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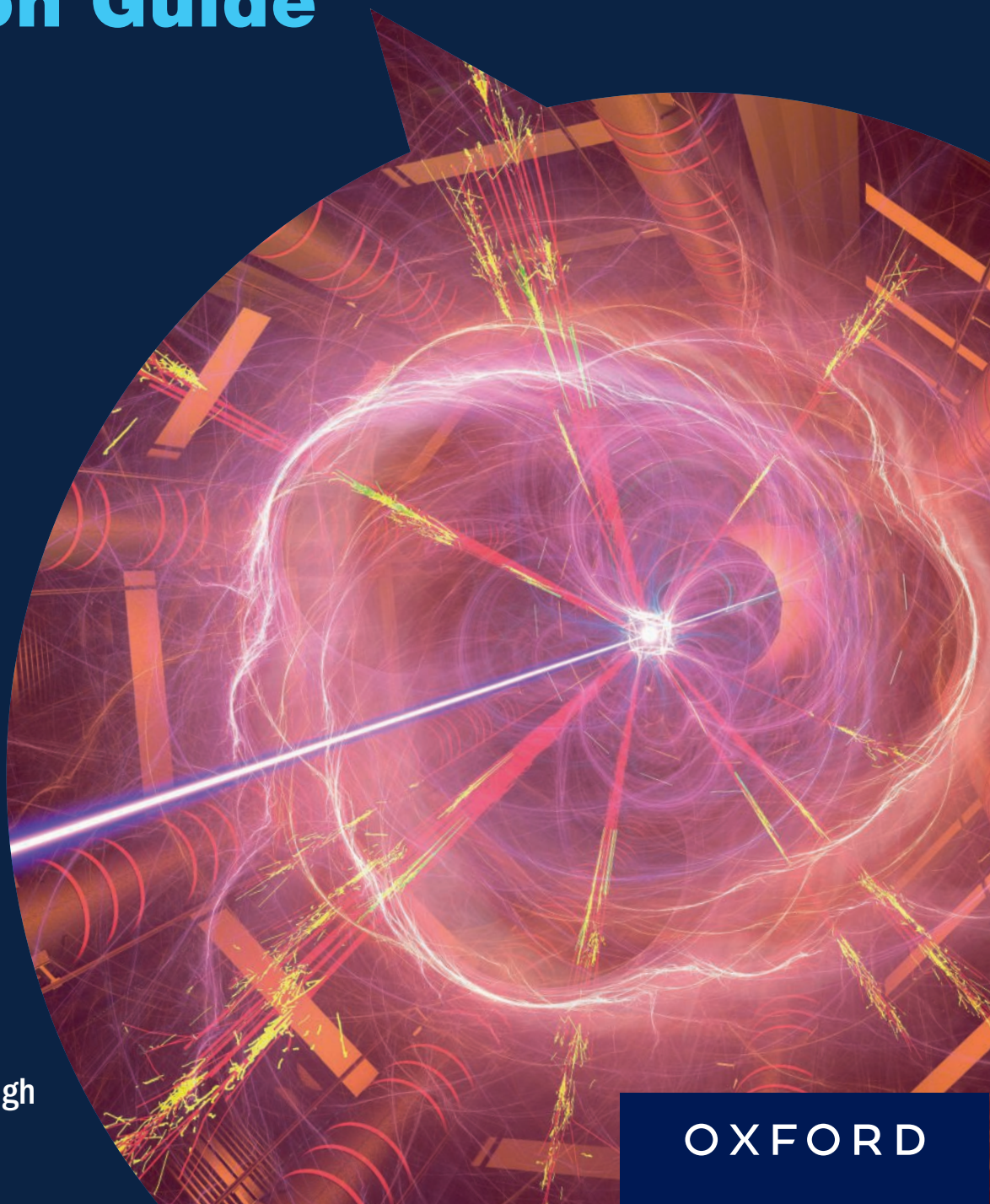
PHYSICS

Revision Guide



Helen Reynolds
Alom Shaha
Editor:
Primrose Kitten
Elizabeth McCullough

OXFORD

Contents

Knowledge Retrieval Practice

Shade in each level of the circle as you feel more confident and ready for your exam.

