EXERCISE 1.2 **PAGE NO: 1.14**

1. Verify commutativity of addition of rational numbers for each of the following pairs of rational numbers:
(i) -11/5 and 4/7
Solution: By using the commutativity law, the addition of rational numbers is commutative ∴ a/b + c/d = c/d + a/b
In order to verify the above property let us consider the given fraction
-11/5 and 4/7 as
-11/5 + 4/7 and 4/7 + -11/5
The denominators are 5 and 7
By taking LCM for 5 and 7 is 35
We rewrite the given fraction in order to get the same denominator
Now, -11/5 = (-11 × 7) / (5 ×7) = -77/35
4/7 = (4 ×5) / (7 ×5) = 20/35
Since the denominators are same we can add them directly
-77/35 + 20/35 = (-77+20)/35 = -57/35

4/7 + -11/5
The denominators are 7 and 5
By taking LCM for 7 and 5 is 35
We rewrite the given fraction in order to get the same denominator
Now, 4/7 = (4 × 5) / (7 ×5) = 20/35
-11/5 = (-11 ×7) / (5 ×7) = -77/35
Since the denominators are same we can add them directly
20/35 + -77/35 = (20 + (-77))/35 = (20-77)/35 = -57/35

∴ -11/5 + 4/7 = 4/7 + -11/5 is satisfied.

(ii) 4/9 and 7/-12
Solution: Firstly we need to convert the denominators to positive numbers.
7/-12 = (7 × -1)/ (-12 × -1) = -7/12
By using the commutativity law, the addition of rational numbers is commutative.
 ∴ a/b + c/d = c/d + a/b
In order to verify the above property let us consider the given fraction
4/9 and -7/12 as
4/9 + -7/12 and -7/12 + 4/9
The denominators are 9 and 12

By taking LCM for 9 and 12 is 36
We rewrite the given fraction in order to get the same denominator
Now, 4/9 = (4 × 4) / (9 ×4) = 16/36
-7/12 = (-7 ×3) / (12 ×3) = -21/36
Since the denominators are same we can add them directly
16/36 + (-21)/36 = (16 + (-21))/36 = (16-21)/36 = -5/36

-7/12 + 4/9
The denominators are 12 and 9
By taking LCM for 12 and 9 is 36
We rewrite the given fraction in order to get the same denominator
Now, -7/12 = (-7 ×3) / (12 ×3) = -21/36
4/9 = (4 × 4) / (9 ×4) = 16/36
Since the denominators are same we can add them directly
-21/36 + 16/36 = (-21 + 16)/36 = -5/36

∴ 4/9 + -7/12 = -7/12 + 4/9 is satisfied.

(iii) -3/5 and -2/-15
Solution:
By using the commutativity law, the addition of rational numbers is commutative.
 ∴ a/b + c/d = c/d + a/b
In order to verify the above property let us consider the given fraction
-3/5 and -2/-15 as
-3/5 + -2/-15 and -2/-15 + -3/5
-2/-15 = 2/15
The denominators are 5 and 15
By taking LCM for 5 and 15 is 15
We rewrite the given fraction in order to get the same denominator
Now, -3/5 = (-3 × 3) / (5×3) = -9/15
2/15 = (2 ×1) / (15 ×1) = 2/15
Since the denominators are same we can add them directly
-9/15 + 2/15 = (-9 + 2)/15 = -7/15

-2/-15 + -3/5
-2/-15 = 2/15
The denominators are 15 and 5
By taking LCM for 15 and 5 is 15
We rewrite the given fraction in order to get the same denominator

Now, 2/15 = (2 ×1) / (15 ×1) = 2/15
-3/5 = (-3 × 3) / (5×3) = -9/15
Since the denominators are same we can add them directly
2/15 + -9/15 = (2 + (-9))/15 = (2-9)/15 = -7/15

∴ -3/5 + -2/-15 = -2/-15 + -3/5 is satisfied.

