6.2 Dot Product of Vectors (continued)

Target 8D: Apply properties of vectors to real life situations

Review of Prior Concepts

1. Given $\vec{u} = \langle 5,2 \rangle$ and $\vec{v} = \langle -4,3 \rangle$, find the angle between the two vectors.

$\cos\theta = \frac{5(-4)+2(3)}{(\sqrt{29})(5)}$

$\cos\theta = \frac{-14}{5\sqrt{29}}$

$\theta = \cos^{-1}\left(\frac{-14}{5\sqrt{29}}\right)$

$\theta \approx 121.329°$

$|\vec{u}| = \sqrt{5^2+2^2} = \sqrt{29}$

$|\vec{v}| = \sqrt{(-4)^2+3^2} = 5$

2. Find the value of x that would make $\vec{u} = \langle 5,2 \rangle$ and $\vec{v} = \langle x, 3 \rangle$ orthogonal.

↳ $\vec{u} \cdot \vec{v} = 0$

$\vec{u} \cdot \vec{v} = 5(x) + 2(3)$

$0 = 5x + 6$

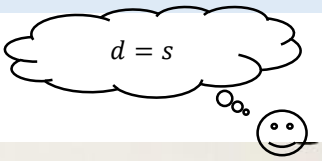
$-6 = 5x$

$-\frac{6}{5} = x$ or -1.2

Work

Work = Force · Distance

$W = F \cdot d$



Examples:

1. Abigail lifts a book that weighs 2 lbs (Force) from the floor onto a shelf that is 4 feet (distance) high. How much work did she do?

$W = F \cdot d$

$= (2 \text{ lbs})(4 \text{ ft})$

$W = 8 \text{ ft} \cdot \text{lbs}$

In science... F in Newtons, d in meters, ∴ W = Newton·meters = Joules

2. Juan is sitting on a desk. The combined weight of Juan and the desk is 155 pounds (Force). How much work must Oswaldo do to lift Juan and the desk 6 ft (distance) high?

