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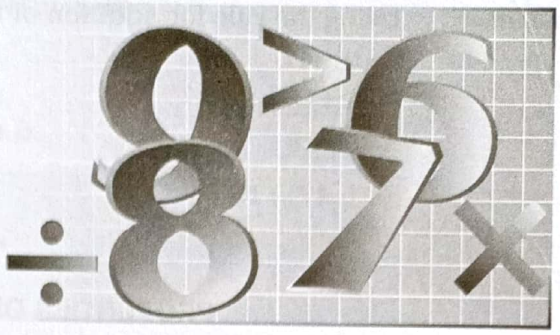
1 Integers



In class VI, we read about integers and various operations on them. We shall review them here and study the various properties satisfied by various operations on them.

Various Types of Numbers

Natural numbers *Counting numbers are called natural numbers.*
Thus, 1, 2, 3, 4, 5, 6, ..., etc., are all natural numbers.

Whole numbers *All natural numbers together with 0 (zero) are called whole numbers.*
Thus, 0, 1, 2, 3, 4, ..., etc., are whole numbers.
Clearly, every natural number is a whole number but 0 is a whole number which is not a natural number.

Integers *All natural numbers, 0 and negatives of counting numbers are called integers.*
Thus, ..., −4, −3, −2, −1, 0, 1, 2, 3, 4, ..., etc., are all integers.

(i) **Positive integers:** 1, 2, 3, 4, 5, ..., etc., are all positive integers.

(ii) **Negative integers:** −1, −2, −3, −4, ..., etc., are all negative integers.

(iii) **Zero** is an integer which is neither positive nor negative.

ADDITION OF INTEGERS

Rule 1. *If two positive or two negative integers are added, we add their values regardless of their signs and give the sum their common sign.*

EXAMPLE 1. *Add: (i) 36 and 27 (ii) −31 and −25*

Solution We have:

(i) $+36$
$+27$
63

(ii) -31
-25
-56

$\therefore$ (i) $36 + 27 = 63$.
(ii) $(-31) + (-25) = -56$.

Rule 2. *To add a positive and a negative integer, we find the difference between their numerical values regardless of their signs and give the sign of the integer with the greater value to it.*

REMARK In order to add two integers of unlike signs, we see which is more and by how much.

EXAMPLE 2. *Add: (i) −47 + 18 (ii) (−29) + 52*

Solution Using the rule for addition of integers with unlike signs, we have:

(i) -47
$+18$
-29

$\therefore\ (-47)+18=-29.$

(ii) -29
$+52$
$+23$

$\therefore\ (-29)+52=+23.$

PROPERTIES OF ADDITION OF INTEGERS

I. Closure Property of Addition: *The sum of two integers is always an integer.*

EXAMPLES (i) $5+4=9$, which is an integer.
(ii) $4+(-8)=-4$, which is an integer.
(iii) $(-3)+(-8)=-11$, which is an integer.
(iv) $15+(-9)=6$, which is an integer.
Hence, the sum of two integers is always an integer.

II. Commutative Law of Addition: If a and b are any two integers, then
$$a+b=b+a.$$

EXAMPLES (i) $(-4)+9=5$ and $9+(-4)=5$.
$\therefore\ (-4)+9=9+(-4).$
(ii) $(-5)+(-8)=-13$ and $(-8)+(-5)=-13$.
$\therefore\ (-5)+(-8)=(-8)+(-5).$

III. Associative Law of Addition: If a, b, c are any three integers, then
$$(a+b)+c=a+(b+c).$$

EXAMPLE Consider the integers (-6), (-8) and 5. We have:
$\{(-6)+(-8)\}+5=(-14)+5=-9.$
And, $(-6)+\{(-8)+5\}=(-6)+(-3)=-9.$
$\therefore\ \{(-6)+(-8)\}+5=(-6)+\{(-8)+5)\}.$
Similarly, other examples may be taken up.

IV. Existence of Additive Identity: For any integer a, we have:
$$a+0=0+a=a.$$
0 is called the *additive identity* for integers.

EXAMPLES (i) $9+0=0+9=9.$ (ii) $(-6)+0=0+(-6)=(-6).$

V. Existence of Additive Inverse: For any integer a, we have:
$$a+(-a)=(-a)+a=0.$$
The *opposite* of an integer a is $(-a)$.
The sum of an integer and its opposite is 0.
Additive inverse of a *is* $(-a)$.
Similarly, *additive inverse of* $(-a)$ *is* a.

EXAMPLE We have: $5+(-5)=(-5)+5=0.$
So, the additive inverse of 5 is (-5).
And, the additive inverse of (-5) is 5.

SUBTRACTION OF INTEGERS

For any integers a and b, we define:

(i) $a - b = a + (\text{additive inverse of } b) = a + (-b)$.

(ii) $a - (-b) = a + [\text{additive inverse of } (-b)] = a + b$.

SUMMARY

(i) $a - b = a + (-b)$

(ii) $a - (-b) = a + b$

EXAMPLE 1. *Subtract:*

(i) 9 from 4 (ii) −8 from 5 (iii) 7 from (−6) (iv) −9 from −5

Solution We have:

(i) $4 - 9 = 4 + (-9) = -5$.

(ii) $5 - (-8) = 5 + 8 = 13$.

(iii) $(-6) - 7 = (-6) + (-7) = -13$.

(iv) $-5 - (-9) = (-5) + 9 = 4$.

EXAMPLE 2. *Write:*

(i) a pair of integers whose sum is −8;

(ii) a pair of integers whose difference is −12;

(iii) a pair of integers whose sum is 0;

(iv) a negative integer and a positive integer whose sum is −6;

(v) a negative integer and a positive integer whose difference is −4.

Solution Clearly, we have:

(i) $(-3) + (-5) = -8$.

(ii) $(-15) - (-3) = (-15) + 3 = -12$.

(iii) $8 + (-8) = 0$.

(iv) $(-8) + 2 = (-6)$.

(v) $(-1) - 3 = -4$.

PROPERTIES OF SUBTRACTION OF INTEGERS

I. Closure Property for Subtraction: *If a and b are any two integers, then $(a - b)$ is always an integer.*

EXAMPLES (i) $2 - 5 = 2 + (-5) = -3$, which is an integer.

(ii) $(-2) - 6 = (-2) + (-6) = -8$, which is an integer.

(iii) $3 - (-5) = 3 + 5 = 8$, which is an integer.

(iv) $-4 - (-6) = -4 + 6 = 2$, which is an integer.

II. Subtraction of Integers is Not Commutative.

EXAMPLES (i) Consider the integers 3 and 5. We have:

$(3 - 5) = 3 + (-5) = -2$ and $(5 - 3) = 5 + (-3) = 2$.

$\therefore \quad (3 - 5) \neq (5 - 3)$.

(ii) Consider the integers (-4) and 2. We have:

$(-4) - 2 = (-4) + (-2) = -6$ and $2 - (-4) = (2 + 4) = 6$.

$\therefore \quad (-4) - 2 \neq 2 - (-4)$.

(iii) Consider the integers (-6) and (-4). We have:

$(-6) - (-4) = (-6) + 4 = -2$ and $(-4) - (-6) = (-4) + 6 = 2$.

$\therefore \quad (-6) - (-4) \neq (-4) - (-6)$.

III. Subtraction of Integers is Not Associative.

EXAMPLE Consider the integers 3, (−4) and (−5). We have:

$\{3-(-4)\}-(-5)=(3+4)-(-5)=7-(-5)=(7+5)=12.$

And, $3-\{(-4)-(-5)\}=3-\{(-4)+5\}=(3-1)=2.$

$\therefore \quad \{3-(-4)\}-(-5)\neq 3-\{(-4)-(-5)\}.$

EXAMPLE 3. *Write a pair of integers whose difference gives*

(i) zero;

(ii) a negative integer;

(iii) an integer smaller than both the integers;

(iv) an integer greater than both the integers;

(v) an integer greater than only one of the integers.

Solution

(i) Consider the integers 5 and 5.

Clearly, $(5-5)=0$.

(ii) Consider the integers 4 and 6. Then,

$(4-6)=4+(-6)=-2$, which is a negative integer.

(iii) Consider the integers (−6) and 4. Then,

$(-6)-4=(-6)+(-4)=-10.$

Thus, we get an integer smaller than both the integers.

(iv) Consider the integers 5 and (−3). Then,

$5-(-3)=(5+3)=8.$

Thus, we get an integer greater than both the integers.

(v) Consider the integers (−5) and (−2). Then,

$(-5)-(-2)=(-5)+2=-3.$

Clearly, $-3>-5$ but −3 is not greater than −2.

EXAMPLE 4. *The sum of two integers is −11. If one of them is 9, find the other.*

Solution Let the other integer be a. Then,

$9+a=-11 \Rightarrow a=(-11)-9=(-11)+(-9)=-20.$

Hence, the other integer is −20.

EXAMPLE 5. *The difference of an integer a and (−5) is −3. Find the value of a.*

Solution We have:

$a-(-5)=-3 \Rightarrow a+5=(-3)$

$\Rightarrow a=(-3)-5=(-3)+(-5)=-8.$

Hence, $a=-8$.

EXERCISE 1A

1. Evaluate:

(i) $15+(-8)$ (ii) $(-16)+9$ (iii) $(-7)+(-23)$

(iv) $(-32)+47$ (v) $53+(-26)$ (vi) $(-48)+(-36)$

2. Find the sum of:

(i) 153 and −302 (ii) 1005 and −277 (iii) −2035 and 297

(iv) −489 and −324 (v) −1000 and 438 (vi) −238 and 500

3. Find the additive inverse of:

(i) −83 (ii) 256 (iii) 0 (iv) −2001

4. Subtract:
   (i) 28 from −42 (ii) −36 from 42 (iii) −37 from −53
   (iv) −66 from −34 (v) 318 from 0 (vi) −153 from −240
   (vii) −64 from 0 (viii) −56 from 144
5. Subtract the sum of −1032 and 878 from −34.
6. Subtract −134 from the sum of 38 and −87.
7. Fill in the blanks:
   (i) $\{(-13)+27\}+(-41)=(-13)+\{27+(\ldots\ldots)\}$
   (ii) $(-26)+\{(-49)+(-83)\}=\{(-26)+(-49)\}+(\ldots\ldots)$
   (iii) $53+(-37)=(-37)+(\ldots\ldots)$
   (iv) $(-68)+(-76)=(\ldots\ldots)+(-68)$
   (v) $(-72)+(\ldots\ldots)=-72$
   (vi) $-(-83)=\ldots\ldots$
   (vii) $(-60)-(\ldots\ldots)=-59$
   (viii) $(-31)+(\ldots\ldots)=-40$
8. Simplify: $\{-13-(-27)\}+\{-25-(-40)\}$.
9. Find $36-(-64)$ and $(-64)-36$. Are they equal?
10. If $a=-8, b=-7, c=6$, verify that $(a+b)+c=a+(b+c)$.
11. If $a=-9$ and $b=-6$, show that $(a-b)\neq(b-a)$.
12. The sum of two integers is −16. If one of them is 53, find the other.
13. The sum of two integers is 65. If one of them is −31, find the other.
14. The difference of an integer a and (−6) is 4. Find the value of a.
15. Write a pair of integers whose sum gives
   (i) zero;
   (ii) a negative integer;
   (iii) an integer smaller than both the integers;
   (iv) an integer greater than both the integers;
   (v) an integer smaller than only one of the integers.

   Hint. *(i) 6 and (−6) (ii) 4 and (−9) (iii) (−3) and (−5) (iv) 4 and 5 (v) 5 and (−3)*
16. For each of the following statements, write (T) for true and (F) for false:
   (i) The smallest integer is zero.
   (ii) −10 is greater than −7.
   (iii) Zero is larger than every negative integer.
   (iv) The sum of two negative integers is a negative integer.
   (v) The sum of a negative integer and a positive integer is always a positive integer.

MULTIPLICATION OF INTEGERS

Rule 1. *To find the product of two integers with unlike signs, we find the product of their values regardless of their signs and give a minus sign to the product.*

EXAMPLE 1. *Find each of the following products:*
(i) $6\times(-5)$ *(ii)* $(-7)\times9$ *(iii)* $35\times(-18)$ *(iv)* $(-42)\times20$

Solution We have:

(i) $6\times(-5)=-30$.

(ii) $(-7)\times 9=-63$.

(iii) $35\times(-18)=-(35\times 18)=-630$.

(iv) $(-42)\times 20=-(42\times 20)=-840$.

Rule 2. *To find the product of two integers with the same sign, we find the product of their values regardless of their signs and give a plus sign to the product.*

EXAMPLE 2. *Find each of the following products:*

(i) 12×16 *(ii)* $(-8)\times(-14)$ *(iii)* $(-25)\times(-19)$ *(iv)* $(-70)\times(-31)$

Solution We have:

(i) $(12\times 16)=192$.

(ii) $(-8)\times(-14)=(8\times 14)=112$.

(iii) $(-25)\times(-19)=(25\times 19)=475$.

(iv) $(-70)\times(-31)=(70\times 31)=2170$.

PROPERTIES OF MULTIPLICATION OF INTEGERS

I. Closure Property for Multiplication: *The product of two integers is always an integer.*

EXAMPLES (i) $7\times 5=35$, which is an integer.

(ii) $(-8)\times 4=-32$, which is an integer.

(iii) $9\times(-6)=-54$, which is an integer.

(iv) $(-8)\times(-7)=56$, which is an integer.

II. Commutative Law for Multiplication: For any two integers a and b, we have:

$$(a\times b)=(b\times a).$$

EXAMPLES (i) $5\times(-8)=-40$ and $(-8)\times 5=-40$.

$\therefore\quad 5\times(-8)=(-8)\times 5$.

(ii) $(-9)\times(-7)=63$ and $(-7)\times(-9)=63$.

$\therefore\quad (-9)\times(-7)=(-7)\times(-9)$.

III. Associative Law for Multiplication: For any integers a, b, c, we have:

$$(a\times b)\times c=a\times(b\times c).$$

EXAMPLES (i) Consider the integers 3, −5 and −8. We have:

$\{3\times(-5)\}\times(-8)=(-15)\times(-8)=120$

and $3\times\{(-5)\times(-8)\}=(3\times 40)=120$.

$\therefore\quad \{3\times(-5)\}\times(-8)=3\times\{(-5)\times(-8)\}$.

(ii) Consider the integers (-8), (-6) and (-5). We have:

$\{(-8)\times(-6)\}\times(-5)=48\times(-5)=-240$

and $(-8)\times\{(-6)\times(-5)\}=(-8)\times 30=-240$.

$\therefore\quad \{(-8)\times(-6)\}\times(-5)=(-8)\times\{(-6)\times(-5)\}$.

IV. Distributive Law of Multiplication over Addition: For any integers a, b, c, we have:

$$a\times(b+c)=(a\times b)+(a\times c).$$

EXAMPLES (i) Consider the integers 5, (-6) and (-8). We have:

$5\times\{(-6)+(-8)\}=5\times(-14)=-70$

and $\{5\times(-6)\}+\{5\times(-8)\}=(-30)+(-40)=-70$.

$\therefore\quad 5\times\{(-6)+(-8)\}=\{5\times(-6)\}+\{5\times(-8)\}$.

(ii) Consider the integers (-5), (-7) and (-9). We have:

$(-5)\times\{(-7)+(-9)\} = (-5)\times(-16) = 80$

and $\{(-5)\times(-7)\}+\{(-5)\times(-9)\} = (35+45) = 80.$

$\therefore \quad (-5)\times\{(-7)+(-9)\} = \{(-5)\times(-7)\}+\{(-5)\times(-9)\}.$

V. Existence of Multiplicative Identity: For every integer a, we have: $(a\times 1) = (1\times a) = a.$

1 is called the *multiplicative identity* for integers.

EXAMPLES (i) $(12\times 1) = 12.$ (ii) $(-16)\times 1 = -16.$

VI. Existence of Multiplicative Inverse: Multiplicative inverse of a nonzero integer a is the number $\frac{1}{a}$, as $a\cdot\left(\frac{1}{a}\right)=\left(\frac{1}{a}\right)\cdot a = 1.$

EXAMPLES (i) Multiplicative inverse of 6 is $\frac{1}{6}$.

(ii) Multiplicative inverse of -6 is $-\frac{1}{6}$.

