Scalar or Dot Product

→ Multiply 2 vectors to get a scalar quantity.

$$\vec{A} \cdot \vec{B} = AB \cos\theta$$

Bold = Vector — Magnitudes ↓ Normal — Angle between

$$\vec{A} = (A_x i + A_y j + A_z k)$$

$$\vec{B} = (B_x i + B_y j + B_z k)$$

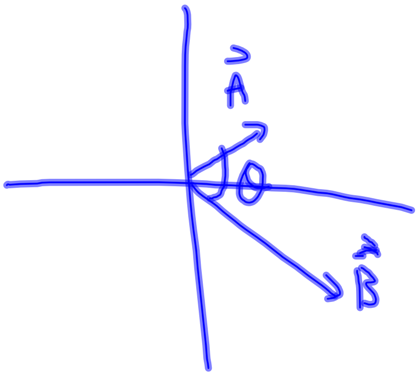
$$\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$$

Since we can treat each comp. as an ind. vector and then the $\theta = 0$

ex 6-6

$\vec{A} = (3.00\hat{i} + 2.00\hat{j})$ $A = \sqrt{9+4} = \sqrt{13}$

$\vec{B} = (4.00\hat{i} - 3.00\hat{j})$ $B = \sqrt{16+9} = 5$



$\vec{A}\cdot\vec{B} = 12 - 6$
$= 6$

$\vec{A}\cdot\vec{B} = AB\cos\theta = 6 = 5\sqrt{13}\cos\theta$

$\frac{}{5\sqrt{13}}$

$\cos^{-1}\frac{6}{5\sqrt{13}} = \theta$

$70.56°$

A_B = Component of A in Direction of B

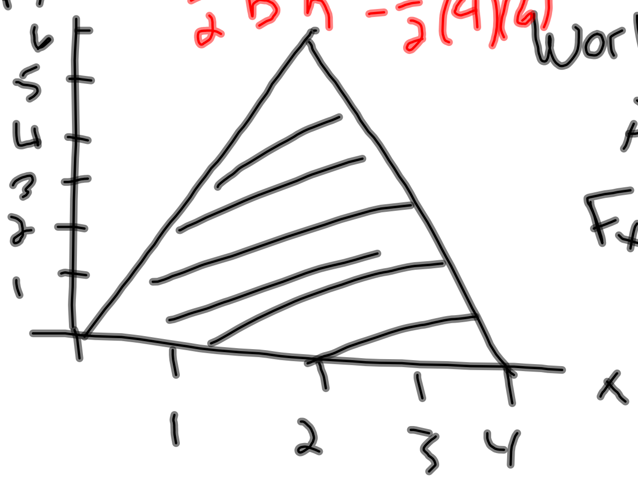
$\vec{A}\cdot\hat{B}$

unit vector in direction of B

$= \frac{\vec{B}}{B}$

$A_B = \frac{\vec{A}\cdot\vec{B}}{B} = \frac{6}{5}$ m

#27



$\frac{1}{2}bh = \frac{1}{2}(4)(6)$

Work = Area under F_x vs x curve

x axis →

$m = 3kg$

$V_0 = +2 m/s$

a) KE @ x=0 $= \frac{1}{2}(3kg)(2 m/s)^2$
$= 6J$

$W = F\Delta X$

$W = \Delta KE$

b) W from x=0 to x=4

$W = \frac{1}{2}(6)(4) = 12J$

c) V @ x=4m

$12J = KE_f - KE_i$

$12J = KE_f - 6J$

$18J = KE_f = \frac{1}{2}(3)v^2$

$12 = v^2$

$V_f = \sqrt{12}\ m/s$

Last note on dot product

$$W = \int_1^2 \vec{F} \cdot d\vec{l}$$

$d\vec{l}$, $\Delta\vec{r}$ } displacement

Power

$$\text{Power} = \frac{\text{Amount of work (in or out)}}{\text{time}}$$

$$= \frac{\Delta W}{\Delta t} = \frac{dw}{dt} = \frac{J}{s} \text{ or } \frac{N \cdot m}{s}$$