(iv) 2/-7 and 12/-35
Solution: Firstly we need to convert the denominators to positive numbers.
2/-7 = (2 × -1)/ (-7 × -1) = -2/7
12/-35 = (12 × -1)/ (-35 × -1) = -12/35
By using the commutativity law, the addition of rational numbers is commutative.
 ∴ a/b + c/d = c/d + a/b
In order to verify the above property let us consider the given fraction
-2/7 and -12/35 as
-2/7 + -12/35 and -12/35 + -2/7
The denominators are 7 and 35
By taking LCM for 7 and 35 is 35
We rewrite the given fraction in order to get the same denominator
Now, -2/7 = (-2 × 5) / (7 ×5) = -10/35
-12/35 = (-12 ×1) / (35 ×1) = -12/35
Since the denominators are same we can add them directly
-10/35 + (-12)/35 = (-10 + (-12))/35 = (-10-12)/35 = -22/35

-12/35 + -2/7
The denominators are 35 and 7
By taking LCM for 35 and 7 is 35
We rewrite the given fraction in order to get the same denominator
Now, -12/35 = (-12 ×1) / (35 ×1) = -12/35
-2/7 = (-2 × 5) / (7 ×5) = -10/35
Since the denominators are same we can add them directly
-12/35 + -10/35 = (-12 + (-10))/35 = (-12-10)/35 = -22/35

∴ -2/7 + -12/35 = -12/35 + -2/7 is satisfied.

(v) 4 and -3/5
Solution: By using the commutativity law, the addition of rational numbers is
commutative.
 ∴ a/b + c/d = c/d + a/b

In order to verify the above property let us consider the given fraction
4/1 and -3/5 as
4/1 + -3/5 and -3/5 + 4/1
The denominators are 1 and 5
By taking LCM for 1 and 5 is 5
We rewrite the given fraction in order to get the same denominator
Now, 4/1 = (4 × 5) / (1×5) = 20/5
-3/5 = (-3 ×1) / (5 ×1) = -3/5
Since the denominators are same we can add them directly
20/5 + -3/5 = (20 + (-3))/5 = (20-3)/5 = 17/5

-3/5 + 4/1
The denominators are 5 and 1
By taking LCM for 5 and 1 is 5
We rewrite the given fraction in order to get the same denominator
Now, -3/5 = (-3 ×1) / (5 ×1) = -3/5
4/1 = (4 × 5) / (1×5) = 20/5
Since the denominators are same we can add them directly
-3/5 + 20/5 = (-3 + 20)/5 = 17/5

∴ 4/1 + -3/5 = -3/5 + 4/1 is satisfied.

(vi) -4 and 4/-7
Solution: Firstly we need to convert the denominators to positive numbers.
4/-7 = (4 × -1)/ (-7 × -1) = -4/7
By using the commutativity law, the addition of rational numbers is commutative.
 ∴ a/b + c/d = c/d + a/b
In order to verify the above property let us consider the given fraction
-4/1 and -4/7 as
-4/1 + -4/7 and -4/7 + -4/1
The denominators are 1 and 7
By taking LCM for 1 and 7 is 7
We rewrite the given fraction in order to get the same denominator
Now, -4/1 = (-4 × 7) / (1×7) = -28/7
-4/7 = (-4 ×1) / (7 ×1) = -4/7
Since the denominators are same we can add them directly
-28/7 + -4/7 = (-28 + (-4))/7 = (-28-4)/7 = -32/7

-4/7 + -4/1
The denominators are 7 and 1
By taking LCM for 7 and 1 is 7
We rewrite the given fraction in order to get the same denominator
Now, -4/7 = (-4 ×1) / (7 ×1) = -4/7
-4/1 = (-4 × 7) / (1×7) = -28/7
Since the denominators are same we can add them directly
-4/7 + -28/7 = (-4 + (-28))/7 = (-4-28)/7 = -32/7

∴ -4/1 + -4/7 = -4/7 + -4/1 is satisfied.

**2. Verify associativity of addition of rational numbers i.e., (x + y) + z = x + (y + z),
when:**
(i) x = ½, y = 2/3, z = -1/5
Solution: As the property states **(x + y) + z = x + (y + z)**
Use the values as such,
(1/2 + 2/3) + (-1/5) = 1/2 + (2/3 + (-1/5))
Let us consider LHS (1/2 + 2/3) + (-1/5)
Taking LCM for 2 and 3 is 6
(1× 3)/(2×3) + (2×2)/(3×2)
3/6 + 4/6
Since the denominators are same we can add them directly,
3/6 + 4/6 = 7/6
7/6 + (-1/5)
Taking LCM for 6 and 5 is 30
(7×5)/(6×5) + (-1×6)/(5×6)
35/30 + (-6)/30
Since the denominators are same we can add them directly,
(35+(-6))/30 = (35-6)/30 = 29/30

