Chapter 2: Motion in 1D

1- A racing car starts from rest at t = 0 and reaches a final speed *v* at time *t*. If the acceleration of the car is constant during this time, which of the following statements are true?

(a) The car travels a distance vt.

(b) The average speed of the car is *v*/2.

(c) The magnitude of the acceleration of the car is *v*/*t*.

(d) The velocity of the car remains constant.

2- When applying the equations of kinematics for an object moving in one dimension, which of the following statements must be true?

(a) The velocity of the object must remain constant.

(b) The acceleration of the object must remain constant.

(c) The velocity of the object must increase with time.

(d) The position of the object must increase with time.

3- Races are timed to an accuracy of 0.001s. What distance could a person rollerblading at a speed of 8.5 m/s travel in that period of time?

(a) 85 mm

(b) 85 cm

(c) 8.5 m

(d) 8.5 mm

4- A particle moves along the x axis according to the equation $x = 2.00 + 3.00t - 1.00t^2$, where x is in meters and t is in seconds. At t = 3.00 s, the position of the particle is:

(a) -2 m

(b) 4 m

(c) 2 m

(d) 0 m

5- From Q4, the velocity of particle is:

(a) -3 m/s

(b) 8 m/s

(c) 3 m/s

(d) -12 m/s

6- From Q4, the acceleration of particle is:

(a) -2 m/s^2

(b) 16 m/s^2

(c) 0.5 m/s^2

(d) -18 m/s^2

7- An object moves along the x axis according to the equation $x(t) = (3.00t^2 - 2.00t + 3.00)$ m. Determine the average speed between t= 1 s and t=3 s.

(a) -21 m

(b) 5.5 m

(c) -5.5 m

(d) 10 m/s

8- From Q7, Determine the instantaneous speed at t = 2.00 s:

(a) 21 m/s

(b) 13 m/s

(c) 10 m/s

(d) 1 m/s

$v = 6 \times 2 - 2 = 10\ m/s$

9- From Q7, Determine the average acceleration between t= 1 s and t=3 s.

(a) 6 m/s^2

(b) 15 m/s^2

(c) 2.5 m/s^2

(d) 7 m/s^2

$v = 6t - 2$

$a = 6$

$\frac{6 + 6}{2}$

10- From Q7, Determine the instantaneous acceleration at t = 2.00 s

(a) 2 m/s^2

(b) 6 m/s^2

(c) 2.5 m/s^2

(d) 7 m/s^2

11- A truck covers 40.0 m in 8.50 s while smoothly slowing down to a final speed of 2.80 m/s. Find its original speed.

(a) 5 m/s

(b) 9.30 m/s

(c) 6.61 m/s

(d) 7 m/s

12- From Q11, Find its acceleration.

(a) -0.448 m/s^2

(b) 0.896 m/s^2

(c) -0.012 m/s^2

(d) 3.93 m/s^2

13- An electron in a cathode-ray tube accelerates uniformly from 2.00 x 10^4 m/s to 6.00 x 10^6 m/s over 1.50 cm. In what time interval does the electron travel this 1.50 cm?

(a) 2.68 x 10^{-7} s

(b) 1.05 x 10^{-10} s

(c) 4.98 x 10^{-9} s

(d) 9.73 x 10^{-8} s

$v_i = 2 \times 10^4\ m/s, \quad v_f = 6 \times 10^6\ m/s$

$x = 1.5 \times 10^{-2}\ m, \quad t = ?$

$1.5 \times 10^{-2} = \frac{1}{2}(2 \times 10^4 + 6 \times 10^6)\, t$

14- From Q13, What is its acceleration?

(a) 1.80 x 10^{10} m/s^2

(b) -4.20 x 10^{16} m/s^2

(c) 6.60 x 10^{12} m/s^2

(d) 1.20 x 10^{15} m/s^2

$6 \times 10^6 = 2 \times 10^4 + a(4.98) \times 10^{-9}$

$v_{xf} = v_{xi} + a_x t$

$x_f = x_i + \frac{1}{2}(v_{xi} + v_{xf})t$

$x_f = x_i + v_{xi}t + \frac{1}{2}a_x t^2$

$v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$

15- The velocity of a particle moving along the x axis from A to B varies according to the expression $v_x = 40 - 5t^2$, where v_x is in meters per second and t is in seconds. Find the average acceleration in the time interval t = 0 to t = 2.0 s.

