[MATHS] – FEEDFORWARD

Reflect. Improve. Develop.

KEY

- **Feedforward Target** — What to improve next.
- **Student Development** — Student reflection and response.
- **What I Did Well** — Student success.
- **Teacher Feedback** — Teacher guidance.
- **My Feedforward Target** — Student's chosen next step.

KO1: BIDMAS PREP 3

FEEDFORWARD TARGETS

Tick the targets that apply to your work for BIDMAS Prep 3.

	Target	What this means
☐	I can use BIDMAS to work out expressions in the correct order.	I will follow the order: Brackets, Indices, Division, Multiplication, Addition, Subtraction.
☐	I can identify and correct mistakes in evaluations.	I will check each step carefully and find where the mistake has been made.
☐	I can insert brackets, signs or square roots to make statements true.	I will choose the correct symbol or root to make each statement correct.
☐	I can decide if statements are true or false and explain my answer.	I will check my working and explain clearly why it is true or false.
☐	I can solve problems involving BIDMAS in real-life contexts.	I will apply my skills to word problems and show all my working.
☐	I can solve challenge problems involving indices and more complex expressions.	I will use my understanding to solve harder problems and show all my working.

WHAT I DID WELL

Today I successfully...

DEVELOPMENTAL FEEDBACK

Next time I need to...

(Student completes in green pen.)

TEACHER FEEDBACK

MY FEEDFORWARD TARGET

From the targets above, choose ONE target for this KO.

My target is: _____

_____

Small improvements → stronger learning.

SELF-QUIZZING
— TO STRENGTHEN MATHS MEMORY —

Self-Quizzing Routine

- Cover your learning box and answer the questions from memory.
- Do not look at your notes – think hard.
- After answering the questions, check the learning box and correct anything you missed.
- Repeat this three times.
- Then leave a one-day-gap and test yourself again to see what you remember.

Retrieval means pulling information out of your memory without looking **at your notes.** Each time you do this, you make the memory in your brain stronger.

KO1 – BIDMAS

WHAT DO I KNOW?
Declarative Knowledge

1. What does BIDMAS stand for?
2. Which operation has the highest priority?
3. Which operations have the same priority?
4. In which direction should you work when the priority is the same?
5. What are brackets used for?

HOW DO I USE IT?
Procedural Knowledge

1. Work out: $7 + 3 \times 2$
2. Work out: $(8 - 2) \times 5$
3. Work out: $24 \div (3 + 3)$
4. Work out: $2^3 + 4 \times 2$
5. Work out: $18 - 6 \div 3 + 2$

WHEN DO I USE IT?
Conditional Knowledge

1. When might I need to use brackets?
2. Why is it important to do multiplication before addition?
3. When might I come across powers in calculations?
4. When is it helpful to check my answer?
5. When should I write steps in my working?

WHAT MISTAKE SHOULD I AVOID?
Metacognitive Knowledge

1. What mistake happens if I do addition before multiplication?
2. What mistake happens if I skip a step?
3. What mistake happens if I forget the brackets?
4. Why is it important to read the question carefully before starting?
5. What mistake happens if I get the order of operations wrong?

WHEN TO USE THIS

- When solving calculations with mixed operations.
- When simplifying expressions.
- When working with indices (powers).
- When checking and explaining answers.

THINKING QUESTIONS

1. Why do we do multiplication and division before addition and subtraction?
2. How can brackets change the answer?
3. What could happen if you ignore the order?

METHOD STEPS

1. Look for any brackets. Do them first.
2. Look for any indices (powers/roots). Do them next.
3. Do multiplication and division from left to right.
4. Do addition and subtraction from left to right.
5. Check your answer.

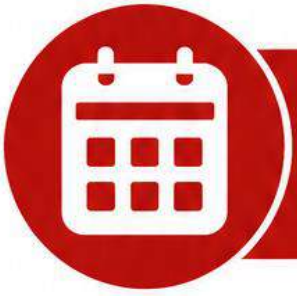
LINK TO MATHEMATICAL PURPOSE

BIDMAS is used in all areas of maths and many real-life situations. Following the correct order helps us get the right answer and avoid mistakes.

The more you retrieve, the stronger your maths memory!

POST TASK

Please complete the task set on MathsWatch.



WEEK 6

PREP LEARNING BOX

KO 1: MONEY PROBLEMS

YEAR 9 MATHS

GOLDEN THREAD

Money problems use the four operations to solve real-life situations.

They help us understand budgeting, shopping, discounts, tax and profit.

KEY STEPS

- ✓ Read the question carefully.
- ✓ Identify what you need to find.
- ✓ Choose the correct operation(s).
- ✓ Check the units (£, p).
- ✓ Show your working clearly.

COMMON MONEY WORDS

Word	What it means
Total	Add
Difference	Subtract
Cost / Price	The amount paid
Each	Divide equally
Times / Multiply	Repeated addition
Discount	Take money off the price
Increase	Add a percentage
Decrease	Take away a percentage
Change	Amount left after paying

REMEMBER

- ✓ Always check the units: £ and p.
- ✓ Convert pence to pounds when needed: 100p = £1
- ✓ Use decimals for pounds and pence (e.g. £3.45).
- ✓ Read the question carefully and plan before you calculate.

KEY INFORMATION

Remember, £1 is made of 100 pence (or 100).

Pounds can be written as pence, for example £3.15 can be written as $315p$.

Pence can be written as pounds, for example $27p$ can be written as £0.27.

UK coins are $1p$, $2p$, $5p$, $10p$, $20p$, £1 and £2.

The UK notes are £5, £10, £20 and £50.

MONEY PROBLEMS

KO 1: MONEY PROBLEMS

YEAR 9 MATHS

1 EXAMPLE 1 (Correct)

A pack of 6 drinks costs £3.60.

A pack of 10 drinks costs £5.50.

Which is the better buy?

£3.60 ÷ 6 = £0.60 per drink

£5.50 ÷ 10 = £0.55 per drink

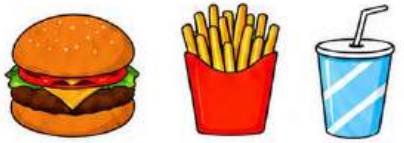
£3.60 £5.50

Best buy: Pack of 10 drinks

2 EXAMPLE 2 (Correct)

Aisha buys:

- Burger £6.80
- Chips £2.40
- Drink £1.90



She pays with £20.

How much change does she receive?

Total = £6.80 + £2.40 + £1.90 = £11.10

Change = £20.00 − £11.10 = £8.90

Change = £8.90

NON EXAMPLE (Incorrect)

A coat costs £60.

It is reduced by 25%.

25% of £60 = £15

New price = £60 + £15 = £75

This is incorrect because a discount means the amount is taken away, not added.

- ✓ Use the four operations carefully.
- ✓ Read the question and check the units.
- ✓ Look for keywords (e.g. total, difference, discount, change, each, times).
- ✓ Show your working and check your answer.
- ✓ Use real-life context to help you reason your answer.

PREP TASK

KO 1: MONEY PROBLEMS

YEAR 9 MATHS

1 BEST BUY

For each pair of offers, work out the cost per item and decide which is the best buy.
Show your working.

a) Pack A: 8 chocolate bars for £3.20
Pack B: 12 chocolate bars for £4.80

b) Pack A: 4 cans of cola for £2.00
Pack B: 10 cans of cola for £4.50

c) Pack A: 3 packets of crisps for £1.35
Pack B: 6 packets of crisps for £2.40

2 MENU & CHANGE

Work out the total cost and how much change is required.
Show your working.

a) Sandwich £3.45, Chips £1.80, Drink £1.25
Pay with £10.

b) Burger £5.60, Chips £2.20, Drink £1.50
Pay with £20.

c) Pizza £8.75, Garlic bread £2.85, Drink £1.40
Pay with £20.

PREP TASK

KO 1: MONEY PROBLEMS

YEAR 9 MATHS

3 DIRECT PROPORTION

Use direct proportion to solve the problems.
Show your working.

a) 5 pens cost £4.75.
How much do 9 pens cost?

b) 7 cinema tickets cost £52.50.
How much do 12 tickets cost?

c) 3 kg of potatoes cost £2.55.
How much do 8 kg cost?

4 DISCOUNTS

Answer the questions.
Show your working.

a) A coat costs £120. It is reduced by 25%.
How much does it cost now?

b) A pair of trainers costs £80.
They are in a sale with 15% off.
How much do they cost now?

c) A TV costs £450. It is reduced by 20%.
How much does it cost now?

PREP TASK

KO 1: MONEY PROBLEMS

YEAR 9 MATHS

1 MULTI-STEP MONEY PROBLEMS

Solve the problems. Show all your working.

a) You buy a coat for £85 with 20% off.
Then you pay £4.95 for delivery.
How much do you pay in total?

b) You spend £45 on clothes and £28 on shoes.
You have a 10% discount voucher for the total.
How much do you pay?

2 EXCHANGE RATES

Use the exchange rate given to answer the questions.
Show your working.

a) £1 = $1.25
You exchange £320 into dollars.
How many dollars do you get?

b) £1 = €1.15
You have €690.
How many pounds is this?

3 TAX AND VAT

Answer the questions. Show your working.

a) A laptop costs £600 including 20% VAT.
What is the price before VAT?

b) A smartphone costs £420 before VAT.
What is the price including 20% VAT?

4 WORD PROBLEMS

Solve the problems. Show all your working.

a) A group of 5 friends go to a restaurant.
The bill is £87.50.
They add a 10% tip.
How much does each person pay?

b) You earn £240.
You spend 35% on rent and 20% on food.
How much money do you have left?

[MATHS] – FEEDFORWARD

Reflect. Improve. Develop.

KEY

- **Feedforward Target** — What to improve next.
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- **What I Did Well** — Student success.
- **Teacher Feedback** — Teacher guidance.
- **My Feedforward Target** — Student's chosen next step.

KO1: MONEY PROBLEMS

FEEDFORWARD TARGETS

Tick the targets that apply to your work for these Prep Tasks.

	Target	What this means
☐	I can choose the best buy by comparing costs and value.	I will compare prices and unit costs and explain which option is the best buy.
☐	I can calculate the total cost after a change is made.	I will work out new totals when items, prices or amounts are changed.
☐	I can solve problems using direct proportion.	I will use the unit rate to find the cost for any quantity.
☐	I can solve problems involving discounts.	I will find the discounted price and the amount saved.
☐	I can solve multi-step money problems.	I will complete each step carefully and show all my working.
☐	I can work with exchange rates.	I will convert between pounds and dollars using the given rate.
☐	I can calculate prices including VAT.	I will find the price before VAT and the price including VAT.
☐	I can solve word problems involving money in real-life situations.	I will read the question carefully, plan my steps and check my answer.

WHAT I DID WELL

Today I successfully...

DEVELOPMENTAL FEEDBACK

Next time I need to...

(Student completes in green pen.)

TEACHER FEEDBACK

MY FEEDFORWARD TARGET

From the targets above, choose ONE target for this KO.

My target is: _____

_____

Small improvements → stronger learning.

SELF-QUIZZING
— TO STRENGTHEN MATHS MEMORY —

Self-Quizzing Routine

- Cover your learning box and answer the questions from memory.
- Do not look at your notes – think hard.
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- Repeat this three times.
- Then leave a one-day-gap and test yourself again to see what you remember.

Retrieval means pulling information out of your memory without **looking at your notes**. Each time you do this, you make the memory in your brain stronger.

KO1 – MONEY PROBLEMS

WHAT DO I KNOW?
Declarative Knowledge

1. What are the four operations used in money problems?
2. What does "total" mean?
3. What does "difference" mean?
4. What does "discount" mean?
5. When do we use pounds (£) and when do we use pence (p)?

HOW DO I USE IT?
Procedural Knowledge

1. Solve: £12.50 + £3.85
2. Solve: £20.00 – £7.35
3. Solve: £4.60 × 3
4. Solve: £45.00 ÷ 5
5. Convert £3.45 to pence.

WHEN DO I USE IT?
Conditional Knowledge

1. When would I add in a money problem?
2. When would I subtract in a money problem?
3. When would I multiply in a money problem?
4. When would I divide in a money problem?
5. When would I use decimals in a money problem?

WHAT MISTAKE SHOULD I AVOID?
Metacognitive Knowledge

1. What mistake might happen if I forget to write the units?
2. What mistake might happen if I use the wrong operation?
3. What mistake might happen if I don't convert pence to pounds (or vice versa)?
4. What mistake might happen if I don't read the question carefully?
5. What mistake might happen if I don't show my working?

WHEN TO USE THIS

- In real-life situations (shopping, budgeting, discounts, tax, profit).
- When comparing costs and getting change.
- When solving multi-step money problems.
- When working with percentages and VAT.

THINKING QUESTIONS

1. How can I check if my answer is reasonable?
2. What steps should I take if there is more than one operation in the question?
3. Why is it important to include the correct units?

METHOD STEPS

1. Read the question carefully and identify what is needed.
2. Identify the key information and any units (£ or p).
3. Choose the correct operation(s).
4. Work through the steps in order.
5. Check your answer and write the correct units.

LINK TO MATHEMATICAL PURPOSE

Money problems help us apply maths to everyday life. They develop financial literacy, decision making and problem solving – important life skills.

The more you retrieve, the stronger your maths memory!

UXBRIDGE
HIGH SCHOOL

YEAR 9 MUSIC

POST AND PREP LEARNING MAP

Post tasks help you recap knowledge that you have learned in the past.

The pink boxes cover previous knowledge you learned in other terms.

The green boxes help you recap what you are learning this term.

Post tasks

1

129 to 135

Prep tasks teach you important knowledge, vocabulary and skills to prepare you for the lessons ahead.

Your prep tasks will always be in an orange box.

Prep tasks

YEAR 9 MUSIC

LEARNING BOX 1

LEARNING BOX

Music for Stage & Screen

GOLDEN THREAD:

You already know the **elements of music**, how to read notation and how music creates **mood**. This year you put it all to work in **stage and screen** music — discovering how composers use sound to tell stories in films, games and theatre.

KEY IDEA:

Composers write music to support a **story** on stage and screen. Two key tools are the **leitmotif** (a short theme for a character or idea) and the **underscore** (background music under a scene).

You explore how famous composers use these tools, then create your own.

- Hans Zimmer — Film
- John Williams — Film
- Stephen Schwartz — Stage

VISUAL REPRESENTATION:

A **leitmotif** is a short musical theme that returns whenever a character or idea appears on screen — like Darth Vader's theme. An **underscore** plays quietly underneath the action.

IMPORTANT MISCONCEPTION:

Film and stage music isn't just "background noise" that anyone could write.

It is **carefully composed** to match the action, build tension and tell us how to feel. The music often does as much storytelling as the words on screen.

WHEN TO USE THIS:

Stage and screen music is everywhere — films, TV, games, musicals and adverts. Composers reach for **leitmotifs** to mark characters and **underscores** to set the mood, choosing the right tool for the moment on stage or on screen.

On screen · On stage

THINKING STEPS:

1. What is the scene about — the mood, the character, the moment?
2. Decide your tool: a **leitmotif** for a character/idea, or an **underscore** to set the mood?
3. Choose elements that fit: **tempo, dynamics, instruments** and **key** (major = bright, minor = dark).
4. Keep your theme **short and memorable** so it can return through the story.

CREATIVE STEPS:

1. Pick a scene or character to score (film clip, game or musical moment).
2. Compose a short **leitmotif** — just a few notes — that captures it.
3. Add an **underscore**: chords or held notes that sit under the action.
4. Play it against the scene — does the music match the mood? Refine it.

SUMMARY:

Music for stage and screen turns sound into **storytelling**. By using **leitmotifs** and **underscores** — like Zimmer, Williams and Schwartz — composers guide our emotions and bring characters and scenes to life.

LISTEN · READ · UNDERSTAND · PRACTISE · PERFORM

BUILDING MUSICAL KNOWLEDGE TODAY, BETTER PERFORMANCES TOMORROW!

YEAR 9 MUSIC

LEARNING BOX 2

EXAMPLE & NON-EXAMPLE

Writing a Leitmotif · Music for Stage & Screen

GOLDEN THREAD:

You know how composers use **leitmotifs** and **underscores** to tell a story. Now you judge the **quality** of a theme: a strong leitmotif is short, memorable and matches the scene — not just random notes.

EXAMPLE ANSWER:

Below is a **strong leitmotif** for a hero scene. It is **short and memorable** — just a few notes with clear shape and gaps — so it can **return** whenever the character appears, like John Williams' themes.

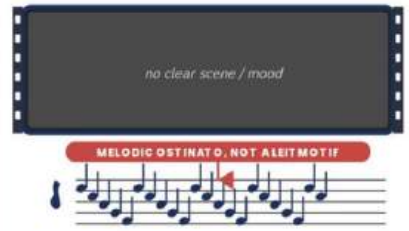
A clear, singable theme that matches a bright, heroic scene.

WHAT IS GOOD ABOUT THIS?

- It is **short and memorable**, so it works as a leitmotif that can return.
- The mood (bright, heroic) **matches the scene** on screen.

NON-EXAMPLE ANSWER:

Below is a **weak attempt**. It is a long string **of random notes** with no clear shape and no gaps — impossible to remember or hum — and **it does not** match any mood or scene.



Too many notes, no shape — not a theme you could recognise again.

WHAT IS WRONG WITH THIS?

- Too many notes with **no shape or gaps** — it can't be remembered or repeated.
- It **does not match a mood or scene**, so it fails as stage/screen music.

REMEMBER:

A good **leitmotif** is short, memorable and matches the scene — so it can **return** through the story. An **underscore** sits underneath to set the mood. Both are carefully composed, never random.

LISTEN · READ · UNDERSTAND · PRACTISE · PERFORM

YEAR 9 MUSIC · MUSIC FOR STAGE & SCREEN

LISTENING TO FILM MUSIC

RED · RECALL

Week 1 · POST TASK

5 mins • Complete on this sheet • Bring it to your next lesson

QUICK RECAP — Music that tells a story

LEITMOTIF	UNDERSCORE	MOOD	ON SCREEN
Theme for a character	Music under a scene	How it makes you feel	Film, TV & games

TASK 1 — Listen to film music

LISTEN

Press play! Watch/listen to a clip of **film or game music** (e.g. a Star Wars or superhero theme). Tick what you notice, then name it.

- [ ] A repeated theme (leitmotif)
- [ ] Music under the action
- [ ] A big mood change

Film / game:

TASK 2 — Leitmotif & underscore

RECALL

Key words. Write a definition for each:

Keyword	My definition
LEITMOTIF	
UNDERSCORE	

REFLECTION

How does the music tell you how to feel before anyone even speaks?

LISTEN · READ · UNDERSTAND · PRACTISE · PERFORM

BUILDING MUSICAL KNOWLEDGE TODAY, BETTER PERFORMANCES TOMORROW!

