

Unit 1: Number System:

Exercise 1.1:

Q.1) i) $\{0\}$

$$0 + 0 = 0$$

$$\text{So, } 0 + 0 = 0 \in \{0\}$$

$$\text{And, } 0 \times 0 = 0 \in \{0\}$$

Hence, $\{0\}$ is closed w.r.t addition and multiplication.

ii) $\{1\}$

$$1 + 1 = 2 \text{ where } 1 + 1 = 2 \notin \{1\}$$

While,

$$1 \times 1 = 1 \in \{1\}$$

Hence, $\{1\}$ is only closed w.r.t multiplication.

iii) $\{0, -1\}$

$$0 + 0 = 0 \in \{0, -1\}$$

$$0 + (-1) = -1 \in \{0, -1\}$$

$$-1 + 0 = -1 \in \{0, -1\}$$

$$-1 + (-1) = -2 \notin \{0, -1\}$$

$$0 \times 0 = 0 \in \{0, -1\}$$

$$0 \times (-1) = 0 \in \{0, -1\}$$

$$-1 \times 0 = 0 \in \{0, -1\}$$

$$-1 \times (-1) = 1 \notin \{0, -1\}$$

Hence, $\{0, -1\}$ is not closed w.r.t addition and multiplication

iv) $\{1, -1\}$

$$1 + 1 = 2 \notin \{1, -1\}$$

$$1 + (-1) = 0 \notin \{1, -1\}$$

$$-1 + 1 = 0 \notin \{1, -1\}$$

$$-1 - 1 = -2 \notin \{1, -1\}$$

And,

$$1 \times 1 = 1 \in \{1, -1\}$$

$$1 \times (-1) = -1 \in \{1, -1\}$$

$$-1 \times 1 = -1 \in \{1, -1\}$$

$$-1 \times (-1) = 1 \in \{1, -1\}$$

Hence, $\{1, -1\}$ is only closed w.r.t multiplication

Q2) Name the properties:

i) $4 + 9 = 9 + 4$

Commutative property w.r.t addition.

ii) $(a+1) + \frac{3}{4} = a + \left(1 + \frac{3}{4}\right)$

Associative property w.r.t addition.

iii) $(\sqrt{3} + \sqrt{5}) + \sqrt{7} = \sqrt{3} + (\sqrt{5} + \sqrt{7})$

Associative property w.r.t addition.

iv) $100 + 0 = 100$

Additive Identity

v) $1000 \times 1 = 1000$

Multiplicative Identity

vi) $4 + (-4) = 0$

Additive Inverse

$$\text{vii) } a - a = 0$$

Additive Inverse.

$$\text{viii) } \sqrt{2} \times \sqrt{5} = \sqrt{5} \times \sqrt{2}$$

Commutative property w.r.t multiplication

$$\text{ix) } a(b - c) = ab - ac$$

Distributive property (left) w.r.t multiplication over subtraction.

$$\text{x) } (x - y)z = xz - yz$$

Distributive property (right) w.r.t subtraction over multiplication.

xii)

$$\text{xii) } 4 \times (5 \times 8) = (4 \times 5) \times 8$$

Associative property w.r.t multiplication

$$\text{xii) } a(b + c - d) = ab + ac - ad.$$

Left distributive property.

Q3) Name the properties:

$$i) -3 < -2 \Rightarrow 0 < 1$$

$$\begin{aligned} -3 + 3 &< -2 + 3 \\ 0 &< 1 \end{aligned}$$

Additive Identity

$$ii) -5 < -4 \Rightarrow 20 > 16$$

$$\begin{aligned} -5 - 4 &> -4 - 4 \\ 20 &> 16 \end{aligned}$$

Multiplicative property

$$iii) 1 > -1 \Rightarrow -3 > -5$$

$$\begin{aligned} 1 - 4 &> -1 - 5 \\ -3 &> -5 \end{aligned}$$

Additive property

$$iv) a < 0 \Rightarrow -a > 0$$

$$\begin{aligned} -1(a) &> 0(-1) \\ -a &> 0 \end{aligned}$$

Multiplicative property

$$v) a > b \Rightarrow \frac{1}{a} < \frac{1}{b}$$

$$a \left(\frac{1}{ab} \right) > b \left(\frac{1}{ab} \right)$$

$$a \left(\frac{1}{a} \right) \frac{1}{b} > b \left(\frac{1}{b} \right) \frac{1}{a}$$

