Calculus 1 Workbook

Physics and economics

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MATH

POSITION, VELOCITY, AND ACCELERATION

■ 1. Find the velocity $v(t)$, speed, and acceleration $a(t)$ at $t = 2$ of the position function.

$$s(t) = -\frac{t^3}{3} + t^2 + 3t - 1$$

■ 2.The position of a particle which moves along the x-axis is given by $s(t) = \cos t + \sin t$. What is the acceleration of the particle at the point where the velocity is first equal to zero?

■ 3. Find the velocity $v(t)$, speed, and acceleration $a(t)$ at $t = 4$ of the position function.

$$s(t) = \frac{t^2}{2t + 4}$$

■ 4. Let $s(t) = 2t^3 - 12t^2 + 18t + 2$ be the position of a particle. What is the velocity when acceleration is zero? What is the total distance traveled by the particle from $t = 0$ to $t = 2$?

■ 5. The position of a particle moving along a line is given. For what values of t is the speed of the particle decreasing?

$$s(t) = \frac{4}{3}t^3 - 12t^2 + 32t - 12 \text{ for } t \geq 0$$

■ 6. A particle moves along the x-axis with its position at time t given by $s(t) = a(t + a)(t - b)$, where a and b are constants and $a \neq b$. Find the values of t when the particle is at rest.

BALL THROWN UP FROM THE GROUND

■ 1. A ball is thrown straight upward from the ground with an initial velocity of $v_0 = 86$ ft/sec. Assuming constant gravity, find the maximum height, in feet, that the ball attains, the time, in seconds, that it's in the air, as well as the ball's velocity, in ft/sec, when it hits the ground.

■ 2. A ball is thrown straight upward from the top of a building, which is 56 feet above the ground, with an initial velocity of $v_0 = 48$ ft/sec. Assuming constant gravity, find the maximum height, in feet, that the ball attains, the time, in seconds, that it's in the air, as well as the ball's velocity, in ft/sec, when it hits the ground.

■ 3. A ball is thrown straight upward from a bridge, which is 24 meters above the water, with an initial velocity of $v_0 = 20$ m/sec. Assuming constant gravity, find the maximum height, in meters, that the ball attains, the time, in seconds, that it's in the air, as well as the ball's velocity, in m/sec, when it hits the water below.

■ 4. A boy needs to jump 2.8 ft in the air in order to dunk a basketball. The height that the boy's feet are above the ground is given by the function $h(t) = -16t^2 + 10t$. What is the maximum height the boy's feet will ever be above the ground, and will he be able to dunk the basketball?

■ 5. A diver jumps up from a platform and then falls down into a pool. His height as a function of time can be modeled by $h(t) = -16t^2 + 12t + 60$, where t is the time in seconds and h is the height in feet. How long did it take for the diver to reach his maximum height? What was the highest point that he reached? In how many seconds does he hit the water?

■ 6. An amateur rocketry club is holding a competition. There is cloud cover at 890 ft. If they launch a rocket with an initial velocity of 365 ft/s, determine the amount of time that the rocket is out of site in the cloud cover.

COIN DROPPED FROM THE ROOF

■ 1. A rock is dropped from the top of an 800 foot tall cliff, with an initial velocity of $v_0 = 0$ ft/sec. Assuming constant gravity, when does the rock hit the ground, and what is its velocity when it hits the ground?

■ 2. A rock is tossed from the top of a 300 foot tall cliff, with an initial velocity of $v_0 = 15$ ft/sec. Assuming constant gravity, when does the rock hit the ground, and what is its velocity when it hits the ground?

■ 3. A coin is tossed downward from the top of a 36 meter tall building, with an initial velocity of $v_0 = 6$ m/sec. Assuming constant gravity, when does the rock hit the ground, and what is its velocity when it hits the ground?

■ 4. A raindrop falls from the sky and takes 25 seconds to reach the ground. Assuming constant gravity, what is the raindrop's velocity at impact? How far did it fall? What is its acceleration when $t = 5$ seconds?

■ 5. You throw a rock into the Grand Canyon and it takes 7.55 seconds to hit the ground. Calculate the velocity of the rock at impact in m/s and then find the distance the rock fell in feet.

6. A coin is dropped into a very deep wishing well. It hits the water 4.5 s later. How far is it from the top of the well to the water at the bottom? At what velocity does the coin hit the water? How far had the coin fallen when it reached -20m/s?

MARGINAL COST, REVENUE, AND PROFIT

■ 1. A company manufactures and sells basketballs for $\$9.50$ each. The company has a fixed cost of $\$395$ per week and a variable cost of $\$2.75$ per basketball. The company can make up to 300 basketballs per week. Find the marginal cost, marginal revenue, and marginal profit, if the company makes 150 basketballs.

■ 2. A company manufactures and sells high end folding tables for $\$250$ each. The company has a fixed cost of $\$3{,}000$ per week and variable costs of $85x + 150\sqrt{x}$, where x is the number of tables manufactured. The company can make up to 200 tables per week. Find the marginal cost, marginal revenue, and marginal profit, if the company makes 64 tables.