YEAR 9 MUSIC · MUSIC FOR STAGE & SCREEN

MEET THE COMPOSERS

ORANGE · PREPARE

Week 1 · PREP TASK

⏱ 5 mins • Complete on this sheet • Bring it to your next lesson

QUICK RECAP — Famous composers

ZIMMER	WILLIAMS	SCHWARTZ
Film scores	Film themes	Stage musicals

TASK 1 — Match the composer

UNDERSTAND

Composer detective. Match each composer to something they are famous for (a quick search is fine).

Hans Zimmer	Star Wars & Jaws themes (film)
John Williams	Wicked & stage musicals (theatre)
Stephen Schwartz	Inception & Interstellar scores (film)

TASK 2 — Composer profile

RESEARCH

Mini-research. Choose one composer and write 3–4 sentences: what do they write for (stage or screen), and one piece they are known for?

REFLECTION

What is the difference between writing for the stage and writing for the screen?

LISTEN | READ | UNDERSTAND | PRACTISE | PERFORM

BUILDING MUSICAL KNOWLEDGE TODAY, BETTER PERFORMANCES TOMORROW!

YEAR 9 MUSIC · MUSIC FOR STAGE & SCREEN

COMPOSITION REFLECTION

GREEN · REFLECT

Week 3 · POST TASK

⏱ 5 mins • Complete on this sheet • Bring it to your next lesson

QUICK RECAP — Evaluating your theme

CREATED	MOOD	IMPROVE
Your theme so far	Does it fit the scene?	What could you change?

TASK 1 — Sentence starters

REFLECT

Finish the sentences:

"My leitmotif represents..."

"I chose these notes/instruments because..."

"I could improve my theme by..."

TASK 2 — Composer's checklist

UNDERSTAND

Does it fit? Tick what your theme already does, then circle the one you'll work on next.

- ☐ Short & memorable
- ☐ Matches the mood
- ☐ Right instruments
- ☐ Can return in the story

REFLECTION

What makes your theme instantly recognisable — and how could you make it stronger?

LISTEN | READ | UNDERSTAND | PRACTISE | PERFORM

BUILDING MUSICAL KNOWLEDGE TODAY, BETTER PERFORMANCES TOMORROW!

YEAR 9 MUSIC · MUSIC FOR STAGE & SCREEN

MOOD & MUSICAL ELEMENTS

ORANGE · PREPARE

Week 3 · PREP TASK

⏱ 5 mins • Complete on this sheet • Bring it to your next lesson

QUICK RECAP — Music & mood

KEY	TEMPO	DYNAMICS	INSTRUMENTS
Major = bright, minor = dark	Fast = tense, slow = calm	Loud = power, quiet = fear	Strings, brass, synths...

TASK 1 — Match the mood

UNDERSTAND

Match the mood. Draw a line from each musical choice to the feeling it usually creates.

Minor key, slow	Happy / heroic
Major key, fast	Power / danger
Loud brass	Sad / scary
Quiet high strings	Tension / suspense

TASK 2 — Score a chase scene

CREATE

Score the scene. For a **chase scene**, choose the elements you would use:

Tempo: _____ · Key: _____

Dynamics: _____ · Instruments: _____

REFLECTION

How do composers change just a few elements to completely change the mood?

LISTEN | READ | UNDERSTAND | PRACTISE | PERFORM

BUILDING MUSICAL KNOWLEDGE TODAY, BETTER PERFORMANCES TOMORROW!

YEAR 9 MUSIC · MUSIC FOR STAGE & SCREEN

STAGE vs SCREEN

RED · RECALL

Week 5 · POST TASK

5 mins • Complete on this sheet • Bring it to your next lesson

QUICK RECAP — Stage vs screen

SCREEN	STAGE	SHARED
Recorded, fits the edit	Live, every night	Both set the mood

TASK 1 — Stage, screen or both?

UNDERSTAND

Where does it belong? Tick stage, screen, or both.

Statement	Stage / Screen / Both
Music must be played live every night	
Music is recorded to match the exact picture	
A leitmotif marks a character	

TASK 2 — Spot the difference

WRITE

Explain it. Write a few sentences: how is composing for a **live stage musical** different from composing for a **film**?

REFLECTION

Why might the same story need different music on stage and on screen?

LISTEN | READ | UNDERSTAND | PRACTISE | PERFORM

BUILDING MUSICAL KNOWLEDGE TODAY, BETTER PERFORMANCES TOMORROW!

YEAR 9 MUSIC · MUSIC FOR STAGE & SCREEN

ANALYSING A FILM SCENE

ORANGE · PREPARE

Week 5 · PREP TASK

5 mins • Complete on this sheet • Bring it to your next lesson

QUICK RECAP — What to listen for

LEITMOTIF	MOOD	UNDERSCORE	ELEMENTS
Any returning theme?	How does it feel?	Music under the action	Tempo, key, dynamics

TASK 1 — Watch & spot the tools

LISTEN

Be the critic! Watch a 1–2 minute film/musical scene with the music on. Tick what you hear, then name the scene.

- [ ] A leitmotif
- [ ] An underscore
- [ ] A mood change
- [ ] Loud/quiet contrast

Scene: _____

TASK 2 — Music detective

UNDERSTAND

Music detective. Two questions:

How does the music make you **feel**, and which element creates that? _____

If you removed the music, how would the scene change?

REFLECTION

How much of the storytelling is done by the music rather than the picture?

LISTEN | READ | UNDERSTAND | PRACTISE | PERFORM

BUILDING MUSICAL KNOWLEDGE TODAY, BETTER PERFORMANCES TOMORROW!

UXBRIDGE
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YEAR 9

HISTORY

POST AND PREP LEARNING MAP

Post tasks help you recap knowledge that you have learned in the past.

The **red boxes** cover previous knowledge you learned in other terms.

The **green boxes** help you recap what you are learning this term.

POST

PREP

1	2	3	4	5	6
Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
PAGES 137 - 141	PAGES –	PAGES 142 - 146	PAGES –	PAGES 147 - 151	PAGES –

Prep tasks teach you important knowledge, vocabulary and skills to prepare you for the lessons ahead.

Your prep tasks will always be in an **orange box**.

LEARNING BOX Year 9 History – The British Empire.

GOLDEN THREAD

Last year, we learnt about several topics that linked in really well with Empire. For example, Queen Elizabeth I (had colonies in North America), The Industrial Revolution and the American and French Revolution. This Half Term we are going to study the British Empire in more depth.

KEY IDEA

Expansion and Control – The British Empire grew by establishing control over territories around the world. Britain sought economic benefits, strategic advantages and political influence, creating an empire that at its height governed a quarter of the world's population.

VISUAL REPRESENTATION

IMPORTANT MISCONCEPTIONS

Common Misconception: 'The British Empire only benefitted Britain.'

In reality, while Britain gained wealth, power and resources from its Empire, many people living in the colonies experienced exploitation, loss of land, discrimination and resistance to British Rule.

THINKING STEPS

1. What was the British Empire? Where did it have colonies?
2. What did the British Empire gain from its empire?
3. Why did Britain want to build and expand an empire?
4. How might people in Britain have viewed the Empire?

WRITING STEPS

1. Identify: What type of source is it? Who created it? When was it created?
2. Observe: What can you see, read or infer from the source? Pick out specific details.
3. Interpret: What message is the source trying to give?
4. Explain: Use evidence from the source to support your interpretation.

PREP TASK: The Colonisation of North America

INSTRUCTIONS:
For Task 1 write down three reasons why someone might choose to leave their home country.
For Task 2 read the statement and complete the 3 sentences.

TASK 1: People move to new places for many reasons. Write down three reasons why someone might choose to leave their home country.

1.

2.

3.

TASK 2: Read the statement below:
Religious freedom means being able to practice your beliefs without being punished for them.

Complete the sentences

1. A person might be unhappy if they are not allowed to _____.
2. If people disagree with the official religion in their country, they might choose to _____.
3. I think religious freedom is important/ not important because _____.

POST TASK: American Revolution and the British Empire

(image relating to topic)

INSTRUCTIONS:

Complete Task 1 by ticking the two statements that explain hpw the American Revolution affected the British Empire.
Complete Task 2 by filling in the missing words using the word bank provided.
Complete the Challenge question by explaining two ways the American Revolution changed Britain.

TASK 1:

- ❑ Britain gained control of the 13 colonies.
- ❑ Britain began to think more carefully about how it governed its colonies.
- ❑ The loss of America encouraged Britain to focus on expanding elsewhere in the empire.
- ❑ The British Empire ended immediately after the Revolution.

TASK 2:

Many American settlers were unhappy about British _____. The American _____ wanted greater control of their own affairs. The Revolution ended with American _____ from Britain. After losing America, Britain continued to build its _____.

CHALLENGE: How did the American Revolution change Britain? State two ways.

POST TASK: Colonisation of North America - Source Analysis Task

INSTRUCTIONS: Task 1: Read the Source and answer the following questions:

1. What does this source suggest about the challenges faced by Pilgrim Fathers in North America? (Give 2 examples from the source).
2. Why does Phinaes Pratt think famine happened in the colony?
3. What impression does the source give of the relationship between the Pilgrim Fathers and Indigenous People?

Source A: Extract from a letter by Phineas Pratt describing the lives of the Pilgrim Fathers who had arrived and settled in North America in the winter of 1620.

"They sent forth their small boat upon discovery. Their boat then being returned to their large ship, they arrived into the bay of Plymouth (north eastern America) and begun their plantation by the river Patuxet. Their ship being returned and safely arrived in England, those gentlemen and merchants, that had undertaken to supply them with necessary resources, understanding that many of them were sick and some dead, made haste to send a new ship with many things necessary; but some deceitful men amongst the Pilgrim Fathers, hoping to encourage their friends to come join them in the New World, wrote letters concerning the great plenty of fish, fowl and deer, not considering that the wild savages (indigenous peoples) were many times hungrier, and that have a better skill to catch such things than the English men have. The adventurers, willing to save their moneys, sent them only a little food, and this went on for some time; and that was the great cause of famine (severe food shortages)."

TASK 1: Answer the questions from the instructions box below:

CHALLENGE:
How useful is this source for a historian studying the experiences of the Pilgrim Fathers in North America?

SELF QUIZZING: The British Empire and North America.

INSTRUCTIONS: Answer the Prep Check Questions in the blank boxes next to the questions.

Answer the Post Check Questions in the blank boxes next to the questions.

PREP CHECK

QUESTION	ANSWER	CHECK
What does the term Empire mean?		
Why do people leave where they live?		
Where did the Pilgrim Fathers settle?		

POST CHECK

QUESTION	ANSWER	CHECK
How many colonies in America was Britain in control of?		
Were the Americans happy or unhappy about the British rule?		
Name one challenge faced by the Pilgrim Fathers in North America.		

LEARNING BOX Year 9 History – The British Empire.

GOLDEN THREAD In the last few lessons, we explored how the British Empire established a colony in North America. Now we are looking at how the British Empire expanded its control across Australia, including why Britain established a colony there and how this affected the Aboriginal people and the lasting impacts of colonisation on Australian people.

KEY IDEA

Britain colonised Australia from 1788, establishing penal colonies and expanding settlements across the continent. Colonisation led to significant changes for the Aboriginal people including the dispossession of land, conflict and disruption of traditional ways of life.

VISUAL REPRESENTATION

IMPORTANT MISCONCEPTIONS

Common Misconception: 'Australia was empty when the British arrived.'

In reality, Aboriginal people had lived in Australia for over 60,000 years with diverse cultures and languages.

THINKING STEPS

1. Why did Britain decide to colonise Australia?
2. Who were the First Peoples of Australia and how did they live before colonisation?
3. How did colonisation affect Aboriginal communities?
4. In what ways has the legacy of colonisation shaped Australia today?

WRITING STEPS

1. Identify: What type of source is it? Who created it? When was it created?
2. Observe: What can you see, read or infer from the source? Pick out specific details.
3. Interpret: What message is the source trying to give?
4. Explain: Use evidence from the source to support your interpretation and link it to your historical knowledge.

PREP TASK: The Colonisation of Australia

INSTRUCTIONS: For Task 1: Read the information and highlight the answers to the questions in the text and label it the number of the question.
For Task 2: Rank the reasons for why Britain colonised Australia in order of importance. (1 being the most important and 9 being the least).

TASK 1:

In the late eighteenth century, Britain's prisons were overcrowded. Before 1776, many convicts were transported to the American colonies. However, after the American Revolution, Britain needed a new destination for transportation. Australia was chosen because it was distant from Britain and offered opportunities for trade and imperial expansion.

1. What problem was Britain facing in the late 18th century?
2. Where did Britain previously send convicts?
3. Why could Britain no longer send convicts to America?
4. Highlight two reasons why Britain decided to colonise Australia?

TASK 2:

- ❑ Overcrowded prisons in Britain
- ❑ No longer able to send convicts to America
- ❑ Expansion of the British Empire
- ❑ Access to new trade routes
- ❑ Increasing Britain influence in the Pacific
- ❑ Punishment for criminals
- ❑ Competition with other European countries
- ❑ Establishing a naval base
- ❑ Exploring new territories

POST TASK: The Industrial Revolution and the British Empire

INSTRUCTIONS:

For Task 1, Fill out the table by writing out where each resource came from and what it was used for. 2 have been done for you as an example.

For Task 2, Read the statements and decide whether they are True or False. Write down True/False next to the statements.

For the challenge, explain why the British Empire was important to Britain's Industrial Revolution.

TASK 1:

Resource	Colony/ Country	Used For
Cotton	India	
Tea		
Sugar		Food production and trade
Rubber		

TASK 2:

1. Britain imported cotton from parts of its empire.
2. Factories produced goods entirely from materials found in Britain.
3. The British Empire provided markers where Britain could sell manufactured goods.
4. Industrialisation reduced Britain's need for overseas trade.

CHALLENGE:

The British Empire was important because

POST TASK: Colonisation of Australia and Source Analysis.

INSTRUCTIONS:

For Task 1: Have a look at the Source next to the task and answer the 4 questions on the source. Outline the nature, origin and purpose of the source and outline what the source shows.

For Task 2: Take a step further and answer the more analytical questions.

Many aboriginal children (especially children who had one aboriginal parent and one white parent) were taken from their families and raised in orphanages like British children

TASK 1:

Nature:

Origin:

Purpose:

What does the source show?

TASK 2:

Can you outline any specific knowledge you have that directly links to this source?

How does the Source agree with your knowledge of the colonisation of Australia?

CHALLENGE

What makes this source useful for telling you about the colonisation of Australia?

SELF QUIZZING: The British Empire and Australia.

INSTRUCTIONS: Answer the Prep Check Questions in the blank boxes next to the questions.

Answer the Post Check Questions in the blank boxes next to the questions.

PREP CHECK

QUESTION	ANSWER	CHECK
When did Britain colonise Australia?		
What were the indigenous people of Australia called?		
What problem was Britain facing in the late 18th century?		

POST CHECK

QUESTION	ANSWER	CHECK
Name 3 resources Britain gained from its colonies to fuel the Industrial Revolution.		
How did Britain's Empire support the Industrial Revolution?		
How were the lives of Aboriginal People affected?		

LEARNING BOX Year 9 History – The British Empire.

GOLDEN THREAD In the last few lessons, we explored how the British Empire established a colonies across America and Australia. We also looked at the impact it had on the Aboriginal People. Now we will be looking at the relationship between Britain and India, examining how British rule affected both countries and how Indians responded to colonial control.

KEY IDEA

Britain gradually gained control over India through the East India Company and later through direct rule by the British Crown after 1858. India provided Britain with valuable resources, trade opportunities and military support. However, British rule also led to economic exploitation, cultural tensions and growing demands for independence from Indian people.

VISUAL REPRESENTATION

IMPORTANT MISCONCEPTIONS

Common Misconception: 'British rule only benefitted India by bringing railways, education and modernisation.'

While British rule introduced new infrastructure and systems, many Indians experienced economic hardship, loss of political power and discrimination. Different groups were affected in different ways.

THINKING STEPS

1. Why was India important to Britain?
2. How did Britain establish and maintain control over India?
3. How did British rule affect the lives of people in India?
4. How did India resist British rule and campaign for independence?

WRITING STEPS

1. Identify: What type of source is it? Who created it? When was it created?
2. Observe: What can you see, read or infer from the source? Pick out specific details.
3. Interpret: What message is the source trying to give?
4. Explain: Use evidence from the source to support your interpretation and link it to your historical knowledge.

PREP TASK: Britain and India

INSTRUCTIONS:
For Task 1, Read the short text and place the events in chronological order by putting the correct number next to each bullet point.
For Task 2, Read the information and complete the fact file below.

TASK 1:

In the 1600s, British merchants began trading with India through the East India Company. Over time, Britain gained more control over parts of India. Following the Indian Rebellion of 1857, the British government took direct control of India. By the late 19th century, India was known as the 'Jewel in the Crown' of the British Empire. However, many Indians became unhappy with British rule and campaigned for independence.

- India becomes known as the 'Jewel in the Crown.'
- British merchants begin trading in India.
- The British government takes direct control of India.
- Indians begin campaigning for independence.

TASK 2:

India was Britain's most valuable colony. Britain gained access to raw materials such as cotton and tea and sold manufactured goods to Indian markets. Britain also used Indian soldiers to help defend the empire. While some developments such as railways were introduced, many Indians believed British rule benefitted Britain more than India.

Why was India important to Britain?
- -
- -
- -

What changes did Britain bring to India?
- -
- -

Why were some Indians unhappy with British rule?
- -
- -

POST TASK: The British Empire and Australia

INSTRUCTIONS:

For Task 1, complete the mind map with at least 5 different negative consequences for the Aboriginal People of the arrival of the British.
For Task 2 create a mind map with at least 5 different positive consequences of the British Arrival.
For the challenge, answer the question 'Do you think the arrival of the British had more positive or negative impacts on the Aboriginal people?'

TASK 1:

Negative Consequences

TASK 2:

Positive Consequences

CHALLENGE

POST TASK: Britain and India – Source Analysis

INSTRUCTIONS:

For Task 1: Have a look at the Source next to the task and answer the 4 questions on the source. Outline the nature, origin and purpose of the source and outline what the source shows.

For Task 2: Take a step further and answer the more analytical questions

A photograph of the preserved bullet marks in a wall of the Jallianwala Bagh from the Amritsar Massacre, 13 April 1919

TASK 1:

Nature:

Origin:

Purpose:

What does the source show?

TASK 2:

Can you outline any specific knowledge you have that directly links to this source?

How does the Source agree with your knowledge of the colonisation of the events of the Amritsar Massacre?

CHALLENGE

What makes this source useful for telling you about the colonisation of India?

SELF QUIZZING: The British Empire and India.

INSTRUCTIONS: Answer the Prep Check Questions in the blank boxes next to the questions.

Answer the Post Check Questions in the blank boxes next to the questions.

PREP CHECK

QUESTION	ANSWER	CHECK
Through which company did Britain gain control over India?		
Name one reason India was important to Britain.		
Name one change Britain brought to India.		

POST CHECK

QUESTION	ANSWER	CHECK
When did the Indian Rebellion take place?		
Where did the Indian Rebellion take place?		
Why did the Indian Rebellion take place?		

