

MEMORY TECHNIQUES

How each method works, how to use it, examples, and how to practise

By

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1. Introduction: what memory is

1.1 Memory is not a box that either holds a fact or loses it. It is a process with three jobs: encoding, storage, and retrieval. Encoding is how information first enters. Storage is how the trace is kept. Retrieval is how you get it back when the paper asks for it. A student can read a page and still fail the question, because reading is weak encoding and almost no retrieval.

1.2 When you learn something, the brain changes. That change is called a memory trace, or an engram. At first the trace is fragile. It becomes steadier through consolidation, which continues after you close the book, especially during sleep. Each time you successfully recall the fact, the trace is used again and grows easier to find. This is why a closed-book recall beats another silent reread.

2. Types of memory

2.1 Sensory memory lasts less than a second. It is the echo of what you just saw or heard. Almost none of it is kept unless you pay attention.

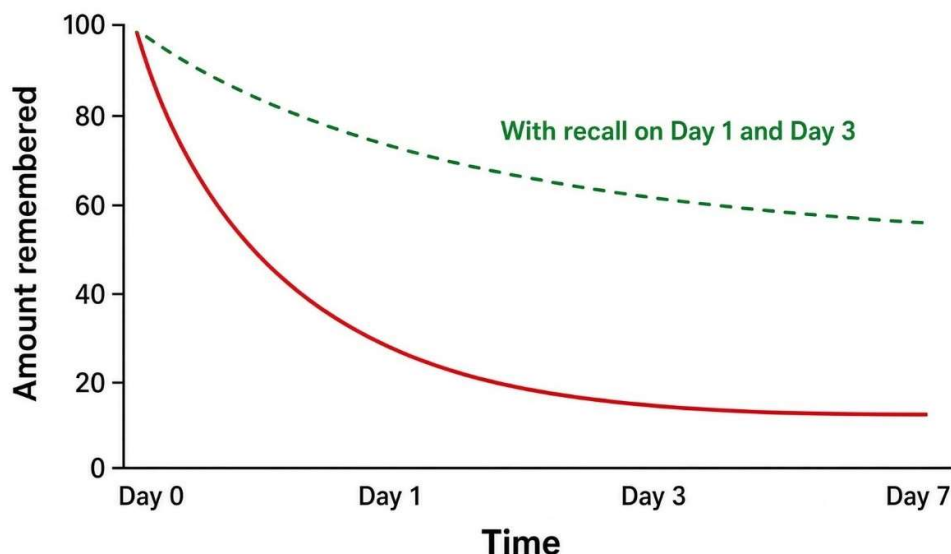
2.2 Short-term memory, and the working memory you use while solving a sum, holds only a few pieces at a time, for seconds to a couple of minutes. This is why a long formula collapses if you try to hold every symbol at once. Chunking works because it turns many pieces into one piece that working memory can carry.

2.3 Long-term memory can last for years, but only if the trace is consolidated. It is not one store. Semantic memory holds facts and meanings, such as the reactivity series or the sine pattern. Episodic memory holds events, such as the afternoon you walked the five rooms of your house. Procedural memory holds skills, such as factoring a quadratic without thinking about each step. The techniques in this paper mostly build semantic memory, and they borrow episodic memory when they use a place or a story.

3. Why a trace fades, and how a technique protects it

3.1 Hermann Ebbinghaus showed that a newly learned list drops fastest in the first day if it is not used. Forgetting is not only decay. New material interferes with old, and a fact encoded without a cue has nothing to pull it back. A sentence, a room, a peg, or a rule is a retrieval cue. It does not replace understanding. It gives the trace a handle.

The forgetting curve



The forgetting curve. Red: a list left unused. Green: the same list recalled on Day 1 and Day 3.

