Topic 4.5 Forces Revision Booklet

AQA GCSE Physics 8463 · Foundation & Higher



Name _____ Class _____ Target grade _____

4.5
Forces

Work through a topic, then come back to it on the dates in your planner. Little and often beats one long cram.

Revise like a scientist

This booklet uses six revision techniques that research shows work best. Every activity is labelled with the technique it uses and the grade it targets.

Retrieval practice

Pulling ideas out of your memory makes them stick far better than re-reading. Brain dumps, quizzes and cover-and-recall tasks.

Spaced practice

Revisit each topic after 2 days, 1 week and 3 weeks. Forgetting a little, then remembering again, strengthens memory.

Interleaving

Mixed-topic questions train you to spot which idea a question needs, just like the real exam.

Dual coding

Words plus diagrams: graphs, ray diagrams and labelled apparatus give your memory two routes in.

Elaboration

Asking 'why?' and 'how?' and linking ideas together turns facts into understanding.

Worked examples

I do → We do → You do: study a full solution, finish a half-done one, then do one alone.

KEY

Grade pathways

GRADE 4

Secure the basics: recall definitions and units, pick the right equation from the equation sheet, and do one-step calculations.

GRADE 5

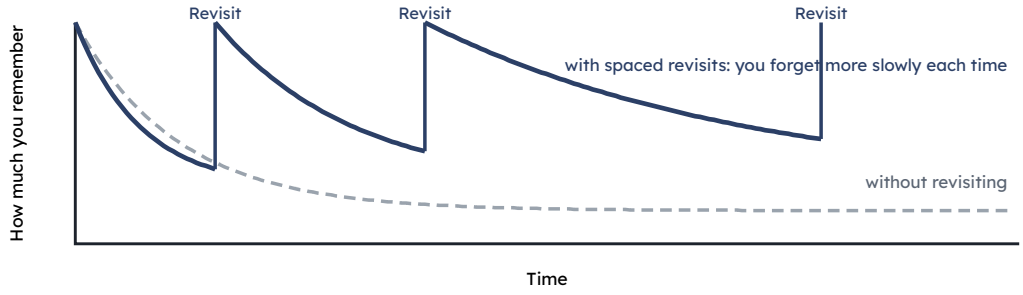
Rearrange equations, convert units, describe practicals and explain in two linked steps.

GRADE 7+

Multi-step calculations, evaluate methods and data, and write logical 6-mark answers.

SPACED PRACTICE DUAL CODING

Why spacing works



SPACED PRACTICE

My spaced revision planner

Write the date you'll do each session. Tick it off when it's done.

Topic	First go	+2 days	+1 week	+3 weeks	Before the mock
4.5 Forces					
Final review					

What's inside

Topic 5 · Forces (4.5)

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Final review

Final review: mixed questions	18

ROUTINE

The routine for every page

1. Try it cold. Answer from memory first, without notes. Struggling a bit is good: it's what makes learning stick.

2. Check and correct. Mark it with the answer booklet in a different colour pen. Fix every mistake.

3. Come back later. Redo anything you got wrong on your next spaced session.

ONLINE

Use it with mrsullyphysics.com

Flashcards for retrieval practice: cards you get wrong come back until you get them right.

Quizzes and Aim higher for extra Grade 5+ and 7+ questions with mark schemes.

Animations to see the physics move (dual coding).

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ A mechanic applies an 80 N force at right angles to the end of a 0.5 m spanner. Calculate the moment, and explain why pushing at an angle would produce a smaller moment. [3]

2 Grade 7+ Calculate the pressure due to a 5.0 m column of water, and explain why dams are thicker at the bottom. (density of water = 1000 kg/m³, g = 9.8 N/kg) [3]

3 The gradient of a velocity–time graph gives... [1]

A acceleration **B** distance **C** speed **D** force

Brain dump and checklist

RETRIEVAL PRACTICE | GRADE 4 | GRADE 5 | GRADE 7

Brain dump

Set a timer for 5 minutes. Write or draw everything you remember about forces. No notes! Afterwards, add anything you missed in a different colour.

Prompts if you get stuck: scalar/vector? · contact forces? · W = mg? · resultant force? · F = ke? · speed-time graphs? · Newton's laws? · stopping distance? · momentum?

METACOGNITION

How confident am I?

