AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname ____________________

Forename(s) ____________________

Candidate signature ____________________
I declare this is my own work.

GCSE PHYSICS

H

Higher Tier   Paper 2

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- a protractor
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

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

0 1 The thinking distance and braking distance for a car vary with the speed of the car.

0 1 . 1 Explain the effect of **two** other factors on the **braking** distance of a car.

Do **not** refer to speed in your answer.

[4 marks]

One factor is a wet or icy road surface, because this decreases friction.

Another factor is more passengers, meaning an increase in the mass of the car. This increases the kinetic energy of the car, so more work has to be done to stop the increased momentum of the car.

Question 1 continues on the next page

Do not write outside the box

0 1 . 2 Which equation links acceleration (a), mass (m) and resultant force (F).

[1 mark]

Tick (✓) **one** box.

resultant force = mass × acceleration	✓
resultant force = mass × acceleration^2	☐
resultant force = $\frac{\text{mass}}{\text{acceleration}^2}$	☐
resultant force = $\frac{\text{mass}}{\text{acceleration}}$	☐

0 1 . 3 The mean braking force on a car is 7200 N.

The car has a mass of 1600 kg.

Calculate the deceleration of the car.

[3 marks]

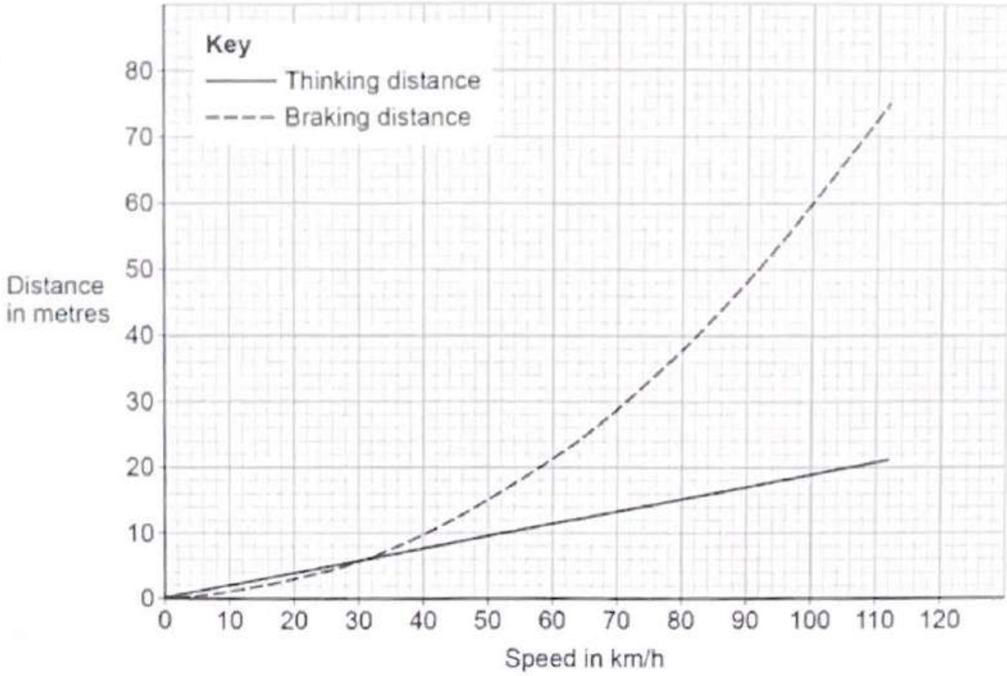
$F = ma$

$7200 = 1600 \times a$ $a = \frac{7200}{1600} = 4.5 \text{ m/s}^2$

Deceleration = 4.5 m/s^2

0 1 . 4 **Figure 1** shows how the thinking distance and braking distance for a car vary with the speed of the car.

Figure 1



Determine the stopping distance when the car is travelling at 80 km/h.

[2 marks]

stopping distance = Thinking distance + breaking distance

Stopping distance = 15 + 38 = 53 m

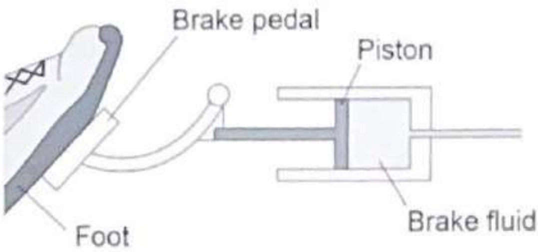
Stopping distance = 53 m

Question 1 continues on the next page

Turn over ▶

Figure 2 shows part of the braking system for a car.

Figure 2



0 1 . 5 Which equation links area of a surface (A), the force normal to that surface (F) and pressure (p).

[1 mark]

Tick (✓) **one** box.

$p = F \times A$ ☐

$p = F \times A^2$ ☐

$p = \frac{F}{A}$ ☑

$p = \frac{A}{F}$ ☐

0 1 . 6 When the brake pedal is pressed, a force of 60 N is applied to the piston.

