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David Sang

Cambridge IGCSE®

Physical Science

Physics Workbook

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Physics Workbook

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Contents

Introduction

This workbook contains exercises designed to help you develop the skills needed for success in Cambridge IGCSE® Physical Science.

The examination tests three different Assessment Objectives, or AOs for short. These are:

AO1 Knowledge with understanding

AO2 Handling information and problem solving

AO3 Experimental skills and investigations.

In the examination, about 50% of the marks are for AO1, 30% for AO2 and 20% for AO3. Just learning your work and remembering it is therefore not enough to make sure that you get the best possible grade in the exam. Half of all the marks are for AO2 and AO3. You need to be able to use what you've learnt in unfamiliar contexts (AO2) and to demonstrate your experimental skills (AO3).

This workbook contains exercises to help you to develop AO2 and AO3 further. There are some questions that just involve remembering things you have been taught (AO1), but most of the questions require you to use what you've learnt to work out, for example, what a set of data means, or to suggest how an experiment might be improved.

These exercises are not intended to be exactly like the questions you will get on your exam papers. This is because they are meant to help you to develop your skills, rather than testing you on them.

There's an introduction at the start of each exercise that tells you the purpose of it – which skills you will be working with as you answer the questions.

The exercises cover both Core and Supplement material of the syllabus. The Supplement material can be identified by the Supplement bar in the margin (as shown). This indicates that the exercise is intended for students who are studying the Supplement content of the syllabus as well as the Core.

Safety

A few practical exercises have been included. These could be carried out at home using simple materials that you are likely to have available to you. (There are many more practical activities on the CD-ROM that accompanies your textbook.)

While carrying out such experiments, it is your responsibility to think about your own safety, and the safety of others. If you work sensibly and assess any risks before starting, you should come to no harm. If you are in doubt, discuss what you are going to do with your teacher before you start.

P1:
Making measurements

A DEFINITION TO LEARN

density: the mass per unit volume

USEFUL EQUATIONS

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Exercise P1.1 The SI system of units

To be part of the international community of scientists, you need to use the SI units (Le Système International d'Unités).

a Give the SI units (name and symbol) of the following quantities:

length

....

volume

....

b Give the name in words and the symbol for the following:

one thousand metres

....

one-thousandth of a metre

....

c How many

centimetres are there in a metre? ....

dm^3 are there in a cubic metre? ....

d List as many non-SI units of length as you can.

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e Give a reason why it is important for scientists to have a system of units that is agreed between all countries.

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f Name some more professions that make use of the SI system of units.

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Exercise P1.2 Paper measurements

This exercise will test your ability to measure lengths.

Find a rectangular sheet of paper, at least as big as the pages of this book. A sheet of newspaper is ideal.

Your task is to use a ruler to measure three lengths: the short side, the long side and the diagonal.

For lengths that are longer than your ruler, you will need to devise a careful technique.

a Describe the method you have used for measuring the length of the diagonal. It may help to include a diagram.

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b Record your results (in centimetres) in the table.

Measurement	Length / cm	Length^2 / cm^2
short side	....	
long side	....	
diagonal	....	

c Now you can use Pythagoras' theorem to test your results. In the third column of the table, calculate and write down the square of each length.

Then calculate:

(short side)^2 + (long side)^2 = ...

This should be equal to (diagonal)^2.

Round off your values to the nearest cm^2.

d How close are your two answers? Write a comment below.

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Exercise P1.3 Density data

This exercise presents some data for you to interpret and use.

Some data about the density of various solids and liquids are shown in the table.

Material	State / type	Density / kg/m^3	Density / g/cm^3
water	liquid / non-metal	1000	1.000
ethanol	liquid / non-metal	800	0.800
olive oil	liquid / non-metal	920	
mercury	liquid / metal	13 500	
ice	solid / non-metal	920	
diamond	solid / non-metal	3500	
cork	solid / non-metal	250	
chalk	solid / non-metal	2700	
iron	solid / metal	7900	
tungsten	solid / metal	19 300	
aluminium	solid / metal	2700	
gold	solid / metal	19 300	

Two units are used for the densities, kg/m^3 and g/cm^3.

a Complete the second column by converting each density in kg/m^3 to the equivalent value in g/cm^3. The first two have been done for you.

b Use the data to explain why ice floats on water.

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c A cook mixes equal volumes of water and olive oil in a jar. The two liquids separate. Complete the drawing of the jar to show how the liquids will appear. Label them.

d A student wrote: "These data show that metals are denser than non-metals." Do you agree? Explain your answer.

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e Calculate the mass of a block of gold that measures 20 cm × 15 cm × 10 cm. Give your answer in kg.

f A metalworker finds a block of silvery metal. He weighs it and he measures its volume. Here are his results:

mass of block = 0.270 kg

volume of block = 14.0 cm^3

Calculate the density of the block.

Suggest what metal this might be ....

Exercise P1.4 Density of steel

In this exercise, you can explain how to find the density of an irregularly-shaped object.

a A student has to determine the density of steel. Her teacher gives her several steel bolts.

The student half-fills a measuring cylinder with water. She then submerges several of the steel bolts in the water.

What quantities should she record in order to find the volume of the bolts?

....

....

b How can she calculate the volume of the bolts?

....

c State one precaution that she should take in determining the volume of the bolts.

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d In order to determine the density of steel, she must also find the mass of the bolts. What instrument should she use for this?

....

e State one precaution that she should take in determining the mass of the bolts.

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Exercise P1.5 Testing your body clock

How good would your pulse be as a means of measuring time intervals?

Galileo used the regular pulse of his heart as a means of measuring intervals of time until he noticed that a swinging pendulum was more reliable.

In this exercise, you need to be able to measure the pulse in your wrist. Place two fingers of one hand gently on the inside of the opposite wrist. Press gently at different points until you find the pulse. (Alternatively, press two fingers gently under your jawbone on either side of your neck.)