3.2 What the curve says. Without recall, most of a new list is gone within a day, then the loss slows. A recall on Day 1 pulls the trace back up, and a recall on Day 3 holds more of it through Day 7. That is why the week of practice in this paper tests on Day 1 and Day 3, not only on the evening of study. The curve is a sketch of the pattern Ebbinghaus found, not a mark scheme.

3.3 The methods that follow are handles for Class 10 to 12 work. A fixed order wants a sentence or a palace. A law wants a rule hook. A process wants a story. Two ideas that papers mix up want a two-column compare. Nothing in the list below changes the rule already stated: a hook only starts the answer. The mark still comes from the reason, the condition, and the unit.

3.4 A hook only helps you pull the fact out. In the answer you still write the reason, the condition, and the unit. Use one method per kind of fact. A fixed order wants a sentence or a palace. A law wants a rule hook. A process wants a story. Twins that papers mix up want a two-column compare. Nothing stays unless you write it with the book closed.

4. Memory palace

4.1 You already remember rooms. You leave one fact in each room, always in the same walking order, so a list comes back as a stroll. This is the method of loci. It is the right tool for five to twelve ordered points: causes, steps of a process, or a set of formulas you mix up.

4.2 How to use it

4.2.1 Choose five stops and walk them for real once: main door, sofa, dining table, kitchen shelf, your bed. Touch each one so the order locks.

4.2.2 One fact per stop. If a chapter has ten facts, use two routes, not one crowded room.

4.2.3 Make the object too big, the wrong colour, or doing a job. A normal kidney is forgettable. A kidney-shaped bowl washing dishes is not.

4.2.4 Revise with the book closed. Stand at the door in your head and name the object, then say the fact in one sentence.

4.3 **Example 1** — Class 10, life processes

Door: a huge nose as the doorbell. Air enters through the nose. Sofa: pink lungs as cushions. Gas exchange is in the lungs. Dining table: a heart pumping soup. Blood carries oxygen. Kitchen shelf: a kidney-shaped bowl filtering water. Kidneys clean blood. Bed: a waste bin in a nightcap. Waste leaves as urine.

4.4 **Example 2** — History, five causes

Door: a torn notice, harsh new laws. Sofa: an empty wallet, heavy tax. Dining table: a soldier's cap used as a plate, the army was unhappy. Kitchen: a locked prayer-room door, a custom was banned. Bed: a map with a red line, land was taken and redrawn.

4.5 **Example 3** — A formula pair

Left side of the study table: a mirror with a green plus. Mirror formula adds, $1/v + 1/u = 1/f$. Right side: a lens with the plus peeled off. Lens formula subtracts, $1/v - 1/u = 1/f$. Chair: a card reading "light goes left to right". Distances that way are positive.

4.6 **Example 4** — Class 10, sources of energy

Door: a sun on the peephole, sunlight is the original source. Sofa: a lump of coal, stored sunlight that will run out. Dining table: a wind-up fan, wind and running water can be used again. Kitchen: a biogas cylinder fed by waste. Bed: a fenced nuclear bead, a lot of energy, waste kept away from people.

4.7 **Example 5** — English, plot of a story

Door: the hero entering, opening and setting. Sofa: a cracked cup, the problem. Dining table: two people arguing, the clash. Kitchen: a fixed cup with steam, the turning point. Bed: the same two sharing a blanket, the ending. Five rooms give five paragraphs.

4.8 **How to practise.** Write the five rooms tonight and place one chapter on them. Before breakfast, walk and write the five facts. A missed room gets a stranger picture, then one more walk. After two days, write a short answer from the walk alone.

5 Sentence mnemonic. Use this when order matters: a series, a spectrum, ranks, stages. Take the first letter of each item and force those letters into a sentence you can picture. Your own sentence is stronger than a copied one, because you built the link.

