

## Energy Problems – Set 1

1

For each vector pair below, sketch the pair and calculate  $\vec{A} \cdot \vec{B}$ .

a.  $\vec{A} = 3\hat{i} + 6\hat{j}$

$$\vec{B} = -4\hat{i} + 2\hat{j}$$

b.  $|\vec{A}| = 2\sqrt{10}, \theta = -71.6^\circ$

$$\vec{B} = -3\hat{i} + 1\hat{j}$$

c.  $\vec{A} = -5\hat{i} + 2\hat{j}$

$$\vec{B} = -3\hat{i} + 1\hat{j}$$

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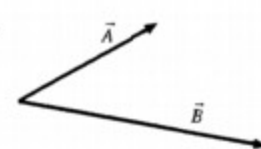

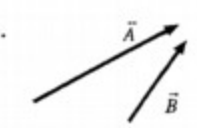
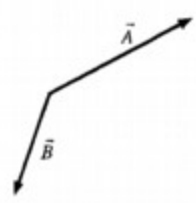
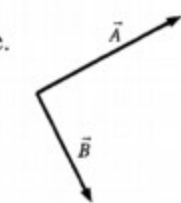
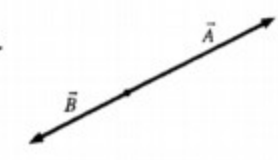
2

For each vector pair in the previous question, use your calculated dot product to find the angle  $\theta$  between  $\vec{A}$  and  $\vec{B}$ .




3. Which pairs of vectors are orthogonal? What is the dot product of the orthogonal pairs?

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For each pair of vectors below, is the sign of  $\vec{A} \cdot \vec{B}$  positive, negative or zero?

a.  Sign = _____	b.  Sign = _____	c.  Sign = _____
d.  Sign = _____	e.  Sign = _____	f.  Sign = _____

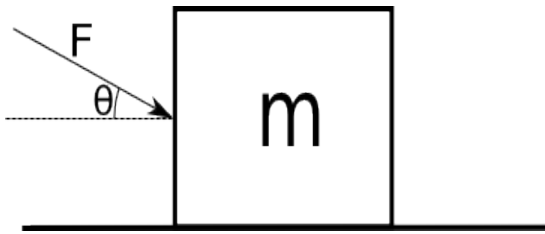
Each of the diagrams below shows a vector  $\vec{A}$ . Draw and label a vector  $\vec{B}$  that will cause  $\vec{A} \cdot \vec{B}$  to have the indicated sign.

a.  $\vec{A} \cdot \vec{B} > 0$	b.  $\vec{A} \cdot \vec{B} < 0$	c.  $\vec{A} \cdot \vec{B} = 0$
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A box with mass  $m$ , initially at rest, is pushed a distance  $d$  along a surface with a force  $F$  making an angle  $\theta$  with the horizontal. The coefficient of friction between the box and the surface is  $\mu_k$ .



- Draw a free body diagram of the box.
- Calculate the work done by each force.

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For each situation described below:

- a) Draw a free body diagram.
- b) Make a table next to each free body diagram showing each force and whether the work is positive, negative, or zero

1. An elevator being pulled upward by a cable.

2. The same elevator on the trip down.

3. A mover pushing a box across a rough floor.

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4. A ball thrown straight up. Consider the ball from the point just after it leaves your hand until the highest point in its trajectory.

5. A mass on a string swings one revolution in a circle on a horizontal, frictionless table at a constant speed.

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A skier of mass  $m$  skis a distance  $L$  down a frictionless hill that has a constant angle of inclination  $\theta$ . The top of the hill is a vertical distance  $h$  above the bottom of the hill.

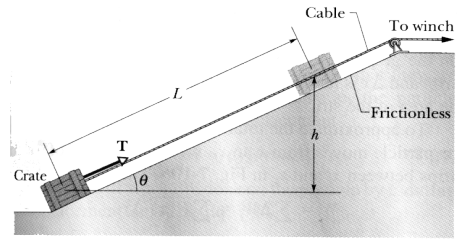
- a. Use the integral form of the definition of work to find an expression for the work done on the skier by each of the forces involved.
- b. Find an expression for the **total** work,  $W_{net}$ , done on the skier. Your expression should be in terms of  $m$ ,  $g$ , and  $h$  only.

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An initially stationary crate of mass  $m$  is pulled a distance  $L$  up a frictionless ramp to a height  $h$  where it stops.

Find an expression for the work  $W_g$  done on the crate by gravity during the lift in terms of  $m$ ,  $h$ , and  $g$ .

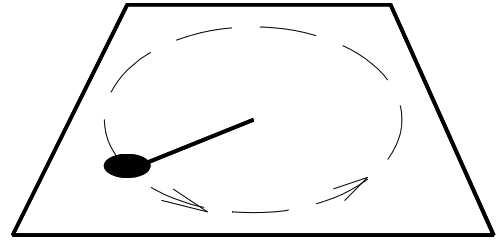




## Energy Problems – Set 1

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A particle of mass  $m$  moves in a horizontal circle of radius  $R$  on a rough table. It is attached to a string fixed at the center of the circle. The coefficient of friction between the mass and the table is  $\mu_k$ .



- Draw a free body diagram of the puck.
- Calculate the work done by each force after one revolution.
- Calculate the net work done after one revolution.