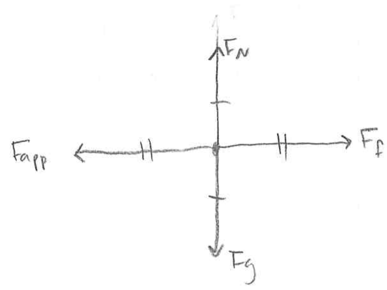
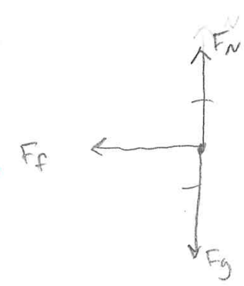
Knowledge Mark: 20 **/ 20** Age: 36 close **Name:** Vivian Kong

April 17

SPH3U Forces Quest

Free Body Diagrams

Draw an appropriate FBD for the underlined object. Include and label all forces acting on that object in the given situation, correctly show relative sizes of vectors, and indicate vectors of equal magnitudes with tick marks. In all cases you may ***ignore air friction****. [6]*

A volleyball while it is on it's way down *after* being popped up vertically through the air.	A train moving at a constant speed of 100 km/h to the left.	A tennis ball rolling to the right on the *court after* hitting net.
1 	3  ✓	2 

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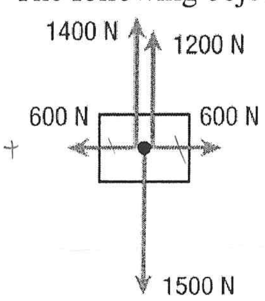
Problems

Solve each problem. Show all work in organized, stepwise solutions. ***Remember to include directions!***

1. The following object has a mass of 320 kg. Determine the acceleration of the object. [3]



$F_{net} = 600 - 600 + 1400 + 1200 - 1500$

$= 1100 N$

$F_{net} = ma$

$a = \frac{F_{net}}{m}$

$= \frac{1100}{320}$

$= 3.44 m/s^2$ [↑] ✓

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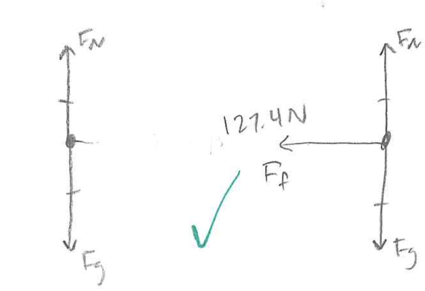
2. A student has pushed a skateboard and it no coasts across a smooth floor (no friction) to his friend at a constant speed of 7 m/s. After 3 s it reaches a rough area and slows down to a stop before reaching his friend. The mass of the skateboard is 25 kg and the coefficient of friction between the skateboard and the rough floor is 0.52. What total distance will the skateboard move before it stops? Include a picture and a free-body diagram for the skateboard in both sections of motion (no friction and friction) as it slides to a stop. [5]

Smooth/no friction Friction



Before: 7 m/s, 3 s const, 25 kg

$v_2 = 7 m/s$, $a = 0$, $\Delta d = ?$, $\Delta t = 3 s$

$\Delta d = v_2 \Delta t - \frac{1}{2} a \Delta t^2$

$\Delta d = 7(3)$

$= 21 m$

Friction: $\mu_k = 0.52$, $v_1 = 7 m/s$, $v_2 = 0$

$F_k = \mu_k F_N$, $F_N = mg = 25(9.8) = 245$

$= 0.52(245)$

$= 127.4 N$ ✓

$F_{net} = ma$

$a = \frac{127.4}{25}$

$= 5.096 m/s^2$ ✓

$v_1 = 7 m/s$, $v_2 = 0$, $a = (-5.096 m/s^2)$, $\Delta d = ?$

$v_2^2 = v_1^2 + 2a\Delta d$

$\Delta d = \frac{-v_1^2}{2a}$

$= \frac{-7^2}{2(-5.096)}$

$= 4.81 m$ (second part) ✓

total distance $= d_{part 1} + d_{part 2}$

$= 21 + 4.81$

$= 25.81 m$ ✓

∴ total distance skateboard moves is 25.81 m

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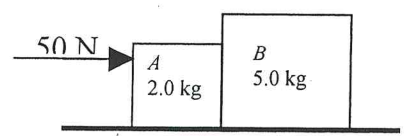
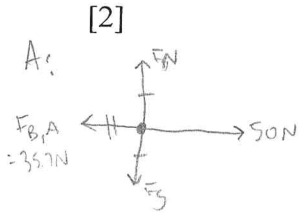
5. A 50 N force pushes on two blocks as shown at the right. Assume there is no friction.

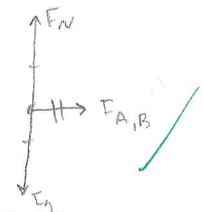


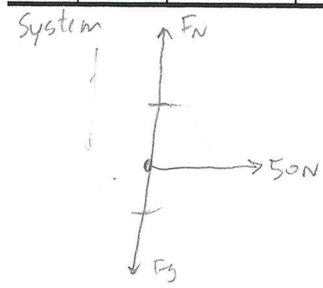
a) Draw a free body diagram for both mass A and mass B showing ***all*** the forces acting. [2]

A:



B:





Fnet = ma

a = Fnet / m

= 50 / 7

= 7.14 m/s

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b) Calculate the force A exerts on B. [2]

Fnet = FA,B

= ma

= 5(7.14)

= 35.714 N

c) Calculate the net force acting on A and the acceleration of A. [2]

Fnet = Fapp − FB,A

= 50 − 35.714

= 14.3 N

Fnet = ma

a = Fnet / m

= 14.286 / 2

= 7.143 m/s² [→]

Communication 9 **/10**

1. In a movie scene, a subway car travelling at constant velocity comes to a stop quickly, people standing are seen to move backwards in the scene as the car is slowing down. Use the appropriate Newton's law to explain why you think this is good physics or bad physics. [2]

This is an example of bad physics because of newton's 3rd law. The force of the car stopping on the people is balanced out by the force of the person. The person's force makes it so that the person doesn't move from the center of gravity. In reality, the people in the subway train should not look like they have moved at all when they stopped.

2. What kind of motion occurs when the net force acting on an object is nonzero? [1]

Acceleration

3. For two given surfaces in contact with one another, the coefficient of kinetic friction is generally Smaller than the corresponding coefficient of static friction. [2]

4. Newton's third law talks about forces always acting in pairs with the two forces of any pair being equal in strength and opposite in direction. Why don't these forces cancel? How is it possible to ever accelerate anything? [1]

To accelerate anything, another force is applied to make it move. When the force overcomes the force of static friction, it will move. The forces in pairs don't cancel because they are on separate objects and the force is not an applied force so the forces are only there because of repulsion between the atoms of the objects. If those forces were applied, they'd cancel out and the object wouldn't move from rest.

5. Friction may be a help in some situations and a hindrance in others. Describe one example for each situation and discuss in that example how it can be increased or decreased if desired. [4]

Friction hinders us when we are trying to move large objects like large furniture or box. because the friction between the large surface area of the object and the floor is really strong and the coefficient of friction (stickiness) may also be large depending on the two surfaces. This friction can be decreased by putting the object on top of something like a large cloth so that when the object is moved, the friction is between the cloth and the surface, making the force of kinetic friction less.

Friction helps us hold objects like pencils. The friction between our fingers and the surface of the object allows us to grip it. It is generally ideal to increase the friction of holding something so to do that, many products have grooves to allow more friction and a better grip on the object (pencils have rubber grooves for hands to grip it better from friction and the coefficient of friction.