PhET Lab: Forces in 1 Dimension Name: ___________________________

Google Search: **"***Forces 1d phet"*, click on top link. Date: _____________
Click "run now", then "keep".
Open the .jnlp file Hour: _____________

1st FBD

2nd FBD

1. Click the tabs "Graph Applied Force", "Graph Acceleration", "Graph Velocity", and "Graph Position" to open these graphs.
2. **In the upper right of the simulation, <u>make sure friction is turned "off"</u>**
3. Make sure the "File Cabinet" is selected, and the initial position is set to -7.0 m (negative seven meters).
4. Draw the free-body diagram <u>found in the upper left corner of the sim</u> in the 1st box above.
5. In the upper left of the simulation, set the applied force to 200. This is in Newtons (N), **<u>but only type</u> in "*200*" in the sim, and then press "Enter" on the keyboard.**
6. Draw the *new* free-body diagram in the box labeled 2nd FBD, now that you have added a force of 200 N to the system.
7. Note: The sim is currently paused. What do you expect the net force will cause the file cabinet to do when you click "Go" in the sim?

   ____
8. Click "Go" near the upper left corner of the sim. **Let it run for about 10 seconds and then <u>Pause</u> the sim.**
9. Label and Graph each of the following: Total (Net) Force, Acceleration, Velocity, and Position. Include title, scaling, units, and graphed line for each of the four graphs. Include scaling for at least 5 seconds of time in the *X*-axes below (time is almost always graphed on the *X*-axis).
   The *Y*-intercept of Force vs. Time is____. The *Y*-intercept of Acceleration v. Time is____
   The *Y*-intercept of Velocity vs. Time is_____. The *Y*-intercept of Position v. Time is____

These *Y* – intercepts represent the _______________, _______________, ________________, and ______________ at time $t = 0$.

10. Now turn friction “on.”
11. Clear the graphs by pressing “Clear”. Then “Yes”, you want to clear the graphs.
12. Again, set the “Applied Force” to 200 (Newtons). Press “Enter” on your keyboard.
13. Draw the new free-body diagram in the space to the right:
14. What is the total/net force? _______ Why?
    ____
15. How do you predict the cabinet will behave when you press “Go” on the sim?__________________________________
16. Press “Go” on the sim. Were you correct?______________

Did the Cabinet move?________________________________

17. Now Clear the graphs by pressing “Clear”. Then “Yes”, you want to clear the graphs.
18. Set the “Applied Force” to 600 (Newtons). Press “Enter” on your keyboard.
19. Draw the new free-body diagram in the space to the right:
20. Is there a total/net force? _______ How do you know?
    ____
21. How do you predict the cabinet will behave when you press “Go” on the sim?__________________________________
22. Press “Go” on the sim. Were you correct?______________

Did the Cabinet move?________________________________

3rd FBD

4th FBD

23. Record the new graphs and include all relevant markings on the next page.
24. Record *all* observations you notice, *especially observations that relate to the force and acceleration graphs*, but other graphs too: ___________________________________
    ____
    ____
    ____
    ____
    ____
    ____
    ____
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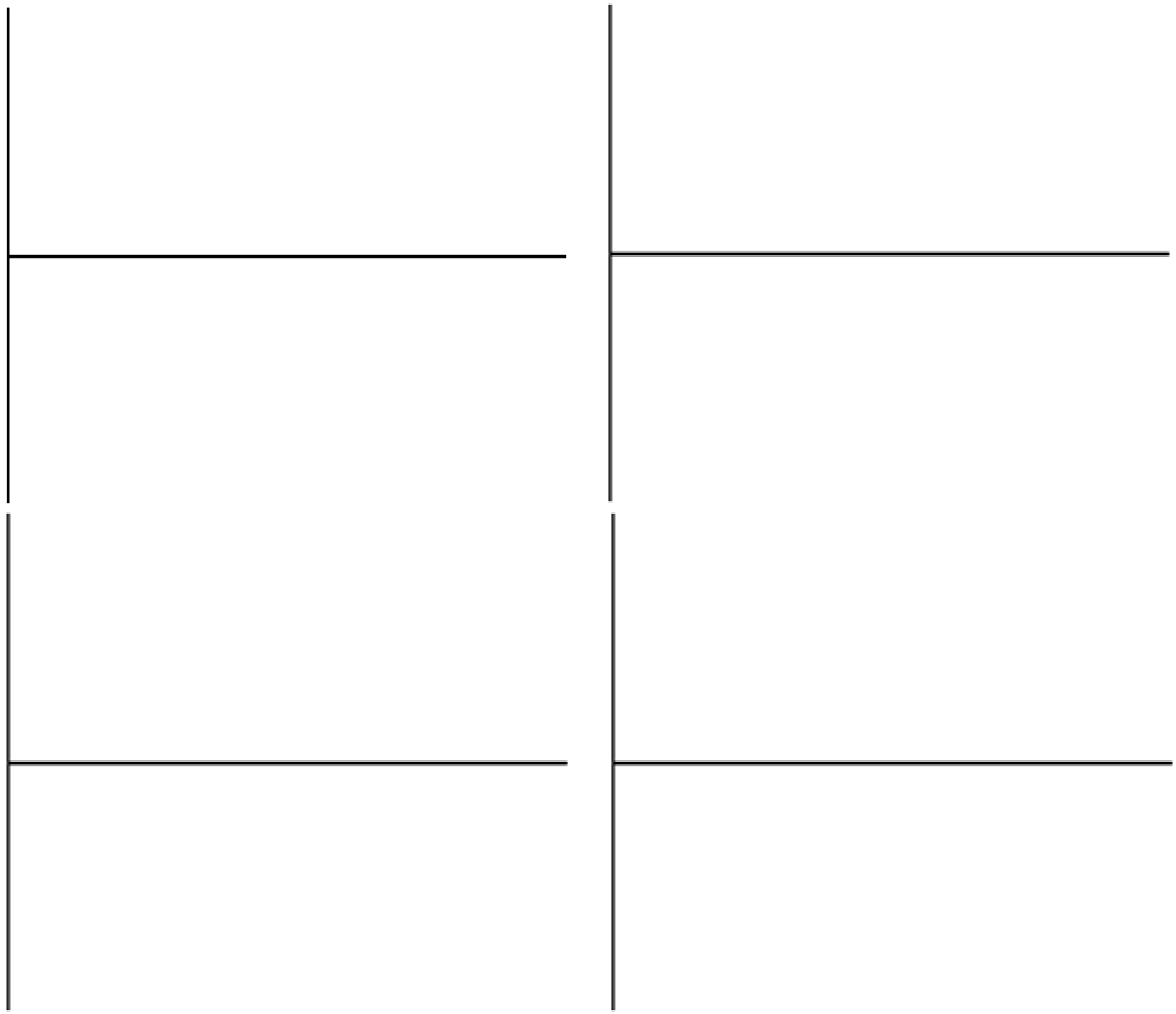

The mass of the cabinet is 200 kg (m = 200kg).
The coefficient of static friction $\mu_S = 0.3$
The normal force **of an object on flat ground** is F_N = mass $*$ gravity = mass $*$ 9.8 m/s^2. Note that this is equal in magnitude and opposite in direction of the equation for the force due to gravity (also known as *weight*):

$$F_g = m * g$$

The maximum opposing force due to static friction is F_S, and is given by:

$$F_S = \mu_S * F_N = \mu_S * m * g$$

25. Calculate the maximum force due to static friction, using the information above, in the space below.

26. Predict the amount of force it would take to get the cabinet moving, that is, how much force would be required to overcome static friction and produce a net horizontal force?