AP Physics C
HW Set 7
Gravitation

1. **The force exerted by a non-linear spring is given by $F(x) = 3x^3$ [N]. What is the change in elastic potential in the spring when it is stretched from 3 [m] to 8 [m]?**

2. **A bullet of mass 1 [kg] is fired into a block of wood of mass 291 [kg] that is fixed in place. The velocity of the bullet the instant before it impacts the block is 279 [m/s]. The bullet enters the wood block and experiences a frictional force F = -51v [N].**

3. **A bullet of mass 1 [kg] is fired into a block of wood of mass 220 [kg] that is fixed in place. The velocity of the bullet the instant before it impacts the block is 3570 [m/s]. The bullet enters the wood block and experiences a frictional force F = -678v [N]. Calculate the DISTANCE the bullet travels inside the wood block before it comes to a stop.**

   (Hint: write a differential equation to obtain v(t). Then from v(t), you can derive x(t) as t goes to infinity)

4. **Zero, a hypothetical planet, has a mass of 3.0×10^{23} [kg], a radius of 3.0×10^6 [m], and no atmosphere. A 11 [kg] space probe is to be launched vertically from its surface.**
   a. **If the probe is launched with an initial kinetic energy of 5.0×10^7 J, what will be its kinetic energy when it is 4.0×10^6 [m] from the center of Zero?**
   b. **If the probe is to achieve a maximum distance of 8.0×10^6 [m] from the center of Zero, with what initial kinetic energy must it be launched from the surface of Zero?**

5. **A spaceship is on the surface of a spherical asteroid. The gravitational acceleration on the surface of the asteroid is 2.9 [m/s^2].**
   a. **What is the escape speed from this spherical asteroid if its radius is 500 [km]?**
   b. **How far from the surface will a particle go if it leaves the asteroid's surface with a radial speed of 1000 [m/s]?**
   c. **With what speed will an object hit the asteroid if it is dropped from 1000 [km] above the surface?**

6. **1998 #2**

AP FRQs

7. **2016 #3**

8. **2015 #3**

9. **1994 #3 (Gravitation)**

1. 3011.25 [J]

2. 169.22 [m/s]

3. 5.26 [m]

4a. 3.17×10^7 [J]
4b. 4.59×10^7 [J]

5a. 1700 [m/s]
5b. 2.63×10^5 [m]
5c. 1390 [m/s]

6.

7. Will discuss in class

8. Will discuss in class

9. Will discuss in class