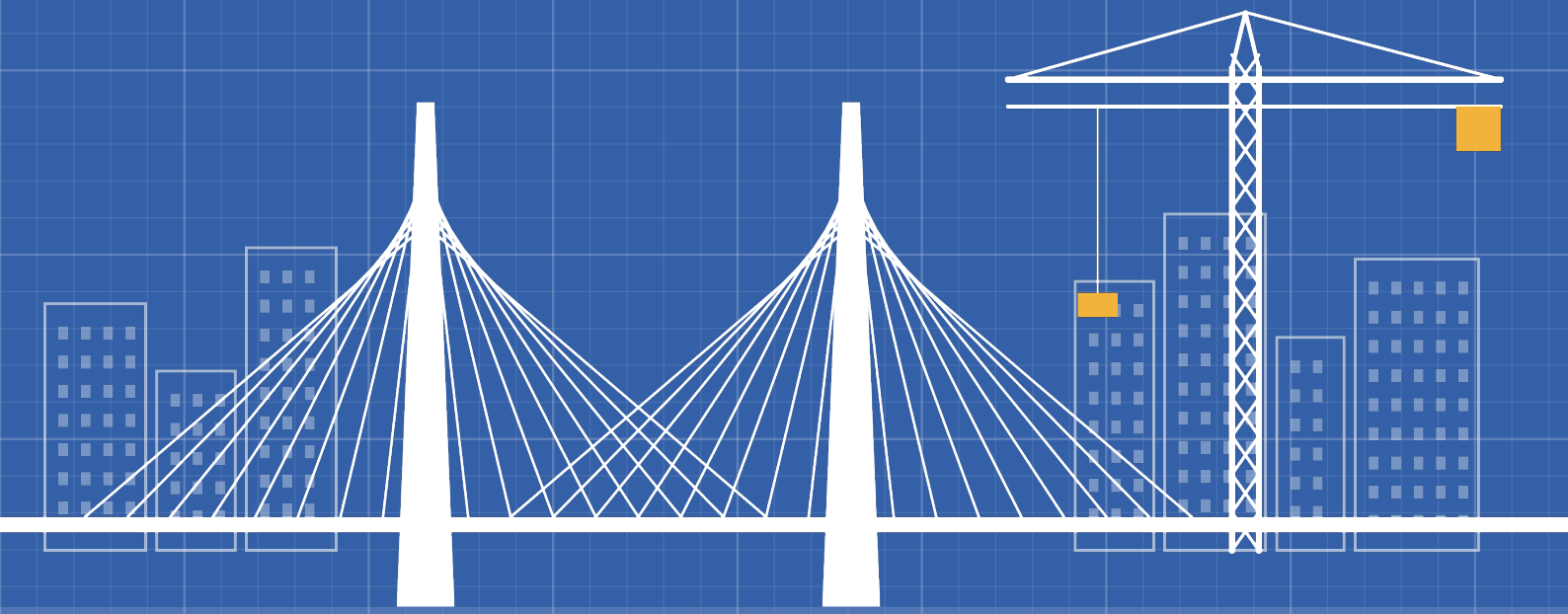


WORKSHEET 3

BEAMS, FRAMES & MOMENTS

Name beam sections, stop frames from racking, and calculate turning forces like an engineer.

Use this worksheet alongside pages 9 and 13–15 of your Structural Engineering course notes.

NAME

CLASS

TEACHER

designclass
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WORKSHEET 3

BEFORE YOU START

LEARNING INTENTIONS

We are learning to: **name** common beam sections · **explain** racking and how cross-bracing stops it · **identify** struts and ties · **calculate** moments and solve balanced beam problems.

SUCCESS CRITERIA

I can name six beam sections from their shape · I can explain why triangles make frames rigid · I can say whether a member is a strut or a tie · I can use **moment = force × distance** and the principle of moments, showing my working and units.

TASK 1 NAME THAT SECTION

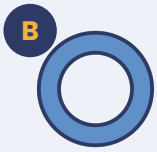
A length of metal is called a **beam**. The shape you see when you cut through it is called the **section**. Name each one.

