Phy 2A 5/1

Friday, April 28, 2017 12:36 PM

Goals for the Lecture:

1) Understand Newton's Third Law, equal and opposite forces, and the role it plays in solving problems
2) Understand Newton's Second Law, forces, and the role they play in acceleration
3) Be able to draw free body diagrams for objects on flat surfaces
4) Use Newton's Second Law to solve motion problems, including: multiple objects, incline planes, friction, pulleys, and ropes

From Last Time worksheet p. 85

Bottom: Find the tension in each rope:

A) x-direction:

RF ← • → T

$\Sigma F_x = 0$ constant velocity

$T - RF = 0$

$T = RF$

$T = 750$ N

B) $T = 800$ N

C) $T = 900$ N

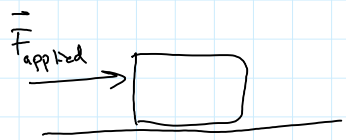
D) $T = 750$ N

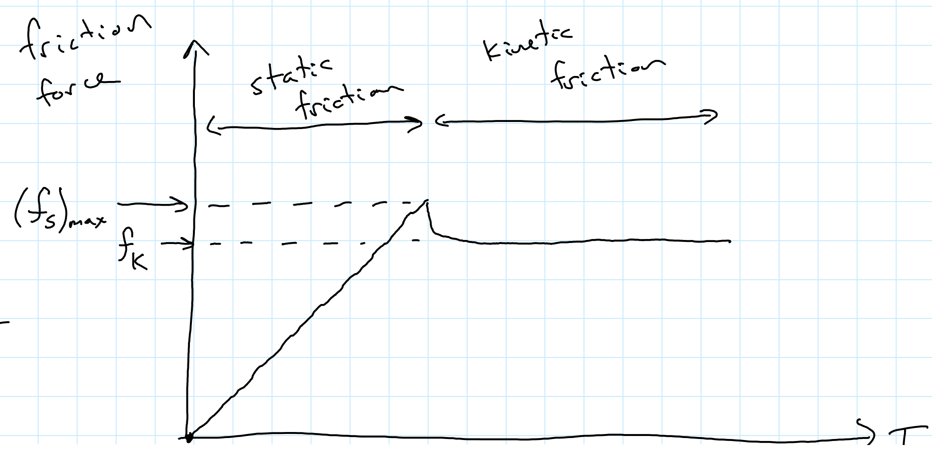
Demo: Force sensors

when two objects interact - their forces are always equal and opposite

$$\vec{F}_{12} = -\vec{F}_{21}$$

Friction:





Normal force

static: $(f_s)_{max} = \mu_s N$

coefficient of friction

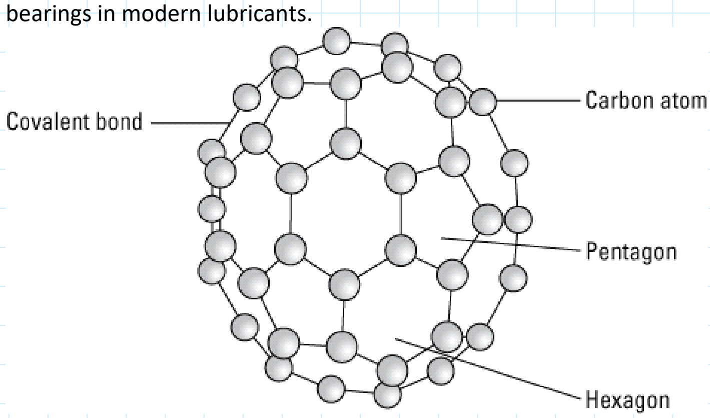
kinetic: $f_k = \mu_k N$

Application of the day - Friction

Sometimes we want to maximize friction – Running (speed up, slow down, make turns) so, running shoes have soles that maximize friction (as do race car tires). Racing tires have coefficients of friction >3 (most object have between 0 and 1)

Sometimes we want to minimize friction – use lubricants, as in engines to reduce wear (friction causes small particles to break off the surfaces that rub together)