5.1 **How to use it**

5.1.1 List the items down the page.

5.1.2 Take the first letter of each.

5.1.3 Build a sentence you can see. Silly is allowed.

5.1.4 If two letters match, mark the second item so you do not swap them.

5.2 **Example 1 — Chemistry, reactivity series**

Please Stop Calling Me A Zebra, I Like Her Cute Smart Goat. Potassium, sodium, calcium, magnesium, aluminium, zinc, iron, lead, hydrogen, copper, silver, gold. A metal higher in the sentence can push out a metal lower down. Iron is above copper, so an iron nail in blue copper sulphate turns brown.

5.3 **Example 2 — Biology, classification**

King Philip Came Over For Good Soup. Kingdom, phylum, class, order, family, genus, species.

5.4 **Example 3 — Physics, waves from low energy to high**

Real Men Inevitably Visit Ugly X-ray Guns. Radio, microwave, infrared, visible, ultraviolet, X-ray, gamma. "Visit" is visible light, in the middle. Rays after that damage living tissue more easily.

5.5 **Example 4 — Mathematics, order of operations**

Please Excuse My Dear Aunt Sally. Parentheses, exponents, multiplication, division, addition, subtraction. Multiplication and division are one group, done left to right. Same for addition and subtraction.

5.6 **Example 5 — Geography, layers of the Earth, outside in**

Come Meet Outer India. Crust, mantle, outer core, inner core. Crust is the thin shell we live on. Outer core is liquid. Inner core is solid.

5.7 **How to practise.** Write the sentence on the chapter's first page. Cover the list and rebuild it, then say one use. Next morning, rebuild it before you reread.

6. **Rule hook**

6.1 If the book gives a reason, store the reason. Initials are for lists. Rules are for laws. Say the job of the formula in ordinary words, write the formula under that sentence, and add the mistake the paper usually sets.

6.1.1 **Example 1.** Oxidation is loss of electrons. Reduction is gain. Short form: OIL RIG. Anode is where oxidation happens. Cathode is where reduction happens. Trap: in a battery the anode is negative; in electrolysis the anode is positive.

6.1.2 **Example 2.** Photosynthesis uses light, water, and carbon dioxide, and releases oxygen. Trap: that oxygen comes from water, not from carbon dioxide. No light means no food, even if carbon dioxide is there.

6.1.3 **Example 3.** Ohm's law: voltage is the push, current is the flow, resistance slows the flow. $V = IR$. If resistance doubles and voltage stays the same, current halves.

6.1.4 **Example 4.** Speed is how far in one unit of time. Trap: units must match. Kilometres with hours, metres with seconds. Thirty minutes is half an hour, not 30 hours.

6.1.5 **Example 5.** Sine of 0° , 30° , 45° , 60° , 90° is $\sqrt{0/2}$, $\sqrt{1/2}$, $\sqrt{2/2}$, $\sqrt{3/2}$, $\sqrt{4/2}$. The number under the root counts up. Cosine is the same line read backwards.

How to practise. Book closed: plain sentence, formula, trap. Next day, one short question, and say the trap before you put the numbers in.

7. Story link

7.1 Use this for a journey: digestion, a bill becoming a law, the steps of a sum. Each step hands an object to the next. If a step has nothing to hand over, something is missing.

7.1.1 **Example 1** — Digestion. Roti is crushed in the mouth, and saliva starts on the starch. The food pipe only carries it. The stomach churns it in acid. The small intestine finishes digestion and passes the useful part into blood. The large intestine takes water back. Waste leaves.

7.1.2 **Example 2** — Gene to protein. DNA is unzipped. One rail is copied into a message. The message leaves the nucleus. A reader takes three letters at a time and clips amino acids into a chain. That chain is the protein. Transcription is the copying. Translation is the chain-building.

7.1.3 **Example 3** — A quadratic. Move every term to one side so it equals zero. Factor, or use the formula. Put each answer back into the original line. The third step is where marks are lost.

7.1.4 **Example 4** — Water cycle. The sun lifts water as vapour. Vapour cools into cloud. Cloud drops rain. Rain runs to rivers and back to the sea.

