

# FRACTIONS

## A DEFINING AND REPRESENTING FRACTIONS

### A.1 WRITING FRACTIONS FROM WORDS

**Ex 1:** Write as a fraction:

$$x \text{ over } 2 = \boxed{\frac{x}{2}}$$

*Answer:*

$$x \text{ over } 2 = \frac{x}{2}$$

**Ex 2:** Write as a fraction:

$$x \text{ squared over } 6 = \boxed{\frac{x^2}{6}}$$

*Answer:*

$$x \text{ squared over } 6 = \frac{x^2}{6}$$

**Ex 3:** Write as a fraction:

$$3 \text{ over } x = \boxed{\frac{3}{x}}$$

*Answer:*

$$3 \text{ over } x = \frac{3}{x}$$

**Ex 4:** Write as a fraction:

$$x + 1 \text{ over } 2 = \boxed{\frac{x + 1}{2}}$$

*Answer:*

$$x + 1 \text{ over } 2 = \frac{x + 1}{2}$$

## B EQUIVALENT FRACTIONS

### B.1 SIMPLIFYING ALGEBRAIC FRACTIONS

**Ex 5:**

$$\frac{6x}{9} = \boxed{\frac{2x}{3}}$$

*Answer:*

$$\begin{aligned} \frac{6x}{9} &= \frac{\cancel{3} \times 2x}{\cancel{3} \times 3} \\ &= \frac{2x}{3} \end{aligned}$$

**Ex 6:**

$$\frac{10x^2}{4} = \boxed{\frac{5x^2}{2}}$$

*Answer:*

$$\begin{aligned} \frac{10x^2}{4} &= \frac{\cancel{2} \times 5x^2}{\cancel{2} \times 2} \\ &= \frac{5x^2}{2} \end{aligned}$$

**Ex 7:**

$$\frac{9x^3}{30x} = \boxed{\frac{3x^2}{10}}$$

*Answer:*

$$\begin{aligned} \frac{9x^3}{30x} &= \frac{\cancel{3} \times 3x^2 \times \cancel{x}}{\cancel{3} \times 10 \times \cancel{x}} \\ &= \frac{3x^2}{10} \end{aligned}$$

**Ex 8:**

$$\frac{3x^2}{2x} = \boxed{\frac{3x}{2}}$$

*Answer:*

$$\begin{aligned} \frac{3x^2}{2x} &= \frac{3 \times x \times \cancel{x}}{2 \times \cancel{x}} \\ &= \frac{3x}{2} \end{aligned}$$

**Ex 9:**

$$\frac{2}{4x} = \boxed{\frac{1}{2x}}$$

*Answer:*

$$\begin{aligned} \frac{2}{4x} &= \frac{\cancel{2}}{\cancel{2} \times 2x} \\ &= \frac{1}{2x} \end{aligned}$$

## C SIMPLIFICATION

### C.1 SIMPLIFYING ALGEBRAIC FRACTIONS

**Ex 10:** Simplify:

$$\frac{4x}{6} = \boxed{\frac{2x}{3}}$$

*Answer:*

$$\begin{aligned} \frac{4x}{6} &= \frac{\cancel{2} \times 2x}{\cancel{2} \times 3} \\ &= \frac{2x}{3} \end{aligned}$$

**Ex 11:** Simplify:

$$\frac{x^2}{3x} = \boxed{\frac{x}{3}}$$

*Answer:*

$$\begin{aligned} \frac{x^2}{3x} &= \frac{\cancel{x} \times x}{\cancel{x} \times 3} \\ &= \frac{x}{3} \end{aligned}$$

**Ex 12:** Simplify:

$$\frac{6x^3}{9x} = \boxed{\frac{2x^2}{3}}$$

Answer:

$$\begin{aligned}\frac{6x^3}{9x} &= \frac{\cancel{3} \times 2x^2 \times \cancel{x}}{\cancel{3} \times 3 \times \cancel{x}} \\ &= \frac{2x^2}{3}\end{aligned}$$

**Ex 13:** Simplify:

$$\frac{8x^4}{12x} = \boxed{\frac{2x^3}{3}}$$

Answer:

$$\begin{aligned}\frac{8x^4}{12x} &= \frac{\cancel{4} \times 2x^3 \times \cancel{x}}{\cancel{4} \times 3 \times \cancel{x}} \\ &= \frac{2x^3}{3}\end{aligned}$$

**Ex 14:** Simplify:

$$\frac{15x^2}{25x} = \boxed{\frac{3x}{5}}$$

Answer:

$$\begin{aligned}\frac{15x^2}{25x} &= \frac{\cancel{5} \times 3x \times \cancel{x}}{\cancel{5} \times 5 \times \cancel{x}} \\ &= \frac{3x}{5}\end{aligned}$$

**Ex 15:** Simplify:

$$\frac{14x^5}{21x^2} = \boxed{\frac{2x^3}{3}}$$

Answer:

$$\begin{aligned}\frac{14x^5}{21x^2} &= \frac{\cancel{7} \times 2x^3 \times \cancel{x^2}}{\cancel{7} \times 3 \times \cancel{x^2}} \\ &= \frac{2x^3}{3}\end{aligned}$$

**Ex 16:** Simplify:


$$\frac{4x^3}{16x} = \boxed{\frac{x^2}{4}}$$

Answer:

$$\begin{aligned}\frac{4x^3}{16x} &= \frac{\cancel{4} \times x^2 \times \cancel{x}}{\cancel{4} \times 4 \times \cancel{x}} \\ &= \frac{x^2}{4}\end{aligned}$$

## D CROSS MULTIPLICATION

### D.1 SOLVING PROPORTIONS USING CROSS-MULTIPLICATION

**Ex 17:**  Solve  $x$  for  $\frac{12}{4} = \frac{x}{6}$ :

$$x = \boxed{18}$$


Answer:

$$\frac{12}{4} = \frac{x}{6}$$

$$4 \times x = 12 \times 6 \quad (\text{cross multiplication})$$

$$x = 12 \times 6 \div 4 \quad (\text{dividing both sides by 4})$$

$$x = 18$$

**Ex 18:**  Solve  $x$  for  $\frac{11}{10} = \frac{x}{5}$ :

$$x = \boxed{5.5}$$


Answer:

$$\frac{11}{10} = \frac{x}{5}$$

$$10 \times x = 11 \times 5 \quad (\text{cross multiplication})$$

$$x = 11 \times 5 \div 10 \quad (\text{dividing both sides by 10})$$

$$x = 5.5$$

**Ex 19:**  Solve  $x$  for  $\frac{12}{10} = \frac{18}{x}$ :

$$x = \boxed{15}$$


Answer:

$$\frac{12}{10} = \frac{18}{x}$$

$$12 \times x = 18 \times 10 \quad (\text{cross multiplication})$$

$$x = 18 \times 10 \div 12 \quad (\text{dividing both sides by 12})$$

$$x = 15$$

**Ex 20:**  Solve  $x$  for  $\frac{27}{x} = \frac{30}{10}$ :

$$x = \boxed{9}$$

Answer:

$$\frac{27}{x} = \frac{30}{10}$$

$$30 \times x = 27 \times 10 \quad (\text{cross multiplication})$$

$$x = 27 \times 10 \div 30 \quad (\text{dividing both sides by 30})$$

$$x = 9$$

### D.2 SOLVING PROPORTIONS USING CROSS-MULTIPLICATION

**Ex 21:** Solve for  $x$  in the equation  $\frac{x}{3} = \frac{x+1}{2}$ .

$$x = \boxed{-3}$$

Answer:

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

$$2x = 3(x+1) \quad (\text{cross multiplication})$$

$$2x = 3x + 3 \quad (\text{distributing})$$

$$2x - 3x = 3 \quad (\text{subtracting } 3x \text{ from both sides})$$

$$-x = 3$$

$$x = -3$$

**Ex 22:** Solve for  $x$  in the equation  $\frac{x}{2} = \frac{x-2}{3}$ .

$$x = \boxed{-4}$$

Answer:

$$\begin{aligned}\frac{x}{2} &= \frac{x-2}{3} \\ 3x &= 2(x-2) && \text{(cross multiplication)} \\ 3x &= 2x-4 && \text{(distributing)} \\ 3x-2x &= -4 && \text{(subtracting } 2x \text{ from both sides)} \\ x &= -4\end{aligned}$$

**Ex 23:** Solve for  $x$  in the equation  $\frac{2}{x+1} = \frac{1}{x}$ .

$$x = \boxed{1}$$

Answer:

$$\begin{aligned}\frac{2}{x+1} &= \frac{1}{x} \\ 2x &= 1(x+1) && \text{(cross multiplication)} \\ 2x &= x+1 && \text{(distributing)} \\ 2x-x &= 1 && \text{(subtracting } x \text{ from both sides)} \\ x &= 1\end{aligned}$$

**Ex 24:** Solve for  $x$  in the equation  $\frac{2x+1}{4} = \frac{x+2}{3}$ .

$$x = \boxed{\frac{5}{2}}$$

Answer:

$$\begin{aligned}\frac{2x+1}{4} &= \frac{x+2}{3} \\ 3(2x+1) &= 4(x+2) && \text{(cross multiplication)} \\ 6x+3 &= 4x+8 && \text{(distributing)} \\ 6x-4x &= 8-3 && \text{(collecting)} \\ 2x &= 5 && \text{(simplify)} \\ x &= \frac{5}{2}\end{aligned}$$

## E ADDITION AND SUBTRACTION

### E.1 ADDING AND SUBTRACTING ALGEBRAIC FRACTIONS

**Ex 25:** Calculate and simplify:

$$\frac{x}{6} + \frac{3x}{6} = \boxed{\frac{2x}{3}}$$

Answer:

$$\begin{aligned}\frac{x}{6} + \frac{3x}{6} &= \frac{x+3x}{6} && \text{(collecting like terms)} \\ &= \frac{4x}{6} \\ &= \frac{\cancel{2} \times 2 \times x}{\cancel{2} \times 3} && \text{(simplifying by canceling common factors)} \\ &= \frac{2x}{3}\end{aligned}$$

**Ex 26:** Calculate and simplify:

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

Answer:

$$\begin{aligned}\frac{x}{2} + \frac{3x}{4} &= \frac{x \times 2}{2 \times 2} + \frac{3x}{4} && \text{(finding a common denominator, which is 4)} \\ &= \frac{2x}{4} + \frac{3x}{4} \\ &= \frac{2x+3x}{4} && \text{(combining fractions with common denominator)} \\ &= \frac{5x}{4}\end{aligned}$$

**Ex 27:** Calculate and simplify:

$$\frac{3x^2}{2} + \frac{5x^2}{3} = \boxed{\frac{19x^2}{6}}$$

Answer:

$$\begin{aligned}\frac{3x^2}{2} + \frac{5x^2}{3} &= \frac{3x^2 \times 3}{2 \times 3} + \frac{5x^2 \times 2}{3 \times 2} && \text{(finding a common denominator, which is 6)} \\ &= \frac{9x^2}{6} + \frac{10x^2}{6} \\ &= \frac{9x^2+10x^2}{6} && \text{(combining fractions with common denominator)} \\ &= \frac{19x^2}{6}\end{aligned}$$

**Ex 28:** Calculate and simplify:

$$\frac{5x}{3} - \frac{x}{6} = \boxed{\frac{3x}{2}}$$

Answer:

$$\begin{aligned}\frac{5x}{3} - \frac{x}{6} &= \frac{5x \times 2}{3 \times 2} - \frac{x \times 1}{6 \times 1} && \text{(finding a common denominator, which is 6)} \\ &= \frac{10x}{6} - \frac{x}{6} \\ &= \frac{10x-x}{6} && \text{(combining fractions with common denominator)} \\ &= \frac{9x}{6} \\ &= \frac{\cancel{3} \times 3 \times x}{\cancel{3} \times 2} && \text{(simplifying by canceling common factors)} \\ &= \frac{3x}{2}\end{aligned}$$

**Ex 29:** Calculate and simplify:

$$\frac{2x^2}{5} + \frac{3x^2}{10} = \boxed{\frac{7x^2}{10}}$$

Answer:

$$\begin{aligned}\frac{2x^2}{5} + \frac{3x^2}{10} &= \frac{2x^2 \times 2}{5 \times 2} + \frac{3x^2 \times 1}{10 \times 1} && \text{(finding a common denominator, which is 10)} \\ &= \frac{4x^2}{10} + \frac{3x^2}{10} \\ &= \frac{4x^2+3x^2}{10} && \text{(combining fractions with common denominator)} \\ &= \frac{7x^2}{10}\end{aligned}$$