$W = F \cdot d$

$= 155(6)$

$= 930 \text{ ft} \cdot \text{lbs}$

3. How much work must Karen do to life a 100 pound (Force) sack of potatoes 3 feet (distance)?

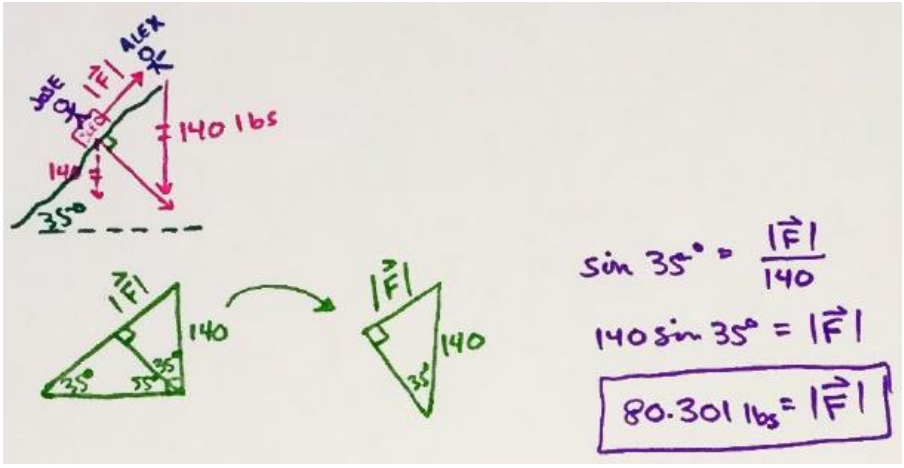
$W = F \cdot d$

$= 100 \cdot 3$

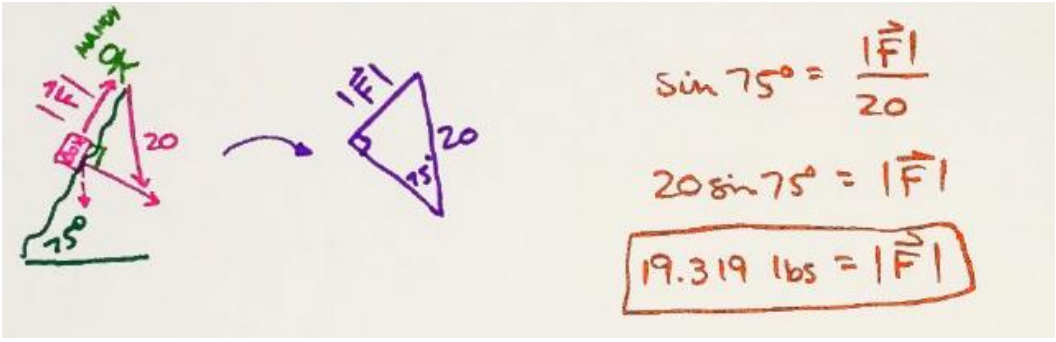
$= 300 \text{ ft} \cdot \text{lbs}$

Work & Force with Angular Direction Examples

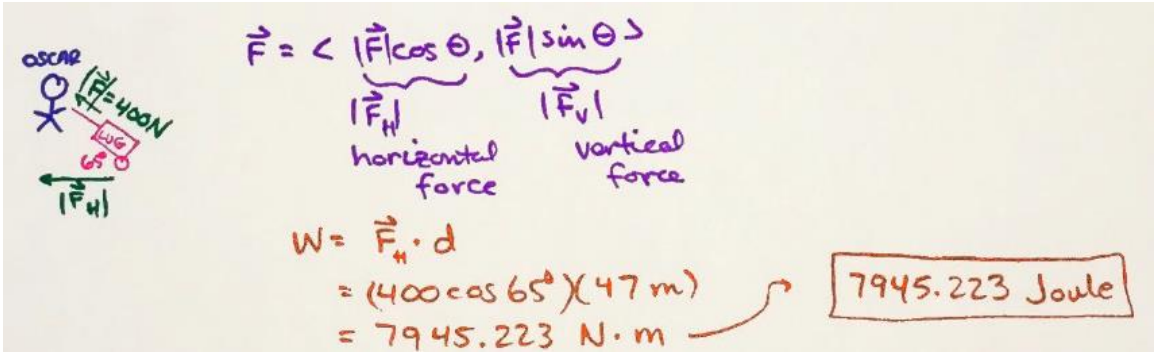
1. Jose is sitting on a sled on the side of a hill that is inclined at a 35° angle. Jose and the sled weigh 140 lbs. Alejandro needs to use what force to pull Jose up the hill?



2. Mandy is pulling a box up a hill that weighs 20 lbs. The hill is at a 75° angle. What force does she need to use?



3. Oscar is dragging his luggage through the airport at an angle of 65° with a force of 400N over a distance of 47m. How much work did he do?



4. Find the work done by a 10 pound force acting in the direction $\langle 1,2 \rangle$ in moving an object 3 feet from (0,0) to (3,0).

horizontal movement

$|\vec{F}| = 10 \text{ lb}$

$|\vec{F}_H| = |\vec{F}| \cos\theta$

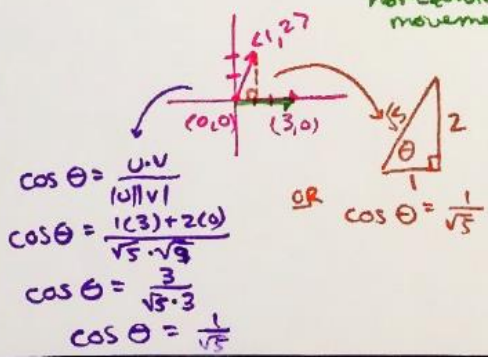
$= 10\left(\frac{1}{\sqrt{5}}\right)$

$|\vec{F}_H| = \frac{10}{\sqrt{5}}$

$W = |\vec{F}_H| \cdot d$

$= \frac{10}{\sqrt{5}} \cdot 3$

$= 13.416 \text{ ft} \cdot \text{lbs}$



More Practice

Work & Force

https://www.varsitytutors.com/hotmath/hotmath_help/topics/solving-problems-with-vectors
https://www.khanacademy.org/math/precalculus/vectors-precalc/applications-of-vectors/v/vector-component-in-direction
http://www.physicsclassroom.com/class/energy/Lesson-1/Calculating-the-Amount-of-Work-Done-by-Forces
https://www.mansfieldct.org/Schools/MMS/staff/hand/work=fxd.htm
http://www.uwgb.edu/fenclh/problems/energy/1/
https://youtu.be/WSY4HzWZIlo
https://youtu.be/tZOBPEwshb8
https://youtu.be/EKyWQKi76uo

Homework Assignment

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