## BIG PICTURE IDEAS

#1) _____ can be used to determine the gravitational force between any two masses.

#2) An ideal _____ is proportional to its displacement from equilibrium position.

#3) The net force in the in-direction acting an object moving along a circular path is called _____.

## Topic 2.6b – Universal Gravitation and Gravitational Field

1) The equation for the magnitude of the gravitational force using Newton's Law of Universal Gravitation is:

   a) G is the _____ and has a value of _____.

      i) However, I do not have to _____ this number because it is on the _____!

   b) m represents the _____ of the two objects which are interacting via the gravitational force.

   c) r is not the _____. r is the distance between the _____ of the two objects.

      i) This could be confusing, because sometimes r is the _____.

   d) The gravitational force is always directed along a line connecting the _____ of the two objects.

      i) The gravitational force on each of the two masses is always directed _____ the other mass.

   e) The gravitational forces acting on both masses have the same _____.

2) In the narrow band of altitudes which humans live on this planet*, the local gravitational field, g, is nearly _____ and can be treated as _____ with negligible error and the local gravitational field is directed _____.

   a) The equation for the gravitational force in that gravitational field is $F_g = mg$, however, a subscript is missing on the mass. The subscript missing on the mass is the mass of the _____.

      i) This gravitational force equation describes the interaction between 2 masses; mass of the _____ and mass of the _____.

   b) On the surface of a planet, gravitational force is also called _____.

   c) The gravitational field can be determined by dividing the _____ exerted by the field on a test mass by the _____ of the test mass.

      i) This is easy to remember because it is a rearrangement of the _____ equation.

         Like this:

3) The equation for the gravitational field on the surface of any planet, g, can be derived using Newton's Law of Universal Gravitation.

   Like this:

* If this does not apply to you, and you are currently working on this Study Guide, please contact me. I have some questions.

## Topic 2.6b – Universal Gravitation and Gravitational Field (continued)

4) If the only force acting on the object is the gravitational force, then the object is in _____, and the _____ of the object has the same magnitude as the gravitational field, g.

   a) The units of the free fall acceleration are _____ and the units of the gravitational field are _____ .

   b) I can show these two units are equivalent. Look! See! →

   c) On the AP Physics 1 exam, we can approximate g near the surface of planet Earth to be:

5) The _____ force is a field force. Field forces occur when two objects interact without touching each other.

   a) Other examples of field forces are the electric force and the magnetic force which are not discussed in AP Physics 1.

## Topic 2.8 – Spring Force

1) An ideal spring force is _____ to its displacement from equilibrium position.
2) The direction of the spring force is always toward _____.

3) The equation for the spring force is called _____ law and it is _____.

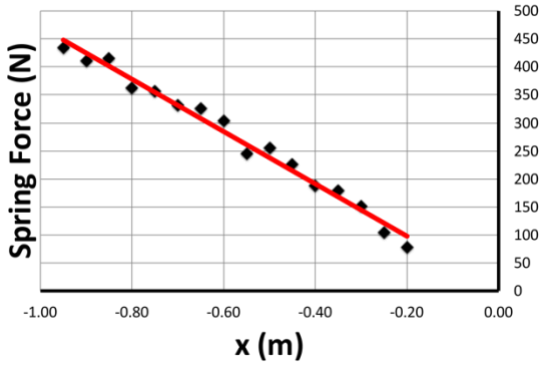
   a) k is the _____ and is a measure of how much _____ it takes to compress or expand a spring per _____. In other words, a larger spring constant will have _____ resistance to changes in distance from _____ position.

      i) Typical units for k are _____ and k is _____ positive.

   b) $\Delta x$ is the _____ of the system/object from _____ position.

   c) The _____ of the slope of a graph of _____ vs. _____ is the spring constant.

4) The negative in Hooke's law represents that the spring force and the displacement of the object from rest position are _____ in direction.
5) An ideal spring has _____ mass.
6) Using the graph to the right, determine the spring constant of the spring:



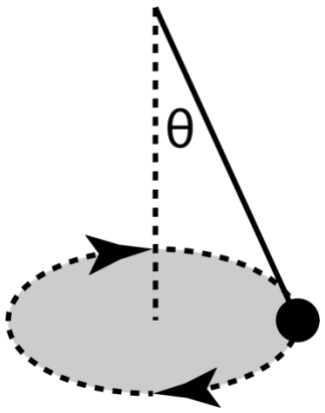
## Topic 2.9 – Circular Motion

1) The linear velocity of an object moving along a circular path is called _____ which is always directed _____ to the radius describing the path and _____ to the path itself.
2) An object, moving along a circular path, must have a _____ acceleration which is always directed _____ toward the _____ of the circle.
   a) Acceleration equals change in _____ over change in _____. And velocity is _____, which means it has both _____ and _____.
   b) The reason an object moving along a circular path must have a _____ acceleration is because the _____ of the tangential velocity of the object is always changing.
      i) This _____ acceleration equals the square of _____ divided by _____.
3) An object, moving along a circular path at a constant speed, can be defined using the following terms:
   a) The time it takes the object to complete one circle is defined as the _____ the symbol for which is ____.
   b) The number of _____ completed by the object per _____ is defined as frequency. The symbol for which is _____.
      i) These two terms are _____ related to one another to using the following equation _____.
   c) Starting with the equation for speed, I can derive the equation for the period of an object traveling at a constant speed in a circular path in terms of radius, r, and tangential speed, v. And yes, I recognize that, for speed here mr.p is using "$v_t$" and I can let that go. Circle → Yes, I can *let it go*.

4) _____ force is the _____ force in the _____ direction or the "center seeking" force which causes the _____ acceleration of the object _____ toward the center of the circle.
   a) The equation for centripetal force is _____.
   b) The centripetal force is _____ a new force.
   c) The centripetal force is _____ in a free body diagram.
   d) When summing the forces in the "in" direction, the direction "in" is _____ and the direction "out" is _____.

## Topic 2.9 – Circular Motion (continued)

5) A simple pendulum is rotating in a horizontal circle where the rope makes an angle θ with the vertical as shown. To clarify, the shaded area is in a horizontal plane and the pendulum bob is moving along that horizontal circle.




a) Draw the free body diagram of all the forces acting on the pendulum bob.

b) What force(s), or force component(s), is(are) the centripetal force acting on the pendulum bob?