



## Work, Energy & Power

### FORMULAS

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

$$1 \text{ hp} = 746 \text{ watts}$$

### 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.

$$PE_i + KE_i = PE_f + KE_f$$

### WORK-ENERGY PRINCIPLE

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

$$\text{Work} = \Delta KE = \frac{1}{2}m(v_f^2 - v_i^2)$$

$$\text{Work} = \Delta PE = mg(h_f - h_i)$$

### 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?

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

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

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

### EXERCISES

- What conditions must be met in order for work to be done?
- Using a force of 85 N, you push a trunk 7.5 m across the floor. How much work do you do?
- 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?
- What is the mass of a baseball that has 120 J of kinetic energy when it is going 25 m/s?