You will also need a clock or watch that will allow you to measure intervals of time in seconds.

a Start by timing 10 pulses. (Remember to start counting from zero: 0, 1, 2, 3, . . ., 9, 10.) Repeat this several times and record your results in the table below.

b Comment on your results. How much do they vary? Is the problem that it is difficult to time them, or is your heart rate varying?

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c Use your results to calculate the average time for one pulse.

d Repeat the above, but now count 50 pulses. Record your results in the table below. Calculate the average time for one pulse.

e Now investigate how your pulse changes if you take some gentle exercise – for example, by walking briskly, or by walking up and down stairs.

Write up your investigation in the lined space. Use the following as a guide.

- Briefly describe your gentle exercise.
- Give the measurements of pulse rate that you have made.
- Comment on whether you agree with Galileo that a pendulum is a better time-measuring instrument than your pulse.

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P2:
Describing motion

DEFINITIONS TO LEARN

speed: the distance travelled by an object in unit time

velocity: the speed of an object in a given direction

acceleration: the rate of change of an object's velocity

USEFUL EQUATIONS

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

speed = gradient of distance–time graph

distance = area under speed–time graph

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

acceleration = gradient of speed–time graph

Exercise P2.1 Measuring speed

This exercise is about how we can measure the speed of a moving object.

a One way to find the speed of an object is to measure the time it takes to travel a measured distance. The table shows the three quantities involved.

Complete the table as follows:

- In the second column, give the SI unit for each quantity (name and symbol).
- In the third column, give some other, non-SI, units for these quantities.
- In the fourth column, name suitable measuring instruments for distance and time.

Quantity	SI unit (name and symbol)	Non-SI units	Measuring instrument
distance			
time			
speed			

b In the laboratory, the speed of a moving trolley can be found using two light gates. A timer measures the time taken for a trolley to travel from one light gate to the other.

What other quantity must be measured to determine the trolley's speed?

....

Write down the equation used to calculate the speed of the trolley:

A trolley takes 0.80 s to travel between two light gates, which are separated by 2.24 m. Calculate its average speed.

c The speed of moving vehicles is sometimes measured using detectors buried in the road. The two detectors are about 1 m apart. As a vehicle passes over the first detector, an electronic timer starts. As it passes over the second detector, the timer stops.

Explain how the vehicle's speed can then be calculated.

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On one stretch of road, any vehicle travelling faster than 25 m/s is breaking the speed limit. The detectors are placed 1.2 m apart. Calculate the speed of a car that takes 0.050 s to travel this distance. Is it breaking the speed limit?

Calculate the shortest time that a car can take to cross the detectors if it is not to break the speed limit.

d Describe briefly how such a speed-detection system could be used to light up a warning light whenever a speeding car goes past.

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Exercise P2.2 Speed calculations

Use the equation for speed to solve some numerical problems.

a The table shows the time taken for each of three cars to travel 100 m. Circle the name of the fastest car. Complete the table by calculating the speed of each car. Give your answers in m/s and to one decimal place.

Car	Time taken / s	Speed / m/s
red car	4.2	
green car	3.8	
yellow car	4.7	

b A jet aircraft travels 1200 km in 1 h 20 min.

How many metres does it travel? ....

For how many minutes does it travel? ....

And for how many seconds? ....

Calculate its average speed during its flight.

c A stone falls 20 m in 2.0 s. Calculate its average speed as it falls.

The stone falls a further 25 m in the next 1.0 s of its fall. Calculate the stone's average speed during the 3 s of its fall.

Explain why we can only calculate the stone's **average** speed during its fall.

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Exercise P2.3 More speed calculations

In these problems, you will have to rearrange the equation for speed.

a A car is moving at 22 m/s. How far will it travel in 35 s?

b A swallow can fly at 25 m/s. How long will it take to fly 1.0 km?

c A high-speed train is 180 m long and is travelling at 50 m/s. How long will it take to pass a person standing at a level crossing?

How long will it take to pass completely through a station whose platforms are 220 m in length?

d In a 100 m race, the winner crosses the finishing line in 10.00 s. The runner-up takes 10.20 s. Estimate the distance between the winner and the runner-up as the winner crosses the line. Show your method of working.

Explain why your answer can only be an estimate.

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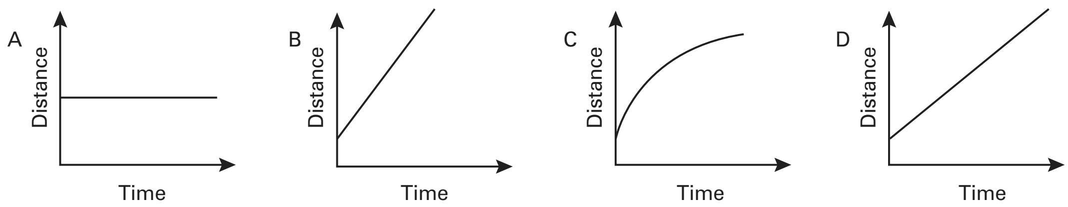
Exercise P2.4 Distance–time graphs

In this exercise, you draw and interpret some distance–time graphs. You can calculate the speed of an object from the gradient (slope) of the graph.

