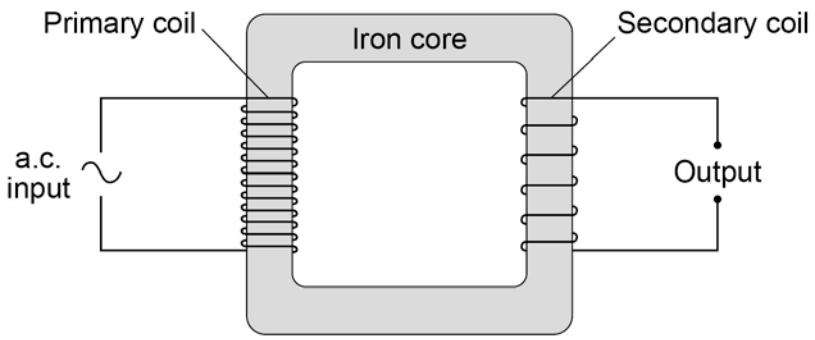
0 6 . 6 Suggest what the scientists should do to calculate an accurate value for the speed of a neutrino.

[1 mark]

Turn over for the next question

0 7 **Figure 14** shows the construction of a simple transformer.

Figure 14



0 7 . 1 Why is iron a suitable material for the core of a transformer?

[1 mark]

Tick **one** box.

It is a metal. ☐

It will not get hot. ☐

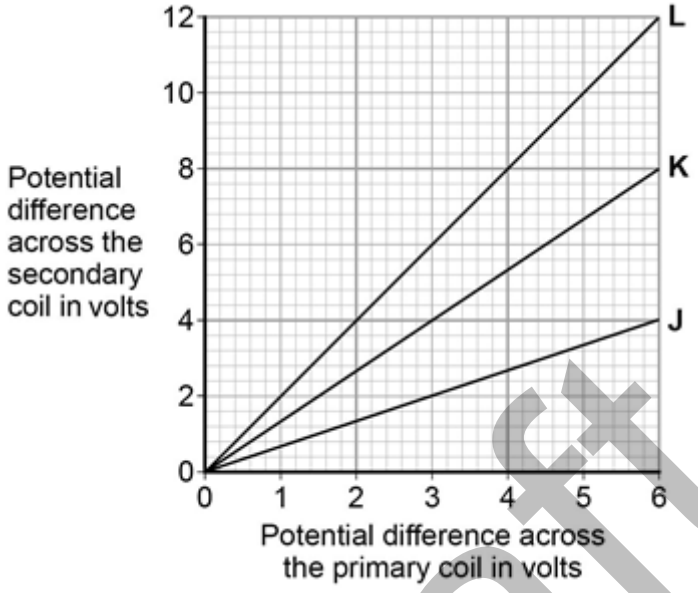
It is easily magnetised. ☐

It is an electrical conductor. ☐

A student makes three simple transformers, **J**, **K** and **L**.

Figure 15 shows how the potential difference across the secondary coil of each transformer varies as the potential difference across the primary coil of each transformer is changed.

Figure 15



0 7 . 2 Transformer **J** is a step-down transformer.

Give a reason why.

[1 mark]

0 7 . 3 Each of the transformers has 50 turns on the primary coil.

Calculate the number of turns on the secondary coil of transformer **L**.

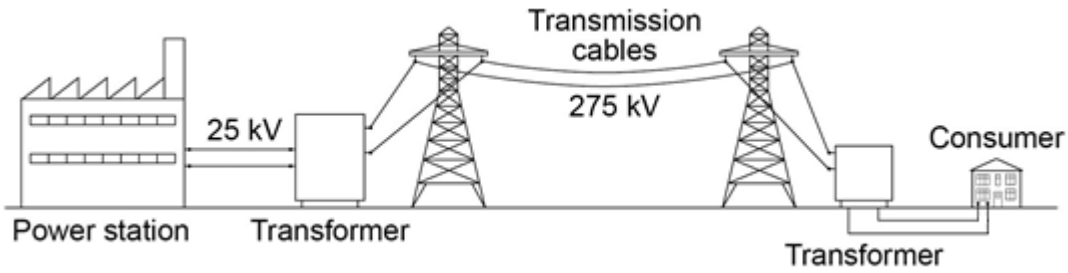
Use the correct equation from the Physics Equation Sheet.