Rate each statement now (before) by shading R, A or G. Rate again at the end of the topic (after).

I can...	Before			After		
	R	A	G	R	A	G
Describe scalars and vectors, and contact and non-contact forces	○	○	○	○	○	○
Calculate weight (W = mg) and work done (W = Fs)	○	○	○	○	○	○
Calculate resultant forces, including with free body diagrams (vector diagrams: Higher)	○	○	○	○	○	○
Use F = ke and describe the force and extension practical (RP6)	○	○	○	○	○	○
Calculate moments and explain levers and gears (Physics only)	○	○	○	○	○	○
Calculate pressure in fluids and explain upthrust (Physics only)	○	○	○	○	○	○
Interpret distance–time and velocity–time graphs	○	○	○	○	○	○
Use $a = \Delta v \div t$ and $v^2 - u^2 = 2as$	○	○	○	○	○	○
Apply Newton's three laws and explain terminal velocity (RP7)	○	○	○	○	○	○
Explain the factors affecting thinking and braking distance	○	○	○	○	○	○
Use p = mv and conservation of momentum (Higher)	○	○	○	○	○	○

Extra practice

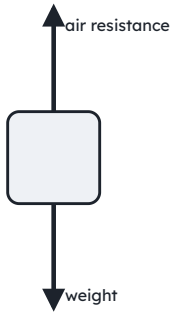
Retrieval · answers in the answer booklet

1 Fill the gap: The weight of an object acts through its centre of _____. [1]

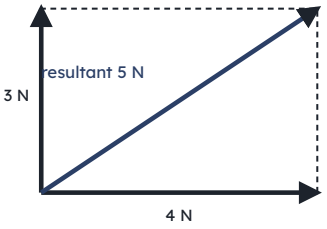
Knowledge organiser

DUAL CODING | GRADE 4 | GRADE 5 | GRADE 7

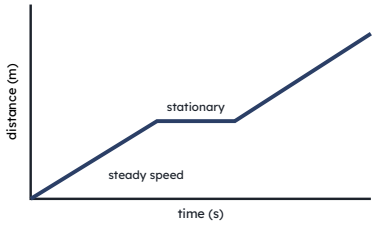
FORCES AND RESULTANTS · MOTION GRAPHS



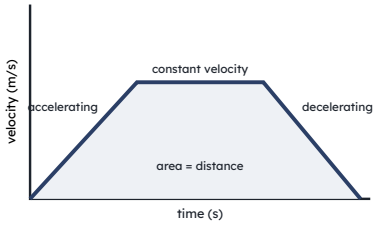
Free body diagram: skydiver



Vector diagram: forces added tip-to-tail (Higher)



gradient = speed



gradient = acceleration

KEY EQUATIONS: ALL GIVEN ON THE PHYSICS EQUATIONS SHEET IN THE EXAM

Equation	Quantities and units	Watch out
W = m g	weight (N), mass (kg), gravitational field strength (N/kg)	g = 9.8 N/kg on Earth
W = F s	work done (J), force (N), distance moved along the line of the force (m)	1 J = 1 N m
F = k e	force (N), spring constant (N/m), extension (m)	Only up to the limit of proportionality
M = F d	moment (N m), force (N), perpendicular distance from the pivot (m) (Physics only)	Perpendicular distance
p = F ÷ A	pressure (Pa), force normal to the surface (N), area (m^2) (Physics only)	1 Pa = 1 N/m^2
p = h ρ g	pressure (Pa), height of column (m), density (kg/m^3), g (N/kg) (Physics only, Higher)	Pressure increases with depth
s = v t	distance (m), speed (m/s), time (s)	km → m, minutes → s
a = Δv ÷ t	acceleration (m/s^2), change in velocity (m/s), time (s)	Negative a = deceleration
$v^2 - u^2 = 2$ a s	final velocity (m/s), initial velocity (m/s), acceleration (m/s^2), distance (m)	Square the velocities
F = m a	resultant force (N), mass (kg), acceleration (m/s^2)	Use the resultant force
p = m v	momentum (kg m/s), mass (kg), velocity (m/s) (Higher)	Momentum has a direction
F = m Δv ÷ Δt	force (N) = rate of change of momentum (Higher)	Longer time → smaller force

TURN OVER

Key words, misconceptions, required practicals and Grade 7+ links are on the next page.

