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27965472900 153757565208 30987948650 12501903.772727 100538880640 107432324012 117215231.55556 85749504567 19011282.859375 28151565.683333 71211866670 22098302.675676 316343951.5 31549191.259259 8957292.4347826 65958902154 76274751680 3255693654 3274469.73 30429149600 7151163264 24379011825 22843120.22807 35782110720 19651098.963415 6601066095 7558041946 20485849.327586 31415074.257143

7) You operate a tour company with the following rates: \$200 per person
 Your tour company accommodates 60 + 90 people.
 If more than 60 people sign up, the rate drops \$2 per person for each additional person after 60...
 If less than 60 people sign up, the tour is cancelled.
 The cost of each tour is \$6000 plus \$32 per person.

- a) How many people would maximize your profit?
 b) What is your maximum profit?

Step 1: Transform above description into math equations:

The domain is [60, 90] let $p = \#$ of people
 Profit = Revenue - Cost Cost = \$6000 + \$32p
 Revenue = $p(\$200 - \$2(p - 60))$

Step 2: Maximize equation (profit)

$$\begin{aligned} \text{Profit} &= p(\$200 - \$2(p - 60)) - [\$6000 + \$32p] \\ &= \$200p - \$2p^2 + \$120p - \$6000 - \$32p \\ &= \$-2p^2 + \$288p - \$6000 \end{aligned}$$

Take derivative: $\frac{d\text{Profit}}{dp} = -4p + 288$

Set equal to zero to find max/min: $-4p + 288 = 0$
 $p = 72$

Step 4: Check your answer

71 tourists: Revenue: $\$200 \times 71 = \$14,200$
 Discount: $(11 \times \$2) \times 71 = -\1562
 Cost: $\$6000 + (\$32 \times 71) = -\$8272$
 Profit: \$4366

72 tourists: Profit: \$4368
 73 tourists: Revenue: $\$200 \times 73 = \$14,600$
 Discount: $(13 \times \$2) \times 73 = -\1898
 Cost: $\$6000 + (\$32 \times 73) = -\$8336$
 Profit: \$4366

Step 3: answer questions

a) What is the optimal number of people: $p = 72$

b) What is your maximum profit?

Revenue: $\$200 \times 72 = \$14,400$
 Discount: 12 people over 60 \rightarrow \$24 discount/person
 $\$24 \times 72 = \1728
 Total revenue: \$12,672
 Cost: $\$6000 + \$32(72 \text{ people}) = \8304
 Profit: $\$12,672 - \$8304 = \$4,368$

8) The quantity $Q = 2x^2 + 3y^2$ is subject to the constraint $x + y = 5$.

What is the minimum quantity of Q?

Since Q is a function of x and y, let's change to 1 variable...

$x + y = 5 \rightarrow y = 5 - x$ then, substitute into the main equation...

$$Q = 2x^2 + 3(5 - x)^2$$

$$Q = 2x^2 + 75 - 30x + 3x^2$$

$$Q = 5x^2 - 30x + 75 \quad \text{find derivative of } Q \dots$$

$$Q' = 10x - 30$$

$$10x - 30 = 0 \quad \text{so,}$$

$$\text{minimum occurs at } x = 3$$

$$\text{and, therefore, } y = 2$$

$$\text{because } x + y = 5$$

$$\text{If } x = 2 \text{ and } y = 3,$$

$$Q = 2(3)^2 + 3(2)^2 \quad \text{then, } Q = 35$$

$$Q = 30$$

$$\text{If } x = 4 \text{ and } y = 1$$

$$\text{then, } Q = 35$$

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Find the derivatives:

(1) $f'(x) = 8x^7 + 8x^2 + 8 + 9$

(2) $f'(x) = 12x^3 + 9x^2 - 4x^5 - 11$

(3) $g'(x) = 82x^3 - 8x^2 + 3x + 7$

(4) $f'(x) = 8x^{10} + 8x^{12} - 4x^2 + 82$

(5) $g'(x) = \frac{x^2 + 5x + 4}{x - 12}$

(6) $f'(x) = \frac{8x^3 + 9x^6 - 9}{9x}$

Derivative Cheat Sheet

1. For Power Functions: $\frac{d}{dx} x^n = nx^{n-1}$

2. For Constant Functions: $\frac{d}{dx} c = 0$

3. For Sum/Difference: $\frac{d}{dx} (f \pm g) = f' \pm g'$

4. For Product: $\frac{d}{dx} (fg) = f'g + fg'$

5. For Quotient: $\frac{d}{dx} \left(\frac{f}{g}\right) = \frac{f'g - fg'}{g^2}$

6. For Chain Rule: $\frac{d}{dx} f(g(x)) = f'(g(x)) \cdot g'(x)$

Function	Derivative
$y = 8x^5$	$y' = 40x^4$
$y = \frac{1}{2x}$	$y' = -\frac{1}{2x^2}$
$y = 8x^3 - 2x^2$	$y' = 24x^2 - 4x$
$y = 2x^2 + 3x - 5$	$y' = 4x + 3$
$y = 2x^2 - 3x^2 + 4x$	$y' = 4x - 6x + 4$