7.1.5 **Example 5** — A bill becomes a law. A member writes the bill. The house debates and votes. The second house does the same. The head of state signs. The bill is now a law. Failure sits at the vote or the signature.

How to practise. Tell the story in one minute. The pause is the gap. Write only that step, then tell the whole story the next day.

5. Pegs

5.1 A numbered row of pictures you never change. New chapters hang on the same row. Learn them until they are boring: 1 bun, 2 shoe, 3 tree, 4 door, 5 hive. Fact 1 rides the bun.

5.1.1 **Example 1** — shape of a science answer. Bun: definition. Shoe: daily-life example. Tree: formula. Door: exception. Hive: how the question is asked.

5.1.2 **Example 2** — parts of a letter. Bun: sender's address. Shoe: date. Tree: Dear. Door: body. Hive: closing and signature.

5.1.3 **Example 3** — a 5-mark answer. Bun: what it is. Shoe: where and when. Tree: two causes. Door: two results. Hive: why it still matters.

5.1.4 **Example 4** — five properties of a metal. Bun shining: shine. Shoe bent: beaten into sheets. Tree with a wire: drawn into wires, and they conduct. Door too hot: they conduct heat. Hive ringing: many make a ringing sound.

5.1.5 **Example 5** — tenses. Bun already eaten: past. Shoe you are wearing: present. Tree you will climb: future. Door still open from yesterday: present perfect. Hive buzzing since morning: present perfect continuous.

How to practise. Recite the empty pegs until you cannot miss. Hang one chapter. Test by number: what is on peg 4?

6. Two-column compare

6.1 Papers like twins. Two columns, one difference that scores. Leave out what both sides share.

6.2 Mitosis copies a cell and the chromosome number stays the same. Meiosis makes cells for reproduction and the number is halved.

6.3 In series the current is the same through each part. In parallel the voltage is the same across each branch.

6.4 A cause is why it happened. A result is what changed afterwards.

6.5 A physical change can often be reversed, and no new substance is made: ice melting. A chemical change makes a new substance: milk turning sour, iron rusting.

6.6 Weather is what you feel today. Climate is the usual pattern over many years. A hot afternoon is weather. A desert is climate.

How to practise. Redraw the two columns from memory. Then write four lines of “distinguish between” using only that row.

7. Three smaller tools

7.1 **Chunking.** Working memory holds about four pieces. Group a table into one pattern. Sine of the standard angles is one count, not twenty facts. Resistors in series add; capacitors in parallel add; the other way is the reciprocal sum.

7.2 **Keyword picture.** Tie a hard name to a picture that sounds like it. Meselson and Stahl: two men weighing nitrogen, heavy then light, proving DNA copies itself by keeping one old rail. Fleming’s left hand for motors: thumb force, index finger field, middle finger current. The picture is the hook. The definition is still written in words.

7.3 **Dual coding.** A sketch beats a highlighted paragraph. Redraw from memory: nephron, heart, ray diagram, lac operon, a right triangle with squares on the sides. In a board paper a correct diagram with three labels often beats a long paragraph. Draw it the same evening, and again the next day with the book closed.

8. **Recall and spacing.** The rooms and the sentences put the fact in. Retrieval keeps it. Rereading a marked page feels like work. The useful moment is when the page is shut and the line still comes.

8.1 Same evening: book closed, write the five rooms or the sentence.

8.2 Next day: write them again before you look.

8.2 After two or three days: write the short answer a paper would ask, in full sentences.

8.3 After a week: only the stops you missed.

9. Elaborative questions make theory answers stronger. Before you close a topic, answer three questions without the book: what would break if this step were removed, what is the opposite case, and what number or condition does the board expect?

Which technique for which work

If the fact is...	Use
A fixed order: series, ranks, stages	Sentence, or a palace
A law or a formula with a reason	Rule hook
A process with steps	Story link
A 5-mark answer shape you reuse	Pegs
Two ideas the paper mixes	Two-column compare
A table of values	Chunking
Anything you must still know next week	Recall, with a gap

10. **Mathematics, with pictures.** These are the mathematics hooks that usually slip. Each one is a picture first, then the rule. The drawings are memory sketches. Rebuild the shape with the book closed.