UXBRIDGE
HIGH SCHOOL

YEAR 9

SCIENCE

POST AND PREP LEARNING MAP

Post tasks help you recap knowledge that you have learned in the past.

The **red boxes** cover previous knowledge you learned in other terms.

The **green boxes** help you recap what you are learning this term.

POST

PREP

BIOLOGY CURRICULUM MAP PAGE 153	1 Week 1 PAGES 154 - 161	3 Week 3 PAGES 162 - 169	5 Week 5 PAGES 170 - 178
CHEMISTRY CURRICULUM MAP PAGE 179	1 Week 1 PAGES 180 - 188	3 Week 3 PAGES 189 - 197	5 Week 5 PAGES 198 - 206
PHYSICS CURRICULUM MAP PAGE 207	1 Week 1 PAGES 208 - 215	3 Week 3 PAGES 216 - 224	5 Week 5 PAGES 225 - 233

CONTENTS — YEAR 9 BIOLOGY

Autumn Term 2026–27

HW	Dates	POST — Retrieval topic	PREP — Upcoming lesson
Autumn 1 · 07 Sep – 23 Oct 2026			
1	21 Sep 26 → 05 Oct 26	GREEN Cell Structure	Transport in Cells
2	05 Oct 26 → 19 Oct 26	RED Y8 Retrieval: Microscopy & Magnification	RP3 Osmosis Investigation
3	19 Oct 26 → 09 Nov 26 ★ Set over Half Term — due first lesson back	GREEN Mitosis and the Cell Cycle	Stem Cells and Differentiation
Autumn 2 · 02 Nov – 18 Dec 2026			
4	09 Nov 26 → 23 Nov 26	RED B1 Retrieval: Cells and Transport	Meiosis Introduction
5	23 Nov 26 → 07 Dec 26	GREEN B1 Assessment Consolidation	B2 Meiosis Stages and Gametes
Autumn 2 · 02 Nov – 18 Dec 2026 (due Jan)			
6	07 Dec 26 → 14 Jan 27 ★ ★ Christmas Homework — complete before returning in January	GREEN B2 DNA Structure and Inheritance	Monohybrid Inheritance (Punnett squares)

Each homework contains: Steps 6–8.5 (Prep: Learning Box, Example/Non-Example, Task, Notes) | Steps 9–11 (Post: Learning Box, Example/Non-Example, Task + Answer page) | Step 12 (Challenge ★★★) | Step 14 (Feedforward) | Step 15 (Self-Quizzing)

YEAR 9 BIOLOGY · AUTUMN TERM

Autumn 1 · 07 Sep – 23 Oct 2026

HW 1

Set: **21 Sep 26** Due: **05 Oct 26**

POST — RETRIEVAL

GREEN POST

Cell Structure

PREP — UPCOMING LESSON

Transport in Cells

Steps 6–15 · ~20 pages

Year 9 Biology

YEAR 9 BIOLOGY STEP 6 PREP · Upcoming Lesson

PREP LEARNING BOX

KO1: Diffusion, osmosis and active transport — how substances move in and out of cells

GOLDEN THREAD:

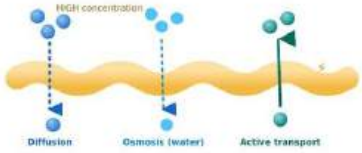
You have just studied cell structure and the role of the cell membrane. The next lessons extend this to how substances actually cross that membrane — three distinct processes depending on the substance and the energy available.

KEY IDEA:

Three transport mechanisms:

- **Diffusion:** movement of particles from high → low concentration (down the gradient). Passive — no energy needed. Examples: O_2 and CO_2 across alveoli; glucose into blood.
- **Osmosis:** movement of water molecules from high water potential (dilute) → low water potential (concentrated) across a partially permeable membrane. Passive.
- **Active transport:** movement of substances from low → high concentration (against the gradient). Requires energy (ATP) and carrier proteins. Example: glucose absorption in the small intestine; mineral ions into root hair cells.

MOVEMENT ACROSS A CELL MEMBRANE



IMPORTANT MISCONCEPTION:

Students often say osmosis is 'water moving from low to high concentration'. **This is incorrect** — water moves from high water potential (dilute/low solute concentration) to low water potential (concentrated/high solute concentration). The water is moving down its own concentration gradient — there is more water in the dilute solution.

WHEN TO USE THIS:

Use this when asked to explain how a named substance enters or leaves a cell, why active transport requires energy, or to predict what happens to a cell placed in a solution of different concentration.

THINKING STEPS:

- What substance is moving — is it water (osmosis) or another molecule (diffusion or active transport)?
- Is it moving down or against the concentration gradient?
- Does the process require energy?

WRITING STEPS:

- Name the transport process and state whether it requires energy.
- State the direction of movement (high → low concentration, or against the gradient).
- Link to a specific cell or organ context (e.g. root hair cells, alveoli).

PREP: EXAMPLE / NON-EXAMPLE

KO1: Diffusion, osmosis and active transport — how substances move in and out of cells

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: Explain how glucose is absorbed from the small intestine into the blood, and why this process requires energy. (4 marks)

EXAMPLE

Glucose is absorbed from the small intestine into the blood by active transport. Although glucose is already present at a higher concentration in the blood than in the intestine (after most has been absorbed), active transport allows glucose to continue moving against this concentration gradient — from low concentration in the intestine to high concentration in the blood. This process requires energy in the form of ATP, produced by mitochondria in the intestinal epithelial cells. Carrier proteins in the cell membrane bind to glucose molecules and use the energy to pull them across the membrane.

WHAT IS GOOD ABOUT THIS?

✓Correct process identified: active transport.

✓Explains direction correctly: against the concentration gradient.

✓ATP and mitochondria named as the energy source.

NON-EXAMPLE

Glucose diffuses into the blood from the small intestine because there is more glucose there. It needs energy to do this.

WHAT IS WRONG WITH THIS?

✗Diffusion is incorrect — diffusion moves substances down the concentration gradient, not against it.

✗'More glucose there' is vague — must state which side has higher concentration and what gradient means.

✗'Needs energy' is stated but not explained — must name ATP and mitochondria.

KEY TAKEAWAY:

Active transport is the only mechanism that moves substances against the concentration gradient. Always name the process, the direction, the energy source (ATP), and carrier proteins.

PREP TASK

KO1: Diffusion, osmosis and active transport — how substances move in and out of cells

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

SCENARIO:

A student places a red blood cell in a very concentrated salt solution. Predict and explain what will happen to the cell. Use your knowledge of osmosis. *(4 marks)*

YOUR ANSWERS:

1. State the direction water will move, using correct osmosis terminology. *(2 marks)*

2. Predict what happens to the cell's appearance and explain why. *(2 marks)*

NOTES PAGE

KO1: Diffusion, osmosis and active transport — how substances move in and out of cells

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 BIOLOGY STEP 9 GREEN POST

POST LEARNING BOX

KO1: Eukaryotic and prokaryotic cells — organelles and their functions

GOLDEN THREAD:

In Year 8 you learned that cells are the basic units of life. Now in Year 9 Biology we look inside the cell in much greater detail — naming organelles, understanding their specific functions, and comparing the two fundamental cell types: eukaryotic and prokaryotic.

KEY IDEA:

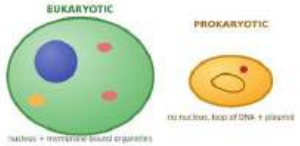
Two cell types:

- **Eukaryotic cells** (animals and plants) have a nucleus containing DNA, and membrane-bound organelles.
- **Prokaryotic cells** (bacteria) have no nucleus — DNA floats free as a loop; no membrane-bound organelles; smaller overall.

Key organelles (eukaryotic):

- **Nucleus —** contains DNA; controls cell activity.
- **Mitochondria** — site of aerobic respiration; produces ATP.
- **Ribosomes** — site of protein synthesis.
- **Cell membrane** — controls what enters and leaves the cell.
- **Plant only:** cell wall (cellulose, rigid support), chloroplasts (photosynthesis), large vacuole (supports cell turgor).

EUKARYOTIC vs PROKARYOTIC CELLS



IMPORTANT MISCONCEPTION:

Students often say bacteria have a nucleus but it is smaller than in animal cells. **This is incorrect** — prokaryotic cells have no nucleus at all. Their DNA exists as a single circular chromosome floating freely in the cytoplasm, not enclosed in a membrane.

WHEN TO USE THIS:

Use this when asked to compare cell types, label cell diagrams, explain the function of an organelle, or describe differences between plant, animal and bacterial cells.

THINKING STEPS:

- Is this cell eukaryotic (nucleus present) or prokaryotic (no nucleus)?
- Which organelle is responsible for this function — nucleus, mitochondria, ribosomes or chloroplasts?
- What structures are unique to plant cells?

WRITING STEPS:

- Name the cell type (eukaryotic/prokaryotic) and state the key distinguishing feature.
- Name the organelle, state its function, and explain how its structure enables that function.
- When comparing: state a similarity AND a difference, with precise vocabulary.

YEAR 9 BIOLOGY STEP 10 GREEN POST

POST: EXAMPLE / NON-EXAMPLE

Cell Structure — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: Compare the structure of a plant cell with a prokaryotic cell. Give three differences. (6 marks)

EXAMPLE

A plant cell is eukaryotic, meaning its DNA is enclosed within a membrane-bound nucleus. In contrast, a prokaryotic cell (such as a bacterium) has no nucleus — its DNA exists as a single circular chromosome floating freely in the cytoplasm. Secondly, a plant cell contains membrane-bound organelles including mitochondria and chloroplasts, which carry out aerobic respiration and photosynthesis respectively. A prokaryotic cell has neither mitochondria nor chloroplasts and therefore cannot carry out aerobic respiration in the same way. Thirdly, both cell types have a cell wall, but they differ in composition: the plant cell wall is made of cellulose, whereas the bacterial cell wall is made of peptidoglycan (murein). Plant cells are also significantly larger — typically 10–100 µm — compared to bacteria, which are typically 1–10 µm.

WHAT IS GOOD ABOUT THIS?

✓Three clear differences identified — nucleus, organelles and cell wall composition.

✓Precise vocabulary throughout: eukaryotic, prokaryotic, circular chromosome, peptidoglycan.

✓Size comparison included with specific units (µm).

NON-EXAMPLE

Plant cells have a nucleus and bacteria don't. Plant cells are bigger. Plant cells have a cell wall and so do bacteria. Plant cells have chloroplasts.

WHAT IS WRONG WITH THIS?

✗Three points identified but not explained — no mechanism or reason given for any difference.

✗'Plant cells are bigger' — no data given (units/approximate sizes not stated).

✗Chloroplasts mentioned but not explained — what is their function and why don't bacteria have them?

KEY TAKEAWAY:

Cell comparison answers must include: name both cell types, state the difference precisely, and explain what each structure does or is made of. Three features with no explanation scores half marks.

CHALLENGE TASK

Cell Structure — stretch your thinking further

CHALLENGE:

Root hair cells are specialised to absorb water and mineral ions from the soil.

Explain how root hair cells absorb (a) water and (b) mineral ions from the soil. For each, name the transport process, state the direction of movement relative to the concentration gradient, and explain whether energy is required. Use at least FOUR scientific points.

★ ★ ★ **Think about:** Water and mineral ions use different transport mechanisms — which is which? What concentration gradient exists for water in soil vs. root hair cells? Why can't mineral ions use osmosis? What provides the energy for active transport?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — Cell Structure

Tick the target that applies to your work	
☐ Name the cell type	Eukaryotic or prokaryotic — always state this first.
☐ Name the organelle AND its function	Not just 'nucleus' — state what it does.
☐ Use precise vocabulary	Circular chromosome, peptidoglycan, µm — not vague terms.
☐ Three differences = three marks	Each difference needs a specific detail, not just a name.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — Transport in Cells

Tick the target that applies to your work	
☐ Name the correct process	Diffusion / osmosis / active transport — not interchangeable.
☐ State the direction	High → low concentration, or against the gradient.
☐ Osmosis = water only	Not 'substances' — osmosis moves water molecules specifically.
☐ Active transport needs ATP	Name ATP and mitochondria as the energy source.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — CELL STRUCTURE

WHAT DO I KNOW?
(Declarative)

What is the difference between a eukaryotic and a prokaryotic cell?

Name four organelles found in plant cells but not animal cells.

HOW DO I USE IT?
(Procedural)

How do you compare an animal cell, plant cell and bacterial cell in an exam answer?

What is the function of the mitochondria? Where does this process occur?

WHEN DO I USE IT?
(Conditional)

When would you describe ribosomes rather than mitochondria in an answer about protein production?

When would you describe a cell as eukaryotic vs prokaryotic?

MISTAKES TO AVOID

Why is it incorrect to say bacteria have a 'smaller nucleus'?

What is wrong with saying 'plant cells have chloroplasts for energy'?

PREP — TRANSPORT IN CELLS

WHAT DO I KNOW?
(Declarative)

What are the three ways substances can move in and out of cells?

What is the difference between osmosis and diffusion?

HOW DO I USE IT?
(Procedural)

How do you explain why active transport requires energy?

How do you use osmosis to predict what happens to a cell in a concentrated solution?

WHEN DO I USE IT?
(Conditional)

When would active transport be needed instead of diffusion?

When would you describe osmosis rather than diffusion for water movement?

MISTAKES TO AVOID

Why is 'water moves from low to high concentration' an incorrect description of osmosis?

What is wrong with saying diffusion requires energy?

YEAR 9 BIOLOGY · AUTUMN TERM

Autumn 1 · 07 Sep – 23 Oct 2026

HW 2

Set: **05 Oct 26** Due: **19 Oct 26**

POST — RETRIEVAL

RED POST

Y8 Retrieval: Microscopy & Magnification

PREP — UPCOMING LESSON

RP3 Osmosis Investigation

Steps 6–15 · ~20 pages

Year 9 Biology

PREP LEARNING BOX

KO1: RP3 Osmosis investigation — planning, variables and data analysis

GOLDEN THREAD:

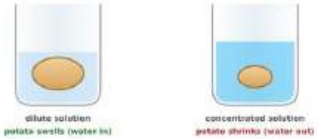
You studied diffusion, osmosis and active transport in your last lesson. The upcoming lessons focus on RP3 — the required practical investigation of osmosis in plant tissue using potato cylinders. This is assessed in GCSE Paper 1.

KEY IDEA:

RP3 — Investigating osmosis in potato cylinders:

- **Method:** Cut potato cylinders of equal length and mass. Place in solutions of different salt concentrations (e.g. 0, 0.2, 0.4, 0.6, 0.8, 1.0 mol/dm³). Leave for 30 minutes. Blot dry and reweigh.
- **IV:** concentration of salt solution (mol/dm³).
- **DV:** percentage change in mass of potato cylinder.
- **CVs:** initial length/mass of cylinders, temperature, time in solution, surface area.
- **% change in mass** = (final mass − initial mass) ÷ initial mass × 100.
- **Isotonic point:** the concentration at which there is no mass change — water potential inside = water potential outside.

OSMOSIS: POTATO IN SUGAR SOLUTION



IMPORTANT MISCONCEPTION:

Students often use change in mass rather than percentage change in mass. If the potato cylinders had slightly different starting masses, this makes comparison unfair. **Always use percentage change** to standardise the data so results from different cylinders can be fairly compared.

WHEN TO USE THIS:

Use this for any question about the osmosis required practical — planning the method, identifying variables, calculating % mass change, or describing the expected graph shape.

THINKING STEPS:

- What is the independent variable — what concentration range is being tested?
- How do I calculate % change in mass from the data given?
- What does the isotonic point represent on the graph?

WRITING STEPS:

- State the IV, DV and at least two CVs.
- Calculate % change in mass: (final − initial) ÷ initial × 100.
- Describe the graph: mass gained at low concentration, lost at high concentration, isotonic point where the line crosses zero.

YEAR 9 BIOLOGY STEP 7 PREP · Upcoming Lesson

PREP: EXAMPLE / NON-EXAMPLE

KO1: RP3 Osmosis investigation — planning, variables and data analysis

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: A student measures the mass of a potato cylinder before and after placing it in a 0.6 mol/dm³ salt solution: initial mass = 4.0 g, final mass = 3.4 g. Calculate the percentage change in mass and explain what this tells us about the relative water potentials. (4 marks)

EXAMPLE

Percentage change in mass = (3.4 − 4.0) ÷ 4.0 × 100 = −0.6 ÷ 4.0 × 100 = −15%. The negative value indicates the potato cylinder lost mass. This means water moved out of the potato cells by osmosis — the water potential outside (in the 0.6 mol/dm³ solution) was lower than the water potential inside the potato cells. Water moves from high water potential (inside the potato) to low water potential (the concentrated solution) across the partially permeable cell membrane.

WHAT IS GOOD ABOUT THIS?

✓Formula correctly applied with working shown; negative sign retained and explained.

✓Explains direction: water left the potato because the external solution had lower water potential.

✓Uses correct osmosis language: water potential, partially permeable membrane, high → low water potential.

NON-EXAMPLE

% change = (3.4 − 4.0) ÷ 4.0 = −0.15. The potato lost water because the solution was concentrated.

WHAT IS WRONG WITH THIS?

✗Forgot to multiply by 100 — answer should be −15%, not −0.15.

✗'Lost water because the solution was concentrated' — must explain using water potential terminology.

✗No mention of partially permeable membrane or osmosis as the mechanism.

KEY TAKEAWAY:

% mass change: (final − initial) ÷ initial × 100. Always retain the sign (positive = gained, negative = lost). Always explain using water potential, not just 'concentration'.

YEAR 9 BIOLOGY STEP 9 RED POST

POST LEARNING BOX

KO1 Retrieval: Cell structure, microscopy, magnification and size calculations

GOLDEN THREAD:

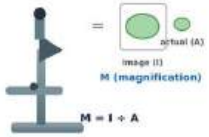
You studied cell structure in Year 8. This Red Post retrieval strengthens that earlier memory trace — the wider the gap since you last recalled this, the stronger the memory becomes. Focus on microscopy calculations and the comparison of cell types.

KEY IDEA:

Microscopy and magnification:

- **Magnification = image size ÷ actual size** (rearrange: actual size = image ÷ magnification).
- Units: µm (micrometres, 1 mm = 1000 µm), nm (nanometres, 1 µm = 1000 nm).
- **Light microscope:** magnification up to ×1500; resolution ~200 nm; can view living cells.
- **Electron microscope:** magnification up to ×2,000,000; resolution ~0.2 nm; cannot view living cells; reveals ultrastructure (mitochondria detail, ribosomes).
- Scale bars: used on micrographs to calculate real sizes.

MICROSCOPE MAGNIFICATION



IMPORTANT MISCONCEPTION:

Students often divide actual size by image size, giving a tiny number. **Always check:** magnification should be a number larger than 1 (you are making the image bigger, not smaller). If your answer is less than 1, you have divided the wrong way around.

WHEN TO USE THIS:

Use this when asked to calculate magnification, actual size or image size from a micrograph, or when comparing light and electron microscopes.

