Student: Cole Lamers **Date:** 09/07/19	**Instructor:** Viktoriya Shcherban **Course:** Calc 1 11:30 AM / Internet (81749&81750) Shcherban	**Assignment:** 3.4 The Derivative as a Rate of Change

1. A body moves on a coordinate line such that it has a position $s = f(t) = t^2 - 7t + 6$ on the interval $0 \le t \le 6$, with s in meters and t in seconds.
    a. Find the body's displacement and average velocity for the given time interval.
    b. Find the body's speed and acceleration at the endpoints of the interval.
    c. When, if ever, during the interval does the body change direction?

The body's displacement for the given time interval is ⎡ −6 ⎤ m.
(Type an integer or a simplified fraction.)

The body's average velocity for the given time interval is ⎡ −1 ⎤ $\dfrac{m}{sec}$.
(Type an integer or a simplified fraction.)

The body's speeds at the left and right endpoints of the interval are ⎡ 7 ⎤ $\dfrac{m}{sec}$ and ⎡ 5 ⎤ $\dfrac{m}{sec}$,
respectively.
(Type integers or simplified fractions.)

The body's accelerations at the left and right endpoints of the interval are ⎡ 2 ⎤ $\dfrac{m}{sec^2}$ and ⎡ 2 ⎤ $\dfrac{m}{sec^2}$,
respectively.
(Type integers or simplified fractions.)

When, if ever, during the interval does the body change direction? Select the correct choice below and fill in any answer boxes within your choice.

✔ **A.**
   The body changes direction at t = ⎡ $\dfrac{7}{2}$ ⎤ sec.

   (Type an integer or a simplified fraction.)

○ **B.** The body does not change direction during the interval.

---

2. The function $s = t^3 - 12t^2 + 48t$, $0 \le t \le 4$, gives the position of a body moving on a coordinate line, with s in meters and t in seconds.
a. Find the body's displacement and average velocity for the given time interval.
b. Find the body's speed and acceleration at the endpoints of the interval.
c. When, if ever, during the interval does the body change direction?

a. What is the body's displacement for the given time interval?

    64   m (Simplify your answer.)

What is the average velocity for the given time interval?

    16   m/s (Simplify your answer.)

b. What is the body's speed at t = 0?

    48   m/s (Simplify your answer.)

What is the body's speed at t = 4?

    0   m/s (Simplify your answer.)

What is the body's acceleration at t = 0?

    − 24   m/s^2 (Simplify your answer.)

What is the body's acceleration at t = 4?

    0   m/s^2 (Simplify your answer.)

c. When, if ever, during the interval does the body change direction? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

○ **A.** t = _____ sec

◉ **B.** There is no solution.

3.

A body moves on a coordinate line such that it has a position $s = f(t) = \dfrac{25}{t^2} - \dfrac{5}{t}$ on the interval $1 \le t \le 5$, with s in meters and t in seconds.

a. Find the body's displacement and average velocity for the given time interval.
b. Find the body's speed and acceleration at the endpoints of the interval.
c. When, if ever, during the interval does the body change direction?

The body's displacement for the given time interval is ____ − 20 ____ m.
(Type an integer or a simplified fraction.)

The body's average velocity for the given time interval is ____ − 5 ____ $\dfrac{m}{sec}$.
(Type an integer or a simplified fraction.)

The body's speeds at the left and right endpoints of the interval are ____ 45 ____ $\dfrac{m}{sec}$ and ____ $\dfrac{1}{5}$ ____ $\dfrac{m}{sec}$,
respectively.
(Type integers or simplified fractions.)

The body's accelerations at the left and right endpoints of the interval are ____ 140 ____ $\dfrac{m}{sec^2}$ and ____ $\dfrac{4}{25}$ ____ $\dfrac{m}{sec^2}$,
respectively.
(Type integers or simplified fractions.)

When, if ever, during the interval does the body change direction? Select the correct choice below and fill in any answer boxes within your choice.

○ **A.** The body changes direction at t = _____ sec.
    (Type an integer or a simplified fraction.)

◉ **B.** The body does not change direction during the interval.

4.

At time t, the position of a body moving along the s-axis is $s = t^3 - 12t^2 + 45t$ m.
a. Find the body's acceleration each time the velocity is zero.
b. Find the body's speed each time the acceleration is zero.
c. Find the total distance traveled by the body from t = 0 to t = 4.

a. What is the body's acceleration each time the velocity is zero? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

◉ **A.** ____ − 6, 6 ____ m/s² (Simplify your answer. Use a comma to separate answers as needed.)

