Name: KEY

Date:

Section C D F

The Masters School
Mr. Alex Rawson
Physics

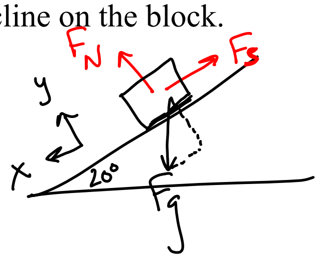
Forces IV

1. An 8 kg block is in equilibrium on an incline of angle θ= 20°. Draw a diagram, label forces, give $F_{net,x}$ and $F_{net,y}$, and find F_n of the incline on the block.

$F_{net,x} = F_{gx} - F_s = 0$

$F_{net,y} = F_N - F_{g,y} = 0$

$F_n = 73.75\ N$

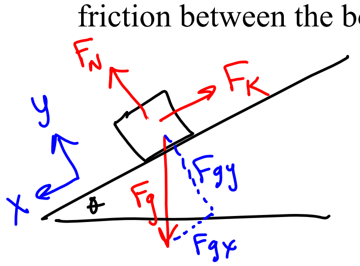


$F_N = F_{g,y} = Mg\cos\theta$

$F_N = 8(9.81)\cos 20$

$\boxed{F_N = 73.75\ N}$

2. A box slides down a 36.5° ramp with an acceleration of 1.41 m/s². Determine the coefficient of kinetic friction between the box and the ramp. Use a system of equations to cancel out mass.



$a = 1.41\ m/s^2$

$\theta = 36.5°$

$F_{net,x} = F_{gx} - F_K$

$F_{net,y} = F_N - F_{g,y} = 0$

$F_N = F_{gy} = mg\cos\theta$

$F_{net,x} = ma$

$ma = F_{gx} - F_K$

$ma = F_{gx} - F_K$

$ma = mg\sin\theta - \boxed{F_K}$

$\cancel{m}a = \cancel{m}g\sin\theta - \mu_K\cancel{m}g\cos\theta$

$\mu_K = \frac{g\sin\theta - a}{g\cos\theta}$

$\boxed{\mu_K = .561}$

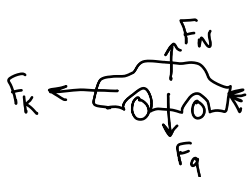
$\mu_K = \frac{F_K}{F_N}$

$F_K = \mu_K F_N$

$\boxed{F_K} = \mu_K mg\cos\theta$

3. A car is traveling at 50.1 km/h on a flat highway.

a. If the coefficient of friction between the road and the tires on a rainy day is 0.100, what is the minimum distance needed for the car to stop? In order to find Δx, you have to find acceleration, which you can find by $F_{net,x}$ = ma. So find acceleration in the x direction (a_x), and then use acceleration formulas.



$V_i = 50.1\ km/h$

$V_i = 13.92\ m/s$

$F_{net_x} = -F_K$

$F_{net_y} = F_N - F_g = 0$

$F_N = F_g = mg$

$F_{net} = ma$

$ma_x = -F_K$

$\cancel{m}a_x = -\mu_K \cancel{m}g$

$\boxed{a_x = -\mu_K g}$

$a = -(.1)(9.81) = \boxed{-.981}$

$\mu_K = \frac{F_K}{F_N}$

$F_K = \mu_K F_N$

$F_K = \mu_K mg$

b. What is the stopping distance when the surface is dry and the coefficient of friction is 0.600?

$a_x = -\mu_K g$

$a_x = -(.6)(9.81)$

$a_x = -5.886$

$V_f^2 = V_i^2 + 2a\Delta x$

$0 = 13.92^2 + 2(-5.886)\Delta x$

$\frac{-13.92^2}{2(-5.886)} = \Delta x$

$\boxed{\Delta x = 16.46\ m}$

$\Delta x = ?$

$V_i = 13.92$

$V_f = 0$

$a = -.981$

$\Delta t =$

$V_f^2 = V_i^2 + 2a\Delta x$

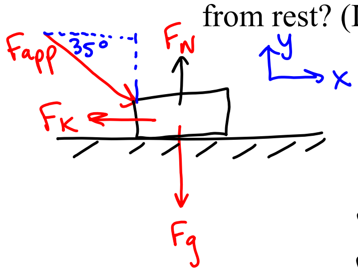
$0 = (13.92)^2 + 2(-.981)\Delta x$

$\frac{-(13.92)^2}{2(-.981)} = \Delta x$

$\boxed{\Delta x = 98.76\ m}$

4. A box of books weighing 299 N is shoved across the floor by a force of 430 N exerted downward at an angle of 35° below the horizontal.

   a. If μ_k between the box and the floor is 0.57, how long does it take to move the box 9 m, starting from rest? (If the box will not move, the correct answer would be 0.)



$F_{net\,x} = F_{appx} - F_K$

$F_{net,y} = F_N - F_{appy} - F_g = 0$

$F_{app} = 430\ N$

$F_{appx} = 430 \cos 35 = 352.2\ N$

$F_{appy} = 430 \sin 35 = 246.6\ N$

$F_N = F_g + F_{appy}$

$F_N = 299 + 246.6$

$F_N = 545.6$

$F_K = \mu_K F_N$

$F_K = (.57)(545.6)$

$\boxed{F_K = 311.0\ N}$

$F_{net\,x} = F_{appx} - F_K$

$= 352.2 - 311.0$

$F_{net\,x} = 41.2\ N$

$(30.48)a = 41.2\ N$

$a = 1.35\ m/s^2$

$\Delta x = \cancel{V_i \Delta t} + \frac{1}{2} a \Delta t^2$

$\boxed{\Delta t = 3.65\ s}$

   b. If μ_k between the box and the floor is 0.75, how long does it take to move the box 5 m, starting from rest? (If the box will not move, the correct answer would be 0.)

