WORK

1. A weight lifter lifts a set of weights a vertical distance of 2 m. If a constant net force of 350 N is exerted on the weights, what is the net work done on the weights?

$\vec{d} = 2\text{ m [up]}$
$\vec{F} = 350\text{ N [up]}$

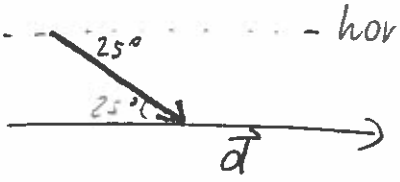
$W = Fd$
$= (350)(2)$
$= 700\text{ J}$

∴ The net work done is 7×10^2 J.

$\vec{F} \uparrow\uparrow \vec{d}$

2. A shopper in a supermarket pushes a cart with a force of 35 N directed at an angle of 25 degrees downward from the horizontal. Find the work done by the shopper on the cart as the shopper moves along a 50 m length of aisle.

$\vec{F} = 35\text{ N [25° below horizontal]}$
$\vec{d} = 50\text{ m}$



$W = F \cdot \cos\theta \cdot d$
$= 35 \cos 25° \cdot 50$
$= 1.6 \times 10^3\text{ J}$

∴ The work done is 1.6×10^3 J.

3. If 2 J of work is done in raising a 180 g apple, how far is it lifted?

$W = 2\text{ J}$
$m = 180\text{ g} \rightarrow 0.18\text{ kg}$
$\|\vec{F}_{app}\| = \|\vec{F}_g\|$

• assume no acceleration

$W = Fd$
$\frac{W}{F} \quad \frac{F}{F}$
$d = \frac{W}{F}$

$d = \frac{2}{(0.18)(9.8)}$
$d = 1.1\text{ m}$

∴ The apple is lifted 1.1 m.

$\vec{F}_{app} \uparrow \uparrow \vec{d}$

4. For each of the following cases, indicate whether the work done on the second object in each example will have a positive or a negative value.

a. The road exerts a friction force on a speeding car skidding to a stop. Negative work.

b. A rope exerts a force on a bucket as the bucket t is raised up a well. (Positive) work.

c. Air exerts a force on a parachute as the parachutist falls to Earth. Negative work.

5. If a neighbor pushes a lawnmower four times as far as you do but exerts only half the force, which one of you does more work and by how much?

$W_n = \frac{F}{2} \cdot 4d$

$W_n = \frac{4Fd}{2}$

$W_n = 2Fd$

→ Neighbour does twice as much work as you do.

6. A worker pushes a 1500 N crate with a horizontal force of 345 N a distance of 24 m. Assume the coefficient of kinetic friction between the crate and the floor is 0.22.

a. How much work is done by the worker on the crate?

$\vec{F} = 345\,N$ → , $\vec{d} = 24\,m$ →

$W_w = \vec{F} \cdot \vec{d}$

$= (345)(24)$ → $8\,280\,J$

$\therefore W_w = 8.3 \times 10^3\,J$

b. How much work is done by the floor on the crate?

$W_f = \vec{F_f} \cdot \vec{d}$ → $W_f = (330)(24)$ ↑ W bc of friction

$= -7920\,J$

$\therefore W_f = -7.9 \times 10^3\,J$

$F_f = F_N \cdot \mu$

$= mg\mu$

$= (1500)(0.22)$

$= 330\,N\,[L]$

c. What is the net work done on the crate?

Net work $= W_w - W_f$

$= 8\,280 - 7920$ → $\therefore W_{net} = 360\,J = \boxed{3.6 \times 10^2\,J}$

$W_{net} = F_{net} \cdot d$

$= (345 - 330)(24) = 360\,J$

7. A 0.075 kg ball in a kinetic sculpture moves at a constant speed along a motorized vertical conveyor belt. The ball rises 1.32 m above the ground. A constant frictional force of 0.35 N acts in the direction opposite the conveyor belt's motion. What is the net work done on the ball?

$\vec{d} = 1.32\,m\,[up]$

$\vec{F_f} = 0.35\,N\,[D]$

Constant speed ⇒ zero acceleration ⇒ zero F_{net}

$\vec{F}_{net} = 0\,N \Rightarrow W_{net} = 0.00\,J$

8. For each of the following statements, identify whether the everyday or the scientific meaning of work is intended.

a. Jack had to work against time as the deadline neared. E

b. Jill had to work on her homework before she went to bed. E

c. Jack did work carrying the pail of water up the hill. S

9. Determine whether work is being done in each of the following examples:

a. a train engine pulling a loaded boxcar initially at rest Work is done as $\vec{d} > 0\,m$ and ($\vec{a} > 0\,m/s^2 \Rightarrow \vec{F}_{net} > 0\,N \Rightarrow W > 0\,J$)

b. a tug of war that is evenly matched

↳ $\vec{d} = 0\,m$ ⇒ zero work; no work is done

c. a crane lifting a car

- $\vec{F} \neq 0\,N\,[up]$
- $\vec{d} \neq 0\,m\,[up]$
- $\vec{F} \not\perp \vec{d}$

} non-zero work ⇒ work is being done