**Ex 30:** Calculate and simplify:

$$\frac{7x^3}{4} - \frac{2x^3}{3} = \boxed{\frac{13x^3}{12}}$$

Answer:

$$\begin{aligned} \frac{7x^3}{4} - \frac{2x^3}{3} &= \frac{7x^3 \times 3}{4 \times 3} - \frac{2x^3 \times 4}{3 \times 4} && \text{(finding a common denominator, which is 12)} \\ &= \frac{21x^3}{12} - \frac{8x^3}{12} \\ &= \frac{21x^3 - 8x^3}{12} && \text{(combining fractions with common denominator)} \\ &= \frac{13x^3}{12} \end{aligned}$$

$$4x^2 \times \frac{x}{8} = \boxed{\frac{x^3}{2}}$$

Answer:

$$\begin{aligned} 4x^2 \times \frac{x}{8} &= \frac{4x^2 \times x}{8} && \text{(multiply the number by the numerator)} \\ &= \frac{4x^3}{8} \\ &= \frac{\cancel{4} \times x^3}{\cancel{4} \times 2} && \text{(simplify by canceling common factors)} \\ &= \frac{x^3}{2} \end{aligned}$$

## F MULTIPLYING A FRACTION BY A NUMBER

### F.1 MULTIPLYING OF ALGEBRAIC FRACTIONS BY NUMBERS

**Ex 31:** Calculate and simplify:

$$x \times \frac{x}{2} = \boxed{\frac{x^2}{2}}$$

Answer:

$$\begin{aligned} x \times \frac{x}{2} &= \frac{x \times x}{2} && \text{(multiply the number by the numerator)} \\ &= \frac{x^2}{2} \end{aligned}$$

**Ex 32:** Calculate and simplify:

$$3x \times \frac{2x}{9} = \boxed{\frac{2x^2}{3}}$$

Answer:

$$\begin{aligned} 3x \times \frac{2x}{9} &= \frac{3x \times 2x}{9} && \text{(multiply the number by the numerator)} \\ &= \frac{6x^2}{9} \\ &= \frac{\cancel{3} \times 2 \times x^2}{\cancel{3} \times 3} && \text{(simplify by canceling common factors)} \\ &= \frac{2x^2}{3} \end{aligned}$$

**Ex 33:** Calculate and simplify:

$$2x \times \frac{x^3}{6} = \boxed{\frac{x^4}{3}}$$

Answer:

$$\begin{aligned} 2x \times \frac{x^3}{6} &= \frac{2x \times x^3}{6} && \text{(multiply the number by the numerator)} \\ &= \frac{2x^4}{6} \\ &= \frac{\cancel{2} \times x^4}{\cancel{2} \times 3} && \text{(simplify by canceling common factors)} \\ &= \frac{x^4}{3} \end{aligned}$$

**Ex 34:** Calculate and simplify:

**Ex 35:** Calculate and simplify:

$$\frac{5}{x} \times x^2 = \boxed{5x}$$

Answer:

$$\begin{aligned} \frac{5}{x} \times x^2 &= \frac{5 \times x^2}{x} && \text{(multiply the numerator and denominator)} \\ &= \frac{5x^2}{x} \\ &= 5x && \text{(simplify by canceling } x \text{ in numerator and denominator)} \end{aligned}$$

**Ex 36:** Calculate and simplify:

$$\frac{x^4}{3} \times 6 = \boxed{2x^4}$$

Answer:

$$\begin{aligned} \frac{x^4}{3} \times 6 &= \frac{x^4 \times 6}{3} && \text{(multiply the numerator and denominator)} \\ &= \frac{6x^4}{3} \\ &= \frac{\cancel{3} \times 2 \times x^4}{\cancel{3}} && \text{(simplify by canceling common factors)} \\ &= 2x^4 \end{aligned}$$

## G MULTIPLICATION OF FRACTIONS

### G.1 MULTIPLYING OF ALGEBRAIC FRACTIONS

**Ex 37:** Calculate and simplify:

$$\frac{2}{3} \times \frac{x}{2} = \boxed{\frac{x}{3}}$$

Answer:

$$\begin{aligned} \frac{2}{3} \times \frac{x}{2} &= \frac{2 \times x}{3 \times 2} && \text{(multiply the numerators and denominators)} \\ &= \frac{2x}{6} \\ &= \frac{\cancel{2} \times x}{\cancel{2} \times 3} && \text{(simplify by canceling common factors)} \\ &= \frac{x}{3} \end{aligned}$$

**Ex 38:** Calculate and simplify:

$$\frac{5}{2} \times \frac{x}{5} = \boxed{\frac{x}{2}}$$

Answer:

$$\begin{aligned}\frac{5}{2} \times \frac{x}{5} &= \frac{5 \times x}{2 \times 5} && \text{(multiply the numerators and denominators)} \\ &= \frac{5x}{10} \\ &= \frac{\cancel{5} \times x}{\cancel{5} \times 2} && \text{(simplify by canceling common factors)} \\ &= \frac{x}{2}\end{aligned}$$

**Ex 39:** Calculate and simplify:

$$\frac{x}{3} \times \frac{2}{x} = \boxed{\frac{2}{3}}$$

Answer:

$$\begin{aligned}\frac{x}{3} \times \frac{2}{x} &= \frac{x \times 2}{3 \times x} && \text{(multiply the numerators and denominators)} \\ &= \frac{2x}{3x} \\ &= \frac{\cancel{x} \times 2}{\cancel{x} \times 3} && \text{(simplify by canceling common factors)} \\ &= \frac{2}{3}\end{aligned}$$

**Ex 40:** Calculate and simplify:

$$\frac{4}{x} \times \frac{1}{2} = \boxed{\frac{2}{x}}$$

Answer:

$$\begin{aligned}\frac{4}{x} \times \frac{1}{2} &= \frac{4 \times 1}{x \times 2} && \text{(multiply the numerators and denominators)} \\ &= \frac{4}{2x} \\ &= \frac{\cancel{2} \times 2}{\cancel{2} \times x} && \text{(simplify by canceling common factors)} \\ &= \frac{2}{x}\end{aligned}$$

## G.2 MULTIPLYING OF ALGEBRAIC FRACTIONS

**Ex 41:** Calculate and simplify:

$$\frac{x}{2} \times \frac{2x}{3} = \boxed{\frac{x^2}{3}}$$

Answer:

$$\begin{aligned}\frac{x}{2} \times \frac{2x}{3} &= \frac{x \times 2x}{2 \times 3} && \text{(multiply the numerators and denominators)} \\ &= \frac{2x^2}{6} \\ &= \frac{\cancel{2} \times x^2}{\cancel{2} \times 3} && \text{(simplify by canceling common factors)} \\ &= \frac{x^2}{3}\end{aligned}$$

**Ex 42:** Calculate and simplify:

$$\frac{x}{2} \times \frac{x^2}{3} = \boxed{\frac{x^3}{6}}$$

Answer:

$$\begin{aligned}\frac{x}{2} \times \frac{x^2}{3} &= \frac{x \times x^2}{2 \times 3} && \text{(multiply the numerators and denominators)} \\ &= \frac{x^3}{6}\end{aligned}$$

