Dear AP Physics C Student:

I am excited to have you in AP Physics C next year. It will be a fun, though difficult class. The material is not difficult, only that we cover a lot of material quickly.

AP Physics C is much less conceptual than AP Physics 1 and you will be solving problems to get numeric or algebraic answers more than you did with AP Physics 1. You will be using Calculus on a regular basis in this class as a result of non constant forces, charge and mass distributions. You should be comfortable with simple polynomial derivatives and integrals.

I teach this class with an assumption that you have already taken AP Physics 1 and passed with an A or B. If you have NOT taken AP Physics 1, I strongly recommend getting Princeton – AP Physics 1 review book and working though all the chapters and chapter problem sets before starting this class.

The following summer assignment is due the first day of class. The summer assignment is worth 40 homework/classwork points and should be turned as a paper copy with your name and period included at the beginning of the first day. No textbook is required to complete this assignment.

I will occasionally check my e-mail during the summer break; you may contact me by e-mail (jnaumann@vcs.net) to arrange to meet if you are having problems with the assignment. You should aim to start the assignment as soon as possible and to complete it before August 1st. Don't try to do it all in one sitting, but rather work one section at a time.

Finding Derivatives

1.

Find the derivative of each of the following functions and simplify.

1. $f(x) = 4x^2 - 6$
2. $f(x) = 5x^3 - 3x$
3. $f(x) = 4x^3 - 3x^2 + 2x - \pi$
4. $f(x) = -3(2x^2 - 5x + 1)$
5. $f(x) = (3x - 2)(2x + 1)$

Finding integrals of polynomial functions

2. Find the antiderrivative (integral) of each of the following.

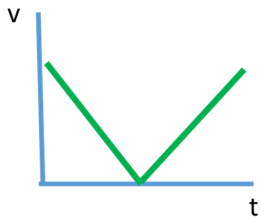
   1. $\int 3x^2 + 2x + 1)dx$
   2. $\int 5x - x^5 + 8)dx$
   3. $\int(\sqrt{x} + x^{2/3} + \frac{x^2}{x^{1/3}}dx$
   4. $\int(sinx - cosx)dx$
   5. $\int \frac{1}{x}dx$

3. Mechanics review

a. **Kinematics.** An object is launched at a velocity of 20 m/s in a direction making an angle of 25° upward with the horizontal.

1. What is the maximum height reached by the object?
2. What is the total flight time (between launch and touching the ground) of the object?
3. What is the horizontal range of the object?
4. What is the magnitude of the velocity of the object just before it hits the ground?

b. **Kinematics graphing.** Given the Velocity vs time graph below



1. Sketch the Acceleration vs time graph and

2. Sketch the Position vs time graph (assume position =0 at t=0)

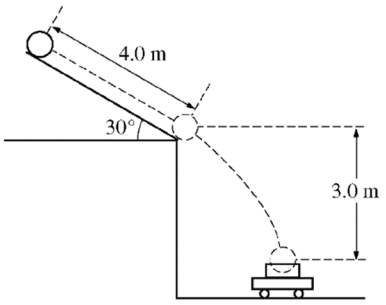
c. **Dynamics.** A father is pulling his daughter uphill on a sled in slushy snow. The daughter has a mass of 25 kg; the sled has a mass of 4 kg. The coefficient of kinetic friction between the hill and the sled is 0.25 and the coefficient of static friction between the hill and the sled is 0.35. How hard does the father have to pull the sled in order to keep it moving at a constant velocity? The hill makes an angle of 15.5° with the horizontal.

i. Draw a picture

ii. Draw a FBD

iii. Write newton's second law equations and solve

d. **Work / Energy/ Momentum.** A bowling ball of mass 6.0 kg is released from rest from the top of a slanted roof that is 4.0 m long and angled at 30° , as shown above. The ball rolls along the roof **without slipping**. The rotational inertia of a sphere of mass *M* and radius *R* about its center of mass is $\frac{2}{5}MR^2$.



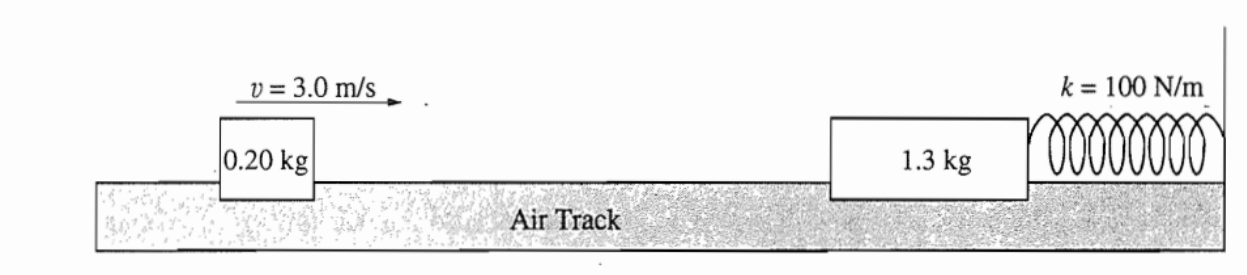
Note: Figure not drawn to scale.

i. Calculate the force due to friction acting on the ball as it rolls along the roof. If you need to draw anything other than what you have shown in part a. to assist in your solution, use the space below. Do NOT add anything to the figure in part a.

ii. Calculate the linear speed of the center of mass of the ball when it reaches the bottom edge of the roof.

iii. A wagon containing a box is at rest on the ground below the roof so that the ball falls a vertical distance of 3.0 m and lands and sticks in the center of the box. The total mass of the wagon and the box is 12 kg. Calculate the horizontal speed of the wagon immediately after the ball lands in it.

Oscillations: As shown above, a 0.20-kilogram mass is sliding on a horizontal friction less air track with a speed of 3.0 meters per second when it instantaneously hits and sticks to a 1.3-kilogram mass initially at rest on the track. The 1.3-kilogram mass is connected to one end of a mass less spring, which has a spring constant of 100 newtons per meter. The other end of the spring is fixed.



1. Determine the following for the 0.20-kilogram mass immediately before the impact.
    a. Its linear momentum

    b. Its kinetic energy

2. Determine the following for the combined masses immediately after the impact
    a. The linear momentum

    b. The kinetic energy

3. After the collision, the two masses undergo simple harmonic motion about their position at impact.
    a. Determine the amplitude of the harmonic motion.

    b. Determine the period of the harmonic motion.