SOLVING EQUATIONS

A DEFINITIONS

A.1 MATH ESCAPE ROOM LEVEL 1

MCQ 1: For this Math escape room, the code is:

$$\bigcirc + 5 = 9$$

Which code do you use to enter?

☐ $\bigcirc = 2$

☒ $\bigcirc = 4$

☐ $\bigcirc = 5$

☐ $\bigcirc = 9$

Answer:

- For $\bigcirc = 2$:
$$(2) + 5 = 9$$
$$7 = 9 \quad \text{(False)}$$

- For $\bigcirc = 4$:
$$(4) + 5 = 9$$
$$9 = 9 \quad \text{(True)}$$

- For $\bigcirc = 5$:
$$(5) + 5 = 9$$
$$10 = 9 \quad \text{(False)}$$

- For $\bigcirc = 9$:
$$(9) + 5 = 9$$
$$14 = 9 \quad \text{(False)}$$

Therefore, the correct code to enter is $\bigcirc = 4$.

MCQ 2: For this Math escape room, the code is:

$$\triangle + 10 = 1 + 2 \times 6$$

Which code do you use to enter?

☒ $\triangle = 3$

☐ $\triangle = 5$

☐ $\triangle = 8$

☐ $\triangle = 10$

Answer:

- For $\triangle = 3$:
$$(3) + 10 = 1 + 2 \times 6$$
$$13 = 1 + 12$$
$$13 = 13 \quad \text{(True)}$$

- For $\triangle = 5$:
$$(5) + 10 = 1 + 2 \times 6$$
$$15 = 1 + 12$$
$$15 = 13 \quad \text{(False)}$$

- For $\triangle = 8$:
$$(8) + 10 = 1 + 2 \times 6$$
$$18 = 1 + 12$$
$$18 = 13 \quad \text{(False)}$$

- For $\triangle = 10$:
$$(10) + 10 = 1 + 2 \times 6$$
$$20 = 1 + 12$$
$$20 = 13 \quad \text{(False)}$$

Therefore, the correct code to enter is $\triangle = 3$.

MCQ 3: For this Math escape room, the code is:

$$\square + 5 = 2 \times 4 + 1$$

Which code do you use to enter?

☐ $\square = 6$

☐ $\square = 8$

☐ $\square = 5$

☒ $\square = 4$

Answer:

- For $\square = 6$:
$$(6) + 5 = 2 \times 4 + 1$$
$$11 = 8 + 1$$
$$11 = 9 \quad \text{(False)}$$

- For $\square = 8$:
$$(8) + 5 = 2 \times 4 + 1$$
$$13 = 8 + 1$$
$$13 = 9 \quad \text{(False)}$$

- For $\square = 5$:
$$(5) + 5 = 2 \times 4 + 1$$
$$10 = 8 + 1$$
$$10 = 9 \quad \text{(False)}$$

- For $\square = 4$:
$$(4) + 5 = 2 \times 4 + 1$$
$$9 = 8 + 1$$
$$9 = 9 \quad \text{(True)}$$

Therefore, the correct code to enter is $\square = 4$.

MCQ 4: For this Math escape room, the code is:

$$\bigcirc - 4 = 3 \times 2 - 1$$

Which code do you use to enter?

☐ $\bigcirc = 7$

☐ $\bigcirc = 6$

☐ ◯ = 5

☒ ◯ = 9

Answer:

- For ◯ = 7:

$$(7) - 4 = 3 \times 2 - 1$$
$$3 = 6 - 1$$
$$3 = 5 \qquad \text{(False)}$$

- For ◯ = 6:

$$(6) - 4 = 3 \times 2 - 1$$
$$2 = 6 - 1$$
$$2 = 5 \qquad \text{(False)}$$

- For ◯ = 5:

$$(5) - 4 = 3 \times 2 - 1$$
$$1 = 6 - 1$$
$$1 = 5 \qquad \text{(False)}$$

- For ◯ = 9:

$$(9) - 4 = 3 \times 2 - 1$$
$$5 = 6 - 1$$
$$5 = 5 \qquad \text{(True)}$$

Therefore, the correct code to enter is ◯ = 9.

A.2 MATH ESCAPE ROOM LEVEL 2

MCQ 5: For this Math escape room, the code is:

$$2 \times ◯ - 2 = ◯ + 10$$

Which code do you use to enter?

☐ ◯ = 8

☐ ◯ = 10

☒ ◯ = 12

☐ ◯ = 14

Answer:

- For ◯ = 8:

$$2 \times (8) - 2 = (8) + 10$$
$$16 - 2 = 8 + 10$$
$$14 = 18 \qquad \text{(False)}$$

- For ◯ = 10:

$$2 \times (10) - 2 = (10) + 10$$
$$20 - 2 = 10 + 10$$
$$18 = 20 \qquad \text{(False)}$$

- For ◯ = 12:

$$2 \times (12) - 2 = (12) + 10$$
$$24 - 2 = 12 + 10$$
$$22 = 22 \qquad \text{(True)}$$

- For ◯ = 14:

$$2 \times (14) - 2 = (14) + 10$$
$$28 - 2 = 14 + 10$$
$$26 = 24 \qquad \text{(False)}$$

Therefore, the correct code to enter is ◯ = 12.

