3.7 Hmwk (Homework)

INSTRUCTOR
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Past Due **Due Date:** TUE, MAR 31, 2026 11:59 PM CDT

Current Score: 20 / 20 POINTS | 100.0 %

Due date has passed. No changes can be made without an approved extension request.
You may not be granted an extension if you have already viewed the answer key.

VIEW ANSWER KEY

Scoring and Assignment Information

QUESTION	1	2	3	4	5	6	7
POINTS	3 / 3	3 / 3	7.5 / 7.5	1.5 / 1.5	2 / 2	1 / 1	2 / 2

Assignment Submission

For this assignment, you submit answers by question parts. The number of submissions remaining for each question part only changes if you submit or change the answer.

Assignment Scoring

Your best submission for each question part is used for your score.

1. **[3 / 3 Points]**

DETAILS | MY NOTES | PREVIOUS ANSWERS | ASK YOUR TEACHER

PRACTICE ANOTHER

SCalcET9 3.7.020.MI.

If a tank holds 3500 gallons of water, which drains from the bottom of the tank in 50 minutes, then Toricelli's Law gives the volume V of water remaining in the tank after t minutes as

$$V = 3500\left(1 - \frac{1}{50}t\right)^2 \qquad 0 \le t \le 50.$$

Find the rate (in gal/min) at which water is draining from the tank after the following amounts of time. (Remember that the rate must be negative because the amount of water in the tank is decreasing.)

(a) 5 min

-126 ✓ gal/min

(b) 10 min

-112 ✓ gal/min

(c) 20 min

-84 ✓ gal/min

(d) 50 min

0 ✓ gal/min

At what time (in min) is the water flowing out the fastest?

t = 0 ✓ min

At what time (in min) is the water flowing out the slowest?

t = 50 ✓ min

Resources

Read It Tutorial

2. **[3 / 3 Points]**

DETAILS | MY NOTES | PREVIOUS ANSWERS | ASK YOUR TEACHER

PRACTICE ANOTHER

SCalcET9 3.7.021.

The quantity of charge Q in coulombs (C) that has passed through a point in a wire up to time t (measured in seconds) is given by $Q(t) = t^3 - 2t^2 + 4t + 5$. [The unit of current is an ampere 1 A = 1 C/s.]

(a) Find the current (in A) when $t = 0.4$ s.

2.88 ✔ A

(b) Find the current (in A) when $t = 1$ s.

3 ✔ A

At what time (in s) is the current the lowest?

$t =$ 2/3 ✔ s

Resources

Read It Watch It

3. **[7.5 / 7.5 Points]**

DETAILS | MY NOTES | PREVIOUS ANSWERS | ASK YOUR TEACHER | PRACTICE ANOTHER

SCalcET9 3.7.032.

The frequency of vibrations of a vibrating string is given by

$$f = \frac{1}{2L}\sqrt{\frac{T}{\rho}}$$

where L is the length of the string, T is its tension, and ρ is its linear density.†

(a) Find the rate of change of the frequency with respect to the following.

(i) the length (when T and ρ are constant)

$$-12L2\sqrt{T\rho}$$

✔ Good job.

(ii) the tension (when L and ρ are constant)

$$14L\sqrt{T\rho}$$

✔ Great job!

(iii) the linear density (when L and T are constant)

$$-14L\rho\sqrt{T\rho}$$

✔ Nicely done.

(b) The pitch of a note (how high or low the note sounds) is determined by the frequency f. (The higher the frequency, the higher the pitch.) Use the signs of the derivatives in part (a) to determine what happens to the pitch of a note for the following.

(i) when the effective length of a string is decreased by placing a finger on the string so a shorter portion of the string vibrates

$\frac{df}{dL}$ [<] ✔ 0 and L is [decreasing] ✔ ⇒ f is [increasing] ✔ ⇒ [higher note] ✔

(ii) when the tension is increased by turning a tuning peg

$\frac{df}{dT}$ [>] ✔ 0 and T is [increasing] ✔ ⇒ f is [increasing] ✔ ⇒ [higher note] ✔

(iii) when the linear density is increased by switching to another string

$\frac{df}{d\rho}$ [<] ✓ 0 and ρ is [increasing] ✓ $\Rightarrow f$ is [decreasing] ✓ $\Rightarrow$ [lower note] ✓

Resources

Read It

4. **[1.5 / 1.5 Points]**

DETAILS | MY NOTES | PREVIOUS ANSWERS | ASK YOUR TEACHER | PRACTICE ANOTHER

SCalcET9 3.7.024.EP.