Word bank: I-beam · channel · angle · T-section · box section · tube

A



B



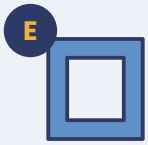
C



D



E



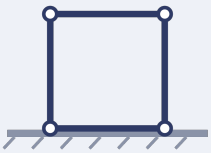
F



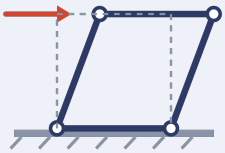
b An I-beam uses much less steel than a solid rectangle of the same size, but it is nearly as stiff. Why is this useful to engineers? Give **two** reasons.

TASK 2 RACK ATTACK

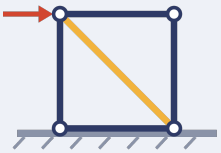
A **frame** is a skeleton of members joined together. If a sideways force pushes on a square frame, it can lean over and change shape. This is called **racking**.



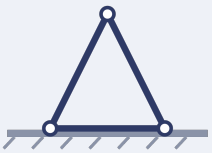
A — square frame



B — racked frame



C — cross-braced frame



D — triangular frame

a In your own words, what is **racking**?

b Frame C has a **cross-brace**. Explain how it stops the frame racking. Use the word **triangle**.

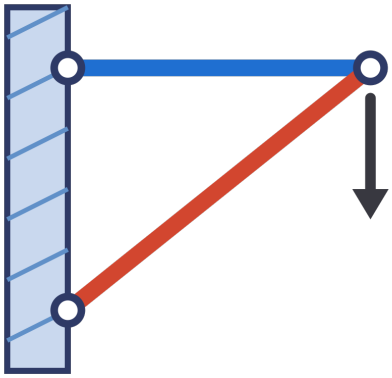
c Sketch a farm gate made from a rectangular frame. Add **one** brace to stop it sagging and racking.

SKETCH HERE

TASK 3 STRUTS AND TIES

SENIOR PHASE WORD

A member that is being **pulled** (in tension) is called a **tie**. A member that is being **pushed** (in compression) is called a **strut**. You will use these words in senior phase Engineering Science.



A shelf bracket on a wall. A load hangs from the end.

a The **blue** member (top) is being pulled away from the wall. Is it a strut or a tie?

b The **red** member (diagonal) is being pushed into the wall. Is it a strut or a tie?

c One member could be replaced by a steel cable. Which one, and why would a cable not work for the other?

TASK 4 MOMENTS

KEY FORMULA

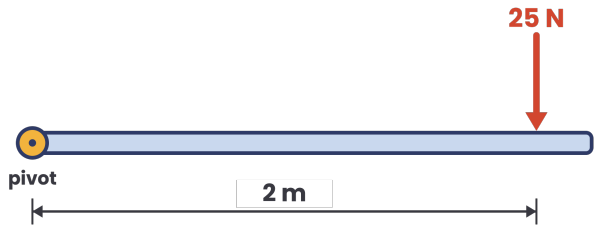
A **moment** is the turning effect of a force.
moment (Nm) = force (N) × distance from the pivot (m)
When a beam is **balanced**: total clockwise moments = total anticlockwise moments.

WORKED EXAMPLE

A 100 N force acts 2 m to the right of the pivot (clockwise). An unknown force F acts 1 m to the left (anticlockwise). The beam is balanced.
Clockwise moments = 100 N × 2 m = **200 Nm** Anticlockwise moments = F × 1 m
Balanced, so F × 1 = 200, so F = 200 ÷ 1 = **200 N**

Show your working for every question: write the formula, put in the numbers, then give the answer **with its unit**.

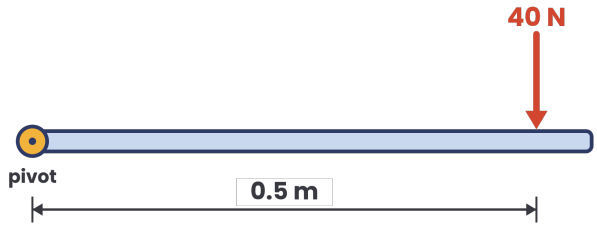
1 Calculate the **moment** of the force about the pivot.



