Physics 100 Name: _____

Test: Newton's Laws

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

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

   1st Law:

   2nd Law:

   3rd Law:

2. Draw a diagram of an object that is experiencing four forces in different directions while experiencing a net force of **7N upward.** Use labeled arrows to show all of the forces.

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.

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

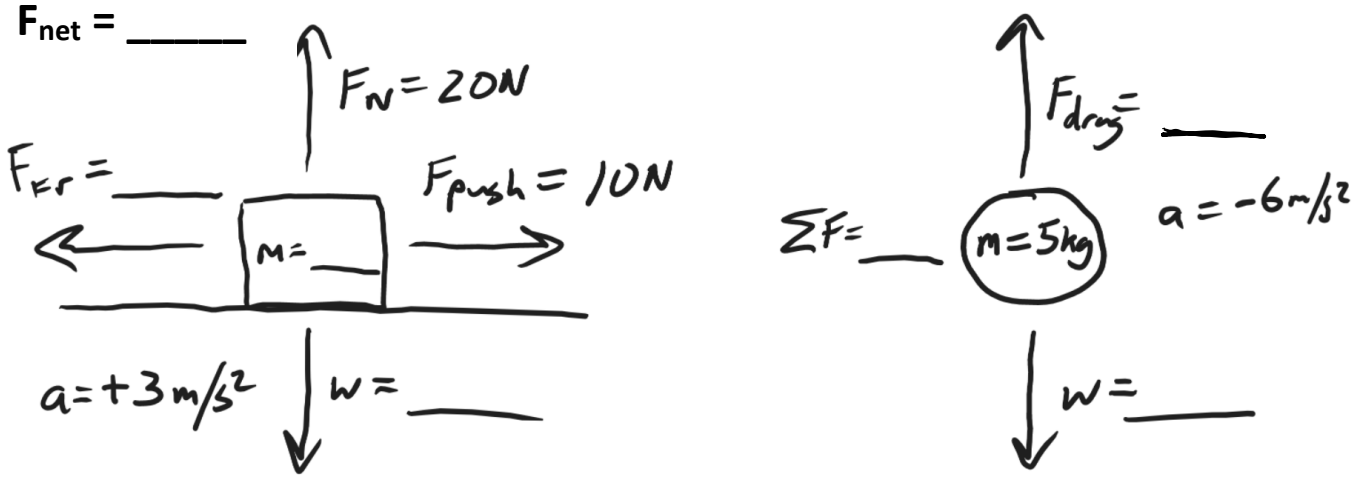
   b. What will happen if the force is kept the same, but the car's mass is increased?

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. A student jumps upward.

b. Water comes out of a water rocket that is blasting upward.

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



7-8. Multiple choice – choose the best answers…

7. When an object is falling from the sky <u>at terminal velocity</u>…
   a. The object's weight is <u>stronger than</u> the force of drag on the object.
   b. The object's weight is <u>weaker than</u> the force of drag on the object.
   c. The object's weight is <u>the same as</u> the force of drag on the object.
   d. There is no way to tell.

8. When an object is falling from the sky, <u>before reaching terminal velocity</u>…
   a. The object's weight is <u>stronger than</u> the force of drag on the object.
   b. The object's weight is <u>weaker than</u> the force of drag on the object.
   c. The object's weight is <u>the same as</u> the force of drag on the object.
   d. There is no way to tell.

9. 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**. **<u>You will only be graded on your answers in the white cells.</u>**

Time	Event
0s	Parachuter steps out of plane
20s	Parachuter reaches a first terminal velocity of 58m/s
75s	Parachuter pulls chute cord. Chute deploys.
80s	Parachuter reaches a second terminal velocity of 4m/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	50 kg					
16s			400 N Upward			50m/s
72s						
76s			900N Upward			41m/s
500s						

Force Problems and Diagrams: Solve these problems by drawing diagrams showing all of the individual forces.

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10. A 6kg box is sliding with a velocity of 5m/s. The force of friction acting on the block. The block's acceleration is 3m/s^2. If a person is pushing the block with a force of 30N, what is the force of friction that is acting on the box? **Draw the box and the ground, and all of the forces that are acting on the box. Use the correct names of the forces.**

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11. A student has a mass of 80kg. He is standing on a bathroom scale in an elevator, and the scale reads 560N. What is the student's acceleration? **Draw the student, the elevator, and the scale, and all of the forces that are acting on the student. Use the correct names of the forces.**

12-14. The table below shows data from the "Newton Sled" activity that you completed in class. In the activity, an object was launched from a sled by rubber bands. The launch caused the sled to move one way and the object to move the other. The same number of rubber bands were used during each launch, and they were always stretched the same amount.

12. During the ping pong ball launch, which object experienced the most force?
    a. The ping pong ball
    b. The sled
    c. Neither; the forces they experienced were the same.

13. During the Earth launch, which object experienced the most force?
    a. The Earth
    b. The sled
    c. Neither; the forces they experienced were the same.

14. Considering both of the launches, which object experienced the most force?
    a. The ping pong ball
    b. The Earth
    c. Neither, the forces they experienced were the same.

Object Launched	**Sled travel distance (m)**	**Launched Object travel distance (or description of its speed)**
Ping pong ball	0.03 m	20 m
Entire Earth	3.2 m	No noticeable movement

15. Explain your reasoning for number 14. How do you know that is the correct answer?

16. A **125g** rubber band car is sitting motionless on smooth, hard, level ground. Once the car is released, the car's motor pushes the car forward for **1.1 seconds**. During this time, the car reaches a maximum velocity of **5 m/s**. After the motor stops pushing, the car keeps moving for **3 more seconds** before coming to a stop. Assuming that the force of friction acting on the car is the same the whole time (when it is speeding up and when it slowing down)…

a. What was the car mass, in kilograms? _____

b. What is the car's acceleration while the motor is still pushing? _____

c. What is the car's acceleration after the motor stops pushing (while it is rolling to a stop)? _____

d. What is the net force acting on the car while the motor is pushing? _____

e. What is the net force acting on the car after the motor stops pushing (while it is rolling to a stop)? _____

f. What is the force of friction that is acting on the car the whole time? _____

g. What is the force of the car's motor? _____