Work, Energy & Power

FORMULAS

$W = Fd$ $P = \frac{W}{t} = \frac{Fd}{t} = Fv$ $PE = mgh$ $KE = \frac{1}{2}mv^2$

1 hp = 746 watts

CONSERVATION OF MECHANICAL ENERGY

In the absence of friction, air resistance or other dissipative forces, the total mechanical energy (PE + KE) of a system remains constant.

$$PE_1 + KE_1 = PE_2 + KE_2$$

WORK-ENERGY PRINCIPLE

The net work done on a body is equal to the change in KE or PE of the body.

$$\text{Work} = \Delta KE = \tfrac{1}{2}m(v_f^2 - v_i^2)$$
$$\text{Work} = \Delta PE = mg(h_f - h_i)$$

KILOWATT-HOURS

If the power output of a machine is measured in kilowatts, and its time of operation is in hours, the product of power and time would give the work in kilowatt-hours (kWh).

Example 1: How much gravitational potential energy is stored in a 12-kg ball that has been lifted 1.5 m?

Solution: $PE = mgh = (12\text{ kg})(10\text{ m/s}^2)(1.5\text{ m}) = 180\text{ J}$

Example 2: Find the kinetic energy of a 5-kg object moving with a speed of 4 m/s.

Solution: $KE = \frac{1}{2}mv^2 = \frac{1}{2}(5\text{ kg})(4\text{ m/s})^2 = 40\text{ J}$

EXERCISES

A. What conditions must be met in order for work to be done?

B. Using a force of 85 N, you push a trunk 7.5 m across the floor. How much work do you do?

C. If you do 1450 J of work in carrying a load of books up a flight of stairs, covering a vertical distance of 15 m, what is the mass of the books?

D. What is the mass of a baseball that has 120 J of kinetic energy when it is going 25 m/s?

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