PH 201 Homework Assignment Chapter on 1 Dimensional Kinematics – 33 Problems Total

1. For each of the three pairs of positions listed in the following table, determine the magnitude and direction (positive or negative) of the displacement.

	Initial position x_0	**Final position x**
(a)	+2.0 m	+6.0 m
(b)	+6.0 m	+2.0 m
(c)	-3.0 m	+7.0 m

Solution for Problem 1

2. Due to continental drift, the North American and European continents are drifting apart at an average speed of about 3 cm per year. At this speed, how long (in years) will it take for them to drift apart by another 1500 m (a little less than a mile)?

Solution for Problem 2

3. You step onto a hot beach with your bare feet. A nerve impulse, generated in your foot, travels through your nervous system at an average speed of 110 m/s. How much time does it take for the impulse, which travels a distance of 1.8 m, to reach your brain?

Solution for Problem 3

4. One afternoon, a couple walks three-fourths of the way around a circular lake, the radius of which is 1.50 km. They start at the west side of the lake and head due south to begin with. **(a)** What is the distance they travel? **(b)** What are the magnitude and direction (relative to due east) of the couple's displacement?

Solution for Problem 4

5. An 18-year-old runner can complete a 10.0-km course with an average speed of 4.39 m/s. A 50-year-old runner can cover the same distance with an average speed of 4.27 m/s. How much later (in seconds) should the younger runner start in order to finish the course *at the same time* as the older runner?

Solution for Problem 5

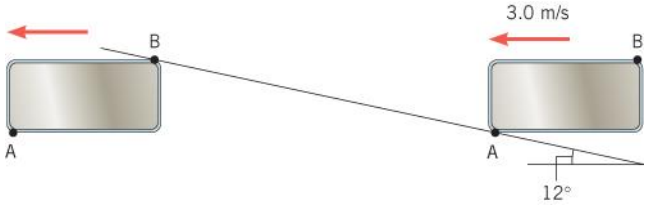
6. A tourist being chased by an angry bear is running in a straight line toward his car at a speed of 4.0 m/s. The car is a distance *d* away. The bear is 26 m behind the tourist and running at 6.0 m/s. The tourist reaches the car safely. What is the maximum possible value for *d*?

Solution for Problem 6

7. In reaching her destination, a backpacker walks with an average velocity of 1.34 m/s, due west. This average velocity results because she hikes for 6.44 km with an average velocity of 2.68 m/s, due west, turns around, and hikes with an average velocity of 0.447 m/s, due east. How far east did she walk?

Solution for Problem 7

8. You are on a train that is traveling at 3.0 m/s along a level straight track. Very near and parallel to the track is a wall that slopes upward at a 12° angle with the horizontal. As you face the window (0.90 m high, 2.0 m wide) in your compartment, the train is moving to the left, as the drawing indicates. The top edge of the wall first appears at window corner A and eventually disappears at window corner B. How much time passes between appearance and disappearance of the upper edge of the wall?



Problem 8

Solution for Problem 8

9. (a) Suppose that a NASCAR race car is moving to the right with a constant velocity of +82 m/s. What is the average acceleration of the car? **(b)** Twelve seconds later, the car is halfway around the track and traveling in the opposite direction with the same speed. What is the average acceleration of the car?

Solution for Problem 9

10. For a standard production car, the highest road-tested acceleration ever reported occurred in 1993, when a Ford RS200 Evolution went from zero to 26.8 m/s (60 mi/h) in 3.275 s. Find the magnitude of the car's acceleration.

Solution for Problem 10

11. A car is traveling along a straight road at a velocity of +36.0 m/s when its engine cuts out. For the next twelve seconds the car slows down, and its average acceleration is $\overline{a_1}$. For the next six seconds the car slows down further, and its average acceleration is $\overline{a_2}$. The velocity of the car at the end of the eighteen-second period is +28.0 m/s. The ratio of the average acceleration values is. $\overline{a_1}/\overline{a_2} = 1.50$ Find the velocity of the car at the end of the initial twelve-second interval.

Solution for Problem 11

12. Two motorcycles are traveling due east with different velocities. However, four seconds later, they have the same velocity. During this four-second interval, cycle A has an average acceleration of 2.0 m/s^2 due east, while cycle B has an average acceleration of 4.0 m/s^2 due east. By how much did the speeds *differ* at the beginning of the four-second interval, and which motorcycle was moving faster?

