The work-energy theorem, part 2

Units for energy

- The SI unit of energy is the Joule (J).

$$1 \text{ Joule } = 1 \text{ Newton } \cdot \text{meter}$$

- A common unit of energy in chemistry is the calorie (cal).

$$1 \text{ calorie } = 4.184 \text{ J}$$

- A common unit of energy in food science is the Calorie = 1 kcal

$$1 \text{ Calorie } = 4184 \text{ J}$$

The work-energy theorem

- This statement is similar to Newton's 2nd law of motion:

$$K_f - K_i = W_{tot}$$

$$K = \frac{1}{2}mv^2$$

$$W_{tot} = W_1 + W_2 + \ldots$$

$$W_1 = \vec{F}_1 \cdot \Delta\vec{r}$$

The falling apple

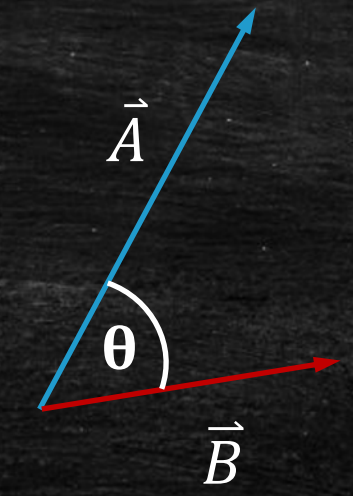
- What work is done by gravity on an apple (m=0.2 kg) that falls from a branch of a tree at a height of 2.6 meters above the ground?

A review of the dot product

- We can multiply two vectors with the dot product to get a scalar (a number).
- There are two ways that we can express the dot product:

$$\vec{A} \cdot \vec{B} = \left|\vec{A}\right|\left|\vec{B}\right| \cos(\theta)$$

$$= A_x B_x + A_y B_y$$



- Which one of these equations is most useful depends on what information you are given.

A biker goes up a slope at constant velocity

- Question 1: what is the correct FBD for bike & rider if they are going up the slope at constant velocity?

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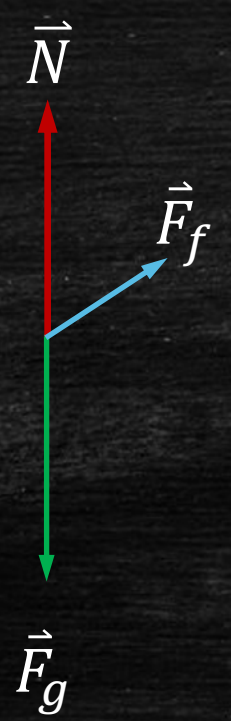
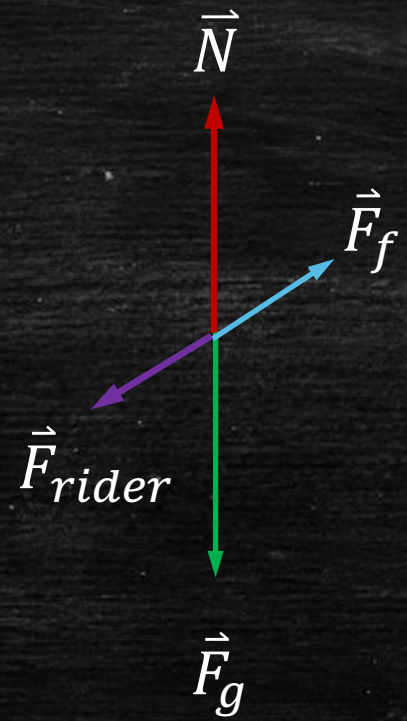
(a)



(b)



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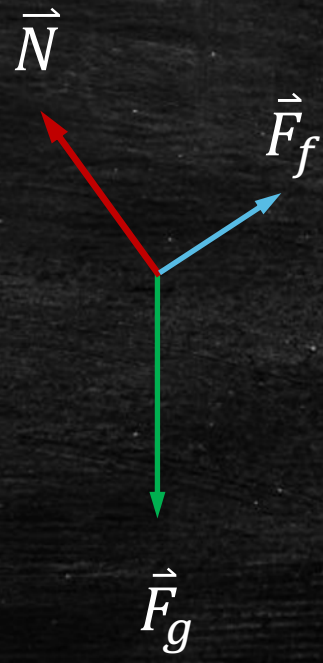

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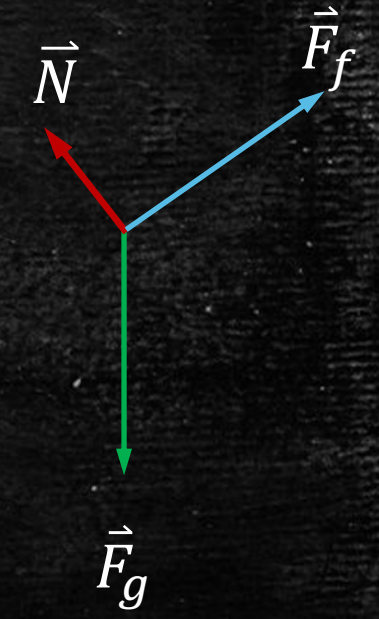

A biker goes up a slope at constant velocity

- Question 2: What is $\vec{F}_g \cdot \vec{d}$ for this case?

(a) $-mgd\cos(\alpha)$

(b) $+mgd\cos(\alpha)$

(c) $-mgd\sin(\alpha)$

(d) $+mgd\sin(\alpha)$

A woman pulls a crate at an angle θ above the horizontal

- What is the work done as she pulls the crate a distance d across the floor with force F at angle **θ**?