

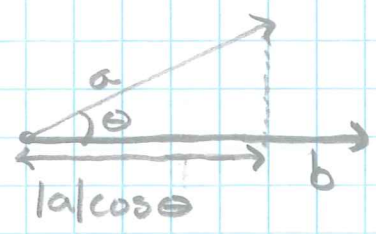
Section 9.2 Solutions p. 589; # 1-8, 11, 12, 16, 17, 21, 22, 25-27, 29, 30, 32, 33, 35, 36, 45, 47, 48, 50, 52

1)  $a \cdot b = a_1 a_2 + b_1 b_2$  scalar/real #

2)  $\cos \theta = \frac{u \cdot v}{|u||v|}$  perpendicular/orthogonal

3)a)  $|a| \cos \theta = \frac{a \cdot b}{|b|}$

3)b)  $\left( \frac{a \cdot b}{|b|^2} \right) b$



$\text{proj}_b a = \frac{a \cdot b}{|b|^2} b$

4)  $W = F \cdot D$

$|u| = \sqrt{2^2 + 0^2} = 2$   $|v| = \sqrt{1^2 + 1^2} = \sqrt{2}$

5) a)  $u \cdot v = 2 \cdot 1 + 0 \cdot 1 = 2$  b)  $\cos \theta = \frac{2}{2 \cdot \sqrt{2}} = \frac{1}{\sqrt{2}}$   $\cos^{-1}\left(\frac{1}{\sqrt{2}}\right) = 45^\circ$

6) a)  $u \cdot v = 1 \cdot -\sqrt{3} + \sqrt{3} \cdot 1 = 0$  b)  $|u| = \sqrt{1+3} = 2$   $|v| = \sqrt{3+1} = 2$   
 $\cos \theta = 0/4$   $\theta = 90^\circ$

7) a)  $u \cdot v = 2 \cdot 3 + 7 \cdot 1 = 13$  b)  $|u| = \sqrt{4+49} = \sqrt{53}$   
 $\cos \theta = \frac{13}{\sqrt{530}}$   $\theta = 55.6^\circ$   $|v| = \sqrt{9+1} = \sqrt{10}$

8) a)  $u \cdot v = -6 \cdot 1 + 6 \cdot -1 = -12$  b)  $|u| = \sqrt{36+36} = \sqrt{72} = 6\sqrt{2}$   
 $\cos \theta = \frac{-12}{6\sqrt{2} \cdot \sqrt{2}} = \frac{-12}{12} = -1$   $|v| = \sqrt{1+1} = \sqrt{2}$   
 $\theta = 180^\circ$

$$11) a) u \cdot v = 0 \cdot -1 + -5 \cdot -\sqrt{3} = 5\sqrt{3} \quad b) |u| = 5$$

$$\cos \theta = \frac{5\sqrt{3}}{10} = \frac{\sqrt{3}}{2} \quad |v| = \sqrt{1+3} = 2$$

$$\theta = 30^\circ$$

$$12) a) u \cdot v = 1 \cdot 1 + 1 \cdot -1 = 0 \quad b) |u| = \sqrt{1+1} = \sqrt{2}$$

$$\cos \theta = \frac{0}{2} = 0 \quad \theta = 90^\circ \quad |v| = \sqrt{1+1} = \sqrt{2}$$

$$16) u \cdot v = 0 \cdot 4 + -5 \cdot 0 = 0 \perp$$

$$17) u \cdot v = -2 \cdot 4 + 6 \cdot 2 = 4 \text{ not } \perp$$

$$19) u \cdot v = 2 \cdot -12 + -8 \cdot -3 = 0 \perp$$

$$21) u \cdot v + u \cdot w = 2 \cdot 1 + 1 \cdot -3 + 2 \cdot 3 + 1 \cdot 4 = -1 + 10 = 9$$

$$22) u \cdot (v+w) = \langle 2, 1 \rangle \cdot (1+3, -3+4) = \langle 2, 1 \rangle \cdot \langle 4, 1 \rangle$$

$$2 \cdot 4 + 1 \cdot 1 = 9$$

$$25) \text{comp}_v u = \frac{u \cdot v}{|v|} = \frac{4 \cdot 3 + 6 \cdot -4}{\sqrt{9+16}} = \frac{-12}{5} =$$

$$26) \text{comp}_v u = \frac{-3 \cdot \frac{1}{\sqrt{2}} + 5 \cdot \frac{1}{\sqrt{2}}}{\sqrt{\frac{1}{2} + \frac{1}{2}}} = \frac{2/\sqrt{2}}{1} = \frac{2}{\sqrt{2}} = \sqrt{2}$$

$$27) \text{comp}_v u = \frac{7 \cdot 0 + -24 \cdot 1}{\sqrt{0+1}} = \frac{-24}{1} = -24$$

$$29) a) \text{proj}_v u = \left( \frac{u \cdot v}{|v|^2} \right) v = \left( \frac{-2 \cdot 1 + 4 \cdot 1}{\sqrt{1+1}^2} \right) \langle 1, 1 \rangle = \left( \frac{2}{2} \right) \langle 1, 1 \rangle$$

