

Power

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Power is rate of doing work.

Units:

$\frac{J}{s}$ or W

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

Climber Mcgee Climbs up a 157m cliff. He is 65kg and takes 5min 3 seconds to climb the cliff. What is his power? \uparrow 303s

$$P = \frac{\Delta E}{t} = \frac{1.0 \times 10^5 \text{ J}}{303 \text{ s}} = \boxed{330 \text{ W}}$$

$$\begin{aligned} PE &= mgh \text{ of } 157\text{m} \\ &= 65(9.8)(157) \\ &= 1.0 \times 10^5 \text{ J} \\ PE &= 0 \end{aligned}$$

Jim pushes along the floor with a force of 15N for 32 seconds and it goes 131m. What Power does he expend?

$$P = \frac{W}{t} = \frac{F \cdot d}{t} = \frac{15 \times 131}{32} = 61 \text{ W}$$

Joe slides a box up a ramp with a force

Joe slides a box up a ramp with a force of 72 N. The box slides at a constant velocity of 4.3 m/s. What is power expended?

$$v = \frac{d}{t}$$

$$P = F \cdot v = 72 \times 4.3 = \boxed{310 \text{ W}}$$

only works with
a constant velocity

How long will it take a 300W hotplate to bring a 20°C cup of water (250g) to boiling?

$$c = 4180 \text{ J/kgK}$$

$$\begin{array}{l} \text{Heat} \\ \downarrow \\ \Delta E \end{array} \rightarrow Q = m \cdot c \cdot \Delta T$$

$$P = \frac{mc\Delta T}{t} \Rightarrow t = \frac{mc\Delta T}{P} = \frac{0.250(4180)(100-20)}{300}$$

$$t = 279 \text{ s}$$