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§ 8.6 Systems of Nonlinear Equations

§ 8.6 Systems of NON Linear Eqn

> Solving systems graphically (use graphing calculators)

(5) $\begin{cases} y = x^2 + 6 \leftarrow \text{parabola} \\ y = 2x + 6 \leftarrow \text{line} \end{cases}$

Window: ymin: 0
ymax: 20

first intersection: (0, 6)
2nd intersection: (2, 10)

Check answer

(0,6)
$y = x^2 + 6$
$6 = 0^2 + 6$
$6 = 6$ ✓ True

$y = 2x + 6$
$6 = 2(0) + 6$
$6 = 6$ ✓

(2,10)
$y = 2x + 6$
$10 = 2(2) + 6$
$10 = 4 + 6$
$10 = 10$ ✓ True.

$y = x^2 + 6$
$10 = (2)^2 + 6$
$10 = 4 + 6$
$10 = 10$ ✓ True.

> Substitution or Elimination?
Solve the system algebraically

(17) $\begin{cases} x + y + 3 = 0 \leftarrow (1) \\ x^2 + y^2 + 4y - 3x = -3 \ (2) \end{cases}$ substitution method

(1) $x + y + 3 = 0$

(1) $y = -x - 3$

Substitute this into the other equation

(2) $x^2 + y^2 + 4y - 3x = -3$

$x^2 + (-x-3)^2 + 4(-x-3) - 3x = -3$

(continued)

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(continued)

$x^2 + (-x-3)^2 + 4(-x-3) - 3x = -3$

$x^2 + (-x-3)(-x-3) - 4x - 12 - 3x = -3$

$x^2 + x^2 + 6x + 9 - 4x - 12 - 3x = -3$ combine like terms

$2x^2 - x - 3 = -3$ set $= 0$ zero $ax^2 + bx + c = 0$

$+3 \quad +3$

$2x^2 - x = 0$

$x(2x-1) = 0$

$x = 0$

$2x - 1 = 0$

$+1 \quad +1$

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

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

Plug value of x (both) into any equations that has both x & y in it.

$y = -x - 3$

$x = 0$

$y = -0 - 3$

$y = -3$

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

$y = -\frac{1}{2} - 3$

$y = -3.5$

or

$-3\frac{1}{2}$

or

or

$-\frac{7}{2}$

$(0, ?)$

$(\frac{1}{2}, ?)$

$(0, -3)$

$(\frac{1}{2}, -\frac{7}{2})$

(38) The difference of two number is 2 & the sum of their squares is 10. find the numbers.

$x :=$ the 1st #
$y :=$ the 2nd #

$$\begin{cases} x - y = 2 & (1) \\ x^2 + y^2 = 10 & (2) \end{cases}$$

check

if $y = 1$ choose eq'n to plug in

$x = y + 2$

$x = 1 + 2$

$\boxed{x = 3}$

(3, 1) answer

if $y = -3$

$x = y + 2$

$x = -3 + 2$

$x = -1$

(-1, -3) answer

(1) $x = y + 2$ isolate x

Plug into other eq'n

(2) $(y+2)^2 + y^2 = 10$

$y^2 + 4y + 4 + y^2 = 10$ combine like terms

$2y^2 + 4y + 4 = 10$ set $= 0$

$-10 \quad -10$

$2y^2 + 4y - 6 = 0$

$\frac{2y^2 + 4y - 6 = 0}{2}$

$2(y^2 + 2y - 3) = 0$

$2(y-1)(y+3) = 0$ apply zero product prop

$2 = 0$ ←

↙ $y - 1 = 0$ $\boxed{y = 1}$

↘ $y + 3 = 0$ $\boxed{y = -3}$

(20) $7x^2 - 3y$

(20) $\begin{cases} 7x^2 - 3y^2 - 49 = 0 & \leftarrow (1) \\ 4x^2 + 4y^2 = 98 & \leftarrow (2) \end{cases}$ Elimination

No "x" or "y" terms, so use elimination.

$4[7x^2 - 3y^2 - 49 = 0]$

$3[4x^2 + 4y^2 = 98]$

term opposites.

$28x^2 - 12y^2 - 196 = 0$

$+ \quad 12x^2 + 12y^2 = 294$

$40x^2 + 0 - 196 = 294$

plug value of x in any Eq'n

$4x^2 + 4y^2 = 98$

$x = \frac{7}{2}$

$4\left(\frac{7}{2}\right)^2 + 4y^2 = 98$

$\frac{28}{2} + 4y^2 = 98$

$14 + 4y^2 = 98$

$-14 \quad -14$

$4y^2 = 84$

$-84 \quad -84$

$\frac{4y^2 - 84}{4} = 0$

$4(y^2 - 21) = 0$

$40x^2 - 196 = 294$ quad "=0"

$-294 \quad -294$

$\frac{40x^2 - 490}{10} = 0$

$10(4x^2 - 49) = 0$

$10(2x - 7)(2x + 7) = 0$ Z.P.P

$10 = 0$

$2x - 7 = 0$ $\quad$ $2x + 7 = 0$

$x = \frac{7}{2}$ $\quad$ $x = -\frac{7}{2}$

$4\left(\frac{49}{4}\right) + 4y^2 = 98$

$49 + 4y^2 = 98$

$-98 \quad -98$

$4y^2 - 49 = 0$

$(2y - 7)(2y + 7) = 0$

$y = \frac{7}{2}$

$y = -\frac{7}{2}$

$\boxed{\left(\frac{7}{2}, \frac{7}{2}\right) \quad \left(\frac{7}{2}, -\frac{7}{2}\right)}$

Check $x = -\frac{7}{2}$

$4x^2 + 4y^2 = 98$

$4\left(-\frac{7}{2}\right)^2 + 4y^2 = 98$

$4\left(\frac{49}{4}\right) + 4y^2 = 98$

$49 + 4y^2 = 98$

$-98 \qquad -98$

$-49 + 4y^2 = 0$

$4y^2 - 49 = 0$

$(2y + 7)(2y - 7) = 0$

apply Zero product prop.

$y = -\frac{7}{2}$ $\qquad$ $y = \frac{7}{2}$

$\left(-\frac{7}{2}, -\frac{7}{2}\right)$ $\left(-\frac{7}{2}, \frac{7}{2}\right)$

Points: $\left(\frac{7}{2}, \frac{7}{2}\right)$ $\left(-\frac{7}{2}, -\frac{7}{2}\right)$

$\left(\frac{7}{2}, -\frac{7}{2}\right)$ $\left(-\frac{7}{2}, \frac{7}{2}\right)$

4 points in total will be your final answer

(16) $\begin{cases} y = x+4 \\ 9x^2+y^2=16 \end{cases}$

check $x=0$

$y=0+4$

$y=4$

$(0,4)$

$x=\frac{-4}{5}$

$y=\frac{-4}{5}+4$

$y=\frac{24}{5}$

$\left(\frac{-4}{5},\frac{24}{5}\right)$

(1) $y=x+4$ choose which Equation to plug into

(2) $9x^2+(x+4)^2=16$

$9x^2+(x+4)(x+4)=16$

$9x^2+x^2+8x+16=16$

$10x^2+8x+16=16$

$-16 \quad -16$

$10x^2+8x=0$

$2(5x^2+4x)=0$

$\frac{10x^2+8x}{2x}=\frac{0}{2x}$

$2x(5x-4)=0$

$\frac{2x}{2}=\frac{0}{2}$

$x=0$

$5x-4=0$

$+4 \quad +4$

$\frac{5x}{5}=\frac{4}{5}$

$x=\frac{4}{5}$