THINKING STEPS:

- Which two values do I know — image size, actual size or magnification?
- Have I converted all measurements to the same unit?
- Is my answer for magnification greater than 1?

WRITING STEPS:

- Write the formula: magnification = image size ÷ actual size.
- Substitute values with units, showing all working.
- Convert units if needed (mm → µm: multiply by 1000).

PREP TASK

KO1: RP3 Osmosis investigation — planning, variables and data analysis

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

DATA:

A student tests potato cylinders in five salt concentrations. Results:

Concentration (mol/dm³)	Initial mass (g)	Final mass (g)	% change
0.0	4.0	4.6	?
0.2	4.0	4.3	?
0.4	4.0	4.0	?
0.6	4.0	3.6	?
0.8	4.0	3.2	?

YOUR ANSWERS:

1. Calculate the % change in mass for all five concentrations. Show working for the first one. ***(3 marks)***

2. At what concentration is the isotonic point? Explain what this means in terms of water potential. ***(2 marks)***

NOTES PAGE

KO1: RP3 Osmosis investigation — planning, variables and data analysis

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 BIOLOGY STEP 10 RED POST

POST: EXAMPLE / NON-EXAMPLE

Y8 Biology Retrieval — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: A student views a cell under a light microscope. The image of the cell is 45 mm wide. The actual width of the cell is 30 µm. Calculate the magnification. Show your working. (3 marks)

EXAMPLE

First convert units: 45 mm = 45,000 µm. Magnification = image size ÷ actual size = 45,000 ÷ 30 = ×1500. The magnification of the microscope is ×1500. This is consistent with a high-powered light microscope, which can achieve magnifications up to ×1500.

WHAT IS GOOD ABOUT THIS?

✓Units converted correctly to µm before calculating.

✓Formula stated, values substituted, working shown.

✓Answer interpreted in context (×1500 = maximum light microscope magnification).

NON-EXAMPLE

Magnification = 45 ÷ 30 = 1.5.

WHAT IS WRONG WITH THIS?

✗Units not converted — must use the same unit (both in µm or both in mm) before dividing.

✗Answer of 1.5 is far too small for a microscope magnification — indicates wrong unit conversion.

✗No formula stated or working shown.

KEY TAKEAWAY:

Magnification calculations: always convert to the same unit first, always show the formula and working, always check your answer is greater than 1.

YEAR 9 BIOLOGY STEP 11 RED POST

POST-TASK

KO1 Retrieval: Cell structure, microscopy, magnification and size calculations

RED POST: RECONNECTS AN EARLIER ROUTE

This task retrieves Y8 Biology Retrieval at the point where forgetting begins — strengthening the memory trace before it fades.

Question: A student views a cell. The image is 60 mm wide at ×2000 magnification. Calculate the actual width of the cell in µm. Show your working. (3 marks)

SCAFFOLDED STEPS TOWARDS 6 MARKS:

- **Step 1 (1 mark):** Write the formula for magnification and rearrange to find actual size.
- **Step 2 (1 mark):** Convert the image size to µm and substitute all values. Show all working.
- **Step 3 (1 mark):** State the final answer in µm and check it is a sensible size for a cell (cells are typically 10–100 µm).

CHALLENGE TASK

Y8 Biology Retrieval — stretch your thinking further

CHALLENGE:

A student notices that the potato cylinders in pure water (0.0 mol/dm³) gained more mass than expected but became soft and flaccid rather than firm.

Explain why the potato became flaccid despite gaining water. Use your knowledge of osmosis, turgor pressure and cell wall structure. Use at least FOUR scientific points.

★ ★ ★ **Think about:** What does turgor pressure mean? What happens when a cell gains too much water — can plant cells burst? How does the cell wall interact with water uptake? What would make a cell turgid vs flaccid?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — Y8 Cell Structure Retrieval

Tick the target that applies to your work	
☐ Always convert units before calculating	mm → µm: multiply by 1000.
☐ Show the formula and working	Magnification = image ÷ actual.
☐ Check your answer is > 1	Magnification must always be greater than 1.
☐ Compare both microscope types	Resolution, magnification, living/dead — all three.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — Osmosis RP3

Tick the target that applies to your work	
☐ Use % change, not change in mass	Standardises data for fair comparison.
☐ Retain the sign (+ or −)	Positive = gained mass; negative = lost mass.
☐ Isotonic point = 0% change	Water potential inside = water potential outside.
☐ Explain using water potential	Not just 'concentration' — use water potential terminology.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

YEAR 9 BIOLOGY STEP 14 FEEDFORWARD

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — Y8 Cell Structure Retrieval

Tick the target that applies to your work

☐ Always convert units before calculating — mm → µm: multiply by 1000.

☐ Show the formula and working — Magnification = image ÷ actual.

☐ Check your answer is > 1 — Magnification must always be greater than 1.

☐ Compare both microscope types — Resolution, magnification, living/dead — all three.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — Osmosis RP3

Tick the target that applies to your work

☐ Use % change, not change in mass — Standardises data for fair comparison.

☐ Retain the sign (+ or −) — Positive = gained mass; negative = lost mass.

☐ Isotonic point = 0% change — Water potential inside = water potential outside.

☐ Explain using water potential — Not just 'concentration' — use water potential terminology.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

Year 9 Biology · HW 2 · STEP 14 — Step 14 of 15 — Feedforward Box

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — Y8 CELL STRUCTURE RETRIEVAL

WHAT DO I KNOW?
(Declarative)

Write the formula for magnification.

What is the difference between resolution and magnification?

HOW DO I USE IT?
(Procedural)

How do you calculate actual cell size from a micrograph?

How do you convert mm to µm?

WHEN DO I USE IT?
(Conditional)

When would you use an electron microscope rather than a light microscope?

When would you check that a magnification calculation answer is sensible?

MISTAKES TO AVOID

Why is dividing actual size by image size a common error?

What is wrong with giving a magnification answer less than 1?

PREP — OSMOSIS REQUIRED PRACTICAL

WHAT DO I KNOW?
(Declarative)

What is the formula for % change in mass?

What is the isotonic point in an osmosis experiment?

HOW DO I USE IT?
(Procedural)

How do you calculate % change in mass from a data table?

How do you describe the graph shape for an osmosis experiment?

WHEN DO I USE IT?
(Conditional)

When would you use % change in mass rather than change in mass?

When would you say water moved 'into' rather than 'out of' the potato?

MISTAKES TO AVOID

Why must you use percentage change rather than absolute change in mass?

What is wrong with saying 'the solution is more concentrated so water moves in'?

YEAR 9 BIOLOGY · AUTUMN TERM

Autumn 1 · 07 Sep – 23 Oct 2026

HW 3

Set: **19 Oct 26** Due: **09 Nov 26**

★ Set over Half Term — due first lesson back

POST — RETRIEVAL

GREEN POST

Mitosis and the Cell Cycle

PREP — UPCOMING LESSON

Stem Cells and Differentiation

Steps 6–15 · ~20 pages

Year 9 Biology

YEAR 9 BIOLOGY STEP 6 PREP · Upcoming Lesson

PREP LEARNING BOX

KO2: Cell growth, differentiation and stem cells — embryonic, adult and therapeutic uses

GOLDEN THREAD:

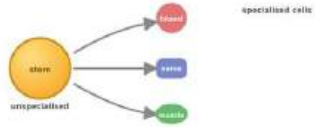
You have learned that mitosis produces identical daughter cells. The next lessons ask: if all cells are genetically identical, how do they become specialised? This requires understanding differentiation — and stem cells are undifferentiated cells that retain the ability to divide and specialise.

KEY IDEA:

Key concepts:

- **Differentiation:** the process by which a cell develops a specialised structure and function by switching certain genes on or off. Most animal cells lose the ability to differentiate early in development; most plant cells retain it throughout life.
- **Stem cells:** undifferentiated cells that can divide by mitosis and then differentiate into specialised cells.
- **Embryonic stem cells:** found in early embryos; can differentiate into any cell type (totipotent/pluripotent) — greatest potential but ethically controversial.
- **Adult stem cells:** found in specific tissues (e.g. bone marrow makes blood cells); can only differentiate into a limited range of cell types.
- **Therapeutic cloning:** creating an embryo with the same genetic material as the patient → harvesting embryonic stem cells → fewer rejection issues.

STEM CELLS DIFFERENTIATING



IMPORTANT MISCONCEPTION:

Students often say stem cells 'become any type of cell' without specifying the type of stem cell. **Only embryonic stem cells** can become any cell type (they are pluripotent). Adult stem cells can only differentiate into a limited range of related cell types. Always specify which type of stem cell you mean.

WHEN TO USE THIS:

Use this when asked to explain what stem cells are, compare embryonic and adult stem cells, evaluate the ethical issues surrounding their use, or explain therapeutic cloning.

THINKING STEPS:

- Is this an embryonic or adult stem cell — what can each type become?
- What ethical issues are associated with using embryonic stem cells?
- How does differentiation occur — which genes are switched on or off?

WRITING STEPS:

- Define stem cells as undifferentiated cells capable of mitosis and differentiation.
- Distinguish embryonic (pluripotent, controversial) from adult (limited range, less controversial).
- For evaluation: name the benefit, name the ethical concern, and give a justified verdict.

PREP: EXAMPLE / NON-EXAMPLE

KO2: Cell growth, differentiation and stem cells — embryonic, adult and therapeutic uses

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: Evaluate the use of embryonic stem cells to treat medical conditions. (4 marks)

EXAMPLE

Embryonic stem cells have the potential to differentiate into any type of cell in the body, making them extremely valuable for treating conditions such as Parkinson's disease, diabetes, and spinal cord injuries — where specific types of cells have been damaged or lost. Unlike adult stem cells, which can only produce a limited range of cell types, embryonic stem cells could theoretically replace any damaged tissue. However, obtaining embryonic stem cells requires the destruction of a human embryo, which raises serious ethical concerns — many people believe that an embryo has the same moral status as a person, and that its destruction is therefore unacceptable. Therapeutic cloning can reduce the risk of rejection (since the embryo carries the patient's own genetic material) but also involves creating an embryo solely for research, which raises further ethical objections. Overall, the potential to treat previously incurable conditions provides a strong scientific justification for their use, but robust regulation is essential to ensure ethical standards are upheld.

WHAT IS GOOD ABOUT THIS?

✓Specific benefit named — can become any cell type; named medical examples given.

✓Ethical concern explained: embryo must be destroyed, moral status of embryo raised.

✓Therapeutic cloning mentioned with both benefit (no rejection) and concern (creates embryo for research).

NON-EXAMPLE

Embryonic stem cells can cure diseases. Some people disagree because embryos are destroyed. It's a difficult issue.

WHAT IS WRONG WITH THIS?

✗'Can cure diseases' is too vague — must name specific conditions and explain why stem cells are needed.

✗'Some people disagree' — must explain the actual ethical argument: embryo has moral status of a person.

✗No justified conclusion — must state a position with evidence, not just 'it's difficult'.

KEY TAKEAWAY:

Stem cell evaluation: specific benefit + mechanism; specific ethical concern + who holds it and why; justified verdict. 'It's complicated' alone scores zero.

PREP TASK

KO2: Cell growth, differentiation and stem cells — embryonic, adult and therapeutic uses

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

TASK:

A scientist proposes using adult stem cells from bone marrow to treat a patient with heart disease. Another scientist argues embryonic stem cells would be more effective. Evaluate both options, considering effectiveness and ethical issues. Give a justified conclusion. *(4 marks)*

YOUR ANSWERS:

NOTES PAGE

KO2: Cell growth, differentiation and stem cells — embryonic, adult and therapeutic uses

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 BIOLOGY STEP 9 GREEN POST

POST LEARNING BOX

KO2: Stages of mitosis, DNA replication, and the role of cell division in growth and repair

GOLDEN THREAD:

You learned that cells contain a nucleus with DNA organised into chromosomes. Now we look at how cells divide — mitosis — so that organisms can grow, replace worn-out cells, and repair damage. This is a key process linking cell structure to how multicellular organisms function.

KEY IDEA:

The cell cycle:

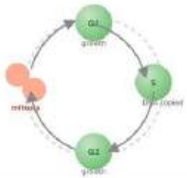
- **Interphase (growth phase):** the cell grows, carries out normal functions, and **replicates its DNA** so each new cell will receive a full copy.
- **Mitosis (division phase):** the nucleus divides, producing two genetically identical daughter nuclei.
- **Cytokinesis:** the cytoplasm divides, producing two genetically identical daughter cells.

Stages of mitosis:

- **Prophase:** chromosomes condense and become visible; nuclear envelope breaks down.
- **Metaphase:** chromosomes line up along the cell equator.
- **Anaphase:** chromatids pulled to opposite poles by spindle fibres.
- **Telophase:** nuclear envelopes reform around each set of chromosomes.

Result: two daughter cells, each genetically identical to the parent cell, each with the full number of chromosomes (diploid).

THE CELL CYCLE



IMPORTANT MISCONCEPTION:

Students often confuse mitosis with meiosis. **Mitosis produces two genetically identical diploid cells** used for growth and repair. Meiosis (coming in Year 9 B2) produces four genetically different haploid cells used for sexual reproduction. If a question mentions growth, repair or asexual reproduction — it is always mitosis.

WHEN TO USE THIS:

Use this when asked to describe or explain the cell cycle, name the stages of mitosis in order, explain why the daughter cells are genetically identical, or explain the role of mitosis in growth, repair or asexual reproduction.

THINKING STEPS:

- Is the question about growth/repair (mitosis) or reproduction/variation (meiosis)?
- What happens to the chromosomes at each stage?
- What is the chromosome number of the daughter cells?

WRITING STEPS:

- State the purpose of mitosis (growth, repair, asexual reproduction).
- Describe the key events: DNA replication in interphase, then the four stages (prophase, metaphase, anaphase, telophase).
- State the result: two diploid, genetically identical daughter cells.

YEAR 9 BIOLOGY STEP 10 GREEN POST

POST: EXAMPLE / NON-EXAMPLE

Mitosis and the Cell Cycle — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: Describe the process of mitosis, including what happens during interphase, and explain why the daughter cells are genetically identical to the parent cell. (6 marks)

EXAMPLE

Before mitosis begins, the cell undergoes interphase, during which the DNA is replicated — each chromosome is copied so that the cell now has two copies of every chromosome (sister chromatids joined at the centromere). During prophase, the chromosomes condense and become visible under a microscope, and the nuclear envelope breaks down. In metaphase, the chromosomes line up along the equator of the cell, attached to spindle fibres from opposite poles. During anaphase, the spindle fibres contract and pull the sister chromatids apart to opposite poles of the cell. In telophase, a nuclear envelope reforms around each set of chromosomes, and the cytoplasm divides (cytokinesis) to produce two daughter cells. The daughter cells are genetically identical to each other and to the parent cell because DNA replication in interphase produced exact copies of every chromosome — so both daughter cells receive an identical set of genetic information.

WHAT IS GOOD ABOUT THIS?

✓All four stages named in correct order with key events described.

✓Interphase correctly described: DNA replication before division.

✓Explains why daughter cells are identical: DNA replication produces exact copies.

NON-EXAMPLE

Mitosis produces two identical cells. In prophase chromosomes appear, in metaphase they line up, in anaphase they split and in telophase the nucleus reforms.

WHAT IS WRONG WITH THIS?

✗Interphase not described — DNA replication must be mentioned.

✗Stages listed but not explained — what happens to chromosomes at each stage must be stated.

✗No explanation of why daughter cells are identical — DNA replication is the key mechanism.

KEY TAKEAWAY:

Mitosis answers: describe interphase (DNA replication) first, then four stages in order with what happens to chromosomes at each, and explain genetic identity through exact copying.

POST-TASK

KO2: Stages of mitosis, DNA replication, and the role of cell division in growth and repair

GREEN POST: STRENGTHENS THE NEW ROUTE

This task retrieves Mitosis and the Cell Cycle at the point where forgetting begins — strengthening the memory trace before it fades.

Question: Describe the process of mitosis, including interphase, and explain why daughter cells are genetically identical. (6 marks)

SCAFFOLDED STEPS TOWARDS 6 MARKS:

- **Step 1 (1 mark):** Describe interphase — what happens to DNA and why this is essential before division can begin.
- **Step 2 (2 marks):** Describe prophase and metaphase — what happens to the chromosomes at each stage.
- **Step 3 (2 marks):** Describe anaphase and telophase — what happens to chromatids and how two nuclei are produced.
- **Step 4 (1 mark):** Explain why the daughter cells are genetically identical — link to what happened in interphase.

CHALLENGE TASK

Mitosis and the Cell Cycle — stretch your thinking further

CHALLENGE:

Some scientists are researching induced pluripotent stem cells (iPSCs) — adult cells that have been reprogrammed to behave like embryonic stem cells.

Explain why iPSCs might be considered better than embryonic stem cells for medical treatment. Consider effectiveness, ethical issues and the risk of rejection. Use at least FOUR scientific points.

★ ★ ★ **Think about:** What is the key advantage of embryonic stem cells? Do iPSCs share this advantage? What is the ethical problem with embryonic stem cells that iPSCs avoid? Would iPSCs cause rejection — why or why not?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — Mitosis and Cell Cycle

Tick the target that applies to your work	
☐ Describe interphase first	DNA replication must be mentioned before the stages.
☐ Name all four stages in order	Prophase → Metaphase → Anaphase → Telophase.
☐ Explain genetic identity	DNA replication produces exact copies — that's why they're identical.
☐ Mitosis ≠ meiosis	Growth/repair = mitosis; reproduction/variation = meiosis.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — Stem Cells

Tick the target that applies to your work	
☐ Specify the stem cell type	Embryonic (any cell) vs adult (limited range).
☐ Explain differentiation	Genes switched on/off — not 'cells change shape'.
☐ Ethical concern = embryo destroyed	Not just 'some people disagree' — explain the argument.
☐ Justified conclusion	Take a position with evidence — don't just say 'both have pros and cons'.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — MITOSIS AND CELL CYCLE

WHAT DO I KNOW?
(Declarative)

What happens during interphase before mitosis begins?

Name the four stages of mitosis in the correct order.

HOW DO I USE IT?
(Procedural)

How do you explain why daughter cells are genetically identical to the parent?

How do you describe what happens to chromosomes during anaphase?

WHEN DO I USE IT?
(Conditional)

When does the nuclear envelope break down and when does it reform?

When would you describe mitosis rather than meiosis in an answer?

MISTAKES TO AVOID

What is the difference between mitosis and meiosis?

Why is it wrong to say 'chromosomes split in half during anaphase'?

PREP — STEM CELLS AND DIFFERENTIATION

WHAT DO I KNOW?
(Declarative)

What is differentiation and how does it occur?

What is the difference between embryonic and adult stem cells?

HOW DO I USE IT?
(Procedural)

How do you evaluate the ethical issues around using embryonic stem cells?

How do you explain therapeutic cloning and its advantages?

WHEN DO I USE IT?
(Conditional)

When would you recommend embryonic over adult stem cells?

When would you evaluate iPSCs as an alternative to embryonic stem cells?

MISTAKES TO AVOID

Why is it wrong to say 'all stem cells can become any cell type'?

