HW → Matter and Interactions

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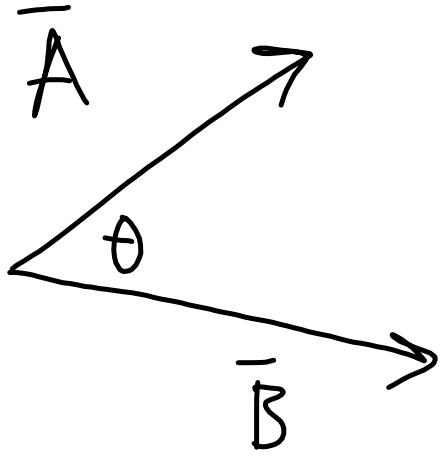
19, 23, 25, 29, 33

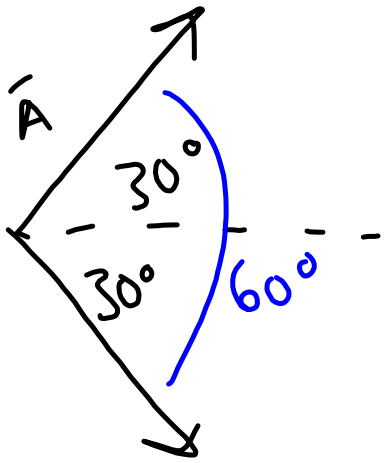
Work

- $W = F \Delta x$
- $W = \int \bar{F} \cdot d\bar{r}$

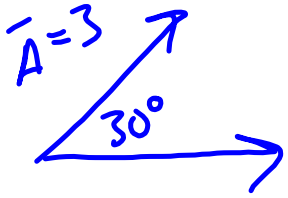
Dot Product (Scalar Product)



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

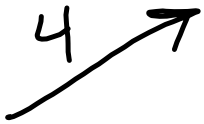


4)



$$\bar{A} \cdot \bar{B} = |A||B| \cos\theta$$
$$= |3||4| \cos(30^\circ) = 10.4$$

Notation for vectors:

- Graphically: 
- "Gator" notation $\langle x, y, z \rangle$
  Set (?)
  head at $(\varnothing, \varnothing, \varnothing)$
  tail at point above
- ijk notation $x\hat{i} + y\hat{j} + z\hat{k}$
  $\hat{i}$-hat
  unit vector in x-direction

Dot Products in different notations

- $\langle A_x, A_y, A_z \rangle \cdot \langle B_x, B_y, B_z \rangle =$

$$A_x B_x + A_y B_y + A_z B_z$$

- $\left(A_x \hat{i} + A_y \hat{j} + A_z \hat{k}\right) \cdot \left(B_x \hat{i} + B_y \hat{j} + B_z \hat{k}\right) =$

$$A_x B_x + A_y B_y + A_z B_z$$

$\hat{i} \cdot \hat{i} = |1||1| \cos 0° = 1$

$\hat{j} \cdot \hat{j} = 1$

$\hat{k} \cdot \hat{k} = 1$

$\hat{i} \cdot \hat{j} = |1||1| \cos(90°) = 0$

5) $\bar{A} = 3\hat{i} + 3\hat{j}$

$\bar{B} = 4\hat{i} - \hat{j}$

$\bar{A} \cdot \bar{B} = (3)(4) + (3)(-1)$

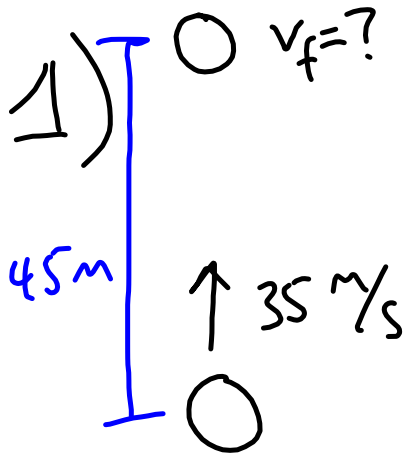
$= 9$

Work, again → Work-Energy Theorem

$$E_i + W_{in} = W_{out} + E_f$$

$$W = \Delta E$$ Work-energy theorem

$$\int \vec{F} \cdot d\vec{r} = E_f - E_i$$ relates forces and energy



$$W = \Delta E$$

$$F_g \cdot \Delta x = K_f - K_i$$

$$F_g \Delta x \cos(180°) = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

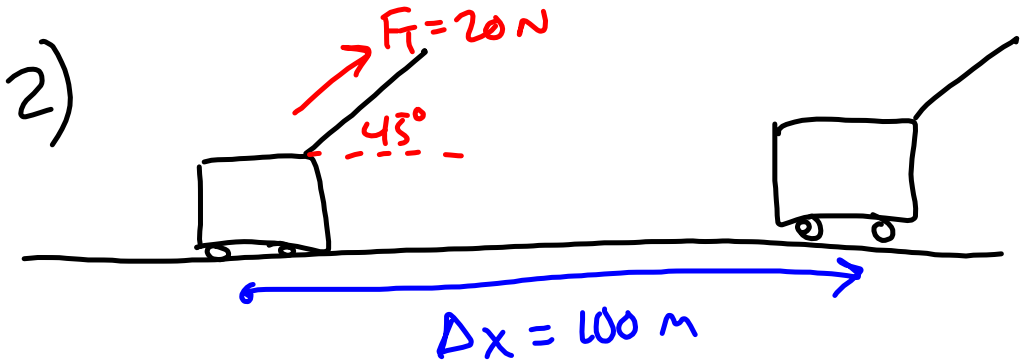
* Earth is NOT in system, so no U_g

$$\frac{1}{2}\cancel{m}v_f^2 = -\cancel{m}a_g\Delta x + \frac{1}{2}\cancel{m}v_i^2$$

$$v_f = \sqrt{2\left(-a_g\Delta x + \frac{1}{2}v_i^2\right)}$$

$$= 18 \text{ m/s}$$

2)



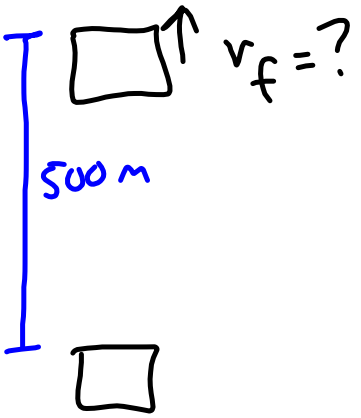
$$W_T = \vec{F}_T \cdot \Delta\vec{x}$$

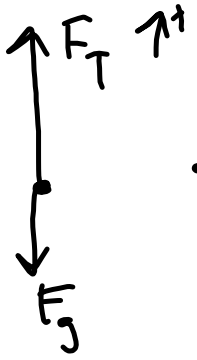
$$= |F_T|\,|\Delta x| \cos(45°)$$

$$= |20\,N|\,|100\,m| \cos(45°)$$

$$= 1400\,J$$

3)





$$\Sigma F = F_T - F_g$$

$$W_{total} = \Delta E = K_f - K_i \quad (K_i \to 0)$$

$$|F_T - F_g||\Delta x|\cos(0^\circ) = \frac{1}{2}mv_f^2$$

$$v_f = 130\ m/s$$

Types of Forces

- Conservative → gravitational, electric, magnetic, spring

When just conservative forces present, we can use conservation of energy

- Non-conservative forces → friction, drag

HAVE to use work-energy theorem