Physics 100
Practice Test: Newton's Laws

Name: Key

Formulas and Information: $\Sigma F = ma$ $w = mg$ 1kg = 1,000g $a = \frac{\Delta v}{\Delta t}$

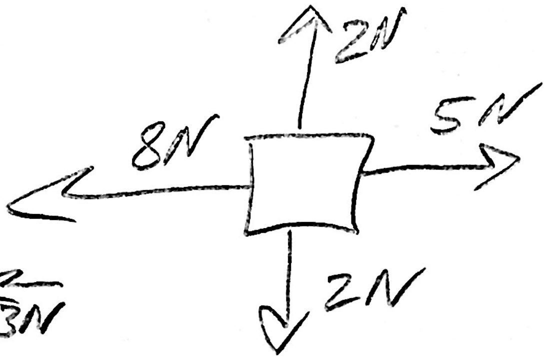
1. List and describe Newton's 3 Laws of Motion:

1st Law: Objects don't accelerate unless acted on by a net force

2nd Law: $\Sigma F = ma$

3rd Law: Every force has an equal and opposite force.

2. Draw a diagram of an object that is experiencing four forces in different directions while experiencing a net force of 3N to the left. Use labeled arrows to show all of the forces.



$\Sigma F = \overleftarrow{3N}$

3. Consider a child pushing a toy car. The child is applying a sideways force. The car has a mass, and the car is accelerating.

$\Sigma F = ma$

a. What will happen if the car's mass is decreased, but the applied force is kept the same.

$\Sigma F = m\,a \leftarrow$ acceleration increases

b. If the car's mass has been kept the same, but it is accelerating faster, what change must have occurred?

$$\Sigma \underset{\uparrow}{F} = m\,a$$

Net force must have increased.

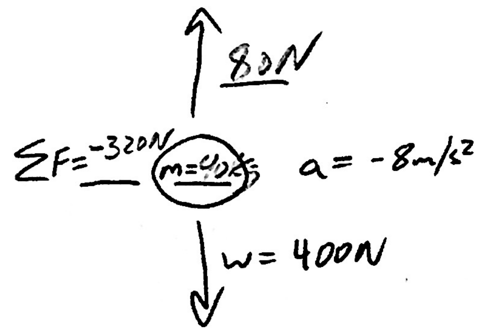
4. Describe the action/reaction pairs of forces that are involved in the situations below. Make sure that you name the objects that are experiencing the forces and give the directions of the forces.

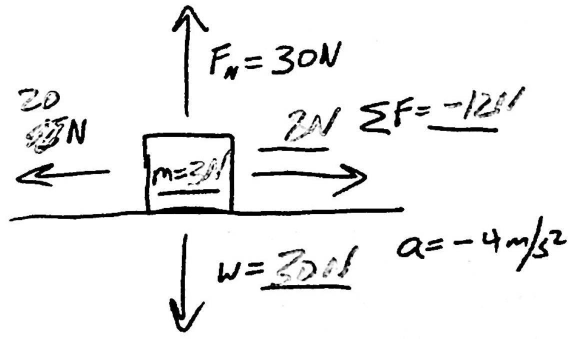
a. Someone walks to the left. Person pushes ground rightward. Ground pushes person leftward.

b. A squirrel climbs up a tree. Squirrel pushes tree down. Tree pushes squirrel up.

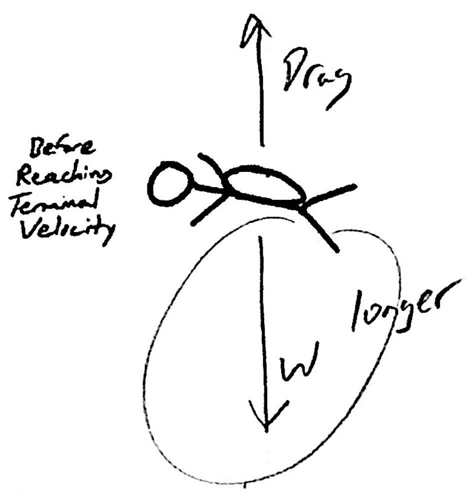
c. A ball falls from the sky. Earth pulls ball down. Ball pulls Earth up. [or Ball pushes air down. Air pushes ball up]

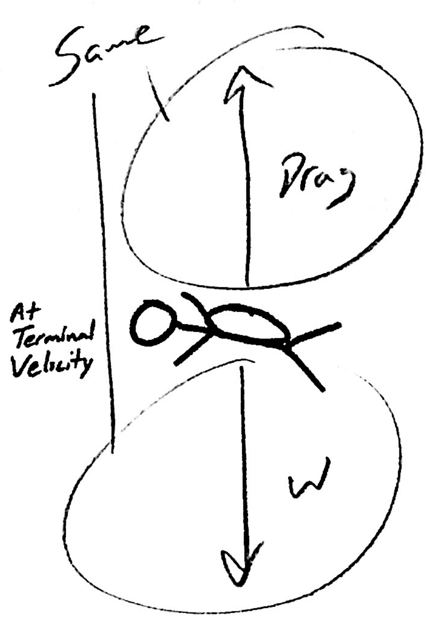
5-6. Fill in the missing masses and forces in the diagrams below. Include proper units.

