

Dear AP Physics C Student,

I am absolutely thrilled to have you in AP Physics C! It is going to be a great experience, though I want to be clear that it is also a rigorous and fast-paced course.

In this class, we'll be balancing deep conceptual thinking with serious mathematical problem-solving. 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 through all the chapters and chapter problem sets before starting this class. We will move through mechanics quickly, and I will be assuming that you retain the knowledge you gained in AP Physics 1.

The following summer assignment is due the first day of class. The summer assignment is worth 40 homework/classwork points and should be turned in 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 (areynolds@warriorlife.net) if you have questions. (Note: I will *not* be checking my VCS email throughout the summer.) 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. Also, if you need assistance remembering concepts, I recommend visiting <https://www.flippingphysics.com>. There are a plethora of useful videos on that site.

I am looking forward to teaching you in August! Have a wonderful summer!

Mrs. Reynolds

Derivatives

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. $f(x) = (3x - 2)(2x + 1)$

Integrals

Find the antiderivative (integral) of each of the following.

6. $\int(3x^2 + 2x + 1)dx$

7. $\int(5x - x^5 + 8)dx$

8. $\int(\sqrt{x} + x^{2/3} + \frac{x^2}{x^{1/3}})dx$

9. $\int(\sin(x) - \cos(x))dx$

10. $\int\left(\frac{1}{x}\right)dx$

Kinematics

11. A potato is launched at a velocity of 20 m/s in a direction making an angle of 25° upward with the horizontal. This potato is in Illinois, so you can assume that the ground is very flat and there are no hills.

a. What is the maximum height of the potato?

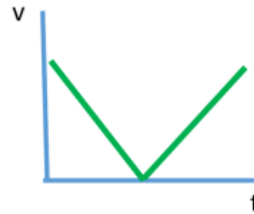
b. What is the total flight time (between launch and touching the ground) of the potato?

- c. What is the horizontal range of the potato?

- d. What is the magnitude of the velocity of the potato just before it hits the ground?

12. Given this velocity vs time graph:

- a. Sketch the acceleration vs time graph:



- b. Sketch the position vs time graph (assume position is zero at $t = 0$).

Dynamics

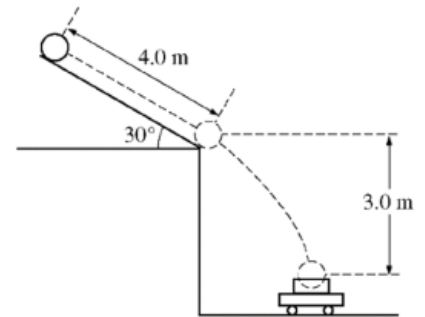
- 13. A father (named Chris) is pulling his daughter (named Evelyn) uphill on a sled in slushy snow. Evelyn has a mass of 25 kg; the sled has a mass of 4 kg. The coefficient of kinetic friction between the hill and the sled is 0.25 and the coefficient of static friction between the hill and the sled is 0.35. How hard does Chris 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.
 - a. Draw a picture.

- b. Draw a FBD
- c. Use Newton's second law equations and solve.

Work / Energy / Momentum

14. 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 below. 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 $\frac{2}{5}MR^2$.

- a. Draw a FBD of the ball and calculate the force due to friction acting on the ball as it rolls along the roof.

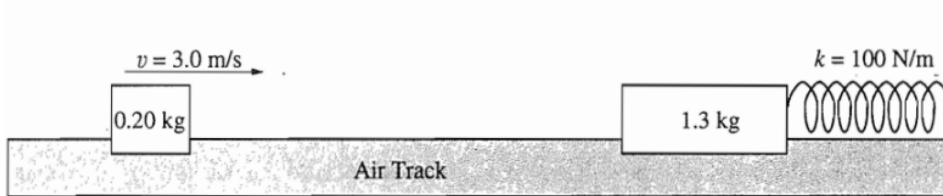


Note: Figure not drawn to scale.

- b. Calculate the linear speed of the center of mass of the ball when it reaches the bottom edge of the roof.
- c. 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. (Assume the box is able to move freely in the horizontal direction.)

Oscillations

15. As shown below, a 0.20-kilogram mass is sliding on a horizontal frictionless 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 massless spring, which has a spring constant of 100 newtons per meter. The other end of the spring is fixed.



- a. Determine the following for the 0.20 kg mass immediately before the impact.
 - i. Its linear momentum

 - ii. Its kinetic energy

- b. Determine the following for the combined masses immediately after the impact.
 - i. The linear momentum

 - ii. The kinetic energy

- c. After the collision, the two masses undergo simple harmonic motion about their position at impact.
 - i. Determine the amplitude of the harmonic motion.

 - ii. Determine the period of the harmonic motion.