$W = F \Delta x$

$V = \frac{\Delta \vec{r}}{\Delta t}$ or $\Delta \vec{x}$

$$= \frac{F \Delta x}{\Delta t} = \vec{F} \cdot \vec{v} = W$$

$\text{Work} = \bar{W}$

$\frac{\text{foot} \cdot \text{pound}}{\text{sec}}$, 1 Horse Power $= \text{h.p.}$

$= 550 \frac{\text{ft} \cdot \text{lb}}{s}$

$\approx 746\, W$

Power Company = kWh

= Energy $\approx$ kJ : 1 kWh = 3600 kJ

Ex 6-10

Brick $F_w = F_g = 500\,N$

$\Delta y = 10\,m$

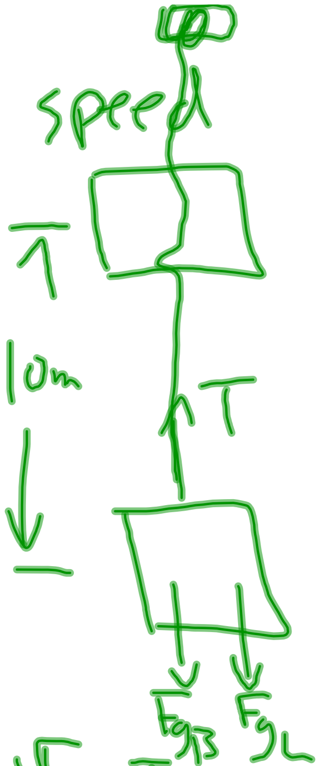
$\Delta t = 20\,s$

Lift $F_w = 300\,N$

Constant speed
$= a = 0$

$P = ?$

$t = 20\,s$



$$P = \frac{W}{t} = \frac{F\Delta x}{t}$$

$$= \frac{800\,N(10\,m)}{20}$$

$$= 400\,W$$

$F_{g_B} + F_{g_L} - T = 0$

$T = 500 + 300$

$800\,N$

Ex 6-11

If $P_{net} = \Delta KE$?

$$\text{Power} = \frac{\Delta W}{\Delta t}$$

$$\frac{\Delta W}{\Delta t}$$

$$\frac{F_{net} \Delta x}{\Delta t}$$

$$\vec{F}_{net} \cdot \vec{v}$$

$$m \vec{a}_{net} \cdot \vec{v}$$

$$m \left(\frac{1}{2} \frac{dv^2}{dt} \right)$$

$$m \cdot \frac{1}{2} \cdot \Delta V^2$$

$$m \cdot \frac{1}{2} (v_f^2 - v_i^2)$$

$$= \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

$$= \Delta KE$$

Show $\vec{a} \cdot \vec{r} = \frac{1}{2} \frac{d(r^2)}{dt}$

$$\frac{d\vec{v}}{dt} \cdot \vec{v} = \frac{1}{2} \frac{d(\vec{v} \cdot \vec{v})}{dt}$$

$$= \frac{1}{2} v \frac{d\bar{v}}{dt} + \frac{1}{2} v \cdot \frac{d\vec{v}}{dt}$$

$$= \frac{1}{2} v \cdot a + \frac{1}{2} va$$

$$= \vec{v} \cdot \vec{a}$$

Practice Prob. 6-8

$t = 2t$

$\text{Power}_2 = \frac{1}{2} P_1$

Gravity $F_g = -T$

$\text{Work} = -W_1$

Work-Power Problems.

#48 $F_A \Rightarrow 5J$ work in 10s.

$F_B \Rightarrow 3J$ work in 5s

P greater?

$P_A = \frac{5J}{10s} = .5W$

$P_B = \frac{3J}{5s} = .6W$

49. $F = 5\,N$ in $+x$ dir

$F = ma$ $m = 8\,kg$ @ $x = 0$

$\frac{5N}{8} = \frac{8a}{8}$ $P(t) = ?$ $v_0 = 0$

$P = \frac{W}{t} = \frac{F\Delta x}{\Delta t} = \vec{F} \cdot \vec{v} = FV$ since $+$ xdir $\theta = 0$

$v_f = v_i^{\nearrow 0} + at$ $= F(a)t$

$v_f^2 = v_i^2 + 2a\Delta x$ $= 5 \cdot \frac{5}{8} t = \frac{25}{8} t = P(t)$

$\Delta x = v_i t + \frac{1}{2}at^2$

b) $t = 3$ $P = \frac{75}{8}\,W$