

## EXERCISE 1.2

**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  $\therefore a/b + c/d = c/d + a/b$

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,  $-11/5 = (-11 \times 7) / (5 \times 7) = -77/35$

$4/7 = (4 \times 5) / (7 \times 5) = 20/35$

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,  $4/7 = (4 \times 5) / (7 \times 5) = 20/35$

$-11/5 = (-11 \times 7) / (5 \times 7) = -77/35$

Since the denominators are same we can add them directly

$20/35 + -77/35 = (20 + (-77))/35 = (20-77)/35 = -57/35$

$\therefore -11/5 + 4/7 = 4/7 + -11/5$  is satisfied.

**(ii)  $4/9$  and  $7/-12$**

**Solution:** Firstly we need to convert the denominators to positive numbers.

$7/-12 = (7 \times -1) / (-12 \times -1) = -7/12$

By using the commutativity law, the addition of rational numbers is commutative.

$\therefore a/b + c/d = c/d + a/b$

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

$$\text{Now, } 4/9 = (4 \times 4) / (9 \times 4) = 16/36$$

$$-7/12 = (-7 \times 3) / (12 \times 3) = -21/36$$

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

$$\text{Now, } -7/12 = (-7 \times 3) / (12 \times 3) = -21/36$$

$$4/9 = (4 \times 4) / (9 \times 4) = 16/36$$

Since the denominators are same we can add them directly

$$-21/36 + 16/36 = (-21 + 16)/36 = -5/36$$

$\therefore 4/9 + -7/12 = -7/12 + 4/9$  is satisfied.

**(iii)  $-3/5$  and  $-2/-15$**

**Solution:**

By using the commutativity law, the addition of rational numbers is commutative.

$$\therefore a/b + c/d = c/d + a/b$$

In order to verify the above property let us consider the given fraction

$-3/5$  and  $-2/-15$  as

$$-3/5 + -2/-15 \text{ and } -2/-15 + -3/5$$

$$-2/-15 = 2/15$$

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

$$\text{Now, } -3/5 = (-3 \times 3) / (5 \times 3) = -9/15$$

$$2/15 = (2 \times 1) / (15 \times 1) = 2/15$$

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

$$\text{Now, } 2/15 = (2 \times 1) / (15 \times 1) = 2/15$$

$$-3/5 = (-3 \times 3) / (5 \times 3) = -9/15$$

Since the denominators are same we can add them directly

$$2/15 + -9/15 = (2 + (-9))/15 = (2-9)/15 = -7/15$$

$\therefore -3/5 + -2/-15 = -2/-15 + -3/5$  is satisfied.

**(iv)  $2/-7$  and  $12/-35$**

**Solution:** Firstly we need to convert the denominators to positive numbers.

$$2/-7 = (2 \times -1) / (-7 \times -1) = -2/7$$

$$12/-35 = (12 \times -1) / (-35 \times -1) = -12/35$$

By using the commutativity law, the addition of rational numbers is commutative.

$$\therefore a/b + c/d = c/d + a/b$$

In order to verify the above property let us consider the given fraction

$-2/7$  and  $-12/35$  as

$$-2/7 + -12/35 \text{ and } -12/35 + -2/7$$

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

$$\text{Now, } -2/7 = (-2 \times 5) / (7 \times 5) = -10/35$$

$$-12/35 = (-12 \times 1) / (35 \times 1) = -12/35$$

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

$$\text{Now, } -12/35 = (-12 \times 1) / (35 \times 1) = -12/35$$

$$-2/7 = (-2 \times 5) / (7 \times 5) = -10/35$$

Since the denominators are same we can add them directly

$$-12/35 + -10/35 = (-12 + (-10))/35 = (-12-10)/35 = -22/35$$

$\therefore -2/7 + -12/35 = -12/35 + -2/7$  is satisfied.

