Practice Exam 2

Equations:

$x = x_0 + v_0 \cdot t + \frac{1}{2} a \cdot t^2$
$v = v_0 + a \cdot t$
$v^2 = v_0^2 + 2a(x - x_0)$
$\bar{v} = (v - v_0)/2$
$\Sigma \mathbf{F} = m\mathbf{a}$
$\mathbf{F}_{12} = -\mathbf{F}_{21}$

$v = \Delta x/\Delta t$
$\bar{a} = \Delta v/\Delta t$
$a_r = v^2/r$
$\mathbf{F}(G) = m\mathbf{g}$
$F(G) = Gm_1m_2/r^2$
$G = 6.67 \times 10^{-11} Nm^2/kg^2$

$v_x = v \cdot \cos(\theta)$
$v_y = v \cdot \sin(\theta)$
$v^2 = v_x^2 + v_y^2$
$\tan(\theta) = v_y/v_x$
$F(f)_k = \mu_k F(N)$
$F(f)_s \leq \mu_s F(N)$

1) Definitions: *(3 points each)*
   a) What is a *tension force*?

   b) What is a *coefficient of kinetic friction*?

   c) What is a *centripetal force*?

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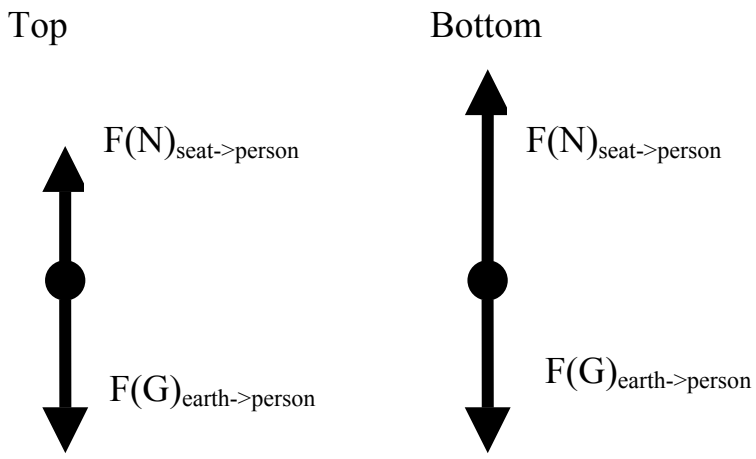
2) Conceptual questions: *(15 points total)*
   a) What is the direction of the frictional force on a car (a) accelerating, (b) braking, and (c) turning right while maintaining a constant speed?

Accelerating	Braking	Turning right
_X_ Forward	___ Forward	___ Forward
___ Backward	_X_ Backward	___ Backward
___ Right	___ Right	_X_ Right
___ Left	___ Left	___ Left
___ No Friction	___ No Friction	___ No Friction

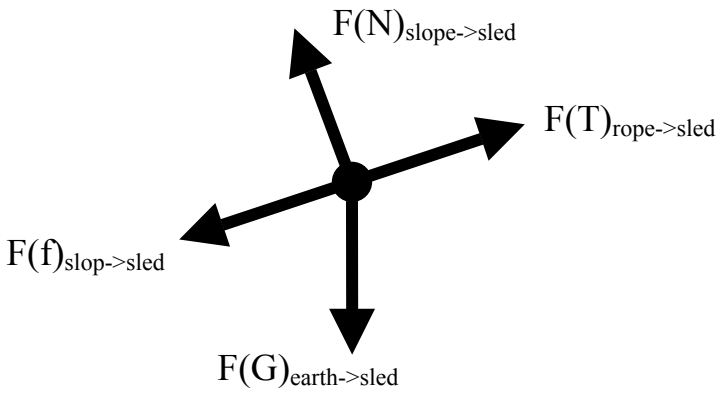
   b) An elevator initially at rest is accelerated upwards by a cable. How does the force of the cable on the elevator compare to
      i) the force of the elevator on the cable, and
      ii) the force of gravity on the elevator?

The force of the elevator on the cable is always equal to the force of the cable on the elevator. If it is being accelerated upward, the upward force from the cable on the elevator must be greater than the downward force of gravity on the elevator to have a net upward force.

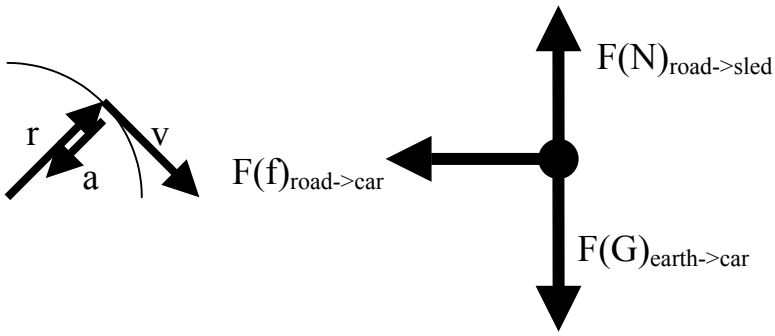
3) A person is riding a Ferris Wheel. Draw a force diagram for a person sitting on a seat at the top and on a seat at the bottom. Make sure the force vectors are the correct size relative to each other, and completely label them. *(8 points)*



4) Draw a force diagram for a sled being pulled up a slope. Show the correct direction of all forces, completely labeling everything. *(8 points)*