VII. Property of Zero: For every integer a, we have :

$(a\times 0) = (0\times a) = 0.$

EXAMPLES (i) $8\times 0 = 0\times 8 = 0.$ (ii) $(-6)\times 0 = 0\times(-6) = 0.$

EXAMPLE 3. *Simplify:*

(i) $8\times(-15)+8\times 6$ *(ii)* $(-18)\times 7+(-18)\times(-4)$

(iii) $15\times(-32)+15\times(-18)$ *(iv)* $16\times(-9)+(-8)\times(-9)$

Solution Using the distributive laws, we get:

(i) $8\times(-15)+8\times 6 = 8\times\{(-15)+6\}$ $[\because\ a\times b+a\times c = a\times(b+c)]$

$= 8\times(-9)$

$= -72.$

(ii) $(-18)\times 7+(-18)\times(-4) = (-18)\times\{7+(-4)\}$ $[\because\ a\times b+a\times c = a\times(b+c)]$

$= (-18)\times 3$

$= -54.$

(iii) $15\times(-32)+15\times(-18) = 15\times\{(-32)+(-18)\}$ $[\because\ a\times b+a\times c = a\times(b+c)]$

$= 15\times(-50)$

$= -750.$

(iv) $16\times(-9)+(-8)\times(-9) = \{16+(-8)\}\times(-9)$ $[\because\ a\times c+b\times c = (a+b)\times c]$

$= 8\times(-9)$

$= -72.$

IMPORTANT RESULTS

(i) $(-a_1)\times(-a_2)\times(-a_3)\times\ldots\times(-a_n) = -(a_1\times a_2\times a_3\times\ldots\times a_n)$**, when n is odd.**

(ii) $(-a_1)\times(-a_2)\times(-a_3)\times\ldots(-a_n) = (a_1\times a_2\times a_3\times\ldots\times a_n)$**, when n is even.**

(iii) $(-a)\times(-a)\times(-a)\times\ldots$ **n times** $= -a^n$**, when n is odd.**

(iv) $(-a)\times(-a)\times(-a)\times\ldots$ **n times** $= a^n$**, when n is even.**

(v) $(-1)\times(-1)\times(-1)\times\ldots$ **n times** $= -1$**, when n is odd.**

(vi) $(-1)\times(-1)\times(-1)\times\ldots$ **n times** $= 1$**, when n is even.**

EXAMPLE 4. *Evaluate:*

(i) $(-1)\times(-2)\times(-3)\times(-4)\times(-5)$ *(ii)* $(-3)\times(-5)\times(-2)\times(-4)$

(iii) $(-2)\times(-2)\times(-2)\times\ldots$ *8 times* *(iv)* $(-2)\times(-2)\times(-2)\times\ldots$ *9 times*

(v) $(-1)\times(-1)\times(-1)\times\ldots$ *100 times* *(vi)* $(-1)\times(-1)\times(-1)\times\ldots$ *301 times*

Solution (i) Number of negative integers in the given product is odd.
Therefore, their product is negative.
$\therefore \quad (-1)\times(-2)\times(-3)\times(-4)\times(-5) = -(1\times2\times3\times4\times5) = -120.$

(ii) Number of negative integers in the given product is even.
Therefore, their product is positive.
$\therefore \quad (-3)\times(-5)\times(-2)\times(-4) = (3\times5\times2\times4) = 120.$

(iii) Number of negative integers in the given product is even.
Therefore, their product is positive.
$\therefore \quad (-2)\times(-2)\times(-2)\times\ldots 8 \text{ times} = 2^8 = 256.$

(iv) Number of negative integers in the given product is odd.
Therefore, their product is negative.
$\therefore \quad (-2)\times(-2)\times(-2)\times\ldots 9 \text{ times} = -2^9 = -512.$

(v) Number of negative integers in the given product is even.
Therefore, their product is positive.
$\therefore \quad (-1)\times(-1)\times(-1)\times\ldots 100 \text{ times} = 1.$

(vi) Number of negative integers in the given product is odd.
Therefore, their product is negative.
$\therefore \quad (-1)\times(-1)\times(-1)\times\ldots 301 \text{ times} = -1.$

EXAMPLE 5. *What will be the sign of the product if we multiply together* 199 *negative and* 10 *positive integers?*

Solution Whatever may be the number of positive integers, it will not affect the sign of the product.
Since 199 is odd and the product of odd number of negative integers is negative, so the given product is negative.

EXAMPLE 6. *In a class test containing* 20 *questions,* 4 *marks are given for every correct answer and* (–2) *marks are given for every incorrect answer. Ranjita attempts all questions and* 12 *of her answers are correct. What is her total score?*

Solution Marks given for 1 correct answer = 4.
Marks given for 12 correct answers = $(4\times12) = 48$.
Marks given for 1 incorrect answer = –2.
Marks given for (20 – 12), i.e., 8 incorrect answers = $(-2)\times8 = -16$.
Ranjita's total score = $48 + (-16) = 32$.

EXAMPLE 7. *A shopkeeper gains* ₹ 1 *on each pen and loses* 40 *paise on each pencil. He sells* 45 *pens and some pencils losing* ₹ 5 *in all. How many pencils does he sell?*

Solution Suppose he sells x pencils.
Total gain on pens = ₹ 45.
Total loss on pencils = $₹\,\frac{40x}{100} = ₹\,\frac{2x}{5}$.

$$\therefore \quad 45 - \frac{2x}{5} = -5 \quad \Rightarrow \quad \frac{2x}{5} = (45+5)$$

$$\Rightarrow \quad \frac{2x}{5} = 50 \quad \Rightarrow \quad x = \frac{(50\times5)}{2} = 125.$$

Hence, the number of pencils sold is 125.

EXAMPLE 8. *A certain freezing process requires that room temperature be lowered from 40°C at the rate of 5°C per hour. What will be the room temperature 12 hours after the process begins?*

Solution Temperature after n hours $= (40 - 5n)°C$.

$\therefore$ temperature after 12 hours $= (40 - 5 \times 12)°C$

$= (40 - 60)°C = -20°C$.

Hence, the room temperature after 12 hours would be $-20°C$.

EXERCISE 1B

1. Multiply:

(i) 16 by 9 (ii) 18 by -6 (iii) 36 by -11 (iv) -28 by 14

(v) -53 by 18 (vi) -35 by 0 (vii) 0 by -23 (viii) -16 by -12

(ix) -105 by -8 (x) -36 by -50 (xi) -28 by -1 (xii) 25 by -11

2. Find each of the following products:

(i) $3 \times 4 \times (-5)$ (ii) $2 \times (-5) \times (-6)$ (iii) $(-5) \times (-8) \times (-3)$

(iv) $(-6) \times 6 \times (-10)$ (v) $7 \times (-8) \times 3$ (vi) $(-7) \times (-3) \times 4$

3. Find each of the following products:

(i) $(-4) \times (-5) \times (-8) \times (-10)$ (ii) $(-6) \times (-5) \times (-7) \times (-2) \times (-3)$

(iii) $(-60) \times (-10) \times (-5) \times (-1)$ (iv) $(-30) \times (-20) \times (-5)$

(v) $(-3) \times (-3) \times (-3) \times \ldots$ 6 times (vi) $(-5) \times (-5) \times (-5) \times \ldots$ 5 times

(vii) $(-1) \times (-1) \times (-1) \times \ldots$ 200 times (viii) $(-1) \times (-1) \times (-1) \times \ldots$ 171 times

4. What will be the sign of the product, if we multiply 90 negative integers and 9 positive integers?

5. What will be the sign of the product, if we multiply 103 negative integers and 65 positive integers?

6. Simplify:

(i) $(-8) \times 9 + (-8) \times 7$ (ii) $9 \times (-13) + 9 \times (-7)$

(iii) $20 \times (-16) + 20 \times 14$ (iv) $(-16) \times (-15) + (-16) \times (-5)$

(v) $(-11) \times (-15) + (-11) \times (-25)$ (vi) $10 \times (-12) + 5 \times (-12)$

(vii) $(-16) \times (-8) + (-4) \times (-8)$ (viii) $(-26) \times 72 + (-26) \times 28$

7. Fill in the blanks:

(i) $(-6) \times (\ldots\ldots) = 6$ (ii) $(-18) \times (\ldots\ldots) = (-18)$

(iii) $(-8) \times (-9) = (-9) \times (\ldots\ldots)$ (iv) $7 \times (-3) = (-3) \times (\ldots\ldots)$

(v) $\{(-5) \times 3\} \times (-6) = (\ldots\ldots) \times \{3 \times (-6)\}$ (vi) $(-5) \times (\ldots\ldots) = 0$

8. In a class test containing 10 questions, 5 marks are awarded for every correct answer and (-2) marks are awarded for every incorrect answer and 0 for each question not attempted.

(i) Ravi gets 4 correct and 6 incorrect answers. What is his score?

(ii) Reenu gets 5 correct and 5 incorrect answers. What is her score?

(iii) Heena gets 2 correct and 5 incorrect answers. What is her score?

9. Which of the following statements are true and which are false?

(i) The product of a positive and a negative integer is negative.

(ii) The product of two negative integers is a negative integer.

(iii) The product of three negative integers is a negative integer.

(iv) Every integer when multiplied with -1 gives its multiplicative inverse.

(v) Multiplication on integers is commutative.
(vi) Multiplication on integers is associative.
(vii) Every nonzero integer has a multiplicative inverse as an integer.

DIVISION OF INTEGERS

We know that division is an inverse process of multiplication.

Rule 1. *For dividing one integer by the other, the two having unlike signs, we divide their values regardless of their signs and give a minus sign to the quotient.*

EXAMPLE 1. *Evaluate:*
(i) $(-48) \div 12$ *(ii)* $144 \div (-16)$ *(iii)* $(-69) \div 23$

Solution We have:

(i) $(-48) \div 12 = \dfrac{-48}{12} = -4.$

(ii) $144 \div (-16) = \dfrac{144}{(-16)} = -9.$

(iii) $(-69) \div 23 = \dfrac{(-69)}{23} = -3.$

Rule 2. *For dividing one integer by the other having like signs, we divide their values regardless of their signs and give a plus sign to the quotient.*

EXAMPLE 2. *Ealuate:*
(i) $98 \div 14$ *(ii)* $(-48) \div (-16)$ *(iii)* $(-90) \div (-15)$

Solution We have:

(i) $98 \div 14 = \dfrac{98}{14} = 7.$

(ii) $(-48) \div (-16) = \dfrac{-48}{-16} = 3.$

(iii) $(-90) \div (-15) = \dfrac{-90}{-15} = 6.$

EXAMPLE 3. *Evaluate:*
(i) $(-133) \div 19$ *(ii)* $168 \div (-14)$ *(iii)* $(-336) \div (-21)$

Solution We have:

(i) $(-133) \div 19 = \dfrac{-133}{19} = -7.$

(ii) $168 \div (-14) = \dfrac{168}{-14} = -12.$

(iii) $(-336) \div (-21) = \dfrac{-336}{-21} = 16.$

EXAMPLE 4. *Fill in the blanks:*
(i) $(-37) \div (\ldots\ldots) = 1$ *(ii)* $(\ldots\ldots) \div 36 = -2$
(iii) $(\ldots\ldots) \div 69 = 0$ *(iv)* $(\ldots\ldots) \div (-18) = -5$

Solution (i) Clearly, $(-37) \div (-37) = 1$.
Hence, the required number is (-37).

(ii) Let the required number be x. Then,

$$x \div 36 = -2 \Rightarrow \frac{x}{36} = -2$$
$$\Rightarrow x = 36 \times (-2) = -72.$$

Hence, the required number is -72.

(iii) When 0 is divided by any nonzero number, then the quotient is 0 (see IV below).
$\therefore \quad 0 \div 69 = 0.$

(iv) Let the required number be x. Then,

$$x \div (-18) = -5 \Rightarrow \frac{x}{-18} = -5$$
$$\Rightarrow x = (-18) \times (-5) = 90.$$

Hence, the required number is 90.

Modulus of An Integer

The modulus of an integer a, denoted by $|a|$ is defined as

$$|a| = \begin{cases} a, \text{ if } a \text{ is positive or zero.} \\ -a, \text{ if } a \text{ is negative.} \end{cases}$$

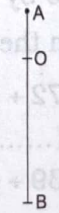
Thus, $|6| = 6$ and $|-6| = -(-6) = 6$.

Distance between the Two Points

Let A and B be two points at distances a and b respectively from the origin. Then, we define $AB = |a - b|$.

EXAMPLE 5. *An elevator descends into a mine shaft at the rate of* 6 m/min. *If the descent starts from* 20 m *above the ground level, how long will it take to reach* -370 m *?*

Solution Let the point O denote the ground level.



Then, $OA = 20$ m and $OB = -370$ m.

$\therefore \quad AB = |OA - OB| = |20 - (-370)| = |20 + 370| = 390$ m.

$\therefore$ distance covered $= 390$ m.

Rate of descent $= 6$ m/min.

$$\text{Time taken} = \frac{390}{6} \text{ min} = 65 \text{ min} = 1 \text{ hr } 5 \text{ min}.$$

PROPERTIES OF DIVISION OF INTEGERS

I. *If a and b are integers then $(a \div b)$ is not necessarily an integer.*

EXAMPLES (i) 16 and 5 are both integers, but $(16 \div 5)$ is not an integer.
(ii) (-9) and 4 are both integers, but $\{(-9) \div 4\}$ is not an integer.

II. *If a is an integer and $a \neq 0$, then $a \div a = 1$.*

EXAMPLES (i) $16 \div 16 = 1$. (ii) $(-8) \div (-8) = 1$.

III. *If a is an integer, then $(a \div 1) = a$.*

EXAMPLES (i) $7 \div 1 = 7$. (ii) $(-6) \div 1 = (-6)$.

IV. *If a is an integer and $a \neq 0$, then $(0 \div a) = 0$ but $(a \div 0)$ is not meaningful.*

EXAMPLES (i) $0 \div 6 = 0$. (ii) $0 \div (-4) = 0$. (iii) $6 \div 0$ is meaningless.

V. *If a, b, c are integers, then $(a \div b) \div c \neq a \div (b \div c)$, unless $c = 1$.*

Thus, division on integers is not associative.

EXAMPLE Let $a = -8$, $b = 4$ and $c = -2$. Then,

$(a \div b) \div c = \{(-8) \div 4\} \div (-2) = (-2) \div (-2) = 1.$

$a \div (b \div c) = (-8) \div \{4 \div (-2)\} = (-8) \div (-2) = 4.$

$\therefore \quad (a \div b) \div c \neq a \div (b \div c).$

However, if $a = -8$, $b = 4$ and $c = 1$, then

$(a \div b) \div c = \{(-8) \div 4)\} \div 1 = (-2) \div 1 = (-2).$

$a \div (b \div c) = (-8) \div \{4 \div 1\} = (-8) \div 4 = (-2).$

So, in this case, $(a \div b) \div c = a \div (b \div c)$.

VI. *If a, b, c are nonzero integers and $a > b$, then*

(i) $(a \div c) > (b \div c)$, if c is positive.

(ii) $(a \div c) < (b \div c)$, if c is negative.

EXAMPLES (i) $27 > 18$ and 9 is positive.

$$\therefore \quad \frac{27}{9} > \frac{18}{9}.$$

(ii) $27 > 18$ and (-9) is negative.

$$\therefore \quad \frac{27}{-9} < \frac{18}{-9}.$$

EXERCISE 1C

1. Divide:

(i) 65 by −13 (ii) −84 by 12 (iii) −76 by 19 (iv) −132 by 12

(v) −150 by 25 (vi) −72 by −18 (vii) −105 by −21 (viii) −36 by −1

(ix) 0 by −31 (x) −63 by 63 (xi) −23 by −23 (xii) −8 by 1

2. Fill in the blanks:

(i) $72 \div (\ldots\ldots) = -4$ (ii) $-36 \div (\ldots\ldots) = -4$ (iii) $(\ldots\ldots) \div (-4) = 24$

(iv) $(\ldots\ldots) \div 25 = 0$ (v) $(\ldots\ldots) \div (-1) = 36$ (vi) $(\ldots\ldots) \div 1 = -37$

(vii) $39 \div (\ldots\ldots) = -1$ (viii) $1 \div (\ldots\ldots) = -1$ (ix) $-1 \div (\ldots\ldots) = -1$

3. Write (T) for true and (F) for false for each of the following statements:

(i) $0 \div (-4) = 0$ (ii) $(-6) \div 0 = 0$ (iii) $(-5) \div (-1) = -5$

(iv) $(-8) \div 1 = -8$ (v) $(-1) \div (-1) = -1$ (vi) $(-9) \div (-1) = 9$

EXERCISE 1D

OBJECTIVE QUESTIONS

Mark (✓) against the correct answer in each of the following:

1. $6 - (-8) = ?$

(a) −2 (b) 2 (c) 14 (d) none of these

2. $-9 - (-6) = ?$

(a) −15 (b) −3 (c) 3 (d) none of these

3. By how much does 2 exceed –3?

(a) –1 (b) 1 (c) –5 (d) 5

Hint. *Required number* = 2 – (–3).

4. What must be subtracted from –1 to get –6?

(a) 5 (b) –5 (c) 7 (d) –7

Hint. $-1-x=-6 \Rightarrow x=-1+6$.

5. How much less than –2 is –6?

(a) 4 (b) –4 (c) 8 (d) –8

Hint. *Required number* = (–2) – (–6).

6. On subtracting 4 from –4, we get

(a) 8 (b) –8 (c) 0 (d) none of these

7. By how much does –3 exceed –5?

(a) –2 (b) 2 (c) 8 (d) –8

Hint. *Required number* = (–3) – (–5) = –3 + 5.