What is wrong with saying 'stem cells are good because they cure diseases' without further explanation?

CONTENTS — YEAR 9 CHEMISTRY

Autumn Term 2026-27

HW	Dates	POST — Retrieval topic	PREP — Upcoming lesson
Autumn 1 · 07 Sep – 23 Oct 2026			
1	21 Sep 26 → 05 Oct 26	GREEN C1 Atomic Structure	Electronic Configuration
2	05 Oct 26 → 19 Oct 26	RED Y8 Retrieval: Periodic Table Groups 1, 7 & 0	Relative Atomic Mass
3	19 Oct 26 → 09 Nov 26 ★ Set over Half Term — due first lesson back	GREEN C1 Ions and Ionic Compounds	Covalent Bonding Introduction
Autumn 2 · 02 Nov – 18 Dec 2026			
4	09 Nov 26 → 23 Nov 26	RED C1 Retrieval: Atomic Structure & Bonding	C2 Periodic Table History
5	23 Nov 26 → 07 Dec 26	GREEN C1 Assessment Consolidation	C2 Groups 1, 7 & 0 Reactions
Autumn 2 · 02 Nov – 18 Dec 2026 (due Jan)			
6	07 Dec 26 → 14 Jan 27 ★ ★ Christmas Homework — complete before returning in January	GREEN C2 Periodic Table & Transition Metals	Transition Metals (colours, catalysts)

Each homework contains: Steps 6–8.5 (Prep: Learning Box, Example/Non-Example, Task, Notes) | Steps 9–11 (Post: Learning Box, Example/Non-Example, Task + Answer page) | Step 12 (Challenge ★★★) | Step 14 (Feedforward) | Step 15 (Self-Quizzing)

YEAR 9 CHEMISTRY · AUTUMN TERM

Autumn 1 · 07 Sep – 23 Oct 2026

HW 1

Set: **21 Sep 26** Due: **05 Oct 26**

POST — RETRIEVAL

GREEN POST

C1 Atomic Structure

PREP — UPCOMING LESSON

Electronic Configuration

Steps 6–15 · ~20 pages

⚗ Year 9 Chemistry

PREP LEARNING BOX

C1: Electron shells, electronic configuration notation and the first 20 elements

GOLDEN THREAD:

You now know how many protons, neutrons and electrons an atom has. The next lessons focus on how electrons are arranged in shells around the nucleus — this is the key to understanding reactivity, bonding and the structure of the periodic table.

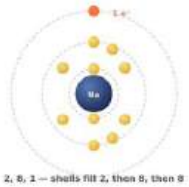
KEY IDEA:

Electron shells and configuration:

- Electrons occupy shells (energy levels) at increasing distances from the nucleus.
- **Shell capacities:** shell 1 = max 2 electrons; shell 2 = max 8; shell 3 = max 8 (for first 20 elements).
- Electrons fill the lowest energy shell first (innermost → outwards).
- **Notation:** written as numbers separated by commas. E.g. Sodium (Na, 11 electrons) = 2,8,1.
- The number of electrons in the outer shell = group number in the periodic table.
- The number of occupied shells = period number.

Examples: H=1; He=2; Li=2,1; C=2,4; Ne=2,8; Na=2,8,1; Cl=2,8,7; Ca=2,8,8,2.

SODIUM: FILLING ELECTRON SHELLS



2, 8, 1 — shells fill 2, then 8, then 8

IMPORTANT MISCONCEPTION:

Students sometimes put more than 8 electrons in shell 2 for elements in Period 3. **Shell 2 holds a maximum of 8** — any extra electrons go into shell 3. For example, aluminium (13 electrons) is 2,8,3 — not 2,11 or 2,10,1.

WHEN TO USE THIS:

Use this whenever you need to write or interpret electronic configurations, explain why elements in the same group have similar properties, or link electron configuration to position in the periodic table.

THINKING STEPS:

- How many electrons does this atom have (= atomic number for neutral atoms)?
- Fill shell 1 first (max 2), then shell 2 (max 8), then shell 3 (max 8).
- How many electrons are in the outer shell — which group is this?

WRITING STEPS:

- Write the atomic number (= electron count for neutral atom).
- Write the configuration by filling shells in order: 2, then 8, then 8.
- State the group number (outer shell electrons) and period number (number of shells occupied).

PREP: EXAMPLE / NON-EXAMPLE

C1: Electron shells, electronic configuration notation and the first 20 elements

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: Write the electronic configuration of phosphorus (atomic number 15). State which group and period it belongs to, and explain how the electronic configuration determines its group number. (4 marks)

EXAMPLE

Phosphorus has 15 electrons. Electronic configuration: 2,8,5. Shell 1 holds 2, shell 2 holds 8, and the remaining 5 electrons go into shell 3. Phosphorus is in Period 3 because it has electrons in three shells. It is in Group 5 because it has 5 electrons in its outer shell. The group number is determined by the number of electrons in the outermost shell — elements in the same group have the same number of outer electrons, which is why they have similar chemical properties.

WHAT IS GOOD ABOUT THIS?

✓Configuration written correctly: 2,8,5.

✓Period (3 shells) and Group (5 outer electrons) correctly identified.

✓Explains the link: outer shell electrons determine group; same outer electrons → similar chemical properties.

NON-EXAMPLE

Phosphorus has 15 electrons so configuration is 2,8,5. It is in group 5.

WHAT IS WRONG WITH THIS?

✗Configuration is correct but period not stated.

✗No explanation of why group = outer shell electron number.

✗No mention of why elements in the same group have similar properties.

KEY TAKEAWAY:

Electronic configuration: fill shells in order (2, 8, 8). Group = outer shell electrons; period = number of shells. Always explain the link between configuration and position in the periodic table.

PREP TASK

C1: Electron shells, electronic configuration notation and the first 20 elements

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

TASK:

Write the electronic configurations for the following elements and state the group and period for each. *(4 marks)*

YOUR ANSWERS:

1. Magnesium (Mg, Z = 12) — configuration, group and period. *(1 mark)*

2. Chlorine (Cl, Z = 17) — configuration, group and period. *(1 mark)*

3. Potassium (K, Z = 19) — configuration, group and period. *(1 mark)*

4. Explain why elements in Group 1 all react in similar ways. *(1 mark)*

NOTES PAGE

C1: Electron shells, electronic configuration notation and the first 20 elements

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 CHEMISTRY STEP 9 GREEN POST

POST LEARNING BOX

C1: Protons, neutrons and electrons — atomic number, mass number and isotopes

GOLDEN THREAD:

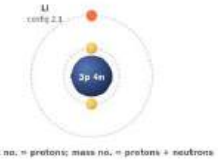
In Year 8 you studied elements, compounds and the periodic table. Now in Year 9 we go deeper — into the atom itself. Understanding atomic structure is the foundation for everything in chemistry: bonding, reactivity, the periodic table and quantitative chemistry.

KEY IDEA:

Inside the atom:

- **Proton:** relative mass 1, charge +1, found in the nucleus.
- **Neutron:** relative mass 1, charge 0, found in the nucleus.
- **Electron:** relative mass ~0 (1/1836), charge −1, found in shells around the nucleus.
- **Atomic number (Z):** number of protons in the nucleus — defines the element.
- **Mass number (A):** total number of protons + neutrons.
- **Number of neutrons = mass number − atomic number.**
- In a neutral atom: number of protons = number of electrons.
- **Isotopes:** atoms of the same element with the same number of protons but different numbers of neutrons (different mass numbers).

LITHIUM ATOM — LABELLED



IMPORTANT MISCONCEPTION:

Students often say isotopes have different numbers of protons. **This is incorrect** — isotopes always have the same number of protons (same atomic number, same element). They differ only in the number of neutrons, giving them different mass numbers. If the proton number changed, it would be a different element entirely.

WHEN TO USE THIS:

Use this when asked to describe atomic structure, calculate numbers of particles from atomic/mass number, or explain what isotopes are.

THINKING STEPS:

- What are the atomic number and mass number of this atom?
- How many neutrons? (mass number − atomic number)
- Is this an isotope question? Same protons, different neutrons.

WRITING STEPS:

- State the number of protons, neutrons and electrons — show the calculation for neutrons.
- Define isotopes: same element (same atomic number), different mass number (different neutron number).
- Explain any differences in properties between isotopes (same chemical properties; different mass/nuclear stability).

YEAR 9 CHEMISTRY STEP 10 GREEN POST

POST: EXAMPLE / NON-EXAMPLE

C1 Atomic Structure — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: An atom of chlorine has atomic number 17 and mass number 35. State the number of protons, neutrons and electrons. Then explain what is meant by the term 'isotope', using chlorine-35 and chlorine-37 as an example. (6 marks)

EXAMPLE

Atomic number = number of protons = 17. Number of electrons = 17 (equal to protons in a neutral atom). Number of neutrons = mass number − atomic number = 35 − 17 = 18. For chlorine-37: protons = 17, electrons = 17, neutrons = 37 − 17 = 20. Isotopes are atoms of the same element that have the same number of protons but different numbers of neutrons — and therefore different mass numbers. Chlorine-35 (^{35}Cl) has 17 protons and 18 neutrons, while chlorine-37 (^{37}Cl) has 17 protons and 20 neutrons. Both are chlorine atoms because they have the same atomic number (17). They have identical chemical properties because chemical behaviour depends on electron configuration, which is determined by proton number — not neutron number.

WHAT IS GOOD ABOUT THIS?

✓All three particle counts calculated correctly for Cl-35.

✓Isotopes defined precisely: same protons, different neutrons, therefore different mass numbers.

✓Explains why isotopes have identical chemical properties: same electron configuration.

NON-EXAMPLE

Chlorine has 17 protons and 17 electrons. Neutrons = 35 − 17 = 18. Isotopes have the same number of protons but different numbers of neutrons.

WHAT IS WRONG WITH THIS?

✗Correct but incomplete — only Cl-35 calculated, not Cl-37 comparison.

✗Isotope definition correct but no explanation of why chemical properties are the same.

✗No example given using both isotopes with their specific particle numbers.

KEY TAKEAWAY:

Atomic structure answers: show the neutron calculation (A − Z), define isotopes using proton and neutron numbers, explain identical chemical properties through electron configuration.

POST-TASK

C1: Protons, neutrons and electrons — atomic number, mass number and isotopes

GREEN POST: STRENGTHENS THE NEW ROUTE

This task retrieves C1 Atomic Structure at the point where forgetting begins — strengthening the memory trace before it fades.

Question: An atom of chlorine has atomic number 17 and mass number 35. State the number of protons, neutrons and electrons. Explain what isotopes are, using chlorine-35 and chlorine-37 as an example. (6 marks)

SCAFFOLDED STEPS TOWARDS 6 MARKS:

- **Step 1 (2 marks):** State the number of protons, neutrons and electrons in chlorine-35. Show the calculation for neutrons: A − Z.
- **Step 2 (2 marks):** Define isotopes precisely using the key terms: same element, same atomic number, different mass number, different number of neutrons.
- **Step 3 (2 marks):** Compare Cl-35 and Cl-37 — state the particle numbers for each and explain why both are classified as chlorine. Explain why they have the same chemical properties.

CHALLENGE TASK

C1 Atomic Structure — stretch your thinking further

CHALLENGE:

Dmitri Mendeleev arranged elements in his early periodic table by atomic mass rather than atomic number. He noticed that some elements didn't fit the pattern and left gaps, predicting undiscovered elements.

Using your knowledge of atomic structure and electronic configuration, explain why the modern periodic table is arranged by atomic number rather than atomic mass, and evaluate why Mendeleev's approach of leaving gaps was scientifically valid. Use at least FOUR scientific points.

★ ★ ★ **Think about:** Why does atomic number (protons) determine chemical properties rather than atomic mass? What determines which group an element belongs to? Why were gaps better than forcing elements into the wrong place? What does this tell us about good scientific practice?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — C1 Atomic Structure

Tick the target that applies to your work	
☐ Neutrons = mass number − atomic number	Always show this calculation.
☐ Neutral atom: protons = electrons	Ions are different — a neutral atom has equal p and e.
☐ Isotopes: same Z, different A	Same protons, different neutrons — same element.
☐ Identical chemical properties	Because same electron configuration — not same mass.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — C1 Electronic Configuration

Tick the target that applies to your work	
☐ Fill shells in order: 2, 8, 8	Shell 2 max = 8, not more.
☐ Group = outer shell electrons	Count the electrons in the outermost shell.
☐ Period = number of shells occupied	3 shells = Period 3.
☐ Same group = same outer electrons	Explains why similar chemical properties.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — C1 ATOMIC STRUCTURE

WHAT DO I KNOW?
(Declarative)

What are the charges and relative masses of protons, neutrons and electrons?

What is the difference between atomic number and mass number?

HOW DO I USE IT?
(Procedural)

How do you calculate the number of neutrons in an atom?

How do you define isotopes using the terms proton, neutron and mass number?

WHEN DO I USE IT?
(Conditional)

When would you explain why isotopes have the same chemical properties?

When would you use atomic number rather than mass number to identify an element?

MISTAKES TO AVOID

Why is it wrong to say isotopes have different numbers of protons?

What is wrong with saying 'an atom has more electrons than protons'?

PREP — C1 ELECTRONIC CONFIGURATION

WHAT DO I KNOW?
(Declarative)

What is the maximum number of electrons in shells 1, 2 and 3?

Write the electronic configuration of sodium (Z = 11).

HOW DO I USE IT?
(Procedural)

How do you determine the group number of an element from its electronic configuration?

How do you determine the period number from the electronic configuration?

WHEN DO I USE IT?
(Conditional)

When would you link electronic configuration to reactivity?

When would you use electronic configuration to explain why two elements have similar properties?

MISTAKES TO AVOID

Why is 2,11 an incorrect electronic configuration for Na?

What is wrong with writing K (Z=19) as 2,8,9 instead of 2,8,8,1?

YEAR 9 CHEMISTRY · AUTUMN TERM

Autumn 1 · 07 Sep – 23 Oct 2026

HW 2

Set: **05 Oct 26** Due: **19 Oct 26**

POST — RETRIEVAL	PREP — UPCOMING LESSON
RED POST **Y8 Retrieval: Periodic Table Groups 1, 7 & 0**	**Relative Atomic Mass**

Steps 6–15 · ~20 pages

⚗ Year 9 Chemistry

YEAR 9 CHEMISTRY STEP 6 — PREP · Upcoming Lesson

PREP LEARNING BOX

C1: Calculating relative atomic mass (RAM) from isotope data — upcoming lessons

GOLDEN THREAD:

You know what isotopes are — atoms of the same element with different mass numbers. The next lessons extend this to calculating the relative atomic mass of an element from its isotopes, weighted by abundance. This is used in mass spectrometry and underpins all quantitative chemistry.

KEY IDEA:

Relative atomic mass (A_r):

- The average mass of atoms of an element, taking into account the **relative abundance** of each isotope.
- **Formula:** A_r = Σ (mass of isotope × % abundance) ÷ 100
- The result is usually not a whole number because it is a weighted average.
- Example: chlorine has two isotopes — ^{35}Cl (75%) and ^{37}Cl (25%).
- $A_r(Cl) = (35 \times 75 + 37 \times 25) \div 100 = (2625 + 925) \div 100 = 3550 \div 100 = 35.5$
- **Mass spectrometry** is used to determine the exact masses and abundances of isotopes.

CHLORINE ISOTOPES → RAM

IMPORTANT MISCONCEPTION:

Students sometimes use the ratio of isotopes directly without weighting by abundance. **You must multiply mass by abundance before dividing.** If you simply average the two masses (35 + 37) ÷ 2 = 36, you get the wrong answer because this assumes equal abundance — but ^{35}Cl is three times more abundant than ^{37}Cl.

WHEN TO USE THIS:

Use this whenever a question gives you isotope masses and abundances and asks for the relative atomic mass. Also use it to explain why Ar values on the periodic table are not whole numbers.

THINKING STEPS:

- What are the masses and % abundances of each isotope?
- Have I multiplied each mass by its abundance before dividing?
- Does my answer make sense — is it between the two isotope masses?

WRITING STEPS:

- Write the formula: A_r = Σ(mass × abundance) ÷ 100.
- Multiply each isotope mass by its % abundance and add the products.
- Divide by 100 and check the answer lies between the two isotope masses.

PREP: EXAMPLE / NON-EXAMPLE

C1: Calculating relative atomic mass (RAM) from isotope data — upcoming lessons

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: Boron has two isotopes: ^{10}B (abundance 20%) and ^{11}B (abundance 80%). Calculate the relative atomic mass of boron. Show all working. (3 marks)

EXAMPLE

$A_r(B) = (10 \times 20 + 11 \times 80) \div 100 = (200 + 880) \div 100 = 1080 \div 100 = 10.8$. The relative atomic mass of boron is 10.8. This value lies between the two isotope masses (10 and 11) and is closer to 11 because ^{11}B is more abundant (80%).

WHAT IS GOOD ABOUT THIS?

✓Formula stated and both products calculated correctly.

✓Division by 100 and correct final answer: 10.8.

✓Answer interpreted: closer to 11 because ^{11}B is more abundant — shows understanding.

NON-EXAMPLE

RAM = (10 + 11) ÷ 2 = 10.5.

WHAT IS WRONG WITH THIS?

✗Averaged the two masses without weighting by abundance — incorrect method.

✗Answer (10.5) assumes equal 50/50 abundance — but ^{11}B is four times more abundant than ^{10}B.

✗No formula shown and no working.

KEY TAKEAWAY:

RAM calculation: always multiply each mass by its % abundance, add the products, then divide by 100. Never average masses without weighting. Check: answer must lie between the two isotope masses.

YEAR 9 CHEMISTRY STEP 8 PREP · Upcoming Lesson

PREP TASK

C1: Calculating relative atomic mass (RAM) from isotope data — upcoming lessons

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

RAM PRACTICE:

Copper has two isotopes: ^{63}Cu (69%) and ^{65}Cu (31%). Calculate the relative atomic mass of copper. Show all working. *(3 marks)*

YOUR ANSWERS:

NOTES PAGE

C1: Calculating relative atomic mass (RAM) from isotope data — upcoming lessons

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 CHEMISTRY STEP 9 RED POST

POST LEARNING BOX

Y8 C1 Retrieval: Groups 1, 7 and 0 — reactivity trends and explanations

GOLDEN THREAD:

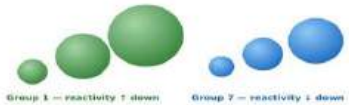
In Year 8 you studied reactivity trends in Groups 1, 7 and 0. This Red Post retrieval strengthens those earlier memories — the wider the gap since you last recalled this, the stronger the memory becomes. These trends are also directly explained by the electronic configurations you are now studying.

KEY IDEA:

Y8 Periodic Table — key retrieval points:

- **Group 1 (alkali metals):** Li, Na, K... Reactivity *increases* down the group. React with water → metal hydroxide + hydrogen. Reaction gets more vigorous down the group. Reason: outer electron is further from the nucleus → held less tightly → lost more easily.
- **Group 7 (halogens):** F, Cl, Br, I... Reactivity *decreases* down the group. More reactive halogen displaces less reactive halide from solution (displacement). Reason: outer shell is further from nucleus → harder to gain an electron.
- **Group 0 (noble gases):** He, Ne, Ar... Unreactive. Full outer shell — no tendency to gain or lose electrons.