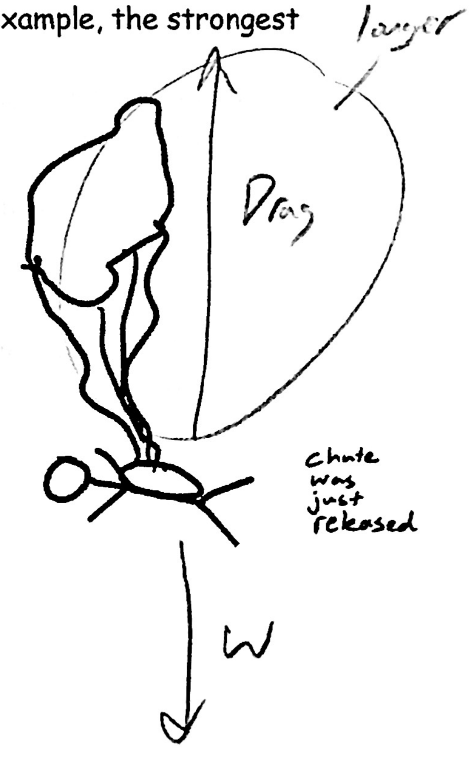




7. In the diagrams below, use arrows to show all of the forces acting on the skydivers. Make sure that the lengths represent the strengths of the forces. For example, the strongest force should have a longer arrow.







8. The first table, below, is a timeline detailing a parachuter's descent from an airplane. Use the timeline and your knowledge of physics to complete the second table.

Time	Event
0s	Parachuter steps out of plane
20s	Parachuter reaches a first terminal velocity of 47m/s
75s	Parachuter pulls chute cord. Chute deploys.
80s	Parachuter reaches a second terminal velocity of 2m/s
700s	Parachuter lands

Don't forget proper units!

Time	Parachuter Mass	Parachuter Weight	Air Resistance (plus direction)	F_{net} (plus direction)	Acceleration (direction)	Speed
0s	100 kg	-1,000N	0N	-1000N	-10m/s²	0m/s
3s	100 kg	-1,000N	200 N Upward	-800N	-8m/s²	30m/s
72s T.V.#1	100 kg	-1,000N	1,000N	0N	0m/s²	47m/s
76s	100 kg	-1,000N	1,800N Upward	800N	8m/s²	41m/s
500s T.V.#2	100 kg	-1,000N	1,000N	0N	0m/s²	2m/s

Force Problems and Diagrams: Draw a diagram showing all of the individual forces and the net force.

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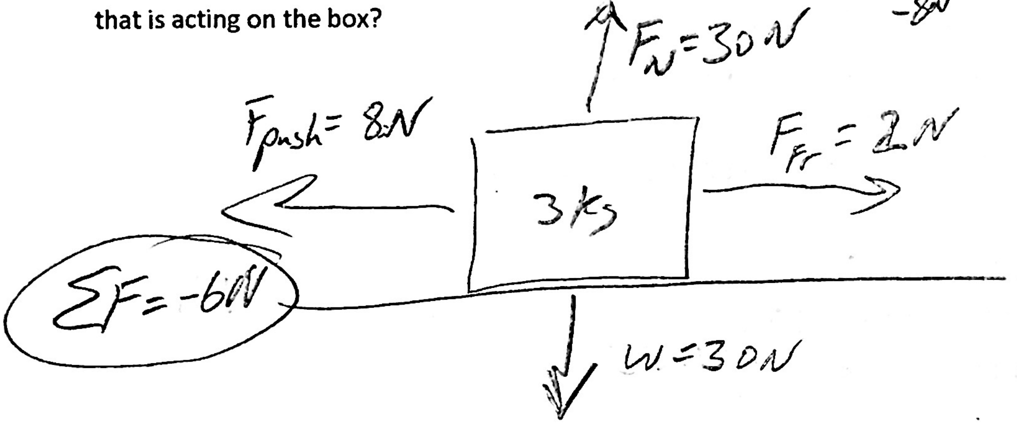
9. A 3kg box is sliding with a velocity of -3m/s. The force of friction acting on the block. The block's acceleration is -2m/s². If a person is pushing the block with a force of ~~-5N~~ -8N, what is the force of friction that is acting on the box?