**Ex 43:** Calculate and simplify:

$$\frac{2}{x} \times \frac{x^2}{3} = \boxed{\frac{2x}{3}}$$

Answer:

$$\begin{aligned}\frac{2}{x} \times \frac{x^2}{3} &= \frac{2 \times x^2}{x \times 3} && \text{(multiply the numerators and denominators)} \\ &= \frac{2x^2}{3x} \\ &= \frac{\cancel{x} \times 2 \times \cancel{x}}{\cancel{x} \times 3} && \text{(simplify by canceling common factors)} \\ &= \frac{2x}{3}\end{aligned}$$

**Ex 44:** Calculate and simplify:

$$\left(\frac{x}{2}\right)^2 = \boxed{\frac{x^2}{4}}$$

Answer:

$$\begin{aligned}\left(\frac{x}{2}\right)^2 &= \frac{x \times x}{2 \times 2} && \text{(square the numerator and the denominator)} \\ &= \frac{x^2}{4}\end{aligned}$$

## H FRACTIONS AS THE RESULT OF DIVISION

### H.1 DIVIDING ALGEBRAIC FRACTIONS

**Ex 45:** Calculate and simplify:

$$\frac{2}{3} \div \frac{2}{x} = \boxed{\frac{x}{3}}$$

Answer:

$$\begin{aligned}\frac{2}{3} \div \frac{2}{x} &= \frac{2}{3} \times \frac{x}{2} && \text{(dividing by a fraction is multiplying by its reciprocal)} \\ &= \frac{\cancel{2} \times x}{3 \times \cancel{2}} && \text{(simplify by canceling common factors)} \\ &= \frac{x}{3}\end{aligned}$$

**Ex 46:** Calculate and simplify:

$$\frac{2x}{3} \div 2 = \boxed{\frac{x}{3}}$$

Answer:

$$\begin{aligned}\frac{2x}{3} \div 2 &= \frac{2x}{3} \times \frac{1}{2} && \text{(dividing by a number is multiplying by its reciprocal)} \\ &= \frac{\cancel{2} \times x \times 1}{3 \times \cancel{2}} && \text{(simplify by canceling common factors)} \\ &= \frac{x}{3}\end{aligned}$$

**Ex 47:** Calculate and simplify:

$$\frac{3}{x} \div \frac{6}{x} = \boxed{\frac{1}{2}}$$

Answer:

$$\begin{aligned} \frac{3}{x} \div \frac{6}{x} &= \frac{3}{x} \times \frac{x}{6} && \text{(dividing by a fraction is multiplying by its reciprocal)} \\ &= \frac{\cancel{x} \times \cancel{x}}{\cancel{x} \times \cancel{3} \times 2} && \text{simplify by canceling common factor)} \\ &= \frac{1}{2} \end{aligned}$$

**Ex 48:** Calculate and simplify:

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

Answer:

$$\begin{aligned} \frac{4x}{5} \div x &= \frac{4x}{5} \times \frac{1}{x} && \text{(dividing by a number is multiplying by its reciprocal)} \\ &= \frac{4 \times \cancel{x} \times 1}{5 \times \cancel{x}} && \text{(simplify by canceling common factors)} \\ &= \frac{4}{5} \end{aligned}$$

## H.2 DIVIDING ALGEBRAIC FRACTIONS

**Ex 49:** Calculate and simplify:

$$\frac{\frac{2}{3}}{\frac{2}{x}} = \boxed{\frac{x}{3}}$$

Answer:

$$\begin{aligned} \frac{\frac{2}{3}}{\frac{2}{x}} &= \frac{2}{3} \times \frac{x}{2} && \text{(dividing by a fraction is multiplying by its reciprocal)} \\ &= \frac{\cancel{2} \times x}{3 \times \cancel{2}} && \text{(simplify by canceling common factors)} \\ &= \frac{x}{3} \end{aligned}$$

**Ex 50:** Calculate and simplify:

$$\frac{\frac{2x}{3}}{2} = \boxed{\frac{x}{3}}$$

Answer:

$$\begin{aligned} \frac{\frac{2x}{3}}{2} &= \frac{2x}{3} \times \frac{1}{2} && \text{(dividing by a number is multiplying by its reciprocal)} \\ &= \frac{\cancel{2} \times x \times 1}{3 \times \cancel{2}} && \text{(simplify by canceling common factors)} \\ &= \frac{x}{3} \end{aligned}$$

**Ex 51:** Calculate and simplify:

$$\frac{\frac{3}{x}}{\frac{6}{x}} = \boxed{\frac{1}{2}}$$

Answer:

$$\begin{aligned} \frac{\frac{3}{x}}{\frac{6}{x}} &= \frac{3}{x} \times \frac{x}{6} && \text{(dividing by a fraction is multiplying by its reciprocal)} \\ &= \frac{\cancel{x} \times \cancel{x}}{\cancel{x} \times \cancel{3} \times 2} && \text{(simplify by canceling common factors)} \\ &= \frac{1}{2} \end{aligned}$$

**Ex 52:** Calculate and simplify:

$$\frac{\frac{4x^2}{5}}{2} = \boxed{\frac{2x^2}{5}}$$

Answer:

$$\begin{aligned} \frac{\frac{4x^2}{5}}{2} &= \frac{4x^2}{5} \div \frac{2}{1} && \text{(dividing by a number is multiplying by its reciprocal)} \\ &= \frac{4x^2}{5} \times \frac{1}{2} && \text{(multiply the numerators and denominators)} \\ &= \frac{4x^2 \times 1}{5 \times 2} \\ &= \frac{4x^2}{10} \\ &= \frac{\cancel{2} \times 2 \times x^2}{\cancel{2} \times 5} && \text{(simplify by canceling common factors)} \\ &= \frac{2x^2}{5} \end{aligned}$$

**Ex 53:** Calculate and simplify:

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

Answer:

$$\begin{aligned} \frac{\frac{4x}{5}}{x} &= \frac{4x}{5} \times \frac{1}{x} && \text{(dividing by a fraction is multiplying by its reciprocal)} \\ &= \frac{4 \times \cancel{x} \times 1}{5 \times \cancel{x}} && \text{(simplify by canceling common factors)} \\ &= \frac{4}{5} \end{aligned}$$

**Ex 54:** Calculate and simplify:

$$\frac{\frac{x^2}{2}}{\frac{x}{4}} = \boxed{2x}$$

Answer:

$$\begin{aligned} \frac{\frac{x^2}{2}}{\frac{x}{4}} &= \frac{x^2}{2} \times \frac{4}{x} && \text{(dividing by a fraction is multiplying by its reciprocal)} \\ &= \frac{\cancel{x} \times 2 \times x \times \cancel{x}}{\cancel{x} \times \cancel{2}} && \text{(simplify by canceling common factors)} \\ &= 2x \end{aligned}$$