[3 marks]

Number of turns on the secondary coil = _____

0 7 . 4 **Figure 16** shows the National Grid system.

Figure 16



Explain the advantage of transmitting electrical power through the transmission cables at 275 kV rather than at the 25 kV output of the power station.

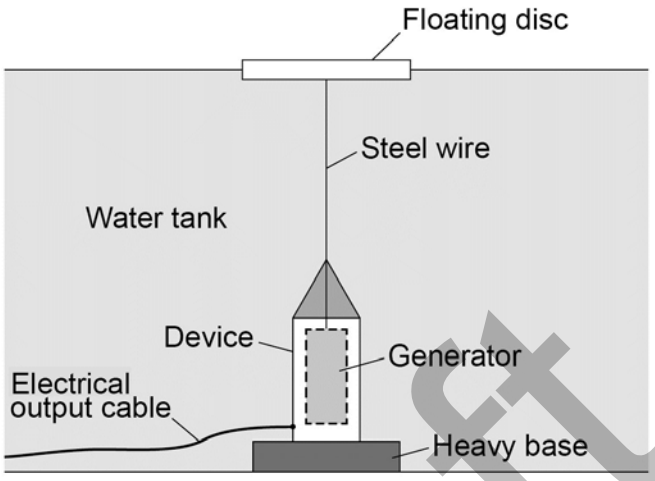
To gain full marks your answer should include a calculation.

[4 marks]

0 8 Scientists have designed a device to generate electricity using the up and down motion of passing water waves.

Figure 17 shows a small prototype model of the device being tested in a large tank of water fitted with a wave generator.

Figure 17



0 8 . 1 In one test, the floating disc takes 2 s to move up, down and then back to its original position.

What is the frequency of the wave that caused the movement of the disc?

Tick **one** box.

[1 mark]

0.5 Hz ☐

1.0 Hz ☐

2.0 Hz ☐

5.0 Hz ☐

0 8 . 2 Suggest **one** advantage of testing a prototype model before building a full size device.

[1 mark]

0 8 . 3 The scientists can also test the design of the device using a computer simulation.

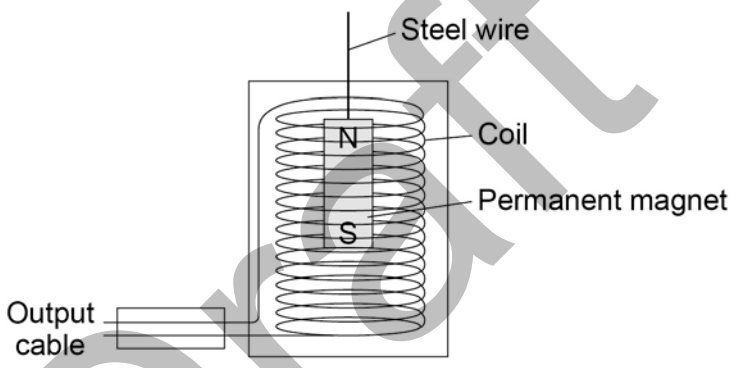
The simulation works using data collected from ocean waves.

Suggest **one** advantage of using a computer simulation rather than a prototype model to test the design of the device.

[1 mark]

0 8 . 4 **Figure 18** shows the basic construction of the generator inside the device.