The pressure in the brake fluid is 120 000 Pa.

Calculate the surface area of the piston.

Give your answer in standard form.

Give the unit.

[5 marks]

~~Force = pressure / Area~~ ~~Force = P / A~~

Pressure = Force / Area Pressure = Force / area $p = \frac{F}{A}$

$120\,000 = \frac{60}{A}$ $A = \frac{60}{120\,000} = 0.0005\ m^2$

Surface area (in standard form) = 5×10^{-4} Unit m^2

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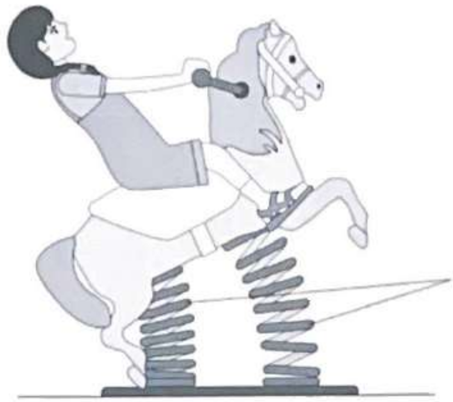
Turn over for the next question

Turn over ▶

0 2 **Figure 3** shows a child on a playground toy.

Figure 3



0 2 . 1 The springs have been elastically deformed.

Explain what is meant by 'elastically deformed'.

[2 marks]

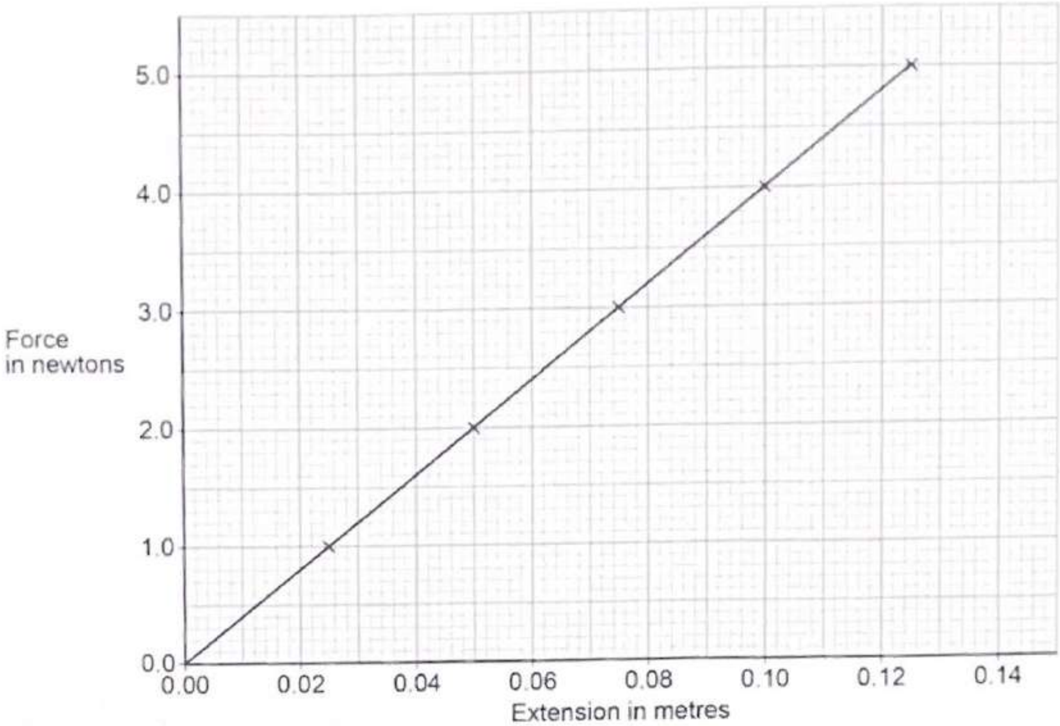
Elastically deformed means the object will return to it's original shape or length when the applied force is remaved.

Question 2 continues on the next page

A student investigated the relationship between the force applied to a spring and the extension of the spring.

Figure 4 shows the results.

Figure 4



0 2 . 2 Describe a method the student could use to obtain the results given in **Figure 4**.

You should include a risk assessment for **one** hazard in the investigation.

Your answer may include a diagram.

[6 marks]

Set up a clamp stand with a clamp, and hang the spring from the clamp, as shown in the diagram. Use a second clamp to fix a half metre ruler along side the spring. Measure the original length of the spring. Hang a 1 N weight from the bottom of the spring and measure the new position of the spring. Use this and the springs original length to calculate extension. Repeat this process, increasing the weights by 1 N, up to 5 N. plot your results.
Risk Assessment: Hazard could be the spring breaking Risk is it could damage your eyes. As a precaution, wear safety goggles.

Question 2 continues on the next page

0 2 . 3 Which equation links extension (e), force (F) and spring constant (k).

