Unit 7: Work, Energy and Power

5 – Power

Power is the rate of doing Work

Power is measured in J/s or Watts (W)

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

Ex. Lover's Leap is a 122 m vertical climb. The record time of 4 min 25 s was achieved by Dan Osman (65 kg). What was his average power output during the climb?

$P = \frac{W}{t} = \frac{\Delta E_p}{t} = \frac{mg\Delta h}{t} = \frac{(65\,kg)(9.8\,m/s^2)(122\,m)}{265\,s}$

$= 290\,W$

since he is climbing $W = \Delta E_p$

$4\,min\ 25\,s = 4(60) + 25 = 265\,s$

Ex. A 1.00×10^3 kg car accelerates from rest to a velocity of 15.0 m/s in 4.00 s. Calculate the power output of the car. Ignore friction.

$P = \frac{W}{t} = \frac{\Delta E_K}{t} = \frac{\frac{1}{2}mv_f^2}{t} = \frac{\frac{1}{2}(1.00\times10^3\,kg)(15.0\,m/s)^2}{4.00\,s}$

$= 28100\,W$

car is speeding up ∴ gain in E_K

Another useful formula:

Since, $P = \frac{W}{t} = \frac{Fd}{t}$

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

Therefore:

$$P = Fv$$

Ex. A student uses 140 N to push a block up a ramp at a constant velocity of 2.2 m/s. What is their power output?

$P = Fv = (140\,N)(2.2\,m/s)$

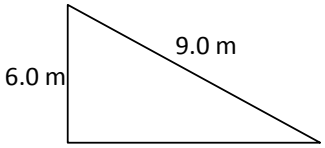
$= 310\,W$

Note that this formula is only useful when...

velocity is constant

Power Worksheet

1) A 45.0 kg student runs at a constant velocity up the incline shown. If the power output of the student is 1.50×10^3 W, how long does it take the student to run the 9.0 m along the incline?



2) A 20.0 kg object is lifted vertically 2.50 m in 2.00 s at a constant velocity. Calculate the power output of the student.

3) A 2.00 kg object is accelerated uniformly from rest to 3.00 m/s while moving 1.5 m across a level frictionless surface. Calculate the power output.

4) An 8.5×10^2 kg elevator is pulled up 32.0 m at a constant velocity of 1.40 m/s. Calculate the power output of the motor.

1) 1.8 s 2) 245 W 3) 9.0 W 4) 12000 W