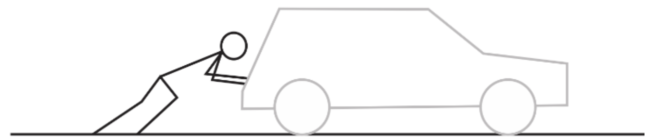
Physics 200 Name: ________________________
20-21 Test: Newton's Laws (1-D) Version 1

Short Answer:

1. A student's car dies in the middle of a friend's flat, smooth, concrete driveway. The student must push the car in order to get it out of the way. The student pushes the car down the driveway at a **constant velocity of 0.5m/s** by applying a constant **160N force to the car**. The **student's mass is 65kg.**



Draw (using arrows), **calculate**, and **label (with the correct name)** the **net force** and all of the **individual forces** ACTING ON THE STUDENT Make sure that you **include correct units** with the forces.

2. A **1kg** brick is dropped from a helicopter. The brick falls until it reaches terminal velocity, and then it hits the ground. The table below provides incomplete descriptions of four moments during the brick's descent (labeled A-D). They are intentionally scrambled so that they are not in order! Use the second column to correctly order the moments in time. Also enter the correct drag force and net force for each of the moments.

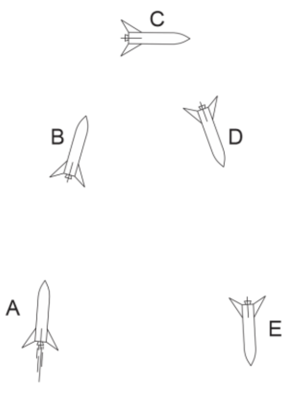
Moments in the descent	Order (1=occurs first, 3 = occurs last)	Brick Weight [Not Graded]	Force of Drag on brick	Net Force acting on brick	Brick Acceleration
A					**$0m/s^2$**
B					**$-9.8m/s^2$**
C					**$-4m/s^2$**

3. Describe the action and reaction forces that explain how a helicopter flies upward.

Action:

Reaction:

4. A rocket is launched directly upward into the air. For a few seconds, the rocket's engine provides thrust (upward force that propels the rocket). After the rocket engine stops providing thrust, the rocket continues flying upward until it reaches its maximum altitude. The rocket then falls back to Earth, eventually reaching terminal velocity before it hits the ground. **Assume that up = positive, and assume that there is air resistance.** For each lettered stage, below, **use labeled arrows to show the individual forces** and **net force** acting on the rocket. Do not try to use numbers unless the net force is zero. In that case, you can use zero for the net force, instead of an arrow. **Use the correct names for the forces.**

Stages A-D. ***Despite the tilted trajectory shown here, the rocket is actually going straight up and straight down* 	a. Thrust phase – engine is causing the rocket to accelerate upward
b. Rocket is still traveling upward, but the engine is no longer providing thrust	c. Rocket is at its maximum altitude
d. Rocket is falling, but has not yet reached terminal velocity	e. Rocket is falling at terminal velocity

Problems:

1. A student has a mass of 40kg.

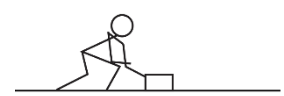
a. What is her weight on Earth?

b. On a different planet the same student has a weight of 1,200N. What is the acceleration due to gravity on that planet?

2. Klem has a 2kg block of wood.

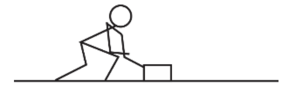
a. How fast does Klem's block of wood accelerate when there is a **net force** of 20N acting on the block?

b. Klem's 2kg block of wood is at rest. If the block has a coefficient of static friction (μ_s) of 0.4, what minimum force does he have to apply to the resting block in order to start it moving?



c. Klem's block of wood has a coefficient kinetic friction (μ_f) equal to 0.3. If Klem keeps pushing the block with the same force that you calculated in part B, how fast will the block accelerate?

3. Klem pushes the same 2kg block again, but this time he is on a different surface. With the block starting from rest, Klem accelerates the block by pushing with a horizontal force of 5N. Pushing with this force, he accelerates the block over a distance of 4m in a time of 7 seconds. What is the blocks coefficient of kinetic friction (μ_k) on this surface?



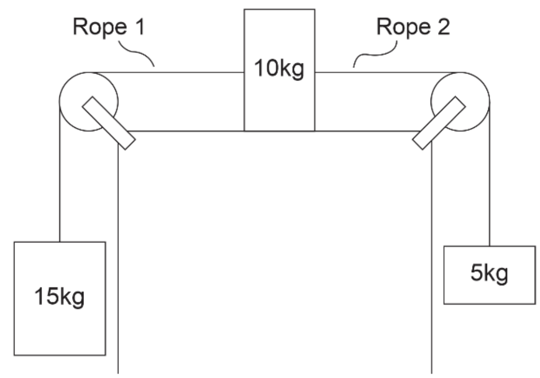
4. A student is standing on a bathroom scale in an elevator, and the scale currently reads 500N. The elevator is accelerating upward at a rate of $2 m/s^2$. What is the student's mass?

5. Matilda and Vern are lowering tools from a roof after finishing a roofing project. One of their saws has a mass of 5kg, and Matilda uses a rope to lower it to her helper, Vern. With the saw starting from rest, Matilda lowers the saw a distance of 5 meters, allowing the saw to accelerate at a constant rate. By the time the saw has traveled 5 meters, it is traveling downward at a speed of 2m/s (velocity = -2m/s).

a. What is the acceleration of the saw as Matilda lowers it?

b. What is the tension in the rope while the saw is being lowered?

6. The diagram on the right shows three masses connected by frictionless, massless strings passing over frictionless pulleys. The surface that is in contact with the 10kg mass has a $\mu_k = 0.6$. The masses and strings are in motion.



a. Find the acceleration of the entire system of masses and ropes.

b. Find the tension in Rope 1

c. Find tension in Rope 2.