## I SIGN CONVENTIONS FOR FRACTIONS

### I.1 SIMPLIFYING ALGEBRAIC FRACTIONS WITH RELATIVE NUMBERS

**Ex 55:** Simplify:

$$\frac{-15x}{-30} = \boxed{\frac{x}{2}}$$

*Answer:*

$$\begin{aligned} \frac{-15x}{-30} &= \frac{\cancel{15} \times x}{\cancel{15} \times 2} \quad (\text{simplify by canceling common factors}) \\ &= \frac{x}{2} \end{aligned}$$

**Ex 56:** Simplify:

$$\frac{-6x}{12} = \boxed{-\frac{x}{2}}$$

*Answer:*

$$\begin{aligned} \frac{-6x}{12} &= \frac{-\cancel{6} \times x}{\cancel{6} \times 2} \quad (\text{simplify by canceling common factors}) \\ &= \frac{-x}{2} \\ &= -\frac{x}{2} \end{aligned}$$

**Ex 57:** Simplify:

$$\frac{-12x^4}{-2x^2} = \boxed{6x^2}$$

*Answer:*

$$\begin{aligned} \frac{-12x^4}{-2x^2} &= \frac{\cancel{2} \times 6 \times x^2 \times \cancel{x^2}}{\cancel{2} \times 1 \times \cancel{x^2}} \quad (\text{simplify by canceling common factors}) \\ &= \frac{6x^2}{1} \\ &= 6x^2 \end{aligned}$$

**Ex 58:** Simplify:

$$\frac{3x^3}{-9x} = \boxed{-\frac{x^2}{3}}$$

*Answer:*

$$\begin{aligned} \frac{3x^3}{-9x} &= \frac{\cancel{3} \times x^2 \times \cancel{x}}{\cancel{3} \times -3 \times \cancel{x}} \quad (\text{simplify by canceling common factors}) \\ &= \frac{x^2}{-3} \\ &= -\frac{x^2}{3} \end{aligned}$$

**Ex 59:** Simplify:

$$\frac{-21x^3}{-7x} = \boxed{3x^2}$$

*Answer:*

$$\begin{aligned} \frac{-21x^3}{-7x} &= \frac{\cancel{7} \times 3 \times x^2 \times \cancel{x}}{\cancel{7} \times 1 \times \cancel{x}} \quad (\text{simplify by canceling common factors}) \\ &= \frac{3x^2}{1} \\ &= 3x^2 \end{aligned}$$

**Ex 60:** Simplify:

$$\frac{-4x^4}{8x^2} = \boxed{-\frac{x^2}{2}}$$

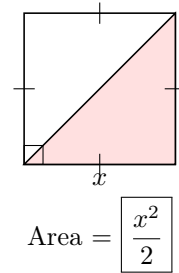
*Answer:*

$$\begin{aligned} \frac{-4x^4}{8x^2} &= \frac{-\cancel{4} \times x^2 \times \cancel{x^2}}{\cancel{4} \times 2 \times \cancel{x^2}} \quad (\text{simplify by canceling common factors}) \\ &= \frac{-x^2}{2} \end{aligned}$$

## J FRACTION AS QUOTIENT

### J.1 FORMULATING ALGEBRAIC EXPRESSIONS

**Ex 61:** Express the colored area in the following diagram:



*Answer:* Let's figure out the area of the colored region step by step:

- The diagram shows a square with side length  $x$ . The area of this square is:

$$\text{Area of square} = x \times x = x^2$$

- The colored region is a right triangle that occupies half the square. Thus:

$$\text{Area of colored region} = \frac{x^2}{2}$$

**Ex 62:** You have  $x$  marbles and want to share them equally among four friends. Express the number of marbles each friend receives.

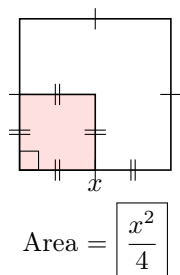
$$\text{Marbles per friend} = \boxed{\frac{x}{4}}$$

*Answer:*

- You have a total of  $x$  marbles.
- These marbles are shared equally among 4 friends. The number of marbles each friend receives is:

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

**Ex 63:** Express the colored area in the following diagram:



*Answer:*

- The area of the square is:

$$\text{Area of square} = x \times x = x^2$$

- The colored region is one of the four equal smaller squares (quadrants), so its area is:

$$\text{Area of colored region} = \frac{x^2}{4}$$

**Ex 64:** A baker bakes 1000 cookies. He wants to put these cookies into  $x$  boxes, with the same number of cookies in each box. Express the number of cookies in each box.

$$\text{Cookies per box} = \frac{1000}{x}$$

*Answer:*

- The total number of cookies is 1000.
- These cookies are distributed into  $x$  boxes. The number of cookies per box is:

$$1000 \div x = \frac{1000}{x}$$

## K FRACTION AS A RATIO AND OPERATOR

### K.1 APPLYING RATIOS TO ALGEBRAIC EXPRESSIONS

**Ex 65:** An item is priced at  $x$  dollars. If it is discounted by a ratio of  $\frac{1}{4}$  of its price, write a simplified expression for the new price.

$$\text{New Price} = \frac{3x}{4}$$

Un article a un prix de  $x$  dollars. S'il est réduit d'un rapport de  $\frac{1}{4}$  de son prix, écrire une expression simplifiée pour le nouveau prix.

$$\text{Nouveau Prix} = \frac{3x}{4}$$

*Answer:* The problem requires subtracting a fraction of the original price from the original price.

$$\text{New Price} = x - \left(\frac{1}{4} \text{ of } x\right)$$

$$= x - \frac{1}{4}x \quad (\text{Apply the 'fraction of' rule})$$

$$= \frac{4}{4}x - \frac{1}{4}x \quad (\text{Express } x \text{ with a common denominator})$$

$$= \frac{3}{4}x \text{ or } \frac{3x}{4}$$

Le problème demande de soustraire une fraction du prix d'origine du prix initial.

$$\text{Nouveau Prix} = x - \left(\frac{1}{4} \text{ de } x\right)$$

$$= x - \frac{1}{4}x \quad (\text{Appliquer la règle « fraction de »})$$

$$= \frac{4}{4}x - \frac{1}{4}x \quad (\text{Exprimer } x \text{ avec un dénominateur commun})$$

$$= \frac{3}{4}x \text{ ou } \frac{3x}{4}$$

**Ex 66:** Calculate and simplify:  $\frac{2}{3}$  of  $(x + 9)$ .

$$\frac{2x + 18}{3}$$

Calculer et simplifier :  $\frac{2}{3}$  de  $(x + 9)$ .

$$\frac{2x + 18}{3}$$

*Answer:* Applying the rule "fraction of a quantity":

$$\frac{2}{3} \text{ of } (x + 9) = \frac{2}{3} \times (x + 9)$$

$$= \frac{2(x + 9)}{3} \quad (\text{Multiply the fraction by the expression})$$

$$= \frac{2x + 18}{3}$$

This can also be expressed as  $\frac{2}{3}x + 6$ . En appliquant la règle « fraction d'une quantité » :

$$\frac{2}{3} \text{ de } (x + 9) = \frac{2}{3} \times (x + 9)$$

$$= \frac{2(x + 9)}{3} \quad (\text{Multiplier la fraction par l'expression})$$

$$= \frac{2x + 18}{3}$$

Cela peut aussi être exprimé par  $\frac{2}{3}x + 6$ .