10.1 Sine of the standard angles

Concept. Sine and cosine of 0° , 30° , 45° , 60° and 90° are one pattern, not twenty separate facts. For sine, the number inside the square root counts up from 0 to 4, and every value is divided by 2. Cosine is the same row read from the right, so $\cos 30^\circ$ is the same number as $\sin 60^\circ$. Tangent is sine divided by cosine, so it does not need its own table.

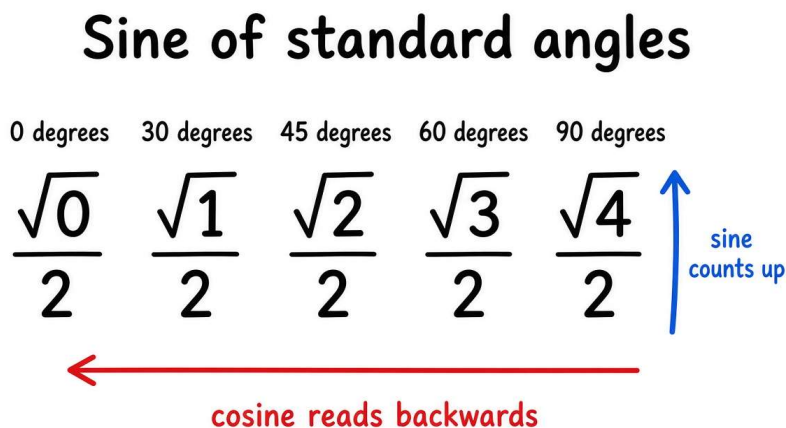


Figure . Read sine left to right as the root counts up. Read cosine right to left.

What the picture says. Under 30° you see $\sqrt{1}/2$, which is $1/2$. Under 45° you see $\sqrt{2}/2$. Under 60° you see $\sqrt{3}/2$. Under 90° you see $\sqrt{4}/2$, which is 1. The red arrow is cosine: start at 90° and walk backwards. Practise by covering the fractions and writing them from the count alone.

10.2 Speed, Distance, Time

Concept. The three quantities are one triangle. Distance sits on top. Speed and time sit underneath. Cover the one you are asked for. If the two that remain are side by side, multiply. If one is above the other, divide the top by the bottom.

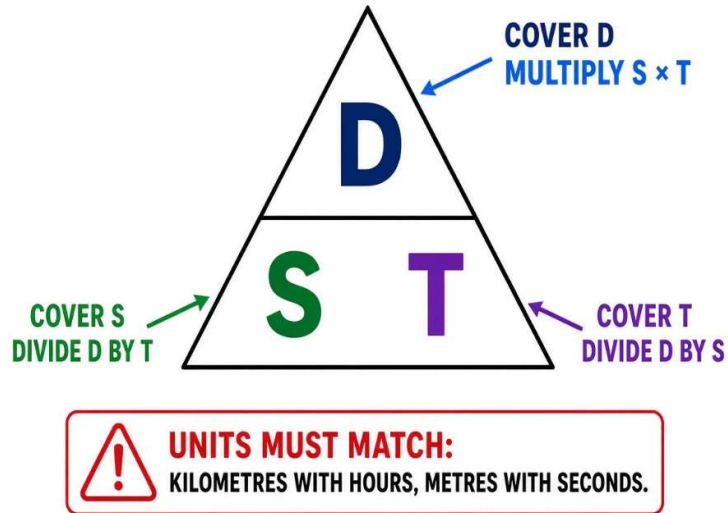


Figure . Cover D to multiply. Cover S or T to divide. Match the units first.

