Chapter 1: Forces

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?

$F = \mu N$

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

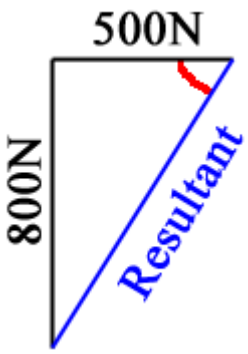
$200N = 0.45(\text{Normal Force})$
Normal force = $200N/0.45 =$ **444N**

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

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

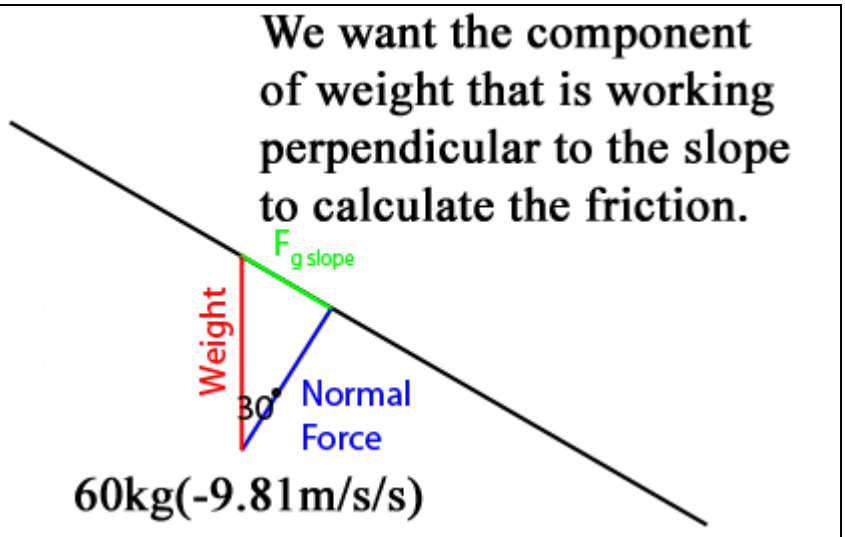
3) A sprinter is just coming out of the starting block, and only one foot is touching the block. The sprinter pushes back (horizontally) against the block with a force of 500 N and down (vertically) against the ground with a force of 800 N. What is the resultant of these forces?



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) A 60-kg skier is in a tuck and moving straight down a 30 slope. Air resistance pushes backward on the skier with a force of 10 N (this force acts in a direction upward and parallel to the 30 slope). The coefficient of dynamic friction between the skis and the snow is 0.08. What is the resultant force that acts on the skier?



W = mg
F = μN

W = 60kg(-9.81m/s^2) = 588.6 N
μ = 0.08

Normal Force
Normal force = 588.6N(cos 30°) = 509.7N

Friction
F = 0.08(509.7N) = 40.8N

Gravity
Force along slope due to gravity = 588.6N(sin 30°) = 294.3N

Force along slope = 294.3N -40.8N - 10N = **243.5N**

5) 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) = adjacent/hypotenuse
Cos (78°) = (horizontal force)/4500N
Horizontal force = 936N

6) 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 (θ) = opposite/hypotenuse
Tan (θ) = (vertical vel)/(horz vel)
Tan (θ) = (7m/s)/(50m/s) = 0.14
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