$|\langle 1, 1 \rangle| = \sqrt{2}$

$$b) u_1 = \langle 1, 1 \rangle \quad u_2 = u - u_1 = \langle -2, 4 \rangle - \langle 1, 1 \rangle = \langle -3, 3 \rangle$$

$$30) a) \left( \frac{7 \cdot 2 + -4 \cdot 1}{\sqrt{4+1}^2} \right) \langle 2, 1 \rangle = \left( \frac{10}{5} \right) \langle 2, 1 \rangle = \langle 4, 2 \rangle$$

$$b) u_1 = \langle 4, 2 \rangle \quad u_2 = \langle 7, -4 \rangle - \langle 4, 2 \rangle = \langle 3, -6 \rangle$$

$$32) a) \left( \frac{11 \cdot -3 + 3 \cdot -2}{\sqrt{9+4}^2} \right) \langle -3, -2 \rangle = \frac{-39}{13} \langle -3, -2 \rangle = \langle 9, 6 \rangle$$

$$b) u_1 = \langle 9, 6 \rangle \quad u_2 = \langle 11, 3 \rangle - \langle 9, 6 \rangle = \langle 2, -3 \rangle$$

$$33) a) \left( \frac{2 \cdot -3 + 9 \cdot 4}{\sqrt{9+16}^2} \right) \langle -3, 4 \rangle = \left( \frac{30}{25} \right) \langle -3, 4 \rangle = \left( \frac{6}{5} \right) \langle -3, 4 \rangle$$

$$b) u_1 = \left\langle \frac{-18}{5}, \frac{24}{5} \right\rangle \quad u_2 = \langle 2, 9 \rangle - \left\langle \frac{-18}{5}, \frac{24}{5} \right\rangle = \left\langle \frac{28}{5}, \frac{21}{5} \right\rangle$$

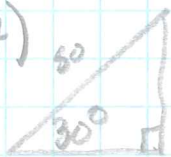
$$35) W = F \cdot D \quad D = \langle 3-0, 8-0 \rangle = \langle 3, 8 \rangle$$

$$= \langle 4, -5 \rangle \cdot \langle 3, 8 \rangle = 12 - 40 = -28$$

$$36) D = \begin{matrix} \langle 200+1, 1-1 \rangle \\ \langle 201, 0 \rangle \end{matrix} \quad W = 400 \cdot 201 + 50 \cdot 0 = 80,400$$

$$45) \langle 4, -7 \rangle \cdot \langle 4, 0 \rangle = 16 + 0 = 16 \text{ ft pounds}$$

$$47) \begin{matrix} 50 \\ \text{ } \\ 30^\circ \end{matrix} \quad x = 50 \cos 30^\circ = 25\sqrt{3}$$



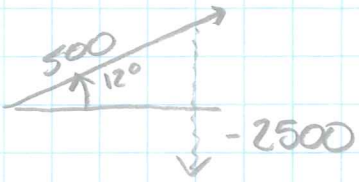
$$y = 50 \sin 30^\circ = 25$$

$$\langle 25\sqrt{3}, 25 \rangle \cdot \langle 200, 0 \rangle$$

$$= 5000\sqrt{3} \text{ ft pounds}$$

$$= 8660.25 \text{ ft pounds}$$

46)

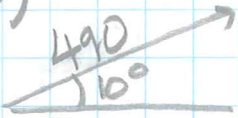


$$x = 500 \cos 120^\circ = 489.1$$

$$y = 500 \sin 120^\circ = 104.0$$

$$\langle 489.1, 104 \rangle \cdot \langle 0, -2500 \rangle = 259, 889.6 \text{ ft pounds}$$

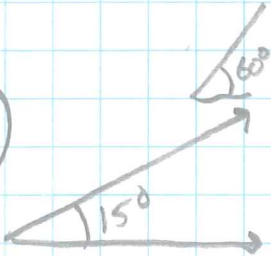
\* 50)



$$x = 490 \cos 10^\circ = 482.6$$

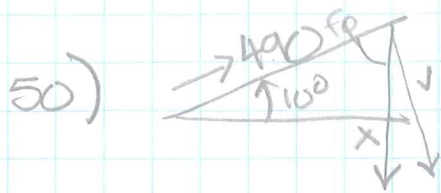
$$y = 490 \sin 10^\circ = 85.1$$

\* 52)



$$x = 40 \cos 15^\circ = 38.6$$

$$y = 40 \sin 15^\circ = 10.4$$

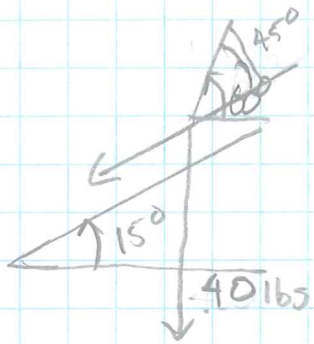


$$|U| = 490 = x \cos 10^\circ$$

$$\frac{490}{\cos 10^\circ} = x = 2821.8 \text{ lbs is car}$$

$$|U| = 2821.8 \cos 10^\circ = 2778.9 \text{ ft/pounds}$$

52)



$$|U| = 40 \cos 75^\circ = 10.35$$

Force needed to hold cart  
in place



14.4 lbs

not yet

= 54.6 lbs