GROUP TRENDS — GROWING ATOMS



IMPORTANT MISCONCEPTION:

Students often state the trend correctly but give the wrong reason. The reason for **Group 1 increasing reactivity** is not 'there are more electrons' — it is that the outer electron is in a shell further from the nucleus, so the nuclear attraction is weaker, and the electron is lost more easily. More electrons shield the outer electron from the nucleus (shielding effect).

WHEN TO USE THIS:

Use this when asked to explain reactivity trends, predict which Group 1 or Group 7 element is most reactive, describe displacement reactions, or write word equations for Group 1 reactions with water.

THINKING STEPS:

- Is this Group 1 (reactivity increases down) or Group 7 (reactivity decreases down)?
- Which element is more reactive and why — focus on outer electron distance from nucleus.
- Can I write the word equation for the reaction?

WRITING STEPS:

- State the trend (increases/decreases down the group).
- Explain using outer electron shell distance from nucleus and nuclear attraction.
- Write the word equation: Group 1 + water → hydroxide + hydrogen.

YEAR 9 CHEMISTRY STEP 10 RED POST

POST: EXAMPLE / NON-EXAMPLE

Y8 Chemistry Retrieval: The Periodic Table — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: Explain why potassium reacts more vigorously with water than lithium. Write the word equation for the reaction of potassium with water. (6 marks)

EXAMPLE

Potassium reacts more vigorously with water than lithium because potassium is lower in Group 1 — its outer electron is in the fourth electron shell, whereas lithium's outer electron is in the second shell. The fourth shell is much further from the positive nucleus than the second shell, so the nuclear attraction on potassium's outer electron is weaker. Additionally, the greater number of inner electron shells in potassium shield the outer electron from the nuclear charge more effectively. As a result, potassium's outer electron is lost more easily, making potassium more reactive. Word equation: potassium + water → potassium hydroxide + hydrogen.

WHAT IS GOOD ABOUT THIS?

✓Identifies the key factor: outer electron in a higher shell (further from nucleus).

✓Mentions shielding effect as an additional reason.

✓Word equation correct with all products named.

NON-EXAMPLE

Potassium is more reactive because it has more electrons. It reacts with water to make potassium hydroxide and hydrogen.

WHAT IS WRONG WITH THIS?

✗'More electrons' is not the correct reason — must state that the outer electron is further from the nucleus.

✗No mention of nuclear attraction or shielding.

✗Word equation missing the word 'water' on the left — reactants must include water.

KEY TAKEAWAY:

Group 1 reactivity: the reason is always outer electron distance from nucleus + shielding — never 'more electrons'. Always write the full word equation with both reactants and both products.

POST-TASK

Y8 C1 Retrieval: Groups 1, 7 and 0 — reactivity trends and explanations

RED POST: RECONNECTS AN EARLIER ROUTE

This task retrieves Y8 Chemistry Retrieval: The Periodic Table at the point where forgetting begins — strengthening the memory trace before it fades.

Question: Explain why potassium reacts more vigorously with water than lithium. Write the word equation for potassium reacting with water. (6 marks)

SCAFFOLDED STEPS TOWARDS 6 MARKS:

- **Step 1 (2 marks):** State the outer electron shell number for lithium (shell 2) and potassium (shell 4). Explain how distance from the nucleus affects the ease of losing the outer electron.
- **Step 2 (2 marks):** Explain the shielding effect — how do inner electrons reduce the attraction between the nucleus and the outer electron in potassium?
- **Step 3 (2 marks):** Write the word equation for potassium reacting with water. State all reactants and products on the correct sides.

CHALLENGE TASK

Y8 Chemistry Retrieval: The Periodic Table — stretch your thinking further

CHALLENGE:

A chemist uses mass spectrometry and discovers that a sample of a newly synthesised element has three isotopes with the following data: isotope A = mass 107, abundance 52%; isotope B = mass 109, abundance 48%.

Calculate the RAM of this element, identify it using the periodic table, and evaluate whether the two-isotope data is sufficient to confidently identify the element. Use at least THREE scientific points.

★ ★ ★ **Think about:** Calculate the RAM — what do you get? Which element on the periodic table has this Ar value? Could rounding or measurement error affect the identification? What additional data would increase confidence?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — Y8 Periodic Table Retrieval

Tick the target that applies to your work	
☐ Direction of reactivity trends	Group 1 increases down; Group 7 decreases down.
☐ Correct explanation: outer e⁻ distance	Not 'more electrons' — further from nucleus.
☐ Write the full word equation	Both reactants (metal + water) and both products (hydroxide + hydrogen).
☐ Shielding effect	Inner shells reduce nuclear attraction on outer electrons.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — C1 Relative Atomic Mass

Tick the target that applies to your work	
☐ Multiply mass × abundance THEN add	Not average: must weight by abundance.
☐ Divide by 100 at the end	Not by the number of isotopes.
☐ Answer between the two isotope masses	Check this as a sense-check.
☐ Closer to more abundant isotope	RAM reflects weighted average — not simple average.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — Y8 PERIODIC TABLE RETRIEVAL

WHAT DO I KNOW?
(Declarative)

What is the reactivity trend in Group 1 and what is the explanation?

What is the reactivity trend in Group 7 and what is the explanation?

HOW DO I USE IT?
(Procedural)

How do you write the word equation for sodium reacting with water?

How do you explain a halogen displacement reaction?

WHEN DO I USE IT?
(Conditional)

When would you explain Group 0 unreactivity in terms of electron configuration?

When would you compare Group 1 and Group 7 trends in the same answer?

MISTAKES TO AVOID

Why is 'potassium is more reactive because it has more electrons' an incorrect explanation?

What is wrong with saying Group 7 reactivity increases down the group?

PREP — C1 RELATIVE ATOMIC MASS

WHAT DO I KNOW?
(Declarative)

What is relative atomic mass and why is it often not a whole number?

What formula is used to calculate RAM from isotope data?

HOW DO I USE IT?
(Procedural)

How do you calculate RAM for an element with two isotopes?

How do you check your RAM answer makes sense?

WHEN DO I USE IT?
(Conditional)

When would you need to calculate RAM rather than just use the periodic table value?

When would you explain why the Ar of chlorine is 35.5?

MISTAKES TO AVOID

Why is (35 + 37) ÷ 2 = 36 an incorrect calculation for chlorine's RAM?

What is wrong with dividing by the number of isotopes rather than by 100?

YEAR 9 CHEMISTRY · AUTUMN TERM

Autumn 1 · 07 Sep – 23 Oct 2026

HW 3

Set: **19 Oct 26** Due: **09 Nov 26**

★ Set over Half Term — due first lesson back

POST — RETRIEVAL

▧ GREEN POST

C1 Ions and Ionic Compounds

PREP — UPCOMING LESSON

Covalent Bonding Introduction

Steps 6–15 · ~20 pages

⚗ Year 9 Chemistry

PREP LEARNING BOX

C1: Covalent bonding — sharing electrons, simple covalent molecules (H_2O, CO_2, CH_4)

GOLDEN THREAD:

You have studied ionic bonding — electron transfer between metals and non-metals. The next lessons look at what happens when two non-metals combine: instead of transferring electrons, they share them. This is covalent bonding, which explains the structure of water, carbon dioxide, methane and many other important molecules.

KEY IDEA:

Covalent bonding:

- Occurs between **non-metal atoms** — both atoms need to gain electrons.
- Each atom donates one electron to form a **shared pair of electrons** — the covalent bond.
- Each shared pair counts as one covalent bond (single bond). Double bonds = 2 shared pairs.
- The bond forms because the shared electrons are attracted to the nuclei of **both** atoms — this holds the atoms together.
- **Examples:**
  - H_2: H—H (1 single bond, 2 shared electrons)
  - H_2O: O with 2 single bonds to H (O needs 2 bonds — has 6 outer electrons)
  - CO_2: O=C=O (2 double bonds — C needs 4 bonds, each O needs 2)
  - CH_4: C with 4 single bonds to H (C needs 4 bonds)

COVALENT vs IONIC BONDING

IMPORTANT MISCONCEPTION:

Students sometimes say covalent bonds form because 'one atom gives its electrons to the other'. **This is incorrect — that describes ionic bonding.** In covalent bonding, both atoms share electrons equally — the bond consists of a pair of electrons attracted to both nuclei simultaneously. Neither atom fully gains or loses the electrons.

WHEN TO USE THIS:

Use this when asked to describe how covalent bonds form, draw dot-and-cross diagrams for simple molecules, or compare covalent and ionic bonding.

THINKING STEPS:

- Are these two non-metals? If so, covalent bonding — sharing, not transfer.
- How many bonds does each atom need? (H needs 1; O needs 2; N needs 3; C needs 4)
- Is this a single or double bond — how many shared pairs?

WRITING STEPS:

- State that covalent bonding occurs between non-metals by sharing electrons.
- Describe the shared pair: each atom contributes one electron; both nuclei attract the pair.
- State the number of bonds needed for each atom and draw the structure.

PREP: EXAMPLE / NON-EXAMPLE

C1: Covalent bonding — sharing electrons, simple covalent molecules (H_2O, CO_2, CH_4)

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: Describe how covalent bonding occurs in a water molecule (H_2O). Explain what holds the atoms together and draw a dot-and-cross diagram. (4 marks)

EXAMPLE

Water (H_2O) is formed by covalent bonding between oxygen (a non-metal) and hydrogen (a non-metal). Oxygen has 6 electrons in its outer shell and needs 2 more to achieve a full shell of 8. Each hydrogen atom has 1 electron in its outer shell and needs 1 more to achieve a full shell of 2. Each hydrogen atom shares its single electron with the oxygen atom, forming a shared pair — a covalent bond. This means oxygen forms two covalent bonds, one with each hydrogen atom. The shared electrons are attracted to the positively charged nuclei of both the oxygen and hydrogen atoms simultaneously — this electrostatic attraction is what holds the molecule together. [Dot-and-cross diagram: O with 4 lone pair electrons and 2 shared pairs, one shared pair with each H].

WHAT IS GOOD ABOUT THIS?

- ✓Explains electron sharing: each atom contributes one electron to the shared pair.
- ✓States that oxygen needs 2 bonds and hydrogen needs 1 — linked to their outer shell electron needs.
- ✓Describes why the bond forms: electrostatic attraction of shared pair to both nuclei.

NON-EXAMPLE

Water has covalent bonds because it is two non-metals. The atoms share electrons. O and H share electrons to get full shells.

WHAT IS WRONG WITH THIS?

- ✗'Share electrons' is correct but not explained — must say each atom contributes one electron to a shared pair.
- ✗No explanation of why the bond holds the atoms together (electrostatic attraction to both nuclei).
- ✗Number of bonds not stated — must say O forms 2 bonds, H forms 1.

KEY TAKEAWAY:

Covalent bonding: non-metals + non-metals; sharing (not transfer); shared pair attracted to both nuclei. State the number of bonds each atom forms and why (to achieve full outer shell).

PREP TASK

C1: Covalent bonding — sharing electrons, simple covalent molecules (H_2O, CO_2, CH_4)

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

TASK:

Describe how covalent bonding occurs in a methane molecule (CH_4). State the number of bonds carbon forms and explain why. Draw a structural formula for methane. *(4 marks)*

YOUR ANSWERS:

NOTES PAGE

C1: Covalent bonding — sharing electrons, simple covalent molecules (H_2O, CO_2, CH_4)

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 CHEMISTRY STEP 9 GREEN POST

POST LEARNING BOX

C1: Ion formation, ionic charges, formulae and the ionic bond

GOLDEN THREAD:

You now understand electronic configuration. The next step is to see what happens when atoms transfer electrons to form ions — the basis of ionic bonding. This links directly to the periodic table: group number tells us how many electrons an atom will gain or lose.

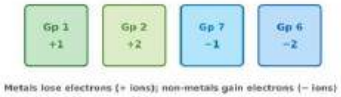
KEY IDEA:

Ion formation:

- Atoms form ions to achieve a **full outer shell** (stable noble gas configuration).
- **Metals** (left of periodic table) lose electrons → form positive ions (cations). E.g. Na → Na^+ (loses $1e^-$); Mg → Mg^{2+} (loses $2e^-$).
- **Non-metals** (right of periodic table) gain electrons → form negative ions (anions). E.g. Cl → Cl^- (gains $1e^-$); O → O^{2-} (gains $2e^-$).
- **Charge on ion = electrons lost (metals) or gained (non-metals).**
- Group 1 → 1+ ions; Group 2 → 2+; Group 6 → 2−; Group 7 → 1−.

Ionic formulae: combine ions so total charge = 0. E.g. NaCl (Na^+ and Cl^-, 1:1); $MgCl_2$ (Mg^{2+} and $2\times Cl^-$, charges cancel).

COMMON IONS ON THE PERIODIC TABLE



Metals lose electrons (+ ions); non-metals gain electrons (− ions)

IMPORTANT MISCONCEPTION:

Students often say atoms 'share' electrons to form ions. **This is incorrect — ions form by electron transfer, not sharing.** Sharing electrons is covalent bonding (which you will study next). In ionic bonding, electrons are completely transferred from the metal to the non-metal.

WHEN TO USE THIS:

Use this when asked to explain ion formation, determine ionic charges from group number, write ionic formulae, or describe what the ionic bond is.

THINKING STEPS:

- Is this a metal or non-metal — does it lose or gain electrons?
- How many electrons are lost/gained — what is the ion charge?
- Do the charges in the formula balance (total charge = 0)?

WRITING STEPS:

- State whether the atom loses or gains electrons, and how many.
- Write the resulting ion with its charge (e.g. Mg^{2+}).
- For formulae: combine ions in the ratio that makes total charge zero.

YEAR 9 CHEMISTRY STEP 10 GREEN POST

POST: EXAMPLE / NON-EXAMPLE

C1 Ions and Ionic Compounds — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: Explain how magnesium and chlorine atoms form ions and combine to produce magnesium chloride. Include electronic configurations in your answer. (6 marks)

EXAMPLE

Magnesium (2,8,2) has 2 electrons in its outer shell. It loses both electrons to form a Mg^{2+} ion with the configuration 2,8 — a stable, full outer shell matching the configuration of neon. Chlorine (2,8,7) has 7 electrons in its outer shell. It gains 1 electron to form a Cl^- ion with the configuration 2,8,8 — a full outer shell matching argon. To form magnesium chloride, the charges must balance: Mg^{2+} has a charge of +2 and each Cl^- has a charge of −1, so two Cl^- ions are needed to balance one Mg^{2+}. The formula is therefore $MgCl_2$. The ionic bond is the strong electrostatic attraction between the oppositely charged Mg^{2+} and Cl^- ions in the giant ionic lattice.

WHAT IS GOOD ABOUT THIS?

✓Electronic configurations shown for Mg and Cl, before and after electron transfer.

✓Correct formula $MgCl_2$ derived by balancing charges.

✓Ionic bond defined as electrostatic attraction between oppositely charged ions.

NON-EXAMPLE

Magnesium loses 2 electrons to become Mg^{2+}. Chlorine gains 1 electron to become Cl^-. The formula is $MgCl_2$.

WHAT IS WRONG WITH THIS?

✗Correct but no electronic configurations shown — must include 2,8,2 → 2,8 for Mg etc.

✗Correct formula but no explanation of why 2 chloride ions are needed (charge balancing not explained).

✗Ionic bond not defined — electrostatic attraction between oppositely charged ions must be stated.

KEY TAKEAWAY:

Ionic bonding: always show electronic configurations before and after, explain charge balancing to derive the formula, and define the ionic bond as electrostatic attraction.

POST-TASK

C1: Ion formation, ionic charges, formulae and the ionic bond

GREEN POST: STRENGTHENS THE NEW ROUTE

This task retrieves C1 Ions and Ionic Compounds at the point where forgetting begins — strengthening the memory trace before it fades.

Question: Explain how magnesium and chlorine atoms form ions and combine to produce magnesium chloride. Include electronic configurations. (6 marks)

SCAFFOLDED STEPS TOWARDS 6 MARKS:

- **Step 1 (2 marks):** Describe magnesium ion formation — state the electronic configuration of the atom (2,8,2), how many electrons are lost, the resulting ion (Mg^{2+}) and its configuration (2,8).
- **Step 2 (2 marks):** Describe chloride ion formation — state Cl's configuration (2,8,7), how many electrons are gained, the resulting ion (Cl^-) and its configuration (2,8,8).
- **Step 3 (2 marks):** Explain how the ions combine: state the charges (+2 and −1), explain why 2 Cl^- are needed to balance one Mg^{2+}, and write the formula $MgCl_2$. Define the ionic bond.

CHALLENGE TASK

C1 Ions and Ionic Compounds — stretch your thinking further

CHALLENGE:

Carbon dioxide (CO_2) has two C=O double bonds, while water (H_2O) has two O−H single bonds. Both contain covalent bonding.

Explain why CO_2 has double bonds but H_2O has only single bonds. Use electronic configurations to support your answer. Then predict the bonding in nitrogen gas (N_2) and justify your prediction. Use at least FOUR scientific points.

★ ★ ★ **Think about:** How many electrons does C need to share? How many does O need — and how does this determine single vs double bonds? How many electrons does N have in its outer shell — how many bonds does it need?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — C1 Ions and Ionic Compounds

Tick the target that applies to your work	
☐ Metal = loses e^-, non-metal = gains e^-	Direction of electron transfer matters.
☐ Show electronic configurations	Before and after ion formation — always include these.
☐ Balance charges to get formula	$MgCl_2$ not MgCl — because +2 needs two −1 ions.
☐ Define ionic bond	Electrostatic attraction between oppositely charged ions.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — Covalent Bonding

Tick the target that applies to your work	
☐ Sharing, not transfer	Covalent = shared pair; ionic = full transfer.
☐ Both atoms contribute one e^-	Each atom provides one electron to the shared pair.
☐ Number of bonds = gaps in outer shell	H needs 1, O needs 2, N needs 3, C needs 4.
☐ Double bond = 2 shared pairs	CO_2 has two C=O double bonds.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — C1 IONS AND IONIC COMPOUNDS

WHAT DO I KNOW?
(Declarative)

What is the charge on the ion formed by Group 1, Group 2, Group 6 and Group 7 atoms?

What is an ionic bond?

HOW DO I USE IT?
(Procedural)

How do you derive the formula of an ionic compound from the charges on its ions?

How do you describe magnesium ion formation using electronic configurations?

WHEN DO I USE IT?
(Conditional)

When would you explain ion formation by linking to group number?

When would you explain why ionic compounds have high melting points?

MISTAKES TO AVOID

What is the difference between ionic and covalent bonding?

Why is it wrong to say ions form by sharing electrons?

PREP — C1 COVALENT BONDING

WHAT DO I KNOW?
(Declarative)

What is a covalent bond?

