Motion Along a Line … Set 4

Rectilinear Motion

1. The position (in feet) of a skateboarder at any time t (in seconds) is given by $s(t) = t^3 - 8t^2 + 8t$.

   a. What are the velocity and acceleration functions in terms of t?

   b. When is the skateboarder at rest?

   c. What is the position of the skateboarder when it is at rest?

   d. What are the position, the velocity, and the acceleration of the skateboarder at three seconds and at five seconds?

   e. What are the initial position, velocity, and acceleration of the skateboarder?

   f. When is the skateboarder moving to the right and to the left? Use interval notation.

   g. When is the skateboarder speeding up and slowing down? Use interval notation.

   h. What is the total distance traveled by the skateboarder over the first six seconds?

2. The position (in meters) of a scooter rider at any time t (in seconds) is given by $s(t) = 2t^2 - 12t + 6$.

   a. What are the velocity and acceleration functions in terms of t?

   b. When is the scooter at rest?

   c. What is the position of the scooter when it is at rest?

   d. What are the position, the velocity, and the acceleration of the scooter at two seconds and at five seconds?

   e. What are the initial position, velocity, and acceleration of the scooter?

   f. When is the scooter moving right and left? Use interval notation.

   g. When is the scooter speeding up and slowing down? Use interval notation.

   h. What is the total distance traveled by the scooter rider in the first seven seconds?

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Answers

1. The position (in feet) of a skateboarder at any time t (in seconds) is given by $s(t) = t^3 - 8t^2 + 8t$.

   a. What are the velocity and acceleration functions in terms of t? $v(t) = 3t^2 - 16t + 8$, $a(t) = 6t - 16$

   b. When is the skateboarder at rest? $t = .558, 4.775$ s.

   c. What is the position of the skateboarder when it is at rest? $s(.558) = 2.147$, $s(4.775) = -35.332$

   d. What are the position, the velocity, and the acceleration of the skateboarder at three seconds and at five seconds? $s(3) = -21$ $v(3) = -13$ $a(3) = 2$; $s(5) = -35$ $v(5) = 3$ $a(5) = 14$

   e. What are the initial position, velocity, and acceleration of the skateboarder? $s_0 = 0$ $v_0 = 8$ $a_0 = -16$

   f. When is the skateboarder moving to the right and to the left? Use interval notation. RT: $[0, .558] \cup [4.775, \infty)$ LEFT: $[.558, 4.775]$

   g. When is the skateboarder speeding up and slowing down? Use interval notation. SP. UP: $(.558, 2.667) \cup (4.775, \infty)$ SL. DWN: $(0, .558) \cup (2.667, 4.775)$

   h. What is the total distance traveled by the skateboarder over the first six seconds? 50.955

2. The position (in meters) of a scooter rider at any time t (in seconds) is given by $s(t) = 2t^2 - 12t + 6$.

   a. What are the velocity and acceleration functions in terms of t? $v(t) = 4t - 12$, $a(t) = 4$

   b. When is the scooter at rest? $t = 3$ s.

   c. What is the position of the scooter when it is at rest? $s(3) = -12$

   d. What are the position, the velocity, and the acceleration of the scooter at two seconds and at five seconds? $s(2) = -10$ $v(2) = -4$ $a(2) = 4$; $s(5) = -4$ $v(5) = 8$ $a(5) = 4$

   e. What are the initial position, velocity, and acceleration of the scooter? $s_0 = 6$ $v_0 = -12$ $a_0 = 4$

   f. When is the scooter moving right and left? Use interval notation. RT: $[3, \infty)$ LF: $[0, 3]$

   g. When is the scooter speeding up and slowing down? Use interval notation. SP. UP: $(3, \infty)$ SL. DWN: $(0, 3)$

   h. What is the total distance traveled by the scooter rider in the first seven seconds?

   $s(0) = 6$, $s(3) = -12$ → 18; $s(7) = 20$ → 32; 50

Motion Along a Line … Set 4

3. A ball is thrown vertically upward from ground level with a velocity of 80 ft/sec.
    a. When will the ball reach its maximum height?
    b. What is the maximum height?
    c. How long is the entire trip?
    d. What is the ball's velocity when it hits the ground?
    e. What is the velocity of the ball when it is 96 ft. off the ground?

4. A rock is jettisoned with velocity 40 ft/sec from the top of a cliff that is 100 ft. high.
    a. When will the rock reach its maximum height? How high will it go?
    b. What is the rocks velocity when it hits the ground at the base of the cliff?

5. A rock is thrown straight down with velocity 50 ft/sec. from the top of a 120 ft. cliff.
    a. What is the velocity of the rock upon release?
    b. How long will it take the rock to reach the base of the cliff?
    c. What is the rock's velocity at impact?

6. The position of an object is given by $s(t)=t^3-6t^2+9t$. (t seconds, s meters)
    a. What is the velocity after 2 seconds? After 4 seconds?
    b. When is the object at rest?
    c. When is the object moving forward?
    d. Find the acceleration after 4 seconds?
    e. When is the particle speeding up or slowing down? Use interval notation.

Motion Along a Line … Set 4

Answers

3. A ball is thrown vertically upward from ground level with a velocity of 80 ft/sec.

   a. When will the ball reach its maximum height? 2.5 s.

   b. What is the maximum height? 100 FT.

   c. How long is the entire trip? 5 s.

   d. What is the ball's velocity when it hits the ground? −80 FT/s.

   e. What is the velocity of the ball when it is 96 ft. off the ground? ± 96 FT/s

   $-16t^2+80t=96$ $-16(t^2-5t+6)=0$ $v(2)=16$

   $-16t^2+80t-96=0$ $-16(t-2)(t-3)=0$ $v(3)=-16$

   $s(t)=-16t^2+80t$ $v(t)=-32t+80$

4. A rock is jettisoned with velocity 40 ft/sec from the top of a cliff that is 100 ft. high.

   $s(t)=-16t^2+40t+100$ $v(t)=-32t+40$

   a. When will the rock reach its maximum height? How high will it go? 1.25 s / 125 FT.

   b. What is the rocks velocity when it hits the ground at the base of the cliff? −89.443 FT/s.

5. A rock is thrown straight down with velocity 50 ft/sec. from the top of a 120 ft. cliff.

   a. What is the velocity of the rock upon release? −50 FT/s.

   b. How long will it take the rock to reach the base of the cliff? 1.590 s.

   c. What is the rock's velocity at impact? $v(1.590) = -100.896$ FT/s

6. The position of an object is given by $s(t)=t^3-6t^2+9t$. (t seconds, s meters)

   $v(t)=3t^2-12t+9=3(t^2-4t+3)=3(t-3)(t-1)$

   a. What is the velocity after 2 seconds? After 4 seconds? $v(2)=-3$ $v(4)=9$

   b. When is the object at rest? $t=1, 3$

   c. When is the object moving forward? $[0,1]\cup[3,\infty)$

   d. Find the acceleration after 4 seconds? $a(t)=6t-12$ $a(4)=12$

   e. When is the particle speeding up or slowing down? Use interval notation.

   Sp up: $(1,2)\cup(3,\infty)$

   Sl own: $(0,1)\cup(2,3)$