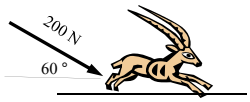
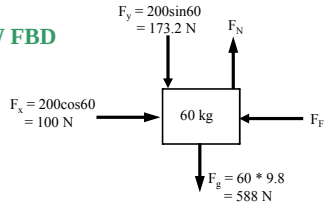
Forces at Angles With Friction

Sample

You push on a 60 kg gazelle as shown in the picture. If $\mu_S = 0.08$ and $\mu_K = 0.05$ what is the gazelles acceleration?



DRAW FBD



WRITE NET FORCE EQUATIONS FOR BOTH X AND Y DIRECTIONS

ΣF_x : $F_x - F_F = ma_x$

$100\ N - F_F = (60kg)\ a_x$

ΣF_y : $F_N - F_y - F_g = ma_y$

$F_N - 173.2\ N - 588\ N = 60\ (0)$

$F_N = 761.2\ N$

DETERMINE IF THE OBJECT WILL MOVE

(is $F_x > F_{FS}$)

$F_X = 100\ N$

$F_{FS} = F_N * \mu_s$

$F_{FS} = 761.2\ N\ (0.08) = 60.88\ N$

$100\ N > 60.88\ N$

It will move!

USE ΣF_X TO SOLVE FOR a_X AND THEN USE A KINEMATIC AS NEEDED

$100\ N - F_{FK} = 60kg\ a_x$

$100\ N - 761.2N(0.05) = 60\ kg\ a_x$

$a_x = 1.03\ m/s^2$

$v_i = 0$ m/s

$a = 1.03\ m/s^2$

$t = 4.0$ sec

$\Delta x = ?$

$$\Delta x = v_i t + \frac{1}{2}at^2$$

$$\Delta x = (0m/s)t + \frac{1}{2}(1.03m/s^2)(4.0s)^2$$

$$\Delta x = 8.26m$$

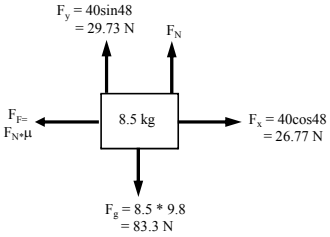
Solving Force Problems

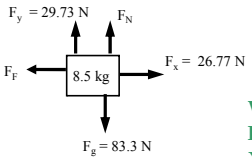
1. **Resolve the vectors.**
2. **Draw Free Body Diagrams (FBD).**
3. **Write the net force equations.**
4. **Plug in numbers and solve for normal force F_N.**
5. **Determine if the object will move. Is the force applied greater than the static frictional force ($F_x > F_{fs}$)?**
6. **Use F_x and kinetic frictional force (F_{fk}) to solve for a_x.**
7. **Use a kinematic equation as needed.**

Practice

A boy is pulling upward with a constant force on his little red wagon as shown in the picture below. The mass of the wagon and gazelle plush toy is 8.5 kg. What is the acceleration of the wagon? ($\mu_s = 0.48$ $\mu_k = 0.27$)

DRAW FBD





WRITE NET FORCE EQUATIONS FOR BOTH X AND Y DIRECTIONS

ΣF_x : $F_x - F_F = ma_x$

$26.77\ N - F_F = (8.5kg)\ a_x$

ΣF_y : $F_N + F_y - F_g = ma_y$

$F_N + 29.73\ N - 83.3\ N = 8.5(0)$

$F_N = 53.57\ N$

DETERMINE IF THE OBJECT WILL MOVE

(is $F_x > F_{FS}$)

$F_X = 26.77\ N$

$F_{FS} = F_N * \mu_s$

$F_{FS} = 53.57\ N\ (0.48) = 25.71\ N$

$26.77\ N > 25.71\ N$

It will move!

USE ΣFX TO SOLVE FOR a_X AND THEN USE A KINEMATIC AS NEEDED

$26.77\ N - F_{FK} = (8.5kg\ )a_x$

$26.77\ N - 53.57N(0.27) = (8.5\ kg)\ a_x$

$a_x = 1.45\ m/s^2$