Chapter 1 Sample questions

1) The coefficient of static friction between a tennis player's hand and her racket is 0.45. How hard must she squeeze the racket if she wants to exert a force of 200 N along its longitudinal axis?

$F = \mu N$

$F = 200N$
$\mu = 0.45$

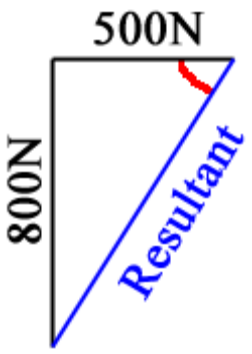
$200N = 0.45(\text{Normal Force})$
Normal force = $200N/0.45 =$ **444N**

2) The coefficient of static friction between the sole of an athletic shoe and the basketball court floor is 0.67. Tyler wears these shoes when he plays basketball. If Tyler exerts a normal contact force of 1400 N when he pushes off the floor to run down the court, how large is the friction force exerted by Tyler's shoes on the floor?

Frictional force = F
Coefficient of static friction = 0.67
Normal force = 1400N

$F = \mu N$
$F = 0.67\ (1400N) = 938N$

3) A sprinter is just coming out of the starting block, and only one foot is touching the block. The sprinter pushes back (horizontally) against the block with a force of 500 N and down (vertically) against the ground with a force of 800 N. What is the resultant of these forces?



Magnitude
Pythagorean Theorum
$a^2 + b^2 = c^2$
$c = \text{sqrt}(a^2 + b^2)$
Resultant = $\text{sqrt}(500N^2 + 800N^2) =$ **943N**

Direction
$\tan \theta = \text{opp/adj}$
$\theta = \tan^{-1}(\text{opp/adj})$
$\theta = \tan^{-1}(800N/500N) =$ **58° below horizontal**

4) The ground reaction force acting on a long jumper is 4500 N acting forward and upward at an angle of 78° from horizontal.
   a. What is the vertical component of this ground reaction force?
   b. What is the horizontal component of this ground reaction force?

Part A

Sin (θ) = opposite/hypotenuse
Sin (78°) = (vertical force)/4500N
Vertical force = 4402N

Part B

Cos (θ) = opposite/hypotenuse
Cos (78°) = (horizontal force)/4500N
Horizontal force = 936N

5) A golfball leaves the tee with a horizontal velocity of 50 m/s and a vertical velocity of 7 m/s.
   a. What is the direction the ball is traveling?
   b. What is the magnitude of the resultant velocity as it leaves the tee?

Part A

Tan^{-1}(opposite/adjacent) = (θ)
Tan^{-1}(vertical vel)/(horz vel) = (θ)
Tan^{-1}(7m/s)/(50m/s) = 7.96°
θ = 8°

Part B

$a^2 + b^2 = c^2$ with a and b being the horizontal and vertical velocities and c being the resultant velocity.

$(50m/s)^2 + (7m/s)^2 = (\text{resultant vel})^2$

Resultant velocity = 50.5m/s