MCQ 6: For this Math escape room, the code is:

$$3x + 7 = x + 19$$

Which code do you use to enter?

☐ $x = 2$

☐ $x = 4$

☒ $x = 6$

☐ $x = 8$

Answer:

- For $x = 2$:

$$3 \times (2) + 7 = (2) + 19$$
$$6 + 7 = 2 + 19$$
$$13 = 21 \qquad \text{(False)}$$

- For $x = 4$:

$$3 \times (4) + 7 = (4) + 19$$
$$12 + 7 = 4 + 19$$
$$19 = 23 \qquad \text{(False)}$$

- For $x = 6$:

$$3 \times (6) + 7 = (6) + 19$$
$$18 + 7 = 6 + 19$$
$$25 = 25 \qquad \text{(True)}$$

- For $x = 8$:

$$3 \times (8) + 7 = (8) + 19$$
$$24 + 7 = 8 + 19$$
$$31 = 27 \qquad \text{(False)}$$

Therefore, the correct code to enter is $x = 6$.

MCQ 7: For this Math escape room, the code is:

$$2x - 2 = x + 10$$

Which code do you use to enter?

☐ $x = 6$

☐ $x = 8$

☐ $x = 10$

☒ $x = 12$

Answer:

- For $x = 6$:

$$2 \times (6) - 2 = (6) + 10$$
$$12 - 2 = 6 + 10$$
$$10 = 16 \qquad \text{(False)}$$

- For $x = 8$:

$$2 \times (8) - 2 = (8) + 10$$
$$16 - 2 = 8 + 10$$
$$14 = 18 \qquad \text{(False)}$$

- For $x = 10$:

$$2 \times (10) - 2 = (10) + 10$$
$$20 - 2 = 10 + 10$$
$$18 = 20 \qquad \text{(False)}$$

- For $x = 12$:

$$2 \times (12) - 2 = (12) + 10$$
$$24 - 2 = 12 + 10$$
$$22 = 22 \qquad \text{(True)}$$

Therefore, the correct code to enter is $x = 12$.

MCQ 8: For this Math escape room, the code is:

$$x \times (x - 2) = 24$$

Which code do you use to enter?

☒ $x = 6$

☐ $x = 7$

☐ $x = 8$

☐ $x = 9$

Answer:

- For $x = 6$:

$$(6) \times ((6) - 2) = 24$$
$$6 \times 4 = 24$$
$$24 = 24 \qquad \text{(True)}$$

- For $x = 7$:

$$(7) \times ((7) - 2) = 24$$
$$7 \times 5 = 24$$
$$35 = 24 \qquad \text{(False)}$$

- For $x = 8$:

$$(8) \times ((8) - 2) = 24$$
$$8 \times 6 = 24$$
$$48 = 24 \qquad \text{(False)}$$

- For $x = 9$:

$$(9) \times ((9) - 2) = 24$$
$$9 \times 7 = 24$$
$$63 = 24 \qquad \text{(False)}$$

Therefore, the correct code to enter is $x = 6$.

A.3 MATH ESCAPE ROOM LEVEL 3

MCQ 9: For this Math escape room, the code is:

$$x^2 - 4 = 0$$

Which code do you use to enter?

☒ $x = 2$

☐ $x = 3$

☐ $x = 4$

☐ $x = 5$

Answer:

- For $x = 2$:

$$(2)^2 - 4 = 0$$
$$4 - 4 = 0$$
$$0 = 0 \quad \text{(True)}$$

- For $x = 3$:

$$(3)^2 - 4 = 0$$
$$9 - 4 = 0$$
$$5 = 0 \quad \text{(False)}$$

- For $x = 4$:

$$(4)^2 - 4 = 0$$
$$16 - 4 = 0$$
$$12 = 0 \quad \text{(False)}$$

- For $x = 5$:

$$(5)^2 - 4 = 0$$
$$25 - 4 = 0$$
$$21 = 0 \quad \text{(False)}$$

Therefore, the correct code to enter is $x = 2$.

MCQ 10: For this Math escape room, the code is:

$$x^2 - 2x + 1 = 0$$

Which code do you use to enter?

☒ $x = 0$

☐ $x = 1$

☐ $x = 2$

☐ $x = 3$

Answer:

- For $x = 0$:

$$(0)^2 - 2 \times (0) + 1 = 0$$
$$0 - 0 + 1 = 0$$
$$1 = 0 \quad \text{(False)}$$

- For $x = 1$:

$$(1)^2 - 2 \times (1) + 1 = 0$$
$$1 - 2 + 1 = 0$$
$$0 = 0 \quad \text{(True)}$$

- For $x = 2$:

$$(2)^2 - 2 \times (2) + 1 = 0$$
$$4 - 4 + 1 = 0$$
$$1 = 0 \quad \text{(False)}$$

- For $x = 3$:

$$(3)^2 - 2 \times (3) + 1 = 0$$
$$9 - 6 + 1 = 0$$
$$4 = 0 \quad \text{(False)}$$

Therefore, the correct code to enter is $x = 1$.

MCQ 11: For this Math escape room, the code is:

$$\frac{2x + 1}{x - 1} = 3$$

Which code do you use to enter?