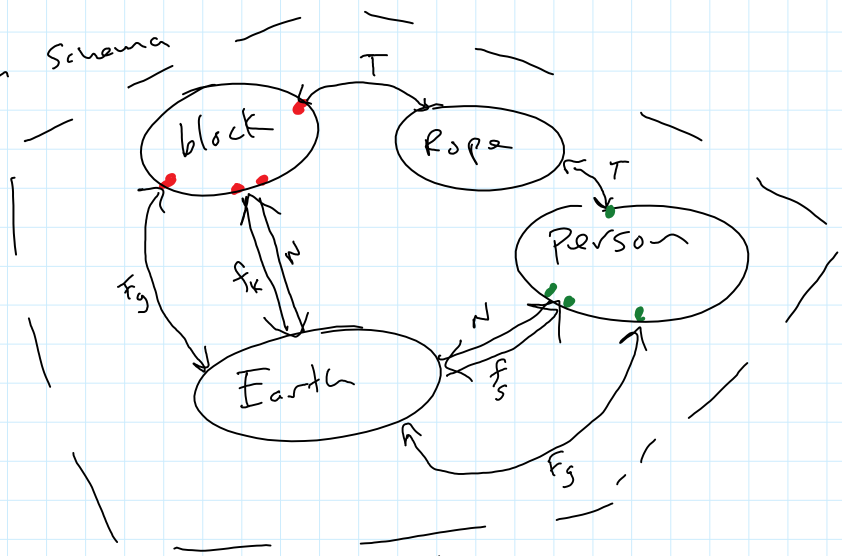
Buckyballs – molecules consisting of 60 carbon atoms arranged in the shape of a soccer ball. They act like microscopic ball bearings in modern lubricants.



Sports – trying to go fast in a turn and maintain static friction, not going to kinetic friction

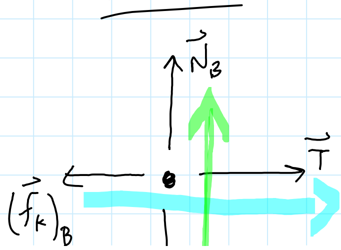
block sliding to the Right at constant speed

(rope is massless)

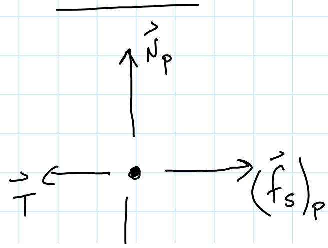


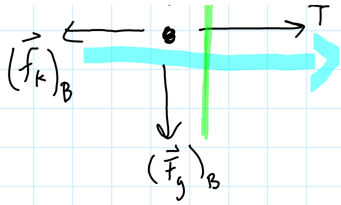
Draw free body diagrams:

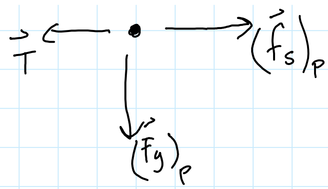
block



person







Block: $\Sigma \vec{F} = m\vec{a}$

$\Sigma F_x = m_B a_x \quad \rightarrow +$

$T - (f_k)_B = m_B \cancel{a_x}^{\,0}$

moving at constant velocity

$T - (f_k)_B = 0$

$T = (f_k)_B$

$\Sigma F_y = m_B a_y \quad \uparrow +$

$N_B - (F_g)_B = m_B \cancel{a_y}^{\,0}$

Not moving in the y-direction

$N_B - (F_g)_B = 0$

$N = (F_g)_B$

Person: $\Sigma \vec{F} = m\vec{a}$

$\Sigma F_x = m_p a_x \quad \rightarrow +$

$(f_s)_p - T = m_p \cancel{a_x}^{\,0}$

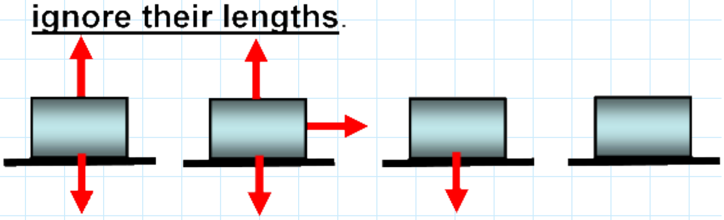
$(f_s)_p = T$

$\Sigma F_y = m_p a_y \quad \uparrow +$

$N_p - (F_g)_p = m_p \cancel{a_y}^{\,0}$

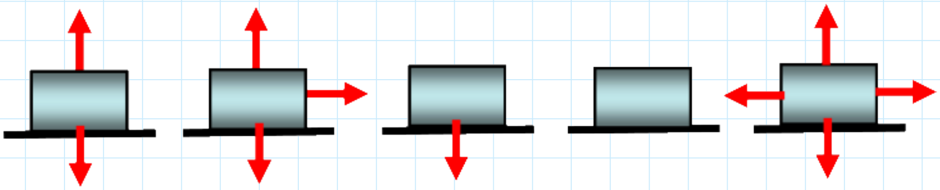
$N_p = (F_g)_p$

A block sits ***at rest*** on a frictionless surface. Which of the following sketches most closely resembles the correct freebody diagram for all forces acting on the block? Each red arrow represents a force. Observe their number and direction, but **ignore their lengths**.



