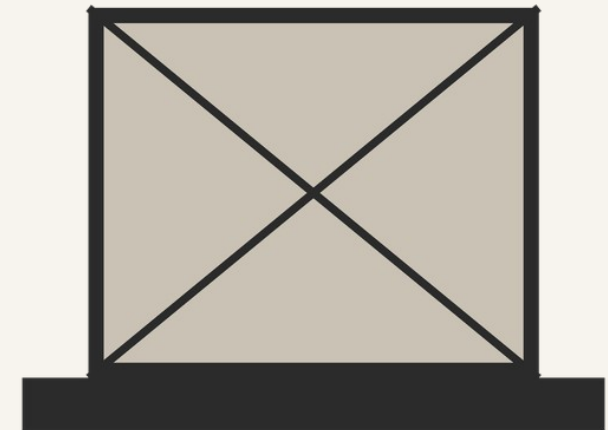


# Work Done

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Push something, move it, and you have done work you can measure.



## LEARNING INTENTION

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To calculate work done using  $E_w = F d$ , setting the working out the way the SQA marks it.

# Daily Review

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SHOW ME BOARDS

- 1 State the law of conservation of energy.
- 2 Useful energy plus wasted energy equals what?
- 3 Name the four forms of energy we calculate at National 5.
- 4 A kettle — name the input and the useful output energy.
- 5 Input 800 J, wasted 150 J — how much is useful?

## By the end of this lesson...

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- 1 I can find  $E_w = F d$  in the data booklet.
- 2 I can calculate work done, in joules.
- 3 I can set my working out the way the SQA marks it.
- 4 I can rearrange the formula to find a force or a distance.

# Work Done

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Work is done when a force moves an object through a distance.

$$E_w = F d$$

$E_w$

work done (J)

$F$

force (N)

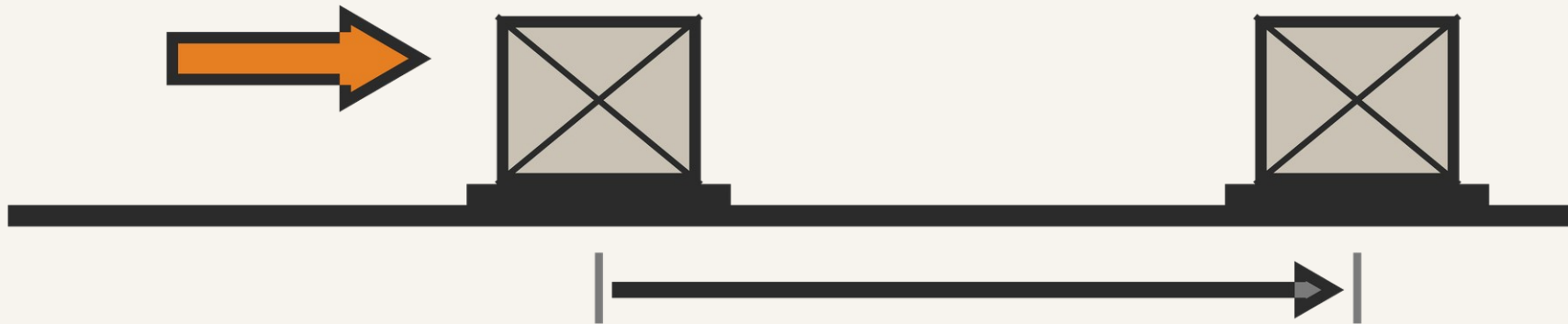
$d$

distance moved (m)

The energy used to do that work is the work done. Same thing, same unit.

# Force, Distance, Work

The force pushes. The distance is how far it actually moved.



the force acts along the movement · the distance is start to finish

# How the SQA Marks a Calculation

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Three marks, three separate things. Show all three, every time.

## 1. SUBSTITUTION

Write the formula, then put your numbers into it. This mark is for showing the numbers.

## 2. TRANSPOSITION

Only when the unknown is not the subject: rearrange it on its own line, before you divide.

## 3. ANSWER + UNIT

The final answer, underlined, with its unit. The unit is part of the mark.