Knowledge organiser: key words, misconceptions, practicals

ELABORATION GRADE 4 GRADE 5 GRADE 7

KEY WORDS: LEARN THESE WORD FOR WORD (SAME AS SIDE 2 OF YOUR KNOWLEDGE ORGANISER)

Scalar: size only (speed, distance, mass, energy, time).
Vector: size and direction (velocity, displacement, force, acceleration, momentum).
Weight: the force acting on an object due to gravity; acts at the centre of mass.
Resultant force: a single force that has the same effect as all the original forces acting together.
Work done: energy transferred when a force moves an object through a distance.
Limit of proportionality: the point beyond which extension is no longer proportional to force.
Terminal velocity: the constant velocity reached when the resultant force on a falling object is zero.
Newton's First Law: if the resultant force is zero, a stationary object stays still and a moving object continues at the same velocity.
Newton's Second Law: acceleration is proportional to the resultant force and inversely proportional to the mass (F = ma).
Newton's Third Law: whenever two objects interact, the forces they exert on each other are equal and opposite.
Inertia (Higher): the tendency of objects to continue in their state of rest or of uniform motion.
Stopping distance: thinking distance (during reaction time) + braking distance (under the braking force).

MISCONCEPTIONS: SPOT THE MISTAKE

× Common mistake	✓ What's actually true
× A moving object needs a resultant force.	✓ Constant velocity means zero resultant force (Newton's First Law).
× Mass and weight are the same.	✓ Mass (kg) doesn't change; weight (N) depends on g.
× Third Law pairs cancel out.	✓ They act on different objects, so they can't cancel.

RP6: FORCE AND EXTENSION

Aim: Investigate how adding weights affects the extension of a spring.
Change: Force (weight added) · **Measure:** Extension · **Control:** Same spring
Must include: Measure the original length; Calculate extension, not just length; Add equal force steps; Plot force against extension.
Common mistake: Plotting length instead of extension.

RP7: ACCELERATION

Aim: Investigate how force and mass affect the acceleration of an object.
Change: Force (or mass) · **Measure:** Acceleration · **Control:** Mass (when changing force), force (when changing mass), surface
Must include: Investigate both effects: varying force at constant mass, and varying mass at constant force; Identify which variable is changed and which is kept constant; Keep the total mass constant when changing force; Measure acceleration with light gates or timings.
Common mistake: Adding masses to the hanger without removing them from the trolley.

AIM FOR GRADE 7+

- $v^2 - u^2 = 2as$ for braking distances; $F = m\Delta v \div \Delta t$ for collisions (Higher).
- Explain terminal velocity in steps: forces → resultant → acceleration.
- Describe RP7 with how to keep the investigation valid (constant total mass).

Extra practice

Retrieval · answers in the answer booklet

1 Which of these increases thinking distance? [1]

A An icy road **B** Worn tyres **C** Using a phone while driving **D** Worn brakes

RETRIEVAL PRACTICE | SPACED PRACTICE | GRADE 4 | GRADE 5

Equation sheet skills: which equation, which unit?

Every equation is on the Physics Equations Sheet, but it won't tell you which one a question needs or what unit the answer has. Cover the knowledge organiser and fill in the table. Redo it on another day.

Situation	Which equation?	Unit of the answer	Redo 1 ✓/×	Redo 2 ✓/×
Weight of an astronaut on the Moon (g = 1.6 N/kg)				
Work done pushing a trolley along a corridor				
Stretch of a spring from the force applied				
Turning effect of a spanner				
Deceleration of a car braking to a stop				
Momentum of a moving lorry				

RETRIEVAL PRACTICE | GRADE 4 | GRADE 5

Fill the gaps

Use the AQA key words. No word bank: that's the point.

1. A quantity with both size and direction is a _____ quantity.
2. Weight is the force acting on an object due to _____.
3. If the resultant force on an object is zero, it stays at rest or moves at a constant _____.
4. Stopping distance = thinking distance + _____ distance.
5. In a closed system, the total momentum before an event equals the total momentum _____ the event.

ELABORATION | GRADE 5

Odd one out

Circle the odd one out in each row and explain why.

