# POWER

Average power is the rate at which work is done

Or, the rate at which energy is transformed

$P = W/t$

Measured in Watts

$1W = 1J/s$

# POWER

A 40 W lightbulb transforms 40 J of electrical energy into light and heat energy every second

A Toyota Corolla has a 132 horsepower (hp) engine

1 hp = 746 W

132 hp = 98.4 kW

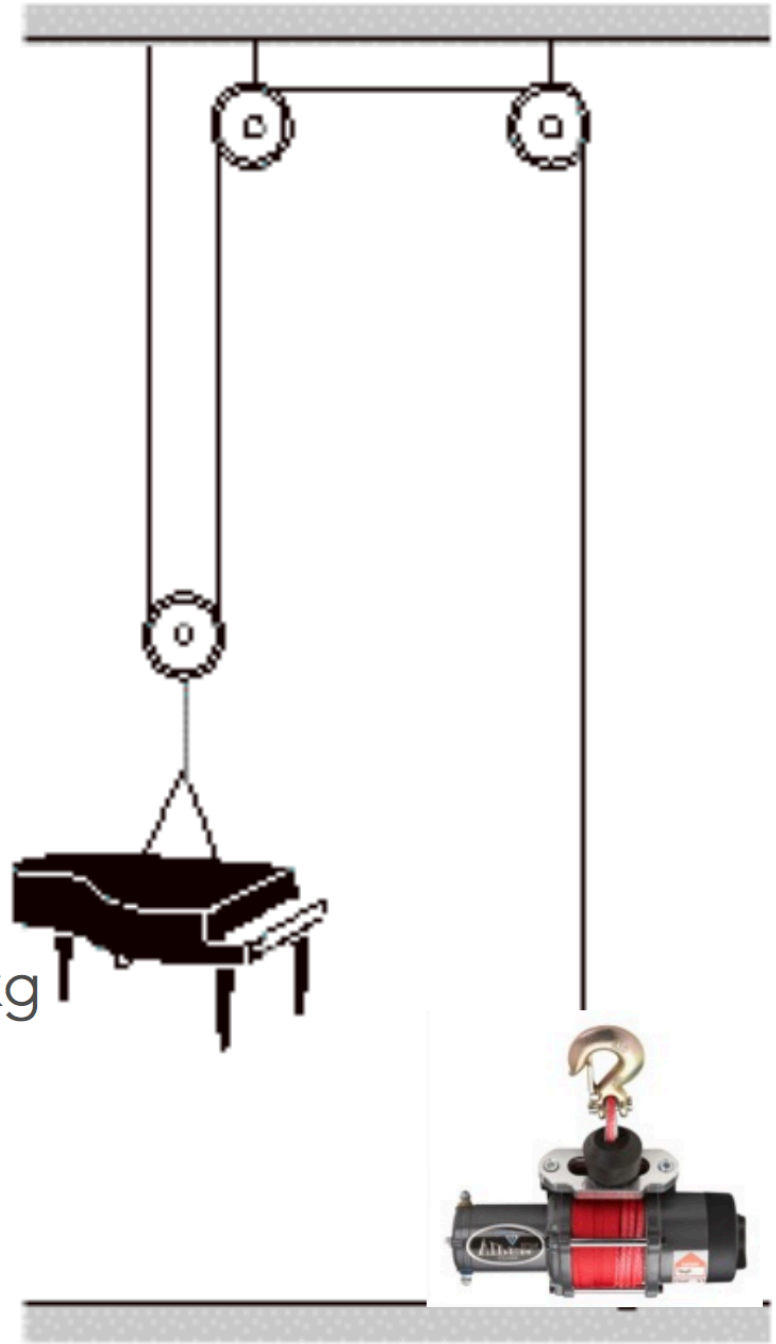
# POWER

How long will it take a 1750 W motor to lift a 285-kg piano to a 6th story window 16.0 m above?

$P = W/t$, $t = W/P$

W done against gravity = 285kg x 9.8 $m/s^2$ x 16.0 m = 44688 J

t = 44688J/ 1750 W = 25.6 s



# POWER

Cars have to do work to overcome the force of friction, air resistance, climb hills, and accelerate

Write power in terms of net force applied to an object and its *average* speed $v$

$P = W/t = Fd/t = Fv$

# POWER

Retarding forces, such as internal friction and air resistance, are typically 400 -1000 N

Calculate the power required of a 1400-kg car assuming a total retarding force of $F_R = 700N$ as the car climbs a 10 degree hill at a steady 800 kph (22.2 m/s).

Fr = 700N + 1400 * 9.8 * sin 10 = 3082 N * 22.2 m/s = 68430 W = 6.4 * 10^4 W