○ **B.** There is no solution.

b. What is the body's speed each time the acceleration is zero? Select the correct choice below and, if necessary, fill in the answer box to complete your choice.

◉ **A.** ____ 3 ____ m/s (Simplify your answer. Use a comma to separate answers as needed.)

○ **B.** There is no solution.

c. What is the total distance traveled by the body from t = 0 to t = 4?

____ 56 ____ m (Simplify your answer.)

5. The equation for free fall at the surface of a celestial body in outer space (s in meters, t in seconds) is $s = 5.72t^2$. How long

   does it take a rock falling from rest to reach a velocity of $20.3 \frac{m}{sec}$ on this celestial body in outer space?

   It takes ____1.8____ sec for a rock falling from rest to reach a velocity of $20.3 \frac{m}{sec}$ on this celestial body in outer space.
   (Round to the nearest tenth as needed.)

   ---

6. Explorers on a small airless planet used a spring gun to launch a ball bearing vertically upward from the surface at a launch
   velocity of 9.5 m/sec. Because the acceleration of gravity at the planet's surface was g_s m/sec^2, the explorers expected the
   ball bearing to reach a height of $s = 9.5t - (1/2)g_s t^2$ m, t sec later. The ball bearing reached its maximum height 10 sec after
   being launched. What was the value of g_s?

   ---

   g_s = ____.95____ m/sec^2 (Simplify your answer.)

   ---

7. An object is dropped from a tower, 180 ft above the ground. The object's height above ground t sec into the fall is
   $s = 180 - 16t^2$.
   a. What is the object's velocity, speed, and acceleration at time t?
   b. About how long does it take the object to hit the ground?
   c. What is the object's velocity at the moment of impact?

   The object's velocity at time t is ____$-32t$____ .

   The object's speed at time t is ____$32t$____ $\frac{ft}{sec}$.

   The object's acceleration at time t is ____-32____ $\frac{ft}{sec^2}$.

   (Simplify your answer.)

   It takes ____3.4____ sec for the object to hit the ground.
   (Round to the nearest tenth.)

   The object's velocity at the moment of impact is ____-108.8____ $\frac{ft}{sec}$.

   (Round to the nearest tenth.)

   ---

8. Suppose that the dollar cost of producing x appliances is $c(x) = 800 + 70x - 0.3x^2$.
   a. Find the average cost per appliance of producing the first 110 appliances.
   b. Find the marginal cost when 110 appliances are produced.
   c. Show that the marginal cost when 110 appliances are produced is approximately the cost of producing one more
   appliance after the first 110 have been made, by calculating the latter cost directly.

   The average cost per appliance of producing the first 110 appliances is $ ____44.27____ / appliance.
   (Round to the nearest cent as needed.)

   The marginal cost when 110 appliances are produced is $ ____4____ .
   (Round to the nearest cent as needed.)

   The cost of producing one more appliance beyond 110 appliances is $ ____3.7____ .
   (Round to the nearest cent as needed.)

9.

When a bactericide is added to a nutrient broth in which bacteria are growing, the bacterium population continues to grow for a while, but then stops growing and begins to decline. The size of the population at time t (hours) is $b = 8^6 + 8^5 t - 8^4 t^2$. Find the growth rates at t = 0 hours, t = 4 hours, and t = 8 hours.

The growth rate at t = 0 hours is $\boxed{8^5}$ bacteria per hour.

The growth rate at t = 4 hours is $\boxed{0}$ bacteria per hour.

The growth rate at t = 8 hours is $\boxed{-8^5}$ bacteria per hour.

10.

The volume $V = \frac{4}{3}\pi r^3$ of a spherical balloon changes with the radius.

a. At what rate (in^3/in) does the volume change with respect to the radius when r = 3 in?
b. Using the rate from part **a**, by approximately how much does the volume increase when the radius changes from 3 to 3.4 in?

a. At what rate (in^3/in) does the volume change with respect to the radius when r = 3 in?

$\boxed{36\pi}$ in^3/in

(Type an exact answer in terms of π.)

b. Using the rate from part **a**, by approximately how much does the volume increase when the radius changes from 3 to 3.4 in?

$\boxed{45.24}$ in^3

(Use the answer from part a to find this answer. Round to two decimal places as needed.)