$\boxed{\text{A}}$ B C D

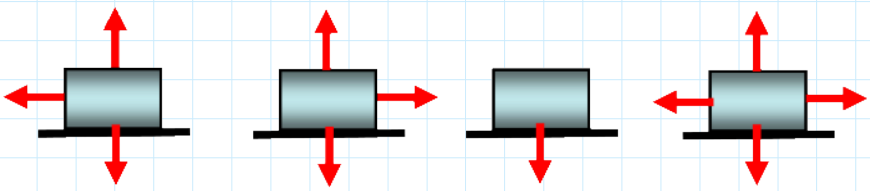
Now, the same block moves with a **constant velocity to *the right on the frictionless surface***. Which of the following most closely resembles the correct freebody diagram for all forces acting on the block?



$\boxed{\text{A}}$ ~~B~~ ~~C~~ ~~D~~ E

$\Sigma F \neq 0$

Now, the block moves with a **constant** velocity ***to the right*** on a surface ***that has friction***. Which of the following most closely resembles the correct freebody diagram for all forces acting on the block?



A B C $\boxed{\text{D}}$

E) None of the above

Worksheet II-8

1.

Left

a) B

b) H

c) G

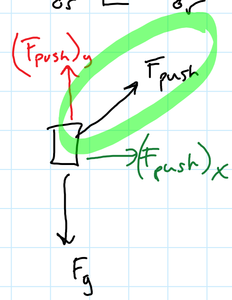
d) E

Right

a) G

b) A or E or zero

c)



Depends on the y-comp of the pushing Force

if $(F_{push})_y = F_g \Rightarrow$ friction is zero

if $(F_{push})_y < F_g \Rightarrow$ friction is up

if $(F_{push})_y > F_g \Rightarrow$ friction is (push)g) down

d) C

e) A

f) E

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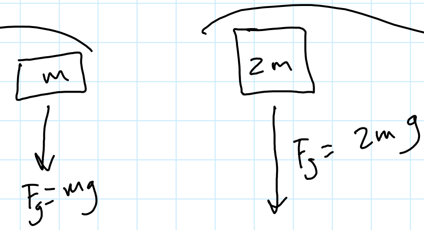
m — 2m



$F = ma$

$mg = ma$

$g = a$

$F = ma$

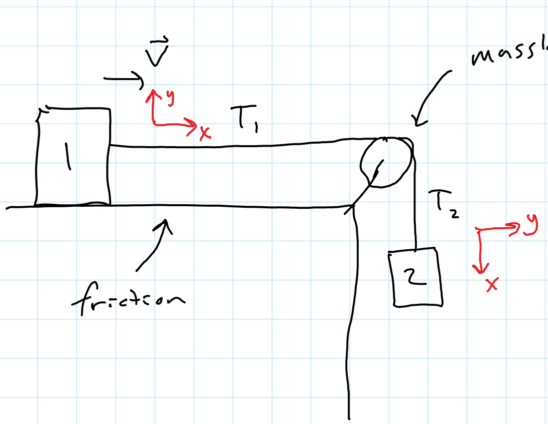
$2mg = (2m)a$

$g = a$

both accelerate at the same rate

Video: bowling ball and feathers

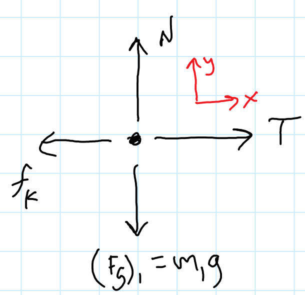
Pulley



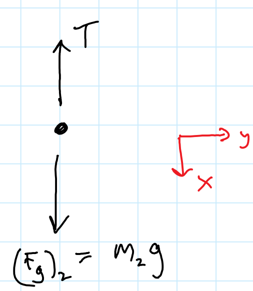
$\boxed{\text{if massless Pulley, } T_1 = T_2}$

Free body diagrams:

block 1



block 2



given: m_1, m_2, μ_k

find: a and T

block 1

$$\Sigma \vec{F} = m_1 \vec{a}$$

$$\Sigma F_x = m_1 a_x \quad \xrightarrow{+}$$

$$T - f_k = m_1 a_x$$

$$T - \mu_k N = m_1 a$$

$$\Sigma F_y = m_1 a_y \quad \uparrow +$$

$$N - m_1 g = m_1 \cancel{a_y}^{\,0}$$

not moving up or down

$$N = m_1 g$$

$$\boxed{T - \mu_k (m_1 g) = m_1 a}$$

2 unknowns

block 2

$$\Sigma F = m_2 a \quad \downarrow +$$

$$\boxed{m_2 g - T = m_2 a}$$

2 equations
can solve for
a and T