8. What must be subtracted from –3 to get –9?

(a) –6 (b) 12 (c) 6 (d) –12

9. On subtracting 6 from –5, we get

(a) 1 (b) 11 (c) –11 (d) none of these

10. On subtracting –13 from –8, we get

(a) –21 (b) 21 (c) 5 (d) –5

11. $(-36) \div (-9) = ?$

(a) 4 (b) –4 (c) none of these

12. $0 \div (-5) = ?$

(a) –5 (b) 0 (c) not defined

13. $(-8) \div 0 = ?$

(a) –8 (b) 0 (c) not defined

14. Which of the following is a true statement?

(a) $-11 > -8$ (b) $-11 < -8$ (c) –11 and –8 cannot be compared

15. The sum of two integers is 6. If one of them is –3, then the other is

(a) –9 (b) 9 (c) 3 (d) –3

16. The sum of two integers is –4. If one of them is 6, then the other is

(a) –10 (b) 10 (c) 2 (d) –2

17. The sum of two integers is 14. If one of them is –8, then the other is

(a) 22 (b) –22 (c) 6 (d) –6

18. The additive inverse of –6 is

(a) $\frac{1}{6}$ (b) $-\frac{1}{6}$ (c) 6 (d) 5

19. $(-15)\times 8+(-15)\times 2 = ?$

(a) 150 (b) −150 (c) 90 (d) −90

20. $(-12)\times 6-(-12)\times 4 = ?$

(a) 24 (b) −24 (c) 120 (d) −120

21. $(-27)\times(-16)+(-27)\times(-14) = ?$

(a) −810 (b) 810 (c) −54 (d) 54

22. $30\times(-23)+30\times 14 = ?$

(a) −270 (b) 270 (c) 1110 (d) −1110

23. The sum of two integers is 93. If one of them is −59, the other one is

(a) 34 (b) −34 (c) 152 (d) −152

24. $(?)\div(-18) = -5$

(a) −90 (b) 90 (c) none of these

Things to Remember

1. *The numbers ..., −4, −3, −2, −1, 0, 1, 2, 3, 4, ..., are integers.*
2. *0 is an integer which is neither positive nor negative.*
3. *0 is less than every positive integer and greater than every negative integer.*
4. *If x and y are integers such that $x > y$ then $-x < -y$.*
   For example: $17 > 13$ *and* $-17 < -13$.
5. *The absolute value of an integer is its numerical value regardless of its sign.*
   Thus, $|-7| = 7$ *and* $|7| = 7$. *Also,* $|0| = 0$.
6. *To add two integers with like signs, we add their numerical values and give the sign of the addends to the sum.*
   Thus, $(-8)+(-7) = -15$ *and* $8+7 = 15$.
7. *To add two integers with unlike signs, we take the difference of their numerical values and give the sign of the integer having the greater absolute value to the difference.*
   Thus, $(-17)+9 = -8$ *and* $17+(-8) = 9$.
8. *For two integers a and b, we define $a-b = a+(-b)$.*
9. *To subtract an integer b from an integer a, we change the sign of b and add it to a.*
10. *All properties of operations on whole numbers are satisfied by these operations on integers.*
11. *If a and b are two integers then $(a-b)$ is also an integer.*
12. *$-a$ and a are negatives, or additive inverses of each other.*
13. *To find the product of two integers with like signs (i.e., both positives or both negatives), we multiply their numerical values and give a plus sign to the product.*
14. *To find the product of two integers with unlike signs (i.e., one positive and one negative), we multiply their numerical values and give a minus sign to the product.*
15. *The quotient of two negative or two positive integers is always positive.*
16. *The quotient of one positive and one negative integer is always negative.*

TEST PAPER-1

A. 1. The sum of two integers is -12. If one of them is 43, find the other.

2. The difference of an integer p and -8 is 3. Find the value of p.

3. Add the product of (-16) and (-9) to the quotient of (-132) by 6.

4. By what number should (-240) be divided to obtain 16?

5. What should be divided by (-7) to obtain 12?

6. Evaluate:

(i) $(-6)\times(-15)\times(-5)$ (ii) $(-8)\times(-5)\times 9$

(iii) $9\times(-12)\times 10$ (iv) $(-75)\times 8$

(v) $(-5)\times(-5)\times(-5)$ ..... taken 5 times (vi) $(-1)\times(-1)\times(-1)\times$ ..... taken 25 times

7. Evaluate:

(i) $(-16)\times 12+(-16)\times 8$ (ii) $25\times(-33)+25\times(-17)$

(iii) $(-19)\times(-25)+(-19)\times(-15)$ (iv) $(-47)\times 68-(-47)\times 38$

(v) $(-105)\div 21$ (vi) $(-168)\div(-14)$

(vii) $0\div(-34)$ (viii) $37\div 0$

B. ***Mark (✓) against the correct answer in each of the following:***

8. The sum of two integers is -6. If one of them is 2, then the other is

(a) -4 (b) 4 (c) 8 (d) -8

9. What must be subtracted from -7 to obtain -15?

(a) -8 (b) 8 (c) -22 (d) 22

10. $(?)\div(-18)=-6$

(a) -108 (b) 108 (c) 3 (d) none of these

11. $(-37)\times(-7)+(-37)\times(-3)=?$

(a) 370 (b) -370 (c) 148 (d) -148

12. $(-25)\times 8+(-25)\times 2=?$

(a) 250 (b) 150 (c) -250 (d) -150

13. $(-9)-(-6)=?$

(a) -15 (b) -3 (c) 3 (d) 15

14. How much less than -2 is -8?

(a) 6 (b) -6 (c) 10 (d) -10

C. 15. ***Fill in the blanks.***

(i) $(-35)\times\ldots=35$ (ii) $(-53)\times(\ldots)=-53$

(iii) $(-14)\times(\ldots)=(-16)\times(-14)$ (iv) $(-21)\times(\ldots)=0$

(v) $(-119)\div 17=(\ldots)$ (vi) $(-247)\div(\ldots)=13$

(vii) $(\ldots)\div 31=0$ (viii) $(\ldots)\div(-19)=-8$

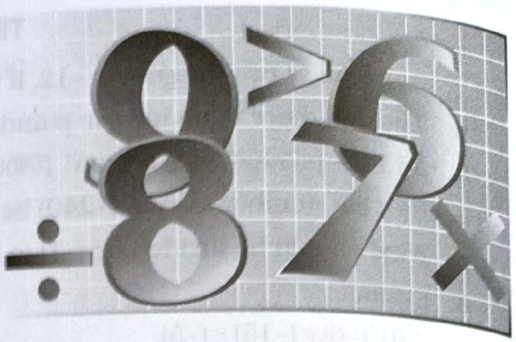
D. 16. ***Write 'T' for true and 'F' for false for each of the following:***

(i) $0\div(-16)=0$ (ii) $(-8)\div 0=0$

(iii) $(-1)\div(-1)=-1$ (iv) $(-36)\div(-1)=36$

(v) $(-52)\div 13=-4$ (vi) $68\div(-17)=4$

2 Fractions



In class VI, we read about fractions, addition and subtraction of fractions, etc. We shall review these concepts in this chapter and take up multiplication and division of fractions.

Fractions *The numbers of the form* $\frac{a}{b}$, *where a and b are natural numbers, are known as fractions.*

In $\frac{a}{b}$, we call a as *numerator* and b as *denominator.*

EXAMPLES (i) $\frac{3}{5}$ is a fraction in which numerator = 3 and denominator = 5.

(ii) $\frac{17}{6}$ is a fraction in which numerator = 17 and denominator = 6.

(iii) $\frac{8}{1}$ is a fraction in which numerator = 8 and denominator = 1.

VARIOUS TYPES OF FRACTIONS

(i) Decimal fraction: *A fraction whose denominator is any of the numbers* 10, 100, 1000, *etc., is called a decimal fraction.*

EXAMPLES Each of the fractions $\frac{3}{10}, \frac{27}{100}, \frac{31}{1000}$, etc., is a decimal fraction.

(ii) Vulgar fraction: *A fraction whose denominator is a whole number, other than* 10,100, 1000, *etc., is called a vulgar fraction.*

EXAMPLES $\frac{2}{9}, \frac{4}{13}, \frac{13}{20}, \frac{27}{109}$, etc., are all vulgar fractions.

(iii) Proper fraction: *A fraction whose numerator is less than its denominator, is called a proper fraction.*

EXAMPLES $\frac{3}{7}, \frac{5}{11}, \frac{23}{40}, \frac{73}{100}$, etc., are all proper fractions.

(iv) Improper fraction: *A fraction whose numerator is more than or equal to its denominator, is called an improper fraction.*

EXAMPLES $\frac{11}{7}, \frac{25}{12}, \frac{41}{36}, \frac{53}{53}$, etc., are all improper fractions.

(v) Mixed fraction: *A number which can be expressed as the sum of a natural number and a proper fraction, is called a mixed fraction.*

EXAMPLES $1\frac{3}{4}, 4\frac{5}{7}, 7\frac{9}{13}, 12\frac{6}{25}$, etc., are all mixed fractions.

EXAMPLE 1. *Convert each of the following into an improper fraction:*

(i) $1\frac{3}{4}$ *(ii)* $4\frac{5}{7}$ *(iii)* $7\frac{9}{13}$ *(iv)* $12\frac{6}{25}$

Solution We have:

(i) $1\frac{3}{4} = \frac{1\times4+3}{4} = \frac{7}{4}$.

(ii) $4\frac{5}{7} = \frac{4\times7+5}{4} = \frac{33}{7}$.

(iii) $7\frac{9}{13} = \frac{7\times13+9}{13} = \frac{100}{13}$.

(iv) $12\frac{6}{25} = \frac{12\times25+6}{25} = \frac{306}{25}$.

EXAMPLE 2. *Convert each of the following into a mixed fraction:*

(i) $\frac{38}{7}$ *(ii)* $\frac{47}{15}$ *(iii)* $\frac{189}{16}$

Solution (i) On dividing 38 by 7, we get quotient = 5 and remainder = 3.

$\therefore \frac{38}{7} = 5\frac{3}{7}$.

```
7)38(5
  -35
   3
```

(ii) On dividing 47 by 15, we get quotient = 3 and remainder = 2.

$\therefore \frac{47}{15} = 3\frac{2}{15}$.

```
15)47(3
  -45
   2
```

(iii) On dividing 189 by 16, we get quotient = 11 and remainder = 13.

$\therefore \frac{189}{16} = 11\frac{13}{16}$.

```
16)189(11
  -16
   29
  -16
   13
```

An Important Property If the numerator and the denominator of a fraction are both multiplied by the same nonzero number, then its value is not changed.

Thus, $\frac{3}{4} = \frac{3\times2}{4\times2} = \frac{3\times3}{4\times3} = \frac{3\times4}{4\times4}$, etc.

(vi) Equivalent fractions: *A given fraction and the fraction obtained by multiplying (or dividing) its numerator and denominator by the same nonzero number, are called equivalent fractions.*

Thus, $\frac{3}{4}, \frac{6}{8}, \frac{9}{12}, \frac{12}{16}$, etc., are all equivalent fractions.

(vii) Like fractions: *Fractions having the same denominator but different numerators are called like fractions.*

EXAMPLES $\frac{5}{14}, \frac{9}{14}, \frac{11}{14}$, etc., are like fractions.

(viii) Unlike fractions: *Fractions having different denominators are called unlike fractions.*

EXAMPLES $\frac{2}{5}, \frac{5}{7}, \frac{9}{13}$, etc., are unlike fractions.

METHOD OF CHANGING UNLIKE FRACTIONS TO LIKE FRACTIONS

Step 1. *Find the LCM of the denominators of all the given fractions.*

Step 2. *Change each of the given fractions into an equivalent fraction having denominator equal to the LCM of the denominators of the given fractions.*

EXAMPLE 3. *Convert the fractions* $\frac{5}{6}, \frac{7}{9}, \frac{11}{12}$ *into like fractions.*

Solution LCM of 6, 9, 12 = $(3\times2\times3\times2) = 36$.

Now, $\frac{5}{6} = \frac{5\times6}{6\times6} = \frac{30}{36}$; $\frac{7}{9} = \frac{7\times4}{9\times4} = \frac{28}{36}$ and $\frac{11}{12} = \frac{11\times3}{12\times3} = \frac{33}{36}$.

Clearly, $\frac{30}{36}, \frac{28}{36}, \frac{33}{36}$ are like fractions.

3	6—9—12
2	2—3—4
	1—3—2

(ix) Irreducible fractions: *A fraction* $\frac{a}{b}$ *is said to be irreducible or in lowest terms, if HCF of* a *and* b *is* 1.

If HCF of a *and* b *is other than* 1 *then* $\frac{a}{b}$ *is said to be reducible.*

EXAMPLE 4. *Convert* $\frac{84}{98}$ *into irreducible form.*

Solution First we find the HCF of 84 and 98.

Clearly, HCF of 84 and 98 is 14.

So, we divide the numerator and denominator of the given fraction by 14.

$\therefore \quad \frac{84}{98} = \frac{84\div14}{98\div14} = \frac{6}{7}$.

Hence, $\frac{84}{98}$ in irreducible form is $\frac{6}{7}$.

```
84)98(1
  -84
  14)84(6
     -84
      ×
```

COMPARING FRACTIONS

Let $\frac{a}{b}$ and $\frac{c}{d}$ be two given fractions. Then,

(i) $\frac{a}{b} > \frac{c}{d} \Leftrightarrow ad > bc$ (ii) $\frac{a}{b} = \frac{c}{d} \Leftrightarrow ad = bc$ (iii) $\frac{a}{b} < \frac{c}{d} \Leftrightarrow ad < bc$.

EXAMPLE 5. *Compare the fractions:* (i) $\frac{3}{5}, \frac{5}{8}$ (ii) $\frac{9}{16}, \frac{13}{24}$.

Solution (i) By cross multiplication, we have:

$3\times8 = 24$ and $5\times5 = 25$.

But, $24 < 25$.

$\therefore \quad \frac{3}{5} < \frac{5}{8}$.

3 → 5, 5 → 8

(ii) By cross multiplication, we have:

$9\times24 = 216$ and $16\times13 = 208$.

But, $216 > 208$

$\therefore \quad \frac{9}{16} > \frac{13}{24}$.

9 → 13, 16 → 24

METHOD OF COMPARING MORE THAN TWO FRACTIONS

Step 1. *Find the LCM of the denominators of the given fractions. Let it be m.*

Step 2. *Convert all the given fractions into like fractions, each having m as denominator.*

Step 3. *Now, if we compare any two of these like fractions, then the one having larger numerator is larger.*

EXAMPLE 6. *Arrange the fractions* $\frac{2}{5}, \frac{3}{10}, \frac{9}{14}, \frac{16}{35}$ *in ascending order.*

Solution The given fractions are $\frac{2}{5}, \frac{3}{10}, \frac{9}{14}, \frac{16}{35}$.

LCM of 5, 10, 14, 35 = $(5 \times 2 \times 7) = 70$.

Now, let us change each of the given fractions into an equivalent fraction having 70 as its denominator.

5	5—10—14—35
2	1—2—14—7
7	1—1—7—7
	1—1—1—1

Now, $\frac{2}{5} = \frac{2\times14}{5\times14} = \frac{28}{70}$; $\frac{3}{10} = \frac{3\times7}{10\times7} = \frac{21}{70}$; $\frac{9}{14} = \frac{9\times5}{14\times5} = \frac{45}{70}$

and $\frac{16}{35} = \frac{16\times2}{35\times2} = \frac{32}{70}$.

Clearly, $\frac{21}{70} < \frac{28}{70} < \frac{32}{70} < \frac{45}{70}$.

Hence, $\frac{3}{10} < \frac{2}{5} < \frac{16}{35} < \frac{9}{14}$.

Hence, the given fractions in ascending order are $\frac{3}{10}, \frac{2}{5}, \frac{16}{35}, \frac{9}{14}$.

ADDITION AND SUBTRACTION OF FRACTIONS

ADDITION OF FRACTIONS

Rule 1. *For adding two like fractions, the numerators are added and the denominator remains the same.*

EXAMPLES (i) $\frac{2}{9} + \frac{5}{9} = \frac{2+5}{9} = \frac{7}{9}$. (ii) $\frac{8}{15} + \frac{6}{15} = \frac{8+6}{15} = \frac{14}{15}$.

Rule 2. *For addition of two unlike fractions, first change them to like fractions and then add them as given in Rule 1.*

EXAMPLE 7. *Add:* $\frac{3}{10} + \frac{8}{15}$.

Solution LCM of 10 and 15 = $(5 \times 2 \times 3) = 30$.

5	10—15
	2—3

$\therefore \quad \frac{3}{10} = \frac{3\times3}{10\times3} = \frac{9}{30}$ and $\frac{8}{15} = \frac{8\times2}{15\times2} = \frac{16}{30}$.

$\therefore \quad \frac{3}{10} + \frac{8}{15} = \frac{9}{30} + \frac{16}{30} = \frac{9+16}{30} = \frac{25^{5}}{30_{6}} = \frac{5}{6}$.

Short Cut Method:

$$\frac{3}{10} + \frac{8}{15} = \frac{9+16}{30} = \frac{25^{5}}{30_{6}} = \frac{5}{6}. \qquad \begin{bmatrix} 30 \div 10 = 3 \text{ and } 3\times3 = 9 \\ 30 \div 15 = 2 \text{ and } 2\times8 = 16 \end{bmatrix}$$

EXAMPLE 8. *Find the sum:* $\frac{13}{14}+\frac{27}{35}$.

Solution LCM of 14, 35 = $(7\times2\times5)=70$.

$$\frac{13}{14}+\frac{27}{35}=\frac{65+54}{70}$$

$$=\frac{119}{70}=\frac{17}{10}=1\frac{7}{10}.$$

$[70+14=5 \text{ and } 5\times13=65]$
$[70+35=2 \text{ and } 2\times27=54]$

7	14—35
	2—5

Properties of Addition of Fractions:

(i) *Addition of fractions is associative, i.e.,* $\left(\frac{a}{b}+\frac{c}{d}\right)+\frac{e}{f}=\frac{a}{b}+\left(\frac{c}{d}+\frac{e}{f}\right)$.

(ii) *Addition of fractions is commutative, i.e.,* $\left(\frac{a}{b}+\frac{c}{d}\right)=\left(\frac{c}{d}+\frac{a}{b}\right)$.

SUBTRACTION OF FRACTIONS

The subtraction of fractions can be performed in a manner similar to that of addition.

EXAMPLE 9. *Find the difference:*

(i) $\frac{7}{9}-\frac{5}{9}$ (ii) $\frac{13}{16}-\frac{7}{12}$ (iii) $\frac{11}{15}-\frac{9}{20}$

Solution We have:

(i) $\frac{7}{9}-\frac{5}{9}=\frac{(7-5)}{9}=\frac{2}{9}$.

