Assignment P–09–1
(Motion)

1. A particle is moving in a circle of diameter 5 m. Calculate the distance covered and the displacement when it competes 3 revolutions.

2. A body thrown vertically upwards reaches a maximum height h. It then returns to the ground. Calculate the distance traveled and the displacement of the stone.

3. An object travels 16 m in 4 s and then another 16 m in 2 s. What is the average speed of the object?

4. Amit is moving in his car with a velocity of 45 km/h. How much distance will he cover (a) in one minute and (b) in one second?

5. The odometer of a car reads 2000 km at the start of a trip and 2400 km at the end of the trip. If the trip took 8 hr, calculate the average speed of the car in km/h and m/s.

6. A train travels some distance with a speed of 30 km/hr and returns with a speed of 45 km/h. Calculate the average speed of the train.

7. A car travels along a straight line for first half time with speed 40 km/h and the second half time with speed 60 km/h. Find the average speed of the car.

8. The position of a pine-wood derby car was observed at various times; the results are summarized in the table below. Find the average velocity of the car for (a) the first second, (b) the last 3 s, and (c) the entire period of observation.

x (m)	0	2.3	9.2	20.7	36.8	57.5
t (s)	0	1.0	2.0	3.0	4.0	5.0

9. The position versus time for a certain particle moving along the x axis is shown in Fig 1. Find the average velocity in the time intervals (a) 0 to 2 s, (b) 0 to 4 s, (c) 2 s to 4 s, (d) 4 s to 7 s, (e) 0 to 8 s.

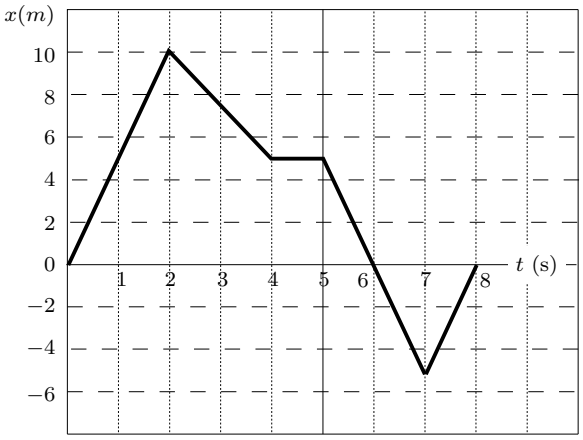

Figure 1: Problem 9

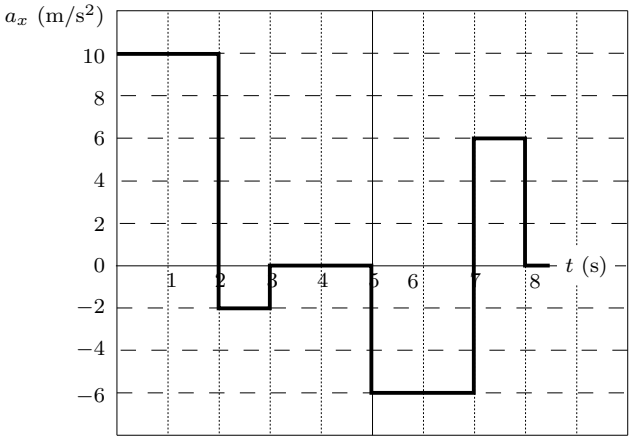

Figure 2: Problem 10

10. A particle starts from rest and accelerates as shown in Fig 2. Determine: (a) the particle's speed at $t = 10$ s and at $t = 20$ s, and (b) the distance traveled in the first 20 s.

11. A car increases its speed from 20 km/h to 50 km/h in 10 seconds. What is its acceleration?

12. A racing car has uniform acceleration of 4 m/s^2. What distance will it cover in 10 s after start?

13. A particle moves along the x axis according to the equation $x = 2.00 + 3.00t - t^2$, where x is in meters and t is in seconds. At $t = 3.00$ s, find (a) the position of the particle, (b) its velocity, and (c) its acceleration.

14. A body starts to slide over a horizontal surface with an initial velocity of 0.5 m/s. Due to friction, its velocity decreases at the rate of 0.05 m/s^2. How much time will it take for the body to stop?

15. The brakes applied to a car produce an acceleration of 6 m/s^2 in the opposite direction to the motion. If the car takes 2 s to stop after the application of brakes, calculate the distance it travels during this time.