Figure 18



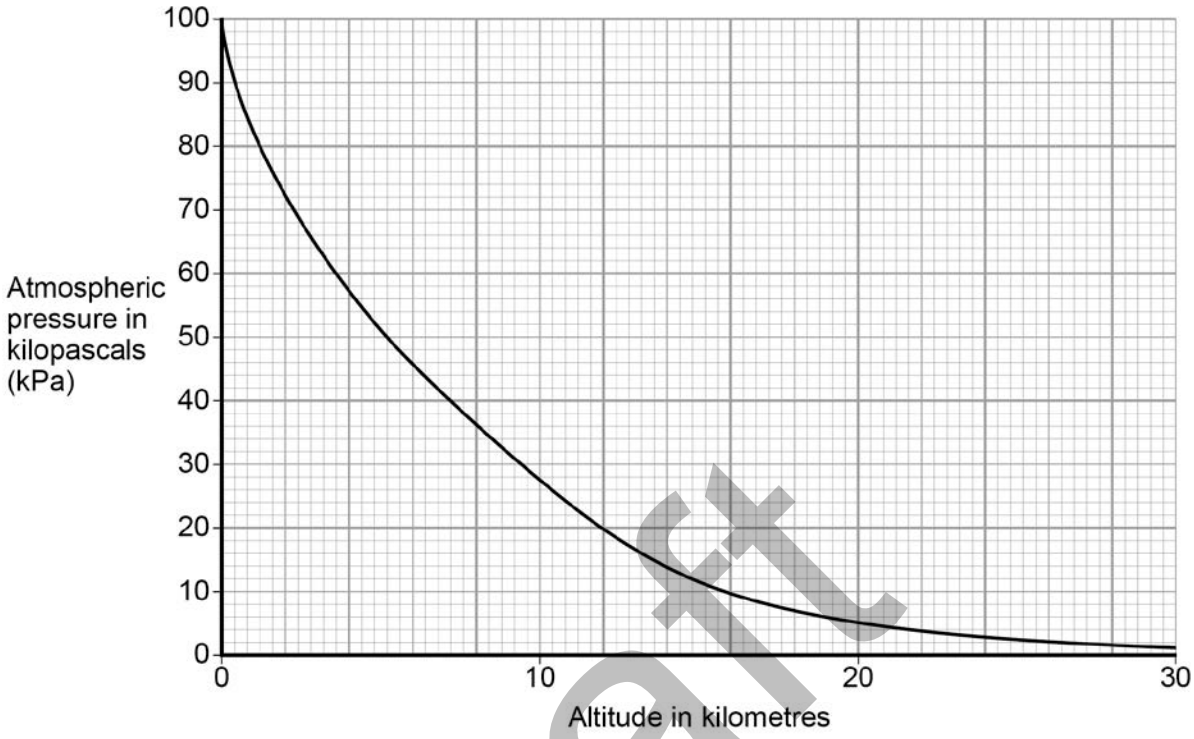
Explain how the up and down movement of the floating disc generates an electric current in the coil.

[3 marks]

Turn over for the next question

0 9 **Figure 19** shows how atmospheric pressure varies with altitude.

Figure 19



0 9 . 1 Explain why atmospheric pressure decreases with increasing altitude.

[3 marks]

0 9 . 2 When flying, the pressure inside the cabin of an aircraft is kept at 70 kPa.

The aircraft window has an area of 900 cm^2.

Write down the equation which links area, force and pressure.

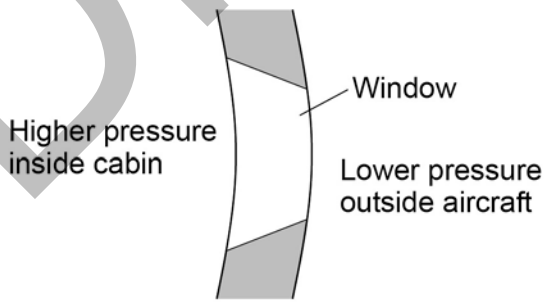
Use data from **Figure 19** to calculate the resultant force acting on an aircraft window when the aircraft is flying at an altitude of 12 km.

[5 marks]

Resultant force = _____ N

0 9 . 3 **Figure 20** shows the cross-section of one type of aircraft window.

Figure 20



Explain why the window has been designed to have this shape.

[2 marks]

1 0 The stopping distance of a car is the sum of the thinking distance and the braking distance.

Table 4 shows how the thinking distance and braking distance vary with speed.

Table 4

Speed in m/s	Thinking distance in m	Braking distance in m
10	6	6.0
15	9	13.5
20	12	24.0
25	15	37.5
30	18	54.0

1 0 . 1 What is meant by the braking distance of a vehicle?

[1 mark]

Tick **one** box.

