Work Done

Stored energy can only be moved from one store to another. We say it is _____ from one store to another. You cannot _____ energy from nothing or _____ it. This is the idea of **Conservation of Energy**.

Mechanical energy transfer happens when there is a _____ that has made the object _____. We say that force does _____ to transfer energy. The amount of **work done** by the force is given by:

$$\text{work} = \text{force} \times \text{distance}$$
$$W = F \times s$$

The work done tells us _____ has been taken from one _____ and moved to another. It is measured in _____ (J).
If there is a _____ in energy, work has been done. The _____ is not always easy to see.

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1 Which of these forces do work? How do you know?

(a) The 2 N weight of a ball on a table.

(b) The force of friction on a box sliding across the floor.

(c) A cook stirring soup.

(d) The force in an elastic band stretched around a stack of letters.

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2 You pick up a ball from the floor with a force of 1 N and put it on a table 1 m high. Complete the sentences.

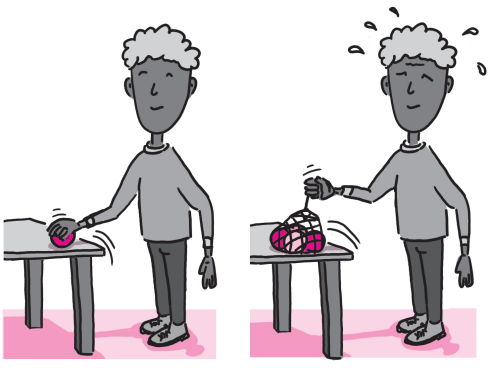
(a) You have done 1 N × 1 m = ☐ J of work.

(b) You pick up a second ball and place it on a shelf 2 m high. How much work have you done?

work (J)	=	force (N)	×	distance (m)
☐	=	1	×	_

Now you pick up 4 balls, with a force of 4 N and put them on the 1 m high table. How much work has been done?

work (J)	=	force (N)	×	distance (m)
☐	=	_	×	_



3 A ball falls off a shelf onto the ground. The weight of the ball does 4 J of work. Complete the sentences using the words **increased, decreased, stayed the same, gravitational potential energy, kinetic energy,** 4 **J**.

(a) Just before the ball hits the ground, the ball's **kinetic energy** store has _____ compared to when it was on the shelf.

(b) Just before the ball hits the ground, the ball's **gravitational potential energy** store has _____ compared to when it was on the shelf.

(c) Just before the ball hits the ground, the ball's **elastic potential energy** store has _____ compared to when it was on the shelf.

(d) 4 J have been transferred from the _____ store to the _____ store of the ball. This last store has _____ by _____.

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4 A lorry drives along a road at a steady 30 mph. It reaches the bottom of a hill and continues to maintain its speed as it goes up the hill. Complete the sentences using the words **decreases, increases, stays the same**.

(a) The lorry's kinetic energy store _____.

(b) The lorry's gravitational potential energy store _____.

(c) The chemical store of the engine _____.

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5 A shopper pushes a trolley with a 4 N force for 5 m.

(a) Complete this: The distance the shopper pushes the trolley is ☐ m.

(b) Work out how much work they will have done.

work (J)	=	force (N)	×	distance (m)
☐	=	4	×	☐

(c) Work out how much work they will have done pushing the trolley 7 m using an equation.

work (J)	=	force (N)	×	distance (m)
☐	=	4	×	☐

(d) How much work will it take the shopper to push the trolley 12 m?

(e) How much work will it take the shopper to push the trolley 12 m with a force of 6 N?

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6 Complete the word equation with the words **work, distance, force**.

☐ = ☐ × ☐

7 A submarine at the surface sinks down to 33 m below the surface of the sea. It is pulled down with a force of $10\,000$ N. How much work was done on the submarine?

work (J)	=	force (N)	×	distance (m)
	=		×	

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8 Place these in order of amount of work being done:

(a) A crane picking up 3 crates of bricks and moving them up 10 m.

(b) A crane picking up 3 crates of bricks and moving them up 15 m.

(c) A crane picking up 5 crates of bricks and moving them up 15 m.

(d) A crane picking up an empty crate and moving it up 10 m.

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9 The work done to pull 10 bricks up a certain height has been recorded and put in the following table.

Work (J)	200	1000		3000	4000
Height (m)	1	5	10	15	20

(a) What was the amount of work done needed to reach 10 m?

(b) How much potential energy do the bricks have at a height of 10 m?

(c) What height was reached after doing $10\,000$ J of work?

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10 Three friends try to jump start a car with a flat battery. Each friend pushes with a force of 200 N, and the car moves forwards 5 m. What is the total amount of work done on the car?

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11 A heavy suitcase weighing 200 N $(20$ kg of mass$)$ has to be lifted on to the storage rack above the seats on a train. This means raising it a height of 2 m.

(a) How much work was done on the suitcase?

(b) As it is so heavy, it is easier to swing it up there. How much extra work is done if you swing it an extra 0.2 m above the top of the rack?

(c) Along a sharp bend in the railway line, the suitcase falls off the rack. How much work is done on the suitcase by gravity as it falls to the floor?