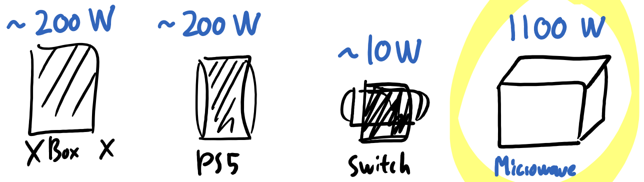
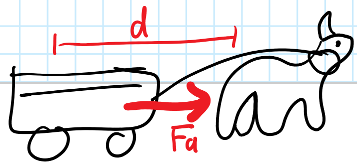




1 hp horse power = 745.7 Watt.

Hot
$0.5/pc
100W

$1/pc
CLF
30 W

$4 - $40
LED
10 W

Unit 4: Work, Energy and Power

5 – Power

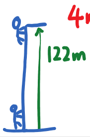
ΔEp / ΔEk / both

Power is the **rate** (per sec) of doing **work** (J)

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

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

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?



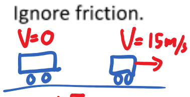
4 min = 240 sec, +25

t = 265 sec

$$P = \frac{\Delta E_p}{t} = \frac{mg\Delta h}{t}$$

$$P = \frac{65(9.8)(122m)}{265\ sec} = 293\ W$$

Ex. A 1.00x10[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.



$$P = \frac{\Delta E_k}{t} = \frac{\frac{1}{2}mv^2}{t} = \frac{\frac{1}{2}(1000)(15)^2}{4s} = 28125\ W$$

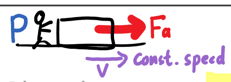
= 38 hp

Another useful formula: W = Fd

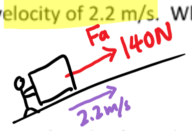
Since, $P = \frac{W}{t} = \frac{Fd}{t} = F \cdot v$

and,

Therefore: $P = F_a \cdot v$ (constant)



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?



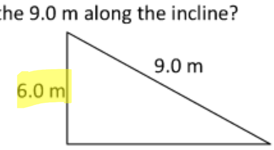
$P = F_a \cdot v = 140 \times 2.2$

$P = 308\ W$

Note that this formula is only useful when... constant speed.

Power Worksheet 4.5

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 x 10[3] W, how long does it take the student to run the 9.0 m along the incline?



$\Delta E_p = mgh$

$\Delta E_p = 45(9.8)6$

$\Delta E_p = 2646\ J$

$P = \frac{\Delta E_p}{t}$ $1500 = \frac{2646}{t}$ $t = 1.764\ sec$

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.

$V = \frac{d}{t} = \frac{2.5}{2} = 1.25\ m/s$

$mg = 20(9.8) = 196\ N$

$P = F_a \times V$

$P = 196N(1.25) = 245\ N$

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

$V_i = 0$, $V_f = 3$, $d = 1.5$, $a = ?$, $t = ?$

$V_f^2 = V_i^2 + 2ad$

$3^2 = 0 + 2a(1.5)$

$a = 3\ m/s^2$

$V_f = V_i + at$

$3 = 0 + 3(t)$

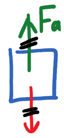
$t = 1\ sec$

$\Delta E_k = E_{kf} - E_{ki}$ (Ø)

$\Delta E_k = \frac{1}{2}mV_f^2 = \frac{1}{2}(2)(3)^2 = 9$

$P = \frac{\Delta E_k}{t} = \frac{9J}{1\ sec} = 9\ Watt.$

4) An 8.5 x 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.



$F_a = 8330N$

$P = F \cdot V = 8330(1.4)$

$P = 11662\ W$

$F_g = mg = 850(9.8) = 8330N$

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