What the picture says. Cover D and you get speed $\times$ time. Cover S and you get distance $\div$ time. Cover T and you get distance $\div$ speed. A car at 60 km/h for 30 minutes has not travelled 1,800 km. Thirty minutes is 0.5 hour, so distance is $60 \times 0.5 = 30$ km. Say the unit change before you multiply.

10.3 Order of operations

Concept. A sum is done in groups, not by taking every $\times$ before every $\div$. Brackets first, then powers, then multiplication and division together from left to right, then addition and subtraction together from left to right.

groups first, then left to right

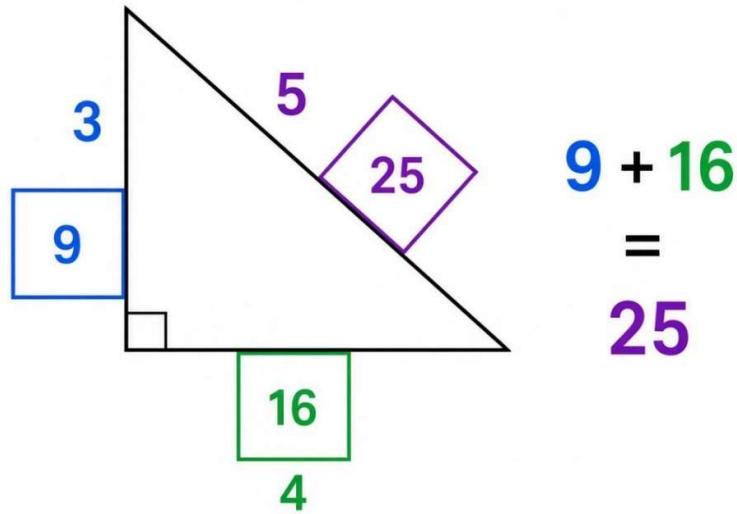
1. Parentheses	$[2 + 3]$
2. Exponents	2^2
3. Multiplication and Division	$\times \div$ →
4. Addition and Subtraction	$+ -$ →

Figure 3. Four shelves. The arrows on shelves 3 and 4 mean left to right.

What the picture says. Shelf 3 is one job, not two. So $12 \div 3 \times 2$ is $4 \times 2 = 8$, not $12 \div 6$. Shelf 4 works the same way: $10 - 4 + 2$ is $6 + 2 = 8$, not $10 - 6$. The sentence Please Excuse My Dear Aunt Sally only names the shelves. The arrows are the part that scores the mark.

10.4 A quadratic in three boxes

Concept. A quadratic has a square term, an x term and a number. You are looking for the values of x that make the whole line equal zero. There are three boxes, and the third box is the one students skip.

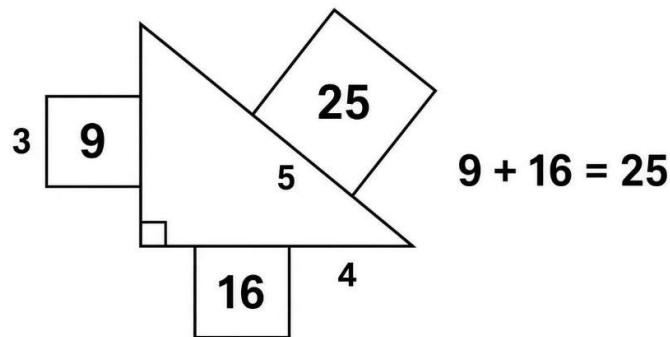


What the picture says. Box 1 writes $x^2 - 5x + 6 = 0$. Box 2 factors it as $(x - 2)(x - 3) = 0$, so $x = 2$ or $x = 3$. Box 3 checks both in the original line: $4 - 10 + 6 = 0$, and $9 - 15 + 6 = 0$. The part under the root in the formula, $b^2 - 4ac$, is a traffic light before you finish: positive means two real roots, zero means one repeated root, negative means no real root.