(a) 1 m/s^2
(b) -5.5 m/s^2
(c) 7.5 m/s^2
(d) -10 m/s^2

$\frac{a_i + a_f}{2} = \frac{0 + (-20)}{2} = -10\ m/s^2$

$a = -10t$

deceleration $= 5\ m/s^2$

16- A jet plane lands with a speed of 100 m/s and can accelerate at a maximum rate of - 5.00 m/s^2 as it comes to rest. From the instant the plane touches the runway, what is the minimum time interval needed before it can come to rest?

(a) 40 s
(b) 10 s
(c) 20 s
(d) 15 s

$v_i = 100\ m/s$, $a = -5\ m/s^2$, $v_f = 0$

$v_f = v_i + at$

$0 = 100 + (-5)(t)$

17- A truck on a straight road starts from rest, accelerating at 2.00 m/s2 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. what is the total time for the truck in motion?

(a) 26 s
(b) 10 s
(c) 50 s
(d) 35 s

$v_i = 0$, $a = 2\ m/s^2$, $v_f = 20\ m/s$

$v = 20\ m/s$, $t_2 = 20\ s$ / $t_3 = 5\ s$

$v_f = v_i + at \Rightarrow t_1 = 10\ s$

18- An object moves along the x axis according to the equation $x(t) = (1.00t - 2.00t^2)$ m. Determine the velocity at t = 1.00 s

(a) -3 m/s
(b) 6 m/s
(c) -5 m/s
(d) 2 m/s

$v = \frac{dx}{dt} = 1 - 2(2t) = 1 - 4t$

19- The velocity of a particle moving along the x axis from A to B varies according to the expression $v_x = 50 - 6t^2$, where v_x is in meters per second and t is in seconds. Find the average acceleration in the time interval t = 0 to t = 2.0 s.

(a) 1 m/s^2
(b) -5.5 m/s^2
(c) 7.5 m/s^2
(d) -12 m/s^2

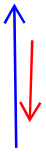
$a = -12t$

$\bar{a} = \frac{a_i + a_f}{2} = \frac{0 + (-24)}{2}$

Question on Freely Falling Objects

20- A juggler throws a bowling pin straight up in the air. After the pin leaves his hand and while it is in the air, which statement is true?

(a) The velocity of the pin is always in the same direction as its acceleration.
(b) The velocity of the pin is never in the same direction as its acceleration.
(c) The acceleration of the pin is zero.
(d) The velocity of the pin is opposite its acceleration on the way up.



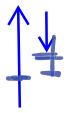
21- A cannon shell is fired straight up from the ground at an initial speed of 225 m/s. After how much time is the shell at a height of 6.20×10^2 m above the ground and moving downward?

(a) 2.96 s
(b) 17.3 s
(c) 25.4 s
(d) 43.0 s

$v_i = 225 m/s$, t, $y = 6.2 \times 10^2 m/s$

$y = v_i t + \frac{1}{2} g t^2 \Rightarrow 6.2 \times 10^2 = 225 t + \frac{1}{2}(-9.81) t^2$

$\frac{1}{2}(-9.81) t^2 + 225 t - 6.2 \times 10^2 = 0$



22- An arrow is shot straight up in the air at an initial speed of 15.0 m/s. After how much time is the arrow moving downward at a speed of 8.00 m/s?

(a) 0.714 s
(b) 1.24 s
(c) 1.87 s
(d) 2.35 s

$v_i = 15 m/s$, $v_f = -8 m/s$

$v_f = v_i + g t$

$-8 = 15 + -9.81 t$

23- A pebble is released from rest at a certain height and falls freely, reaching an impact speed of 4 m/s at the floor. Next, the pebble is thrown down with an initial speed of 3 m/s from the same height. What is its speed at the floor?

