CHAPTER: 2 - Introduction to Linear Polynomials

Exercise set 3.1 (Solution)

1. A merchant in the port city of Lothal is exchanging bags of spices for copper ingots. He receives 15 ingots for every 2 bags of spices. If he brings $\mathbf{12}$ bags of spices to the market, how many copper ingots will he leave with ?

   Sol.- Given that:
   2 bags of spices= 15 ingots
   So, 1 bag of spices= $15/2$ ingots
   Similarly, for 12 bags of spices
   $= 12 \times (15/2)$
   $= 6 \times 15$
   $= 90$
   Therefore, the merchant will leave with 90 copper ingots.

2. Look at the sequence of numbers on one column of the Ishango bone: 11, 13, 17, 19. What do these numbers have in common? List the next three numbers that fit this pattern.

   Sol.- The numbers 11, 13, 17, 19 are all prime numbers (numbers that have only two factors: 1 and itself).
   Next three prime numbers after 19 are 23, 29, 31.
   Therefore, the next three numbers are 23, 29, 31.

3. We know that Natural Numbers are closed under addition (the sum of any two natural numbers is always a natural number). Are they closed under subtraction? Provide a couple of examples to justify your answer.

   Sol.- Natural numbers are NOT closed under subtraction.
   Explanation:
   Closure means the result should also be a natural number.
   Examples:
   (I) $5 - 3 = 2$ (Natural number)
   (ii) $3 - 5 = -2$ (Not a natural number)

   Since subtraction can give a negative number, so natural numbers are not closed under subtraction.

4. Ancient Indians used the joints of their fingers to count, a practice still seen today. Each finger has 3 joints, and the thumb is used to count them. How many can you count on one hand ? How does this relate to the ancient base-12 counting systems?

   Sol.-Each finger (except thumb) has 3 joints.
   Number of fingers used= 4 (excluding thumb)
   Total joints $= 4 \times 3 = 12$

So, we can count up to 12 using one hand.
Relation to base-12 system:
Since counting reaches 12 on one hand, it naturally leads to a base- 12 (duodecimal) counting system used in ancient times.It directly explains how ancient people developed the **base-12 counting system** using finger joints.

Therefore:

- ✓ Total count = 12
- ✓ This explains the origin of base-12 counting system.

Note- **Why base-12 was useful**

Ancient civilizations preferred base-12 because:

- ✓ 12 is divisible by **2, 3, 4, 6** (very practical for trade & measurement)
- ✓ This idea influenced:
  - 12 months in a year
  - 12 hours on a clock
  - 60 minutes/seconds (related to 12 × 5)

Exercise set 3.2 (Solution)

1. The temperature in the high-altitude desert of Ladakh is recorded as 4 °C at noon. By midnight, it drops by 15 °C. What is the midnight temperature?

Sol.- Initial temperature $= 4^{\circ}\mathrm{C}$
Drop $= 1\ s^{\circ}c$
Midnight temperature $= 4 - 15 = -11^{\circ}\mathrm{C}$
Therefore, the midnight temperature is $-11^{\circ}\mathrm{C}$

2. A spice trader takes a loan (debt) of Rs. 850. The next day, he makes a profit (fortune) of Rs.1,200. The following week, he incurs a loss of Rs. 450. Write this sequence as an equation using integers and calculate his final financial standing.

Sol.-Debt = - 850 Rs.
Profit = +1200 Rs.
Loss = $-$ 450 Rs.
Equation: - 850 Rs. +1200 Rs. – 450 Rs.
Step-by-step calculation:
= 350 - 450
= - 100 Rs.
Therefore, his final financial standing is -100 Rs. (Loss of 100 Rs.)

3. Calculate the following using Brahmagupta's laws:
(i) (–12) × 5 (ii) (–8) × (–7) (iii) 0 – (–14) (iv) (–20) ÷ 4

Sol.-As per Brahmagupta's laws:
Debt indicates Negative
Fortune indicates Positive
(i) $(-12) \times 5$
Negative × Positive = Negative [As Debt × Fortune = Debt]
Therefore, $(-12) \times 5 = -60$

(ii) $(-8) \times (-7)$
Negative x Negative = Positive (As Debt x Debt = Fortune]
Therefore, $(-8), (-7) = 55$

(iii) $0 - (-14)$

As per Brahmagupta, zero minus debt is a fortune.
Subtracting a negative is same as adding:
Therefore, $0-(-14)=0+14=14$

(iv) $(-20) \div 4$

Negative + Positive = Negative (As Debt + Fortune = Debt]
Therefore, $(-20)+4=-5$.