10.5 Pythagoras

Concept. This works only for a right triangle, the one with a square corner. The longest side is opposite that corner and is called the hypotenuse. The square drawn on the longest side equals the other two squares added together: $c^2 = a^2 + b^2$.

Pythagoras, square on the longest side



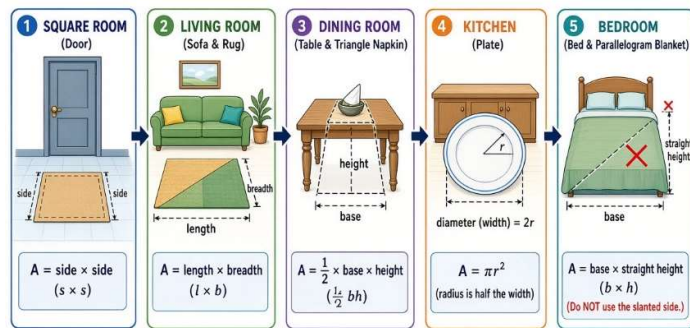
What the picture says. 3^2 is 9, 4^2 is 16, and $9 + 16 = 25$, which is 5^2 . That is why 3-4-5 is the memory set. Double every side and you get 6-8-10. If a question calls the longest side a leg, the picture is wrong before the sum starts. The right angle is never on the longest side.

10.6 Area formulas as five rooms

Concept. This picture belongs only to area, not to the memory-palace chapter above. Area is the flat space inside a shape. Each room holds one shape and the one length you must not misuse. A slanted side is not a height. A diameter is not a radius.

AREA FORMULAS – MEMORY PALACE

Walk through the house, remember the formulas.



MEMORY TIP: One room, one shape, one formula. Walk it. Picture it. Recall it.

What the picture says. The door has a square tile: side $\times$ side. The sofa has a rectangle rug: length $\times$ breadth. The table has a triangle napkin: half $\times$ base $\times$ height. The half is the part people forget. The kitchen plate uses πr^2 , and the radius is half the width across the plate. The bed is a parallelogram: base $\times$ straight height. The crossed slanted side is not the height.

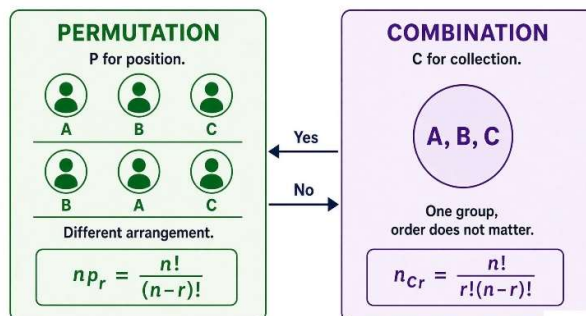
10.7 Permutations and combinations. This is one idea split in two. First ask whether the order of the chosen things matters. That single question picks the formula.

The split

Concept. This picture belongs only to permutations and combinations. Permutation means arrangement: the job, the seat or the rank changes the result. Combination means selection: the group is the same however you list the names. Ask one question before you touch a formula. If I swap two chosen things, is it a new result? Yes means permutation. No means combination. Memory line: P for position, C for collection.

Order matters?

Does swapping two items make a new result?



What the picture says. On the left, swapping A and B makes a different line, so you are arranging. On the right, A, B and C sit in one circle with no first place, so you are only choosing. The formulas under the panels are $nPr = n! / (n - r)!$ and $nCr = n! / (r! (n - r)!)$.