$$1 \left(\frac{1}{b} \right) > 1 \left(\frac{1}{a} \right)$$

$$\frac{1}{b} > \frac{1}{a}$$

$$\frac{1}{a} < \frac{1}{b}$$

Multiplicative property

$$vi) a > b \Rightarrow -a < -b$$

$$a(-1) < b(-1)$$

$$-a < -b$$

Multiplicative property-

Q.4) Prove:

$$i) \frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$$

L.H.S

$$= \frac{a}{c} + \frac{b}{c}$$

$$= a\left(\frac{1}{c}\right) + b\left(\frac{1}{c}\right)$$

Taking common:

$$= (a+b) \frac{1}{c}$$

$$= \frac{a+b}{c}$$

R.H.S

$$= \frac{a+b}{c}$$

$$L.H.S = R.H.S$$

$$\text{ii) } \frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}$$

L.H.S

$$= \frac{a}{b} + \frac{c}{d}$$

Golden Rule of Fractions:

$$= \frac{ad}{bd} + \frac{bc}{bd}$$

$$= ad \left(\frac{1}{bd} \right) + bc \left(\frac{1}{bd} \right)$$

$$= (ad + bc) \frac{1}{bd}$$

$$= \frac{ad + bc}{bd}$$

R.H.S

$$= \frac{ad + bc}{bd}$$

L.H.S = R.H.S

Q5) Prove:

$$i) \quad -\frac{7}{12} - \frac{5}{18} = \frac{-21-10}{36}$$

L.H.S

$$= -\frac{7}{12} - \frac{5}{18}$$

$$= -\frac{7}{12} \left(\frac{3}{3}\right) - \left(\frac{5}{18}\right) \left(\frac{2}{2}\right)$$

$$= -\frac{21}{36} - \frac{10}{36}$$

$$= -21 \left(\frac{1}{36}\right) - 10 \left(\frac{1}{36}\right)$$

$$= (-21-10) \left(\frac{1}{36}\right)$$

$$= \frac{-21-10}{36}$$

R.H.S

$$= \frac{-21-10}{36}$$

L.H.S = R.H.S

Q6) Simplify and Justify:

$$i) \frac{4+16x}{4}$$

$$= \frac{4+16x}{4}$$

Division property:

$$= 4+16x \left(\frac{1}{4} \right)$$

Distributive Law:

$$= 4 \left(\frac{1}{4} \right) + 16x \left(\frac{1}{4} \right)$$

Multiplicative property:

$$= 4 \left(\frac{1}{4} \right) + 4x \cdot \left(4 \cdot \frac{1}{4} \right)$$

$$= 1 + 4x(1)$$

$$= 4x + 1$$

$$\text{ii) } \frac{1/4 + 1/5}{1/4 - 1/5}$$

$$= \frac{1/4 + 1/5}{1/4 - 1/5}$$

Golden Rule of Fraction:

$$= \frac{20(1/4 + 1/5)}{20(1/4 - 1/5)}$$

Distributive property

$$= \frac{20^5(1/4) + 20^4(1/5)}{20^5(1/4) - 20^4(1/5)}$$

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

$$= \frac{9}{1}$$

$$= 9$$

$$\text{iii) } \frac{a/b + c/d}{a/b - c/d}$$

$$= \frac{a/b + c/d}{a/b - c/d}$$

G.R.F:

$$= \frac{\frac{d}{d}(a/b) + \frac{db}{db}(c/d)}{\frac{d}{d}(a/b) - \frac{db}{db}(c/d)}$$

$$= \frac{ad/bd + bcd/bd}{ad/bd - bcd/bd}$$

$$= \frac{ad(1/bd) + bc(1/bd)}{ad(1/bd) - bc(1/bd)}$$

$$= \frac{(ad + bc)1/bd}{(ad - bc)1/bd}$$

$$= \frac{(ad + bc)1/bd \cdot bd}{(ad - bc)}$$

$$= \frac{ad + bc}{ad - bc}$$

$$\text{iv) } \frac{\frac{1}{a} - \frac{1}{b}}{1 - \frac{1}{a} \cdot \frac{1}{b}}$$

$$= \frac{\frac{1}{a} - \frac{1}{b}}{1 - \frac{1}{a} \cdot \frac{1}{b}}$$

$$= \frac{\frac{1}{a} - \frac{1}{b}}{1 - \frac{1}{ab}}$$

G.R.F:

$$= \frac{ab(\frac{1}{a} - \frac{1}{b})}{ab(1 - \frac{1}{ab})}$$

Distributive property:

$$= \frac{ab(\frac{1}{a}) - ab(\frac{1}{b})}{ab(1) - ab(\frac{1}{ab})}$$

$$= \frac{b - a}{ab - 1}$$