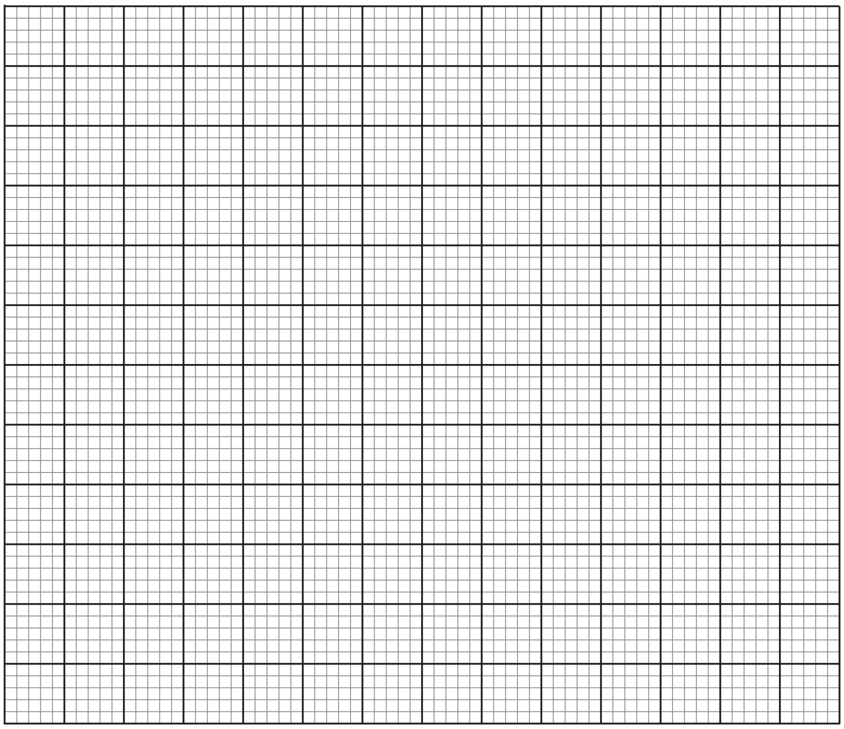
a The diagrams A–D show distance–time graphs for four moving objects. Complete the table by indicating (in the second column) the graph or graphs that represent the motion described in the first column.



Description of motion	Graph(s)
moving at a steady speed	
stationary (not moving)	
moving fastest	
changing speed	

b The table shows the distance travelled by a runner during a 100 m race. Use the data to draw a distance–time graph on the graph paper grid below.

Distance / m	0	10.0	25.0	45.0	65.0	85.0	105.0
Time / s	0.0	2.0	4.0	6.0	8.0	10.0	12.0



Now use your graph to answer these questions:

How far did the runner travel in the first 9.0 s? ....

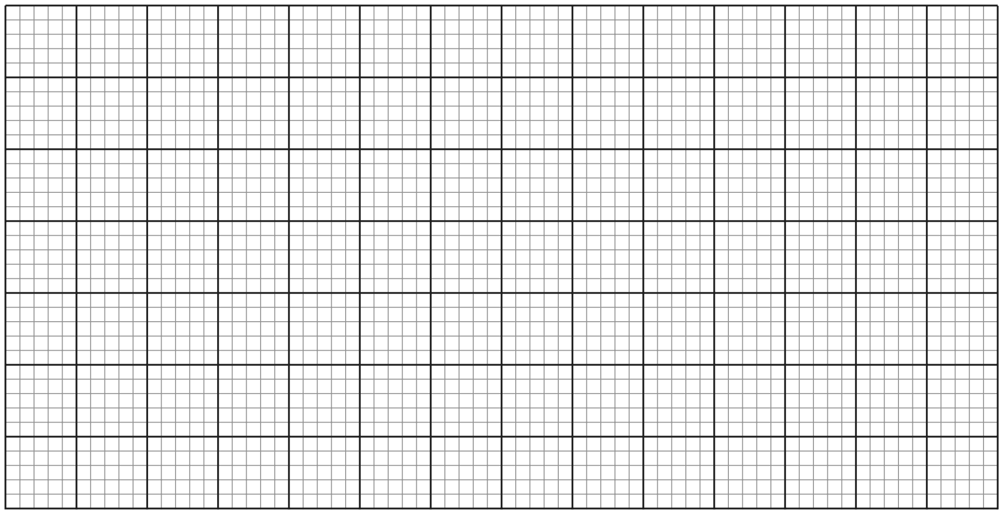
How long did the runner take to run the first 50.0 m? ....

How long did the runner take to complete the 100 m? ....

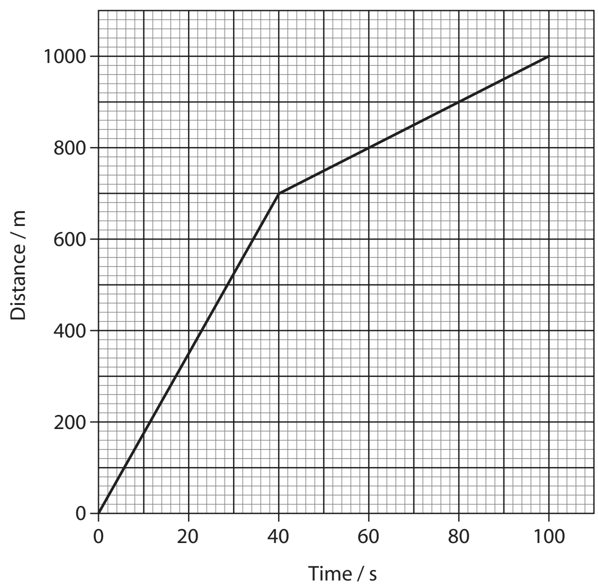
Use the gradient of your graph to determine the runner's average speed between 4.0 s and 10.0 s. On your graph, show the triangle that you use.

c On the graph paper grid below, sketch a distance–time graph for the car whose journey is described here:

- The car set off at a slow, steady speed for 20 s.
- Then it moved for 40 s at a faster speed.
- Then it stopped at traffic lights for 20 s before setting off again at a slow, steady speed.



d The graph represents the motion of a bus for part of a journey.



On the graph, mark the section of the journey where the bus was moving faster.

From the graph, calculate the following:

- the speed of the bus when it was moving faster

- the average speed of the bus.

