Math 10C

L49 Elimination

Part 1 – Method

Elimination is an algebraic method of solving systems of equations.

Process:

1. Arrange both equations so the terms are in the same order.
2. Multiply one (or both) of the equations by a value so the coefficients of a variable is equal in magnitude to the corresponding coefficient.
3. Add or subtract the equations to eliminate a variable.
4. Solve for the other variable.

Part 1 – Adding Equations

Q1: Find the solution to the system of equations using *elimination*.

$x + y = 4$

$+ (x - y = 10)$

$2x \quad = 14$

$2x = 14$

$\div 2 \quad \div 2$

$\boxed{x = 7}$

→ Plug into any eqn

$x + y = 4$

$(7) + y = 4$

$-7 \qquad -7$

$\boxed{y = -3}$

$\boxed{\text{soln is } (7, -3)}$

Q2: Find the solution to the system of equations using *elimination*.

$5x - 3y - 2 = 0$

$+ (-4x + 3y - 2 = 0)$

$1x \quad -4 = 0$

$1x - 4 = 0$

$+4 \quad +4$

$\boxed{x = 4}$

→ Plug into any eqn.

$5x - 3y - 2 = 0$

$5(4) - 3y - 2 = 0$

$20 - 3y - 2 = 0$

$18 - 3y = 0$

$+3y \quad +3y$

$18 = 3y$

$\div 3 \quad \div 3$

$\boxed{6 = y}$

$\boxed{\text{soln is } (4, 6)}$

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Part 2 – Subtracting Equations

Q3: Find the solution to the system of equations using *elimination*.

$x + y = 7$

$- (x - 2y = -2)$

$\overline{3y = 9}$

$3y = 9$

$\div 3 \quad \div 3$

$\boxed{y = 3}$ → Plug into any eqn.

$x + y = 7$

$x + 3 = 7$

$ -3 \quad -3$

$\boxed{x = 4}$

$\boxed{\text{soln is } (4, 3)}$

Q4: Find the solution to the system of equations using *elimination*.

$2x + 3y = 7$

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

$\overline{x = 8}$

$\boxed{x = 8}$ → Plug into any eqn.

$2x + 3y = 7$

$2(8) + 3y = 7$

$16 + 3y = 7$

$-16 -16$

$3y = -9$

$\div 3 \quad \div 3$

$\boxed{y = -3}$

$\boxed{\text{soln is } (8, -3)}$

Part 3 – Reorganizing Equations First

Q5: Find the solution to the system of equations using *elimination*.

$5 = 6x + 2y$

$2y = x + 5$

$5 = 6x + 2y$

$-5 -5$

$0 = 6x + 2y - 5$

$2y = x + 5$

$-2y \quad -2y$

$0 = x - 2y + 5$

$0 = 6x + 2y - 5$

$+ (0 = x - 2y + 5)$

$\overline{0 = 7x + 0}$

$\div 7 \quad \div 7$

$\boxed{0 = x}$

→ Plug into any eqn.

$2y = x + 5$

$2y = (0) + 5$

$\div 2 \div 2$

$\boxed{y = \tfrac{5}{2}}$

$\boxed{\text{soln is } (0, \tfrac{5}{2})}$

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Part 4 – Multiplying to Increase Coefficients (Two Different Ways)

Q6: Find the solution to the system of equations using *elimination*.

$2x + y = 15$

$5x - 6y = -22$

Method #1: Eliminate x

$5(2x + y = 15)$ ⟶ $10x + 5y = 75$ ⟶ Plug into __any__ eqn.

$2(5x - 6y = -22)$ ⟶ $-(10x - 12y = -44)$

$\qquad\qquad\qquad\qquad\qquad 17y = 119$ $2x + y = 15$

$\qquad\qquad\qquad\qquad\qquad \div 17 \quad \div 17$ $2x + (7) = 15$

$\qquad\qquad\qquad\qquad\qquad \boxed{y = 7}$ $\qquad\quad -7 \quad\; -7$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad 2x = 8$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \div 2 \quad\; \div 2$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \boxed{x = 4}$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \boxed{\text{Soln is } (4, 7)}$

Method #2: Eliminate y

$6(2x + y = 15)$ ⟶ $12x + 6y = 90$ ⟶ Plug into __any__ eqn.

$\quad 5x - 6y = -22$ $+(5x - 6y = -22)$

$\qquad\qquad\qquad\qquad\qquad 17x \quad = 68$ $2x + y = 15$

$\qquad\qquad\qquad\qquad\qquad \div 17 \qquad \div 17$ $2(4) + y = 15$

$\qquad\qquad\qquad\qquad\qquad \boxed{x = 4}$ $\quad 8 + y = 15$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad -8 \qquad\quad -8$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \boxed{y = 7}$

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad \boxed{\text{Soln is } (4, 7)}$
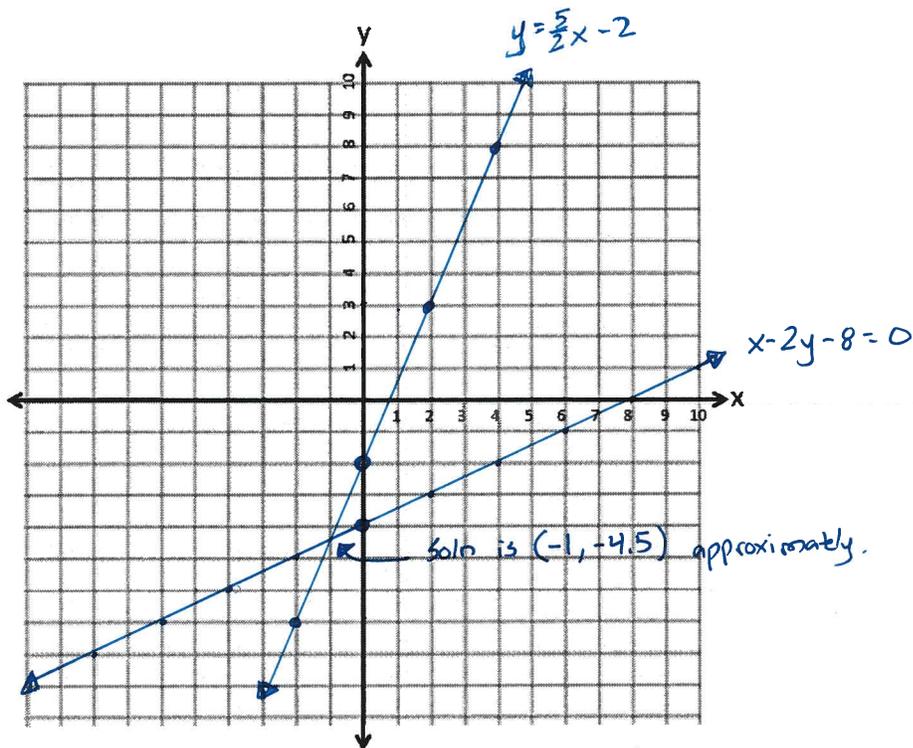
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Part 5– Graphing, Substitution, and Elimination

Q7: Find the solution to the system of equations using (a) graphing, (b) substitution, and (c) elimination.

$$y = \frac{5}{2}x - 2 \qquad\qquad x - 2y - 8 = 0$$

$x - 2y - 8 = 0$
$+2y \qquad +2y$

$x - 8 = 2y$
$\div 2 \quad \div 2 \quad \div 2$

$\frac{1}{2}x - 4 = y$

$y = \frac{1}{2}x - 4$

$y = \frac{5}{2}x - 2$

$x - 2y - 8 = 0$

Soln is $(-1, -4.5)$ approximately.

Substitution

$y = \frac{5}{2}x - 2 \qquad x - 2y - 8 = 0$

$x - 2(\frac{5}{2}x - 2) - 8 = 0$

$x - 5x + 4 - 8 = 0$

$-4x - 4 = 0$
$+4 \quad +4$

$-4x = 4$
$\div(-4) \quad \div(-4)$

$\boxed{x = -1}$

$y = \frac{5}{2}x - 2$

$y = \frac{5}{2}(-1) - 2$

$y = -\frac{5}{2} - \frac{4}{2}$

$\boxed{y = -\frac{9}{2}}$

$\boxed{\text{Soln is } (-1, -\frac{9}{2})}$

Elimination

$y = \frac{5}{2}x - 2 \rightarrow \frac{5}{2}x - 1y - 2 = 0 \rightarrow 5x - 2y - 4 = 0$

$x - 2y - 8 = 0$
$-(5x - 2y - 4 = 0)$
_____
$-4x \qquad -4 = 0$
$+4 \quad +4$

$-4x = 4$
$\div(-4) \quad \div(-4)$

$\boxed{x = -1}$

$y = \frac{5}{2}(-1) - 2$

$\boxed{y = -\frac{9}{2}}$

$\boxed{\text{Soln is } (-1, -\frac{9}{2})}$