5) A car rounds a level curve at a speed of 45 km/h. If the radius of the curve is 65 m and the car has a mass of 1900 kg, what is the force of friction? *(12 points)*



F(N) – F(G) = 0
F(f) = ma
A = v^2/r

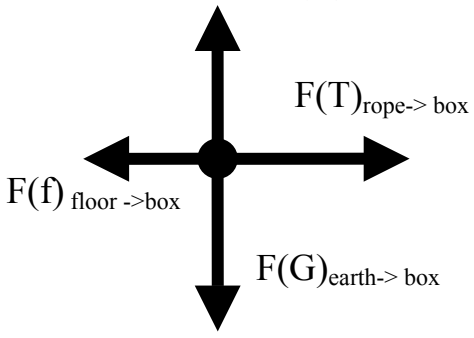
F(f) = m(v^2/r)

V = 45 km/h
R = 65 m
A = ?
M = 1900 kg
F(N) = ?
F(G) = ?
F(f) = ?

$$F(f) = (1900\ kg)\ \frac{(45\ km/h * 1000\ m/1km * 1\ hr/3600s)^2}{65\ m}$$

F(f) = 4570 N

6) A rope pulls on a 30 kg box with a force of 200 N. The box is accelerated at 1.5 m/s^2. What must be the coefficient of kinetic friction? *(14 points)*



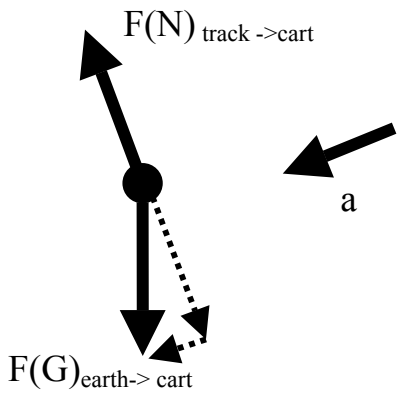
F(T) = 200 N
F(G) = ?
F(f) = ?
F(N) = ?
M = 30 kg
A = 1.5 m/s^2
μ = ?

F(N) – F(G) = 0
F(T) – F(f) = ma
F(G) = mg
F(f) = μ F(N)

$$\mu = \frac{F(f)}{F(N)} = \frac{F(T) - ma}{F(g)} = \frac{200\ N - 30\ kg * 1.5\ m/s^2}{30\ kg * 9.8\ m/s^2}$$

μ = 0.53

7) A laboratory track is set up so it slopes at an angle of 25°. One of the carts we use in our labs (negligible friction) rolls 90 cm down it. How fast is it going when it hits the bottom? *(18 points)*



F(N) = ?
F(G) = ?
M = ?
A = ?
V_0 = 0 m/s
V = ?
X_0 = 0 m
X = 0.9 m
t = ?
angle = 25°
Find acceleration from force and then use motion to find final velocity.

F(N) – F(G)cos(angle) = 0
F(G)sin(angle) = ma
F(G) = mg
$V^2 = V_0^2 + 2a(x-x_0)$

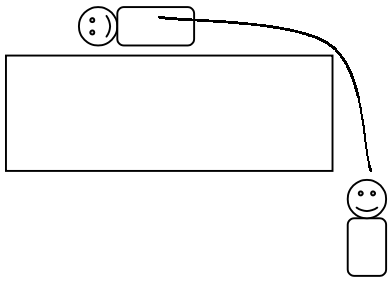
a = F(G)sin(angle)/m = mg*sin(angle)/m = g*sin(angle)
a = 9.8 m/s^2 * sin(25°) = 4.14 m/s^2

v^2 = 0 + 2(4.14 m/s^2)(0.90 m)
v = 2.7 m/s

8) **Real World Problem. Set up, but do not solve, this problem.** *(16 points)*
Larry, Curly and Moe are crossing an icy bridge. They come to a section where there is no rail, so Curly (80 kg) and Moe (70 kg) decide to tie a rope between them for safety. Of course, as soon as this is accomplished Curly slips off the bridge and Moe is dragged across the bridge to the edge. How fast will Moe accelerate if the coefficient of friction on the ice is 0.15? You may ignore friction between the rope and the bridge.

Everyday language description

1) Make a sketch with given information.



2) What do you want to find out?

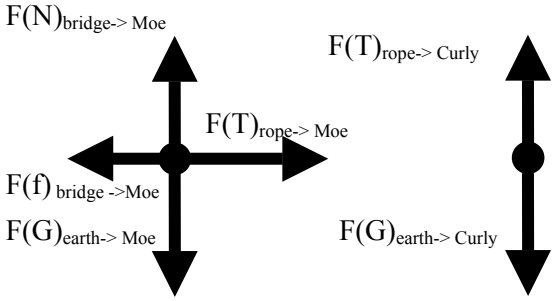
Moe's acceleration

3) What are the physics ideas?

Force with two object

Physics Description

1) Draw a Physics Diagram



2) Make a chart of known and unknown variables. Indicate which one you will solve for.

$F(G)_{Curly}$ = ?
$F(G)_{Moe}$ = ?
F(T) = ?
F(f) = ?
F(N) = ?
M_{curly} = 80 kg
M_{Moe} = 70 kg
a = ?

3) Write down the general equations
(include only the equations needed to solve this problems.)

$F(N) - F(G)_{Moe} = 0$
$F(T) - F(f) = m_{Moe}a$
$F(G)_{Curly} - F(T) = m_{Curly}a$
$F(G) = mg$
$F(f) = \mu F(N)$