Answers

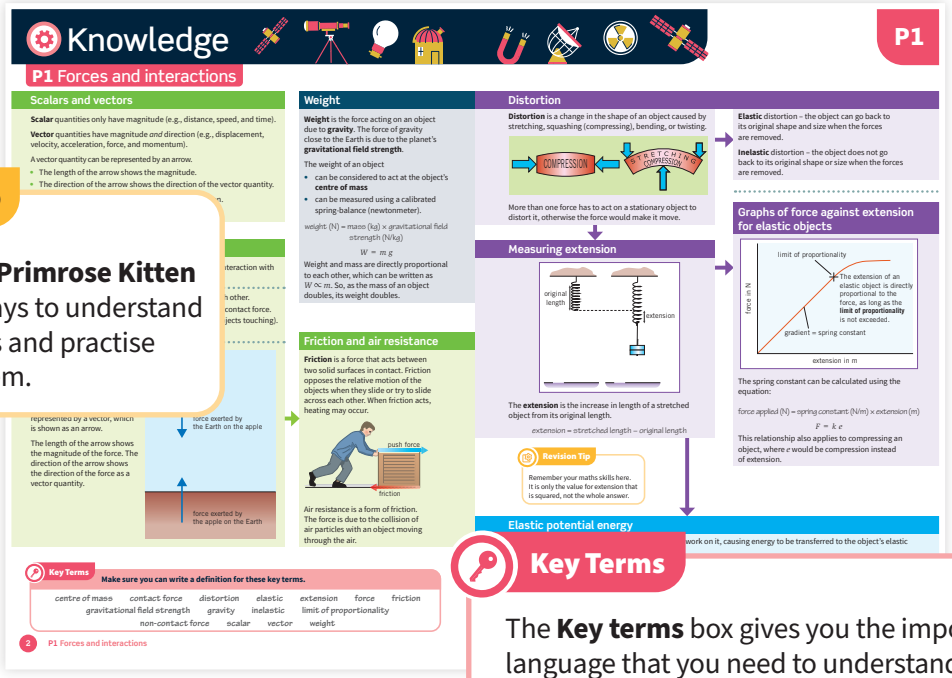
All of the **answers** are on the website at www.oxfordsecondary.com/oxfordaqa-revision

How to use this book

This book uses a three-step approach to revision: **Knowledge**, **Retrieval**, and **Practice**. It is important that you do all three; they work together to make your revision effective.

1 Knowledge

Knowledge comes first. Each chapter starts with a **Knowledge Organiser**. These are clear, easy-to-understand, concise summaries of the content that you need to know for your exam. The information is organised to show how one idea flows into the next so you can learn how all the science is tied together, rather than lots of disconnected facts.



Revision Tip

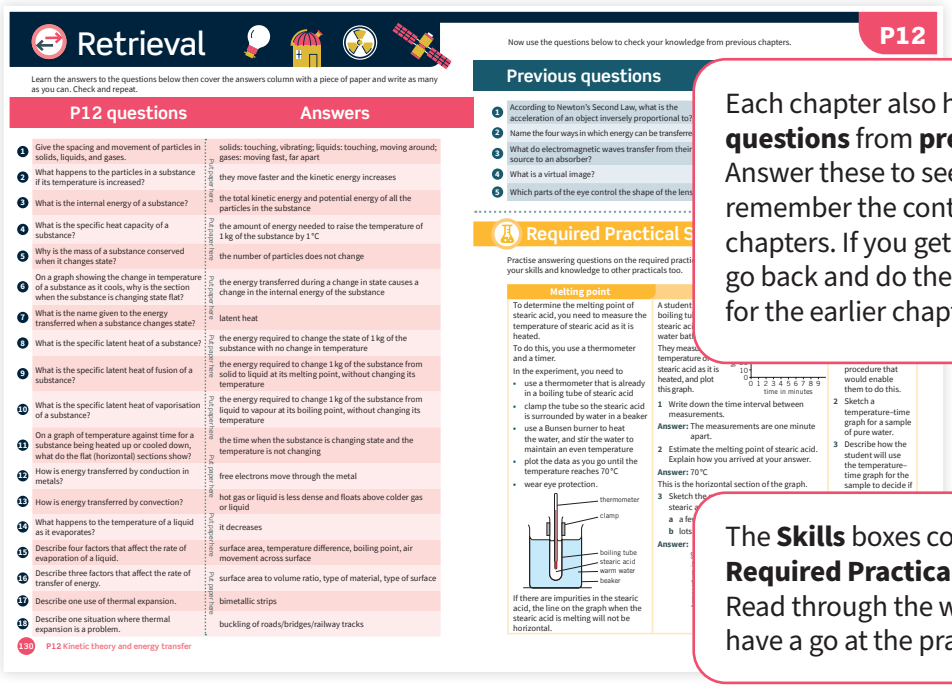
Revision tips by **Primrose Kitten** give you quick ways to understand the core concepts and practise remembering them.