(ii) LCM of 16 and 12 = $(4\times4\times3)=48$.

$$\therefore \quad \frac{13}{16}-\frac{7}{12}=\frac{(39-28)}{48}=\frac{11}{48}.$$

$[48\div16=3 \text{ and } 3\times13=39]$
$[48\div12=4 \text{ and } 4\times7=28]$

4	16—12
	4—3

(iii) LCM of 15 and 20 = $(5\times3\times4)=60$.

$$\therefore \quad \frac{11}{15}-\frac{9}{20}=\frac{(44-27)}{60}=\frac{17}{60}.$$

$[60\div15=4 \text{ and } 4\times11=44]$
$[60\div20=3 \text{ and } 3\times9=27]$

5	15—20
	3—4

EXAMPLE 10. *Simplify:* $\frac{5}{9}-\frac{7}{12}+\frac{1}{2}$.

Solution LCM of 9, 12, 2 = $(2\times3\times3\times2)=36$.

$$\therefore \quad \frac{5}{9}-\frac{7}{12}+\frac{1}{2}=\frac{(20-21+18)}{36}$$

$$=\frac{(38-21)}{36}=\frac{17}{36}.$$

$[36\div9=4 \text{ and } 4\times5=20]$
$[36\div12=3 \text{ and } 3\times7=21]$
$[36\div2=18 \text{ and } 18\times1=18]$

2	9—12—2
3	9—6—1
	3—2—1

EXAMPLE 11. *Simplify:* $3\frac{1}{5}+2\frac{1}{10}-1\frac{1}{2}-\frac{1}{4}$.

Solution We have:

$$3\frac{1}{5}+2\frac{1}{10}-1\frac{1}{2}-\frac{1}{4}=\frac{16}{5}+\frac{21}{10}-\frac{3}{2}-\frac{1}{4}$$

$$=\frac{(64+42-30-5)}{20} \quad [\because \text{ LCM of } 5, 10, 2, 4 = 2\times5\times2]$$

$$=\frac{(106-35)}{20}=\frac{71}{20}=3\frac{11}{20}.$$

2	5—10—2—4
5	5—5—1—2
	1—1—1—2

EXAMPLE 12. *Sarita bought* $5\frac{3}{4}$ kg *potatoes and* $3\frac{1}{2}$ kg *tomatoes from a vendor. What is the total weight of vegetables bought by her?*

Solution Total weight of vegetables bought by Sarita

$$= \left(\frac{23}{4} + \frac{7}{2}\right)\text{kg} = \frac{(23+14)}{4}\text{ kg}$$

$$= \frac{37}{4}\text{ kg} = 9\frac{1}{4}\text{ kg.}$$

EXAMPLE 13. *Rohit ate* $\frac{4}{7}$ *part of an apple and his sister Ritu ate the remaining part of it? Who ate more and by how much?*

Solution Part of apple eaten by Rohit $= \frac{4}{7}$.

Remaining part of apple $= \left(1 - \frac{4}{7}\right) = \frac{(7-4)}{7} = \frac{3}{7}$.

$\therefore$ part of apple eaten by Ritu $= \frac{3}{7}$.

Clearly, $\frac{4}{7} > \frac{3}{7}$.

So, Rohit ate more.

Difference of their parts $= \left(\frac{4}{7} - \frac{3}{7}\right) = \frac{(4-3)}{7} = \frac{1}{7}$.

EXAMPLE 14. *What should be added to* $15\frac{2}{3}$ *to get* $18\frac{5}{6}$*?*

Solution Required number to be added $= \left(18\frac{5}{6} - 15\frac{2}{3}\right) = \left(\frac{113}{6} - \frac{47}{3}\right)$

$$= \frac{(113-94)}{6} = \frac{19}{6} = 3\frac{1}{6}.$$

EXAMPLE 15. *What should be subtracted from* $17\frac{3}{4}$ *to get* $11\frac{2}{3}$*?*

Solution Required number to be subtracted $= \left(17\frac{3}{4} - 11\frac{2}{3}\right) = \left(\frac{71}{4} - \frac{35}{3}\right)$

$$= \frac{(213-140)}{12} = \frac{73}{12} = 6\frac{1}{12}.$$

EXERCISE 2A

1. Compare the fractions:

   (i) $\frac{5}{8}$ and $\frac{7}{12}$ (ii) $\frac{5}{9}$ and $\frac{11}{15}$ (iii) $\frac{11}{12}$ and $\frac{15}{16}$

2. Arrange the following fractions in ascending order:

   (i) $\frac{3}{4}, \frac{5}{6}, \frac{7}{9}, \frac{11}{12}$ (ii) $\frac{4}{5}, \frac{7}{10}, \frac{11}{15}, \frac{17}{20}$

3. Arrange the following fractions in descending order:
   (i) $\frac{3}{4}, \frac{7}{8}, \frac{7}{12}, \frac{17}{24}$ (ii) $\frac{2}{3}, \frac{3}{5}, \frac{7}{10}, \frac{8}{15}$

4. Reenu got $\frac{2}{7}$ part of an apple while Sonal got $\frac{4}{5}$ part of it. Who got the larger part and by how much?

5. Find the sum:
   (i) $\frac{5}{9}+\frac{3}{9}$ (ii) $\frac{8}{9}+\frac{7}{12}$ (iii) $\frac{5}{6}+\frac{7}{8}$
   (iv) $\frac{7}{12}+\frac{11}{16}+\frac{9}{24}$ (v) $3\frac{4}{5}+2\frac{3}{10}+1\frac{1}{15}$ (vi) $8\frac{3}{4}+10\frac{2}{5}$

6. Find the difference:
   (i) $\frac{5}{7}-\frac{2}{7}$ (ii) $\frac{5}{6}-\frac{3}{4}$ (iii) $3\frac{1}{5}-\frac{7}{10}$
   (iv) $7-4\frac{2}{3}$ (v) $3\frac{3}{10}-1\frac{7}{15}$ (vi) $2\frac{5}{9}-1\frac{7}{15}$

7. Simplify:
   (i) $\frac{2}{3}+\frac{5}{6}-\frac{1}{9}$ (ii) $8-4\frac{1}{2}-2\frac{1}{4}$ (iii) $8\frac{5}{6}-3\frac{3}{8}+1\frac{7}{12}$

8. Aneeta bought $3\frac{3}{4}$ kg apples and $4\frac{1}{2}$ kg guava. What is the total weight of fruits purchased by her?

9. A rectangular sheet of paper is $15\frac{3}{4}$ cm long and $12\frac{1}{2}$ cm wide. Find its perimeter.

10. A picture is $7\frac{3}{5}$ cm wide. How much should it be trimmed to fit in a frame $7\frac{3}{10}$ cm wide?

11. What should be added to $7\frac{3}{5}$ to get 18?

12. What should be added to $7\frac{4}{15}$ to get $8\frac{2}{5}$?

13. A piece of wire $3\frac{3}{4}$ m long broke into two pieces. One piece is $1\frac{1}{2}$ m long. How long is the other piece?

14. A film show lasted for $3\frac{2}{3}$ hours. Out of this time $1\frac{1}{2}$ hours was spent on advertisements. What was the actual duration of the film?

15. Of $\frac{2}{3}$ and $\frac{5}{9}$, which is greater and by how much?

16. The cost of a pen is ₹$16\frac{3}{5}$ and that of a pencil is ₹$4\frac{3}{4}$. Which costs more and by how much?

MULTIPLICATION OF FRACTIONS

Rule: $\text{Product of Fractions} = \frac{\text{Product of their Numerators}}{\text{Product of their Denominators}}$.

Thus, $\left(\frac{a}{b}\times\frac{c}{d}\right)=\frac{(a\times c)}{(b\times d)}$.

EXAMPLE 1. Find the product:

(i) $\frac{5}{8}\times\frac{3}{4}$ (ii) $\frac{3}{4}\times\frac{5}{2}$ (iii) $\frac{9}{16}\times\frac{8}{15}$ (iv) $\frac{5}{12}\times 9$

Solution We have:

(i) $\frac{5}{8}\times\frac{3}{4}=\frac{5\times3}{8\times4}=\frac{15}{32}$.

(ii) $\frac{3}{4}\times\frac{5}{2}=\frac{3\times5}{4\times2}=\frac{15}{8}=1\frac{7}{8}$.

(iii) $\frac{9}{16}\times\frac{8}{15}=\frac{\cancel{9}^{3}\times\cancel{8}^{1}}{\cancel{16}_{2}\times\cancel{15}_{5}}=\frac{3}{10}$.

(iv) $\frac{5}{12}\times9=\frac{5}{12}\times\frac{9}{1}=\frac{5\times\cancel{9}^{3}}{\cancel{12}_{4}\times1}=\frac{15}{4}=3\frac{3}{4}$.

EXAMPLE 2. *Multiply:*

(i) $7\frac{5}{9}$ *by* $\frac{3}{2}$ *(ii)* $9\frac{3}{8}$ *by* 12 *(iii)* $6\frac{11}{14}$ *by* $3\frac{1}{2}$

Solution We have:

(i) $7\frac{5}{9}\times\frac{3}{2}=\frac{68}{9}\times\frac{3}{2}=\frac{\cancel{68}^{34}\times3^{1}}{\cancel{9}_{3}\times\cancel{2}_{1}}=\frac{34}{3}=11\frac{1}{3}$.

(ii) $9\frac{3}{8}\times12=\frac{75}{\cancel{8}_{2}}\times\frac{\cancel{12}^{3}}{1}=\frac{225}{2}=112\frac{1}{2}$.

(iii) $6\frac{11}{14}\times3\frac{1}{2}=\frac{95}{14}\times\frac{7}{2}=\frac{95\times7^{1}}{\cancel{14}_{2}\times2}=\frac{95}{4}=23\frac{3}{4}$.

EXAMPLE 3. *Simplify:* $\frac{14}{25}\times\frac{35}{51}\times\frac{34}{49}$.

Solution We have:

$$\frac{14}{25}\times\frac{35}{51}\times\frac{34}{49}=\frac{\cancel{14}^{2}\times\cancel{35}^{5}\times\cancel{34}^{2}}{\cancel{25}_{5}\times\cancel{51}_{3}\times\cancel{49}_{7}}=\frac{4}{15}.$$

EXAMPLE 4. *Simplify:* $3\frac{4}{7}\times2\frac{2}{5}\times1\frac{3}{4}$.

Solution We have:

$$3\frac{4}{7}\times2\frac{2}{5}\times1\frac{3}{4}=\frac{25}{7}\times\frac{12}{5}\times\frac{7}{4}=\frac{\cancel{25}^{5}\times\cancel{12}^{3}\times\cancel{7}^{1}}{\cancel{7}_{1}\times\cancel{5}_{1}\times\cancel{4}_{1}}=15.$$

Use of 'OF'

We define: $\frac{a}{b}$ of $c=\left(c\times\frac{a}{b}\right)$.

EXAMPLE 5. *Find:*

(i) $\frac{2}{5}$ *of* 40 *(ii)* $\frac{5}{9}$ *of* 48 *(iii)* $\frac{11}{14}$ *of* 63

Solution We have:

(i) $\frac{2}{5}$ of $40=\frac{2}{5}$ of $\frac{40}{1}=\frac{40}{1}\times\frac{2}{5}=\frac{\cancel{40}^{8}\times2}{1\times\cancel{5}_{1}}=16$.

(ii) $\frac{5}{9}$ of $48=\frac{5}{9}$ of $\frac{48}{1}=\frac{48}{1}\times\frac{5}{9}=\frac{\cancel{48}^{16}\times5}{1\times\cancel{9}_{3}}=\frac{80}{3}=26\frac{2}{3}$.

(iii) $\frac{11}{14}$ of $63=\frac{11}{14}$ of $\frac{63}{1}=\frac{63}{1}\times\frac{11}{14}=\frac{\cancel{63}^{9}\times11}{1\times\cancel{14}_{2}}=\frac{99}{2}=49\frac{1}{2}$.

EXAMPLE 6. *Find:*

(i) $\frac{1}{5}$ *of a rupee* *(ii)* $\frac{2}{3}$ *of an year* *(iii)* $\frac{5}{8}$ *of a day*

(iv) $\frac{7}{8}$ *of a kilogram* *(v)* $\frac{11}{25}$ *of a litre* *(vi)* $\frac{4}{5}$ *of an hour*

Solution We have:

(i) $\frac{1}{5}$ of a rupee $= \frac{1}{5}$ of 100 paise $= \left(100 \times \frac{1}{5}\right)$ paise

$= \left(\frac{100}{1} \times \frac{1}{5}\right)$ paise $= \left(\frac{\cancel{100}^{20} \times 1}{1 \times \cancel{5}_{1}}\right)$ paise $= 20$ paise.

(ii) $\frac{2}{3}$ of an year $= \frac{2}{3}$ of 12 months $= \left(12 \times \frac{2}{3}\right)$ months

$= \left(\frac{12}{1} \times \frac{2}{3}\right)$ months $= \frac{(\cancel{12}^{4} \times 2)}{(1 \times \cancel{3}_{1})}$ months $= 8$ months.

(iii) $\frac{5}{8}$ of a day $= \frac{5}{8}$ of 24 hours $= \left(24 \times \frac{5}{8}\right)$ hours

$= \left(\frac{24}{1} \times \frac{5}{8}\right)$ hours $= \left(\frac{\cancel{24}^{3} \times 5}{1 \times \cancel{8}_{1}}\right)$ hours $= 15$ hours.

(iv) $\frac{7}{8}$ of a kilogram $= \frac{7}{8}$ of 1000 g $= \left(1000 \times \frac{7}{8}\right)$ g

$= \left(\frac{1000}{1} \times \frac{7}{8}\right)$ g $= \left(\frac{\cancel{1000}^{125} \times 7}{1 \times \cancel{8}_{1}}\right)$ g $= 875$ g.

(v) $\frac{11}{25}$ of a litre $= \frac{11}{25}$ of 1000 mL $= \left(1000 \times \frac{11}{25}\right)$ mL

$= \left(\frac{1000}{1} \times \frac{11}{25}\right)$ mL $= \left(\frac{\cancel{1000}^{40} \times 11}{1 \times \cancel{25}_{1}}\right)$ mL $= 440$ mL.

(vi) $\frac{4}{5}$ of an hour $= \frac{4}{5}$ of 60 min $= \left(60 \times \frac{4}{5}\right)$ min

$= \left(\frac{60}{1} \times \frac{4}{5}\right)$ min $= \left(\frac{\cancel{60}^{12} \times 4}{1 \times \cancel{5}_{1}}\right)$ min $= 48$ min.

EXAMPLE 7. *Milk is sold at* ₹ $16\frac{3}{4}$ *per litre. Find the cost of* $6\frac{2}{5}$ *litres of milk.*

Solution Cost of 1 litre of milk $= ₹\, 16\frac{3}{4} = ₹\, \frac{67}{4}$.

Cost of $6\frac{2}{5}$ litres of milk $= ₹\left(\frac{67}{4} \times \frac{32}{5}\right)$

$= ₹\left(\frac{67 \times \cancel{32}^{8}}{\cancel{4}_{1} \times 5}\right) = ₹\left(\frac{536}{5}\right) = ₹\, 107\frac{1}{5}$.

Hence, the cost of $6\frac{2}{5}$ litres of milk is ₹ $107\frac{1}{5}$.

EXAMPLE 8. *Sajal can walk* $2\frac{2}{5}$ km *in an hour. How much distance will he cover in* $3\frac{1}{3}$ *hours?*

Solution Distance covered by Sajal in 1 hour $= 2\frac{2}{5}$ km $= \frac{12}{5}$ km.

Distance covered by Sajal in $3\frac{1}{3}$ hours $= \left(\frac{12}{5} \times \frac{10}{3}\right)$ km

$= \left(\frac{\cancel{12}^{4} \times \cancel{10}^{2}}{\cancel{5}_{1} \times \cancel{3}_{1}}\right)$ km $= 8$ km.

Hence, the distance covered by Sajal in 1 hour is 8 km.

EXAMPLE 9. *A carton contains* 16 *boxes of nails and each box weighs* $4\frac{3}{4}$ kg. How much would a carton of nails weigh?

Solution Weight of 1 box $= 4\frac{3}{4}$ kg $= \frac{19}{4}$ kg.

Weight of 16 boxes $= \left(\frac{19}{4} \times 16\right)$ kg $= \left(\frac{19}{4} \times \frac{16}{1}\right)$ kg

$= \left(\frac{19 \times \cancel{16}^{4}}{\cancel{4}_{1} \times 1}\right)$ kg $= 76$ kg.

Hence, the weight of a carton is 76 kg.

EXAMPLE 10. *A book consists of* 216 *pages. During last week Vikas read* $\frac{3}{4}$ *of the book. How many pages did he read?*

Solution Total number of pages in the book $= 216$.

Number of pages read $= \left(\frac{3}{4} \text{ of } 216\right) = \left(216 \times \frac{3}{4}\right)$

$= \left(\frac{216}{1} \times \frac{3}{4}\right) = \left(\frac{\cancel{216}^{54} \times 3}{1 \times \cancel{4}_{1}}\right) = 162.$

Hence, Vikas read 162 pages during last week.

EXAMPLE 11. *A tin contains* 18 kg *ghee. After consuming* $\frac{2}{3}$ *of it, how much ghee is left in the tin?*

Solution Total quantity of ghee in the tin $= 18$ kg.

Quantity of ghee consumed $= \frac{2}{3}$ of 18 kg $= \left(18 \times \frac{2}{3}\right)$ kg

$= \left(\frac{18}{1} \times \frac{2}{3}\right)$ kg $= \left(\frac{\cancel{18}^{6} \times 2}{1 \times \cancel{3}_{1}}\right)$ kg $= 12$ kg.

Quantity of ghee left in the tin $= (18 - 12)$ kg $= 6$ kg.

EXAMPLE 12. *Renu spends* $\frac{4}{5}$ *of her income on household expenses. Her monthly income is* ₹ 30000. *How much does she save every month?*

Solution Total monthly income = ₹ 30000.

Monthly expenditure $= \frac{4}{5}$ of ₹ 30000

$= ₹\left(30000 \times \frac{4}{5}\right) = ₹\left(\frac{30000}{1} \times \frac{4}{5}\right)$

$= ₹\left(\frac{\overset{6000}{\cancel{30000}} \times 4}{1 \times \cancel{5}_1}\right) = ₹24000.$

Monthly savings = ₹ (30000 – 24000) = ₹ 6000.

EXERCISE 2B

1. Find the product:

(i) $\frac{3}{5} \times \frac{7}{11}$ (ii) $\frac{5}{8} \times \frac{4}{7}$ (iii) $\frac{4}{9} \times \frac{15}{16}$

(iv) $\frac{2}{5} \times 15$ (v) $\frac{8}{15} \times 20$ (vi) $\frac{5}{8} \times 1000$

(vii) $3\frac{1}{8} \times 16$ (viii) $2\frac{4}{15} \times 12$ (ix) $3\frac{6}{7} \times 4\frac{2}{3}$

(x) $9\frac{1}{2} \times 1\frac{9}{19}$ (xi) $4\frac{1}{8} \times 2\frac{10}{11}$ (xii) $5\frac{5}{6} \times 1\frac{5}{7}$

2. Simplify:

(i) $\frac{2}{3} \times \frac{5}{44} \times \frac{33}{35}$ (ii) $\frac{12}{25} \times \frac{15}{28} \times \frac{35}{36}$ (iii) $\frac{10}{27} \times \frac{28}{65} \times \frac{39}{56}$

(iv) $1\frac{4}{7} \times 1\frac{13}{22} \times 1\frac{1}{15}$ (v) $2\frac{2}{17} \times 7\frac{2}{9} \times 1\frac{33}{52}$ (vi) $3\frac{1}{16} \times 7\frac{3}{7} \times 1\frac{25}{39}$

3. Find:

(i) $\frac{1}{3}$ of 24 (ii) $\frac{3}{4}$ of 32 (iii) $\frac{5}{9}$ of 45

(iv) $\frac{7}{50}$ of 1000 (v) $\frac{3}{20}$ of 1020 (vi) $\frac{5}{11}$ of ₹ 220

(vii) $\frac{4}{9}$ of 54 metres (viii) $\frac{6}{7}$ of 35 litres (ix) $\frac{1}{6}$ of an hour

(x) $\frac{5}{6}$ of an year (xi) $\frac{7}{20}$ of a kg (xii) $\frac{9}{20}$ of a metre

(xiii) $\frac{7}{8}$ of a day (xiv) $\frac{3}{7}$ of a week (xv) $\frac{7}{50}$ of a litre

4. Apples are sold at ₹ $48\frac{4}{5}$ per kg. What is the cost of $3\frac{3}{4}$ kg of apples?

5. Cloth is being sold at ₹ $42\frac{1}{2}$ per metre. What is the cost of $5\frac{3}{5}$ metres of this cloth?

6. A car covers a certain distance at a uniform speed of $66\frac{2}{3}$ km per hour. How much distance will it cover in 9 hours?

7. One tin holds $12\frac{3}{4}$ litres of oil. How many litres of oil can 26 such tins hold?

8. For a particular show in a circus, each ticket costs ₹ $35\frac{1}{2}$. If 308 tickets are sold for the show, how much amount has been collected?

9. Nine boards are stacked on the top of each other. The thickness of each board is $3\frac{2}{3}$ cm. How high is the stack?

10. Rohit takes $4\frac{4}{5}$ minutes to make a complete round of a circular park. How much time will he take to make 15 rounds?

11. Amit weighs 35 kg. His sister Kavita's weight is $\frac{3}{5}$ of Amit's weight. How much does Kavita weigh?

12. There are 42 students in a class and $\frac{5}{7}$ of the students are boys. How many girls are there in the class?

13. Sapna earns ₹ 24000 per month. She spends $\frac{7}{8}$ of her income and deposits rest of the money in a bank. How much money does she deposit in the bank each month?

14. Each side of a square field is $4\frac{2}{3}$ m. Find its area.

15. Find the area of a rectangular park which is $41\frac{2}{3}$ m long and $18\frac{3}{5}$ m broad.

DIVISION OF FRACTIONS

RECIPROCAL OF A FRACTION

Two fractions are said to be the reciprocal of each other, if their product is 1.

For example, $\frac{4}{9}$ and $\frac{9}{4}$ are the reciprocals of each other, since $\left(\frac{4}{9}\times\frac{9}{4}\right)=1$.

In general, if $\frac{a}{b}$ is a fraction, then its reciprocal is $\frac{b}{a}$.

Resiprocal of 0 does not exist.

EXAMPLE 1. *Write down the reciprocal of:*

(i) $\frac{3}{7}$ *(ii)* $\frac{1}{5}$ *(iii)* 6 *(iv)* $3\frac{5}{8}$

Solution We have:

(i) Reciprocal of $\frac{3}{7}$ is $\frac{7}{3}$. $\left[\because \frac{3}{7}\times\frac{7}{3}=1\right]$

(ii) Reciprocal of $\frac{1}{5}$ is $\frac{5}{1}=5$. $\left[\because \frac{1}{5}\times 5=1\right]$

(iii) Reciprocal of 6 is $\frac{1}{6}$. $\left[\because 6\times\frac{1}{6}=1\right]$

(iv) Reciprocal of $3\frac{5}{8}$ = reciprocal of $\frac{29}{8}=\frac{8}{29}$. $\left[\because \frac{29}{8}\times\frac{8}{29}=1\right]$

DIVISION OF FRACTIONS

Rule *To divide a fraction by another fraction, the first fraction is multiplied by the reciprocal of the second.*

Thus, $\left(\frac{a}{b}\div\frac{c}{d}\right)=\left(\frac{a}{b}\times\frac{d}{c}\right)$.

EXAMPLE 2. *Simplify:*

(i) $\frac{4}{9}\div\frac{5}{6}$ *(ii)* $\frac{5}{7}\div 10$ *(iii)* $5\frac{3}{5}\div 2\frac{1}{10}$

Solution We have:

(i) $\frac{4}{9} \div \frac{5}{6} = \frac{4}{9} \times \frac{6}{5}$ $\left[\because \text{ the reciprocal of } \frac{5}{6} \text{ is } \frac{6}{5}\right]$

$= \frac{4 \times \cancel{6}^{2}}{\cancel{9}_{3} \times 5} = \frac{8}{15}$.

(ii) $\frac{5}{7} \div 10 = \frac{5}{7} \div \frac{10}{1}$

$= \frac{5}{7} \times \frac{1}{10}$ $\left[\because \text{ the reciprocal of } \frac{10}{1} \text{ is } \frac{1}{10}\right]$

$= \frac{\cancel{5}^{1} \times 1}{7 \times \cancel{10}_{2}} = \frac{1}{14}$.

(iii) $5\frac{3}{5} \div 2\frac{1}{10} = \frac{28}{5} \div \frac{21}{10}$

$= \frac{28}{5} \times \frac{10}{21}$ $\left[\because \text{ the reciprocal of } \frac{21}{10} \text{ is } \frac{10}{21}\right]$

$= \frac{\cancel{28}^{4} \times \cancel{10}^{2}}{\cancel{5}_{1} \times \cancel{21}_{3}} = \frac{8}{3} = 2\frac{2}{3}$.

EXAMPLE 3. *Divide:*

(i) $\frac{5}{9}$ *by* $\frac{2}{3}$ *(ii)* $5\frac{4}{7}$ *by* $\frac{13}{14}$ *(iii)* $4\frac{2}{7}$ *by* $2\frac{2}{5}$

Solution We have:

(i) $\frac{5}{9} \div \frac{2}{3} = \frac{5}{9} \times \frac{3}{2}$ $\left[\because \text{ reciprocal of } \frac{2}{3} \text{ is } \frac{3}{2}\right]$

$= \frac{5 \times \cancel{3}^{1}}{\cancel{9}_{3} \times 2} = \frac{5}{6}$.

(ii) $5\frac{4}{7} \div \frac{13}{14} = \frac{39}{7} \div \frac{13}{14}$

$= \frac{39}{7} \times \frac{14}{13}$ $\left[\because \text{ reciprocal of } \frac{13}{14} \text{ is } \frac{14}{13}\right]$

$= \frac{\cancel{39}^{3} \times \cancel{14}^{2}}{\cancel{7}_{1} \times \cancel{13}_{1}} = \frac{6}{1} = 6$.

(iii) $4\frac{2}{7} \div 2\frac{2}{5} = \frac{30}{7} \div \frac{12}{5}$

$= \frac{30}{7} \times \frac{5}{12}$ $\left[\because \text{ reciprocal of } \frac{12}{5} \text{ is } \frac{5}{12}\right]$

$= \frac{\cancel{30}^{5} \times 5}{7 \times \cancel{12}_{2}} = \frac{25}{14} = 1\frac{11}{14}$.

EXAMPLE 4. *Divide:*

(i) 28 *by* $\frac{7}{4}$ *(ii)* 36 *by* $6\frac{2}{3}$

Solution We have:

(i) $28 \div \frac{7}{4} = \frac{28}{1} \div \frac{7}{4} = \frac{28}{1} \times \frac{4}{7}$ $\left[\because \text{ reciprocal of } \frac{7}{4} \text{ is } \frac{4}{7}\right]$

$= \frac{\cancel{28}^{4} \times 4}{1 \times \cancel{7}_{1}} = \frac{16}{1} = 16$.

(ii) $36 \div 6\frac{2}{3} = \frac{36}{1} \div \frac{20}{3}$

$= \frac{36}{1} \times \frac{3}{20}$ $\left[\because \text{ reciprocal of } \frac{20}{3} \text{ is } \frac{3}{20}\right]$

$= \frac{\cancel{36}^{9} \times 3}{1 \times \cancel{20}_{5}} = \frac{27}{5} = 5\frac{2}{5}.$

EXAMPLE 5. *A rope of length* $9\frac{3}{4}$ m *is cut into 6 pieces of equal length. Find the length of each piece.*

Solution Length of the rope $= 9\frac{3}{4}$ m $= \frac{39}{4}$ m.

Number of equal pieces = 6.

Length of each piece $= \left(\frac{39}{4} \div 6\right)$ m $= \left(\frac{39}{4} \div \frac{6}{1}\right)$ m

$= \left(\frac{39}{4} \times \frac{1}{6}\right)$ m $\left[\because \text{ reciprocal of 6 is } \frac{1}{6}\right]$

$= \frac{\cancel{39}^{13} \times 1}{4 \times \cancel{6}_{2}}$ m $= \frac{13}{8}$ m $= 1\frac{5}{8}$ m.

Hence, the length of each piece is $1\frac{5}{8}$ m.

EXAMPLE 6. *If the cost of* $5\frac{2}{5}$ *litres of milk is* ₹ $236\frac{1}{4}$, *find its cost per litre.*

Solution Cost of $\frac{27}{5}$ litres of milk = ₹ $\frac{945}{4}$

$\Rightarrow$ cost of 1 litre of milk $= ₹\left(\frac{945}{4} \div \frac{27}{5}\right)$

$= ₹\left(\frac{\cancel{945}^{35}}{4} \times \frac{5}{\cancel{27}_{1}}\right)$ $\left[\because \text{ reciprocal of } \frac{27}{5} \text{ is } \frac{5}{27}\right]$

$= ₹\frac{175}{4} = ₹\, 43\frac{3}{4}.$

Hence, the cost of milk per litre is ₹ $43\frac{3}{4}$.

EXAMPLE 7. *The cost of* $5\frac{1}{4}$ kg *of mangoes is* ₹ 231. *At what rate per* kg *are the mangoes being sold?*

Solution Cost of $\frac{21}{4}$ kg of mangoes = ₹ 231

$\Rightarrow$ cost of 1 kg of mangoes $= ₹\left(231 \div \frac{21}{4}\right)$

$= ₹\left(\cancel{231}^{11} \times \frac{4}{\cancel{21}_{1}}\right)$ $\left[\because \text{ reciprocal of } \frac{21}{4} \text{ is } \frac{4}{21}\right]$

$= ₹\, 44.$

Hence, the mangoes are being sold at ₹ 44 per kg.

EXAMPLE 8. *The product of two numbers is* $15\frac{5}{6}$. *If one of the numbers is* $6\frac{2}{3}$, *find the other.*

Solution Product of two numbers $= 15\frac{5}{6} = \frac{95}{6}$.

One of the numbers $= 6\frac{2}{3} = \frac{20}{3}$.

The other number $= \frac{95}{6} \div \frac{20}{3}$

$= \left(\frac{95}{6} \times \frac{3}{20}\right)$ $\left[\because \text{ reciprocal of } \frac{20}{3} \text{ is } \frac{3}{20}\right]$

$= \frac{95^{19} \times 3^{1}}{6_{2} \times 20_{4}} = \frac{19}{8} = 2\frac{3}{8}$.

Hence, the other number is $2\frac{3}{8}$.

EXAMPLE 9. *By what number should* $6\frac{2}{9}$ *be multiplied to get* 40?

Solution Product of two numbers = 40.

One of the numbers $= 6\frac{2}{9} = \frac{56}{9}$.

The other number $= \left(40 \div \frac{56}{9}\right) = \left(\frac{40}{1} \div \frac{56}{9}\right)$

$= \left(\frac{40}{1} \times \frac{9}{56}\right) = \frac{40^{5} \times 9}{1 \times 56_{7}} = \frac{45}{7} = 6\frac{3}{7}$.

Hence, the other number is $6\frac{3}{7}$.

EXERCISE 2C

1. Write down the reciprocal of:

(i) $\frac{5}{8}$ (ii) 7 (iii) $\frac{1}{12}$ (iv) $12\frac{3}{5}$

2. Simplify:

(i) $\frac{4}{7} \div \frac{9}{14}$ (ii) $\frac{7}{10} \div \frac{3}{5}$ (iii) $\frac{8}{9} \div 16$

(iv) $9 \div \frac{1}{3}$ (v) $24 \div \frac{6}{7}$ (vi) $3\frac{3}{5} \div \frac{4}{5}$

(vii) $3\frac{3}{7} \div \frac{8}{21}$ (viii) $5\frac{4}{7} \div 1\frac{3}{10}$ (ix) $15\frac{3}{7} \div 1\frac{23}{49}$

3. Divide:

(i) $\frac{11}{24}$ by $\frac{7}{8}$ (ii) $6\frac{7}{8}$ by $\frac{11}{16}$ (iii) $5\frac{5}{9}$ by $3\frac{1}{3}$

(iv) 32 by $1\frac{3}{5}$ (v) 45 by $1\frac{4}{5}$ (vi) 63 by $2\frac{1}{4}$

4. A rope of length $13\frac{1}{2}$ m has been divided into 9 pieces of the same length. What is the length of each piece?

5. 18 boxes of nails weigh equally and their total weight is $49\frac{1}{2}$ kg. How much does each box weigh?

6. By selling oranges at the rate of ₹ $6\frac{3}{4}$ per orange, a man gets ₹ 378. How many oranges does he sell?
7. Mangoes are sold at ₹ $43\frac{1}{2}$ per kg. What is the weight of mangoes available for ₹ $326\frac{1}{4}$?
8. Vikas can cover a distance of $20\frac{2}{3}$ km in $7\frac{3}{4}$ hours on foot. How many km per hour does he walk?
9. Preeti bought $8\frac{1}{2}$ kg of sugar for ₹ $242\frac{1}{4}$. Find the price of sugar per kg.
10. If the cost of a notebook is ₹ $27\frac{3}{4}$, how many notebooks can be purchased for ₹ $249\frac{3}{4}$?
11. At a charity show the price of each ticket was ₹ $32\frac{1}{2}$. The total amount collected by a boy was ₹ $877\frac{1}{2}$. How many tickets were sold by him?
12. A group of students arranged a picnic. Each student contributed ₹ $261\frac{1}{2}$. The total contribution was ₹ $2876\frac{1}{2}$. How many students are there in the group?
13. 24 litres of milk was distributed equally among all the students of a hostel. If each student got $\frac{2}{5}$ litre of milk, how many students are there in the hostel?
14. A bucket contains $20\frac{1}{4}$ litres of water. A small jug has a capacity of $\frac{3}{4}$ litre. How many times the jug has to be filled with water from the bucket to get it emptied?
15. The product of two numbers is $15\frac{5}{6}$. If one of the numbers is $6\frac{1}{3}$, find the other.
16. By what number should $9\frac{4}{5}$ be multiplied to get 42?
17. By what number should $6\frac{2}{9}$ be divided to obtain $4\frac{2}{3}$?

EXERCISE 2D

OBJECTIVE QUESTIONS

Mark (✓) against the correct answer in each of the following:

1. Which of the following is a vulgar fraction?
   (a) $\frac{3}{10}$ (b) $\frac{13}{10}$ (c) $\frac{10}{3}$ (d) none of these
2. Which of the following is an improper fraction?
   (a) $\frac{7}{10}$ (b) $\frac{7}{9}$ (c) $\frac{9}{7}$ (d) none of these
3. Which of the following is a reducible fraction?
   (a) $\frac{105}{112}$ (b) $\frac{104}{121}$ (c) $\frac{77}{72}$ (d) $\frac{46}{63}$

4. $\frac{2}{3}, \frac{4}{6}, \frac{6}{9}, \frac{8}{12}$ are

(a) like fractions (b) irreducible fractions
(c) equivalent fractions (d) none of these

5. Which of the following statements is true?

(a) $\frac{9}{16} = \frac{13}{24}$ (b) $\frac{9}{16} < \frac{13}{24}$ (c) $\frac{9}{16} > \frac{13}{24}$ (d) none of these

6. Reciprocal of $1\frac{3}{4}$ is

(a) $1\frac{4}{3}$ (b) $4\frac{1}{3}$ (c) $3\frac{1}{4}$ (d) none of these

7. $\left(\frac{3}{10} + \frac{8}{15}\right) = ?$

(a) $\frac{11}{10}$ (b) $\frac{11}{15}$ (c) $\frac{5}{6}$ (d) none of these

8. $\left(3\frac{1}{4} - 2\frac{1}{3}\right) = ?$

(a) $1\frac{1}{12}$ (b) $\frac{1}{12}$ (c) $1\frac{1}{11}$ (d) $\frac{11}{12}$

9. $36 \div \frac{1}{4} = ?$

(a) 9 (b) $\frac{1}{9}$ (c) $\frac{1}{144}$ (d) 144

10. By what number should $2\frac{3}{5}$ be multiplied to get $1\frac{6}{7}$?

(a) $1\frac{5}{7}$ (b) $\frac{5}{7}$ (c) $1\frac{1}{7}$ (d) $\frac{1}{7}$

11. By what number should $1\frac{1}{2}$ be divided to get $\frac{2}{3}$?

(a) $2\frac{2}{3}$ (b) $1\frac{2}{3}$ (c) $\frac{4}{9}$ (d) $2\frac{1}{4}$

12. $1\frac{3}{5} \div \frac{2}{3} = ?$

(a) $1\frac{1}{15}$ (b) $1\frac{9}{10}$ (c) $2\frac{2}{5}$ (d) none of these

13. $2\frac{1}{5} \div 1\frac{1}{5} = ?$

(a) 1 (b) 2 (c) $1\frac{1}{5}$ (d) $1\frac{5}{6}$

14. The reciprocal of $1\frac{2}{3}$ is

(a) $3\frac{1}{2}$ (b) $2\frac{1}{3}$ (c) $1\frac{1}{3}$ (d) $\frac{3}{5}$

15. Which one of the following is the correct statement?

(a) $\frac{2}{3} < \frac{3}{5} < \frac{14}{15}$ (b) $\frac{3}{5} < \frac{2}{3} < \frac{14}{15}$ (c) $\frac{14}{15} < \frac{3}{5} < \frac{2}{3}$ (d) none of these

16. A car runs 16 km using 1 litre of petrol. How much distance will it cover in $2\frac{3}{4}$ litres of petrol?

(a) 24 km (b) 36 km (c) 44 km (d) $32\frac{3}{4}$ km

17. Lalit reads a book for $1\frac{3}{4}$ hours every day and reads the entire book in 6 days. How many hours does he take to read the entire book?

(a) $10\frac{1}{2}$ hours (b) $9\frac{1}{2}$ hours (c) $7\frac{1}{2}$ hours (d) $11\frac{1}{2}$ hours

Things to Remember

1. *The numbers of the form* $\frac{a}{b}$, *where a and b are natural numbers, are called fractions.*
2. *In* $\frac{a}{b}$, *we call a as numerator and b as denominator.*
3. *To get a fraction equivalent to a given fraction, we multiply (or divide) its numerator and denominator by the same nonzero number.*
4. *Fractions having same denominator are called like fractions. Otherwise, they are called unlike fractions.*
5. *In order to convert some given fractions into like fractions, we convert each one of them into an equivalent fraction having a denominator equal to the LCM of all the denominators of the given fractions.*
6. *A fraction whose numerator is less than its denominator is called a proper fraction. Otherwise, it is called an improper fraction.*
7. *A mixed fraction = A whole number + A fraction.*
8. *Let* $\frac{a}{b}$ *and* $\frac{c}{d}$ *be two given fractions.*
   Cross multiply them as $a \times c$, $b \times d$.
   (i) *If* $ad > bc$, *then* $\frac{a}{b} > \frac{c}{d}$.
   (ii) *If* $ad < bc$, *then* $\frac{a}{b} < \frac{c}{d}$.
   (iii) *If* $ad = bc$, *then* $\frac{a}{b} = \frac{c}{d}$.
9. *Sum of like fractions* $= \frac{\text{sum of their numerators}}{\text{common denominator}}$.
10. *For adding unlike fractions, change them into equivalent like fractions and then add.*
11. *Difference of like fractions* $= \frac{\text{difference of their numerators}}{\text{common denominator}}$.
12. *For subtracting unlike fractions, change them into equivalent like fractions and then subtract.*
13. $\left(\frac{a}{b} \times \frac{c}{d}\right) = \frac{(a \times c)}{(b \times d)}$.
14. *Reciprocal of a nonzero fraction* $\frac{a}{b}$ *is* $\frac{b}{a}$.
15. $\left(\frac{a}{b} \div \frac{c}{d}\right) = \left(\frac{a}{b} \times \frac{d}{c}\right)$.

TEST PAPER-2

A. 1. Define: (i) Fractions (ii) Vulgar fractions (iii) Improper fractions
Give two examples of each.

2. What should be added to $6\frac{3}{5}$ to get 15?

3. Simplify: $9\frac{5}{6}-4\frac{3}{8}+2\frac{7}{12}$.

4. Find: (i) $\frac{12}{25}$ of a litre (ii) $\frac{5}{8}$ of a kilogram (iii) $\frac{3}{5}$ of an hour

5. Milk is sold at ₹ $37\frac{3}{4}$ per litre. Find the cost of $6\frac{2}{5}$ litres of milk.

6. The cost of $5\frac{1}{4}$ kg of mangoes is ₹ 189. At what rate per kg are the mangoes being sold?

7. Simplify: (i) $1\frac{3}{4}\times 2\frac{2}{5}\times 3\frac{4}{7}$ (ii) $5\frac{5}{9}\div 3\frac{1}{3}$

8. By what number should $6\frac{2}{9}$ be divided to obtain $4\frac{2}{3}$?

9. Each side of a square is $5\frac{2}{3}$ m long. Find its area.

B. ***Mark (✓) against the correct answer in each of the following:***

10. Which of the following is a vulgar fraction?
(a) $\frac{7}{10}$ (b) $\frac{19}{100}$ (c) $3\frac{3}{10}$ (d) $\frac{5}{8}$

11. Which of the following is an irreducible fraction?
(a) $\frac{105}{112}$ (b) $\frac{66}{77}$ (c) $\frac{46}{63}$ (d) $\frac{51}{85}$

12. Reciprocal of $1\frac{3}{5}$ is
(a) $1\frac{5}{3}$ (b) $5\frac{1}{3}$ (c) $3\frac{1}{5}$ (d) none of these

13. $1\frac{3}{5}\div\frac{2}{3}=?$
(a) $1\frac{9}{10}$ (b) $1\frac{1}{15}$ (c) $2\frac{2}{5}$ (d) none of these

14. Which of the following is correct?
(a) $\frac{2}{3}<\frac{3}{5}<\frac{11}{15}$ (b) $\frac{3}{5}<\frac{2}{3}<\frac{11}{15}$
(c) $\frac{11}{15}<\frac{3}{5}<\frac{2}{3}$ (d) $\frac{3}{5}<\frac{11}{15}<\frac{2}{3}$

15. By what number should $1\frac{3}{4}$ be divided to get $2\frac{1}{2}$?
(a) $\frac{3}{7}$ (b) $1\frac{2}{5}$ (c) $\frac{7}{10}$ (d) $1\frac{3}{7}$

16. A car runs 9 km using 1 litre of petrol. How much distance will it cover in $3\frac{2}{3}$ litres of petrol?

(a) 36 km (b) 33 km (c) $2\frac{5}{11}$ km (d) 22 km

C. 17. *Fill in the blanks.*

(i) Reciprocal of $8\frac{2}{5}$ is ..... .

(ii) $13\frac{1}{2} \div 8 =$ .....

(iii) $69\frac{3}{4} \div 7\frac{3}{4} =$ .....

(iv) $41\frac{2}{3} \times 18\frac{3}{5} =$.....

(v) $\frac{84}{98}$ (in irreducible form) = ...

D. 18. *Write 'T' for true and 'F' for false for each of the following:*

(i) $\frac{9}{16} < \frac{13}{24}$.

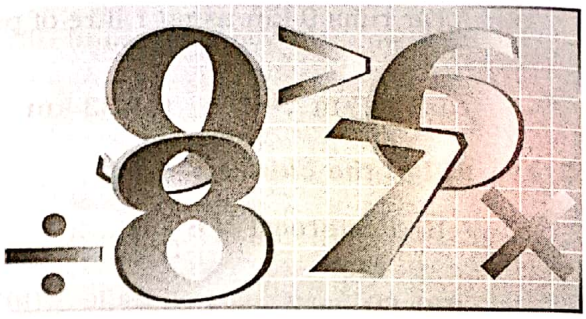
(ii) Among $\frac{2}{5}, \frac{16}{35}$ and $\frac{9}{14}$, the largest is $\frac{16}{35}$.

(iii) $\frac{11}{15} - \frac{9}{20} = \frac{17}{60}$.

(iv) $\frac{11}{25}$ of a litre = 440 mL.

(v) $16\frac{3}{4} \times 6\frac{2}{5} = 107\frac{3}{10}$.

3 Decimals



In class VI we read about decimals, addition and subtraction of decimals, etc. We shall review these concepts in this chapter and take up multiplication and division of decimals.

Decimals *The numbers expressed in decimal forms are called decimals.*

EXAMPLES Each of the numbers 6.8, 16.73, 7.364, 0.053, etc., is a decimal.

A decimal has two parts, namely

(i) *whole-number part,* (ii) *decimal part.*

These parts are separated by a dot (·), called the decimal point.

The part on the left side of the decimal point is the whole-number part and that on its right side is the decimal part.

EXAMPLE In 73.62 we have, whole-number part = 73 and decimal part = .62.

Decimal places The number of digits contained in the decimal part of a decimal gives the number of decimal places.

EXAMPLES 5.74 has two decimal places and 8.536 has three decimal places.

Like decimals *Decimals having the same number of decimal places are called like decimals.*

EXAMPLES 6.73, 8.05, 19.68 are like decimals, each having two decimal places.

Unlike decimals *Decimals having different number of decimal places are called unlike decimals.*

EXAMPLES Clearly, 5.3, 8.64, 10.023 are unlike decimals.

An Important Result *Putting any number of zeros to the extreme right of the decimal part of a decimal does not change its value.*

Thus, 3.8 = 3.80 = 3.800, etc., 2.94 = 2.940 = 2.9400, etc.

EXAMPLE 1. *Arrange the digits of* 374.568 *in the place-value chart.*

Solution We may arrange the digits of the given number in the place-value chart as shown below:

Hundreds	Tens	Ones	Decimal point	Tenths	Hundredths	Thousandths
3	7	4	·	5	6	8

Comparing Decimals

Suppose we have to compare two given decimals. We follow the following steps to do this.

Step 1. *Convert the given decimals into like decimals.*

Step 2. *First compare the whole-number part.*
The decimal with the greater whole-number part is greater.

Step 3. *If the whole-number parts are equal, compare the tenths digits.*
The decimal with the bigger digit in the tenths place is greater.

Step 4. *If the tenths digits are also equal, compare the hundredths digits, and so on.*

EXAMPLE 2. *Write the following decimals in ascending order:*
5.74, 6.03, 0.8, 0.658 *and* 7.2.

Solution Converting the given decimals into like decimals, we get them as:
5.740, 6.030, 0.800, 0.658 and 7.200.
Clearly, $0.658 < 0.800 < 5.740 < 6.030 < 7.200$.
Hence, the given decimals in ascending order are:
0.658, 0.8, 5.74, 6.03, 7.2.

METHOD OF CONVERTING A DECIMAL INTO A FRACTION

Step 1. *Write the given decimal without the decimal point as the numerator of the fraction.*

Step 2. *In the denominator, write* 1 *followed by as many zeros as there are decimal places in the given decimal.*

Step 3. *Reduce the above fraction to the simplest form.*

EXAMPLE 3. *Convert each of the following decimals into a fraction in its simplest form:*
(i) .5 *(ii)* .24 *(iii)* .08 *(iv)* .225

Solution We have:

(i) $.5 = \frac{\cancel{5}^{1}}{\cancel{10}_{2}} = \frac{1}{2}$.

(ii) $.24 = \frac{\cancel{24}^{6}}{\cancel{100}_{25}} = \frac{6}{25}$.

(iii) $.08 = \frac{\cancel{8}^{2}}{\cancel{100}_{25}} = \frac{2}{25}$.

(iv) $.225 = \frac{\cancel{225}^{9}}{\cancel{1000}_{40}} = \frac{9}{40}$.

CONVERTING A FRACTION INTO A DECIMAL

Step 1. *Divide the numerator by the denominator till a nonzero remainder is obtained.*

Step 2. *Put a decimal point in the dividend as well as in the quotient.*

Step 3. *Put a zero on the right of the decimal point in the dividend as well as on the right of the remainder.*

Step 4. *Divide again just as we do in whole numbers.*

Step 5. *Repeat steps* 3 *and* 4, *till the remainder is zero.*

EXAMPLE 4. *Convert each of the following into a decimal fraction:*

(i) $\frac{27}{4}$ *(ii)* $2\frac{5}{8}$

Solution On dividing, we get:

(i) $\frac{27}{4}$

$$\begin{array}{r} 6.75 \\ 4\overline{)27.00} \\ -24 \\ \hline 30 \\ -28 \\ \hline 20 \\ -20 \\ \hline \times \end{array}$$

$\therefore \quad \frac{27}{4} = 6.75.$

(ii) $2\frac{5}{8} = \frac{21}{8}$

$$\begin{array}{r} 2.625 \\ 8\overline{)21.000} \\ -16 \\ \hline 50 \\ -48 \\ \hline 20 \\ -16 \\ \hline 40 \\ -40 \\ \hline \times \end{array}$$

$\therefore \quad 2\frac{5}{8} = \frac{21}{8} = 2.625.$

EXAMPLE 5. *Express as rupees using decimals:*

(i) 536 paise (ii) 65 rupees 78 paise (iii) 6 rupees 6 paise

(iv) 28 paise (v) 5 paise

Solution We have:

(i) 536 paise $= ₹\frac{536}{100} = ₹\,5.36.$

(ii) 65 rupees 78 paise $= ₹\,65.78.$

(iii) 6 rupees 6 paise $= (6\times100+6)$ paise $= 606$ paise $= ₹\frac{606}{100} = ₹\,6.06.$

(iv) 28 paise $= ₹\frac{28}{100} = ₹\,0.28.$

(v) 5 paise $= ₹\frac{5}{100} = ₹\,0.05.$

EXAMPLE 6. *Express 5 cm in metre and kilometre.*

Solution $5 \text{ cm} = \frac{5}{100} \text{ m} = 0.05 \text{ m}$

$= \frac{0.05}{1000} \text{ km} = 0.00005 \text{ km}.$

$\therefore \quad 5 \text{ cm} = 0.05 \text{ m} = 0.00005 \text{ km}.$

EXAMPLE 7. *Express in kg using decimals:*

(i) 60 g (ii) 7380 g (iii) 6 kg 8 g

Solution We have:

(i) $60 \text{ g} = \frac{60}{1000} \text{ kg} = \frac{6}{100} \text{ kg} = 0.06 \text{ kg}.$

(ii) $7380 \text{ g} = \frac{7380}{1000} \text{ kg} = 7.380 \text{ kg}.$

(iii) $6 \text{ kg } 8 \text{ g} = (6\times1000) \text{ g} + 8 \text{ g} = (6008) \text{ g}$

$= \frac{6008}{1000} \text{ kg} = 6.008 \text{ kg}.$

EXERCISE 3A

1. Convert each of the following into a fraction in its simplest form:
   (i) .8 (ii) .75 (iii) .06 (iv) .285
2. Convert each of the following as a mixed fraction:
   (i) 5.6 (ii) 12.25 (iii) 6.004 (iv) 4.625
3. Convert each of the following into a decimal:
   (i) $\frac{47}{10}$ (ii) $\frac{156}{100}$ (iii) $\frac{2516}{100}$ (iv) $\frac{3524}{1000}$
   (v) $\frac{25}{8}$ (vi) $3\frac{2}{5}$ (vii) $2\frac{2}{25}$ (viii) $\frac{17}{20}$
4. Convert each of the following into like decimals:
   (i) 6.5, 16.03, 0.274, 119.4 (ii) 3.5, 0.67, 15.6, 4
5. Fill in each of the place holders with the correct symbol > or <.
   (i) 78.23 ☐ 69.85 (ii) 3.406 ☐ 3.46
   (iii) 5.68 ☐ 5.86 (iv) 14.05 ☐ 14.005
   (v) 1.85 ☐ 1.805 (vi) 0.98 ☐ 1.07
6. Arrange the following decimals in ascending order:
   (i) 4.6, 7.4, 4.58, 7.32, 4.06 (ii) 0.5, 5.5, 5.05, 0.05, 5.55
   (iii) 6.84, 6.48, 6.8, 6.4, 6.08 (iv) 2.2, 2.202, 2.02, 22.2, 2.002
7. Arrange the following decimals in descending order:
   (i) 7.4, 8.34, 74.4, 7.44, 0.74 (ii) 2.6, 2.26, 2.06, 2.007, 2.3
8. Express 45 mm in cm, m and km.
9. Express as rupees using decimals:
   (i) 8 paise (ii) 9 rupees 75 paise (iii) 8 rupees 5 paise
10. Express in km using decimals:
    (i) 65 m (ii) 284 m (iii) 3 km 5 m

ADDITION AND SUBTRACTION OF DECIMALS

ADDITION OF DECIMALS

METHOD:

Step 1. *Convert the given decimals into like decimals.*

Step 2. *Write the addends one under the other in column form, keeping the decimal points of all the addends in the same column and the digits of the same place in the same column.*

Step 3. *Add as in the case of whole numbers.*

Step 4. *In the sum, put the decimal point directly under decimal points in the addends.*

EXAMPLE 1. *Add 36.4, 273.06, 9.397 and 68.*

Solution Converting the given decimals into like decimals, we get:
36.400, 273.060, 9.397 and 68.000.

Writing these decimals in column form and adding, we get:

$$\begin{array}{r} 36.400 \\ 273.060 \\ 9.397 \\ 68.000 \\ \hline 386.857 \end{array}$$

Hence, the sum of the given decimals is 386.857.

SUBTRACTION OF DECIMALS

METHOD:

Step 1. *Convert the given decimals into like decimals.*

Step 2. *Write the smaller number under the larger one in column form in such a way that the decimal points of both the numbers are in the same column and the digits of the same place lie in the same column.*

Step 3. *Subtract as we do in case of whole numbers.*

Step 4. *In the difference, put the decimal point directly under the decimal points of the given numbers.*

EXAMPLE 2. *Subtract* 47.56 *from* 83.2.

Solution Converting the given decimals into like decimals, we get 47.56 and 83.20.
Writing them in column form with the larger one at the top and subtracting, we get:

$$\begin{array}{r} 83.20 \\ -47.56 \\ \hline 35.64 \end{array}$$

Hence, (83.20 – 47.56) = 35.64.

EXAMPLE 3. *Simplify:* 63.7 – 28.89 + 76.4 – 37.66.

Solution Converting the given decimals into like decimals, we have:

63.7 – 28.89 + 76.4 – 37.66
= 63.70 – 28.89 + 76.40 – 37.66
= (63.70 + 76.40) – (28.89 + 37.66)
= (140.10 – 66.55)
= 73.55.

$$\begin{array}{r|r} 63.70 & 28.89 \\ +76.40 & +37.66 \\ \hline 140.10 & 66.55 \end{array}$$

$$\begin{array}{r} 140.10 \\ -66.55 \\ \hline 73.55 \end{array}$$

EXAMPLE 4. *How much less is* 28.8 km *than* 42.3 km?

Solution Required difference
= (42.3 – 28.8) km
= 13.5 km.

$$\begin{array}{r} 42.3 \\ -28.8 \\ \hline 13.5 \end{array}$$

EXAMPLE 5. *Shayama bought* 4 kg 350 g *potato,* 3 kg 80 g *tomato and some onion. If the total weight of the three vegetables is* 10 kg 200 g, *what is the weight of onion?*

Solution Total weight of all the vegetables = 10 kg 200 g = 10.200 kg.
Weight of potato = 4 kg 350 g = 4.350 kg.
Weight of tomato = 3 kg 80 g = 3.080 kg.
Weight of onion = [10.200 – (4.350 + 3.080)] kg
= (10.200 – 7.430) kg = 2.770 kg.
Hence, the weight of onion is 2 kg 770 g.

$$\begin{array}{r} 4.350 \\ +3.080 \\ \hline 7.430 \end{array}$$

$$\begin{array}{r} 10.200 \\ -7.430 \\ \hline 2.770 \end{array}$$

EXERCISE 3B

Add:

1. 16, 8.7, 0.94, 6.8 and 7.77
2. 18.6, 206.37, 8.008, 26.4 and 6.9
3. 63.5, 9.7, 0.8, 26.66 and 12.17
4. 17.4, 86.39, 9.435, 8.8 and 0.06
5. 26.9, 19.74, 231.769 and 0.048
6. 23.8, 8.94, 0.078 and 214.6
7. 6.606, 66.6, 666, 0.066, 0.66
8. 9.09, 0.909, 99.9, 9.99, 0.099

Subtract:

9. 14.79 from 72.43
10. 36.74 from 52.6
11. 13.876 from 22
12. 15.079 from 24.16
13. 0.68 from 1.007
14. 0.4678 from 5.05
15. 2.5307 from 8
16. 6.732 from 9.001
17. Take out 5.746 from 9.1.
18. What is to be added to 63.58 to get 92?
19. What is to be subtracted from 8.1 to get 0.813?
20. By how much should 32.67 be increased to get 60.1?
21. By how much should 74.3 be decreased to get 26.87?
22. Rohit purchased a notebook for ₹ 23.75, a pencil for ₹ 2.85 and a pen for ₹ 15.90. He gave a 50-rupee note to the shopkeeper. What amount did he get back?

MULTIPLICATION OF DECIMALS

MULTIPLICATION OF A DECIMAL BY 10, 100, 1000, etc.

Rules: *(i) On multiplying a decimal by* 10, *the decimal point is shifted to the right by one place.*

(ii) On multiplying a decimal by 100, *the decimal point is shifted to the right by two places.*

(iii) On multiplying a decimal by 1000, *the decimal point is shifted to the right by three places, and so on.*

EXAMPLE 1. *Find the product:*

(i) 67.24×10 *(ii)* 4.956×100 *(iii)* 2.3748×1000

Solution We have:

(i) $67.24 \times 10 = 672.4$ [shifting decimal point to the right by 1 place]

(ii) $4.956 \times 100 = 495.6$ [shifting decimal point to the right by 2 places]

(iii) $2.3748 \times 1000 = 2374.8$ [shifting decimal point to the right by 3 places]

EXAMPLE 2. *Multiply* 35.6 *by* 1000.

Solution On multiplying 35.6 by 1000, the decimal point will be shifted to the right by 3 places.

So, we write, $35.6 = 35.600$.

$\therefore \quad 35.6 \times 1000 = 35.600 \times 1000 = 35600.$

Hence, $35.6 \times 1000 = 35600$.

MULTIPLICATION OF A DECIMAL BY A WHOLE NUMBER

METHOD:

Step 1. *Multiply the decimal without the decimal point by the given whole number.*

Step 2. *Mark the decimal point in the product to have as many places of decimal as are there are in the given decimal.*

EXAMPLE 3. *Find the product:*
(i) 5.43×15 *(ii)* 0.327×12 *(iii)* 0.065×9

Solution We have:

(i) $543 \times 15 = 8145$.
$\therefore\ 5.43 \times 15 = 81.45$. (2 places of decimal)

(ii) $327 \times 12 = 3924$.
$\therefore\ 0.327 \times 12 = 3.924$. (3 places of decimal)

(iii) $65 \times 9 = 585$.
$\therefore\ 0.065 \times 9 = 0.585$. (3 places of decimal)

MULTIPLICATION OF A DECIMAL BY A DECIMAL

METHOD:

Step 1. *Multiply the two decimals without the decimal point just like whole numbers.*

Step 2. *Mark the decimal point in the product in such a way that the number of decimal places in the product is equal to the sum of the decimal places in the given decimals.*

EXAMPLE 4. *Multiply* 73.68 *by* 5.4.

Solution First we multiply 7368 by 54.

$$\begin{array}{r} 7368 \\ \times 54 \\ \hline 29472 \\ 368400 \\ \hline 397872 \end{array}$$

$\therefore\ 7368 \times 54 = 397872$.

Sum of decimal places in the given decimals $= (2 + 1) = 3$.

So, the product must contain 3 places of decimal.

$\therefore\ 73.68 \times 5.4 = 397.872$. (3 places of decimal)

EXAMPLE 5. *Multiply* 0.089 *by* 0.76.

Solution First we multiply 89 by 76.

$$\begin{array}{r} 89 \\ \times 76 \\ \hline 534 \\ 6230 \\ \hline 6764 \end{array}$$

$\therefore\ 89 \times 76 = 6764$.

Sum of decimal places in the given decimals $= (3 + 2) = 5$.

So, the product must contain 5 places of decimal.

$\therefore\ 0.089 \times 0.76 = 0.06764$. (5 places of decimal)

EXAMPLE 6. *Multiply* 0.0235 *by* 0.0327.

Solution First we multiply 235 by 327.

$$\begin{array}{r} 235 \\ \times 327 \\ \hline 1645 \\ 4700 \\ 70500 \\ \hline 76845 \end{array}$$

$\therefore$ $235 \times 327 = 76845$.

Sum of decimal places in the given decimals = (4 + 4) =8.

So, the product must contain 8 places of decimal.

$\therefore$ $0.0235 \times 0.0327 = 0.00076845$.

EXAMPLE 7. *Find the product* $0.47 \times 5.3 \times 0.06$.

Solution First we find the product $47 \times 53 \times 6$.

Now, $47 \times 53 \times 6 = 2491 \times 6 = 14946$.

Sum of decimal places in the given decimals = $(2+1+2) = 5$.

So, the product must contain 5 places of decimal.

$\therefore$ $0.47 \times 5.3 \times 0.06 = 0.14946$.

$$\begin{array}{r} 47 \\ \times 53 \\ \hline 141 \\ 2350 \\ \hline 2491 \\ \times 6 \\ \hline 14946 \end{array}$$

EXAMPLE 8. *If the cost of a pen is* ₹ 28.50, *find the cost of* 48 *such pens.*

Solution Cost of 1 pen = ₹ 28.50.

Cost of 48 pens = ₹ (28.50×48)

= ₹ 1368.00

= ₹ 1368.

Hence, the cost of 48 pens is ₹ 1368.

$$\begin{array}{r} 2850 \\ \times 48 \\ \hline 22800 \\ 114000 \\ \hline 136800 \end{array}$$

EXAMPLE 9. *The cost of* 1 *metre of ribbon is* ₹ 35.80. *What will be the cost of* 9.8 *metres of ribbon?*

Solution Cost of 1 m of ribbon = ₹ 35.80.

Cost of 9.8 m of ribbon = ₹ (35.80×9.8)

= ₹ 350.840

= ₹ 350.84.

Hence, the cost of 9.8 m of ribbon is ₹ 350.84.

$$\begin{array}{r} 3580 \\ \times 98 \\ \hline 28640 \\ 322200 \\ \hline 350840 \end{array}$$

EXAMPLE 10. 1 kg *of milk has* 0.264 kg *of fat. How much fat is there in* 12.5 kg *of milk?*

Solution Quantity of fat in 1 kg of milk = 0.264 kg.

Quantity of fat in 12.5 kg of milk = (0.264×12.5) kg

= 3.3000 kg

= 3.3 kg.

Hence, the quantity of fat in 12.5 kg of milk is 3.3 kg.

$$\begin{array}{r} 264 \\ \times 125 \\ \hline 1320 \\ 5280 \\ 26400 \\ \hline 33000 \end{array}$$

EXERCISE 3C

1. Find the product:

(i) 73.92×10 (ii) 7.54×10 (iii) 84.003×10

(iv) 0.83×10 (v) 0.7×10 (vi) 0.032×10

2. Find the product:

(i) 2.397×100 (ii) 6.83×100 (iii) 2.9×100

(iv) 0.08×100 (v) 0.6×100 (vi) 0.003×100

3. Find the product:

(i) 6.7314×1000 (ii) 0.182×1000 (iii) 0.076×1000

(iv) 6.25×1000 (v) 4.8×1000 (vi) 0.06×1000

4. Find the product:

(i) 5.4×16 (ii) 3.65×19 (iii) 0.854×12

(iv) 36.73×48 (v) 4.125×86 (vi) 104.06×75

(vii) 6.032×124 (viii) 0.0146×69 (ix) 0.00125×327

5. Find the product:

(i) 7.6×2.4 (ii) 3.45×6.3 (iii) 0.54×0.27

(iv) 0.568×4.9 (v) 6.54×0.09 (vi) 3.87×1.25

(vii) 0.06×0.38 (viii) 0.623×0.75 (ix) 0.014×0.46

(x) 54.5×1.76 (xi) 0.045×2.4 (xii) 1.245×6.4

6. Find the product:

(i) $13 \times 1.3 \times 0.13$ (ii) $2.4 \times 1.5 \times 2.5$ (iii) $0.8 \times 3.5 \times 0.05$

(iv) $0.2 \times 0.02 \times 0.002$ (v) $11.1 \times 1.1 \times 0.11$ (vi) $2.1 \times 0.21 \times 0.021$

7. Evaluate:

(i) $(1.2)^2$ (ii) $(0.7)^2$ (iii) $(0.04)^2$ (iv) $(0.11)^2$

8. Evaluate:

(i) $(0.3)^3$ (ii) $(0.05)^3$ (iii) $(1.5)^3$

9. A bus can cover 62.5 km in one hour. How much distance can it cover in 18 hours?

10. A tin of oil weighs 16.8 kg. What is the weight of 45 such tins?

11. A bag of wheat weighs 97.8 kg. How much wheat is contained in 500 such bags?

12. Find the weight of 16 bags of sugar, each weighing 48.450 kg.

13. A small bottle holds 0.845 kg of sauce. How much sauce will be there in 72 such bottles?

14. A bottle holds 925 g of jam. How many kg of jam will be there in 25 such bottles?

15. If one drum can hold 16.850 litres of oil, how many litres can 48 such drums hold?

16. 1 kg of rice costs ₹ 56.80. What is the cost of 16.25 kg of rice?

17. 1 metre of cloth costs ₹ 108.50. What is the cost of 18.5 metres of this cloth?

18. A car can cover a distance of 8.6 km on one litre of petrol. How far can it go on 36.5 litres of petrol?

19. A taxi driver charges ₹ 9.80 per km. How much will he charge for a journey of 106.5 km?

DIVISION OF DECIMALS

DIVIDING A DECIMAL BY 10, 100, 1000, etc.

Rules: *(i) On dividing a decimal by 10, the decimal point is shifted to the left by one place.*

(ii) On dividing a decimal by 100, the decimal point is shifted to the left by two places.

(iii) On dividing a decimal by 1000, the decimal point is shifted to the left by three places, and so on.

EXAMPLE 1. *Divide:*
(i) 16.8 *by* 10 *(ii)* 236.4 *by* 100 *(iii)* 3709.6 *by* 1000

Solution We have:

(i) $16.8 \div 10 = \frac{16.8}{10} = 1.68$ [shifting decimal point to the left by 1 place]

(ii) $236.4 \div 100 = \frac{236.4}{100} = 2.364$ [shifting decimal point to the left by 2 places]

(iii) $3709.6 \div 1000 = \frac{3709.6}{1000} = 3.7096$ [shifting decimal point to the left by 3 places]

EXAMPLE 2. *Divide:*
(i) 0.46 *by* 10 *(ii)* 2.34 *by* 100 *(iii)* 6.28 *by* 1000

Solution We have:

(i) $0.46 \div 10 = \frac{0.46}{10} = 0.046$ [shifting decimal point to the left by 1 place]

(ii) $2.34 \div 100 = \frac{2.34}{100} = 0.0234$ [shifting decimal point to the left by 2 places]

(iii) $6.28 \div 1000 = \frac{6.28}{1000} = 0.00628$ [shifting decimal point to the left by 3 places]

DIVIDING A DECIMAL BY A WHOLE NUMBER

METHOD:

Step 1. *Perform the division by considering the dividend a whole number.*

Step 2. *When the division of whole-number part of the dividend is complete, put the decimal point in the quotient and proceed with the division as in case of whole numbers.*

EXAMPLE 3. *Divide* 39.168 *by* 12.

Solution We have:

```
12)39.168(3.264
  -36
   31
  -24
    76
   -72
     48
    -48
      0
```

$\therefore$ $39.168 \div 12 = 3.264$.

EXAMPLE 4. *Divide* 0.567 *by* 9.

Solution We have:

```
9)0.567(0.063
 -0
  56
 -54
   27
  -27
    0
```

$\therefore$ $0.567 \div 9 = 0.063$.

REMARK Sometimes on dividing a decimal by a whole number, the last remainder obtained is nonzero. In such cases insert as many zeros on the right of decimal part of the dividend as necessary to make the last remainder zero.

EXAMPLE 5. *Divide* 2.32 *by* 16.

Solution We have:

$$\begin{array}{r} 0.145 \\ 16\overline{)2.320} \\ -0 \\ \hline 23 \\ -16 \\ \hline 72 \\ -64 \\ \hline 80 \\ -80 \\ \hline 0 \end{array} \quad \leftarrow \text{one zero annexed}$$

$\therefore\ 2.32 \div 16 = 0.145.$

EXAMPLE 6. *Divide* 48.38 *by* 8.

Solution We have:

$$\begin{array}{r} 6.0475 \\ 8\overline{)48.3800} \\ -48 \\ \hline 38 \\ -32 \\ \hline 60 \\ -56 \\ \hline 40 \\ -40 \\ \hline 0 \end{array} \quad \leftarrow \text{two zeros annexed}$$

$\therefore\ 48.38 \div 8 = 6.0475.$

EXAMPLE 7. *Divide* 202.4 *by* 40.

