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**, which is a law that keeps appearing in Science.

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:

$$\text{Work} = \text{Force} \times \text{Distance} \quad (1)$$

$$W = F \times s \quad (2)$$

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

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1 You pick up a ball from the floor with a force of 1 N and put it on a table 1 m high. You have done $1\text{ N} \times 1\text{ m} = 1$ J of work.

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

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2 Which of these forces do work and why?

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

(b) A cook stirring soup.

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

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

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3 A ball falls off a shelf onto the ground. The weight of the ball does 4 J of work. Have these different energy stores of the ball increased, decreased or stayed the same just before the ball hits the ground?

(a) Its kinetic energy

(b) Its gravitational potential energy

(c) Its elastic potential energy

(d) Can you complete the sentence?
4 J have been transferred from the _____ store to the _____ of the ball. It has increased by ___.

4 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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5 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. Fill in the blanks.

(a) The lorry's kinetic energy

(b) The lorry's gravitational potential energy

(c) The chemical store of the engine

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

Work $(\mathbf{J})$	200	1000		3000	4000
Height $(\mathbf{m})$	1	5	10	15	20

(a) What was the amount of work done at 10 m?

(b) At what height was 10000 J done?

(c) How much potential energy do the bricks have at a height of 20 m?

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7 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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8 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 through 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?