(a) 4 m/s
(b) 5 m/s
(c) 6 m/s
(d) 7 m/s

$v_i = 0$, $v_f = 4 m/s$

$v_f^2 = v_i^2 + 2 g y$

$16 = 2 \times 10 y$

$y = 0.8$

$v_i = 3 m/s$, $v_f = ??$

$v_f^2 = 3^2 + 2(10)(0.8) = 25$

$v_f = 5 m/s$

24- A baseball is hit so that it travels straight upward after being struck by the bat. A fan observes that it takes 3.00 s for the ball to reach its maximum height. Find the ball's initial velocity?

(a) 29.4 m/s
(b) 10 m/s
(c) 12.9 m/s
(d) 15.1 m/s

v_i, $t = 3 s$, $v_f = 0$

$v_f = v_i + g t$

$0 = v_i + (-9.81)(3)$

25- From Q24, the height it reaches

(a) 22 m
(b) 44.1 m
(c) 102 m
(d) 66.8 m

$y = v_i t + \frac{1}{2} g t^2 = 29.4 \times 3 + \frac{1}{2}(-9.81) \times 3^2$

26- A student throws a set of keys vertically upward to her sorority sister, who is in a window 4.00 m above. The second student catches the keys 1.50 s later. With what initial velocity were the keys thrown?

(a) 10 m/s

$y = 4 m$, $t = 1.5 s$, v_i

$y = v_i t + \frac{1}{2} g t^2$

$4 = v_i (1.5) + \frac{1}{2}(-9.81)(1.5)^2$

(b) -20 m/s
(c) 15 m/s
(d) 17 m/s

27- A ball is hit by the bat so that it travels straight upward with initial velocity 29.4 m/s. it takes 2.94s to reach its maximum height. Find the maximum height it reachs (g = 10 m/s^2)?

(a) 48 m
(b) 39.33 m
(c) 43.2 m
(d) 50.1 m

$v_i = 29.4\ m/s,\ t = 2.94\ s$

$y = v_i t + \frac{1}{2} g t^2 = 29.4 * 2.94 + \frac{1}{2}(-10) * 2.94^2$

28- A stone is thrown directly upward with speed 20m/s. Then it back downward to the ground> Find the total time for the stone when it return to the ground (g = 10 m/s^2)

(a) 2s
(b) 5s
(c) 8s
(d) 4s

$v_i = 20\ m/s$

$v_f = v_i + gt$

$0 = 20 + -10 * t \Rightarrow t = 2s$

Which of the following statements is Ture and which one is false

1- Distance is defined as the length of a path followed by a particle. **(T)**
2- Distance can be either positive or negative. **(F)**
3- If a car is moving in cricle road, the displaecemnt of the car will be zero when it back to the same starting point. **(T)**
4- The SI unit of displacement and distance is meters (m). **(T)**
5- If the acceleration of a particle is zero, the velocity of the particle is a constant. **(T)**
6- It is possible for the velocity and the acceleration of an object to have opposite signs. **(T)**
7- The equations of kinematics can be used in a situation where the acceleration varies in time. **(F)**
8- The equations of kinematics can be used in a situation when the acceleration is zero. **(T)**
9- A freely falling object is any object moving freely under the influence of gravity alone. **(T)**
10- Objects thrown upward or downward and those released from rest are all falling freely. **(T)**
11- You throw a ball straight upward. No air resistance. When it reaches the top of its trajectory its acceleration is zero. **(F)**
12- A ball is thrown upward. While the ball is in free fall, its acceleration increase and then decrease. **(F)**
13- If a car is slowing down, its acceleration must be negative. **(F)**
14- After a ball is thrown upward and is in the air, its speed decreases and then increases. **(T)**
15- If a car is traveling eastward and slowing down, the direction of the force on the car causes it to slow down must be in same direction. **(F)**
16- The instantaneous velocity of a particle is defined as the limit of the ratio $\Delta x/\Delta t$ as Δt approaches zero. **(T)**
17- When the object's velocity and acceleration are in the same direction, the object is speeding up. **(T)**
18- When the object's velocity and acceleration are in opposite directions, the object is slowing down. **(T)**
19- If the average velocity of an object is zero in some time interval; the displacement of the object for that interval must be nonzero. **(F)**