Classroom convention, not booklet text – but it is exactly how the marking instructions award the marks.

## Worked Example – Trolley

A factory worker pushes a trolley with a force of 80 N for 12 m.  
Calculate the work done.

$$F = 80 \text{ N}$$

$$d = 12 \text{ m}$$

$$E_w = ?$$

$$E_w = F d$$

$$E_w = 80 \times 12$$

$$\underline{E_w = 960 \text{ J}}$$



# Show Me — Work Done

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SHOW ME BOARDS

- 1 Write the formula for work done.
- 2 State the unit of force.
- 3 A force of 20 N moves a box 5 m. Calculate the work done.
- 4 State the unit of work done.
- 5 A force of 300 N moves a pallet 4 m. Calculate the work done.

# Show Me — More Work Done

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SHOW ME BOARDS

EXTRA PRACTICE

- 1 What does the  $d$  stand for in  $E_w = F d$ ?
- 2 A force of 50 N moves a crate 6 m. Calculate the work done.
- 3 State the unit of distance in this formula.
- 4 A force of 120 N acts over 0.5 m. Calculate the work done.
- 5 A force of 15 N moves a component 2 m. Calculate the work done.

# Watch Out – Which Distance?

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## THE MISTAKE

- “I will use the whole length of the workshop.”
- “The force pushes down, so I use the height.”
- “960 is the answer, so that is what I write.”

## THE CORRECT ANSWER

- Use the distance the object actually moved.
- The distance must be along the direction of the force.
- Write 960 J. Without the unit you lose a mark.

# Task 1 – Work Done

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Three calculations in your jotter, SQA layout every time.  
Q3 has a distance under a metre – that is not a mistake.  
3 marks each. One of them is for the unit.

**Booklet – “TRY THIS: Work Done”**

# Worked Example – Finding the Force

A conveyor does 750 J of work moving a box 2.5 m.  
Calculate the size of the force needed.

$$E_w = 750 \text{ J}$$

$$d = 2.5 \text{ m}$$

$$F = ?$$

$$E_w = F d$$

$$F = E_w \div d$$

$$F = 750 \div 2.5$$

$$\underline{F = 300 \text{ N}}$$

# Checkpoint

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- 1 Write the formula for work done and give the unit of the answer.
- 2 A force of 40 N moves a part 3 m. Calculate the work done.
- 3 What + why: you push a wall hard for a minute. How much work have you done?

# Exam Practice — Past Papers

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2022 Q3 — workbench pushed 12 m by a 2 200 N force (2)

The one direct work-done question in the papers we hold.

Two marks: one for the substitution, one for the answer.

**Find the relationship in the data booklet**

LOOKING AHEAD

# Kinetic and Potential Energy

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Two more formulae: one for moving, one for lifted.



# Plenary – Prove Your I Can... Statements

SHOW ME BOARDS

- 1 Write the formula for work done.
- 2 State the unit of work done.
- 3 A force of 10 N moves a block 7 m. Calculate the work done.
- 4 Rearrange  $E_w = F d$  to make  $d$  the subject.
- 5 Name the three things the SQA gives marks for in a calculation.

# Plenary – More Quick Checks

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SHOW ME BOARDS

EXTRA PRACTICE

- 1 State the unit of force.
- 2 A force of 25 N moves a part 4 m. Calculate the work done.
- 3 Rearrange  $E_w = F d$  to make  $F$  the subject.
- 4 Where do you find the formula in the exam?
- 5 Why must you write the unit on the final line?

## Extension – If You Finish Early

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- 1 A crane does 36 000 J of work lifting a beam 8 m. Find the force.
- 2 A 250 N force does 2 000 J of work. How far did the load move?
- 3 What + why: two workers move the same crate the same distance. One takes twice as long. Same work done?

## Extension — More Challenges

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EXTRA PRACTICE

- 1 A robot does 90 J of work over 0.6 m. Calculate the force.
- 2 A 400 N force does 10 000 J of work. Find the distance moved.
- 3 What + why: why is work done measured in joules, like every other energy?