■ 3. A company manufactures and sells electric food mixers for $\$150$ each. The company has a fixed cost of $\$7{,}800$ per week and variable costs of $24x + 0.04x^2$, where x is the number of mixers manufactured. The company can make up to 200 mixers per week. Find the marginal cost, marginal revenue, and marginal profit, if the company makes 75 mixers.

■ 4. A coffee machine manufacturer determines that the demand function for their coffee machines is given by p, while the cost of producing x coffee

machines is given by $C(x) = 25x + 10\sqrt{x^3} + 1{,}250$. What is the marginal cost, marginal revenue, and marginal profit at $x = 25$?

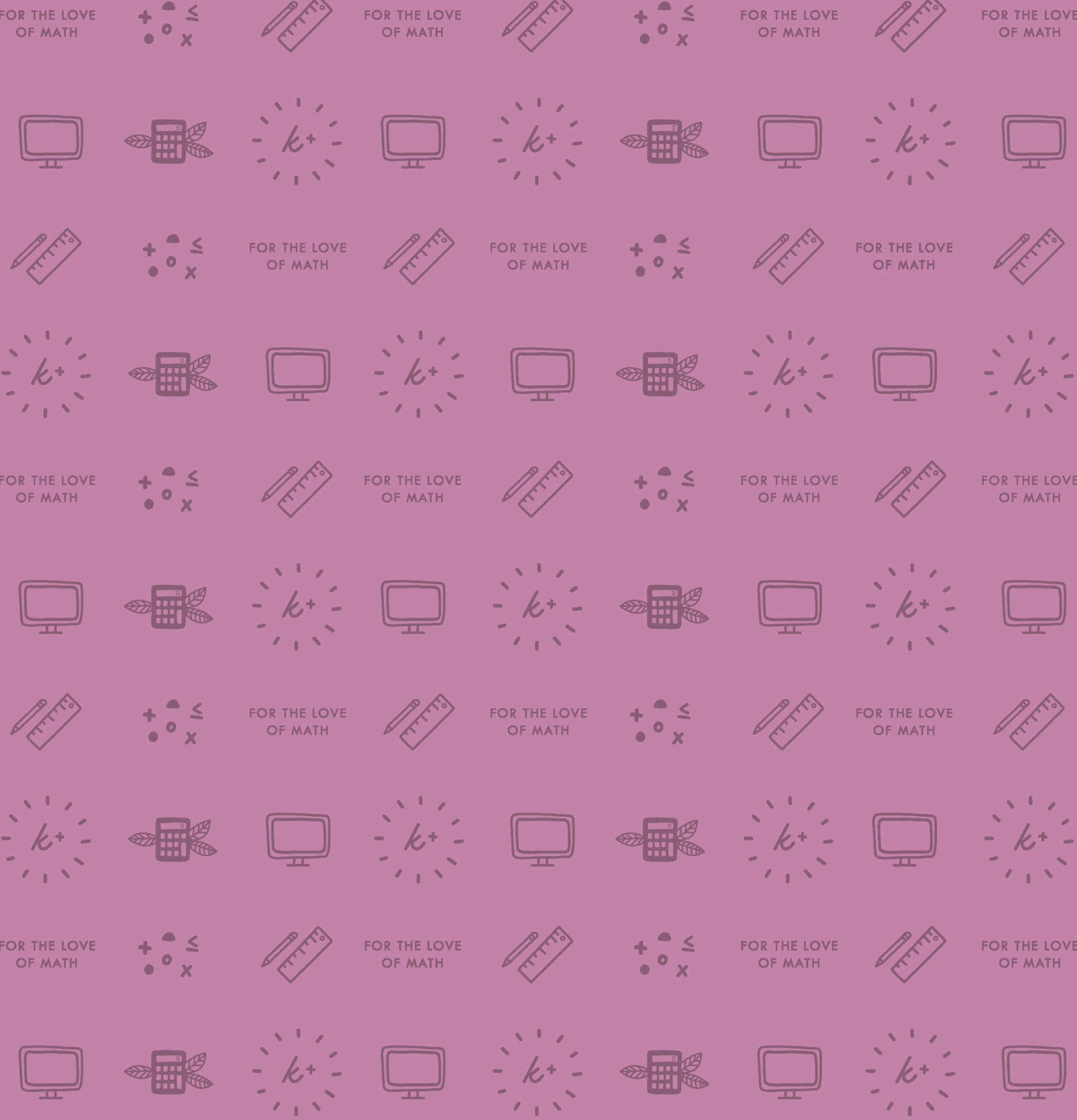
$$p = \frac{750}{\sqrt{x^3}}$$

■ 5. For the given cost and demand functions, find the number of units the company needs to produce in order to maximize profit.

$$C(x) = 15x + 300$$

$$p = 2x - 250$$

■ 6. A company manufactures and sells kids' toys. The total cost of producing x toys is $C(x) = -0.3x^2 + 25x + 975$, and demand is given by $p(x) = 12 + 3x$. Calculate the marginal profit from selling the 10th toy.



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