Some of the highest tides in the world occur in the Bay of Fundy on the Atlantic Coast of Canada. At Hopewell Cape the water depth at low tide is about 2.0 m and at high tide it is about 12.0 m. The natural period of oscillation is a little more than 12 hours, and on a day in June, high tide occurs at 6:45 a.m. This helps explain the following model for the water depth D (in meters) as a function of the time t (in hours after midnight) on that day.

$$D(t) = 7 + 5 \cos\left[0.503(t - 6.75)\right].$$

Find the derivative $D'(t)$.

$D'(t) =$

$$-2.515sin(0.503(t-6.75))$$

✔ Amazing work.

How fast (in m/h) was the tide rising (or falling) at the following times? (Round your answers to two decimal places.)

(a) 3:00 a.m.

2.39 ✔ m/h

(b) 5:00 a.m.

1.94 ✔ m/h

(c) 8:00 a.m.

-1.48 ✔ m/h

(d) 10:00 a.m.

-2.51 ✔ m/h

Resources

Read It

5. **[2 / 2 Points]**

DETAILS | MY NOTES | PREVIOUS ANSWERS | ASK YOUR TEACHER | PRACTICE ANOTHER

SCalcET9 3.7.022.

Newton's Law of Gravitation says that the magnitude F of the force exerted by a body of mass m on a body of mass M is

$$F = \frac{GmM}{r^2},$$

where G is the gravitational constant and r is the distance between the bodies.

(a) Find $\frac{dF}{dr}$.

$\frac{dF}{dr}$ =

$$-2GmMr3$$

Great!

What is the meaning of $\frac{dF}{dr}$ in the context of this problem?

- $\frac{dF}{dr}$ represents the rate of change of the mass with respect to the distance between the bodies.
- $\frac{dF}{dr}$ represents the rate of change of the distance between the bodies with respect to the force.
- $\frac{dF}{dr}$ represents the amount of force per distance.
- **(selected)** $\frac{dF}{dr}$ represents the rate of change of the force with respect to the distance between the bodies.
- $\frac{dF}{dr}$ represents the rate of change of the mass with respect to the force.

Excellent job!

What does the minus sign in the expression indicate?

- The minus sign indicates that the bodies are being forced in the negative direction.
- **(selected)** The minus sign indicates that as the distance between the bodies increases, the magnitude of the force decreases.
- The minus sign indicates that as the distance between the bodies increases, the magnitude of the force increases.
- The minus sign indicates that as the distance between the bodies decreases, the magnitude of the force remains constant.
- The minus sign indicates that the force between the bodies is decreasing.

Terrific!

(b) Suppose it is known that the earth attracts an object with a force that decreases at the rate of 4 N/km when r = 20,000 km. How fast does this force change when r = 10,000 km?

-32 ✔ N/km

Resources

Read It

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6. [1 / 1 Points]

DETAILS | MY NOTES | PREVIOUS ANSWERS | ASK YOUR TEACHER | PRACTICE ANOTHER

SCalcET9 3.7.039.

The gas law for an ideal gas at absolute temperature T (in kelvins), pressure P (in atmospheres), and volume V (in liters) is $PV = nRT$, where n is the number of moles of the gas and R = 0.0821 is the gas constant. Suppose that, at a certain instant, P = 7.0 atm and is increasing at a rate of 0.15 atm/min and V = 14 L and is decreasing at a rate of 0.17 L/min. Find the rate of change of T with respect to time (in K/min) at that instant if n = 10 mol. (Round your answer to four decimal places.)

$\frac{dT}{dt}$ = 1.1084 ✔ K/min

Resources

Read It Watch It

7. **[2 / 2 Points]**

DETAILS | MY NOTES | PREVIOUS ANSWERS | ASK YOUR TEACHER | PRACTICE ANOTHER

SCalcET9 3.7.027.

Suppose that a population of bacteria triples every hour and starts with 200 bacteria. Find an expression for the number n of bacteria after time t hours.

$n(t)$ =
$$200 \cdot 3t$$

✔ Nice!

Use it to estimate the rate of growth of the bacterial population at 3.5 hours. (Round your answer to the nearest whole number.)

$n'(3.5)$ = 10275 ✔ bacteria/hr

Resources

Read It Watch It

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