- ☐ $x = 2$

- ☐ $x = 3$

- ☒ $x = 4$

- ☐ $x = 5$

Answer:

- For $x = 2$:

$$\frac{2 \times (2) + 1}{(2) - 1} = 3$$
$$\frac{4 + 1}{2 - 1} = 3$$
$$\frac{5}{1} = 3$$
$$5 = 3 \quad \text{(False)}$$

- For $x = 3$:

$$\frac{2 \times (3) + 1}{(3) - 1} = 3$$
$$\frac{6 + 1}{3 - 1} = 3$$
$$\frac{7}{2} = 3$$
$$3.5 = 3 \quad \text{(False)}$$

- For $x = 4$:

$$\frac{2 \times (4) + 1}{(4) - 1} = 3$$
$$\frac{8 + 1}{4 - 1} = 3$$
$$\frac{9}{3} = 3$$
$$3 = 3 \quad \text{(True)}$$

- For $x = 5$:

$$\frac{2 \times (5) + 1}{(5) - 1} = 3$$
$$\frac{10 + 1}{5 - 1} = 3$$
$$\frac{11}{4} = 3$$
$$2.75 = 3 \quad \text{(False)}$$

Therefore, the correct code to enter is $x = 4$.

B SOLVING BY TRIAL AND ERROR

B.1 FINDING A SOLUTION LEVEL 1

Ex 12: Consider the equation $2x + 3 = 11$.
Use the trial-and-error method to find a solution (try $x = 2, 3, \ldots$).

$$x = \boxed{4}$$

Answer:

- Try $x = 2$:

$$2 \times (2) + 3 = 11$$
$$4 + 3 = 11$$
$$7 = 11 \quad \text{(False)}$$

- Try $x = 3$:

$$2 \times (3) + 3 = 11$$
$$6 + 3 = 11$$
$$9 = 11 \quad \text{(False)}$$

- Try $x = 4$:

$$2 \times (4) + 3 = 11$$
$$8 + 3 = 11$$
$$11 = 11 \quad \text{(True)}$$

Therefore, a solution to the equation $2x + 3 = 11$ is $x = 4$.

Ex 13: Consider the equation $3x - 5 = 10$.
Use the trial-and-error method to find a solution (try $x = 4, 5, \ldots$).

$$x = \boxed{5}$$

Answer:

- Try $x = 4$:

$$3 \times (4) - 5 = 10$$
$$12 - 5 = 10$$
$$7 = 10 \quad \text{(False)}$$

- Try $x = 5$:

$$3 \times (5) - 5 = 10$$
$$15 - 5 = 10$$
$$10 = 10 \quad \text{(True)}$$

Therefore, a solution to the equation $3x - 5 = 10$ is $x = 5$.

Ex 14: Consider the equation $x(x - 1) = 6$.
Use the trial-and-error method to find a solution (try $x = 2, 3, \ldots$).

$$x = \boxed{3}$$

Answer:

- Try $x = 2$:

$$(2) \times ((2) - 1) = 6$$
$$2 \times 1 = 6$$
$$2 = 6 \quad \text{(False)}$$

- Try $x = 3$:

$$(3) \times ((3) - 1) = 6$$
$$3 \times 2 = 6$$
$$6 = 6 \quad \text{(True)}$$

Therefore, a solution to the equation $x(x - 1) = 6$ is $x = 3$.

Ex 15: Consider the equation $2x - 3 = 5x - 9$.
Use the trial-and-error method to find a solution (try $x = 0, 1, \ldots$).

$$x = \boxed{2}$$

Answer:

- Try $x = 0$:

$$2 \times (0) - 3 = 5 \times (0) - 9$$
$$0 - 3 = 0 - 9$$
$$-3 = -9 \qquad \text{(False)}$$

- Try $x = 1$:

$$2 \times (1) - 3 = 5 \times (1) - 9$$
$$2 - 3 = 5 - 9$$
$$-1 = -4 \qquad \text{(False)}$$

- Try $x = 2$:

$$2 \times (2) - 3 = 5 \times (2) - 9$$
$$4 - 3 = 10 - 9$$
$$1 = 1 \qquad \text{(True)}$$

Therefore, a solution to the equation $2x - 3 = 5x - 9$ is $x = 2$.

B.2 FINDING A SOLUTION LEVEL 2

Ex 16: Consider the equation $x^2 - 2x + 1 = 0$.
Use the trial-and-error method to find a solution (try $x = 0, 1, \ldots$).

$$x = \boxed{1}$$

Answer:

- Try $x = 0$:

$$(0)^2 - 2 \times (0) + 1 = 0$$
$$0 - 0 + 1 = 0$$
$$1 = 0 \quad \text{(False)}$$

- Try $x = 1$:

$$(1)^2 - 2 \times (1) + 1 = 0$$
$$1 - 2 + 1 = 0$$
$$0 = 0 \quad \text{(True)}$$

Therefore, a solution to the equation $x^2 - 2x + 1 = 0$ is $x = 1$.