Solution for Problem 12

13. The left ventricle of the heart accelerates blood from rest to a velocity of +26 cm/s. **(a)** If the displacement of the blood during the acceleration is +2.0 cm, determine its acceleration (in cm/s^2). **(b)** How much time does blood take to reach its final velocity?

Solution for Problem 13

14. A jetliner, traveling northward, is landing with a speed of 69 m/s. Once the jet touches down, it has 750 m of runway in which to reduce its speed to 6.1 m/s. Compute the average acceleration (magnitude and direction) of the plane during landing.

Solution for Problem 14

15. Two rockets are flying in the same direction and are side by side at the instant their retrorockets fire. Rocket A has an initial velocity of +5800 m/s, while rocket B has an initial velocity of +8600 m/s. After a time *t* both rockets are again side by side, the displacement of each being zero. The acceleration of rocket A is –15 m/s^2. What is the acceleration of rocket B?

Solution for Problem 15

16. A car is traveling at 20.0 m/s, and the driver sees a traffic light turn red. After 0.530 s (the reaction time), the driver applies the brakes, and the car decelerates at 7.00 m/s^2. What is the stopping distance of the car, as measured from the point where the driver first sees the red light?

Solution for Problem 16

17. In a historical movie, two knights on horseback start from rest 88.0 m apart and ride directly toward each other to do battle. Sir George's acceleration has a magnitude of 0.300 m/s^2, while Sir Alfred's has a magnitude of 0.200 m/s^2. Relative to Sir George's starting point, where do the knights collide?

Solution for Problem 17

18. Two soccer players start from rest, 48 m apart. They run directly toward each other, both players accelerating. The first player's acceleration has a magnitude of 0.50 m/s^2. The second player's acceleration has a magnitude of 0.30 m/s^2. **(a)** How much time passes before the players collide? **(b)** At the instant they collide, how far has the first player run?

Solution for Problem 18

19. A car is traveling at a constant speed of 33 m/s on a highway. At the instant this car passes an entrance ramp, a second car enters the highway from the ramp. The second car starts from rest and has a constant acceleration. What acceleration must it maintain, so that the two cars meet for the first time at the next exit, which is 2.5 km away?

Solution for Problem 19

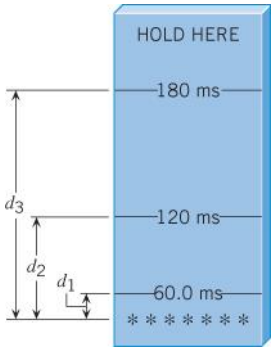
20. A train has a length of 92 m and starts from rest with a constant acceleration at time t = 0 s. At this instant, a car just reaches the end of the train. The car is moving with a constant velocity. At a time t = 14 s, the car just reaches the front of the train. Ultimately, however, the train pulls ahead of the car, and at time t = 28 s, the car is again at the rear of the train. Find the magnitudes of **(a)** the car's velocity and **(b)** the train's acceleration.

Solution for Problem 20

21. The greatest height reported for a jump into an airbag is 99.4 m by stuntman Dan Koko. In 1984 he jumped from rest from the top of the Vegas World Hotel and Casino. He struck the airbag at a speed of 39 m/s (88 mi/h). To assess the effects of air resistance, determine how fast he would have been traveling on impact had air resistance been absent.

Solution for Problem 21

22. The drawing shows a device that you can make with a piece of cardboard, which can be used to measure a person's reaction time. Hold the card at the top and suddenly drop it. Ask a friend to try to catch the card between his or her thumb and index finger. Initially, your friend's fingers must be level with the asterisks at the bottom. By noting where your friend catches the card, you can determine his or her reaction time in milliseconds (ms). Calculate the distances d_1, d_2, and d_3.



Solution for Problem 22

23. Two identical pellet guns are fired simultaneously from the edge of a cliff. These guns impart an initial speed of 30.0 m/s to each pellet. Gun A is fired straight upward, with the pellet going up and then falling back down, eventually hitting the ground beneath the cliff. Gun B is fired straight downward. In the absence of air resistance, how long after pellet B hits the ground does pellet A hit the ground?

