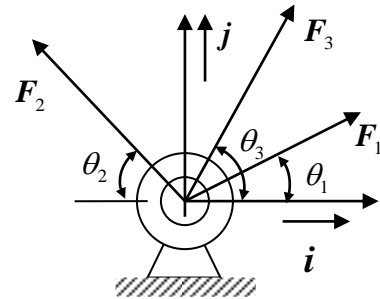


## ENGR 1990 Engineering Mathematics

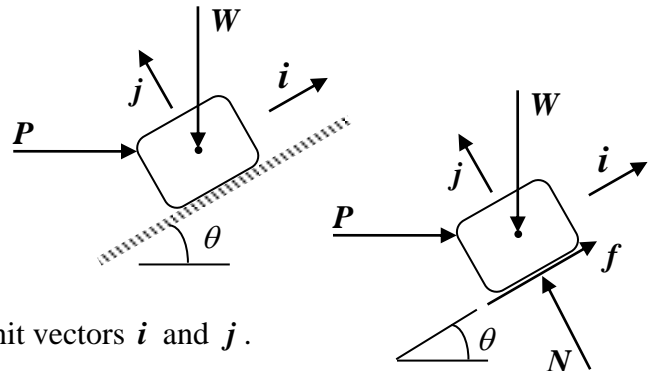
### Homework #4 – Two Dimensional (2D) Vectors

1. A force  $F$  has a magnitude  $|F|=250$  (lb) and makes an angle  $\theta=135$  (deg) with the  $X$  axis. Express the force  $F$  in terms of the unit vectors  $i$  and  $j$ .
2. A force  $F$  has a magnitude  $|F|=100$  (lb) and makes an angle  $\theta=55$  (deg) with the  $X$  axis. Express the force  $F$  in terms of the unit vectors  $i$  and  $j$ .
3. A force  $F = -50i - 150j$  (lbs). Find the magnitude of  $F$  and the angle between it and the  $i$  direction. Express the angle in both degrees and radians.
4. A force  $F = 80i - 100j$  (lbs). Find the magnitude of  $F$  and the angle between it and the  $i$  direction. Express the angle in both degrees and radians.
5. Given the three forces and angles  $|F_1|=50$  (lbs),  $\theta_1 = 20$  (deg),  $|F_2|=100$  (lbs),  $\theta_2 = 30$  (deg), and  $|F_3|=75$  (lbs),  $\theta_3 = 70$  (deg), find (a) the total force  $F$  in terms of the unit vectors  $i$  and  $j$ , (b) the magnitude of  $F$ , (c) the angle that  $F$  makes with the  $i$  direction, and (d) a unit vector in the direction of  $F$ .



6. Given a force  $F = 150i - 80j$  (lbs) and a unit vector  $n = \frac{4}{5}i + \frac{3}{5}j$ , find (a) the angle between the two vectors, (b)  $F_{\parallel}$  the component of  $F$  parallel to  $n$ , and (c)  $F_{\perp}$  the component of  $F$  perpendicular to  $n$ . Express all vectors in terms of unit vectors  $i$  and  $j$ .
7. Given a force  $F = 50i + 200j$  (lbs) and a unit vector  $n = \frac{\sqrt{3}}{2}i + \frac{1}{2}j$ , find (a) the angle between the two vectors, (b) the component of  $F$  parallel to  $n$ , and (c) the component of  $F$  perpendicular to  $n$ . Express the angle in degrees and radians and all vectors in terms of unit vectors  $i$  and  $j$ .
8. A force  $F = 150i - 80j$  (lbs) is applied at a point  $A$  whose coordinates are  $(3,2)$  (ft). Find (a)  $M_B$  the moment of  $F$  about point  $B$  whose coordinates are  $(4,5)$  (ft), and (b) the perpendicular distance from  $B$  to the line of action of  $F$ .
9. A force  $F = 50i + 200j$  (lbs) is applied at a point  $A$  whose coordinates are  $(2,5)$  (ft). Find (a)  $M_B$  the moment of  $F$  about point  $B$  whose coordinates are  $(10,0)$  (ft), and (b) the perpendicular distance from  $B$  to the line of action of  $F$ .

10. A block is resting on an inclined plane under the action of its weight  $W$  and the external force  $P$ . The plane exerts a friction force  $f$  and normal force  $N$  on the block holding it in place. Given  $|W|=200$  (lbs),  $|P|=100$  (lbs) and  $\theta = 60^\circ$



- a) Express the forces  $W$  and  $P$  in terms of the unit vectors  $i$  and  $j$ .
- b) Find the friction and normal forces  $f$  and  $N$  so  $P+W+f+N=0$ .