Exercise P2.5 Acceleration

When an object changes velocity, we say that it accelerates. Its acceleration is the rate at which its velocity increases.

a A car is travelling at 14 m/s. This tells us its *speed*. What further information is required to tell us its *velocity*?

....

b In an advertisement, a car is described like this:

"It can accelerate from 0 km/h to 80 km/h in 10 s."

By how much does its velocity increase in each second (on average)? ....

c A cyclist is travelling at 4.0 m/s. She speeds up to 16 m/s in a time of 5.6 s. Calculate her acceleration.

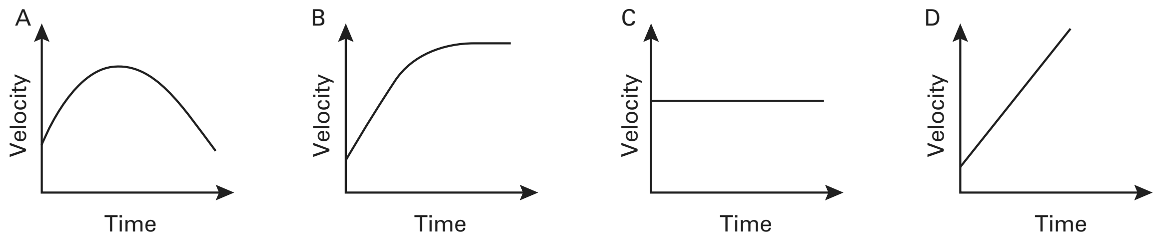
d A stone falls with an acceleration of 10.0 m/s^2. Calculate its velocity after falling for 3.5 s.

e On the Moon, gravity is weaker than on Earth. A stone falls with an acceleration of 1.6 m/s^2. How long will it take to reach a velocity of 10 m/s?

Exercise P2.6 Velocity–time graphs

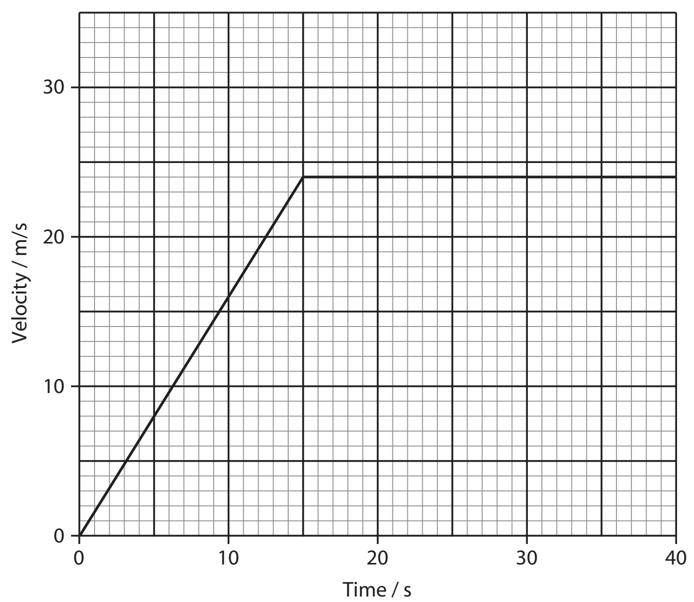
In this exercise, you draw and interpret some velocity–time graphs. You can calculate the acceleration of an object from the gradient (slope) of the graph. You can calculate the distance travelled from the area under the graph.

a The diagrams A–D show velocity–time graphs for four moving objects. Complete the table by indicating (in the second column) the graph or graphs that represent the motion described in the first column.



Description of motion	Graph(s)
moving at a constant velocity	
speeding up, then slowing down	
moving with constant acceleration	
accelerating to a constant velocity	

b The graph represents the motion of a car that accelerates from rest and then travels at a constant velocity.



From the graph, determine the acceleration of the car in the first part of its journey.

On the graph, shade in the area that represents the distance travelled by the car while accelerating. Label this area A.

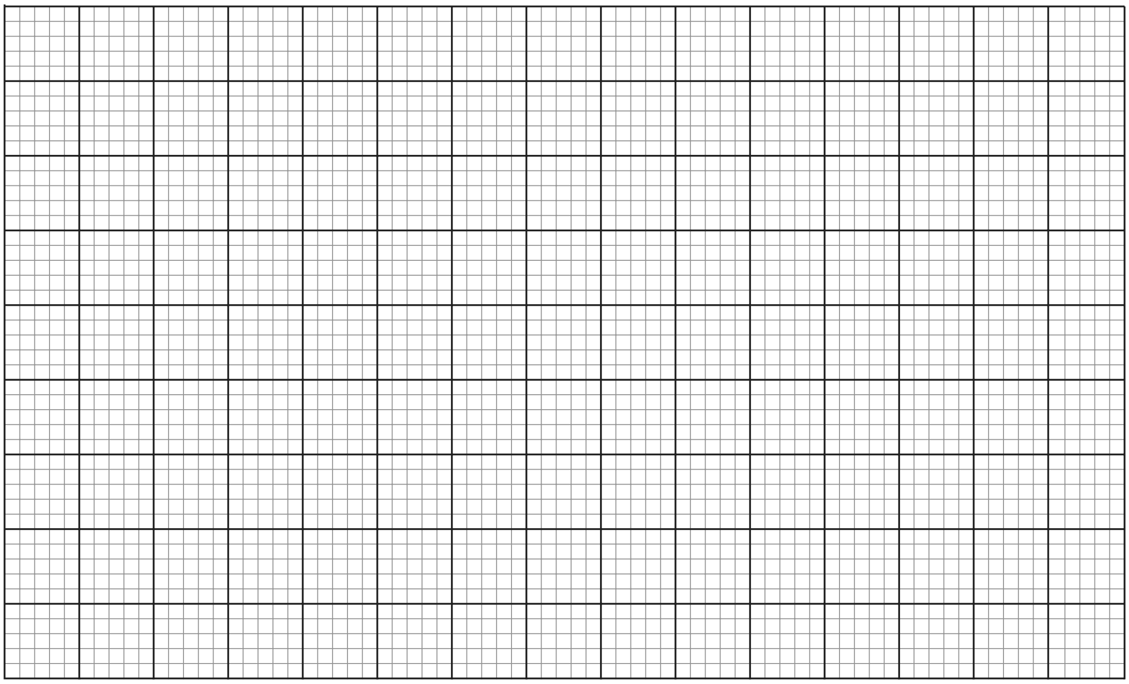
Shade the area that represents the distance travelled by the car at a constant velocity. Label this area B.

