

# Power

**Definition:** The rate at which work is done or the rate at which an external force changes the energy of the system.

$$\text{Power} = \frac{\text{Work}}{\text{time}} = \frac{W}{t}$$

**Units for Power = Watts (W)**

1) A 2 kg box is lifted at a constant speed. The box is lifted 4 m in 8 seconds. (a) How much work was done on the box? (b) What was the power of the lifting force?

$$\begin{aligned} m &= 2 \text{ kg} \\ d &= 4 \text{ m} \\ t &= 8 \text{ s} \end{aligned}$$

$$W = Fd$$

$$W = 20(4) = 80 \text{ J}$$

$$P = \frac{W}{t} = \frac{80}{8} = \boxed{10 \text{ W}}$$

2) A 4 kg box is lifted at a constant speed of 1.5 m/s. What was the power of the lifting force?

$v = 1.5 \text{ m/s}$  so if  $d = 1.5 \text{ m}$  then  $t = 1 \text{ s}$   
or  $d = 3.0 \text{ m}$  and  $t = 2 \text{ s}$ , etc.

$$W = Fd \text{ and } P = \frac{W}{t}$$

$$\text{So we can say: } P = \frac{Fd}{t}$$

$$P = \frac{Fd}{t} = \frac{40(1.5)}{1} = \frac{40(3)}{2} = \boxed{60 \text{ W}}$$