**(v) 4 and  $-3/5$**

**Solution:** By using the commutativity law, the addition of rational numbers is commutative.

$$\therefore a/b + c/d = c/d + a/b$$

In order to verify the above property let us consider the given fraction

$\frac{4}{1}$  and  $-\frac{3}{5}$  as

$\frac{4}{1} + -\frac{3}{5}$  and  $-\frac{3}{5} + \frac{4}{1}$

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,  $\frac{4}{1} = \frac{(4 \times 5)}{(1 \times 5)} = \frac{20}{5}$

$-\frac{3}{5} = \frac{(-3 \times 1)}{(5 \times 1)} = -\frac{3}{5}$

Since the denominators are same we can add them directly

$\frac{20}{5} + -\frac{3}{5} = \frac{(20 + (-3))}{5} = \frac{(20-3)}{5} = \frac{17}{5}$

$-\frac{3}{5} + \frac{4}{1}$

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,  $-\frac{3}{5} = \frac{(-3 \times 1)}{(5 \times 1)} = -\frac{3}{5}$

$\frac{4}{1} = \frac{(4 \times 5)}{(1 \times 5)} = \frac{20}{5}$

Since the denominators are same we can add them directly

$-\frac{3}{5} + \frac{20}{5} = \frac{(-3 + 20)}{5} = \frac{17}{5}$

$\therefore \frac{4}{1} + -\frac{3}{5} = -\frac{3}{5} + \frac{4}{1}$  is satisfied.

**(vi) -4 and  $\frac{4}{-7}$**

**Solution:** Firstly we need to convert the denominators to positive numbers.

$\frac{4}{-7} = \frac{(4 \times -1)}{(-7 \times -1)} = -\frac{4}{7}$

By using the commutativity law, the addition of rational numbers is commutative.

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

In order to verify the above property let us consider the given fraction

$-\frac{4}{1}$  and  $-\frac{4}{7}$  as

$-\frac{4}{1} + -\frac{4}{7}$  and  $-\frac{4}{7} + -\frac{4}{1}$

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,  $-\frac{4}{1} = \frac{(-4 \times 7)}{(1 \times 7)} = -\frac{28}{7}$

$-\frac{4}{7} = \frac{(-4 \times 1)}{(7 \times 1)} = -\frac{4}{7}$

Since the denominators are same we can add them directly

$-\frac{28}{7} + -\frac{4}{7} = \frac{(-28 + (-4))}{7} = \frac{(-28-4)}{7} = -\frac{32}{7}$

$$-4/7 + -4/1$$

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

$$\text{Now, } -4/7 = (-4 \times 1) / (7 \times 1) = -4/7$$

$$-4/1 = (-4 \times 7) / (1 \times 7) = -28/7$$

Since the denominators are same we can add them directly

$$-4/7 + -28/7 = (-4 + (-28))/7 = (-4-28)/7 = -32/7$$

$\therefore -4/1 + -4/7 = -4/7 + -4/1$  is satisfied.