[1 mark]

Tick (✓) **one** box.

force = spring constant × (extension)^2 ☐

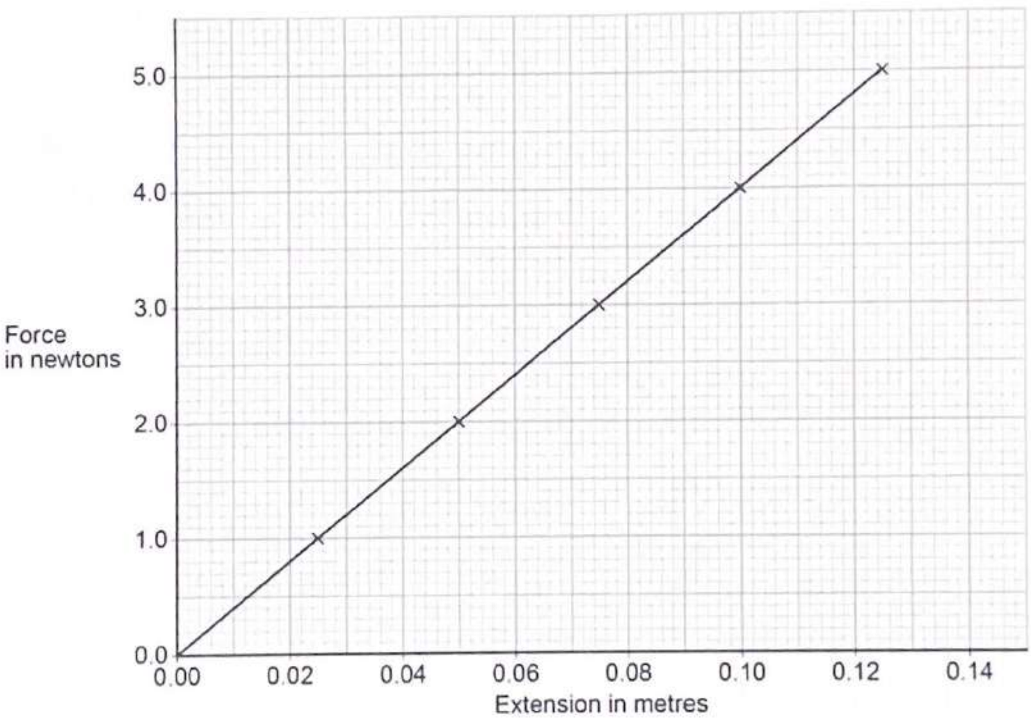
force = spring constant × extension ☑

force = $\frac{\text{extension}}{\text{spring constant}}$ ☐

force = $\frac{\text{spring constant}}{\text{extension}}$ ☐

Figure 4 is repeated below.

Figure 4



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0 2 . 4 Determine the spring constant of the spring.

Use **Figure 4**.

[3 marks]

Force = Spring Constant x extension

Using the graph: Force = 5N Extension = 0.125 m

$k = \frac{5.00}{0.125}$ k = 40 N/m

Spring constant = 40 N/m

0 2 . 5 The student concluded:

'The extension of the spring is directly proportional to the force applied to the spring.'

Describe how **Figure 4** supports the student's conclusion.

[2 marks]

Because the line is straight, and passes through the origin.

Question 2 continues on the next page

0 2 . 6 The student repeated the investigation using a different spring with a spring constant of 13 N/m.

Calculate the elastic potential energy of the spring when the extension of the spring was 20 cm.

Use the Physics Equations Sheet.

[3 marks]

$E_e = \frac{1}{2} k e^2$ $\quad e = 0.20\ m$

$k = 13\ N/m$

$E_e = 0.5 \times 13 \times 0.20^2$

$E_e = 0.26\ J$

Elastic potential energy = 0.26 J

17

0 3 A main sequence star in a distant galaxy is the same size and mass as the Sun.

0 3 . 1 Explain why the star is stable while it is in the main sequence stage of its life cycle.

[2 marks]

The gravitational force inwards and forces as a result of fusion reactions outwards are in equilibrum.

0 3 . 2 Describe what will happen to the star between the main sequence stage and the end of the star's life cycle.

You should include the names of the stages in the life cycle of the star.

[3 marks]

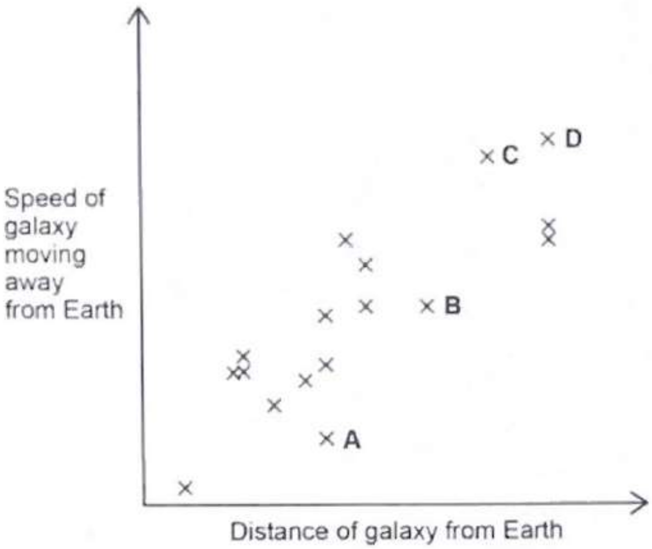
The Star will expand to become a red giant.

Then it will collapse to become a white dwarf.

Then the star will finally cool to become a black dwarf

0 3 . 3 **Figure 5** shows how the speed of galaxies moving away from Earth varies with the distance of the galaxies from Earth.

Figure 5



Which galaxy would show the smallest observed change in the wavelength of visible light?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ✓ B ☐ C ☐ D ☐

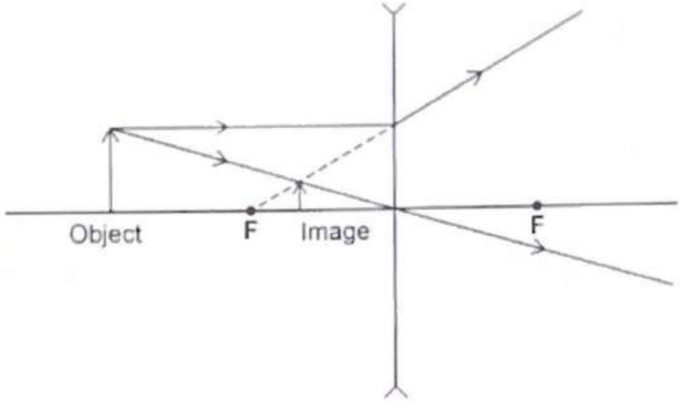
Reason It is the closest to earth.

7

0 4 Lenses are used to form images of objects.

0 4 . 1 **Figure 6** shows how a concave lens forms an image of an object.

Figure 6



The image of the object in **Figure 6** is upright.

Give **two** other words that describe the image.

[1 mark]

1 Virtual

2 Diminished

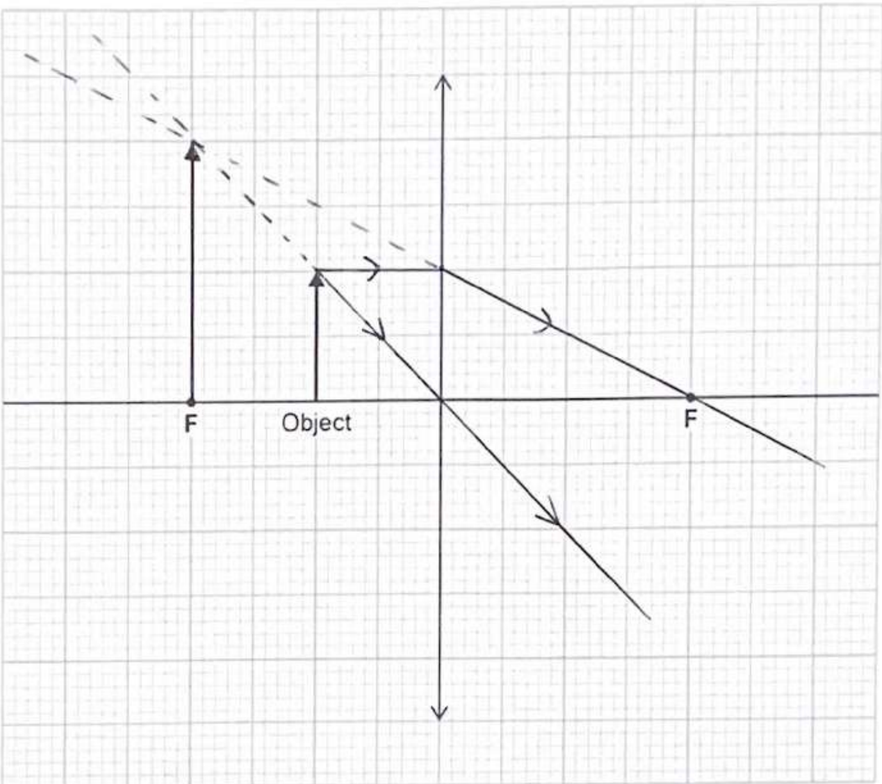
0 4 . 2 **Figure 7** shows an object near to a **convex** lens.

Complete the ray diagram to show how the image is formed.

Use an arrow to represent the image.

[3 marks]

Figure 7



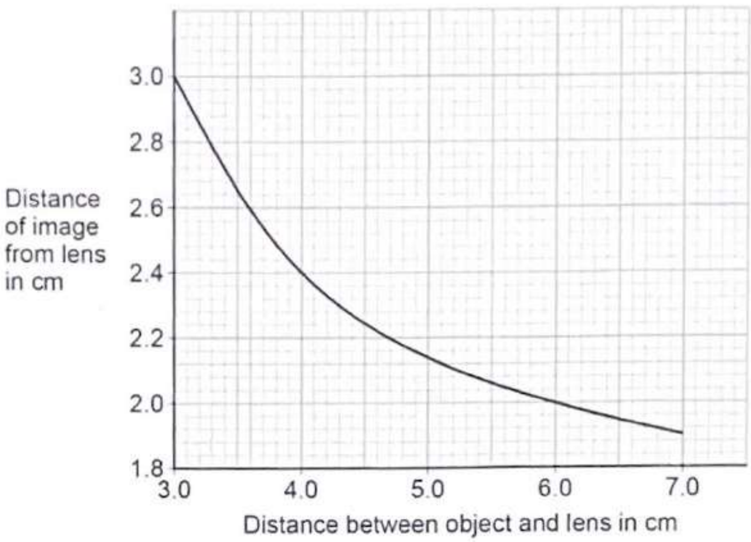
Question 4 continues on the next page

Do not write outside the box

The position of an image formed by a convex lens varies with the distance between the object and the lens.

Figure 8 shows the results of a student's investigation using a convex lens.

Figure 8



0 4 . 3 Describe how the distance of the image from the lens decreases as the distance between the object and the lens increases.

[1 mark]

Increasing the distance between the object and the lens decreases the image distance more rapidly at small object distances

0 4 . 4 The student measured the distance from the image to the lens four times.

The distance between the object and the lens did not change.

The 4 measurements from the image to the lens were:

1.9 cm 1.7 cm 2.2 cm 1.4 cm

Calculate the uncertainty in the measurements.

[2 marks]

$\frac{2.2 - 1.4}{2}$ = uncertanty

uncertanty = ± 0.4 cm

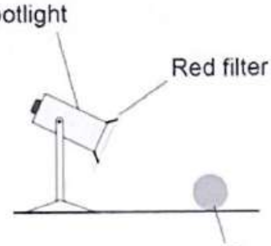
Uncertainty = ± 0.4 cm

0 4 . 5 **Figure 9** shows a spotlight containing a convex lens.

A red filter is placed in front of the spotlight.

The spotlight is directed at a blue object.

Figure 9



Explain why the blue object appears black.

[3 marks]

Only red is trasmitted from the filte.

The red is absorbed by the blue object, So no light is reflected by the blue object

10

Turn over ▶

0 5 Ultraviolet is a type of electromagnetic wave.

0 5 . 1 Give **one** use of ultraviolet.

[1 mark]

Energy efficient lamps

0 5 . 2 An ultraviolet wave has a wavelength of 300 nanometres.

Which of the following is equal to 300 nanometres?

[1 mark]

Tick (✓) **one** box.

- [ ] 3×10^{7} m
- [x] 3×10^{-7} m
- [ ] 3×10^{9} m
- [ ] 3×10^{-9} m

0 5 . 3 The speed of ultraviolet waves is 3×10^{8} m/s.

Calculate the frequency of the ultraviolet wave.

Use your answer to Question **05.2**

[3 marks]

Wave speed = frequency x wavelength

3×10^{8} = frequency x 3×10^{-7}

frequency = $\frac{3 \times 10^{8}}{3 \times 10^{-7}}$

Frequency = 1×10^{15} Hz

Do not write outside the box

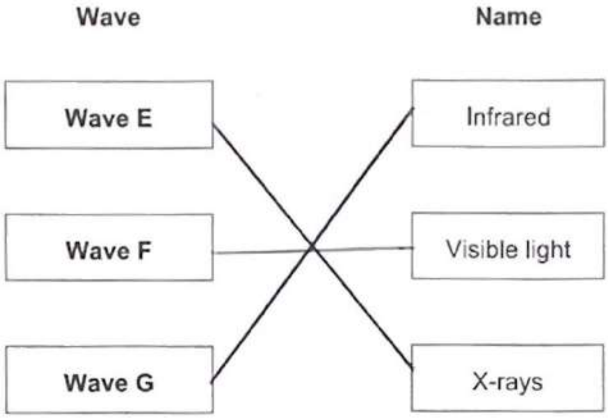
0 5 . 4 **Table 1** gives the wavelength of an ultraviolet wave and three other electromagnetic waves.

Table 1

	Ultraviolet	Wave E	Wave F	Wave G
Wavelength in nanometres	300	0.1	600	100 000

Draw **one** line from each wave to the name of the wave.

[1 mark]



0 5 . 5 Electromagnetic waves are transverse.

Some other types of wave are longitudinal.

Describe the difference between transverse and longitudinal waves.

[2 marks]

In a transverse wave, the oscillations/vibrations are perpendicular to the direction of energy transfer. In a longitudinal wave, the oscillations are parallel to the direction of energy transfer.

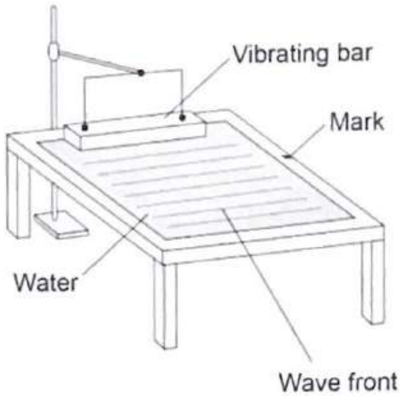
8

Turn over ▶

0 6 A teacher demonstrated some features of waves using a ripple tank.

Figure 10 shows the ripple tank.

Figure 10



0 6 . 1 The teacher measured the time taken for 10 wave fronts to pass the mark.

The teacher repeated this measurement three times and calculated the mean.

What is the advantage of repeating measurements and calculating a mean?

[1 mark]

It reduces the effect of random errors.

Do not write outside the box

0 6 . 2 The teacher's measurements for the time taken for 10 wave fronts to pass the mark were:

8.4 s 7.8 s 8.1 s

Calculate the mean frequency of the wave.

Give your answer to 2 significant figures.

[5 marks]

mean $= \frac{(8.4 + 7.8 + 8.1)}{3} = 8.1$ s

frequency $= \frac{1}{T}$

For 1 wave front is 8.1 / 10 = 0.81 because there's 10 wavefronts

frequency = 1/0.81 = 1.2345

Mean frequency (2 significant figures) = 1.2 Hz

0 6 . 3 In a different investigation, the teacher wanted to determine the speed of water waves in the ripple tank.

The teacher did **not** measure the wavelength of the wave.

Explain how the teacher could determine the speed of the wave.

[3 marks]

The teacher could measure the distance travelled by a wave using a meter rule. They could then measure the time taken for the wave to travel the measured distance with a timer, and divide the distance by the time to get the speed.

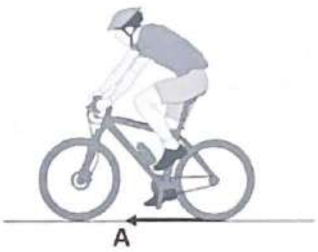
9

Do not write outside the box

0 7 **Figure 11** shows a cyclist riding a bicycle.

Force **A** causes the bicycle to accelerate forwards.

Figure 11



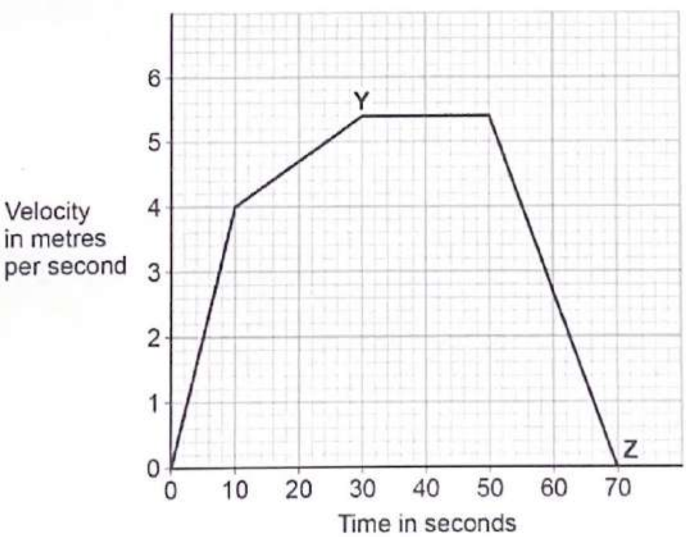
0 7 . 1 What name is given to force **A**?

[1 mark]

Friction

Figure 12 shows how the velocity of the cyclist changes during a short journey.

Figure 12



Do not write outside the box

0 7 . 2 Determine the distance travelled by the cyclist between **Y** and **Z**.

[3 marks]

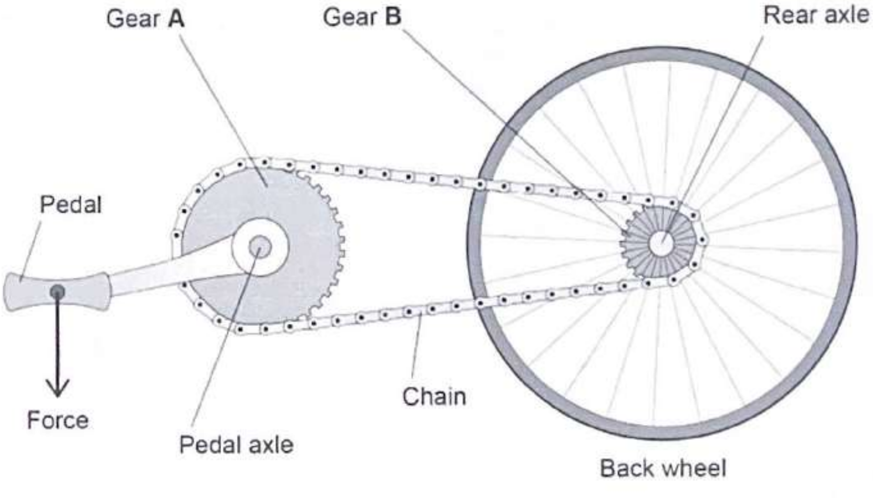
Distance = Velocity x time
So we need area of the shape

Area of rectangle = ~~54m~~ 108m
Area of triangle = 54m

Distance travelled by the cyclist between **Y** and **Z** = 162 m

0 7 . 3 **Figure 13** shows the gears on the bicycle.

Figure 13



Describe how the force on the pedal causes a moment about the rear axle.

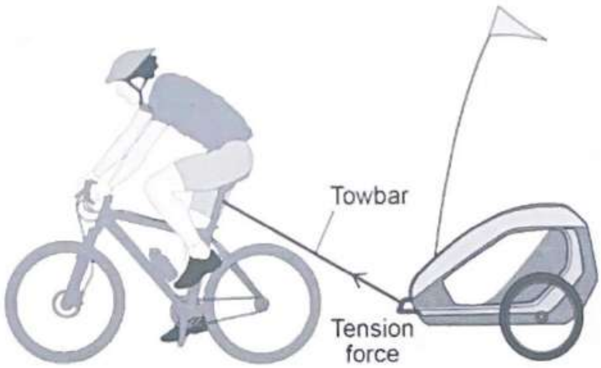
[2 marks]

The force on the pedal causes a moment about the pedal axle, which causes a force on the chain, causing a moment about the rear axle.

Question 7 continues on the next page

Figure 14 shows a different cyclist towing a trailer.

Figure 14



0 7 . 4 The speed of the cyclist and trailer increased uniformly from 0 m/s to 2.4 m/s.

The cyclist travelled 0.018 km while accelerating.

Calculate the initial acceleration of the cyclist.

[3 marks]

Final speed^2 − initial speed^2 = 2 x acceleration x distance

$2.4^2 - 0^2 = 2 \times a \times 18$

$a = \frac{2.4^2}{2 \times 18} = 0.16$ (m/s^2)

Acceleration = 0.16 m/s^2

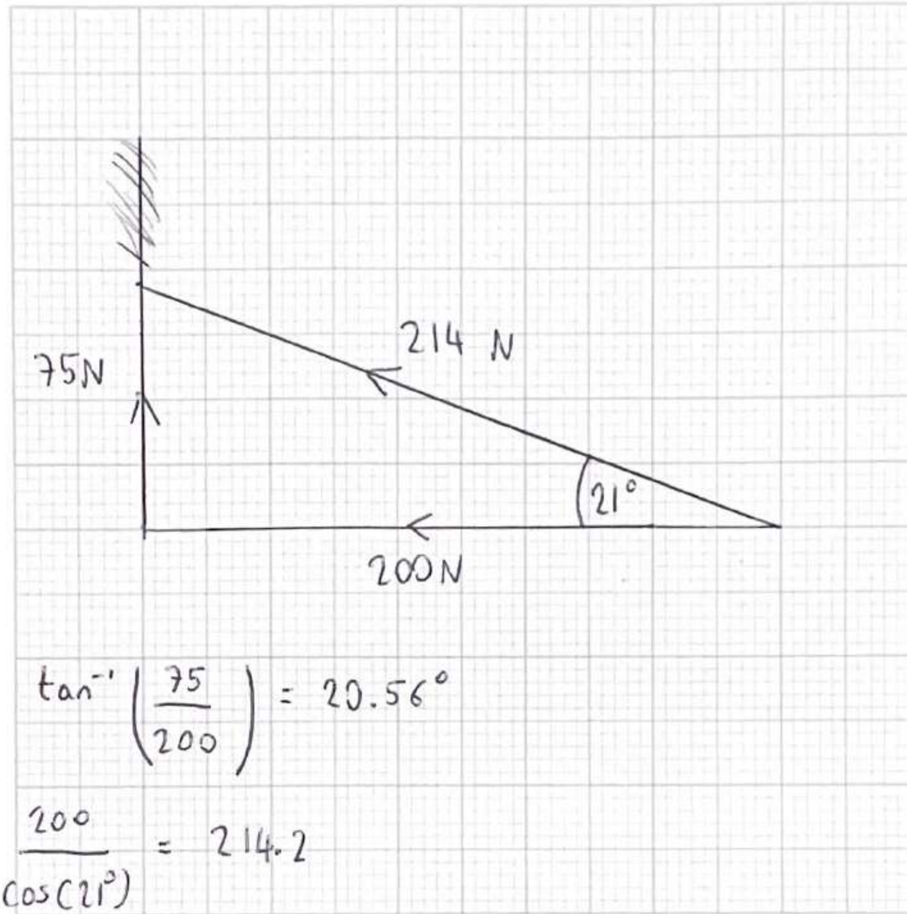
0 7 . 5 The resultant force of the towbar on the trailer has a horizontal component and a vertical component.

horizontal force = 200 N

vertical force = 75 N

Determine the magnitude and direction of the resultant force of the towbar on the trailer by drawing a vector diagram.