Calculate each of these distances and the total distance travelled by the car.

[Note: area of a triangle = $\frac{1}{2}$ × base × height.]

c On the graph paper grid, sketch a velocity–time graph for the car whose journey is described here:

- The car set off at a slow, constant velocity for 20 s.
- Then, during a time of 10 s, it accelerated to a faster velocity.
- It travelled at this constant velocity for 20 s.
- Then it rapidly decelerated and came to a halt after 10 s.



P3:
Forces and motion

DEFINITIONS TO LEARN

force: the action of one body on a second body that causes its velocity to change
resultant force: the single force that has the same effect on a body as two or more forces
mass: the property of an object that causes it to resist changes in its motion
weight: the downward force of gravity that acts on an object because of its mass

USEFUL EQUATIONS

force = mass × acceleration
$F = ma$

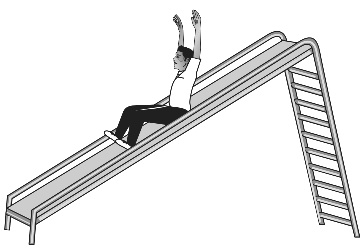
Exercise P3.1 Identifying forces

Forces are invisible (although we can often see their effects). Being able to identify forces is an important skill for physicists.

The pictures show some bodies. Your task is to add at least one force arrow to each body, showing a force acting on it. (Two force arrows are already shown.)
Each force arrow should be labelled to indicate the following:

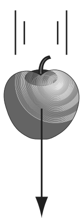
1 the type of force (contact, drag/air resistance, weight/gravitational, push/pull, friction, magnetic)
2 the body causing the force
3 the body acted on by the force.

For example: the gravitational force of the Earth on the apple.

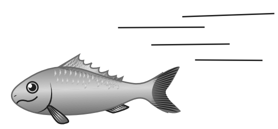


A

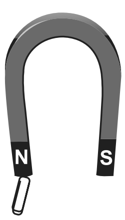
B



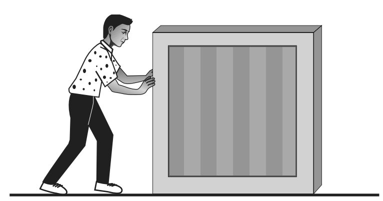
C



D



E

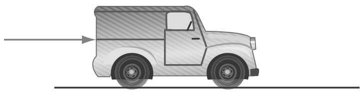


F

Exercise P3.2 The effects of forces

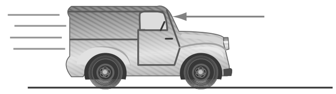
A force can change how a body moves, or it may change its shape.

a Each diagram shows a body with a single force acting on it. For each, say what effect the force will have.



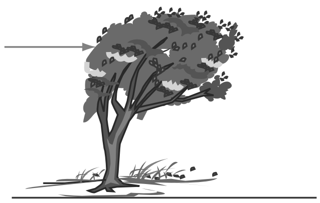
A ....

....



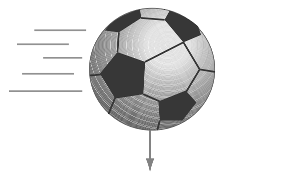
B ....

....



C ....

....



D ....

....

b A boy slides down a sloping ramp. In the space below, draw a diagram of the boy on the ramp and add a labelled arrow to show the force of friction that acts on him.

What effect will the force have on the boy's movement?

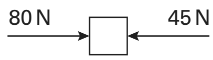
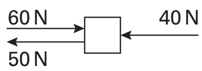
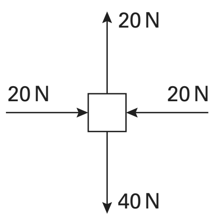
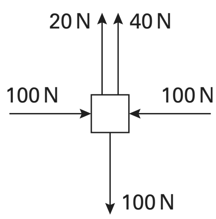
....

....

Exercise P3.3 Combining forces

When two or more forces act on a body, we can replace them by a single resultant force that has the same effect.

a In the table below, the left-hand column shows four objects acted on by different forces. For the same objects in the right-hand column, add a force arrow to show the resultant force acting on it in each case.

Forces on object	Resultant force
	
	
	
	

b In the space below, draw a diagram showing a body with four forces acting on it. Their resultant force must be 4 N acting vertically downwards.

Exercise P3.4 Force, mass and acceleration

Here you practise using the relationship $F = ma$.

a The equation $F = ma$ relates three quantities. Complete the table to show the names of these quantities and their SI units.

Quantity	Symbol	SI unit
	F	
	m	
	a	

b Rearrange the equation $F = ma$ to change its subject:

$m =$ $a =$

c Calculate the force needed to give a mass of 20 kg an acceleration of $0.72\ \text{m/s}^2$.

d A car of mass 450 kg is acted on by a resultant force of 1575 N. Calculate its acceleration.

e One way to find the mass of an object is to apply a force to it and measure its acceleration.
An astronaut pushes on a spacecraft with a force of 200 N. The spacecraft accelerates at 0.12 m/s^2.
What is the mass of the spacecraft?

f In the space below, draw a falling stone with the following forces acting on it:

- its weight, 8.0 N
- air resistance, 2.4 N.

g Calculate the stone's acceleration. (Its mass is 0.80 kg.)

Exercise P3.5 Mass and weight

Mass and weight are two quantities that can easily be confused.

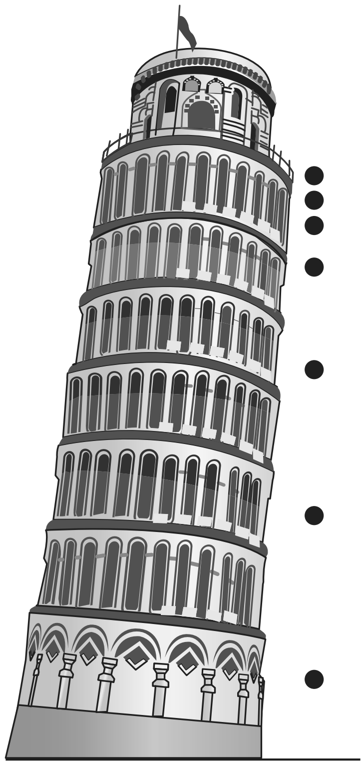
How well do you understand the difference between mass and weight? In the second column of the table, write 'mass' or 'weight' (or 'both'), as appropriate.

Description	Mass or weight or both?
a force	
measured in kilograms	
measured in newtons	
decreases if you go to the Moon	
a measure of how difficult it is to accelerate a body	
caused by the attraction of another body	
increases if more atoms are added to a body	
balanced by the contact force of the floor when you are standing	
makes it difficult to change the direction of a body as it moves	
decreases to zero as a body moves far from the Earth or any other object	

Exercise P3.6 Falling

What is the pattern of motion of a falling object? How do the forces of gravity and friction affect a falling body?

Galileo is said to have dropped two objects of different masses from the top of the Leaning Tower of Pisa. The diagram shows the position of the smaller object at equal intervals of time as it fell.



a The spacing between the dots gradually increases. What does this tell you about the velocity of the falling object?

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b On the diagram, add dots to show the pattern you would expect to find for the object with greater mass (at the same intervals of time).

c What can you say about the accelerations of the two objects?

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d Galileo's young assistant would probably have enjoyed attaching a parachute to a stone and dropping it from the tower. After a short time, the stone would fall at a constant velocity. On the diagram, add some small crosses to show the pattern you would expect to see for this.

e The graph shows how the stone's speed would change as it fell. On the right are two drawings of the stone. These correspond to points A and B on the graph.

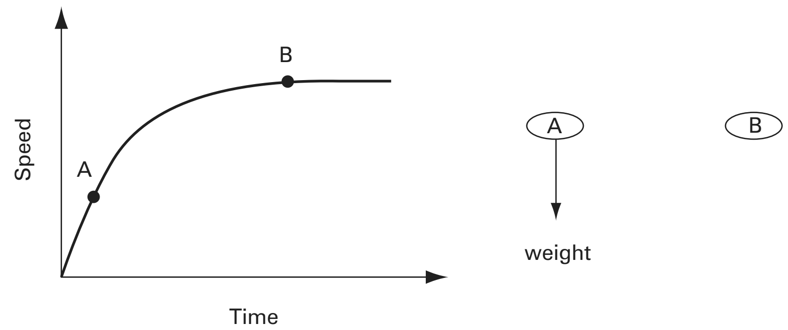


Diagram A shows the stone's weight. Add a second force arrow to this diagram to show the force of air resistance acting on the stone at point A.

Add two force arrows to diagram B to show the forces acting on the stone at this point B in its fall.

P4: Turning effects of forces

DEFINITIONS TO LEARN

moment of a force about a point: the turning effect of a force about a point

moment of a force about a point: the turning effect of a force about a point, given by force × perpendicular distance from pivot to force

equilibrium: when no net force and no net moment act on a body

centre of mass: the point at which the mass of an object can be considered to be concentrated

USEFUL EQUATIONS

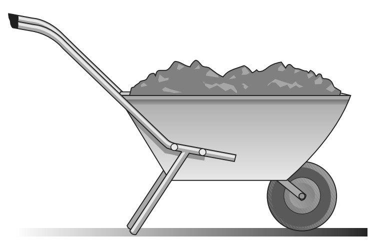
moment of a force = force × perpendicular distance from pivot to force

for a body in equilibrium, total clockwise moment = total anticlockwise moment

Exercise P4.1 Turning effect of a force

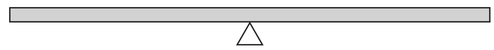
When a force acts on a body that is pivoted, it can have a turning effect. The body may start to rotate.

a The diagram shows a wheelbarrow with a heavy load of soil. Add an arrow to show how you could lift the left-hand end of the barrow with the smallest force possible. Remember to indicate clearly the direction of the force.



b The diagram shows a beam balanced on a pivot. Add arrows to show the following forces:

- A 100 N force pressing downwards on the beam that will have the greatest possible clockwise turning effect. Label this force A.
- A 200 N force pressing downwards on the beam that will have an anticlockwise turning effect equal in size to the turning effect of force A. Label this force B.



c If a body is in equilibrium, what can you say about:

- the resultant force on the body?

....

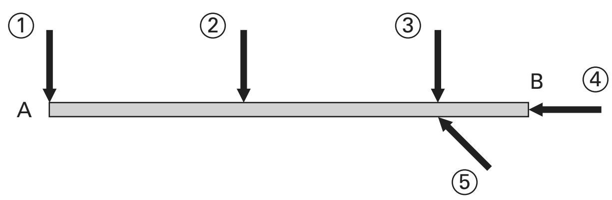
- the resultant turning effect on the body?

....