$\Sigma F=ma$
$=3kg(-2m/s^2)$
$=-6N$

$\Sigma F=F_{Fr}-8N=-6N$
$F_{Fr}=2N$

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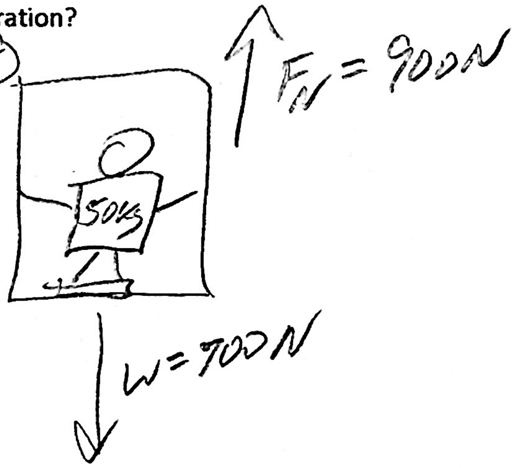
10. A student has a mass of ~~70~~ 50kg. He is standing on a bathroom scale in an elevator, and the scale reads 900N. What is the student's acceleration?

$\Sigma F=900N-700N=200N$



$\Sigma F=ma$

$a=\frac{\Sigma F}{m}=\frac{200N}{50kg}$

$a=4m/s^2$

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11. ~~A student has a mass of 60kg, and she is standing on a bathroom scale in an elevator. This elevator is accelerating downward at a rate of -2m/s². What is the scale reading?~~

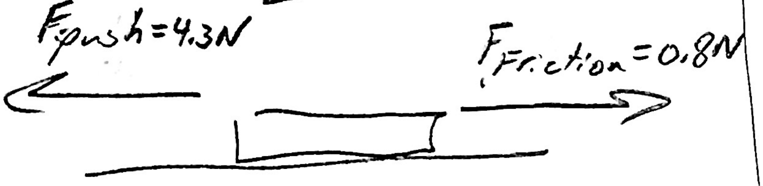
b. dogfood

12. I know this because, when I throw them as hard as I can, the dogfood pushes me backward harder than the ping pong ball does. Since I'm pushing the dogfood with the same force that it pushes against me, I must be pushing it harder than the ping pong ball

16. A **400g** shuffleboard disk is sitting motionless on smooth, hard, level ground. Someone pushes the disk to the left with a constant force for **0.8 seconds**. During this time, the disk reaches a final velocity of **-7m/s.** After the push is over, the disk continues sliding for **3.5 seconds** before coming to a stop. Assuming that the force of friction acting on the disk is the same during the entire event...

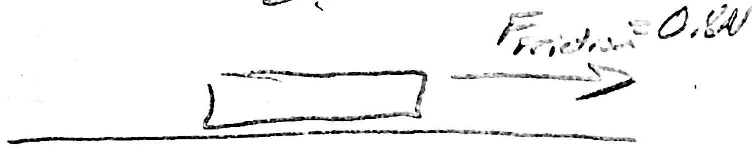
Speeding up

$\Sigma F = -3.5N$



Slowing Down

$\Sigma F = 0.8N$



a. What was the mass of the disk, in kilograms? 0.4kg

$$400g\left(\frac{1\ kg}{1000\ g}\right) = 0.4kg$$

b. What is the disk's acceleration while it is being pushed? $-8.75m/s^2$

$$a = \frac{\Delta v}{\Delta t} = \frac{-7m/s}{0.8s} = -8.75m/s^2$$

c. What is the disk's acceleration after the push ends (while it is sliding to a stop)? $2m/s^2$

$$a = \frac{\Delta V}{\Delta t} = \frac{7m/s}{3.5s} = 2m/s^2$$

d. What is the net force acting on the disk while it is being pushed? $-3.5N$

$$\Sigma F = ma = 0.4kg(-8.75m/s^2) = -3.5N$$

e. What is the net force acting on the disk after the push ends (while it is sliding to a stop)? 0.8N

$$\Sigma F = ma = 0.4kg(2m/s^2) = 0.8N$$

f. What is the force of friction that is acting on the disk the whole time? 0.8N

$$F_{Fr} = \Sigma F_{slowing\ down} = 0.8N$$

g. What is the force of the push? $-4.3N$

$$\Sigma F_{speeding\ up} = -3.5N = F_{Friction} - F_{push}$$

$$-3.5N = 0.8N - F_{push}$$

$$F_{push} = 4.3N$$