1. speed · distance · mass · velocity

2. tiredness · alcohol · icy road · distractions

3. N · kg · N/kg · m/s²

Extra practice

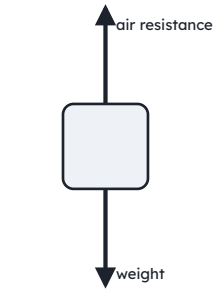
Retrieval · answers in the answer booklet

1 True or false? Thinking distance increases if the driver is tired. Explain. [2]

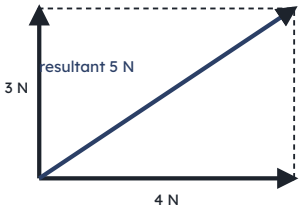
DUAL CODING GRADE 4 GRADE 5 GRADE 7

Forces on a parachutist

A skydiver jumps from a plane and later opens her parachute.



Free body diagram: skydiver



Vector diagram: forces added tip-to-tail (Higher)

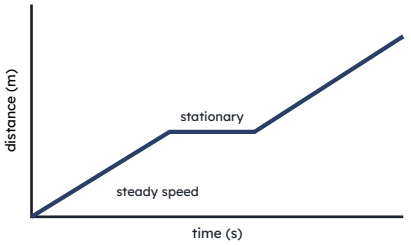
a Just after she jumps, why does she accelerate? [1]

b Explain why she reaches terminal velocity. [3]

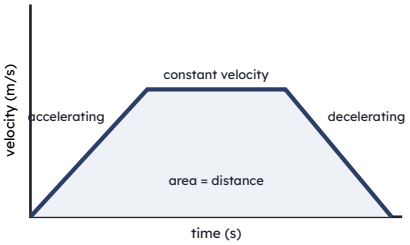
c Explain what happens when she opens the parachute. [2]

DUAL CODING GRADE 4 GRADE 5 GRADE 7

Read the motion graphs



gradient = speed



gradient = acceleration

a What does the gradient of a distance–time graph show? [1]

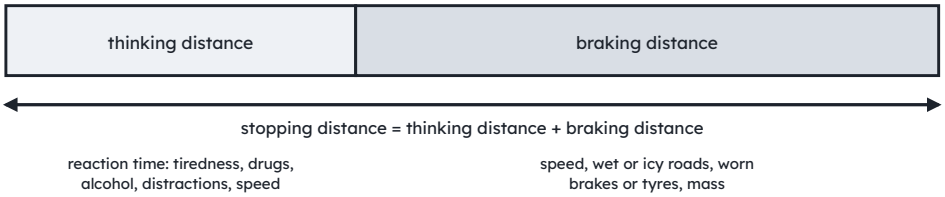
b What does the area under a velocity–time graph show? (Higher) [1]

c A velocity–time graph is a horizontal line. Describe the motion. [1]

Picture it (continued)

ELABORATION GRADE 5 GRADE 7

Stopping safely



a Give two factors that increase braking distance. [2]

b Explain why braking hard from a high speed can be dangerous. [3]

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 A cyclist accelerates from 2 m/s to 8 m/s in 4 s. Calculate the acceleration. [3]

2 Grade 7+ In a crash, a 70 kg driver slows from 15 m/s to rest in 0.1 s when stopped by an airbag. Calculate the force and explain why an airbag reduces injury. [4]

3 Grade 7+ A 60 kg skater moving at 4 m/s grabs hold of a stationary 40 kg skater, and they move off together. Calculate their velocity. [4]

WORKED EXAMPLES GRADE 4 GRADE 5

Resultant force and acceleration

I do (worked example)

A 1500 kg car: driving force 4000 N, drag 1000 N. Calculate a.

1. Resultant = 4000 − 1000 = 3000 N

2. a = F ÷ m = 3000 ÷ 1500

3. **a = 2 m/s²**

We do (finish it)

A 60 kg skater, push 150 N, friction 30 N.

1. Resultant = ___ N

2. a = 120 ÷ ___

3. a = ___ m/s²

You do

Force to accelerate 0.2 kg at 15 m/s².

WORKED EXAMPLES GRADE 4 GRADE 5

Work done and weight

I do (worked example)

A 40 kg box is lifted 2 m. Work done? (g = 9.8)

1. W = m g = 40 × 9.8 = 392 N

2. Work = F s = 392 × 2

3. **= 784 J**

We do (finish it)

A 25 N force moves a sledge 30 m.