Exercise P4.2 Calculating moments

In this exercise, you will calculate some moments. Remember that it is important to note whether a moment acts in a clockwise or anticlockwise direction.

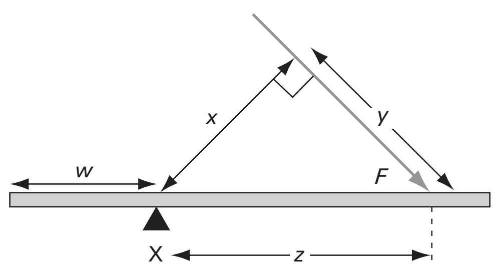
a In the diagram, all the forces are of equal size.



Which force has the greatest moment about point A? ....

Which force has no moment about point B? ....

b Look at the diagram.



Which distance should be used in calculating the moment of force *F* about point X? ....

Explain why you chose this distance for your answer.

....

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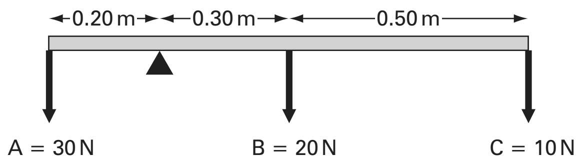
....

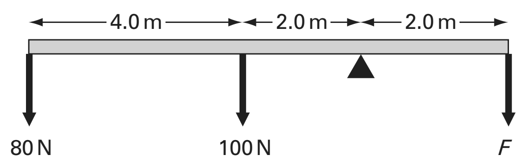
c Calculate the moment about the pivot of each force in the diagram. Write your answers in the table.



Force	Moment	Clockwise or anticlockwise?
A		
B		
C		

Which force must be removed if the beam is to be balanced? ....

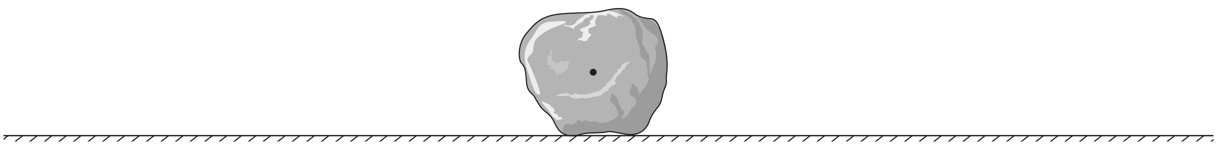
d In the diagram, the beam is balanced (in equilibrium). Calculate the size of force *F*.



Exercise P4.3 Stability and centre of mass

An object is stable if it will not topple over easily.

a The first diagram shows an object that is fairly stable. Its centre of mass is marked with a dot. This is the point at which the mass of an object can be considered to be concentrated.



On the left of this object, draw an object that is more stable. Mark its centre of mass.

On the right of this object, draw an object that is less stable. Mark its centre of mass.

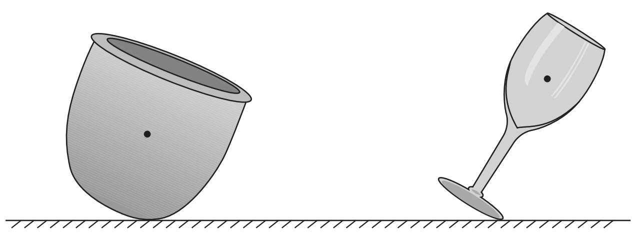
b The second diagram shows two objects that are not very stable. The centre of mass of each is marked with a dot.

Two vertical forces act on each of these objects. Name them.

upward force: ....

downward force: ....

For each object, draw arrows showing the two forces acting on it. Decide whether each object will fall over. Write an explanation under the diagram.



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Exercise P4.4 Finding the centre of mass of a thin sheet of card

In this exercise you will explain how to find the position of the centre of mass of a 'lamina' – a thin sheet of card of uniform thickness.

Here are the initial instructions for this experiment. Read them carefully and answer the questions which follow.

1 Cut a shape from the card. This is your lamina.
2 Use the pin to make three holes around the edge of the lamina.
3 Fix the pin horizontally in the clamp.
4 Using one hole, hang the lamina from the pin. Make sure that it can turn freely.
5 Hang the string from the pin so that the weight makes it hang vertically. Mark two points on the lamina along the length of the string.

a List the equipment and materials needed for this experiment.

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....

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b The lamina hangs freely from the pin. What can you say about the position of its centre of mass?

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c Complete the list of instructions to explain how you would find the centre of mass of the lamina.

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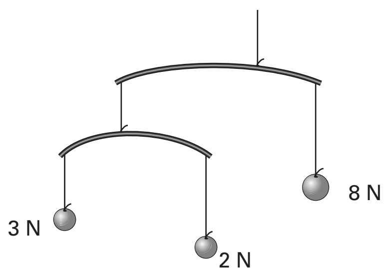
Exercise P4.5 Make a mobile

A hanging mobile is usually decorative. You can make one that will help people to understand a bit of physics.

You will need:

- two different lengths of stiff wire (or thin wooden rod)
- cotton thread
- small objects of different weights
- sticky paper or labels



This is what you do:

- Start by weighing your chosen objects. Label them with their approximate weights.
- Take the two lightest objects and hang them from the ends of the shorter piece of wire.
- Attach a piece of thread close to the midpoint of the wire. Adjust its position until the wire balances horizontally.
- Attach the suspension thread to one end of the second piece of wire. Attach the third weight to the other end.
- Attach a piece of thread close to the midpoint of the second wire. Adjust its position until it all balances horizontally.
- Hang your mobile from a high point.

- Write a short script for a talk in which you use your mobile to explain about the moments of forces and how they can be balanced.