Let us consider RHS 1/2 + (2/3 + (-1/5))
Taking LCM for 3 and 5 is 15
(2/3 + (-1/5)) = (2×5)/(3×5) + (-1×3)/(5×3)
              = 10/15 + (-3)/15
 Since the denominators are same we can add them directly,
10/15 + (-3)/15 = (10-3)/15 = 7/15
1/2 + 7/15
Taking LCM for 2 and 15 is 30
1/2 + 7/15 = (1×15)/(2×15) + (7×2)/(15×2)

= 15/30 + 14/30
Since the denominators are same we can add them directly,
   = (15 + 14)/30 = 29/30
∴ LHS = RHS associativity of addition of rational numbers is verified.

(ii) x = -2/5, y = 4/3, z = -7/10
Solution: As the property states **(x + y) + z = x + (y + z)**
Use the values as such,
(-2/5 + 4/3) + (-7/10) = -2/5 + (4/3 + (-7/10))
Let us consider LHS (-2/5 + 4/3) + (-7/10)
Taking LCM for 5 and 3 is 15
(-2× 3)/(5×3) + (4×5)/(3×5)
-6/15 + 20/15
Since the denominators are same we can add them directly,
-6/15 + 20/15= (-6+20)/15 = 14/15
14/15 + (-7/10)
Taking LCM for 15 and 10 is 30
(14×2)/(15×2) + (-7×3)/(10×3)
28/30 + (-21)/30
Since the denominators are same we can add them directly,
(28+(-21))/30 = (28-21)/30 = 7/30

Let us consider RHS -2/5 + (4/3 + (-7/10))
Taking LCM for 3 and 10 is 30
(4/3 + (-7/10)) = (4×10)/(3×10) + (-7×3)/(10×3)
    = 40/30 + (-21)/30
 Since the denominators are same we can add them directly,
40/30 + (-21)/30 = (40-21)/30 = 19/30
-2/5 + 19/30
Taking LCM for 5 and 30 is 30
-2/5 + 19/30 = (-2×6)/(5×6) + (19×1)/(30×1)
   = -12/30 + 19/30
Since the denominators are same we can add them directly,
   = (-12 + 19)/30 = 7/30
∴ LHS = RHS associativity of addition of rational numbers is verified.

(iii) x = -7/11, y = 2/-5, z = -3/22
Solution: Firstly convert the denominators to positive numbers

2/-5 = (2×-1)/ (-5×-1) = -2/5

As the property states **(x + y) + z = x + (y + z)**

Use the values as such,

(-7/11 + -2/5) + (-3/22) = -7/11 + (-2/5 + (-3/22))

Let us consider LHS (-7/11 + -2/5) + (-3/22)

Taking LCM for 11 and 5 is 55

(-7×5)/(11×5) + (-2×11)/(5×11)

-35/55 + -22/55

Since the denominators are same we can add them directly,

-35/55 + -22/55 = (-35-22)/55 = -57/55

-57/55 + (-3/22)

Taking LCM for 55 and 22 is 110

(-57×2)/(55×2) + (-3×5)/(22×5)

-114/110 + (-15)/110

Since the denominators are same we can add them directly,

(-114+(-15))/110 = (-114-15)/110 = -129/110

Let us consider RHS -7/11 + (-2/5 + (-3/22))

Taking LCM for 5 and 22 is 110

(-2/5 + (-3/22))= (-2×22)/(5×22) + (-3×5)/(22×5)

               = -44/110 + (-15)/110

 Since the denominators are same we can add them directly,

-44/110 + (-15)/110 = (-44-15)/110 = -59/110

-7/11 + -59/110

Taking LCM for 11 and 110 is 110

-7/11 + -59/110 = (-7×10)/(11×10) + (-59×1)/(110×1)

             = -70/110 + -59/110

Since the denominators are same we can add them directly,

         = (-70 -59)/110 = -129/110

∴ LHS = RHS associativity of addition of rational numbers is verified.