Ex 17: Consider the equation $x^2 - 9 = 0$.
Use the trial-and-error method to find a solution (try $x = 2, 3, \ldots$).

$$x = \boxed{3}$$

Answer:

- Try $x = 2$:

$$(2)^2 - 9 = 0$$
$$4 - 9 = 0$$
$$-5 = 0 \quad \text{(False)}$$

- Try $x = 3$:

$$(3)^2 - 9 = 0$$
$$9 - 9 = 0$$
$$0 = 0 \quad \text{(True)}$$

Therefore, a solution to the equation $x^2 - 9 = 0$ is $x = 3$.

Ex 18: Consider the equation $\dfrac{x + 2}{x - 2} = 2$.
Use the trial-and-error method to find a solution (try $x = 6, 3, 4$).

$$x = \boxed{6}$$

Answer:

- Try $x = 6$:

$$\frac{6 + 2}{6 - 2} = 2$$
$$\frac{8}{4} = 2$$
$$2 = 2 \quad \text{(True)}$$

- Try $x = 3$:

$$\frac{3 + 2}{3 - 2} = 2$$
$$\frac{5}{1} = 2$$
$$5 = 2 \quad \text{(False)}$$

- Try $x = 4$:

$$\frac{4 + 2}{4 - 2} = 2$$
$$\frac{6}{2} = 2$$
$$3 = 2 \quad \text{(False)}$$

Therefore, a solution to the equation $\frac{x+2}{x-2} = 2$ is $x = 6$.

C EQUIVALENT EQUATIONS

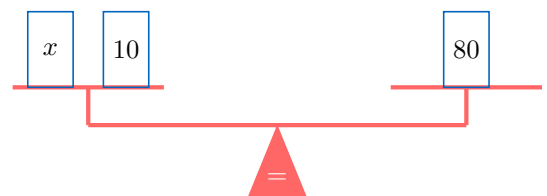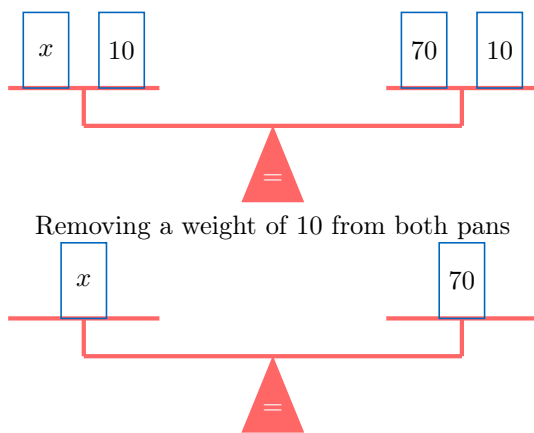## C.1 SOLVING EQUATIONS BY ADDING OR SUBTRACTING

Ex 19: Solve for x:

$$x + 10 = 80$$

$$x = \boxed{70}$$

Answer:

- Balance scale:

Removing a weight of 10 from both pans

- Equivalent equations:

$$x + 10 = 80$$
$$x + 10 - 10 = 80 - 10 \qquad (-10)$$
$$x + 0 = 70$$
$$x = 70$$

Ex 20: Solve for x:

$$x + 20 = 36$$
$$x = \boxed{16}$$

Answer:

- Balance scale:

Removing a weight of 20 from both pans
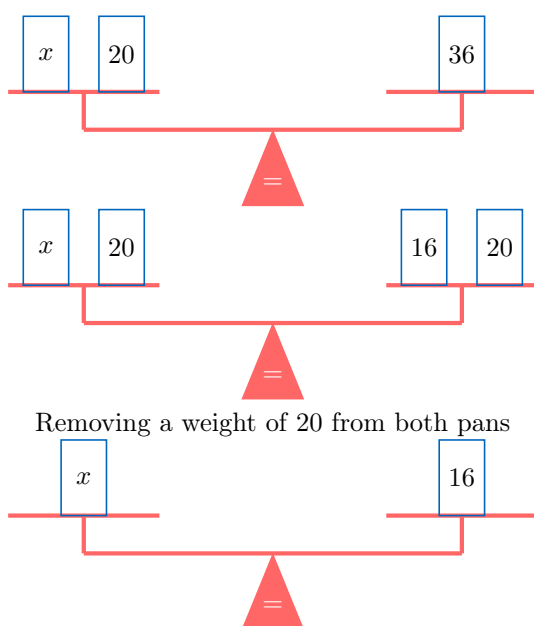
- Equivalent equations:

$$x + 20 = 36$$
$$x + 20 - 20 = 36 - 20 \qquad (-20)$$
$$x + 0 = 16$$
$$x = 16$$

Ex 21: Solve for x:

$$x + 1 = 100$$
$$x = \boxed{99}$$

Answer:

- Balance scale:

Removing a weight of 1 from both pans
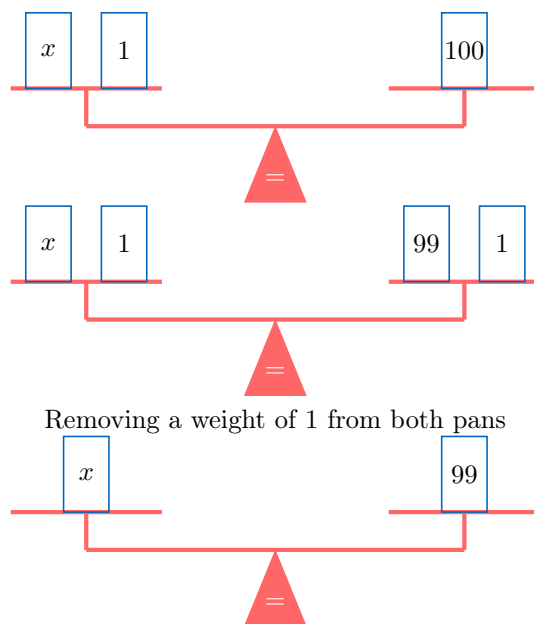
- Equivalent equations:

$$x + 1 = 100$$
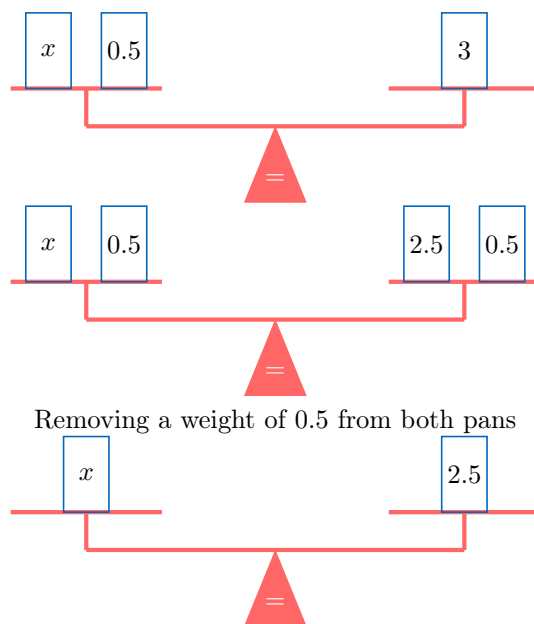$$x + 1 - 1 = 100 - 1 \qquad (-1)$$
$$x + 0 = 99$$
$$x = 99$$

Ex 22: Solve for x:

$$x + 0.5 = 3$$
$$x = \boxed{2.5} \text{ (write in decimal form)}$$

Answer:

- Balance scale:

Removing a weight of 0.5 from both pans

- Equivalent equations:

$$x + 0.5 = 3$$
$$x + 0.5 - 0.5 = 3 - 0.5 \qquad (-0.5)$$
$$x + 0 = 2.5$$
$$x = 2.5$$

Ex 23: Solve for x:
$$x - 10 = -20$$
$$x = \boxed{-10}$$

Answer:
$$x - 10 = -20$$
$$x - 10 + 10 = -20 + 10 \qquad (+10)$$
$$x + 0 = -10$$
$$x = -10$$

Ex 24: Solve for x:
$$x - 5 = -2$$
$$x = \boxed{3}$$

Answer:
$$x - 5 = -2$$
$$x - 5 + 5 = -2 + 5 \qquad (+5)$$
$$x + 0 = 3$$
$$x = 3$$

C.2 SOLVING EQUATIONS BY MULTIPLYING OR DIVIDING

Ex 25: Solve for x:
$$2x = 16$$
$$x = \boxed{8}$$

Answer:

- Balance scale:

Divide the weight into two equal parts
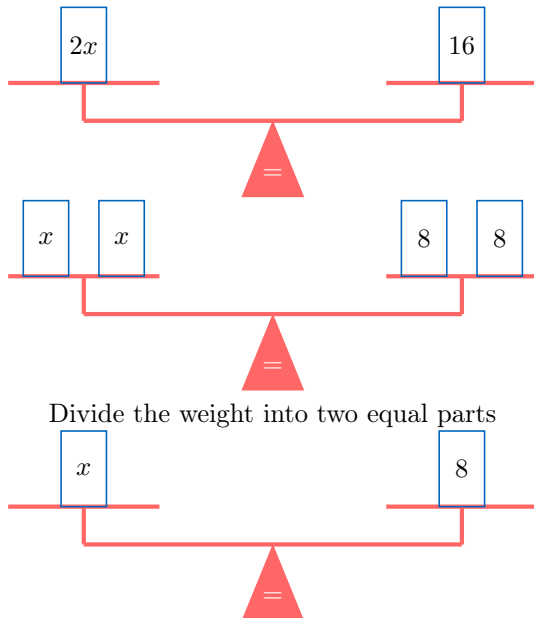
- Equivalent equations:
$$2x = 16$$
$$\therefore \quad \frac{2x}{2} = \frac{16}{2} \qquad (\div 2)$$
$$x = 8$$

Ex 26: Solve for x:
$$2x = 30$$

$$x = \boxed{15}$$

Answer:

- Balance scale:

Divide the weight into two equal parts
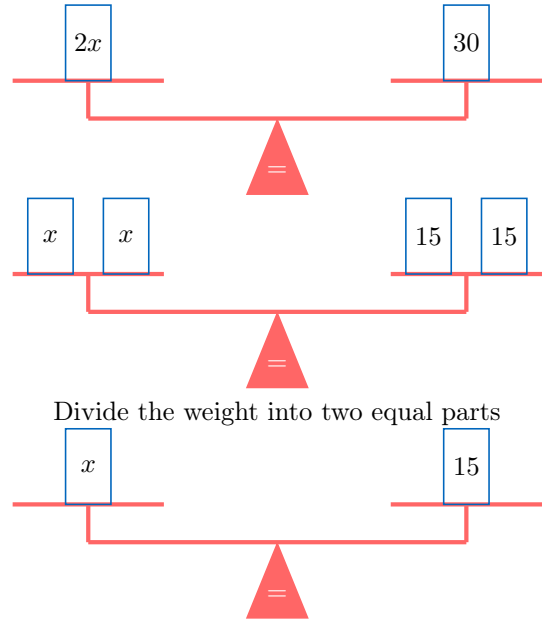
- Equivalent equations:
$$2x = 30$$
$$\therefore \quad \frac{2x}{2} = \frac{30}{2} \qquad (\div 2)$$
$$x = 15$$

Ex 27: Solve for x:
$$3x = 27$$
$$x = \boxed{9}$$

Answer:
$$3x = 27$$
$$\therefore \quad \frac{3x}{3} = \frac{27}{3} \qquad (\div 3)$$
$$x = 9$$

Ex 28: Solve for x:
$$\frac{x}{4} = 5$$
$$x = \boxed{20}$$

Answer:
$$\frac{x}{4} = 5$$
$$\therefore \quad \frac{x}{4} \times 4 = 5 \times 4 \qquad (\times 4)$$
$$x = 20$$

Ex 29: Solve for x:
$$\frac{x}{3} = \frac{1}{2}$$

$$x = \boxed{1.5} \text{ (write in decimal form)}$$

Answer:

$$\frac{x}{3} = \frac{1}{2}$$
$$\therefore \quad \frac{x}{3} \times 3 = \frac{1}{2} \times 3 \qquad (\times 3)$$
$$x = \frac{3}{2}$$
$$x = 1.5$$

D DOING AND UNDOING EXPRESSIONS

D.1 DOING EXPRESSIONS

Ex 30: Do the expression $3 + 5x$

$$\boxed{x} \xrightarrow{\times 5} \boxed{5x} \xrightarrow{+3} \boxed{3 + 5x}$$

Answer: To do the expression $3 + 5x$, follow the steps:

$$\boxed{x} \xrightarrow{\times 5} \boxed{5x} \xrightarrow{+3} \boxed{3 + 5x}$$

Ex 31: Do the expression $2x + 1$

$$\boxed{x} \xrightarrow{\times 2} \boxed{2x} \xrightarrow{+1} \boxed{2x + 1}$$

Answer: To do the expression $2x + 1$, follow the steps:

$$\boxed{x} \xrightarrow{\times 2} \boxed{2x} \xrightarrow{+1} \boxed{2x + 1}$$

Ex 32: Do the expression $5x - 1$

$$\boxed{x} \xrightarrow{\times 5} \boxed{5x} \xrightarrow{-1} \boxed{5x - 1}$$

Answer: To do the expression $5x - 1$, follow the steps:

$$\boxed{x} \xrightarrow{\times 5} \boxed{5x} \xrightarrow{-1} \boxed{5x - 1}$$

Ex 33: Do the expression $\frac{x}{2} + 3$

$$\boxed{x} \xrightarrow{\div 2} \boxed{x/2} \xrightarrow{+3} \boxed{x/2 + 3}$$

Answer: To do the expression $\frac{x}{2} + 3$, follow the steps:

$$\boxed{x} \xrightarrow{\div 2} \boxed{\frac{x}{2}} \xrightarrow{+3} \boxed{\frac{x}{2} + 3}$$

Ex 34: Do the expression $2 - 5x$

$$\boxed{x} \xrightarrow{\times(-5)} \boxed{-5x} \xrightarrow{+2} \boxed{2 - 5x}$$

Answer: To do the expression $2 - 5x$, follow the steps:

$$\boxed{x} \xrightarrow{\times(-5)} \boxed{-5x} \xrightarrow{+2} \boxed{2 - 5x}$$

Ex 35: Do the expression $2(x - 3)$

$$\boxed{x} \xrightarrow{-3} \boxed{x - 3} \xrightarrow{\times 2} \boxed{2(x - 3)}$$

Answer: To do the expression $2(x - 3)$, follow the steps:

$$\boxed{x} \xrightarrow{-3} \boxed{x - 3} \xrightarrow{\times 2} \boxed{2(x - 3)}$$

Ex 36: Do the expression $\frac{x - 3}{2}$

$$\boxed{x} \xrightarrow{-3} \boxed{x - 3} \xrightarrow{\div 2} \boxed{(x - 3)/2}$$

Answer: To do the expression $\frac{x-3}{2}$, follow the steps:

$$\boxed{x} \xrightarrow{-3} \boxed{x - 3} \xrightarrow{\div 2} \boxed{\frac{x - 3}{2}}$$

D.2 UNDOING EXPRESSIONS

Ex 37: Undo the expression $2x + 1$

$$\boxed{2x + 1} \xrightarrow{-1} \boxed{2x} \xrightarrow{\div 2} \boxed{x}$$

Answer:

- To do the expression $2x + 1$:

$$\boxed{x} \xrightarrow{\times 2} \boxed{2x} \xrightarrow{+1} \boxed{2x + 1}$$

- To undo the expression $2x + 1$, perform inverse operations in the reverse order:

$$\boxed{2x + 1} \xrightarrow{-1} \boxed{2x} \xrightarrow{\div 2} \boxed{x}$$

Ex 38: Undo the expression $3x - 2$

$$\boxed{3x - 2} \xrightarrow{+2} \boxed{3x} \xrightarrow{\div 3} \boxed{x}$$

Answer:

- To do the expression $3x - 2$:

$$\boxed{x} \xrightarrow{\times 3} \boxed{3x} \xrightarrow{-2} \boxed{3x - 2}$$

- To undo the expression $3x - 2$, perform inverse operations in the reverse order:

$$\boxed{3x - 2} \xrightarrow{+2} \boxed{3x} \xrightarrow{\div 3} \boxed{x}$$

Ex 39: Undo the expression $\frac{x}{3} + 2$

$$\boxed{x/3 + 2} \xrightarrow{-2} \boxed{x/3} \xrightarrow{\times 3} \boxed{x}$$
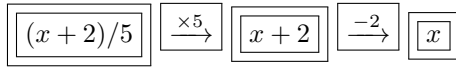
Answer:

- To do the expression $\frac{x}{3} + 2$:

$$\boxed{x} \xrightarrow{\div 3} \boxed{\frac{x}{3}} \xrightarrow{+2} \boxed{\frac{x}{3} + 2}$$

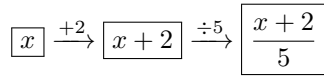- To undo the expression $\frac{x}{3} + 2$, perform inverse operations in the reverse order:

$$\boxed{\frac{x}{3} + 2} \xrightarrow{-2} \boxed{\frac{x}{3}} \xrightarrow{\times 3} \boxed{x}$$
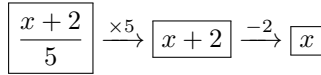
Ex 40: Undo the expression $\dfrac{x+2}{5}$

$$\boxed{(x+2)/5} \; \xrightarrow{\times 5} \; \boxed{x+2} \; \xrightarrow{-2} \; \boxed{x}$$

Answer:

- To do the expression $\frac{x+2}{5}$:

$$\boxed{x} \xrightarrow{+2} \boxed{x+2} \xrightarrow{\div 5} \boxed{\dfrac{x+2}{5}}$$

- To undo the expression $\frac{x+2}{5}$, perform inverse operations in the reverse order:

$$\boxed{\dfrac{x+2}{5}} \xrightarrow{\times 5} \boxed{x+2} \xrightarrow{-2} \boxed{x}$$

E SOLVING LINEAR EQUATIONS

E.1 SOLVING LINEAR EQUATIONS: LEVEL 1

Ex 41: Solve for x:
$$2x + 1 = 7$$
$$x = \boxed{3}$$

Answer:

- To **do** the expression $2x + 1$:

$$\boxed{x} \xrightarrow{\times 2} \boxed{2x} \xrightarrow{+1} \boxed{2x+1}$$
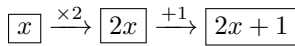
- To **undo** the expression $2x + 1$, do the inverse operations in reverse order:

$$\boxed{2x+1} \xrightarrow{-1} \boxed{2x} \xrightarrow{\div 2} \boxed{x}$$

- So,
$$2x + 1 = 7$$
$$2x + 1{\color{red}-1} = 7{\color{red}-1} \quad ({\color{red}-1})$$
$$2x = 6$$
$$\frac{2x}{2} = \frac{6}{2} \quad (\div 2)$$
$$x = 3$$
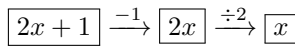
Ex 42: Solve for x:
$$2x - 4 = 5$$
$$x = \boxed{4.5}$$

Answer:

- To **do** the expression $2x - 4$:

$$\boxed{x} \xrightarrow{\times 2} \boxed{2x} \xrightarrow{-4} \boxed{2x-4}$$
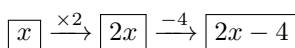
- To **undo** the expression $2x - 4$, do the inverse operations in reverse order:

$$\boxed{2x-4} \xrightarrow{+4} \boxed{2x} \xrightarrow{\div 2} \boxed{x}$$

- So,
$$2x - 4 = 5$$
$$2x - 4{\color{red}+4} = 5{\color{red}+4} \quad ({\color{red}+4})$$
$$2x = 9$$
$$\frac{2x}{2} = \frac{9}{2} \quad (\div 2)$$
$$x = 4.5$$

Ex 43: Solve for x:
$$4x - 7 = 9$$
$$x = \boxed{4}$$

Answer:

- To **do** the expression $4x - 7$:

$$\boxed{x} \xrightarrow{\times 4} \boxed{4x} \xrightarrow{-7} \boxed{4x-7}$$

- To **undo** the expression $4x - 7$, do the inverse operations in reverse order:

$$\boxed{4x-7} \xrightarrow{+7} \boxed{4x} \xrightarrow{\div 4} \boxed{x}$$

- So,
$$4x - 7 = 9$$
$$4x - 7{\color{red}+7} = 9{\color{red}+7} \quad ({\color{red}+7})$$
$$4x = 16$$
$$\frac{4x}{4} = \frac{16}{4} \quad (\div 4)$$
$$x = 4$$
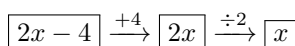
Ex 44: Solve for x:
$$3x + 10 = 4$$
$$x = \boxed{-2}$$

Answer:

- To **do** the expression $3x + 10$:

$$\boxed{x} \xrightarrow{\times 3} \boxed{3x} \xrightarrow{+10} \boxed{3x+10}$$
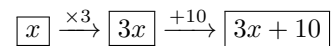
- To **undo** the expression $3x + 10$, do the inverse operations in reverse order:

$$\boxed{3x+10} \xrightarrow{-10} \boxed{3x} \xrightarrow{\div 3} \boxed{x}$$

- So,
$$3x + 10 = 4$$
$$3x + 10{\color{red}-10} = 4{\color{red}-10} \quad ({\color{red}-10})$$
$$3x = -6$$
$$\frac{3x}{3} = \frac{-6}{3} \quad (\div 3)$$
$$x = -2$$
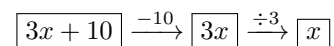
E.2 SOLVING LINEAR EQUATIONS: LEVEL 2

Ex 45: Solve for x:

$$\frac{x - 17}{3} = 10$$

$$x = \boxed{47}$$

Answer:

- To **do** the expression $\frac{x - 17}{3}$:

$$\boxed{x} \xrightarrow{-17} \boxed{x - 17} \xrightarrow{\div 3} \boxed{\frac{x - 17}{3}}$$

- To **undo** the expression $\frac{x - 17}{3}$, do the inverse operations in reverse order:

$$\boxed{\frac{x - 17}{3}} \xrightarrow{\times 3} \boxed{x - 17} \xrightarrow{+17} \boxed{x}$$

- So,

$$\frac{x - 17}{3} = 10$$
$$\frac{x - 17}{3}{\color{red}\times 3} = 10{\color{red}\times 3} \quad ({\color{red}\times 3})$$
$$x - 17 = 30$$
$$x - 17{\color{red}+17} = 30{\color{red}+17} \quad ({\color{red}+17})$$
$$x = 47$$

Ex 46: Solve for x:

$$\frac{x - 2}{6} = \frac{2}{3}$$

$$x = \boxed{6}$$

Answer:

- To **do** the expression $\frac{x - 2}{6}$:

$$\boxed{x} \xrightarrow{-2} \boxed{x - 2} \xrightarrow{\div 6} \boxed{\frac{x - 2}{6}}$$

- To **undo** the expression $\frac{x - 2}{6}$, do the inverse operations in reverse order:

$$\boxed{\frac{x - 2}{6}} \xrightarrow{\times 6} \boxed{x - 2} \xrightarrow{+2} \boxed{x}$$

- So,

$$\frac{x - 2}{6} = \frac{2}{3}$$
$$\frac{x - 2}{6}{\color{red}\times 6} = \frac{2}{3}{\color{red}\times 6} \quad ({\color{red}\times 6})$$
$$x - 2 = 4$$
$$x - 2{\color{red}+2} = 4{\color{red}+2} \quad ({\color{red}+2})$$
$$x = 6$$

Ex 47: Solve for x:

$$4(x + 2) = 40$$

$$x = \boxed{8}$$

Answer:

- To **do** the expression $4(x + 2)$:

$$\boxed{x} \xrightarrow{+2} \boxed{x + 2} \xrightarrow{\times 4} \boxed{4(x + 2)}$$

- To **undo** the expression $4(x + 2)$, do the inverse operations in reverse order:

$$\boxed{4(x + 2)} \xrightarrow{\div 4} \boxed{x + 2} \xrightarrow{-2} \boxed{x}$$

- So,

$$4(x + 2) = 40$$
$$4(x + 2){\color{red}\div 4} = 40{\color{red}\div 4} \quad ({\color{red}\div 4})$$
$$x + 2 = 10$$
$$x + 2{\color{red}-2} = 10{\color{red}-2} \quad ({\color{red}-2})$$
$$x = 8$$

Ex 48: Solve for x:

$$\frac{2x + 5}{4} = 3$$

$$x = \boxed{3.5}$$

Answer:

- To **do** the expression $\frac{2x + 5}{4}$:

$$\boxed{x} \xrightarrow{\times 2} \boxed{2x} \xrightarrow{+5} \boxed{2x + 5} \xrightarrow{\div 4} \boxed{\frac{2x + 5}{4}}$$

- To **undo** the expression $\frac{2x + 5}{4}$, do the inverse operations in reverse order:

$$\boxed{\frac{2x + 5}{4}} \xrightarrow{\times 4} \boxed{2x + 5} \xrightarrow{-5} \boxed{2x} \xrightarrow{\div 2} \boxed{x}$$

- So,

$$\frac{2x + 5}{4} = 3$$
$$\frac{2x + 5}{4}{\color{red}\times 4} = 3{\color{red}\times 4} \quad ({\color{red}\times 4})$$
$$2x + 5 = 12$$
$$2x + 5{\color{red}-5} = 12{\color{red}-5} \quad ({\color{red}-5})$$
$$2x = 7$$
$$\frac{2x}{2} = \frac{7}{2} \quad ({\color{red}\div 2})$$
$$x = 3.5$$