Power & Efficiency

Thursday, April 11, 2013
9:40 AM

Power: the rate at which energy or work is used

$$\text{Power} = \frac{\text{work}}{t} = \frac{\Delta E}{t} \Rightarrow E = P \cdot t$$

$$1 \text{ watt} = 1 \text{ J/s}$$

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

Ex A 1400 W microwave is used for 3 hours/day. How much energy is used in 30 days.

$$E = P \cdot t$$

$$= (1400 \text{ W})\left(30 \text{ days} \cdot 3 \frac{\text{hours}}{\text{day}} \cdot \frac{3600 \text{ s}}{\text{hour}}\right)$$

$$= 453600000 \text{ J}$$

$$E = (1.4 \text{ kW})(90 \text{ H})$$

$$= 126 \text{ kW} \cdot \text{H}$$

Efficiency: the % at which a device converts input energy into desired/useful output energy

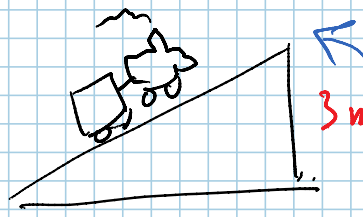
$$\text{Eff} = \frac{\text{useful (desired) output energy/power}}{\text{input energy/power}} \times 100\%$$

ex: An electric motor is 82% efficient. What energy is required if the motor lifts a 25kg object 4m?

$$.82 = \frac{(25kg)(9.8)(4m)}{input}$$

$$input = \frac{980\,J}{.82} = 1200\,J$$

ex: A mini locomotive engine of mass 120kg is able to pull a 230kg car up a hill of 3.0 high in 5.0s. If the engine produces a total power of 7440W, what is the efficiency?



$$eff: \frac{output}{input} = \frac{10300\,J}{37200\,J} \times 100\% = 28\%$$

$E_p = mgh$
$= (350)(9.8)(3m)$
$= 10300\,J$

$E = P \cdot t$
$= (7440W)(5.0s)$
$= 37200J$

WEP A Quick Revi...

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PHYSICS 12

NAME: _____

Work, Energy, Power: A Quick Review

1. A 10 kg block initially at rest is pulled 13 m across a floor by a 50 N force.

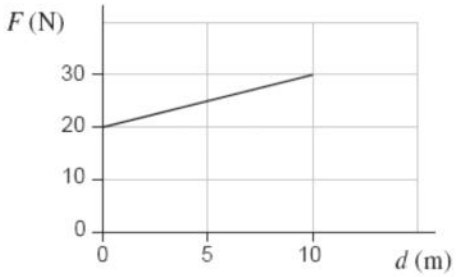
If friction does 380 J of work over this distance, what is the block's final velocity?

A. 7.3 m/s
B. 8.7 m/s
C. 11 m/s
D. 14 m/s

2. An electric motor outputs 1500 W of power in pulling a 70 kg crate of fish up a very slippery loading ramp at a constant speed. The ramp is inclined 31° to the horizontal. Determine the speed of the crate. (Ignore friction.)

A. 1.9 m/s
B. 2.1 m/s
C. 2.6 m/s
D. 4.2 m/s

3. The graph below shows the force exerted by a rope in lifting a 2.0 kg mass a vertical distance of 10 m from the ground.



What is the final speed of the box at 10 m?

A. 7.3 m/s
B. 10 m/s
C. 16 m/s
D. 21 m/s

4. A 0.030 kg toy car is pushed back against a spring-based launcher as shown in Diagram 1.

Diagram 1

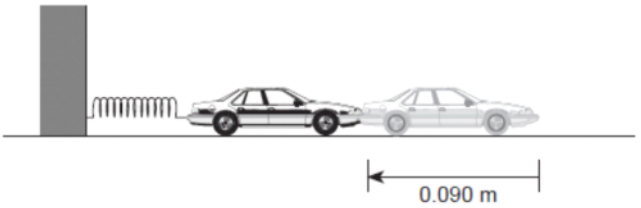
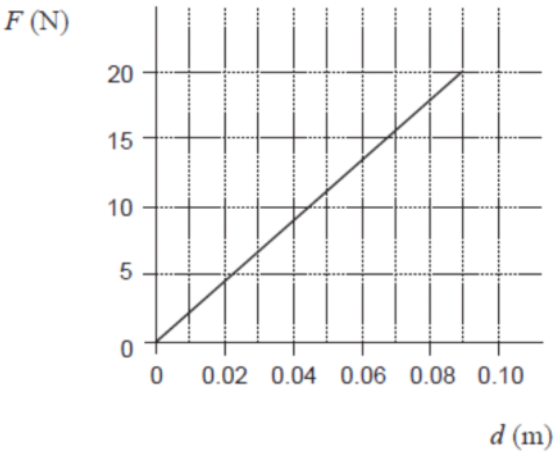


Diagram 2 shows a graph of the force required to compress the spring 0.090 m.

Diagram 2



a) What is the work done in compressing the spring?

b) Assuming no losses due to heat, what maximum speed is reached by the toy car when it is released?