How many covalent bonds do H, O, N and C each form?

HOW DO I USE IT?
(Procedural)

How do you describe covalent bond formation in H_2O?

How do you explain why CO_2 has double bonds?

WHEN DO I USE IT?
(Conditional)

When would you describe covalent rather than ionic bonding for a compound?

When would you explain a double bond rather than a single bond?

MISTAKES TO AVOID

Why is 'sharing electrons' insufficient as an explanation of covalent bonding?

What is wrong with saying 'both atoms gain a full outer shell' in covalent bonding?

CONTENTS — YEAR 9 PHYSICS

Autumn Term 2026-27

HW	Dates	POST — Retrieval topic	PREP — Upcoming lesson
Autumn 1 · 07 Sep – 23 Oct 2026			
1	21 Sep 26 → 05 Oct 26	GREEN P1 Energy Stores and Transfers	Specific Heat Capacity (E = mcΔT)
2	05 Oct 26 → 19 Oct 26	RED Y8 Retrieval: Energy Efficiency & Sankey Diagrams	Power and Work Done
3	19 Oct 26 → 09 Nov 26 ★ Set over Half Term — due first lesson back	GREEN P1 Energy Efficiency and Conservation	Reducing Dissipation in Real Systems
Autumn 2 · 02 Nov – 18 Dec 2026			
4	09 Nov 26 → 23 Nov 26	RED P1 Retrieval: Energy, Power & Efficiency	RP9 Specific Heat Capacity Practical
5	23 Nov 26 → 07 Dec 26	GREEN P1 Assessment Consolidation	P2 Introduction: Conduction, Convection & Radiation
Autumn 2 · 02 Nov – 18 Dec 2026 (due Jan)			
6	07 Dec 26 → 14 Jan 27 ★ ★ Christmas Homework — complete before returning in January	GREEN P2 Energy Transfer by Heating	P2 Infrared Radiation and Insulation

Each homework contains: Steps 6–8.5 (Prep: Learning Box, Example/Non-Example, Task, Notes) | Steps 9–11 (Post: Learning Box, Example/Non-Example, Task + Answer page) | Step 12 (Challenge ★★★) | Step 14 (Feedforward) | Step 15 (Self-Quizzing)

YEAR 9 PHYSICS STEP 6 PREP · Upcoming Lesson

PREP LEARNING BOX

P1: Specific heat capacity — the equation E = mcΔT and calculations

GOLDEN THREAD:

You can describe energy stores and transfers. The next lessons quantify how much energy is stored in the thermal store of a substance — using specific heat capacity. This allows us to calculate the energy needed to heat objects, and is directly assessed in GCSE Paper 1.

KEY IDEA:

Specific heat capacity (SHC):

- The **specific heat capacity (c)** of a substance is the amount of energy needed to raise the temperature of 1 kg of the substance by 1°C.
- Units: J/kg/°C (joules per kilogram per degree Celsius).
- **Formula: E = mcΔT** where:
  - E = energy transferred (J)
  - m = mass (kg)
  - c = specific heat capacity (J/kg/°C)
  - ΔT = change in temperature (°C)
- A high SHC means a substance requires a lot of energy to heat up — water has a very high SHC (4200 J/kg/°C), which is why it is used in central heating systems.

HEATING WATER — SHC EXAMPLE

IMPORTANT MISCONCEPTION:

Students often substitute the final temperature rather than the temperature change (ΔT) into the formula. **ΔT = final temperature − initial temperature.** If water starts at 20°C and is heated to 70°C, then ΔT = 70 − 20 = 50°C — not 70°C.

WHEN TO USE THIS:

Use this whenever a question asks how much energy is needed to heat something, or what temperature change results from a given energy input. Always identify m, c and ΔT before substituting.

THINKING STEPS:

- What are the mass, specific heat capacity and temperature change?
- Is the question giving ΔT directly, or do I need to calculate it from initial and final temperatures?
- Have I checked that mass is in kg (not g)?

WRITING STEPS:

- Write the formula: E = mcΔT.
- Identify and substitute each value with its unit.
- Calculate E in joules and check the magnitude is sensible.

YEAR 9 PHYSICS STEP 7 PREP · Upcoming Lesson

PREP: EXAMPLE / NON-EXAMPLE

P1: Specific heat capacity — the equation E = mcΔT and calculations

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: A 0.5 kg block of aluminium (c = 900 J/kg/°C) is heated from 20°C to 80°C. Calculate the energy stored in the thermal store of the aluminium. Show all working. (4 marks)

EXAMPLE

E = mcΔT. m = 0.5 kg; c = 900 J/kg/°C; ΔT = 80 − 20 = 60°C. E = 0.5 × 900 × 60 = 27,000 J = 27 kJ. The thermal store of the aluminium block increases by 27,000 joules (27 kJ).

WHAT IS GOOD ABOUT THIS?

✓ Formula written first.

✓ ΔT calculated correctly as final minus initial temperature (60°C, not 80°C).

✓ Correct answer with unit (J or kJ) and working shown.

NON-EXAMPLE

E = 0.5 × 900 × 80 = 36,000 J.

WHAT IS WRONG WITH THIS?

✗ Substituted 80°C (the final temperature) instead of ΔT (60°C) — must subtract initial temperature.

✗ No formula written before substitution.

✗ No unit given for the final answer.

KEY TAKEAWAY:

E = mcΔT: always calculate ΔT = final − initial first. Write the formula, substitute with units, calculate, state the unit.

PREP TASK

P1: Specific heat capacity — the equation E = mcΔT and calculations

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

TASK:

A kettle heats 1.5 kg of water (c = 4200 J/kg/°C) from 15°C to 100°C. Calculate the energy required. Show all working and give the answer in kJ. *(4 marks)*

YOUR ANSWERS:

NOTES PAGE

P1: Specific heat capacity — the equation E = mcΔT and calculations

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 PHYSICS STEP 9 GREEN POST

POST LEARNING BOX

P1: Energy stores, pathways and the conservation of energy

GOLDEN THREAD:

In Year 8 you studied energy stores and energy transfers at an introductory level. Now in Year 9 GCSE Physics we build on this systematically — using precise scientific vocabulary, conservation principles and calculations. Understanding energy is the foundation for all physics topics this year.

KEY IDEA:

Energy stores and pathways:

- **Energy stores:** kinetic, thermal (internal), chemical, gravitational potential energy (GPE), elastic potential energy, magnetic, electrostatic, nuclear.
- **Energy transfer pathways:** mechanically (by a force doing work), electrically, by heating, by radiation (e.g. light or sound waves).
- **Conservation of energy:** energy cannot be created or destroyed — only transferred from one store to another. The total energy of a closed system always remains constant.
- **Dissipation:** in any real energy transfer, some energy is always transferred to the thermal store of the surroundings (wasted). This is why no system is 100% efficient.
- **Describing energy transfers:** use the format: '*energy is transferred from the [store] store of [object] to the [store] store of [object] by [pathway].*'

ENERGY STORES

IMPORTANT MISCONCEPTION:

Students often say energy is 'used up' or 'lost' during a transfer. **This is incorrect.** Energy is conserved — it cannot be created or destroyed. What actually happens is that some energy is transferred to the thermal store of the surroundings (dissipated) rather than to the intended useful store. The total energy before always equals the total energy after.

WHEN TO USE THIS:

Use this when asked to describe an energy transfer, explain conservation of energy, identify energy stores, or explain why devices are not 100% efficient.

THINKING STEPS:

- What store(s) does the energy start in, and what store(s) does it end in?
- What pathway is the energy transferred by (mechanical work, heating, electrically, radiation)?
- Where is energy dissipated — what happens to the wasted energy?

WRITING STEPS:

- Name the initial and final energy stores, and the object associated with each.
- Name the transfer pathway used.
- Describe where energy is wasted — always the thermal store of the surroundings.

YEAR 9 PHYSICS STEP 10 GREEN POST

POST: EXAMPLE / NON-EXAMPLE

P1 Energy Stores and Transfers — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: A ball is dropped from a height. Describe the energy transfers that occur as it falls and when it hits the ground. Include the names of the stores, the pathway and what happens to the energy that is 'wasted'. (6 marks)

EXAMPLE

Before the ball is released, it has energy in its gravitational potential energy (GPE) store — due to its height above the ground. As the ball falls, work is done by gravity (a mechanical transfer), and energy is transferred from the GPE store to the kinetic energy store of the ball — the ball speeds up. Just before hitting the ground, almost all the GPE has been converted to kinetic energy (ignoring air resistance). When the ball hits the ground, it decelerates rapidly — the kinetic energy is transferred to the elastic potential store of the ball and ground momentarily (as they deform), then to the thermal stores of the ball and the ground (they warm slightly), and some energy is transferred as a sound wave (by radiation) which we hear as the impact sound. None of the energy is 'lost' — it is all accounted for in these stores, consistent with the conservation of energy principle.

WHAT IS GOOD ABOUT THIS?

✓Energy stores named precisely at each stage: GPE → kinetic → thermal + sound.

✓Transfer pathway named: mechanical (work done by gravity).

✓Conservation of energy stated: total energy accounted for, not 'lost'.

NON-EXAMPLE

The ball has potential energy which becomes kinetic energy as it falls. When it hits the ground the kinetic energy is lost as heat and sound.

WHAT IS WRONG WITH THIS?

✗'Potential energy' is too vague — must say gravitational potential energy store.

✗'Lost as heat' — energy is not lost; it is transferred to the thermal store of the surroundings.

✗Transfer pathway not named — must say mechanical transfer (work done by gravity).

KEY TAKEAWAY:

Energy transfer answers: name stores precisely (GPE, kinetic, thermal), name the pathway, never say energy is 'lost' — say it is dissipated to the thermal store of the surroundings.

POST-TASK

P1: Energy stores, pathways and the conservation of energy

GREEN POST: STRENGTHENS THE NEW ROUTE

This task retrieves P1 Energy Stores and Transfers at the point where forgetting begins — strengthening the memory trace before it fades.

Question: A ball is dropped from a height. Describe the energy transfers as it falls and when it hits the ground. Name stores, pathway and where energy is wasted. (6 marks)

SCAFFOLDED STEPS TOWARDS 6 MARKS:

- **Step 1 (2 marks):** Describe the energy in the GPE store before the ball is released. As it falls, name the pathway (mechanical/work done by gravity) and the store energy transfers to.
- **Step 2 (2 marks):** Describe what happens to the kinetic energy when the ball hits the ground — name all stores that energy transfers to (thermal of ball/ground, sound).
- **Step 3 (2 marks):** Explain conservation of energy — state that the total energy is conserved (not lost), and explain what 'wasted' energy means in terms of thermal dissipation.

CHALLENGE TASK

P1 Energy Stores and Transfers — stretch your thinking further

CHALLENGE:

Water has a very high specific heat capacity (4200 J/kg/°C) compared to aluminium (900 J/kg/°C) and copper (385 J/kg/°C).

Explain why water is used in central heating systems rather than aluminium or copper. Use the concept of specific heat capacity and at least FOUR scientific points in your answer.

★ ★ ★ **Think about:** What does high SHC mean in terms of energy stored per kg per °C? Which material stores the most energy for the same temperature rise? What happens when water releases this energy to the room? How does this compare to heating the same volume of aluminium?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — P1 Energy Stores and Transfers

Tick the target that applies to your work	
☐ Name stores precisely	GPE, kinetic, elastic PE, thermal, chemical — not just 'energy'.
☐ Name the pathway	Mechanical (work), electrical, heating, radiation.
☐ Energy is conserved, not 'lost'	Say 'dissipated to thermal store of surroundings'.
☐ Use the store→pathway→store format	'From [store] to [store] by [pathway]'.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — P1 Specific Heat Capacity

Tick the target that applies to your work	
☐ ΔT = final − initial	Not just the final temperature — always subtract.
☐ Write E = mcΔT first	Show the formula before substituting values.
☐ Mass must be in kg	Convert grams to kg if needed (÷ 1000).
☐ State the unit	Joules (J) or kilojoules (kJ) — always include.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — P1 ENERGY STORES AND TRANSFERS

WHAT DO I KNOW?
(Declarative)

Name six different types of energy store.

Name four pathways by which energy can be transferred.

HOW DO I USE IT?
(Procedural)

How do you describe an energy transfer using the correct format?

How do you explain why energy is never 'lost' — only transferred?

WHEN DO I USE IT?
(Conditional)

When would you say energy is dissipated rather than transferred usefully?

When would you describe a Sankey diagram to show energy transfers?

MISTAKES TO AVOID

Why is it incorrect to say energy is 'used up' during a process?

What is wrong with saying 'kinetic energy is lost as heat' instead of using correct scientific language?

PREP — P1 SPECIFIC HEAT CAPACITY

WHAT DO I KNOW?
(Declarative)

What does specific heat capacity mean and what are its units?

Write the formula for calculating energy change using specific heat capacity.

HOW DO I USE IT?
(Procedural)

How do you calculate ΔT for a substance heated from 25°C to 75°C?

How do you calculate the energy required to heat 3 kg of water by 40°C?

WHEN DO I USE IT?
(Conditional)

When would you use a high SHC material rather than a low SHC material in an application?

When would you need to convert grams to kg before using E = mcΔT?

MISTAKES TO AVOID

Why is substituting the final temperature instead of ΔT a common error?

What is wrong with giving an energy answer without a unit?

YEAR 9 PHYSICS · AUTUMN TERM

Autumn 1 · 07 Sep – 23 Oct 2026

HW 2

Set: **05 Oct 26** Due: **19 Oct 26**

POST — RETRIEVAL

RED POST

Y8 Retrieval: Energy Efficiency & Sankey Diagrams

PREP — UPCOMING LESSON

Power and Work Done

Steps 6–15 · ~20 pages

⚡ Year 9 Physics

YEAR 9 PHYSICS STEP 6 — PREP · Upcoming Lesson

PREP LEARNING BOX

P1: Power, work done and the relationship between force, distance and energy transfer

GOLDEN THREAD:

You can calculate energy stored and transferred. The next lessons quantify how quickly energy is transferred — this is power. You will also study work done — the energy transferred when a force moves through a distance.

KEY IDEA:

Power and work done:

- **Power:** P = E ÷ t. Power is the rate of energy transfer. Unit: watts (W). 1 W = **1** J/s.
- **Work done:** W = F × d. Work done equals force times distance moved in the direction of the force. Unit: joules (J).
- Work done = energy transferred. When a force does work on an object, it transfers energy to that object.
- **Example:** pushing a 100 N box 5 m across a floor: W = 100 × 5 = 500 J.
- **Power from force:** P = F × v (power = force × velocity). Useful for moving objects at constant speed.
- Converting units: 1 kW = 1000 W; 1 kJ = 1000 J.

WORK DONE PUSHING A LOAD

IMPORTANT MISCONCEPTION:

Students sometimes confuse power and energy. **Power is the rate of energy transfer** — how much energy is transferred per second. A high-power device transfers the same amount of energy in less time. Energy is the total amount transferred; power is how quickly. A 2000 W kettle transfers energy twice as fast as a 1000 W kettle — but if the 1000 W kettle runs for twice as long, the total energy transferred is the same.

WHEN TO USE THIS:

Use this when asked to calculate power, work done, or the force required for a given power and velocity. Always identify which formula to use first.

THINKING STEPS:

- Does the question involve time (→ use P = E/t) or force and distance (→ use W = Fd)?
- Is the answer in watts (power) or joules (energy)?
- Do I need to convert minutes to seconds or kW to W?

WRITING STEPS:

- Write the formula, identify the given quantities and rearrange if needed.
- Substitute values with units, calculate and state the unit.
- Check: power in W, energy in J, force in N, distance in m.

PREP: EXAMPLE / NON-EXAMPLE

P1: Power, work done and the relationship between force, distance and energy transfer

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: A crane lifts a 2000 N load through 15 m in 30 seconds. Calculate the work done and the power of the crane. Show all working. (4 marks)

EXAMPLE

Work done: W = F × d = 2000 × 15 = 30,000 J = 30 kJ. Power: P = E ÷ t = 30,000 ÷ 30 = 1000 W = 1 kW. The crane does 30,000 J of work and has a power of 1000 watts (1 kW).

WHAT IS GOOD ABOUT THIS?

✓Work done formula written and applied correctly: W = F × d = 30,000 J.

✓Power formula applied using the work done from the first calculation: P = E/t = 1000 W.

✓Units given for both answers (J and W) with sensible conversions to kJ and kW.

NON-EXAMPLE

Work = 2000 × 15 = 30000. Power = 30000/30 = 1000.

WHAT IS WRONG WITH THIS?

✗No units given for either answer — J for work done and W for power are required.

✗No formulas written — both W = Fd and P = E/t must be stated.

✗No conversion to kJ/kW — while not strictly wrong, showing conversions demonstrates understanding.

KEY TAKEAWAY:

Power and work done: always write both formulas, substitute with units, give the correct units in the answer (J for work, W for power).

PREP TASK

P1: Power, work done and the relationship between force, distance and energy transfer

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

TASK:

A 60 kg person climbs a flight of stairs 3 m high in 5 seconds. Calculate the work done against gravity and the power developed. (g = 10 N/kg) *(4 marks)*

YOUR ANSWERS:

NOTES PAGE

P1: Power, work done and the relationship between force, distance and energy transfer

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 PHYSICS STEP 9 RED POST

POST LEARNING BOX

Y8 P2 Retrieval: Efficiency calculations, Sankey diagrams and power

GOLDEN THREAD:

In Year 8 you studied energy efficiency and Sankey diagrams. This Red Post retrieval strengthens those earlier memories at the point where forgetting is most likely. These skills are directly built upon in the P1 content you are now studying.

KEY IDEA:

Y8 Energy — key retrieval points:

- **Efficiency** = useful energy output ÷ total energy input (× 100 for %).
- Efficiency has no unit as a decimal; add % if expressed as a percentage.
- **Sankey diagram:** arrow width represents amount of energy. The input arrow splits into useful output arrow(s) and wasted arrow(s) (usually thermal). Widths are proportional to energy.
- **Wasted energy:** always transferred to the thermal store of the surroundings — not 'lost'.
- **Power:** P = E ÷ t (power in watts W; energy in joules J; time in seconds s).
- 1 watt = 1 joule per second.

ENERGY EFFICIENCY

IMPORTANT MISCONCEPTION:

Students sometimes divide total input by useful output rather than the other way around. **Efficiency = useful OUTPUT ÷ total INPUT.** The result must be between 0 and 1 (or 0% and 100%). If your answer is greater than 1, you have divided the wrong way around — no device can be more than 100% efficient.

WHEN TO USE THIS:

Use this when asked to calculate efficiency from energy data, describe a Sankey diagram, calculate wasted energy, or explain why efficiency can never reach 100%.

THINKING STEPS:

- What is the useful energy output and what is the total energy input?
- Is the answer between 0 and 1 (decimal) or 0–100% (percentage)?
- Have I identified all the wasted energy pathways?

WRITING STEPS:

- Write the formula: efficiency = useful output ÷ total input.
- Substitute values and calculate — check answer is between 0 and 1.
- Calculate wasted energy: total input − useful output.