1. W = 25 × ___

2. W = ___ J

You do

Mass of an object with weight 49 N on Earth.

WORKED EXAMPLES GRADE 7

Equation of motion (Grade 7+)

Use $v^2 - u^2 = 2 a s$ (given on the Physics Equations Sheet).

1 A car travelling at 20 m/s brakes with a deceleration of 5 m/s². [3]

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 A 30 N force pushes a box 4 m along the floor. Calculate the work done. [2]

WORKED EXAMPLES | GRADE 5 | GRADE 7

Momentum (Higher)

I do (worked example)

A 0.15 kg ball moves at 40 m/s. Calculate p.

1. p = m v
2. p = 0.15 × 40
3. **p = 6 kg m/s**

We do (finish it)

An 80 kg runner at 7 m/s.

1. p = 80 × ___
2. p = ___ kg m/s

You do

A 2000 kg van has p = 30 000 kg m/s. Calculate v.

WORKED EXAMPLES | GRADE 4 | GRADE 5

Springs

I do (worked example)

A 6 N force stretches a spring 0.04 m. Calculate k.

1. F = k e, so k = F ÷ e
2. k = 6 ÷ 0.04
3. **k = 150 N/m**

We do (finish it)

k = 40 N/m, stretched 0.25 m. Calculate F.

1. F = 40 × ___
2. F = ___ N

You do

k = 200 N/m, F = 8 N. Calculate e in cm.

ELABORATION | GRADE 5

Spot the mistake

Each student has made one mistake. Find it and correct it.

1 Pip: "My mass is 600 N." [1]

2 Raj: "A car moving at a constant speed round a bend has a constant velocity." [1]

3 Sam: "Moment = 20 N × 30 cm = 600 N m." [2]

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ A car travelling at 20 m/s brakes with a deceleration of 5 m/s². Calculate its braking distance. [3]

2 True or false? An object moving at a constant velocity has a resultant force of zero. Explain. [2]

Why? How? Explaining forces

ELABORATION GRADE 4 GRADE 5 GRADE 7

Build an explanation

Answer each question in two steps. Use the starter, then push yourself with the Grade 7+ extension.

1 Explain why a seatbelt reduces injuries in a crash. (Higher)

Grade 4–5 starter: "The seatbelt stretches, so the time taken for the passenger to stop…"

Grade 7+ extension: "Link to force and rate of change of momentum:…"

2 Explain why an object moving in a circle at a constant speed is accelerating. (Higher)

Grade 4–5 starter: "Velocity is a vector, so…"

Grade 7+ extension: "Link to the resultant force:…"

3 Explain why the pressure on a diver increases as she swims deeper. (Physics only)

Grade 4–5 starter: "At a greater depth, the column of water above her…"

Grade 7+ extension: "Use $p = h\rho g$:…"

ELABORATION GRADE 5

True or false? Justify it.

Saying why is worth more marks than saying true or false.

4 "A heavy object always falls faster than a light one." [2]

5 "If an object is moving, there must be a resultant force on it." [1]

DUAL CODING | WORKED EXAMPLES | GRADE 4 | GRADE 5 | GRADE 7

RP6: stretching a rubber band

A student hangs masses on a rubber band and measures its extension.

Force (N)	0	1	2	3	4	5	6
Length (cm)	8.0	9.0	10.1	11.0	12.4	14.3	16.9
Extension (cm)							



a Complete the extension row and plot the graph. [3]

b Up to what force does the rubber band obey Hooke's law? Explain. [2]

c Use the linear part to find the spring constant in N/m. [2]

d How should the student measure the length accurately? [2]

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ A spring extends by 4 cm when a 2 N force is applied. Calculate the spring constant, then the force needed for an extension of 10 cm (within the limit of proportionality). [3]

RP7: mass

RETRIEVAL PRACTICE | ELABORATION | GRADE 5 | GRADE 7

RP7: acceleration and mass

A trolley is pulled by a constant force of 1.0 N. Masses are added to the trolley.