4. Explain, using a real-world example of debt, why subtracting a negative number is the same as adding a positive number (e.g., 10 – (–5) = 15).

Sol.-

Think of a negative number as debt.

You have Rs 10. You also owe Rs 5, which is written as –5.

Now consider the expression 10 – (–5). Subtracting a negative number means removing a debt. So this situation means you have Rs 10 and your Rs 5 debt is taken away.

Before removing the debt, you effectively have Rs 10 but owe Rs 5. When the debt is removed, you are Rs 5 better off.

So your total becomes 10 + 5 = Rs 15.

This is why subtracting a negative number is the same as adding a positive number.

Note-

Negative number = debt

Subtracting a negative = removing debt

Removing debt = gaining money

Exercise set 3.3 (Solution)

1. Prove that the following rational numbers are equal:

(i) $2/3$ and $4/6$
(ii) $5/4$ and $10/8$
(iii) $-3/5$ and $-6/10$
(iv) $9/3$ and 3

Sol:-

(i) $2/3$ and $4/6$
First Fraction: $2/3 = 2/3$
Second Fraction: $4/6 = 2/3$ (dividing numerator and denominator by 2)
Therefore, $2/3$ and $4/6$ are equal.

(ii) $5/4$ and $10/8$
First Fraction: $5/4 = 5/4$
Second Fraction: $10/8 = 5/4$ (dividing numerator and denominator by 2)
Therefore, $5/4$ and 10/8 are equal.

(iii) $-3/5$ and $-6/10$
First Fraction: $-3/5 = -3/5$
Second Fraction: $-6/10 = -3/5$ (dividing numerator and denominator by 2)
Therefore, $-3/5$ and $-6/10$ are equal.

(iv) $9/3$ and 3
First Fraction: $9/3 = 3$
Hence, 9/3 and 3 are equal.

2. Find the sum:

(i) $2/5 + 3/10$
(ii) $7/12 + 5/8$
(iii) $-4/7 + 3/14$

Sol.-

(i)$2/5 + 3/10$

LCM of 5 and $10 = 10$
Simplifying the first number: $2/5 = 4/10$ [Making the same denominator]
Now, the sum

$= 2/5 + 3/10$
$= 4/10 + 3/10$
$= 7/10$
Therefore, the sum of $2/5 + 3/10$ is $7/10$.

(ii)$7/12 + 5/8$

LCM of 12 and $8 = 24$
Simplifying the first number: $7/12 = 14/24$ [Making the same denominator]
Simplifying the second number: $5/8 = 15/24$ [Making the same denominator]
Now, the sum
$= 7/12 + 5/8$
$= 14/24 + 15/24$
=29/24
Therefore, the sum of $\frac{7}{12} + \frac{5}{8}$ is $29/24$.

(iii) $-4/7 + 3/14$

LCM of 7 and $14 = 14$
Simplifying the first number: $-4/7 = -8/14$ [Making the same denominator]
So, the sum
$= -4/7 + 3/14$
$= -8/14 + 3/14$
$= -\frac{5}{14}$
Therefore, the sum of $-4/7 + 3/14$ is $-5/14$.

3. Find the difference :
(i) $5/6 - 1/4$
(ii) $\frac{11}{8} - \frac{3}{4}$
(iii) $-7/9 - (-2/3)$

Sol.-
(i) $5/6 - 1/4$
LCM of 6 and $4 = 12$
Simplifying the first number: $5/6 = 10/12$ [Making the same denominator]
Simplifying the Second number: $1/4 = 3/12$ [Making the same denominator]
So, the difference
$= 5/6 - 1/4$
$= 10/12 - 3/12$
$= 7/12$
Therefore, the difference is 7/12.

(ii) $\frac{11}{8} - \frac{3}{4}$

LCM of 8 and $4 = 8$

Simplifying the Second number: $3/4 = 6/8$ [Making the same denominator]

So, the difference

$= 11/8 - 3/4$

$= 11/8 - 6/8$

$= \frac{5}{8}$

Therefore, the difference is $5/8$.

(iii) $-7/9 - (-2/3)$

$-7/9 - (-2/3) = -7/9 + 2/3$

LCM of 9 and $3 = 9$

Simplifying the Second number: $2/3 = 6/9$ [Making the same denominator]

So, the difference

$= -7/9 - (-2/3)$

$= -7/9 + 6/9$

$= -1/9$

Therefore, the difference is $-1/9$.

4. Find the product:

(i) $2/3 \times 3/10$

(ii) $7/11 \times 5/8$

(iii) $-4/7 \times 5/14$

Sol:- **(i)** $2/3 \times 3/10$

$= (2 \times 3)/(3 \times 10)$

$= 6/30$

$= 1/5$ [After simplification]

Therefore, the product is $1/5$.

(ii) $7/11 \times 5/8$

$\frac{7}{11} \times \frac{5}{8}$

$= (7 \times 5)/(11 \times 8)$

$= 35/88$

Therefore, the product is $35/88$.

(iii) $-4/7 \times 5/14$

$-4/7 \times 5/14$
$= (4 \times 5)/(7 \times 14)$
$= -20/98$
$= -10/49$ [After simplification]
Therefore, the product is $-10/49$.

5. Find the quotient:
(i) $2/3 \div 3/10$
(ii) $\frac{7}{11} \div \frac{5}{8}$
(iii) $-4/7 \div 5/14$

Sol.-(i)$2/3 \div 3/10$
$= 2/3 \times 10/3$
$= (2 \times 10)/(3 \times 3)$
$= 20/9$

(ii) $\frac{7}{11} \div \frac{5}{8}$
$= 7/11 \times 8/5$
$= (7 \times 8)/(11 \times 5)$
$= 56/55$
Therefore, the quotient is 56/55.
(iii) $-4/7 \div 5/14$
$= -4/7 \times 14/5$
$= (4 \times 14)/(7 \times 5)$
$= -56/35$
$= -8/5$ [After simplification]
Therefore, the quotient is $-8/5$.

6. Show that: $(1/2 + 3/4) \times 8/3 = 1/2 \times 8/3 + \mathbf{3/4} \times \mathbf{8/3}$

Sol.-LHS $= (1/2 + 3/4) \times 8/3$
$= (2/4 + 3/4) \times 8/3$ [First add inside the bracket: $1/2 = 2/4$]
$= (5/4) \times 8/3$ [Since $2/4 + 3/4 = 5/4$)
$= 5/4 \times 8/3$
$= (5 \times 8)/4 \times 3)$
$= 40/12$
$= 10/3$ [After simplification]
$\mathrm{RHS} = 1/2 \times 8/3 + 3/4 \times 8/3$
$= (1 \times 8)/(2 \times 3) + (3 \times 8)/(4 \times 3)$
$= 8/6 + 24/12$
$= 4/3 + 6/3$ [After simplification: $8/6 = 4/3$ and 24/12 =6/3]
$= 10/3$

Since LHS $=$ RHS,
Therefore, $(1/2+3/4)\times 8/3 = 1/2\times 8/3 + 3/4\times 8/3$
Hence proved.

7. Simplify the following using the distributive property: (7/9)(6/7-3/4).
Sol.-

Using distributive property:
7/9 (6/7-3/4)
$= 7/9\times 6/7 - 7/9\times 3/4$
$= 6/9 - 21/36$
$= 2/3 - 7/12$
$= 8/12 - 7/12$ [LCM of 3 and $12 = 12$ and $2/3 = 8/12$]
= 1/12
Therefore, the simplified value of $7/9(6/7-3/4)$ is $1/12$.

8. Find the rational number x such that:

$$(5/6)(x+3/5) = (5/6)x + 1/2$$

Sol.-

Given: $(5/6)(x+3/5) = (5/6)x + 1/2$

$(5/6)x + (5/6\times 3/5) = (5/6)x + 1/2$

$(5/6)x + 15/30 = (5/6)x + 1/2$
$15/30 = 1/2$, which is universal truth.
So, $(5/6)(x+3/5) = (5/6)x + 1/2$ is true for every value of x
Therefore, x can be any rational number.

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