16. A car starts from rest and moves along the x-axis with constant acceleration 5 m/s^2 for 8 seconds. If it then continues with constant velocity, what distance will the car cover in 12 seconds since it started from the rest?

17. A truck on a straight road starts from rest, accelerating at 2.00 m/s^2 until it reaches a speed of 20.0 m/s. Then the truck travels for 20.0 s at constant speed until the brakes are applied, stopping the truck in a uniform manner in an additional 5.00 s. (a) How long is the truck in motion? (b) What is the average velocity of the truck for the motion described?

18. Two towns A and B are connected by a regular bus service with a bus leaving in either direction every T minutes. A man cycling with a speed of 20 km/h in the direction A to B notices that a bus goes past him every 18 minutes in the direction of his motion, and every 6 minutes in the opposite direction. What is the period T of the bus service and with what speed(assumed constant) do the buses ply on the road?

19. An object is dropped from rest at a height of 150 m and simultaneously another object is dropped from rest at a height 100 m. What is the difference in their heights after 2 s if both the objects drop with same acceleration? How does the difference in heights vary with time?

20. An inquisitive physics student and mountain climber climbs a 50.0–m cliff that overhangs a calm pool of water. He throws two stones vertically downward, 1.00 s apart, and observes that they cause a single splash. The first stone has an initial speed of 2.00 m/s. (a) How long after release of the first stone do the two stones hit the water? (b) What was the initial velocity of the second stone? (c) What is the velocity of each stone at the instant the two hit the water?

21. A commuter train travels between two stations. Because the stations are only 1.00 km apart, the train never reaches its maximum possible cruising speed. The engineer minimizes the time t between the two stations by accelerating at a rate $a_1 = 0.100$ m/s^2 for a time t_1 and then by braking with acceleration $a_2 = -0.500$ m/s^2 for a time t_2. Find the minimum time of travel t and the time t_1.

22. Two cars start off to race with velocities v_1 and v_2 and travel in a straight line with uniform accelerations a_1 and a_2. If the race ends in a dead heat(both cars reach finish line simultaneously), prove that the length of the course is

$$\frac{2(v_1 - v_2)(v_1 a_2 - v_2 a_1)}{(a_1 - a_2)^2}$$

23. In a 100–m race, Maggie and Judy cross the finish line in a dead heat, both taking 10.2 s. Accelerating uniformly, Maggie took 2.00 s and Judy 3.00 s to attain maximum speed, which they maintained for the rest of the race. (a) What was the acceleration of each sprinter? (b) What were their respective maximum speeds? (c) Which sprinter was ahead at the 6.00–s mark, and by how much?

24. A rock is dropped from rest into a well. (a) If the sound of the splash is heard 2.40 s later, how far below the top of the well is the surface of the water? The speed of sound in air (at the ambient temperature) is 336 m/s. (b) If the travel time for the sound is neglected, what percentage error is introduced when the depth of the well is calculated?

25. A body dropped from rest travels a distance h_1 during the first 5 s, h_2 during the next 5 s, and h_3 during the next 5 s. Determine $h_1 : h_2 : h_3$.

26. A mail train and a goods train are moving on the same track in the same direction with velocities 108 km/h and 36 km/h respectively. The driver of the mail train sights the goods train when the latter is only 175 m ahead of him and immediately puts on brakes to get a deceleration of 0.65 m/s^2. At the same instant the driver of the goods train apprehending danger makes his train pick up an acceleration of 0.5m/s^2. Determine whether collision can be averted.

27. An electron moving with a velocity of 5×10^4 m enters into a uniform electric field and acquires a uniform acceleration of 10^4 m/s^2 in the direction of its initial motion. (i) Calculate the time in which the electron would acquire a velocity double of its initial velocity. (ii) How much distance the electron would cover in this time?

28. A stone thrown vertically upward. On its way, it passes point A with speed v, and the point B, 3.00 m higher than A, with speed $v/2$. Calculate: (a) the speed v, and (b) the maximum height reached by the stone above the point B.

29. A body moving in a straight line with uniform acceleration describes three successive equal distances in time intervals t_1, t_2 and t_3. Prove that

$$\frac{1}{t_1} - \frac{1}{t_2} + \frac{1}{t_3} = \frac{3}{t_1 + t_2 + t_3}$$

30. The velocity of a particle moving in the positive x direction varies as $v = \alpha\sqrt{x}$, where α is a positive constant. Assuming that at moment $t = 0$, the particle was located at the point $x = 0$, determine the acceleration of the particle.