YEAR 9 PHYSICS STEP 10 RED POST

POST: EXAMPLE / NON-EXAMPLE

Y8 Physics Retrieval: Energy Efficiency — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: A motor uses 500 J of electrical energy and produces 350 J of useful kinetic energy. Calculate the efficiency of the motor as a percentage and calculate the amount of energy wasted. Explain what happens to the wasted energy. (6 marks)

EXAMPLE

Efficiency = useful energy output ÷ total energy input = 350 ÷ 500 = 0.7. As a percentage: 0.7 × 100 = 70%. The motor is 70% efficient. Energy wasted = total input − useful output = 500 − 350 = 150 J. The 150 J of wasted energy is transferred to the thermal store of the surroundings — primarily through friction in the motor's moving parts and heating of the electrical components. This thermal energy is dissipated to the surrounding air. No device can be 100% efficient because some energy is always transferred to the thermal store of the surroundings in any real energy transfer — this is because friction and electrical resistance are unavoidable.

WHAT IS GOOD ABOUT THIS?

✓Efficiency calculated correctly: 350 ÷ 500 = 0.7 = 70% — both decimal and % given.

✓Wasted energy calculated correctly: 500 − 350 = 150 J.

✓Explains destination of wasted energy: thermal store of surroundings via friction/heating.

NON-EXAMPLE

Efficiency = 350/500 = 70%. Wasted = 150 J. The wasted energy is lost as heat.

WHAT IS WRONG WITH THIS?

✗Correct but 'lost as heat' is incorrect language — must say 'transferred to thermal store of surroundings'.

✗No explanation of why no device can be 100% efficient.

✗No formula written before calculation.

KEY TAKEAWAY:

Efficiency: always write formula first, give both decimal and percentage, calculate wasted energy (input − useful), and say wasted energy goes to thermal store of surroundings (not 'lost').

YEAR 9 PHYSICS STEP 11 RED POST

POST-TASK

Y8 P2 Retrieval: Efficiency calculations, Sankey diagrams and power

RED POST: RECONNECTS AN EARLIER ROUTE

This task retrieves Y8 Physics Retrieval: Energy Efficiency at the point where forgetting begins — strengthening the memory trace before it fades.

Question: A motor uses 500 J and produces 350 J of useful kinetic energy. Calculate efficiency as %, calculate wasted energy, and explain where wasted energy goes. (6 marks)

SCAFFOLDED STEPS TOWARDS 6 MARKS:

- **Step 1 (2 marks):** Write the efficiency formula. Substitute the values and calculate the efficiency as a decimal, then convert to a percentage.
- **Step 2 (2 marks):** Calculate the wasted energy (total input − useful output). State the unit.
- **Step 3 (2 marks):** Explain where the wasted energy goes — name the store (thermal store of surroundings) and explain why no device can be 100% efficient.

CHALLENGE TASK

Y8 Physics Retrieval: Energy Efficiency — stretch your thinking further

CHALLENGE:

A car engine has a power output of 120 kW. The car travels at a constant speed of 30 m/s.

Calculate the driving force of the engine at this speed. Then explain what happens to the power when the car accelerates to 40 m/s while maintaining the same engine power. Use at least THREE scientific points.

★ ★ ★ **Think about:** Use P = Fv to find the force. If power stays the same but speed increases, what must happen to the force? What does this mean for acceleration — is Newton's 2nd law involved?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — Y8 Energy Efficiency Retrieval

Tick the target that applies to your work	
☐ Efficiency = useful OUT ÷ total IN	Not the other way round — answer must be 0–1.
☐ Wasted energy → thermal store	Not 'lost' — transferred to thermal store of surroundings.
☐ Include the % sign	0.7 ≠ 70% — they mean different things.
☐ Sankey: width proportional to energy	Arrow width shows the amount of energy.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — P1 Power and Work Done

Tick the target that applies to your work	
☐ Power = E ÷ t (watts)	Energy ÷ time — not force × distance.
☐ Work done = F × d (joules)	Force × distance — not energy ÷ time.
☐ Convert minutes to seconds	Power formula needs time in seconds.
☐ Power ≠ energy	Power is the rate; energy is the total amount transferred.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — Y8 ENERGY EFFICIENCY RETRIEVAL

WHAT DO I KNOW?
(Declarative)

Write the formula for efficiency and state what units it has.

What is wasted energy and where does it always go?

HOW DO I USE IT?
(Procedural)

How do you calculate efficiency as a percentage from energy data?

How do you describe a Sankey diagram for a device that is 40% efficient?

WHEN DO I USE IT?
(Conditional)

When would you explain why efficiency can never reach 100%?

When would you use a Sankey diagram rather than a numerical calculation?

MISTAKES TO AVOID

Why is efficiency = total input ÷ useful output an incorrect formula?

What is wrong with saying 'wasted energy is lost'?

PREP — P1 POWER AND WORK DONE

WHAT DO I KNOW?
(Declarative)

Write the formula for power and state its unit.

Write the formula for work done and state its unit.

HOW DO I USE IT?
(Procedural)

How do you calculate the power of a device that transfers 6000 J in 2 minutes?

How do you calculate the work done when a 500 N force moves 4 m?

WHEN DO I USE IT?
(Conditional)

When would you use P = Fv rather than P = E/t?

When would you need to convert kW to W or kJ to J?

MISTAKES TO AVOID

Why is power measured in watts rather than joules?

What is wrong with saying a powerful engine 'has more energy' than a less powerful one?

YEAR 9 PHYSICS · AUTUMN TERM

Autumn 1 · 07 Sep - 23 Oct 2026

HW 3

Set: **19 Oct 26** Due: **09 Nov 26**

★ Set over Half Term — due first lesson back

POST — RETRIEVAL

GREEN POST

P1 Energy Efficiency and Conservation

PREP — UPCOMING LESSON

Reducing Dissipation in Real Systems

Steps 6–15 · ~20 pages

⚡ Year 9 Physics

PREP LEARNING BOX

P1: Reducing energy dissipation — insulation, lubrication and energy flow in real systems

GOLDEN THREAD:

You have calculated efficiency and identified wasted energy. The next lessons look at real systems — how engineers reduce energy dissipation in practice, and how to analyse energy flow through a whole system using sankey diagrams and efficiency figures.

KEY IDEA:

Reducing energy dissipation in real systems:

- **Insulation:** reduces thermal energy transfer to surroundings. E.g. loft insulation in houses slows conduction through the roof; double glazing reduces conduction through windows.
- **Lubrication:** reduces friction between moving parts. E.g. oil in engines; grease in bearings. Friction converts kinetic energy to thermal energy — less friction means less waste.
- **Streamlining:** reduces air resistance (drag). E.g. aerodynamic car designs, cyclists tucking in.
- **Energy flow in systems:** energy input → useful output + thermal dissipation. The system boundary matters — for a house, the system is the house and surroundings.
- Payback time = cost of installation ÷ annual saving. A cheaper installation or greater saving gives a shorter payback time.

REDUCING ENERGY DISSIPATION

IMPORTANT MISCONCEPTION:

Students say insulation 'stops heat escaping'. This is imprecise — insulation **reduces the rate of thermal energy transfer** to the surroundings. It does not stop all energy loss — it slows it. The house still cools down eventually; insulation just makes it happen more slowly, reducing the energy needed to maintain a given temperature.

WHEN TO USE THIS:

Use this when asked to suggest improvements to reduce energy waste, calculate payback time, or explain how a specific method reduces dissipation.

THINKING STEPS:

- Is the dissipation due to friction (→ lubrication), thermal loss (→ insulation), or air resistance (→ streamlining)?
- Have I explained the mechanism — not just 'less energy is wasted'?
- Payback time: cost ÷ annual saving?

WRITING STEPS:

- Name the specific method and what it reduces.
- Explain the mechanism: lubrication reduces friction → less kinetic energy converted to thermal; insulation reduces rate of conduction → less thermal energy transferred to surroundings.
- For payback: cost ÷ annual saving = payback time in years.

PREP: EXAMPLE / NON-EXAMPLE

P1: Reducing energy dissipation — insulation, lubrication and energy flow in real systems

GOLDEN THREAD:

Study the example and non-example carefully. Use the writing steps in your Prep Task.

Question: A house loses 40 W of energy through its roof. Loft insulation costs £250 to install and reduces the heat loss to 10 W. If energy costs 20p per kWh, calculate the annual saving and the payback time. (4 marks)

EXAMPLE

Energy saved per second = 40 − 10 = 30 W = 0.03 kW. Annual saving in energy = 0.03 kW × (365 × 24) h = 0.03 × 8760 = 262.8 kWh. Annual cost saving = 262.8 × £0.20 = £52.56. Payback time = cost of installation ÷ annual saving = £250 ÷ £52.56 ≈ 4.8 years.

WHAT IS GOOD ABOUT THIS?

- ✓Energy saving (30 W) correctly calculated from the reduction in heat loss.
- ✓Annual energy saving calculated correctly in kWh.
- ✓Payback time = £250 ÷ annual saving — calculated correctly.

NON-EXAMPLE

Energy saved = 30W. Annual saving = 30 × 365 = 10950. Payback = 250 ÷ 10950.

WHAT IS WRONG WITH THIS?

- ✗30 × 365 gives watt-hours (Wh) not kWh — must divide by 1000 or use 0.03 kW.
- ✗Division gives a number in the thousands — must then multiply by price per kWh (£0.20) to get £.
- ✗Payback should be in years from dividing by the annual £ saving.

KEY TAKEAWAY:

Payback time calculations: find power saved (W) → convert to kW → multiply by hours per year = kWh → multiply by cost per kWh = annual £ saving → divide cost by annual saving = payback time (years).

PREP TASK

P1: Reducing energy dissipation — insulation, lubrication and energy flow in real systems

INSTRUCTIONS:

Cover your Learning Box and Example / Non-Example. Complete all questions from memory. Do not look back until finished, then check and correct in a different colour.

TASK:

Cavity wall insulation costs £400 and reduces annual heating costs by £80. Calculate the payback time. Explain why a homeowner might still choose not to install it despite this. *(3 marks)*

YOUR ANSWERS:

NOTES PAGE

P1: Reducing energy dissipation — insulation, lubrication and energy flow in real systems

INSTRUCTIONS:

Use this page to make your own notes on the Prep Learning Box and Example / Non-Example. Write down anything you want to remember, questions you still have, or diagrams to sketch.

MY NOTES:

QUESTIONS I STILL HAVE:

YEAR 9 PHYSICS STEP 9 GREEN POST

POST LEARNING BOX

P1: Calculating efficiency, reducing dissipation and the principle of energy conservation

GOLDEN THREAD:

You have studied energy stores, transfers and power. Now we focus on efficiency — the proportion of energy usefully transferred — and the principle that energy is always conserved. These ideas underpin everything from household appliances to power stations.

KEY IDEA:

Efficiency and conservation:

- **Efficiency** = useful energy output ÷ total energy input (×100 for %).
- Also: efficiency = useful power output ÷ total power input.
- Efficiency is always between 0 and 1 (0% to 100%). No real device can be 100% efficient.
- **Reducing energy dissipation:** insulation (thermal), lubrication (friction/mechanical), streamlining (air resistance).
- **Conservation of energy:** in a closed system, the total energy before = total energy after. Energy is never created or destroyed — only transferred between stores.
- If a system is 80% efficient, 20% of the input energy is dissipated to the thermal store of the surroundings — not lost.

ENERGY EFFICIENCY

IMPORTANT MISCONCEPTION:

Students sometimes include dissipated energy as 'useful'. **Wasted energy is energy transferred to unintended stores** — usually the thermal store of the surroundings. Only the energy that fulfils the device's intended purpose counts as useful. The thermal energy from a light bulb is wasted; the light energy is useful.

WHEN TO USE THIS:

Use this when asked to calculate efficiency, suggest ways to improve efficiency, or explain why energy conservation does not mean devices are perfectly efficient.

THINKING STEPS:

- What is the useful energy output — what is the device's intended purpose?
- Is the efficiency answer between 0 and 1?
- What is reducing efficiency — friction, air resistance, or heating?

WRITING STEPS:

- Write the formula: efficiency = useful output ÷ total input.
- Identify what counts as useful energy (matches the device's purpose).
- Suggest a specific method to reduce dissipation: lubrication (friction), insulation (thermal), streamlining (drag).

YEAR 9 PHYSICS STEP 10 GREEN POST

POST: EXAMPLE / NON-EXAMPLE

P1 Energy Efficiency and Conservation — modelling a full 6-mark answer

GOLDEN THREAD:

We use the same writing steps from the Post Learning Box, applied at full 6-mark depth.

Question: A car engine takes in 40,000 J from burning petrol and produces 12,000 J of useful kinetic energy. Calculate the efficiency. State two specific ways the engineer could improve the engine's efficiency and explain how each reduces energy dissipation. (6 marks)

EXAMPLE

Efficiency = useful energy output ÷ total energy input = 12,000 ÷ 40,000 = 0.3 = 30%. The engine is only 30% efficient — 70% (28,000 J) is wasted, primarily as thermal energy from the hot exhaust gases and engine components. Improvement 1: Use engine oil (lubrication) — this reduces friction between moving metal parts in the engine, reducing the amount of kinetic energy transferred to the thermal store of the components, meaning more energy is available for useful kinetic output. Improvement 2: Improve aerodynamic streamlining of the car body — this reduces air resistance (drag), meaning less of the kinetic energy of the car is transferred to the thermal store of the surrounding air molecules, so the engine needs to do less work to maintain speed and wastes less energy.

WHAT IS GOOD ABOUT THIS?

✓Efficiency calculated correctly: 12000 ÷ 40000 = 0.3 = 30%.

✓Two specific improvements named: lubrication AND streamlining (or insulation).

✓Each improvement explained: what is reduced (friction/drag) and how this reduces thermal dissipation.

NON-EXAMPLE

Efficiency = 12000/40000 = 30%. Could use oil and better design to improve it.

WHAT IS WRONG WITH THIS?

✗Correct efficiency but no wasted energy calculated.

✗Improvements too vague — 'better design' is not a specific improvement.

✗No explanation of how each improvement reduces energy dissipation.

KEY TAKEAWAY:

Efficiency improvements: name a specific method (lubrication, insulation, streamlining), state what it reduces (friction, thermal loss, drag), and explain the mechanism by which this reduces dissipation.

POST-TASK

P1: Calculating efficiency, reducing dissipation and the principle of energy conservation

GREEN POST: STRENGTHENS THE NEW ROUTE

This task retrieves P1 Energy Efficiency and Conservation at the point where forgetting begins — strengthening the memory trace before it fades.

Question: A car engine takes in 40,000 J and produces 12,000 J useful kinetic energy. Calculate efficiency and suggest two specific ways to improve it. (6 marks)

SCAFFOLDED STEPS TOWARDS 6 MARKS:

- **Step 1 (2 marks):** Write the efficiency formula, substitute values, calculate the efficiency as a decimal and as a percentage. Calculate the wasted energy.
- **Step 2 (2 marks):** Name the first specific improvement. Explain what it reduces (e.g. friction) and how this reduces dissipation to the thermal store.
- **Step 3 (2 marks):** Name the second specific improvement. Explain what it reduces and how this increases the useful energy output.

CHALLENGE TASK

P1 Energy Efficiency and Conservation — stretch your thinking further

CHALLENGE:

A student argues: 'The most efficient device is always the best choice, regardless of other factors.'

Evaluate this statement. Consider at least THREE examples where a more efficient device might not be the best choice. Include factors such as cost, reliability, environmental impact, payback time and fitness for purpose.

★ ★ ★ **Think about:** Is a highly efficient LED always better than an inefficient incandescent bulb? What about upfront cost vs long-term saving? Is a highly efficient but unreliable engine better? What about environmental impact of manufacturing?

YOUR ANSWER:

FEEDFORWARD BOX

Reflect. Improve. Develop.

POST — P1 Energy Efficiency and Conservation

Tick the target that applies to your work	
☐ Efficiency = useful OUT ÷ total IN	Always useful output in numerator.
☐ Two specific improvements with mechanisms	Not just 'less friction' — explain how it reduces dissipation.
☐ No real device is 100% efficient	Energy always dissipated to thermal store of surroundings.
☐ Wasted = total − useful	Always calculate and state the wasted energy too.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

PREP — Energy Conservation in Real Systems

Tick the target that applies to your work	
☐ Name method + mechanism	Lubrication → reduces friction → less kinetic converted to thermal.
☐ Insulation slows rate, not stops	'Reduces rate of thermal transfer' — not 'stops heat escaping'.
☐ Payback = cost ÷ annual saving	In years — check units throughout.
☐ Convert W to kW before × hours	30 W = 0.03 kW → × 8760 h = kWh.

WHAT I DID WELL

Today I successfully...

MY FEEDFORWARD TARGET

My target is:

Small improvements → stronger learning.

SELF-QUIZZING BOX

Cover your Learning Box. Answer from memory. Check and correct.

QUESTIONS ONLY — do not include or explain any answers.

POST — P1 ENERGY EFFICIENCY AND CONSERVATION

WHAT DO I KNOW?

(Declarative)

Write the formula for efficiency. What is the range of possible values?

Name three methods of reducing energy dissipation.

HOW DO I USE IT?

(Procedural)

How do you calculate efficiency and wasted energy from the same set of data?

How do you explain why no device can ever be 100% efficient?

WHEN DO I USE IT?

(Conditional)

When would you use efficiency = useful power ÷ total power?

When would you suggest lubrication vs insulation as the appropriate improvement?

MISTAKES TO AVOID

Why is the thermal energy produced by a light bulb 'wasted' rather than 'useful'?

What is wrong with saying 'the device wastes energy'?

PREP — REDUCING DISSIPATION IN REAL SYSTEMS

WHAT DO I KNOW?

(Declarative)

Name three methods of reducing energy dissipation and state what each reduces.

What does payback time mean and how is it calculated?

HOW DO I USE IT?

(Procedural)

How do you calculate annual energy saving from a power reduction in watts?

How do you explain the mechanism of lubrication in reducing energy dissipation?

WHEN DO I USE IT?

(Conditional)

When would insulation be more appropriate than lubrication as an improvement?

When would you account for payback time in evaluating an energy-saving measure?

MISTAKES TO AVOID

Why does insulation 'slow' rather than 'stop' thermal energy transfer?

What is wrong with calculating payback time in kW

UXBRIDGE
HIGH SCHOOL

ENRICHMENT

Reflection

TAKE TIME TO REFLECT ON YOUR ENRICHMENT EXPERIENCES.
WHAT HAVE YOU LEARNED? HOW HAVE YOU GROWN?

WEEK ONE

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WEEK TWO

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WEEK THREE

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UXBRIDGE
HIGH SCHOOL

ENRICHMENT

Reflection

TAKE TIME TO REFLECT ON YOUR ENRICHMENT EXPERIENCES.
WHAT HAVE YOU LEARNED? HOW HAVE YOU GROWN?

WEEK FOUR

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WEEK SIX

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WEEK SEVEN

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