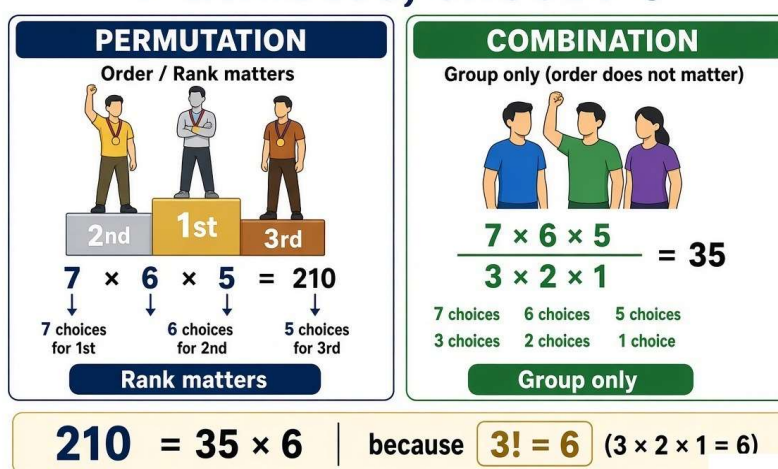
The formulas

$n!$ means $n \times (n - 1) \times \dots \times 1$. A permutation of r things from n can be written as r factors: $7 \times 6 \times 5$ is $7P3$, because the first place has 7 choices, the second has 6 left, and the third has 5 left. A combination uses the same product, then divides by $r!$, because those r chosen things could have stood in $r!$ orders and a selection does not care. The check is $nPr = nCr \times r!$. If that fails, one answer is wrong.

10.8 Seven athletes, choose three

Same seven athletes, two different questions. This picture is only for that pair of questions. Medals are positions, so order matters. A team has no ranks, so order does not.

7 athletes, choose 3



What the picture says. For gold, silver and bronze there are 7 choices for first, 6 left for second and 5 left for third: 210 arrangements. For a team, divide by $3 \times 2 \times 1$ because the three chosen athletes could have stood in 6 orders: 35 teams. The bottom line is the check: $210 = 35 \times 6$, and 6 is $3!$. A word using all five different letters of MATHS is $5! = 120$. If a letter repeated, you would divide by the factorial of that repeat.

How to practise. Write P or C in the margin before you touch the formula. Then do the medals, the team, and the check $210 = 35 \times 3!$ from memory. Tomorrow, one line only: "A committee of 4 is to be chosen from 9 students." The word chosen, with no posts named, is the signal for $9C4$.

11. A week of practice

- ✓ Day 0. Pick one chapter. Five rooms, or one sentence, plus one rule hook. Walk or rebuild it the same evening.
- ✓ Day 1. Book closed, write it again before breakfast. Do one short question and say the trap first.
- ✓ Day 3. A 3-mark or 5-mark answer in full sentences, or one numerical with the unit stated.
- ✓ Day 7. Only the missed stops. If the chapter stayed, keep the rooms and change the objects.
- ✓ One chapter done this way is worth more than five chapters reread. The palace, the sentence, and the pegs are keys. Understanding is the lock. Recall, a day later, is what makes it stay.

12. Conclusion: the trace you can find again

12.1 A memory technique does not pour a chapter into the head. It builds a trace you can find under pressure. Encoding without a cue leaves a weak trace. A room, a sentence, a peg, or a rule is the cue. Understanding is what the cue points to. Retrieval, a day later, is what consolidates it.

12.2 The types of memory explain the design of this paper. Working memory is small, so lists are chunked or parked in places. Semantic memory holds the formula and the reason. Episodic memory holds the walk through the house, which is why the same five rooms can carry a new chapter if only the objects change. Procedural memory is the skill of writing the answer in the form the board expects, and that skill comes from doing the closed-book write, not from highlighting.

12.3 Forgetting will still happen. The forgetting curve is steepest early, which is why Day 1 and Day 3 matter more than a long sitting on Day 0. Interference will still happen, which is why twins such as mitosis and meiosis, or mirror and lens, are kept in a two-column compare. None of this replaces the textbook. It makes the textbook answer available when the book is not open.

12.4 Start with one chapter. Five rooms, or one sentence, plus one rule hook. Walk it the same evening. Write it before breakfast. The palace, the sentence, and the pegs are keys. Understanding is the lock. Recall is what makes the trace stay.