(iv) x = -2, y = 3/5, z = -4/3

Solution: As the property states **(x + y) + z = x + (y + z)**

Use the values as such,

(-2/1 + 3/5) + (-4/3) = -2/1 + (3/5 + (-4/3))

Let us consider LHS (-2/1 + 3/5) + (-4/3)

Taking LCM for 1 and 5 is 5

(-2×5)/(1×5) + (3×1)/(5×1)

-10/5 + 3/5
Since the denominators are same we can add them directly,
-10/5 + 3/5= (-10+3)/5 = -7/5
-7/5 + (-4/3)
Taking LCM for 5 and 3 is 15
(-7×3)/(5×3) + (-4×5)/(3×5)
-21/15 + (-20)/15
Since the denominators are same we can add them directly,
(-21+(-20))/15 = (-21-20)/15 = -41/15

Let us consider RHS -2/1 + (3/5 + (-4/3))
Taking LCM for 5 and 3 is 15
(3/5 + (-4/3)) = (3×3)/(5×3) + (-4×5)/(3×5)
              = 9/15 + (-20)/15
 Since the denominators are same we can add them directly,
9/15 + (-20)/15 = (9-20)/15 = -11/15
-2/1 + -11/15
Taking LCM for 1 and 15 is 15
-2/1 + -11/15 = (-2×15)/(1×15) + (-11×1)/(15×1)
              = -30/15 + -11/15
Since the denominators are same we can add them directly,
              = (-30 -11)/15 = -41/15
∴ LHS = RHS associativity of addition of rational numbers is verified.

3. Write the additive of each of the following rational numbers:
(i) -2/17
(ii) 3/-11
(iii) -17/5
(iv) -11/-25
Solution:
(i) The additive inverse of -2/17 is 2/17
(ii) The additive inverse of 3/-11 is 3/11
(iii) The additive inverse of -17/5 is 17/5
(iv) The additive inverse of -11/-25 is -11/25

4. Write the negative(additive) inverse of each of the following:
(i) -2/5
(ii) 7/-9
(iii) -16/13

(iv) -5/1
(v) 0
(vi) 1
Solution:
(i) The negative (additive) inverse of -2/5 is 2/5
(ii) The negative (additive) inverse of 7/-9 is 7/9
(iii) The negative (additive) inverse of -16/13 is 16/13
(iv) The negative (additive) inverse of -5/1 is 5
(v) The negative (additive) inverse of 0 is 0
(vi) The negative (additive) inverse of 1 is -1
(vii) The negative (additive) inverse of -1 is 1

**5. Using commutativity and associativity of addition of rational numbers, express
each of the following as a rational number:**
(i) 2/5 + 7/3 + -4/5 + -1/3
Solution: Firstly group the rational numbers with same denominators
2/5 + -4/5 + 7/3 + -1/3
Now the denominators which are same can be added directly.
(2+(-4))/5 + (7+(-1))/3
(2-4)/5 + (7-1)/3
-2/5 + 6/3
By taking LCM for 5 and 3 we get, 15
(-2×3)/(5×3) + (6×5)/(3×5)
-6/15 + 30/15
Since the denominators are same can be added directly
(-6+30)/15 = 24/15
Further can be divided by 3 we get,
24/15 = 8/5

(ii) 3/7 + -4/9 + -11/7 + 7/9
Solution: Firstly group the rational numbers with same denominators
3/7 + -11/7 + -4/9 + 7/9
Now the denominators which are same can be added directly.
(3+ (-11))/7 + (-4+ 7)/9
(3-11)/7 + (-4+7)/9
-8/7 + 3/9
-8/7 + 1/3
By taking LCM for 7 and 3 we get, 21
(-8×3)/ (7×3) + (1×7)/ (3×7)

-24/21 + 7/21
Since the denominators are same can be added directly
(-24+7)/21 = -17/21

(iii) 2/5 + 8/3 + -11/15 + 4/5 + -2/3
Solution: Firstly group the rational numbers with same denominators
2/5 + 4/5 + 8/3 + -2/3 + -11/15
Now the denominators which are same can be added directly.
(2 + 4)/5 + (8 + (-2))/3 + -11/15
6/5 + (8-2)/3 + -11/15
6/5 + 6/3 + -11/15
6/5 + 2/1 + -11/15
By taking LCM for 5, 1 and 15 we get, 15
(6×3)/ (5×3) + (2×15)/ (1×15) + (-11×1)/ (15×1)
18/15 + 30/15 + -11/15
Since the denominators are same can be added directly
(18+30+ (-11))/15 = (18+30-11)/15 = 37/15

