Work Class Notes
Physics
Western International HS

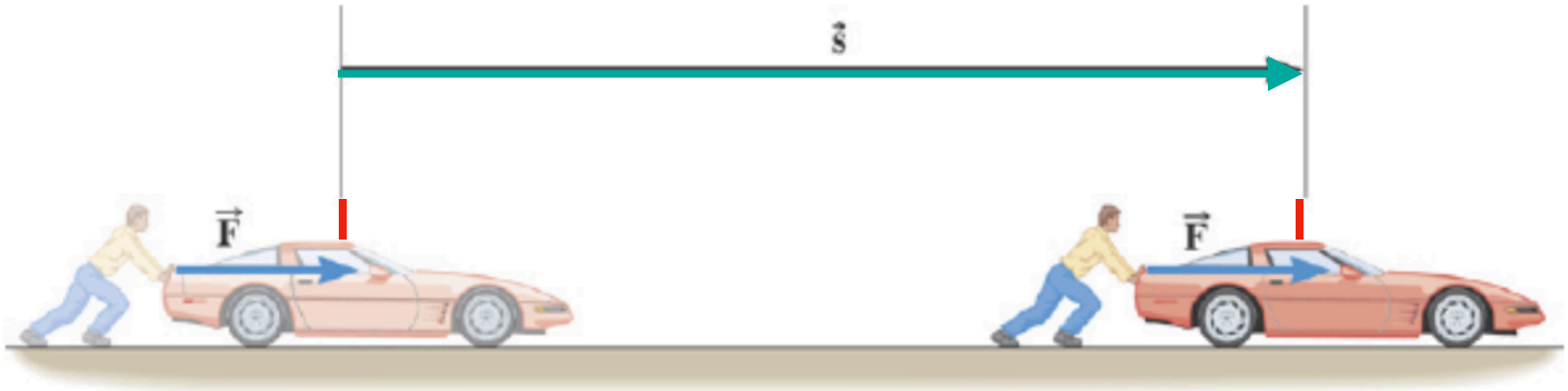
2020 - 2021

Nada Saab, Ph.D

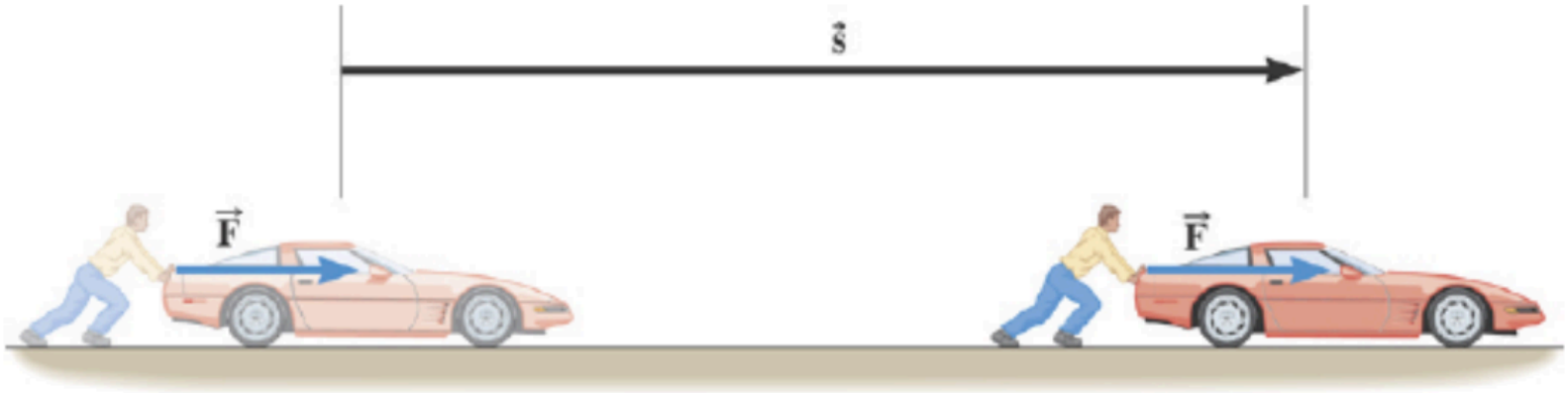
Work : W

$$W = F \times S$$

W (N.m = Joules) = F (N) x S (m)



$$W = \frac{F}{S}$$



Work (W) is done on an object whenever a force makes that **object move.**

W = 0 if the object does not move.

If the object does not move, no work : W = 0

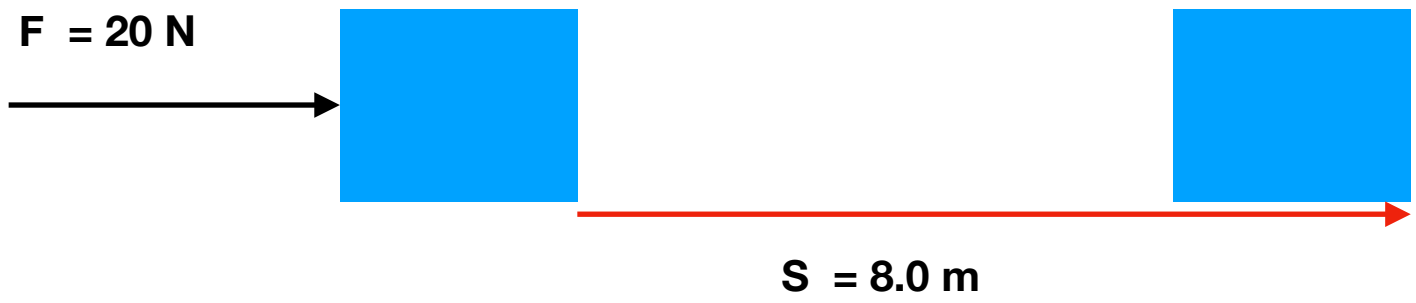
$$W = F \times S$$
$$W = F \times 0 = 0$$

Homework

1) A force of 20 N was used to push a box 8.0 m along the floor. How much work was done? Answer: 1.6 x 102 J

F = 20 N
S = 8.0 m

$$W = F \times S = 20 \times 8 = 160 \text{ J}$$



2) A 2.0 kg puck accelerated at 5.0 m/s^2 for 0.50 m across a frictionless air hockey table. How much work was one on the puck? Answer: 5.0 J

$m = 2.0$ kg

$a = 5.0\ m/s^2$

$S = 0.5$ m

$$W = F \times S$$

$$F = m \times a = 2.0 \times 5.0 = 10\ N$$

$$W = F \times S = 10 \times 0.5 = 5.0\ \text{Joules}$$

3) A bulldozer pushed a large rock with a force of 5000 N at 2.0 m/s for 20 s. How much work was done by the bulldozer?
Answer: 2.0×10^5 J $W = F \times S$

Force = 5000 N
Velocity of the rock (V) = 2.0 m/s
Time = 20 s
Find S:

$$V = \frac{S}{t}$$

$$2.0 = \frac{S}{20}$$

$$2.0 \times 20 = \frac{S \times 20}{20}$$

$$S = 2.0 \times 20 = 40 \text{ m}$$

$$W = F \times S = 5000 \times 40 = 200000 \text{ Joules.}$$

Another way to solve

$$\frac{2.0}{1} = \frac{S}{20}$$

Cross multiply:

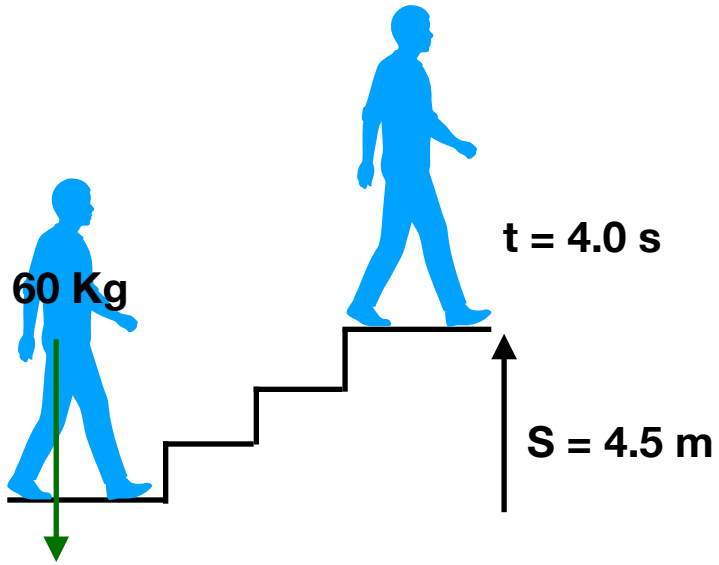
$$2.0 \times 20 = S \times 1$$

$$40 = S$$

Example 4: Running Up the Stairs.

How much power is developed by a 60 kg boy running up a 4.5 m high flight of stairs in 4.0 s?

$P = W / t$ $W = F \times S$ $F = m \times g$



$F_{gravity} = W = m \times g = 60 \times 9.8 = 588$ N

1) The gravitational force (Fg) on the boy: $Fg = m \times g = 60 \times 9.8 = 588$ N.

2) The work done by the boy: $W = F \times S = 500 \times 4.5 = 2646$ Joules

3) The power developed by the boy:

$$P = W / \Delta t = 2646 / 4.0 = 660 \text{ watts}$$

The boy develops 660 watts of power

Power Homework

$$P = \frac{W}{t}$$

1) How much power does a crane develop doing 6.0×10^4 J of work in 5.00 min (5 x 60 = 300 s) ? Answer: 2.0×10^2 W

$W = 6.0 \times 10^4$ J

t = 300 s

$$P = \frac{W}{t} = \frac{6.0 \times 10^4 \text{ J}}{300 \text{ s}} = 200 \text{ Watts}$$

2) How long does it take a 2500 W electric motor to do 7.5×10^4 J of work? Answer: 30 s

$$\mathbf{P = \frac{W}{t}}$$

P = 2500 w

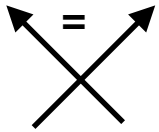
W = 7.5×10^4 J

t = ?

$$\mathbf{P = \frac{W}{t}}$$

$$2500 = \frac{7.5 \times 10^4}{t}$$

$$\frac{2500}{1} = \frac{7.5 \times 10^4}{t}$$



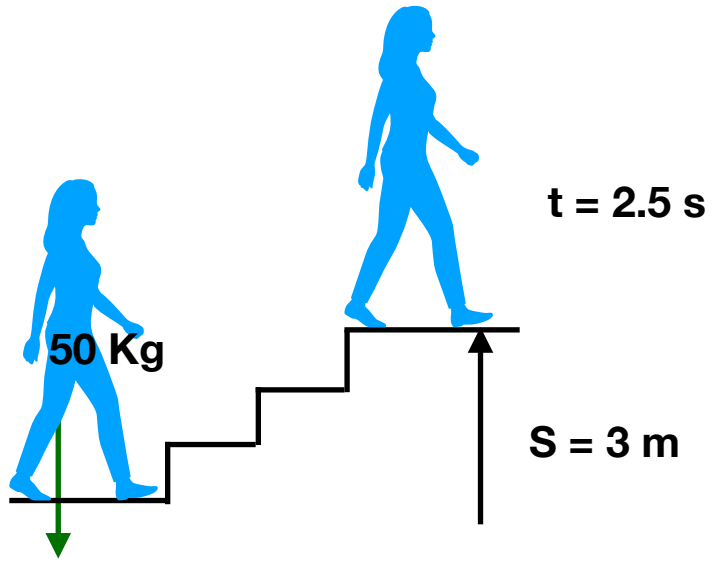
$$2500 \times t = 75000$$

$$\frac{2500}{2500} \times t = \frac{75000}{2500}$$

$$t = 30 \text{ s}$$

3) How much power is developed by a 50 kg girl running up a 3.00 m high flight of stairs in 2.5 s?

$P = W / t$ $W = F \times S$ $F = m \times g$



$F_{gravity} = W = m \times g = 50 \times 9.8 = 490$ N.

1) The gravitational force (Fg) on the boy: $Fg = m \times g = 490$ N

2) The work done by the boy: $W = F \times S = 490 \times 3 = 1470$ Joules

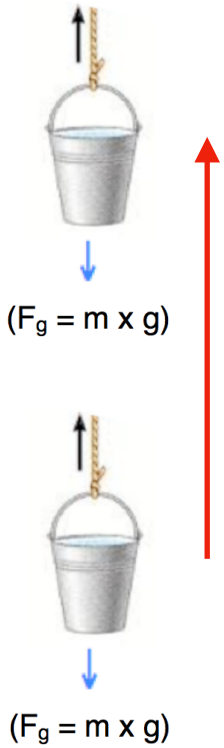
3) The power developed by the boy:

$$P = w / \Delta t = 1470 / 2.5 = 588 \text{ Watts}$$

The boy develops 588 watts of power

A camper uses a rope and pail to get water from a well. If the pail with water has a mass of 20 kg and if it is raided a vertical distance of 3.5 m, how much work is done by the camper?

W = F x S = 200 x 3.5 = 700 Joules



S = 3.5 m

$F_{gravity}$ = W = m x g = 20 x 9.8 = 200 N.