The time it takes a vehicle to stop once the brakes are applied. ☐

The distance a vehicle travels after the driver realises the need to stop. ☐

The time taken for the driver to react to an emergency. ☐

The distance taken to stop once the vehicles brakes are applied. ☐

1 0 . 2 The data in **Table 3** refers to a car in good mechanical condition driven by an alert driver.

Explain why the stopping distance of the car increases if the driver is very tired.

[2 marks]

1 0 . 3 The relationship between the speed of the car and the thinking distance can be written as:

$$\text{thinking distance} \propto \text{speed}$$

Explain how the data in **Table 4** shows that the relationship is correct.

To gain full marks your answer must include a calculation.

[2 marks]

Applying the brakes with too much force can cause a car to skid.

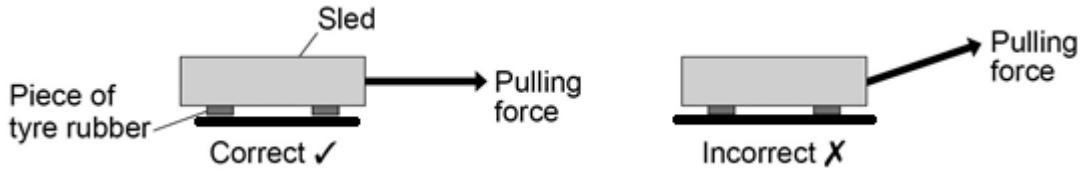
The distance a car skids before stopping depends on the friction between the road surface and the car tyres and also the speed of the car.

Friction can be investigated by pulling a device called a 'sled' across a surface at constant speed.

Figure 21 shows a sled being pulled correctly and incorrectly across a surface.

The constant of friction for the surface is calculated from the value of the force pulling the sled and the weight of the sled.

Figure 21



1 0 . 4 Why is it important that the sled is pulled at a constant speed?

[1 mark]

Tick **one** box.

If the sled accelerates it will be difficult to control. ☐

If the sled accelerates the value for the constant of friction will be wrong. ☐

If the sled accelerates the normal contact force will change. ☐

1 0 . 5 If the sled is pulled at an angle to the surface the value calculated for the constant of friction would not be appropriate.

Explain why.

[2 marks]

1 0 . 6 By measuring the length of the skid marks, an accident investigator determines that the distance a car travelled between the brakes being applied and stopping was 22 m.

The investigator used a sled to determine the friction. The investigator then calculated that the car decelerated at 7.2 m/s^2.

Calculate the speed of the car just before the brakes were applied.

Give your answer to two significant figures.

Use the correct equation from the Physics Equation Sheet.

[3 marks]

Speed = _____ m/s

1 0 . 7 In the accident report the investigator wrote that the calculated speed of the car had an uncertainty of ±10%.

Calculate the maximum speed that the car could have been travelling.

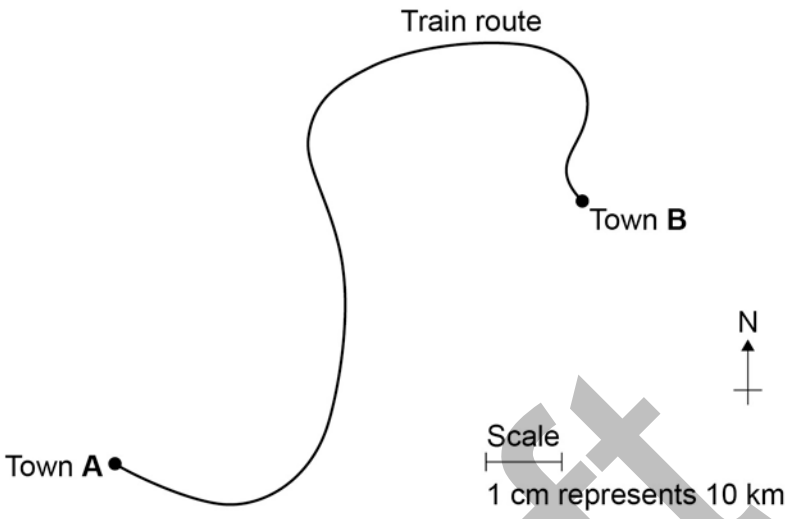
[1 mark]

Maximum speed = _____ m/s

1 1 A train travels from town **A** to town **B**.

