

Name _____

Class _____

Date _____

By the end of this worksheet I can...

- ☐ choose and justify a material from a data table
- ☐ calculate direct stress and strain
- ☐ calculate Young's modulus
- ☐ label a stress-strain graph: limit of proportionality, yield, UTS, break
- ☐ calculate factor of safety and strain energy
- ☐ explain how strain gauges are used to measure strain

I DO**Worked example** Read how a full-mark answer is built*A steel rod of diameter 10 mm carries a tensile load of 5 kN.***1 Calculate the stress in the rod.** (3 marks)**Full-mark answer** each ✓ is one mark

$$A = \pi \times 5^2 = 78.5 \text{ mm}^2 \quad \checkmark. \quad \sigma = F \div A = 5000 \div 78.5 \quad \checkmark = 64 \text{ N/mm}^2 \quad \checkmark.$$

Why marks are not awarded

$$"\sigma = 5 \div 78.5 = 0.064 \text{ N/mm}^2"$$

2 marks: kN not converted to N.

WE DO**Guided practice** Use the starters and word bank to help you*A 2 m wire stretches by 1.2 mm.***2 Calculate the strain.** (2 marks)**Sentence starters**

One ... is ..., which means ...

Another ... is ..., so ...

Word bank

Tip: 2 marks = 2 separate, developed points.

YOU DO

On your own No notes. Check your answers afterwards.

3 Quick check: tick one box for each.

- a) Strain has units of...
☐ N/mm² ☐ mm ☐ None ☐ N
- b) A material that breaks with almost no plastic region is...
☐ Ductile ☐ Brittle ☐ Malleable ☐ Elastic
- c) UTS 430 N/mm² with a factor of safety of 3 gives a working stress of about...
☐ 143 N/mm² ☐ 1290 N/mm² ☐ 433 N/mm² ☐ 3 N/mm²
- d) Which justification scores?
☐ It is strong, so it is a good choice for the boat ☐ It is low cost and easy for the builder to get hold of ☐ It is a good material that will last a long time ☐ It is corrosion resistant, so it won't degrade in sea water

4 Key terms: write the letter of the matching description next to each term.

- | | | |
|--------------------------|-------|--|
| 1. Fatigue | _____ | A $\epsilon = \Delta l \div l$ (no units) |
| 2. Stress | _____ | B UTS $\div$ working stress |
| 3. Strain | _____ | C $\sigma = F \div A$ (N/mm ²) |
| 4. Justifying a material | _____ | D Failure from repeated loading, below the UTS. |
| 5. Young's modulus | _____ | E Name the property and link it to the job. |
| 6. Factor of safety | _____ | F $E = \text{stress} \div \text{strain}$ |

A hydrofoil mast must be strong, light and resist corrosion in seawater.

5 Choose a suitable material from aluminium, mild steel and carbon fibre, and justify your choice. (2 marks)

A tie has a working stress of 85 N/mm². Its material has a UTS of 430 N/mm².

6 Calculate the factor of safety. (2 marks)

A structural engineer recommends a high factor of safety for a footbridge.

7 Give two reasons for the advice. (2 marks)

Check and reflect

Mark your answers with the answer sheet. Go back to the checklist on the site and re-rate each “I can” statement above. Which one still needs work?
