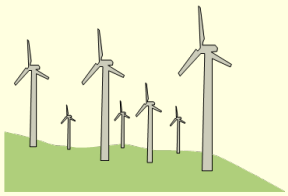
POWER

Learning Target	Description
9.3	I can define, analyze, and calculate mechanical power.



Work Done

Work done is the amount of energy transferred.
Work done = force x distance moved in the direction of the force.

$$W = \Delta E$$

$$W = F \times d \cos\theta$$

W = work done (J)
ΔE = energy transferred (J)
F = force (N)
d = distance moved in the direction of the force (m)

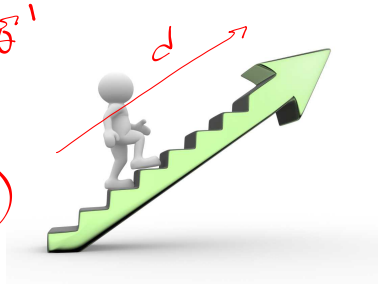
The Human Engine

A 70.0 kg man walks up a long flight of stairs. Calculate the work done if the vertical height of the stairs is 4.5 m.

$W = F \cdot d \cos\theta^{0}$

$W = mgh$

$W = 3100\ J$



The Human Engine

Would it be more work for the man to run up the stairs?

Power

Power is the rate at which energy is transferred or the rate at which work is done.

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

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

$$P = \frac{\Delta E}{t}$$

P = power (Watt)
W = work done (J)
ΔE = energy transferred (J)
t = time (s)

POWER

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

Vector or Scalar?

Units? $1 \frac{J}{s} = 1 W$

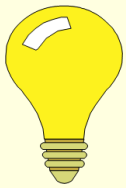
Relationship?

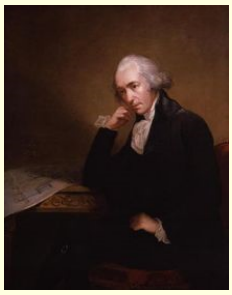
W → Directly Proportional

t → Inversely Proportional

James Watt

1736 - 1819





Bronc Power

Horsepower

1 hp = 746 W

TABLE 7–3
Typical Values of Power

Source	Approximate power (W)
Hoover Dam	1.34×10^9
Car moving at 40 mph	7×10^4
Home stove	1.2×10^4
Sunlight falling on one square meter	1380
Refrigerator	615
Television	200
Person walking up stairs	150
Human brain	20

IN CLASS: Power

5. A 70.0 kg man runs up a long flight of stairs in 4.0 s. The vertical height of the stairs is 4.5 m. What power does the man develop, in watts and horsepower, as he climbs the stairs?

6. To pass a slow-moving truck, you want your fancy 1.30×10^3 kg car to accelerate from 13.4 m/s to 17.9 m/s in 3.00 s. What is the minimum power required for this pass?

The Human Engine

A 70.0 kg man runs up a long flight of stairs in 4.0 s. The vertical height of the stairs is 4.5 m. What power does the man develop, in watts and horsepower, as he climbs the stairs?

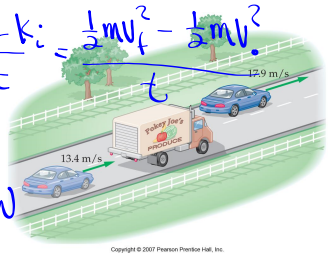
$P = \frac{W}{t} = \frac{mgh}{t}$

$P = 770 W = 1.0 hp$

Passing Fancy

To pass a slow-moving truck, you want your fancy 1.30×10^3 kg car to accelerate from 13.4 m/s to 17.9 m/s in 3.00 s. What is the minimum power required for this pass?

$P = \frac{W}{t} = \frac{\Delta K}{t} = \frac{K_f - K_i}{t} = \frac{\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2}{t}$



$P = 3.05 \times 10^4 W$

$P = 40.9 hp$

Power: Force and Velocity

$$P = \frac{W}{t} = \frac{F \cdot d}{t}$$

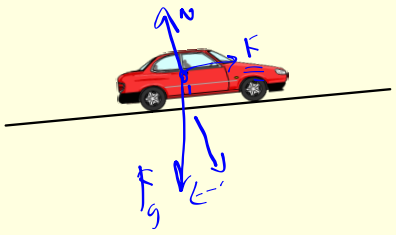
$$P = \vec{F} \cdot \vec{V}$$

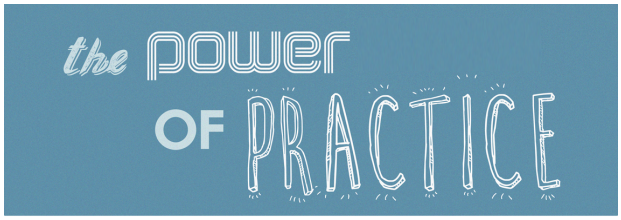
* constant $\vec{V}$

Find the Maximum Speed

It takes a force of 1280 N to keep a 1500 kg car moving with constant speed up a slope of 5.00°. If the engine delivers 50.0 hp to the drive wheels, what is the maximum speed of the car?

$P = F \cdot v$ $\quad v = \frac{P}{F} = 29 m/s$





PRACTICE PROBLEMS (12-16)