Figure 22 shows the route taken by the train
Figure 22 has been drawn to scale.

Figure 22



1 1 . 1 The distance the train travels between **A** and **B** is not the same as the displacement of the train.

What is the difference between distance and displacement?

[1 mark]

1 1 . 2 Use **Figure 21** to determine the displacement of the train in travelling from **A** to **B**.

Show how you obtain your answer.

[2 marks]

Displacement = _____ km

Direction = _____

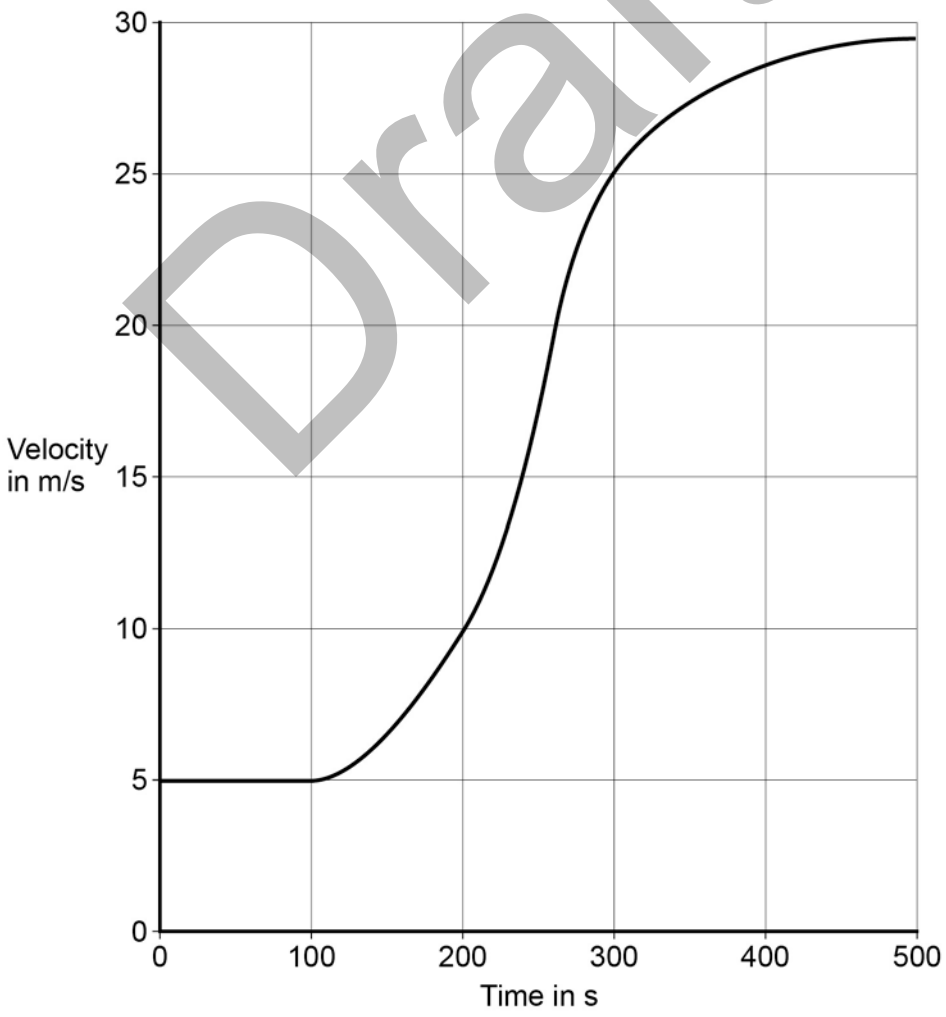
1 1 . 3 There are places on the journey where the train accelerates without changing speed.

Explain how this can happen.

[2 marks]

1 1 . 4 **Figure 23** shows how the velocity of the train changes with time as the train travels along a straight section of the journey.

Figure 23



Estimate the distance travelled by the train along the section of the journey shown in **Figure 23**.

To gain full marks you must show how you worked out your answer.

[3 marks]

Distance = _____ m

END OF QUESTIONS