Key Terms

The **Key terms** box gives you the important words and language that you need to understand and be able to use confidently.

2 Retrieval

The **Retrieval questions** help you learn and quickly recall the information you've acquired. These are short questions and answers about the content in the Knowledge Organiser. Cover up the answers with some paper; write down as many answers as you can from memory. Check back to the Knowledge Organiser for any you got wrong, then cover the answers and attempt *all* the questions again until you can answer all the questions correctly.



Each chapter also has some **Retrieval questions** from **previous chapters**. Answer these to see if you can remember the content from the earlier chapters. If you get the answers wrong, go back and do the Retrieval questions for the earlier chapters again.

The **Skills** boxes cover either a **Required Practical** or a key **Maths skill**. Read through the worked example then have a go at the practice questions.

Make sure you revisit the Retrieval questions on different days to help them stick in your memory. You need to write down the answers each time, or say them out loud, otherwise it won't work.

3 Practice

Once you think you know the Knowledge Organiser and Retrieval answers really well, you can move on to the final stage: **Practice**.

Each chapter has lots of **exam-style questions**, including some questions from previous chapters, to help you apply all the knowledge you have learnt and can retrieve.

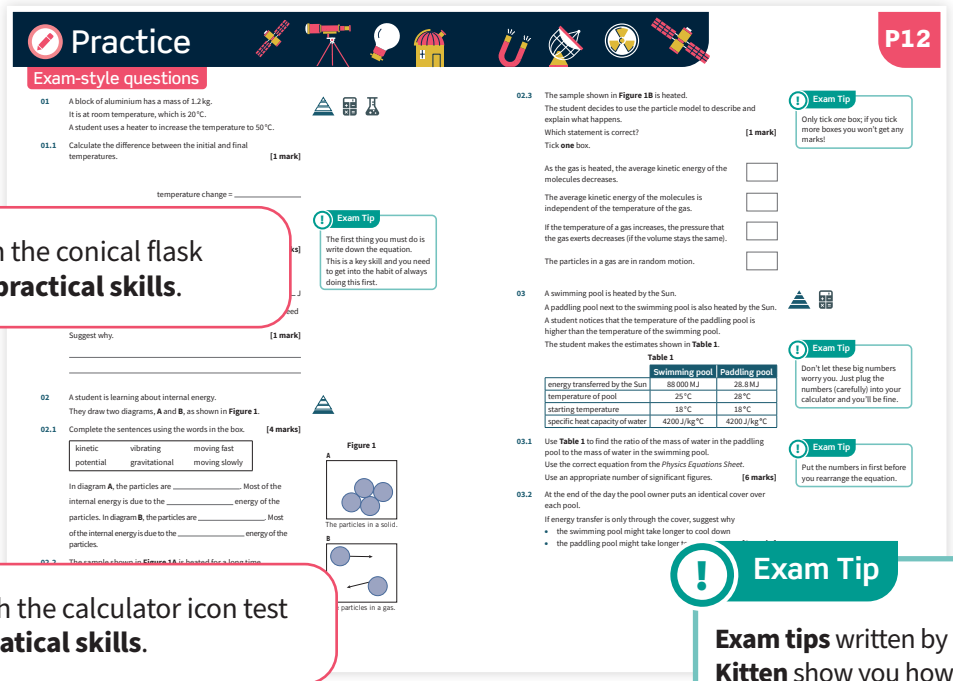
Each question has a difficulty icon that shows the level of challenge.

These questions build your confidence.

These questions consolidate your knowledge.

These questions stretch your understanding.