(iv) 4/7 + 0 + -8/9 + -13/7 + 17/21
Solution: Firstly group the rational numbers with same denominators
4/7 + -13/7 + -8/9 + 17/21
Now the denominators which are same can be added directly.
(4 + (-13))/7 + -8/9 + 17/21
(4-13)/7 + -8/9 + 17/21
-9/7 + -8/9 + 17/21
By taking LCM for 7, 9 and 21 we get, 63
(-9×9)/ (7×9) + (-8×7)/ (9×7) + (17×3)/ (21×3)
-81/63 + -56/63 + 51/63
Since the denominators are same can be added directly
(-81+(-56)+ 51)/63 = (-81-56+51)/63 = -86/63

6. Re-arrange suitably and find the sum in each of the following:
(i) 11/12 + -17/3 + 11/2 + -25/2
Solution: Firstly group the rational numbers with same denominators
11/12 + -17/3 + (11-25)/2
11/12 + -17/3 + -14/2
By taking LCM for 12, 3 and 2 we get, 12
(11×1)/(12×1) + (-17×4)/(3×4) + (-14×6)/(2×6)
11/12 + -68/12 + -84/12

Since the denominators are same can be added directly
(11-68-84)/12 = -141/12

(ii)-6/7 + -5/6 + -4/9 + -15/7
Solution: Firstly group the rational numbers with same denominators
-6/7 + -15/7 + -5/6 + -4/9
(-6 -15)/7 + -5/6 + -4/9
-21/7 + -5/6 + -4/9
-3/1 + -5/6 + -4/9
By taking LCM for 1, 6 and 9 we get, 18
(-3×18)/(1×18) + (-5×3)/(6×3) + (-4×2)/(9×2)
-54/18 + -15/18 + -8/18
Since the denominators are same can be added directly
(-54-15-8)/18 = -77/18

(iii) 3/5 + 7/3 + 9/ 5+ -13/15 + -7/3
Solution: Firstly group the rational numbers with same denominators
3/5 + 9/5 + 7/3 + -7/3 + -13/15
(3+9)/5 + -13/15
12/5 + -13/15
By taking LCM for 5 and 15 we get, 15
(12×3)/(5×3) + (-13×1)/(15×1)
36/15 + -13/15
Since the denominators are same can be added directly
(36-13)/15 = 23/15

(iv) 4/13 + -5/8 + -8/13 + 9/13
Solution: Firstly group the rational numbers with same denominators
4/13 + -8/13 + 9/13 + -5/8
(4-8+9)/13 + -5/8
5/13 + -5/8
By taking LCM for 13 and 8 we get, 104
(5×8)/(13×8) + (-5×13)/(8×13)
40/104 + -65/104
Since the denominators are same can be added directly
(40-65)/104 = -25/104

(v) 2/3 + -4/5 + 1/3 + 2/5
Solution: Firstly group the rational numbers with same denominators

2/3 + 1/3 + -4/5 + 2/5
(2+1)/3 + (-4+2)/5
3/3 + -2/5
1/1 + -2/5
By taking LCM for 1 and 5 we get, 5
(1×5)/(1×5) + (-2×1)/(5×1)
5/5 + -2/5
Since the denominators are same can be added directly
(5-2)/5 = 3/5

(vi) 1/8 + 5/12 + 2/7 + 7/12 + 9/7 + -5/16
Solution: Firstly group the rational numbers with same denominators
1/8 + 5/12 + 7/12 + 2/7 + 9/7 + -5/16
1/8 + (5+7)/12 + (2+9)/7 + -5/16
1/8 + 12/12 + 11/7 + -5/16
1/8 + 1/1 + 11/7 + -5/16
By taking LCM for 8, 1, 7 and 16 we get, 112
(1×14)/(8×14) + (1×112)/(1×112) + (11×16)/(7×16) + (-5×7)/(16×7)
14/112 + 112/112 + 176/112 + -35/112
Since the denominators are same can be added directly
(14+112+176-35)/112 = 267/112