Total mass (kg)	0.50	0.75	1.00	1.25	1.50
Acceleration (m/s²)	1.96	1.31	0.99	0.81	0.66
mass × acceleration (N)					

a Complete the bottom row. What does it show? [2]

b Why is the pulling force kept the same? [1]

c The acceleration is measured using light gates. Why is this better than a stopwatch? [2]

d Suggest why mass × acceleration is slightly less than 1.0 N. [1]

e Predict the acceleration of a 2.0 kg trolley with the same force. [1]

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 Explain why a car's braking distance increases on an icy road. [3]

2 Grade 7+ A train accelerates uniformly from 5 m/s to 25 m/s over a distance of 400 m. Calculate its acceleration. [4]

3 Define **contact forces**. [1]

Exam practice

GRADE RADE 4

Secure the basics

1 State the unit of weight. [1]

2 Give an example of a contact force. [1]

3 Calculate the speed of a cyclist who travels 150 m in 30 s. [2]

4 Name the type of quantity that has size only. [1]

5 What is the typical walking speed of a person? [1]

GRADE RADE 5

Apply and rearrange

6 A car accelerates from 5 m/s to 25 m/s in 8 s. Calculate its acceleration. [2]

7 Explain how a driver's reaction time affects the stopping distance. [2]

8 A 30 N force acts 0.4 m from a pivot. Calculate the moment. (Physics only) [2]

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 A person pushes a box with a force of 200 N for 15 m. Calculate the work done. [2]

2 Grade 5 An astronaut has a mass of 60 kg. Calculate their weight on the Moon. (g on the Moon = 1.6 N/kg) [2]

Exam practice (continued)

GRADE RADE 7+

Stretch

9 A 1200 kg car moving at 15 m/s collides with a stationary 800 kg car. They move off together. Calculate their velocity just after the collision. (Higher) [4]

10 Describe how to investigate how the mass of a trolley affects its acceleration. Include how to make the results valid. [6]

Total: _____ / 22

RETRIEVAL PRACTICE SPACED PRACTICE GRADE 4

Quick-fire retrieval: Forces

Cover everything. Answer in under 3 minutes. Redo it on your next spaced session.

1 Unit of momentum?

2 Weight = ?

3 Newton's First Law?

4 Typical reaction time?

5 Gradient of v–t graph?

6 Vector: speed or velocity?

Extra practice

Retrieval · answers in the answer booklet

1 Grade 5 Calculate the weight of a 5 kg bag. (g = 9.8 N/kg) [2]

Reflect and plan

METACOGNITION

Re-rate yourself

Go back to the checklist at the start of this topic and fill in the 'After' column.

METACOGNITION GRADE 4 GRADE 5 GRADE 7

Exam wrapper: why did I drop marks?

After marking the exam practice, write the question numbers you got wrong in the right row.

Reason I lost marks	Question numbers	What to do next
I didn't know or remember it (knowledge gap)		Flashcards and brain dumps
I knew it but misread the question or command word		Underline command words
Maths slip: units, rearranging, standard form		Redo the "we do / you do" pages
I ran out of time or didn't finish		Timed practice: 1 mark per minute

METACOGNITION

Two things I'm now confident about

METACOGNITION

One thing I still need to work on, and how I'll fix it

e.g. 'Rearranging equations → redo the Grade 7+ questions and use the website's Aim higher section.'

SPACED PRACTICE

Book my next spaced sessions

Write the dates in the planner at the front: +2 days, +1 week, +3 weeks.

Extra practice

Retrieval · answers in the answer booklet

1 Define **equation: weight**. [1]

RETRIEVAL PRACTICE | SPACED PRACTICE | GRADE 4 | GRADE 5 | GRADE 7

Final review: test yourself on the whole topic

Do these without your notes, a week after finishing the booklet. Mark them with the answer booklet and add any you got wrong to your 'still to learn' list on the reflect page.

Each question shows its target grade. Aim to get every Grade 4 and 5 question right before moving on to Grade 7+.

Extra practice

Retrieval · answers in the answer booklet

1 Grade 7+ Explain why doubling a car's speed more than doubles its stopping distance. [4]

2 Grade 7+ Explain why a skydiver slows down when the parachute opens and then reaches a new, lower terminal velocity. [4]

3 Grade 5 State Newton's First Law and use it to explain why a car moving at a constant velocity has no resultant force on it. [3]

4 Grade 7+ A car travelling at 20 m/s brakes with a deceleration of 5 m/s². Calculate the braking distance. [4]