WORKING

Answer = _____ **Nm**

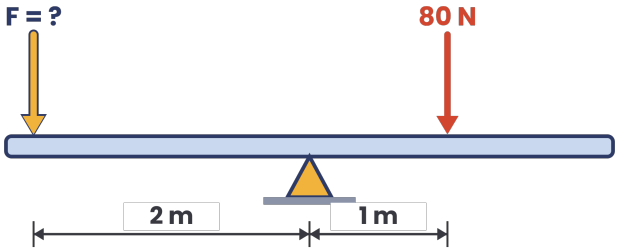
2 Calculate the **moment** of the force about the pivot.



WORKING

Answer = _____ **Nm**

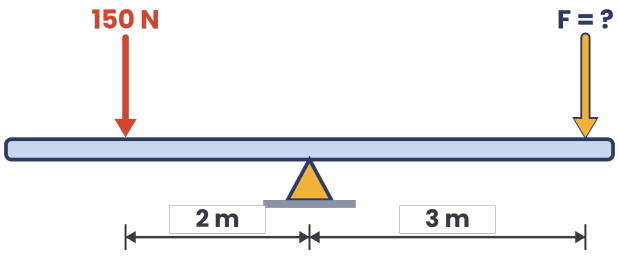
3 The beam is balanced. Calculate the force **F**.



WORKING

Answer = _____ **N**

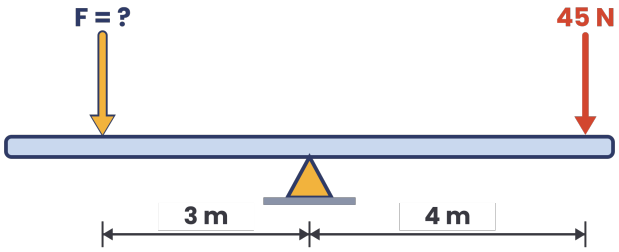
4 The beam is balanced. Calculate the force **F**.



WORKING

Answer = _____ **N**

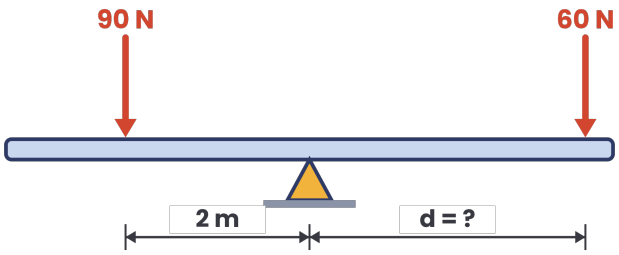
5 The beam is balanced. Calculate the force **F**.



WORKING

Answer = _____ **N**

6 The beam is balanced. Calculate the distance **d**.



WORKING

Answer = _____ **m**

TASK 5 MOMENTS IN REAL LIFE

a Why is a door handle fitted on the side **furthest** from the hinges? Use the word **moment** in your answer.

b A mechanic cannot undo a tight wheel nut. Explain why using a **longer spanner** helps.

REFLECT

HOW CONFIDENT AM I?

	Not yet	Getting there	Got it!
I can name six beam sections.	○	○	○
I can explain racking and how cross-bracing (triangles) prevents it.	○	○	○
I can identify struts (compression) and ties (tension).	○	○	○
I can calculate a moment using moment = force × distance.	○	○	○
I can find an unknown force or distance on a balanced beam.	○	○	○

YOU DID IT.

Next up: **design and build your own bridge truss**, then the **topic test**.

Want more moments practice? Try the **Moments Practice Pack** — Levels 1, 2 and 3.

"Engineering is the art of directing the great sources of power in nature for the use and convenience of man."

Thomas Tredgold, civil engineer (1788–1829)

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