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P5:
Forces and matter

DEFINITIONS TO LEARN

extension: the increase in length of a spring when a load is attached

limit of proportionality: the point beyond which the extension of an object is no longer proportional to the load producing it

load: a force that causes a spring to extend

pressure: the force acting per unit area at right angles to a surface

USEFUL EQUATIONS

Hooke's law: force = spring constant × extension

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

$$p = \frac{F}{A}$$

Exercise P5.1 Stretching a spring

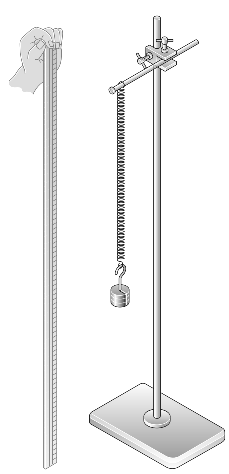
Robert Hooke discovered his law of springs by attaching weights and measuring the extension of a spring.

a Add mathematical symbols in the wide spaces to turn the following words into an equation. There are **two** different ways to do it. Can you find both?

stretched length original length extension

stretched length original length extension

b A student carried out an experiment as shown in the diagram to stretch a spring. The table shows her results. Complete the third column of the table.

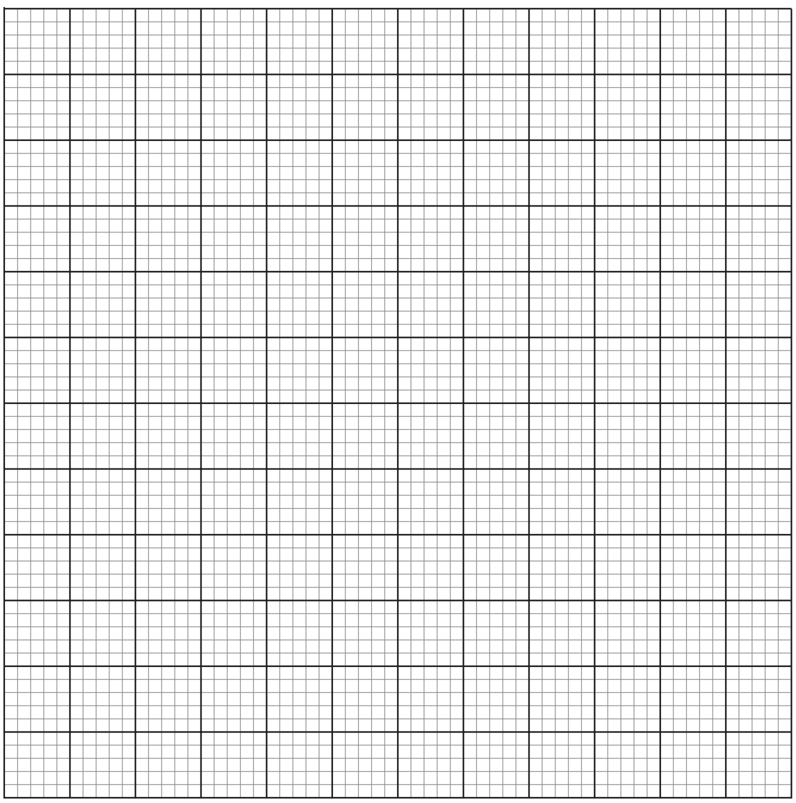


Load / N	Length / cm	Extension / mm
0	25.0	
1.0	25.4	
2.0	25.8	
3.0	26.2	
4.0	26.6	
5.0	27.0	
6.0	27.4	
7.0	27.8	
8.0	28.5	
9.0	29.2	
10.0	29.9	

From the data in the table, estimate the force needed to produce an extension of 1.0 cm.

....

On the graph paper grid, draw a extension–load graph for the spring.



From your graph, estimate the load at the limit of proportionality.

....

Exercise P5.2 Stretching rubber

Rubber is an interesting material. It is very elastic (stretchy) and this means that it has many practical uses.

For this activity, you will need several rubber bands: three identical bands, and another that is broad and long. You will also need a ruler.

a Take one of the three identical bands. Measure its original length. Then stretch it as much as you can and measure its new length.

Record your results here:

....

....

Calculate this quantity:

$$\frac{\text{extension}}{\text{original length}} = \dots\dots\dots\dots$$

b Take one of the three identical bands. Stretch it by hand. Repeat this with two bands side-by-side, and then with three bands.

The spring constant of a band tells you the force needed to stretch it by 1 cm (or some other standard amount). How does the spring constant depend on the number of bands when you stretch them side-by-side?

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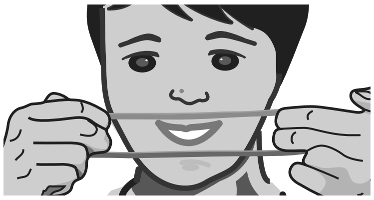
c Take the broad, long band. Grip it so that your thumbs are about 2 cm apart.

Touch the band gently against your to lip. This is a good way to sense its temperature.



Now stretch and release the band vigorously about 20 times in about 5 s. Once again, quickly sense its temperature against your lip.

State what you observe, and give an explanation.

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Exercise P5.3 Pressure

Has an elephant ever stood on your foot? Ideas about pressure explain why it might not hurt quite as much as you might think!

a The equation $p = \frac{F}{A}$ is used to calculate pressure.

Complete the table to show the name of each quantity and the SI unit (name and symbol) of each quantity.

Quantity	Symbol	SI unit
	F	
	p	
	A	

Rearrange the equation to make F and A the subject:

$F =$ $A =$

b It is dangerous to stand on the icy surface of a frozen pond or lake.

Explain why it is more dangerous to stand on one foot than on both feet.

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....

Describe how you could move across the ice in such a way as to minimise the danger of falling through.

....

....

....

c Calculate the pressure when a force of 200 N presses on an area of 0.40 m^2.

d The pressure inside a car tyre is 250 kPa (250 000 Pa). Calculate the total force exerted on the inner surface of the tyre if its surface area is 0.64 m^2.