[4 marks]



Magnitude of force = 214 N

Direction of force = 21 degrees

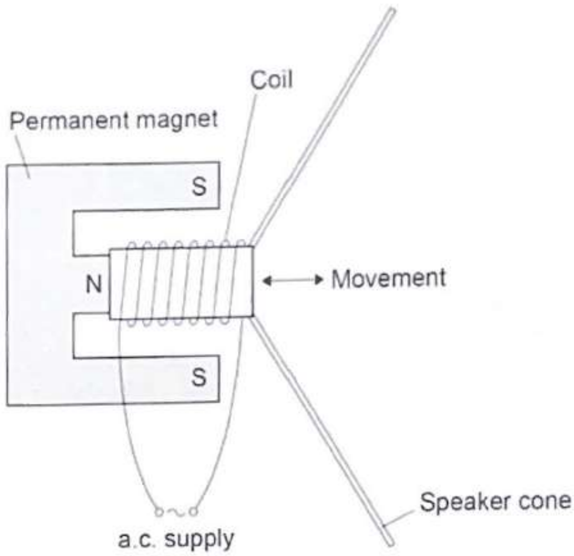
13

Turn over for the next question

0 8 A student made a moving-coil loudspeaker.

Figure 15 shows a diagram of the loudspeaker.

Figure 15



0 8 . 1 What is the name of the effect used by the moving-coil loudspeaker to produce sound waves?

[1 mark]

Motor effect

Do not write outside the box

0 8 . 2 Explain how a moving-coil loudspeaker produces a sound wave.

[4 marks]

The current in the coil creates a magnetic field. This interacts with the magnetic field from the permanent magnet. This produces a resultant force causing the coil/cone to move.

When the direction of the current reverses, the direction of the resultant force reverses, producing a sound wave.

Question 8 continues on the next page

0 8 . 3 A student investigated how the loudness of sound from the loudspeaker depends on:

- the number of turns on the coil
- the frequency of the supply.

Table 2 shows the results.

Table 2

Number of turns	Frequency of supply in Hz	Loudness of sound in arbitrary units
100	200	32
200	400	47
300	600	63

Explain why the results **cannot** be used to make a valid conclusion.

[2 marks]

The student changed two variables (number of turns and frequency) at the same time, so it isn't possible to know the effect of each variable

7

Do not write outside the box

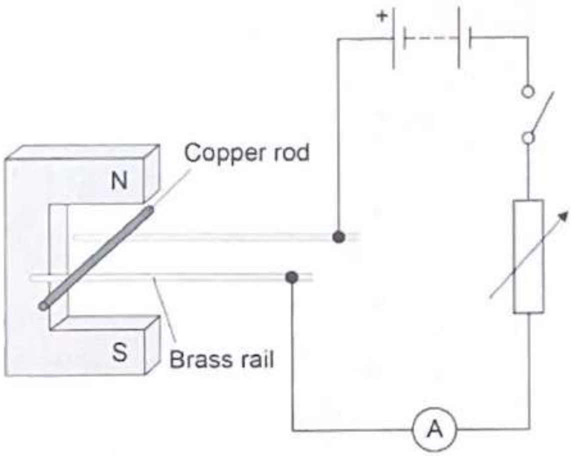
0 9 A teacher demonstrated how a magnetic field can cause a copper rod to accelerate.

The teacher placed the copper rod on two brass rails in a magnetic field.

The copper rod was able to move.

Figure 16 shows the equipment used.

Figure 16



0 9 . 1 The teacher closes the switch and the copper rod accelerates.

Explain how Fleming's left hand rule can be used to predict the direction in which the copper rod will move.

[5 marks]

Using Flemings left hand rule, hold your thumb, first finger and second finger.

The second finger represents the current pointing out of the paper. The first finger represents the field pointing downwards. The thumb points in the direction of the force. Therefore the thumb points ~~left~~ right, so the rod moves left to right

0 9 . 2 Suggest **two** changes to the equipment that would increase the force on the copper rod.

[2 marks]

1 Decrease the resistance of the variable resistor

2 You could use a stronger magnet.

Question 9 continues on the next page

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Do not write outside the box

0 9 . 3 The teacher closed the switch and the copper rod accelerated uniformly from rest for 0.15 s.

The current in the copper rod was 1.7 A.

mass of copper rod = 4.0 g

length of copper rod in the magnetic field = 0.050 m

magnetic flux density = 0.30 T

Calculate the maximum possible velocity of the copper rod when it left the magnetic field.

[6 marks]

Force = magnetic flux density × current × length

$F = 0.30 \times 1.7 \times 0.050$

$F = 0.0255$ N

$m = 0.004$ kg

$F = ma$ $\quad 0.0255 = 0.004 \times a$

$a = \frac{0.0255}{0.004} = 6.375$ $\quad a = \frac{\Delta V}{t}$

$\Delta V = at = 6.375 \times 0.15$

$= 0.95625$

Maximum velocity = 0.95625 m/s

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END OF QUESTIONS