Solution for Problem 23

24. A hot-air balloon is rising upward with a constant speed of 2.50 m/s. When the balloon is 3.00 m above the ground, the balloonist accidentally drops a compass over the side of the balloon. How much time elapses before the compass hits the ground?

Solution for Problem 24

25. A golf ball is dropped from rest from a height of 9.50 m. It hits the pavement, then bounces back up, rising just 5.70 m before falling back down again. A boy then catches the ball on the way down when it is 1.20 m above the pavement. Ignoring air resistance, calculate the total amount of time that the ball is in the air, from drop to catch.

Solution for Problem 25

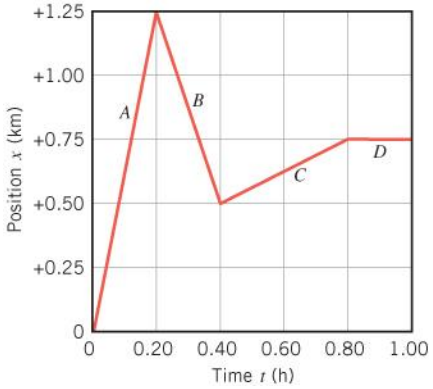
26. A cement block accidentally falls from rest from the ledge of a 53.0-m-high building. When the block is 14.0 m above the ground, a man, 2.00 m tall, looks up and notices that the block is directly above him. How much time, at most, does the man have to get out of the way?

Solution for Problem 26

27. While standing on a bridge 15.0 m above the ground, you drop a stone from rest. When the stone has fallen 3.20 m, you throw a second stone straight down. What initial velocity must you give the second stone if they are both to reach the ground at the same instant? Take the downward direction to be the negative direction.

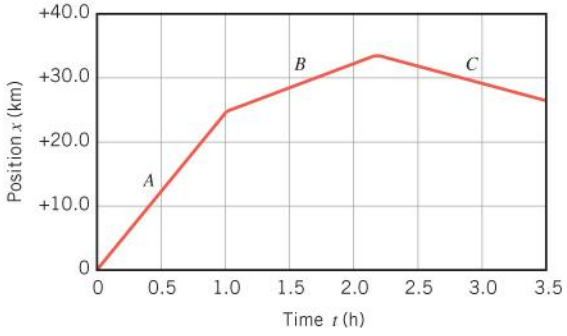
Solution for Problem 27

28. A person who walks for exercise produces the position–time graph given with this problem. **(a)** Without doing any calculations, decide which segments of the graph (*A*, *B*, *C*, or *D*) indicate positive, negative, and zero average velocities. **(b)** Calculate the average velocity for each segment to verify your answers to part (a).



Solution for Problem 28

29. A bus makes a trip according to the position–time graph shown in the illustration. What is the average acceleration (in km/h^2) of the bus for the entire 3.5-h period shown in the graph?



Solution for Problem 29

30. Electrons move through a certain electric circuit at an average speed of 1.1×10^{-2} m/s. How long (in minutes) does it take an electron to traverse 1.5 m of wire in the filament of a light bulb?

Solution for Problem 30

31. In 1998, NASA launched *Deep Space 1* (DS-1), a spacecraft that successfully flew by the asteroid named 1992 KD (which orbits the sun millions of miles from the earth). The propulsion system of DS-1 worked by ejecting high-speed argon ions out the rear of the engine. The engine slowly increased the velocity of DS-1 by about +9.0 m/s per day. **(a)** How much time (in days) would it take to increase the velocity of DS-1 by +2700 m/s? **(b)** What was the acceleration of DS-1 (in m/s^2)?

Solution for Problem 31

32. A woman and her dog are out for a morning run to the river, which is located 4.0 km away. The woman runs at 2.5 m/s in a straight line. The dog is unleashed and runs back and forth at 4.5 m/s between his owner and the river, until the woman reaches the river. What is the total distance run by the dog?

Solution for Problem 32

33. In a quarter-mile drag race, two cars start simultaneously from rest, and each accelerates at a constant rate until it either reaches its maximum speed or crosses the finish line. Car A has an acceleration of 11.0 m/s^2 and a maximum speed of 106 m/s. Car B has an acceleration of 11.6 m/s^2 and a maximum speed of 92.4 m/s. Which car wins the race, and by how many seconds?

Solution for Problem 33

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