**2. Verify associativity of addition of rational numbers i.e.,  $(x + y) + z = x + (y + z)$ , when:**

**(i)  $x = 1/2, y = 2/3, z = -1/5$**

**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

$$(1 \times 3)/(2 \times 3) + (2 \times 2)/(3 \times 2)$$

$$3/6 + 4/6$$

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

$$(7 \times 5)/(6 \times 5) + (-1 \times 6)/(5 \times 6)$$

$$35/30 + (-6)/30$$

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

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

$$= 10/15 + (-3)/15$$

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

$$1/2 + 7/15 = (1 \times 15)/(2 \times 15) + (7 \times 2)/(15 \times 2)$$

$$= 15/30 + 14/30$$

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

$$(-2 \times 3)/(5 \times 3) + (4 \times 5)/(3 \times 5)$$

$$-6/15 + 20/15$$

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

$$(14 \times 2)/(15 \times 2) + (-7 \times 3)/(10 \times 3)$$

$$28/30 + (-21)/30$$

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

$$(4/3 + (-7/10)) = (4 \times 10)/(3 \times 10) + (-7 \times 3)/(10 \times 3)$$

$$= 40/30 + (-21)/30$$

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

$$-2/5 + 19/30 = (-2 \times 6)/(5 \times 6) + (19 \times 1)/(30 \times 1)$$

$$= -12/30 + 19/30$$

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

$$2/-5 = (2 \times -1)/(-5 \times -1) = -2/5$$

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

$$(-7 \times 5)/(11 \times 5) + (-2 \times 11)/(5 \times 11)$$

$$-35/55 + -22/55$$

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

$$(-57 \times 2)/(55 \times 2) + (-3 \times 5)/(22 \times 5)$$

$$-114/110 + (-15)/110$$

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

$$(-2/5 + (-3/22)) = (-2 \times 22)/(5 \times 22) + (-3 \times 5)/(22 \times 5)$$

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

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

$$-7/11 + -59/110 = (-7 \times 10)/(11 \times 10) + (-59 \times 1)/(110 \times 1)$$

$$= -70/110 + -59/110$$

Since the denominators are same we can add them directly,

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

$\therefore$  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

$$(-2 \times 5)/(1 \times 5) + (3 \times 1)/(5 \times 1)$$

$$-10/5 + 3/5$$

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

$$(-7 \times 3)/(5 \times 3) + (-4 \times 5)/(3 \times 5)$$

$$-21/15 + (-20)/15$$

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

$$(3/5 + (-4/3)) = (3 \times 3)/(5 \times 3) + (-4 \times 5)/(3 \times 5)$$

$$= 9/15 + (-20)/15$$

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

$$-2/1 + -11/15 = (-2 \times 15)/(1 \times 15) + (-11 \times 1)/(15 \times 1)$$

$$= -30/15 + -11/15$$

Since the denominators are same we can add them directly,

$$= (-30 - 11)/15 = -41/15$$

$\therefore$  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)  $1$

(vii)  $-1$

**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

$$(-2 \times 3)/(5 \times 3) + (6 \times 5)/(3 \times 5)$$

$$-6/15 + 30/15$$

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

$$(-8 \times 3)/(7 \times 3) + (1 \times 7)/(3 \times 7)$$

$$-24/21 + 7/21$$

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

$$(6 \times 3)/(5 \times 3) + (2 \times 15)/(1 \times 15) + (-11 \times 1)/(15 \times 1)$$

$$18/15 + 30/15 + -11/15$$

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

$$(-9 \times 9)/(7 \times 9) + (-8 \times 7)/(9 \times 7) + (17 \times 3)/(21 \times 3)$$

$$-81/63 + -56/63 + 51/63$$

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

$$(11 \times 1)/(12 \times 1) + (-17 \times 4)/(3 \times 4) + (-14 \times 6)/(2 \times 6)$$

$$11/12 + -68/12 + -84/12$$

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

$$(-3 \times 18)/(1 \times 18) + (-5 \times 3)/(6 \times 3) + (-4 \times 2)/(9 \times 2)$$

$$-54/18 + -15/18 + -8/18$$

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

$$(12 \times 3)/(5 \times 3) + (-13 \times 1)/(15 \times 1)$$

$$36/15 + -13/15$$

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

$$(5 \times 8)/(13 \times 8) + (-5 \times 13)/(8 \times 13)$$

$$40/104 + -65/104$$

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

$$(1 \times 5)/(1 \times 5) + (-2 \times 1)/(5 \times 1)$$

$$5/5 + -2/5$$

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

$$(1 \times 14)/(8 \times 14) + (1 \times 112)/(1 \times 112) + (11 \times 16)/(7 \times 16) + (-5 \times 7)/(16 \times 7)$$

$$14/112 + 112/112 + 176/112 + -35/112$$

Since the denominators are same can be added directly

$$(14+112+176-35)/112 = 267/112$$

