Name: ______________________________________ Date: ______________________ Block: ______

Physics 11: Forces – Three PhET Simulations

Part 1 – Universal Gravitation

- Search up "Gravity Force Lab"
- Place blue mass (m_1) to the far left and set to 100 kg.
- Place ruler "zero" mark right at center of blue mass.
- Place the center of the red mass (m_2) at the 10 m mark and set mass to 100 kg also.

1. State the F_g in scientific notation:
2. Calculate F_g using the equation for universal gravitation and show work:

3. How do the values in step 1 and 2 compare?

4. Double the size of m_1 (blue). What is F_g now?
   How does this compare to the value in step 1?

5. Return m_1 to 100 kg. Now move m_2 to half the distance (5 m) and state the F_g.

   How does this compare to step 1? (State as a ratio or a fraction)

Part 2 – Friction

- Search up "Forces and Motion: Basics" and select the ***Friction*** module
- Check the boxes for "sum of forces", "values", and "masses"

1. Without changing anything, slowly build up the applied force until F_A just overcomes F_f. What was the critical force when F_A was <u>just</u> equal to F_f? (i.e. when $F_A = F_f$)

2. Calculate the μ_s (static coefficient of friction) with the information in step 1.
   m =
   g =
   F_f =

3. Notice that as soon as the box begins to move in step 1, it begins to accelerate. If the force is reduced, however, the velocity of the box can be held steady when F_A and F_f are equal. Find out what force is required to keep the box moving at a <u>constant velocity</u> after it's moving (when the "sum of forces" is equal to 0).

   Now calculate μ_k (kinetic coefficient of friction) with the information in step 3.
   m =
   g =
   F_f =

Name: ____ Date: _______________________ Block: ______

4. Add the fridge (200 kg) on top of the box and apply the F_A required to get the box moving in step 1. Does the load move?

   Why or why not?

5. Now click the circular 'reset' button; also check the same boxes as before. Begin to push the box so that it gets moving and then let go. What force or forces act on the box after you let go?

   Could we say that the box is accelerating?

6. If so, calculate the acceleration (make sure the sign is correct).
   F_{Net} =
   m =

<u>Part 3 – Springs (Hooke's Law)</u>

- Search up "Hooke's Law" and select ***Intro*** Module
- Check <u>all</u> boxes to view forces, displacement, etc.
- Select 2 spring option

1. Stretch the 1st spring with 100 N of applied force by grabbing the red base of the clamp.
   Compress the 2nd spring with an applied force of 100 N
   What is the Δx for:
   Spring 1 =
   Spring 2 =
2. Now click reset and increase the spring constant to 1000 N/m. Stretch the spring with 100 N.
   What is the Δx now?

   Why doesn't the spring move as far as in step 1 when the same force is applied?

- Now select the ***Energy*** module of the same simulation
- Check <u>all</u> boxes to view forces, displacement, etc.
- Select the option to see a 'Force Plot'

3. Increase the spring constant to 300 N/m and stretch the spring to 1 m.
4. Calculate the slope of the line of the graph.
   $\frac{rise}{run} =$

   What does the slope of the graph represent?