AP Physics 1: Summer Assignment

Welcome to AP Physics 1! Attached is the summer assignment, which consists of two parts. The first part is an easy read about the fundamental physics concepts and processes we will be applying throughout the upcoming school year. There are a few follow up questions to review the reading.

The second part of the summer assignment sets the foundation for the first unit we will be focusing on—Kinematics, which is the study of an object's motion. Throughout the one dimension kinematics chapter you will find many examples of experiments, conceptual and quantitative questions, as well as, real-life application problems. Do not memorize concepts as you go, instead, make sense of the concepts and quantitative reasoning. Use the diagrams, graphs, and example problems throughout the chapter to fully understand the written text.

For the experiment tables throughout the chapter, you will see QR codes in the upper right hand corner of the tables. Using a QR scanner app on a smartphone (free apps for this purpose are available on iPhones and Androids), or a QR scanner website and webcam, you can scan the code and get access to the corresponding experimental videos. These experimental videos are there for you to visualize the experiments and make sense of the patterns discussed in the text.

You are expected to complete all the problems for the kinematics unit. These problems combine conceptual and quantitative concepts through open-ended, multiple-choice, and multi-step problems. You will be responsible for explaining your reasoning behind problems and how you completed them. Do not just fill in answers just to show you 'completed' the work; instead, provide meaningful answers. If you get stuck, write down what part you are confused on and why. This way, we can specifically address any issues without wasting time. This assignment will be graded.

If you have any questions about the assignment, or you are stuck on a question, feel free to send an email.

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Have a great summer! Look forward to seeing you in September!

THE READING PACKETS WERE HANDED OUT DURING THE MEETING. IF YOU WOULD LIKE A COPY, PLEASE SEND AN EMAIL.

Name_______________________________________

Introducing Physics

The "Introducing Physics" reading serves as a foundation to understanding the fundamental processes used by physicists. These processes include collecting and analyzing data, devising explanations and testing them, using multiple representations, deriving mathematical relations, and further applying these concepts to other fields.

Answer the following questions thoroughly as a review for the attached reading.

1. Explain the purpose of an observational experiment, and what scientists gain from these types of experiments.

2. Many students think a *hypothesis* and *prediction* are interchangeable. Identify the difference between these two terms and how they are used in testing experiments.

3. What is the purpose of making assumptions in experiments?

4. Identify the difference between physical quantities and units. Provide examples of both.

5. Identify the difference between scalar and vector quantities.

6. You will be applying the problem solving strategy throughout the year. Some topics will lend themselves to more detailed strategies than others. In your own words, summarize the steps of the problem solving strategy.

7. What are the units for the following SI physical quantities?

   a. Time:
   b. Mass:
   c. Length

Kinematics: Motion in One Dimension

Part 1: Review Questions

1. 1.1: Physicists say, "Motion is relative." Why is this true?

2. 1.2: What information about a moving object can we extract from a motion diagram?

3. 1.3: Sammy went hiking between two camps that were separated by about 10 kilometers (km). He hiked approximately 16 km to get from one camp to the other. Translate 10 km and 16 into the language of physical quantities.

4. 1.4: A position versus time graph representing a moving object is shown in Figure 1.10 (pg. 13). What are the positions of the object at clock reading 2.0 s and 5.0 s?

5. 1.5: Why is the following statement true? "Displacement is equal to the area between a velocity versus time graph line and the time axis with a positive or negative sign." You may provide an example to support your reasoning.

6. 1.6: (a) Give an example in which an object with negative acceleration is speeding up.
(b) Give an example in which an object with positive acceleration is slowing down.

7. 1.7: A car's motion with respect to the ground is described by the following function: $x = (-48m) + \left(12\frac{m}{s}\right)t + (-2\frac{m}{s^2})t^2$
Mike says that its original position is (-48 m) and its acceleration is (-2 m/s^2). Do you agree?
Based on the car's motion, determine how long it would take for the car to come to a stop.

8. 1.8: Free-fall acceleration can be either positive or negative. Why is this true?

Part 2: Conceptual Exercises, Quantitative Exercises, and Examples

1. Based on conceptual exercise 1.1 (pg. 8), create your own "Try it yourself" question and solution based on the concept of motion diagrams.

2. Based on conceptual exercise 1.2 (pg. 12-13), could there have been an observer that had the same recorded values as shown in Table 1.6? Explain.

3. Based on example 1.4 (pg. 16-17), would the answer change if you were running at 4 m/s instead of 5m/s? Show all work.

4. Based on example 1.6 (pg. 21), if an object's acceleration and velocity have the same sign (both positive or both negative), what does that tell you about the object's motion? If the object's acceleration and velocity have opposite signs (one is positive, and the other is negative), what does that tell you about the object's motion? Try to support your answer with motion diagrams.

5. Refer to the example 1.7 (pg. 24). The answers for the "Try it yourself" questions *a* and *b* are provided. Explain how they came up with these answers mathematically.

6. Refer to the example 1.8 (pg. 25). The answers for the "Try it yourself" questions (Determine the time when Jim and Sarah are at the same position, and where that position is.) are provided. Show how these answers were found based on the equations that represent Jim and Sarah's motion.

7. Refer to the example 1.10 (pg. 27). Come up with your own scenario based on the same mathematical representation.

8. Follow the detailed problem solving strategy example on pages 28-29. This is an ideal example of a solution.
Based on the "Try it yourself" question, create a velocity versus time graph representing the motion of the cyclist. Explain how you know the graph accurately represents the cyclist's acceleration.

Part 3: Multiple Choice Questions

1. Match the general elements of physics knowledge (left) with the appropriate examples (right).

Model of a process	Free fall
Model of an object	Acceleration
Physical quantity	Rolling ball
Physical phenomenon	Point-like object

a. Model of a process- acceleration; model of an object- point-like object; physical quantity- free fall; physical phenomenon- rolling ball.
b. Model of a process- rolling ball; model of an object- point-like object; physical quantity- acceleration; physical phenomenon- free fall.
c. Model of a process- free fall; model of an object- point-like object; physical quantity- acceleration; physical phenomenon- rolling ball.

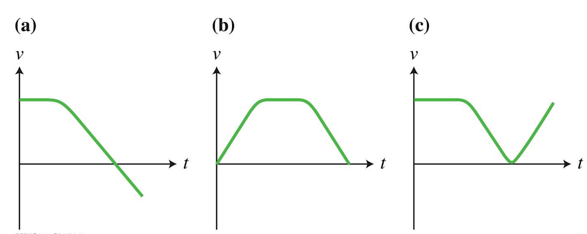
2. Which group of quantities below consists only of scalar quantities?
a. Average speed, displacement, time interval
b. Average speed, path length, clock reading
c. Temperature, acceleration, position

3. Which of the following are examples of time interval?
(1) I woke up at 7am.
(2) The lesson lasted 45 minutes.
(3) Svetlana was born on November 26.
(4) An astronaut orbited Earth in 4 hours.

a. 1, 2, 3, and 4
b. 2 and 4
c. 2
d. 4
e. 3

4. An object moves so that its position depends on time as $x = +12 - 4t + t^2$. Which statement below is not true?
a. The object is accelerating
b. The speed of the object is always decreasing
c. The object first moves in the negative direction and then in the position direction.
d. The acceleration of the object is +2 m/s^2.
e. The object stops for an instant at 2 s.

5. Choose a correct approximate velocity versus time graph for the following hypothetical motion: a car moves at constant velocity, and then slows to a stop and without a pause moves in the opposite direction with the same acceleration.

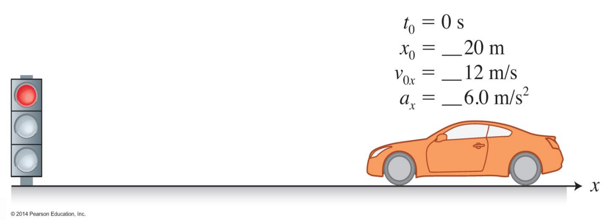


6. In which case are average and instantaneous velocities the same? Explain.
a. When the object moves at constant velocity
b. When the object moves at constant acceleration
c. When the object does not move
d. a and c
e. a, b, and c

7. You drop a small ball, and then a second small ball. When you drop the second ball, the distance between them is 3 cm. What statement below is correct? Explain.
a. The distance between the balls stays the same.
b. The distance between the balls decreases.
c. The distance between the balls increases.

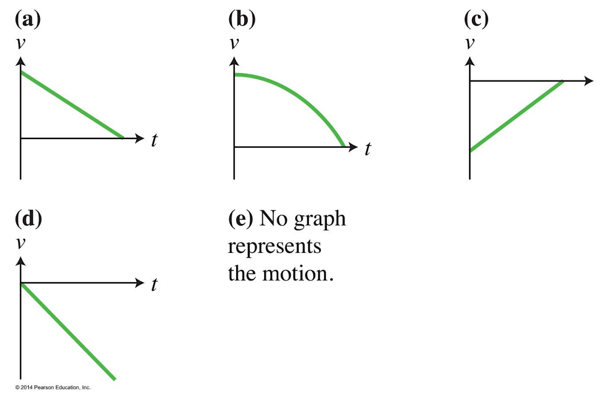
8. An apple falls from a tree. It hits the ground at a speed of about 5.0 m/s. What is the approximate height of the tree?
a. 2.5 m
b. 1.2 m
c. 10.0 m
d. 2.4 m

9. Your car is traveling west at 12 m/s. A stoplight (the origin of the coordinate axis) to the west of you turns yellow when you are 20m from the edge of the intersection. You apply the brakes and your car's speed decreases. Your car stops before it reaches the stoplight. What are the signs for the components of kinematics equations?



	x_0	v_{0x}	a_x
(a)	+	−	−
(b)	+	−	+
(c)	+	+	−
(d)	+	+	+
(e)	−	−	+

10. Which velocity versus time graph describes the motion of the car in the previous problem as it approaches the stoplight?



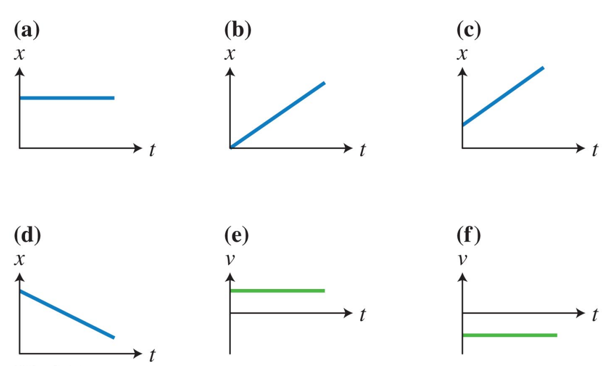
11. You throw a small ball upward. Then you throw it again, this time at twice the initial speed. Choose the correct statement.
- **a.** The second time, the ball travels twice as far up as the first time.
- **b.** The second time, the ball has twice the magnitude of acceleration while in flight compared to the first time.
- **c.** The second time, the ball spends twice as much time in flight.
- **d.** All of the choices are correct.

12. You throw a small ball upward and notice the time it takes to come back. If you then throw the same ball so that it takes twice as much time to come back, what is true about the motion of the ball the second time?
- **a.** Its initial speed was twice the speed in the first experiment.
- **b.** It traveled an upward distance that is twice the distance of the original toss.
- **c.** It had twice as much acceleration on the way up as it did the first time.
- **d.** The ball stopped at the highest point and had zero acceleration at that point.

Part 4: Conceptual Questions

1. What is the difference between speed and velocity? Between distance and displacement?

2. Lance Armstrong is cycling along an 800 m straight stretch of track. His speed is 13 m/s. Choose all of the graphical representations of motion that correctly describe Armstrong's motion. Explain your choices.

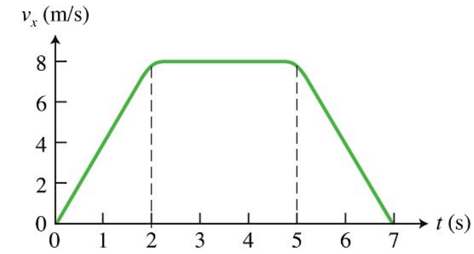


3. Can an object have nonzero velocity and zero acceleration? If so, give an example.

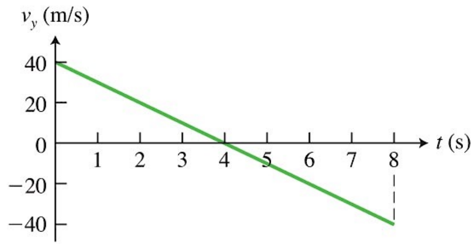
4. Can an object at one instant of time have zero velocity and nonzero acceleration? If so, give example.

5. Devise a story describing each of the motions shown in each of the graphs below. Identify the object of reference.

(a)



(b)



6. Your little sister has a battery-powered toy truck. When the truck is moving, how can you determine whether it has constant velocity, constant acceleration, or changing acceleration? Explain in detail and support your explanation with motion diagrams.

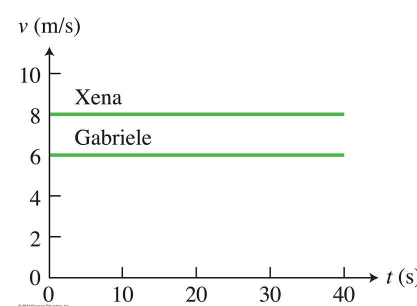
Part 5: General Problem Solving: Follow the problem solving strategy for the following problems.

1. The graph below shoes a velocity versus time graph for the bicycle trips of two friends with respect to the parking lot where they started.

a. Determine their displacements in 20 s.

b. If Xena's position at time zero is 0 m and Gabriele's position is 60 m, what time interval is needed for Xena to catch Gabriele?

c. Use the information from *b* to write a function x(t) for Gabriele with respect to Xena.



2. You are walking to your physics class at a speed of 1 m/s with respect to the ground. Your friend leaves 2 minutes after you and is walking at a speed of 1.3 m/s in the same direction. How fast is she walking with respect to you? How far does your friend travel before she catches up with you? Describe any assumptions you made.

3. Jim is driving his car at 32 m/s (72 mi/hr) along a highway where the speed limit is 25 m/s (55 mi/hr). A highway patrol car observes him pass and quickly reaches a speed of 36 m/s. At that point, Jim is 300 m ahead of the patrol car. How far does the patrol car travel before catching him?

4. A jogger is running at +4.0 m/s when a bus passes her. The bus is accelerating from +16 m/s to +20 m/s in 8 seconds. The jogger speeds up with the same acceleration. What can you determine about the jogger's motion using this information? (and solve for it)

5. In 1977, Kitty O'Neil drove a hydrogen peroxide-powered rocket dragster for a record time interval (3.22 s) and final speed (663 km/hr) on a 402-meter long Mojave Desert track. Determine her average acceleration during the race and the acceleration while stopping (it took about 20 seconds to stop). What assumptions did you make?

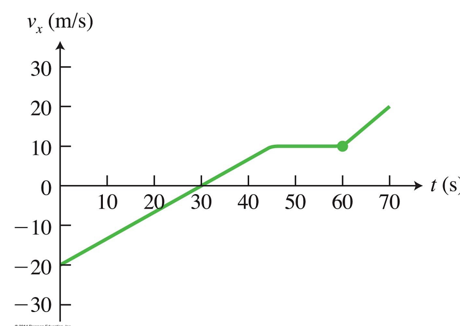
6. A spittlebug called the froghopper is believed to be the best jumper in the animal world. It pushes off with muscular rear legs for 0.0010 s, reaching a speed of 4 m/s. Determine its acceleration during this launch and the distance that the froghopper moves while its legs are pushing.

7. The changing velocity of a car is represented in the velocity versus time graph.

a. Describe everything you can about the motion of the car using the graph.

b. What is the displacement of the car between times 0 s and 45 s.

c. What is the average velocity of the car during all 70 s?



8. You accidentally drop an eraser out the window of an apartment 15 m above the ground.

a. How long will it take for the eraser to reach the ground?

b. What speed will it have just before it reaches the ground?

c. If you multiple the time interval answer from *a* and the speed answer *b*, why is the result much more than 15 m?

9. While skydiving, your parachute opens and you down slow from 50 m/s to 8 m/s in 0.8 s. Determine the distance you fall while the parachute is opening. Some people faint if they experience acceleration greater than 5*g* (5 times 9,8 m/s^2). Will you feel faint? Explain and discuss simplifying assumptions inherent in your explanation.

10. A driver with a 0.80 s reaction time applies the brakes, causing the car to have 7 m/s^2 acceleration opposite the direction of motion. If the car is initially traveling at 21 m/s, how far does the car travel during the reaction time? How far does the car travel after the brakes are applied and while skidding to a stop?