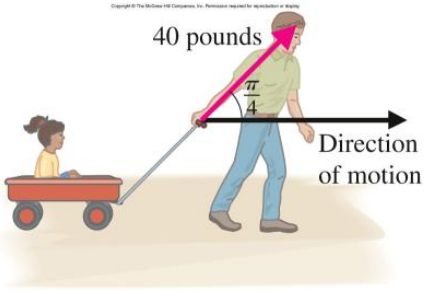
Name:_____

§11.3 Dot Products

1. You exert a constant force of 40lb in the direction of the handle of the wagon pictured in the figure. If the handle makes an angle of $\frac{\pi}{4}$ with the horizontal and you pull the wagon along a flat surface for 1 mi (5280 ft), find the work done.

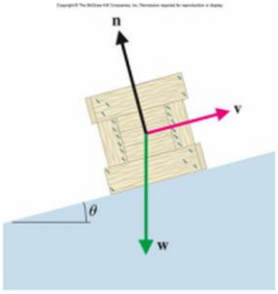


2. A constant force of $\langle 60, -30 \rangle$ lb moves an object in a straight line from the point $(0, 0)$ to the point $(10, -10)$. Compute the work done.

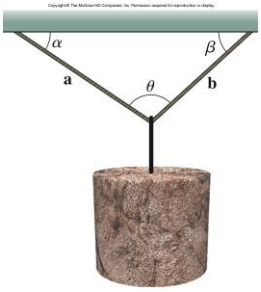
3. Parametric equations for one object are $x_1 = a\cos t$ and $y_1 = b\sin t$. The object travels along the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. The parametric equations for a second object are $x_2 = a\cos\left(t + \frac{\pi}{2}\right)$ and $y_2 = b\sin\left(t + \frac{\pi}{2}\right)$. This object travels along the same ellipse but is $\frac{\pi}{2}$ time units ahead. If $a = b$, use the trigonometric identity $\cos(u)\cos(v) + \sin(u)\sin(v) = \cos(u - v)$ to show that the position vectors of the two objects are orthogonal. Show also that if $a \neq b$, the position vectors are not orthogonal.

4. Show that the object with parametric equations $x_3 = b\cos\left(t + \frac{\pi}{2}\right)$ and $y_3 = a\sin\left(t + \frac{\pi}{2}\right)$ has position vector that is orthogonal to the first object of Exercise 3.

5. In the diagram, a crate of weight w lb is placed on a ramp inclined at angle θ above the horizontal. The vector $\mathbf{v}$ along the ramp is given by $\mathbf{v} = \langle \cos\theta, \sin\theta \rangle$ and the *normal vector* by $\mathbf{n} = \langle -\sin\theta, \cos\theta \rangle$. Show that $\mathbf{v}$ and $\mathbf{n}$ are perpendicular. Find the componend of $\mathbf{w} = \langle 0, -w \rangle$ along $\mathbf{v}$ and the component of $\mathbf{w}$ along $\mathbf{n}$.



6. A weight of 500, lb is supported by two ropes that exert forces of $\mathbf{a} = \langle -100, 200 \rangle$ lb and $\mathbf{b} = \langle 100, 300 \rangle$ lb. Find the angle θ between the ropes.



§11.4 Cross Products

7. Find the distance from the point $Q = (1, 3, 1)$ to the line through $(1, 3, -2)$ and $(1, 0, -2)$.

8. If you apply a force of magnitude 40 lb at the end of an 18 in-long wrench at an angle of $\frac{\pi}{3}$ to the wrench, find the magnitude of the torque applied to the bolt.

9. Find the area of the parallelogram with two adjacent sides formed by $\langle -2, 1\rangle$ and $\langle 1, -3\rangle$.

10. Find the area of the triangle with vertices $(0, 0, 0)$, $(0, -2, 1)$, and $(1, -3, 0)$.

11. Find the volume of the parallelepiped with three adjacent edges formed by $\langle 0, -1, 0\rangle$, $\langle 0, 2, -1\rangle$, and $\langle 1, 0, 2\rangle$.

12. Use the parallelepiped volume formula to determine whether the vectors are coplanar: $\langle 2, 3, 1\rangle$, $\langle 1, 0, 2\rangle$, and $\langle 0, 3, -3\rangle$.