Solution We have:

$$\frac{202.4}{40} = \frac{202.4}{4\times 10} = \frac{202.4}{4} \times \frac{1}{10} = \frac{50.6}{10} = 5.06.$$

EXAMPLE 8. *Find the quotient:*

(i) $0.018 \div 0.6$ *(ii)* $0.0018 \div 0.09$ *(iii)* $0.196 \div 1.4$

Solution We have:

(i) $\dfrac{0.018}{0.6} = \dfrac{0.018\times 10}{0.6\times 10} = \dfrac{0.18}{6}$

$$\begin{array}{r} 0.03 \\ 6\overline{)0.18} \\ -0 \\ \hline 18 \\ -18 \\ \hline 0 \end{array}$$

$\therefore\ \dfrac{0.018}{0.6} = \dfrac{0.18}{6} = 0.03.$

(ii) $\frac{0.0018}{0.09} = \frac{0.0018 \times 100}{0.09 \times 100} = \frac{0.18}{9}$

$$\begin{array}{r} 9\overline{)0.18}(0.02 \\ -0 \\ \hline 18 \\ -18 \\ \hline 0 \end{array}$$

$\therefore \frac{0.0018}{0.09} = \frac{0.18}{9} = 0.02.$

(iii) $\frac{0.196}{1.4} = \frac{0.196 \times 10}{1.4 \times 10} = \frac{1.96}{14}$

$$\begin{array}{r} 14\overline{)1.96}(0.14 \\ -0 \\ \hline 19 \\ -14 \\ \hline 56 \\ -56 \\ \hline 0 \end{array}$$

$\therefore \frac{0.196}{1.4} = \frac{1.96}{14} = 0.14.$

EXAMPLE 9. *A bowler took 15 wickets for 321 runs. What is his average score per wicket?*

Solution Total score = 321 runs.

Total number of wickets = 15.

Average score per wicket = $\frac{321}{15}$ runs = 21.4 runs.

Hence, the average score is 21.4 runs per wicket.

EXAMPLE 10. *A car covers a distance of 108.9 km in 1.8 hours. What is the average speed of the car?*

Solution Total distance covered = 108.9 km.

Total time taken = 1.8 hours.

Average speed of the car = $\frac{\text{distance}}{\text{time taken}}$

$= \frac{108.9}{1.8}$ km/h $= \frac{1089}{18}$ km/h

$= \frac{121}{2}$ km/h = 60.5 km/h.

Hence, the average speed of the car is 60.5 km/h.

EXAMPLE 11. *The cost of 24 toys of the same kind is ₹ 783.60. Find the cost of each toy.*

Solution Cost of 24 toys = ₹ 783.60.

Cost of 1 toy = $₹\left(\frac{783.60}{24}\right)$

= ₹ 32.65.

Hence, the cost of each toy is ₹ 32.65.

$$\begin{array}{r} 24\overline{)783.60}(32.65 \\ -72 \\ \hline 63 \\ -48 \\ \hline 156 \\ -144 \\ \hline 120 \\ -120 \\ \hline 0 \end{array}$$

EXAMPLE 12. *The total weight of some bags of cement is 1743 kg. If each bag weighs 49.8 kg, how many bags are there?*

Solution Total weight of all the bags = 1743 kg.

Weight of each bag = 49.8 kg.

$$\text{Number of bags} = \frac{\text{total weight}}{\text{weight of each bag}}$$

$$= \frac{1743}{49.8} = \left(\frac{1743}{49.8} \times \frac{10}{10}\right)$$

$$= \frac{17430}{498} = 35.$$

Hence, the required number of bags = 35.

```
498)17430(35
  -1494
   2490
  -2490
      0
```

EXAMPLE 13. *Mr Thukral distributed ₹ 1840 equally among NCC cadets for refreshment. If each cadet received ₹ 28.75, how many cadets were there?*

Solution Total amount distributed = ₹ 1840.

Amount received by each cadet = ₹ 28.75.

$$\text{Number of cadets} = \frac{\text{total amount}}{\text{amount received by each}}$$

$$= \frac{1840}{28.75} = \frac{1840}{28.75} \times \frac{100}{100}$$

$$= \frac{184000}{2875} = 64.$$

Hence, there were 64 cadets in all.

```
        64
2875)184000(
  -17250
   11500
  -11500
       0
```

EXAMPLE 14. *Mrs Bose bought 15.5 litres of refined oil for ₹ 1122.20. Find its cost per litre.*

Solution Cost of 15.5 litres of refined oil = ₹ 1122.20.

$$\text{Cost of 1 litre of refined oil} = ₹\left(\frac{1122.20}{15.5}\right)$$

$$= ₹\left(\frac{1122.20}{15.5} \times \frac{10}{10}\right)$$

$$= ₹\left(\frac{11222}{155}\right) = ₹\ 72.40.$$

Hence, the cost of refined oil is ₹ 72.40 per litre.

```
      72.40
155)11222.00(
  -1085
    372
   -310
    620
   -620
      00
     -00
      0
```

EXAMPLE 15. *The product of two decimals is 1.5008. If one of them is 0.56, find the other.*

Solution Product of given decimals = 1.5008.

One decimal = 0.56.

The other decimal = 1.5008 ÷ 0.56

$$= \left(\frac{1.5008}{0.56} \times \frac{100}{100}\right)$$

$$= \frac{150.08}{56} = 2.68.$$

Hence, the other decimal is 2.68.

```
56)150.08(2.68
  -112
   380
  -336
    448
   -448
      0
```

EXAMPLE 16. *Each side of a polygon is 2.9 cm in length and its perimeter is 17.4 cm. How many sides does the polygon have?*

Solution Let the number of sides of the polygon be n.

Length of each side of the polygon = 2.9 cm.

$\therefore$ perimeter of the polygon = $(2.9 \times n)$ cm.

But, its perimeter = 17.4 cm (given).

$\therefore \quad 2.9 \times n = 17.4 \quad \Rightarrow \quad n = \dfrac{17.4}{2.9} = \dfrac{174}{29} = 6.$

Hence, the given polygon has 6 sides.

EXAMPLE 17. *Find the average of* 4.2, 7.4 *and* 8.8.

Solution Average of the given numbers $= \dfrac{(4.2 + 7.4 + 8.8)}{3}$

$= \dfrac{20.4}{3} = 6.8.$

Hence, the average of the given numbers is 6.8.

EXERCISE 3D

1. Divide:

(i) 131.6 by 10 (ii) 32.56 by 10 (iii) 4.38 by 10

(iv) 0.34 by 10 (v) 0.08 by 10 (vi) 0.062 by 10

2. Divide:

(i) 137.2 by 100 (ii) 23.4 by 100 (iii) 4.7 by 100

(iv) 0.3 by 100 (v) 0.58 by 100 (vi) 0.02 by 100

3. Divide:

(i) 1286.5 by 1000 (ii) 354.16 by 1000 (iii) 38.9 by 1000

(iv) 4.6 by 1000 (v) 0.8 by 1000 (vi) 2 by 1000

4. Divide:

(i) 12 by 8 (ii) 63 by 15 (iii) 47 by 20

(iv) 101 by 25 (v) 31 by 40 (vi) 11 by 16

5. Divide:

(i) 43.2 by 6 (ii) 60.48 by 12 (iii) 117.6 by 21

(iv) 217.44 by 18 (v) 2.575 by 25 (vi) 6.08 by 8

(vii) 0.765 by 9 (viii) 0.768 by 16 (ix) 0.175 by 25

(x) 0.3322 by 11 (xi) 2.13 by 15 (xii) 6.54 by 12

(xiii) 5.52 by 16 (xiv) 1.001 by 14 (xv) 0.477 by 18

6. Divide:

(i) 16.46 ÷ 20 (ii) 403.8 ÷ 30 (iii) 19.2 ÷ 80

(iv) 156.8 ÷ 200 (v) 12.8 ÷ 500 (vi) 18.08 ÷ 400

7. Divide:

(i) 3.28 by 0.8 (ii) 0.288 by 0.9 (iii) 25.395 by 1.5

(iv) 2.0484 by 0.18 (v) 0.228 by 0.38 (vi) 0.8085 by 0.35

(vii) 21.976 by 1.64 (viii) 11.04 by 1.6 (ix) 6.612 by 11.6

(x) 0.076 by 0.19 (xi) 148 by 0.074 (xii) 16.578 by 5.4

(xiii) 28 by 0.56 (xiv) 204 by 0.17 (xv) 3 by 80

8. The total cost of 24 chairs is ₹ 9255.60. Find the cost of each chair.
9. 1.8 m of cloth is required for a shirt. How many such shirts can be made from a piece of cloth 45 m long?
10. A car covers a distance of 22.8 km in 2.4 litres of petrol. How much distance will it cover in 1 litre of petrol?
11. A tin holds 16.5 litres of oil. How many such tins will be required to hold 478.5 litres of oil?
12. The weight of 37 bags of sugar is 3644.5 kg. If all the bags weigh equally, what is the weight of each bag?
13. If 69 buckets of equal capacity can be filled with 586.5 litres of water, what is the capacity of each bucket?
14. Monica cuts 46 m of cloth into pieces of 1.15 m each. How many pieces does she get?
15. Mr Soni bought some bags of cement, each weighing 49.8 kg. If the total weight of all the bags is 1792.8 kg, how many bags did he buy?
16. How many pieces of plywood, each 0.35 cm thick, are required to make a pile 1.89 m high?
Hint. 1.89 m = (1.89×100) cm = 189 cm.
17. The product of two decimals is 261.36. If one of them is 17.6, find the other.

EXERCISE 3E

OBJECTIVE QUESTIONS

Mark (✓) against the correct answer in each of the following:

1. .06 = ?
(a) $\frac{3}{5}$ (b) $\frac{3}{50}$ (c) $\frac{3}{500}$ (d) none of these

2. 1.04 = ?
(a) $1\frac{1}{5}$ (b) $1\frac{2}{5}$ (c) $1\frac{1}{25}$ (d) none of these

3. $2\frac{2}{25}$ = ?
(a) 2.8 (b) 2.08 (c) 2.008 (d) none of these

4. 6 cm = ?
(a) 0.006 km (b) 0.0006 km (c) 0.00006 km (d) none of these

5. 70 g = ?
(a) 0.7 kg (b) 0.07 kg (c) 0.007 kg (d) none of these

6. 5 kg 6 g = ?
(a) 5.0006 kg (b) 5.06 kg (c) 5.006 kg (d) 5.6 kg

7. 2 km 5 m = ?
(a) 2.5 km (b) 2.05 km (c) 2.005 km (d) 2.0005 km

8. (1.007 – 0.7) = ?
(a) 1 (b) 0.37 (c) 0.307 (d) none of these

9. What should be subtracted from .1 to get .03?
(a) .7 (b) .07 (c) .007 (d) none of these

10. What should be added to 3.07 to get 3.5?
(a) .57 (b) .34 (c) .43 (d) .02

11. $0.23 \times 0.3 = ?$
(a) 0.69 (b) 6.9 (c) 0.069 (d) none of these

12. $0.02 \times 30 = ?$
(a) 6 (b) 0.6 (c) 0.06 (d) none of these

13. $0.25 \times 0.8 = ?$
(a) 0.02 (b) 0.2 (c) 0.002 (d) 2

14. $0.4 \times 0.4 \times 0.4 = ?$
(a) 6.4 (b) .64 (c) .064 (d) none of these

15. $1.1 \times .1 \times .01 = ?$
(a) .011 (b) .0011 (c) .11 (d) none of these

16. $2.08 \div (.16) = ?$
(a) 13 (b) .13 (c) 1.3 (d) none of these

17. $1.02 \div 6 = ?$
(a) 1.7 (b) 0.17 (c) 0.017 (d) none of these

18. $30.94 \div 0.7 = ?$
(a) 44.2 (b) 4.42 (c) 442 (d) 0.442

19. $2.73 \div 1.3 = ?$
(a) 21 (b) 2.1 (c) 0.21 (d) none of these

20. $89.1 \div 2.2 = ?$
(a) 40.5 (b) 4.05 (c) 41 (d) 41.5

21. $0.5 \times 0.05 = ?$
(a) 0.25 (b) 2.5 (c) 0.025 (d) none of these

Things to Remember

1. *The fractions in which the denominators are 10, 100, 1000, etc., are known as decimal fractions.*
2. *Numbers written in decimal form are called decimals.*
3. *A decimal has two parts, namely, the whole-number part and the decimal part.*
4. *The number of digits contained in the decimal part of a decimal is called the number of its decimal places.*
5. *Decimals having the same number of decimal places are called like decimals, otherwise they are known as unlike decimals.*
6. *We have 0.1 = 0.10 = 0.100, etc., 0.2 = 0.20 = 0.200, etc., and so on.*
7. *We may convert unlike decimals into like decimals by annexing the requisite number of zeros at the end of the decimal part.*
8. *Comparing Decimals:*
   Step 1. *Convert the given decimals into like decimals.*
   Step 2. *First compare the whole-number parts. The decimal having larger whole-number part is larger than the other.*
   Step 3. *If the whole-number parts are equal, compare the tenths digits. The decimal having bigger digit in the tenths place is the larger one.*
   If the tenths digits are equal, compare the hundredths digits, and so on.
9. *Addition of Decimals:*
   Step 1. *Convert the given decimals into like decimals.*
   Step 2. *Write the addends one under the other so that the decimal points of all the addends are in the same column.*

Step 3. *Add as in case of whole numbers.*
Step 4. *In the sum, put the decimal point directly under the decimal points in the addends.*

10. *Subtraction of Decimals:*
Step 1. *Convert the given decimals into like decimals.*
Step 2. *Write the smaller number under the larger one so that their decimal points are in the same column.*
Step 3. *Subtract as in the case of whole numbers.*
Step 4. *In the difference, put the decimal point directly under the decimal points of the given number.*

11. *Multiplication of Decimals by 10, 100, 1000, etc.*
Rules: (i) *On multiplying a decimal by 10, the decimal point is shifted to the right by one place.*
(ii) *On multiplying a decimal by 100, the decimal point is shifted to the right by two places, and so on.*

12. *Multiplication of a Decimal by a Whole Number:*
Step 1. *Multiply the decimal without the decimal point by the given whole number.*
Step 2. *Mark the decimal point in the product to have as many places of decimal as there are in the given decimal.*

13. *Multiplication of a Decimal by a Decimal:*
Step 1. *Multiply the two decimals without the decimal point just like whole numbers.*
Step 2. *Mark the decimal point in the product in such a way that the number of decimal places in the product is equal to the sum of the decimal places in the given decimals.*

14. *Dividing a Decimal by 10, 100, 1000, etc.*
Rules: (i) *On dividing a decimal by 10, the decimal point is shifted to the left by one place.*
(ii) *On dividing a decimal by 100, the decimal point is shifted to the left by two places, and so on.*

15. *Dividing a Decimal by a Whole Number:*
Step 1. *Perform the division by considering the dividend a whole number.*
Step 2. *When the division of whole-number part of the dividend is complete, put the decimal point in the quotient and proceed with the division as in case of whole numbers.*

16. *Dividing a Decimal by a Decimal:*
Step 1. *Convert the divisor into a whole number by multiplying the dividend and the divisor by a suitable power of 10.*
Step 2. *Divide the new dividend by the whole number obtained above.*

TEST PAPER-3

A. 1. If the cost of a pen is ₹ 32.50, find the cost of 24 such pens.

2. A bus can cover 64.5 km in an hour. How much distance can it cover in 18 hours?

3. Find the product $0.68 \times 6.5 \times 0.04$.

4. Each bag of cement weighs 48.5 kg. How many such bags will weigh 2231 kg?

5. Divide:
   (i) 0.196 by 1.4 (ii) 39.168 by 1.2 (iii) 0.228 by 0.38

6. The product of two decimals is 1.824. If one of them is 0.64, find the other.

7. How many pieces of plywood, each 0.45 cm thick, are required to make a pile 2.43 m high?

8. Each side of a polygon is 3.8 cm in length and its perimeter is 22.8 cm. How many sides does the polygon have?

B. ***Mark (✓) against the correct answer in each of the following:***

9. $2\frac{1}{25} = ?$
   (a) 2.4 (b) 2.04 (c) 2.004 (d) none of these

10. 1.008 = ?
    (a) $1\frac{2}{25}$ (b) $1\frac{1}{125}$ (c) $1\frac{2}{125}$ (d) none of these

11. 2 kg 5 g = ?
    (a) 2.5 kg (b) 2.05 kg (c) 2.005 kg (d) none of these

12. .012 ÷ .15 = ?
    (a) 0.8 (b) 0.08 (c) 0.008 (d) none of these

13. 1.1 × .1 × .01 = ?
    (a) .11 (b) .011 (c) .0011 (d) none of these

14. 4.669 ÷ 2.3 = ?
    (a) 2.3 (b) 2.03 (c) 2.003 (d) none of these

15. What should be added to 2.06 to get 3.1?
    (a) 1.4 (b) 1.24 (c) 1.04 (d) none of these

16. What should be subtracted from .1 to get .04?
    (a) 0.6 (b) 0.06 (c) 0.006 (d) none of these

C. 17. ***Fill in the blanks.***
   (i) 1.001 ÷ 14 = ... (ii) 204 ÷ 0.17 = ...
   (iii) 0.47 × 5.3 = ... (iv) 0.023 × 0.03 = ...
   (v) $(0.7)^2$ = ... (vi) $(0.05)^3$ = ...

D. 18. ***Write 'T' for true and 'F' for false for each of the following:***
   (i) 0.5 × 0.05 = 0.25 (ii) 0.25 × 0.8 = 0.2
   (iii) 0.35 ÷ 0.7 = 0.5 (iv) .4 × .4 × .4 = 0.64
   (v) 6 cm = 0.06 m