**Ex 67:** Calculate and simplify: one-half of  $x$  plus one-third of  $x$ .

$$\frac{5x}{6}$$

Calculer et simplifier : la moitié de  $x$  plus un tiers de  $x$ .

$$\frac{5x}{6}$$



*Answer:* First, express the problem as an algebraic expression.

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

To combine the like terms, find a common denominator for the coefficients. The least common multiple of 2 and 3 is 6.

$$\begin{aligned}\frac{1}{2}x + \frac{1}{3}x &= \left(\frac{1 \times 3}{2 \times 3}\right)x + \left(\frac{1 \times 2}{3 \times 2}\right)x \\ &= \frac{3}{6}x + \frac{2}{6}x \\ &= \left(\frac{3+2}{6}\right)x \\ &= \frac{5}{6}x \text{ or } \frac{5x}{6}\end{aligned}$$

D'abord, exprimer le problème sous forme d'expression algébrique.

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

Pour combiner les termes semblables, trouver un dénominateur commun pour les coefficients. Le plus petit commun multiple de 2 et 3 est 6.

$$\begin{aligned}\frac{1}{2}x + \frac{1}{3}x &= \left(\frac{1 \times 3}{2 \times 3}\right)x + \left(\frac{1 \times 2}{3 \times 2}\right)x \\ &= \frac{3}{6}x + \frac{2}{6}x \\ &= \left(\frac{3+2}{6}\right)x \\ &= \frac{5}{6}x \text{ ou } \frac{5x}{6}\end{aligned}$$

**Ex 68:** A quantity  $x$  is increased by  $\frac{2}{5}$  of its value. Write a simplified expression for the new quantity.

$$\text{New Quantity} = \boxed{\frac{7x}{5}}$$

Une quantité  $x$  est augmentée de  $\frac{2}{5}$  de sa valeur. Écrire une expression simplifiée pour la nouvelle quantité.

$$\text{Nouvelle Quantité} = \boxed{\frac{7x}{5}}$$

*Answer:* The problem is represented by the expression:

$$x + \frac{2}{5}x$$

To simplify, combine the like terms by finding a common denominator.

$$\begin{aligned}1x + \frac{2}{5}x &= \frac{5}{5}x + \frac{2}{5}x \\ &= \left(\frac{5+2}{5}\right)x \\ &= \frac{7}{5}x \text{ or } \frac{7x}{5}\end{aligned}$$

Le problème est représenté par l'expression :

$$x + \frac{2}{5}x$$

Pour simplifier, combiner les termes semblables en trouvant un dénominateur commun.

$$\begin{aligned}1x + \frac{2}{5}x &= \frac{5}{5}x + \frac{2}{5}x \\ &= \left(\frac{5+2}{5}\right)x \\ &= \frac{7}{5}x \text{ ou } \frac{7x}{5}\end{aligned}$$

## L FRACTIONS AS DECIMAL NUMBERS

### L.1 SIMPLIFYING EXPRESSIONS WITH FRACTIONAL AND DECIMAL COEFFICIENTS

**Ex 69:** Calculate and simplify:

$$0.5x - \frac{x}{2} = \boxed{0}$$

Calculer et simplifier :

$$0,5x - \frac{x}{2} = \boxed{0}$$

*Answer:* To simplify the expression, we first convert the decimal coefficient to its equivalent fractional form.

$$\begin{aligned}0.5x - \frac{x}{2} &= \frac{1}{2}x - \frac{x}{2} \quad (\text{Convert } 0.5 \text{ to a fraction}) \\ &= \frac{1}{2}x - \frac{1}{2}x \quad (\text{Rewrite } \frac{x}{2} \text{ as } \frac{1}{2}x) \\ &= 0\end{aligned}$$

Pour simplifier l'expression, nous convertissons d'abord le coefficient décimal en sa forme fractionnaire équivalente.

$$\begin{aligned}0,5x - \frac{x}{2} &= \frac{1}{2}x - \frac{x}{2} \quad (\text{Convertir } 0,5 \text{ en fraction}) \\ &= \frac{1}{2}x - \frac{1}{2}x \quad (\text{Réécrire } \frac{x}{2} \text{ en } \frac{1}{2}x) \\ &= 0\end{aligned}$$

**Ex 70:** Calculate and simplify:

$$0.25y + \frac{3y}{4} = \boxed{y}$$

Calculer et simplifier :

$$0,25y + \frac{3y}{4} = \boxed{y}$$

*Answer:* To simplify the expression, convert the decimal to a fraction and find a common denominator.

$$\begin{aligned}0.25y + \frac{3y}{4} &= \frac{1}{4}y + \frac{3}{4}y \quad (\text{Convert } 0.25 \text{ to a fraction}) \\ &= \left(\frac{1}{4} + \frac{3}{4}\right)y \quad (\text{Factor out } y) \\ &= \frac{4}{4}y \\ &= y\end{aligned}$$

Pour simplifier l'expression, convertir le nombre décimal en fraction et trouver un dénominateur commun.

$$\begin{aligned}0,25y + \frac{3y}{4} &= \frac{1}{4}y + \frac{3}{4}y \quad (\text{Convertir } 0,25 \text{ en fraction}) \\ &= \left(\frac{1}{4} + \frac{3}{4}\right)y \quad (\text{Factoriser } y) \\ &= \frac{4}{4}y \\ &= y\end{aligned}$$

**Ex 71:** Calculate and simplify:

$$a - 0.2a - \frac{2a}{5} = \boxed{0.4a}$$

Calculer et simplifier :

$$a - 0,2a - \frac{2a}{5} = \boxed{0.4a}$$

*Answer:* To simplify, convert all terms to a consistent format (either decimal or fraction). Here, we will convert the fraction to a decimal.

$$\begin{aligned} a - 0.2a - \frac{2a}{5} &= 1a - 0.2a - (2 \div 5)a \quad (\text{Convert fraction to decimal}) \\ &= 1a - 0.2a - 0.4a \\ &= (1 - 0.2 - 0.4)a \\ &= 0.4a \end{aligned}$$

Alternatively, converting all terms to fractions with a common denominator gives  $\frac{2}{5}a$ . Pour simplifier, convertir tous les termes dans un format cohérent (soit décimal, soit fractionnaire). Ici, nous convertirons la fraction en décimal.

$$\begin{aligned} a - 0,2a - \frac{2a}{5} &= 1a - 0,2a - (2 \div 5)a \quad (\text{Convertir la fraction en décimal}) \\ &= 1a - 0,2a - 0,4a \\ &= (1 - 0,2 - 0,4)a \\ &= 0,4a \end{aligned}$$

Alternativement, la conversion de tous les termes en fractions avec un dénominateur commun donne  $\frac{2}{5}a$ .