$F_N = 545.6\ N$ still

$F_K = \mu_K F_N$

$F_K = (.75)(545.6)$

$F_K = 409.2$

$F_{net,x} = F_{appx} - F_K$

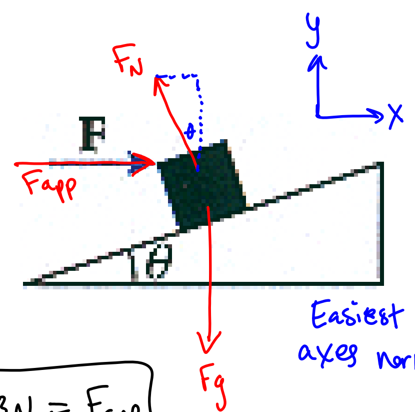
$= 352.2 - 409.2$

$F_{net\,x} = -57\ N$

F_K stronger than F_{appx}, thus no movement $(a = 0)$

$\boxed{\Delta t = 0}$

5. A block with a mass of 14 kg is held in equilibrium on an incline of angle θ = 30.0° by the horizontal force, **F**, as shown in the figure below. (Disregard friction)



Easiest to set axes normal

   a. Find the magnitude of **F**. ← Fapp

$F_{net\,x} = F_{app} - F_{N,x} = 0$

$F_{net,y} = F_{Ny} - F_g = 0$

$F_g = F_{Ny} = mg$

$F_{Ny} = 137.34\ N$

$F_{app} = F_{Nx}$

$\tan\theta = \frac{F_{Nx}}{F_{Ny}}$

$F_{Nx} = F_{Ny} \tan\theta$

$F_{Nx} = (137.34)\tan 30 = \boxed{79.3\ N = F_{app}}$

   b. Find the normal force exerted by the incline on the block.

$\cos\theta = \frac{F_{Ny}}{F_N}$

$F_N = \frac{F_{Ny}}{\cos\theta} = \frac{137.34}{\cos 30} = \boxed{158.6\ N}$

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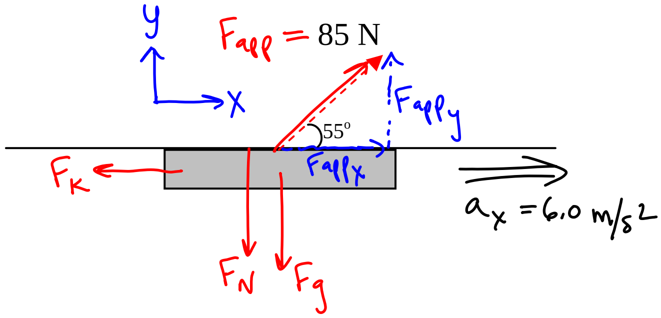
A 4.00 kg block is pushed along a ceiling with a constant applied force of 85 N that acts at an angle of 55° with the horizontal, as shown below. The block accelerates to the right at 6.00 m/s^2. Determine the coefficient of kinetic friction between the block and the ceiling.



$F_{net,x} = F_{appx} - F_K \neq 0$

$F_{net,y} = F_{appy} - F_g - F_N = 0$

1) $F_g = mg$

$F_g = (4)(9.81)$

$F_g = 39.24$ N

2) $F_{app} = 85$ N

$F_{appx} = 85 \cos 55 = 48.75$ N

$F_{appy} = 85 \sin 55 = 69.63$ N

3) $F_{net,y} = F_{appy} - F_g - F_N = 0$

$F_N = F_{appy} - F_g$

$F_N = 69.63 - 39.24$

$\boxed{F_N = 30.39 \text{ N}}$

4) $a_x = 6.0$ m/s^2

$F_{net,x} = ma_x$

$F_{net,x} = (4)(6)$

$F_{net,x} = 24$ N

5) $F_{net,x} = F_{appx} - F_K$

$24 = 48.75 - F_K$

$\boxed{F_K = 24.75 \text{ N}}$

6) $\mu_K = \dfrac{F_K}{F_N}$

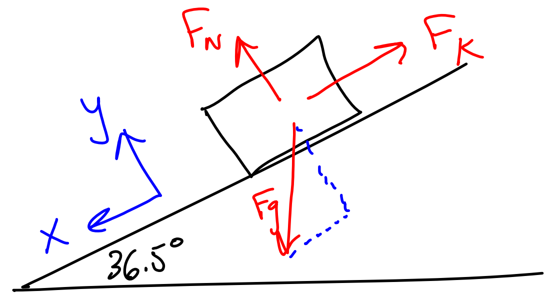
$\mu_K = \dfrac{24.75}{30.39}$

$\boxed{\mu_K = .814 \pm .003}$

for rounding

Chris K-F's Method

2) A box slides down a 36.5° ramp with an acceleration of 1.41 m/s^2. Determine the coefficient of kinetic friction between the box and the ramp. Use a system of equations to cancel out mass.



$F = ma$

$a = \frac{F}{m}$

$1.41 = \frac{F}{m}$

$1.41 = \frac{F_{net,x}}{m}$

$1.41 = \frac{F_{gx} - F_K}{m}$

$1.41 = \frac{5.84m - F_K}{m}$

$1.41m = 5.84m - F_K$

$\boxed{F_K = 4.43m}$

$F_{net,x} = F_{gx} - F_K \neq 0$

$F_{net,y} = F_N - F_{gy} = 0$

$F_N = F_{gy}$

$F_g = mg$

$F_{gx} = mg\sin\theta$

$F_{gx} = 5.84(m)$

$F_{gy} = 7.89(m) = F_N$

$\mu_K = \frac{F_K}{F_N} = \frac{4.43\cancel{m}}{7.89\cancel{m}} = \boxed{.561}$