Make sure you attempt all of the questions no matter what grade you are aiming for.


Practice

P12

Exam-style questions

01 A block of aluminium has a mass of 1.2 kg.
It is at room temperature, which is 20 °C.
A student uses a heater to increase the temperature to 50 °C.

01.1 Calculate the difference between the initial and final temperatures. [1 mark]

temperature change = _____

Exam Tip
The first thing you must do is write down the equation. This is a key skill and you need to get into the habit of always doing this first.

Suggest why. [1 mark]

_____

_____

02 A student is learning about internal energy.
They draw two diagrams, **A** and **B**, as shown in **Figure 1**.

02.1 Complete the sentences using the words in the box. [4 marks]

kinetic	vibrating	moving fast
potential	gravitational	moving slowly

In diagram **A**, the particles are _____. Most of the internal energy is due to the _____ energy of the particles. In diagram **B**, the particles are _____. Most of the internal energy is due to the _____ energy of the particles.

Figure 1

A

The particles in a solid.

B

particles in a gas.

02.3 The sample shown in **Figure 1B** is heated.
The student decides to use the particle model to describe and explain what happens.
Which statement is correct? [1 mark]
Tick **one** box.

Exam Tip
Only tick *one* box; if you tick more boxes you won't get any marks!

As the gas is heated, the average kinetic energy of the molecules decreases. ☐

The average kinetic energy of the molecules is independent of the temperature of the gas. ☐

If the temperature of a gas increases, the pressure that the gas exerts decreases (if the volume stays the same). ☐

The particles in a gas are in random motion. ☐

03 A swimming pool is heated by the Sun.
A paddling pool next to the swimming pool is also heated by the Sun.
A student notices that the temperature of the paddling pool is higher than the temperature of the swimming pool.
The student makes the estimates shown in **Table 1**.

Table 1

	Swimming pool	Paddling pool
energy transferred by the Sun	88 000 MJ	28.8 MJ
temperature of pool	25 °C	28 °C
starting temperature	18 °C	18 °C
specific heat capacity of water	4200 J/kg °C	4200 J/kg °C

Exam Tip
Don't let these big numbers worry you. Just plug the numbers (carefully) into your calculator and you'll be fine.

03.1 Use **Table 1** to find the ratio of the mass of water in the paddling pool to the mass of water in the swimming pool.
Use the correct equation from the *Physics Equations Sheet*.
Use an appropriate number of significant figures. [6 marks]

Exam Tip
Put the numbers in first before you rearrange the equation.

03.2 At the end of the day the pool owner puts an identical cover over each pool.
If energy transfer is only through the cover, suggest why
- the swimming pool might take longer to cool down
- the paddling pool might take longer t

Questions with the conical flask icon test your **practical skills**.

Questions with the calculator icon test your **mathematical skills**.

Exam Tip

Exam tips written by **Primrose Kitten** show you how to interpret the questions, what you need to do in your answers, and advice on how to secure as many marks as possible.

Knowledge

P1 Forces and interactions

Scalars and vectors

Scalar quantities only have magnitude (e.g., distance, speed, and time).

Vector quantities have magnitude *and* direction (e.g., displacement, velocity, acceleration, force, and momentum).

A vector quantity can be represented by an arrow.

- The length of the arrow shows the magnitude.
- The direction of the arrow shows the direction of the vector quantity.

Displacement is the distance travelled in a given direction.

Velocity is speed with a direction.

Forces

A **force** can be a push or pull on an object caused by an interaction with another object. Forces are vector quantities.

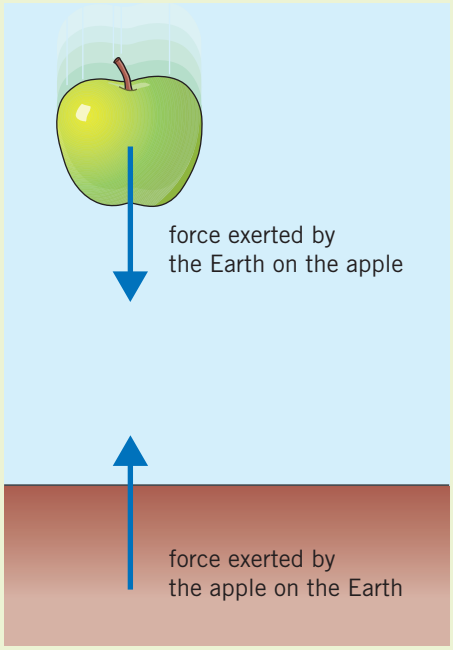
Contact forces occur when two objects are touching each other. For example, friction, air resistance, tension, and normal contact force.

Non-contact forces act at a distance (without the two objects touching). For example, gravity, electrostatics, and magnetism.

When an object exerts a force on another object, it will experience an *equal and opposite* force.

This means that forces always occur in pairs. Each force can be represented by a vector, which is shown as an arrow.

The length of the arrow shows the magnitude of the force. The direction of the arrow shows the direction of the force as a vector quantity.



Weight

Weight is the force acting on an object due to **gravity**. The force of gravity close to the Earth is due to the planet's **gravitational field strength**.

The weight of an object:

- can be considered to act at the object's **centre of mass**
- can be measured using a calibrated spring-balance (newtonmeter).

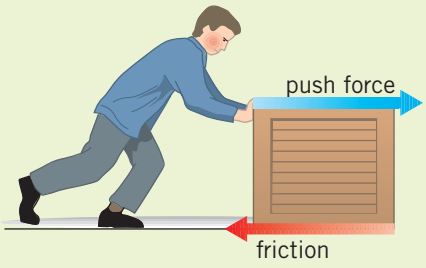
weight (N) = mass (kg) × gravitational field strength (N/kg)

$$W = m\,g$$

Weight and mass are directly proportional to each other, which can be written as $W \propto m$. So, as the mass of an object doubles, its weight doubles.

Friction and air resistance

Friction is a force that acts between two solid surfaces in contact. Friction opposes the relative motion of the objects when they slide or try to slide across each other. When friction acts, heating may occur.



Air resistance is a form of friction. The force is due to the collision of air particles with an object moving through the air.

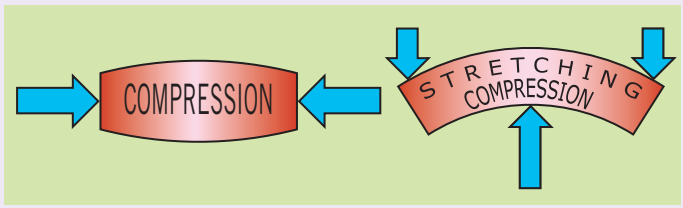
Key Terms

Make sure you can write a definition for these key terms.

centre of mass *contact force* *distortion* *elastic* *extension* *force* *friction* *gravitational field strength* *gravity* *inelastic* *limit of proportionality* *non-contact force* *scalar* *vector* *weight*

Distortion

Distortion is a change in the shape of an object caused by stretching, squashing (compressing), bending, or twisting.

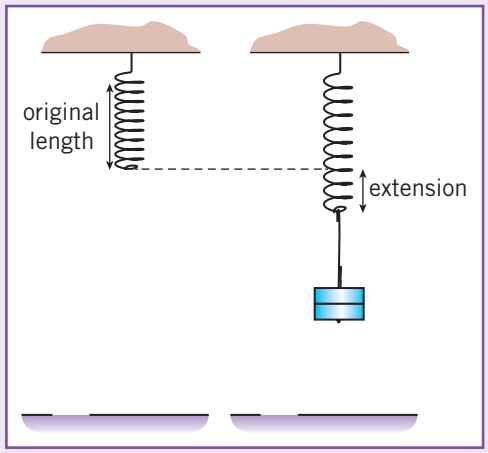


More than one force has to act on a stationary object to distort it, otherwise the force would make it move.

Elastic distortion – the object can go back to its original shape and size when the forces are removed.

Inelastic distortion – the object does not go back to its original shape or size when the forces are removed.

Measuring extension



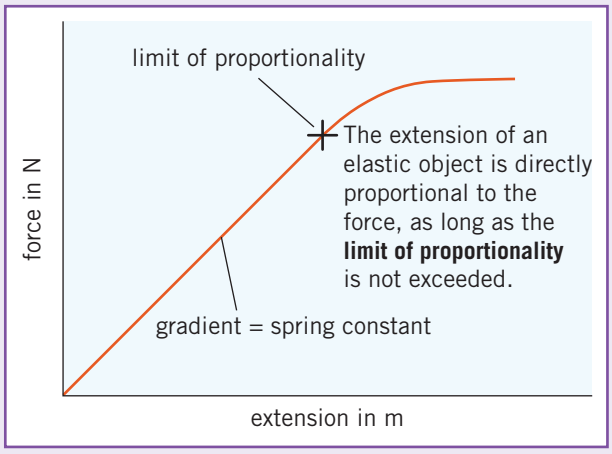
The **extension** is the increase in length of a stretched object from its original length.

extension = stretched length – original length

Revision Tip

Remember your maths skills here. It is only the value for extension that is squared, not the whole answer.

Graphs of force against extension for elastic objects



The spring constant can be calculated using the equation:

force applied (N) = *spring constant* (N/m) × *extension* (m)

$$F = k\,e$$

This relationship also applies to compressing an object, where e would be compression instead of extension.

Elastic potential energy

A force that stretches or compresses an object does work on it, causing energy to be transferred to the object's elastic potential energy.

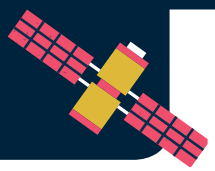
The elastic potential energy in an elastically stretched or compressed spring can be calculated using:

$$\text{elastic potential energy (J)} = \frac{1}{2} \times \text{spring constant (N/m)} \times (\text{extension})^2\ (\text{m}^2)$$

$$E_e = \frac{1}{2}\,k\,e^2$$

Retrieval



Learn the answers to the questions below then cover the answers column with a piece of paper and write as many as you can. Check and repeat.

	P1 questions		Answers
1	What is a scalar quantity?	Put paper here	only has size (magnitude)
2	Name three scalar quantities.		distance, speed, time
3	What is a vector quantity?		has both size and direction
4	Name three vector quantities.	Put paper here	three from: displacement, velocity, acceleration, force, momentum
5	What is a force?	Put paper here	a push or pull that acts on an object due to the interaction with another object
6	What is a contact force?	Put paper here	a force between objects that are physically touching (e.g., friction, air resistance, tension, normal contact force)
7	What is a non-contact force?	Put paper here	a force between objects that are physically separated (e.g., gravitational, electrostatic, magnetic)
8	What is the same about the interaction pair of forces when two objects interact with each other?	Put paper here	the forces are the same size
9	What is different about the interaction pair of forces when two objects interact with each other?	Put paper here	forces are in opposite directions
10	What is the name for the force acting on an object due to gravity?	Put paper here	weight
11	What instrument can be used to measure the weight of an object?	Put paper here	calibrated spring-balance (newtonmeter)
12	What two quantities do you need to calculate the weight of an object?	Put paper here	mass and gravitational field strength
13	What is elastic distortion?	Put paper here	an object can go back to its original shape and size when distorting forces are removed
14	What is inelastic distortion?		an object does not go back to its original shape and size when distorting forces are removed
15	How do you find the spring constant from a force–extension graph of a spring?	Put paper here	find the gradient of the straight-line section
16	On a force–extension graph, where is the limit of proportionality?		where the straight line starts to curve
17	What type of energy is stored in a spring?	Put paper here	elastic potential energy
18	What does the energy stored in a spring depend on?		spring constant and extension

Required Practical Skills

Practise answering questions on the required practicals using the example below. You need to be able to apply your skills and knowledge to other practicals too.

Extension of a spring

In this practical you measure the extension of a spring as different forces are applied to it.

To be accurate and precise you need to:

- measure extension using a pointer directed at the same position on the spring each time
- ensure the ruler is positioned so that it is parallel to the spring
- make measurements by looking in a direction perpendicular to the ruler
- convert mass to weight (force), if necessary
- use a measurement of zero force = zero extension
- use the equation

$$\text{gradient} = \frac{1}{\text{spring constant}}$$

for a graph of force against extension.

Worked example

A student records the following measurements for a spring.

Force in N						
Mass in kg	0	0.1	0.2	0.3	0.4	0.5
Length in cm	5.0	9.2	13.1	17.4	21	25
Extension in cm						

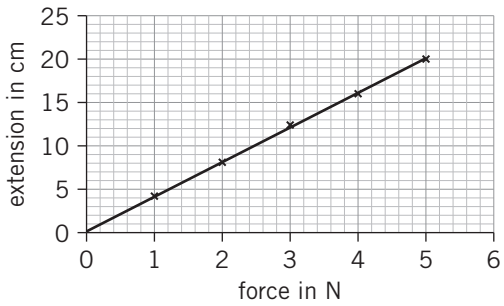
1 Calculate the spring extensions and forces.

weight (= force) = mass × gravitational field strength (= 10 N/kg)

extension = length – 5 (original length of spring)

Force in N	0	1	2	3	4	5
Extension in cm	0	4.2	8.1	12.4	16	20

2 Plot a graph of the results. Calculate the spring constant from your graph and give the unit.



$$\text{gradient} = \frac{20\,\text{cm}}{5\,\text{N}} = 4$$

$$\text{gradient} = \frac{1}{\text{spring constant}}$$

$$\text{so spring constant} = \frac{1}{\text{gradient}} = \frac{1}{4} = 0.25\,\text{N/cm or } 25\,\text{N/m}$$

Practice

1 A student measures an extension of 24 mm when they hang a 40 g mass on a spring. Calculate the spring constant in N/m. Show your working.

2 Compare the meaning of the gradient of a graph of force against extension with the meaning of the gradient of a graph of extension against force.

Practice

Exam-style questions

01 Force is a vector.

01.1 Select the correct definition of a vector. **[1 mark]**

Tick **one** box.

A vector has magnitude only. ☐

A vector has direction only. ☐

A vector has magnitude and direction. ☐

Exam Tip

Tick only one box here. Ticking two boxes (or all the boxes) will mean you won't get any marks, even if you pick the correct answer.

01.2 Some forces are contact forces and some are non-contact forces.

Here are some forces.

Circle the non-contact forces. **[2 marks]**

weight	air resistance	friction	magnetism

Exam Tip

Look at the number of marks given here. This is a two mark question so you need to circle two things.

01.3 Name a contact force that is not listed in **01.2**. **[1 mark]**

_____

02 Sometimes people confuse 'weight' and 'mass'.

02.1 Match the words on the left to their descriptions on the right.
You should draw **two** lines for each word. **[4 marks]**

Mass	is measured in kilograms.
Weight	is a measure of the force of gravity on an object.
	is measured in newtons.
	is a measure of the amount of material in an object or its reluctance to move when you apply a force.

02.2 Write down the name of the region around the Earth where the force of gravity acts on objects. **[1 mark]**

_____

02.3 Complete the sentences using the words in the box below. You may use each word once, more than once, or not at all. **[4 marks]**

weight	mass	N/kg	N	kg

To calculate the weight of an object, you need to know the _____ and gravitational field strength.

Gravitational field strength is measured in _____.

The weight of an object can be considered to act at a point, which we call the centre of _____.

You measure _____ with a newtonmeter.

03 A student investigates the extension of a spring.

03.1 Give the name of the pieces of equipment that they could use to measure force and extension. **[2 marks]**

03.2 Describe how they can use this equipment to make the measurements. **[4 marks]**

03.3 Explain why the student should take repeat measurements. **[1 mark]**

03.4 Suggest what the student should do if they see a result that does not fit with the pattern of their other results. **[1 mark]**

03.5 Describe the type of graph the student should plot.
Give reasons for your answer. **[2 marks]**

Exam Tip

The units for force and extension might give you a clue.

Exam Tip

If you only get one result, how do you know that it is the correct result?

04 A student watches a video about forces.
The video shows a piece of wood floating in a tank of water.

04.1 Write down the name of the non-contact force acting on the wood and the name of the contact force acting on the wood. **[2 marks]**

04.2 Write down whether the forces in **04.1** are scalar or vector. **[1 mark]**

04.3 In the video the presenter shows that a piece of wood from an ironwood tree will sink rather than float. The presenter shows this by placing the ironwood on the surface of the water. It moves down through the water until it reaches the bottom of the tank.
Give the name of **one** other force that is acting on the wood as it moves through the water.
Write down whether it is a contact or a non-contact force. **[2 marks]**

Exam Tip

This question has two parts – make sure you answer both.