**Ex 72:** Calculate and simplify:

$$0.75 \times \frac{z}{3} = \boxed{z/4}$$

Calculer et simplifier :

$$0,75 \times \frac{z}{3} = \boxed{z/4}$$

*Answer:* To simplify, convert the decimal to a fraction and then multiply.

$$\begin{aligned} 0.75 \times \frac{z}{3} &= \frac{3}{4} \times \frac{z}{3} \quad (\text{Convert 0.75 to a fraction}) \\ &= \frac{3 \times z}{4 \times 3} \\ &= \frac{3z}{12} \quad (\text{Simplify by dividing by the common factor 3}) \\ &= \frac{z}{4} \end{aligned}$$

Pour simplifier, convertir le nombre décimal en fraction, puis multiplier.

$$\begin{aligned} 0,75 \times \frac{z}{3} &= \frac{3}{4} \times \frac{z}{3} \quad (\text{Convertir 0,75 en fraction}) \\ &= \frac{3 \times z}{4 \times 3} \\ &= \frac{3z}{12} \quad (\text{Simplifier en divisant par le facteur commun 3}) \\ &= \frac{z}{4} \end{aligned}$$

**Ex 73:** Calculate and simplify:

$$0.25x + \frac{3x}{4} = \boxed{x}$$

Calculer et simplifier :

$$0,25x + \frac{3x}{4} = \boxed{x}$$

*Answer:* To simplify the expression, convert the decimal to a fraction to achieve a common format.

$$\begin{aligned} 0.25x + \frac{3x}{4} &= \frac{1}{4}x + \frac{3}{4}x \quad (\text{Convert 0.25 to a fraction}) \\ &= \left(\frac{1}{4} + \frac{3}{4}\right)x \quad (\text{Factor out } x) \\ &= \frac{4}{4}x \\ &= x \end{aligned}$$

Pour simplifier l'expression, convertir le nombre décimal en fraction pour obtenir un format commun.

$$\begin{aligned} 0,25x + \frac{3x}{4} &= \frac{1}{4}x + \frac{3}{4}x \quad (\text{Convertir 0,25 en fraction}) \\ &= \left(\frac{1}{4} + \frac{3}{4}\right)x \quad (\text{Factoriser } x) \\ &= \frac{4}{4}x \\ &= x \end{aligned}$$

**Ex 74:** Calculate and simplify:

$$x - 0.2x - \frac{2x}{5} = \boxed{0.4x}$$

Calculer et simplifier :

$$x - 0,2x - \frac{2x}{5} = \boxed{0.4x}$$

*Answer:* To simplify, convert all terms to a consistent format. In this case, converting the fraction to a decimal is efficient.

$$\begin{aligned} x - 0.2x - \frac{2x}{5} &= 1x - 0.2x - (2 \div 5)x \quad (\text{Convert fraction to decimal}) \\ &= 1x - 0.2x - 0.4x \\ &= (1 - 0.2 - 0.4)x \\ &= 0.4x \end{aligned}$$

Alternatively, converting all terms to fractions with a common denominator gives the equivalent answer  $\frac{2}{5}x$ . Pour simplifier, convertir tous les termes dans un format cohérent. Dans ce cas, il est efficace de convertir la fraction en nombre décimal.

$$\begin{aligned} x - 0,2x - \frac{2x}{5} &= 1x - 0,2x - (2 \div 5)x \quad (\text{Convertir la fraction en decimal}) \\ &= 1x - 0,2x - 0,4x \\ &= (1 - 0,2 - 0,4)x \\ &= 0,4x \end{aligned}$$

Alternativement, la conversion de tous les termes en fractions avec un dénominateur commun donne la réponse équivalente  $\frac{2}{5}x$ .

**Ex 75:** Calculate and simplify:

$$0.75 \times \frac{x}{3} = \boxed{x/4}$$

Calculer et simplifier :

$$0,75 \times \frac{x}{3} = \boxed{\frac{x}{4}}$$

*Answer:* To simplify, convert the decimal to a fraction and then perform the multiplication.

$$\begin{aligned} 0,75 \times \frac{x}{3} &= \frac{3}{4} \times \frac{x}{3} && \text{(Convert 0.75 to a fraction)} \\ &= \frac{3 \times x}{4 \times 3} \\ &= \frac{\cancel{3} \times x}{4 \times \cancel{3}} && \text{(Simplify by canceling the common factor of 3)} \\ &= \frac{x}{4} \end{aligned}$$

Pour simplifier, convertir le nombre décimal en fraction, puis effectuer la multiplication.

$$\begin{aligned} 0,75 \times \frac{x}{3} &= \frac{3}{4} \times \frac{x}{3} && \text{(Convertir 0,75 en fraction)} \\ &= \frac{\cancel{3} \times x}{4 \times \cancel{3}} && \text{(Simplifier en annulant le facteur commun de 3)} \\ &= \frac{x}{4} \end{aligned}$$

## M ORDER OF OPERATIONS

### M.1 CALCULATING ALGEBRAIC EXPRESSIONS

**Ex 76:** Calculate and simplify:

$$\frac{x + 7x}{3 \times 4} = \boxed{\frac{2x}{3}}$$

Calcule et simplifie :

$$\frac{x + 7x}{3 \times 4} = \boxed{\frac{2x}{3}}$$

*Answer:*

$$\begin{aligned} \frac{x + 7x}{3 \times 4} &= \frac{8x}{12} && \text{(simplify numerator and denominator)} \\ &= \frac{\cancel{4} \times 2 \times x}{\cancel{4} \times 3} && \text{(simplify by canceling common factors)} \\ &= \frac{2x}{3} \\ \frac{x + 7x}{3 \times 4} &= \frac{8x}{12} && \text{(simplifier le numérateur et le dénominateur)} \\ &= \frac{\cancel{4} \times 2 \times x}{\cancel{4} \times 3} && \text{(simplifier en annulant les facteurs communs)} \\ &= \frac{2x}{3} \end{aligned}$$

