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2.5

1. Of all numbers whose sum is 50 find the two that have the maximum product. That is, maximine $Q = xy$, where $x + y = 50$

$Q = xy$

$= x(50 - x)$

$\boxed{= 50x - x^2}$

$Q = 50 - 2x = 0$
$-50 \quad = -50$
$\frac{-2x}{-2} = \frac{-50}{-20}$
$\boxed{x = 25}$

$Q(25) = 25(50 - 25)$
$= 25(25)$
$\boxed{= 625}$

$x = 25$ $\quad y = 25$

$\boxed{\text{Maximum } Q = 625}$

2. Of all numbers whose sum is 70, find the two that have the maximum product. That is, maximize $Q = xy$, where $x + y = 70$

$Q = xy$

$= x(70 - x)$

$= 70x - x^2$

$Q = 70 - 2x = 0$
$-70 \quad = -70$
$\frac{-2x}{-2} = \frac{-70}{-2}$
$\boxed{x = 35}$

$Q(35) = 35(70 - 35)$
$35(35)$
$\boxed{= 1225}$

$x = 35$ $\quad y = 35$

$\boxed{\text{Maximum } Q = 1{,}225}$

5. of all number whose difference is 4, find the two that have the minimum product.

$= xy$

$x(4 - x)$

$4x - x^2$

$4 - 2x = 0$
$-4 \quad = -4$
$\frac{-2x}{-2} = \frac{-4}{-2}$
$x = 2$

$2(2 - 4)$
$2(-2)$
$\boxed{-4}$

$x = 2$ $\quad y = -2$

$\boxed{\text{Minimum product} = -4}$

7. Maximize $Q = xy^2$, where x and y are positive numbers such that $x + y^2 = 1$

$x + y^2 = 1$
$y^2 = 1 - x$

$Q = x(1 - x)$
$Q = 1x - x^2$

$1 - 2x = 0$
$-1 \quad = -1$
$-2x = -2$

$x = \frac{1}{2}$

$y^2 = 1 - x$
$y^2 = 1 - \frac{1}{2}$

$y^2 = \frac{1}{2}$

$y = \sqrt{\frac{1}{2}}$

$x = \frac{1}{2}$ $\quad y = \sqrt{\frac{1}{2}}$

$\boxed{\text{Maximum } Q = \frac{1}{4}}$

Norma Esta hoja de papel, está hecha de caña. Papel de caña de azúcar

13. Maximizing area.

$A(x) = x(180-2x)$
$-2x^2 + 180x$

$45(180-2(45))$
$= 45(180-40)$
$= 45(40)$
$= 4{,}050 \ yd^2$

$A(x) = -4x + 180 = 0$
$-180 \quad -180$
$\frac{-4x}{-4} = \frac{-180}{-4}$
$x = 45$

width
45 yd

length
40yd

$\boxed{\text{Maximum are} = 4050 \ yd^2}$

17. Maximizing volume

$V = l \cdot w \cdot h$
$= (50-2x)(50-2x)x$
$= (4x^2 - 200x + 2500)x$
$4x^3 - 200x^2 + 2500x$

$V' = 12x^2 - 400x + 2500$
$V' = 4(x-25)(3x-25)$

$x - 25 = 0$
$25 = 25$
$\boxed{x = 25}$

$3x - 25 = 0$
$25 = 25$
$3x = 25 = \boxed{x = \frac{25}{3}}$

$50 - 2x$
$50 - 2\left(\frac{25}{3}\right) =$
$= \frac{100}{3}$

$\boxed{33\frac{1}{3} \text{ cm}}$

$\boxed{8\frac{1}{3} \text{ cm}}$

$\boxed{9259\frac{7}{27} \text{ cm}^3}$

$V\left(\frac{25}{3}\right) = 4\left(\frac{25}{3}\right)^3 - 200\left(\frac{25}{3}\right)^2 + 2500\left(\frac{25}{3}\right) =$

$= \frac{250000}{27} = 9261\frac{137}{216}$

21. Minimizing surface area.

$V = lwh$

$V = x^2 y = 12$

$V = 2x^2 y = 12$

$y = \frac{12}{2x^2}$

$y = \frac{6}{x^2}$

$w = \sqrt[3]{9} = 2.08\,yd$

$L = 2\sqrt[3]{9} = 4.16\,yd$

$H = \frac{6}{(\sqrt[3]{9})^2} = 1.387\,yd$

31. Maximizing revenue

Cost of ticket = \$ 18 - x

People = 40,000 + 3,333.3x

$R = (40,000 + 3,333.3x)(18 - x) + 4.50(40,000 + 3,333.3x)$

$-3333.3x^2 + 19,999.4x + 720,000 + 180,000 + 14,999.85x$

$R = -3,333.3x^2 + 34,999.25x$

$f(x) = -6,666.6x + 34,999.25$

$-6,666.6x = 34,999.25 = 5.25$

$18 - 5.25 = \boxed{12.75}$

$40,000 + 3,333.3x$

$40,000 + 17,499.9 = \boxed{57,500}$

Ticket = \$ 12.75	People 57,500

33. Maximizing yield

$Y = [30 - (n-20)]$

$Y = 30 - n + 20$

$Y = (50 - n)^n$; $\boxed{50 - 2n}$

$50 - 2n = 0$

$-50 \qquad -50$

$\frac{-2n}{-2} = \frac{-50}{-2}$

$\boxed{n = 25}$

$n = 20$

$n = 25$

$Y = (30 - 5)^{25} = \boxed{625 \text{ bushels}}$

25 trees / acre

37. Minimizing costs

$320 = x^2 h$

$h = \frac{320}{x^2}$

$l = 4 ft$

$w = 4 ft$

$h = 20 ft$

$50x - \frac{3200}{x^2} = 0$

$50x = \frac{3200}{x^2}$

$\frac{50x^3}{50} = \frac{3200}{50} = x^3 = 64$

$\boxed{x = 4}$

41 Minimizing inventory costs

$C = 2 \cdot \frac{x}{2} + (5 + 0.50x)\frac{720}{x}$

$x + \frac{3600}{x} + 360 =$

$x + 3600x^{-1} + 360$

$C' = 1 - \frac{3600}{x^2}$

$1 = \frac{3600}{x^2}$

$x^2 = \sqrt{3600} = \boxed{x = 60}$

Order 12 times / yr, lot size is 60

51 Maximizing light

$2x + 2y + \pi x = 24$

$2y = 24 - (2 + \pi)x$

$y = 12 - (2 + \pi)x \cdot \frac{1}{2}$

$= 12 - 2.57x$

Norma

Esta hoja de papel, está hecha de caña. Papel de caña de azúcar

$A = \frac{1}{2}\pi x^2 + 2x \cdot y$

$= \frac{1}{2}\pi x^2 + 2x(12 - 2.57x)$

$= \frac{1}{2}\pi x^2 + 24x - 3.14x^2$

$= 24x - 3.57x^2$

$x \approx 3.36\ ft$

$y \approx 3.36\ ft$