**Ex 77:** Calculate and simplify:

$$x \times \frac{3x + x}{4 + 2} = \boxed{\frac{2x^2}{3}}$$

Calcule et simplifie :

$$x \times \frac{3x + x}{4 + 2} = \boxed{\frac{2x^2}{3}}$$

*Answer:*

$$\begin{aligned} x \times \frac{3x + x}{4 + 2} &= x \times \frac{4x}{6} && \text{(simplify the numerator and the denominator)} \\ &= \frac{x \times 4x}{6} && \text{(multiply the numerators and denominators)} \\ &= \frac{4x^2}{6} \\ &= \frac{\cancel{2} \times 2 \times x^2}{\cancel{2} \times 3} && \text{(simplify by canceling common factors)} \\ &= \frac{2x^2}{3} \end{aligned}$$

$$\begin{aligned} x \times \frac{3x + x}{4 + 2} &= x \times \frac{4x}{6} && \text{(simplifier le numérateur et le dénominateur)} \\ &= \frac{x \times 4x}{6} && \text{(multiplier les numérateurs et les dénominateurs)} \\ &= \frac{4x^2}{6} \\ &= \frac{\cancel{2} \times 2 \times x^2}{\cancel{2} \times 3} && \text{(simplifier en annulant les facteurs communs)} \\ &= \frac{2x^2}{3} \end{aligned}$$

**Ex 78:** Calculate and simplify:

$$\frac{2x^3}{2x - x} = \boxed{2x^2}$$

Calcule et simplifie :

$$\frac{2x^3}{2x - x} = \boxed{2x^2}$$

*Answer:*

$$\begin{aligned} \frac{2x^3}{2x - x} &= \frac{2x^3}{x} && \text{(combine like terms in the denominator)} \\ &= \frac{2 \times x^2 \times \cancel{x}}{\cancel{x}} && \text{(simplify by canceling common factors)} \\ &= 2x^2 \end{aligned}$$

$$\begin{aligned} \frac{2x^3}{2x - x} &= \frac{2x^3}{x} && \text{(additionner les termes semblables au dénominateur)} \\ &= \frac{2 \times x^2 \times \cancel{x}}{\cancel{x}} && \text{(simplifier en annulant les facteurs communs)} \\ &= 2x^2 \end{aligned}$$

**Ex 79:** Calculate and simplify:

$$4x \times \frac{6x - 2x}{2 \times 8} = \boxed{x^2}$$

Calcule et simplifie :

$$4x \times \frac{6x - 2x}{2 \times 8} = \boxed{x^2}$$

*Answer:*

$$\begin{aligned} 4x \times \frac{6x - 2x}{2 \times 8} &= 4x \times \frac{4x}{16} && \text{(simplify the numerator and the denominator)} \\ &= \frac{4x \times 4x}{16} && \text{(multiply the numerators and denominators)} \\ &= \frac{16x^2}{16} \\ &= \frac{\cancel{16} \times x^2}{\cancel{16} \times 1} && \text{(simplify by canceling common factors)} \\ &= x^2 \end{aligned}$$

$$\begin{aligned}
4x \times \frac{6x-2x}{2 \times 8} &= 4x \times \frac{4x}{16} && \text{(simplifier le numérateur et le dénominateur)} \\
&= \frac{4x \times 4x}{16} && \text{(multiplier les numérateurs et les dénominateurs)} \\
&= \frac{16x^2}{16} \\
&= \frac{\cancel{16} \times x^2}{\cancel{16} \times 1} && \text{(simplifier en annulant les facteurs communs)} \\
&= x^2
\end{aligned}$$

$$\frac{x+1}{3} - \frac{x+4}{2} = \boxed{\frac{-x-10}{6}}$$

Answer:

$$\begin{aligned}
\frac{x+1}{3} - \frac{x+4}{2} &= \frac{(x+1) \times 2}{3 \times 2} - \frac{(x+4) \times 3}{2 \times 3} && \text{(common denominator = 6)} \\
&= \frac{2(x+1)}{6} - \frac{3(x+4)}{6} \\
&= \frac{2(x+1) - 3(x+4)}{6} \\
&= \frac{2x+2-3x-12}{6} && \text{(distribute the negative sign)} \\
&= \frac{-x-10}{6} && \text{(combine like terms)}
\end{aligned}$$

## M.2 CALCULATING ALGEBRAIC EXPRESSIONS

**Ex 80:** Write as a single fraction:

$$2 - \frac{x+1}{3} = \boxed{\frac{5-x}{3}}$$

Answer:

$$\begin{aligned}
2 - \frac{x+1}{3} &= \frac{2 \times 3}{3} - \frac{x+1}{3} && \text{(common denominator = 3)} \\
&= \frac{6}{3} - \frac{x+1}{3} \\
&= \frac{6 - (x+1)}{3} && \text{(combine with common denominator)} \\
&= \frac{6 - x - 1}{3} && \text{(distribute the negative sign)} \\
&= \frac{5-x}{3}
\end{aligned}$$

**Ex 81:** Write as a single fraction:

$$3x - \frac{2-x}{4} = \boxed{\frac{13x-2}{4}}$$

Answer:

$$\begin{aligned}
3x - \frac{2-x}{4} &= \frac{3x \times 4}{4} - \frac{2-x}{4} && \text{(common denominator = 4)} \\
&= \frac{12x}{4} - \frac{2-x}{4} \\
&= \frac{12x - (2-x)}{4} && \text{(combine with common denominator)} \\
&= \frac{12x - 2 + x}{4} && \text{(distribute the negative sign)} \\
&= \frac{13x-2}{4}
\end{aligned}$$

**Ex 82:** Write as a single fraction:

$$\frac{x}{2} - \frac{x+1}{3} = \boxed{\frac{x-2}{6}}$$

Answer:

$$\begin{aligned}
\frac{x}{2} - \frac{x+1}{3} &= \frac{x \times 3}{2 \times 3} - \frac{(x+1) \times 2}{3 \times 2} && \text{(common denominator = 6)} \\
&= \frac{3x}{6} - \frac{2(x+1)}{6} \\
&= \frac{3x - 2(x+1)}{6} && \text{(combine with common denominator)} \\
&= \frac{3x - 2x - 2}{6} && \text{(distribute the negative sign)} \\
&= \frac{x-2}{6} && \text{(combine like terms)}
\end{aligned}$$

**Ex 83:** Write as a single fraction: