Mathematics - 8
(Part–I)

1. A Square and A Cube

Page-8

Do it Now!

1. To find how many natural numbers lie between the squares of two consecutive numbers n and $n + 1$, we use a simple rule.

(i) Between 12^2 and 13^2

Here, $n = 12$

Apply the formula $2n$,

$\Rightarrow \quad 2 \times 12 = 24$

24 numbers lie between the squares of two consecutive numbers.

(ii) Between 30^2 and 31^2

Here, $n = 30$

Apply the formula $2n$,

$\Rightarrow \quad 2 \times 30 = 60$

60 numbers lie between the squares of the two consecutive numbers.

2. Analysing the pattern :

- $1^2 + 2^2 = 5$ (Which is $2^2 + 1$)
- $2^2 + 3^2 = 13$ (Which is $3^2 + 4$)
- $3^2 + 4^2 = 25$ (Which is $4^2 + 9$ or 5^2)

Note : The pattern uses the next squares plus a remainder.

Thus, $4^2 + 5^2 = 41 = 5^2 + 16$

$5^2 + 6^2 = 6^1 = 6^2 + 25$

Work it Out-1

1. To identify a perfect square, we can look at the ending digits. A perfect square never ends in 2, 3, 7, 8 or an odd number of zeros.

(i) 2150 : Ends in a single zero. Therefore, it is not a perfect square.

(ii) 2304 : Ends in 4.

$48 \times 48 = 2304$. This is a perfect

(iii) 980 : Ends in a single zero. So it is not a perfect square.

(iv) 1369 : Ends in 9.

$37 \times 37 = 1369$.

This is a perfect square.

2. To find the ones digit of a square, we only need to square the last of the number.

(i) $75^2 : 5 \times 5 = 25$ (Ends in 5)

(ii) $108^2 : 8 \times 8 = 64$ (Ends in 4)

(iii) $77^2 : 7 \times 7 = 49$ (Ends in 9)

(iv) $207^2 : 7 \times 7 = 49$ (Ends in 9)

3. There is a mathematical property for consecutive square :

$(n + 1)^2 = n^2 + n + (n + 1)$

In this case, $n = 115$ and $n + 1 = 116$

$116^2 = 115^2 + 115 + 116$

$116^2 = 13225 + 115 + 116$

So, the value of 116^2 is (i) 13225 + 115 + 116.

4. Given, Area of square = 529 m^2

Formula : Area = side × side = s^2

$s^2 = 529m^2$

$s = \sqrt{529\,m^2}$

$s = \sqrt{23\,m \times 23\,m}$

$s = 23m$

So, the length of the side is 23m.

5. To find the LCM of 3, 5, 7 and 9.

LCM = $3 \times 3 \times 5 \times 7 = 315$

3	3, 5, 7, 9
3	1, 5, 7, 3
5	1, 5, 7, 1
7	1, 1, 7, 1
	1, 1, 1, 1

For a number to be a perfect square, all factors must be in pairs. Here 5 and 7 are unpaired.

To multiply 315 by the missing factors (5 and 7) smallest square = $315 \times 5 \times 7$ = 11025.

So, the smallest square number is 11025.

6. To find the prime factors of 24 and group the factors into pairs.

$24 = (2 \times 2) \times 2 \times 3$

2	24
2	12
2	6
3	3
	1

The factors 2 and 3 do not have pairs. Therefore, we must multiply 24 by (2 × 3).

$\Rightarrow \quad 24 \times 6 = 144$

To find the square root of 144,

$\Rightarrow \quad \sqrt{144} = 12$

So, the least number is 6, and the square root of the product is 12.

Page-10

Do it Now!

1. To add pair the first and the last number :

- 91 + 109 = 200
- 93 + 107 = 200
- 95 + 105 = 200
- 97 + 103 = 200
- 99 + 101 = 200

We have exactly 5 pairs, and each pair equals 200.

Thus, value = 5 × 200 = 1000

So, the value is 1000.

Work it Out-2

1. To find the cube root, we use the prime factorization method by grouping factors into sets of three :

15625 = (5 × 5 × 5) × (5 × 5 × 5)

$\sqrt[3]{15625} = \sqrt[3]{(5\times5\times5)\times(5\times5\times5)}$

$= 5 \times 5 = 25$

5	15625
5	3125
5	625
5	125
5	25
5	5
	1

9261 = (3 × 3 × 3) × (7 × 7 × 7)

$\sqrt[3]{9261} = \sqrt[3]{(3\times3\times3)\times(7\times7\times7)}$

$= 3 \times 7 = 21$

3	9261
3	3087
3	1029
7	343
7	49
7	7
	1

2. To find the required muliplier, we look at the prime factors of 1352 and see which one is not in a group of three.

1352 = (2 × 2 × 2) × 13 × 13

So, we need one more 13 to make a perfect cube.

2	1352
2	676
2	338
13	169
13	13
	1

3. (i) False, the product of odd number is always odd.

(ii) False, a number ending in 2 will have a cube ending in 8.

(iii) False, the smallest 3-digit number is 100.

(iv) False, the property belongs to perfect squares, not cubes.

4. $\sqrt[3]{1331} = \sqrt[3]{11\times11\times11} = 11$

11	1331
11	121
11	11
	1

$\sqrt[3]{4096} = \sqrt[3]{2\times2\times2\times2\times2\times2 \times2\times2\times2\times2\times2\times2}$

$= 2 \times 2 \times 2 \times 2$

$= 16$

2	4096
2	2048
2	1024
2	512
2	256
2	128
2	64
2	32
2	16
2	8
2	4
2	2
	1

$\sqrt[3]{5832} = \sqrt[3]{\underbrace{2 \times 2 \times 2}\times\underbrace{3 \times 3 \times 3} \times \underbrace{3 \times 3 \times 3}}$

$= 2 \times 3 \times 3 = 18$

2	5832
2	2916
2	1458
3	729
3	243
3	81
3	27
3	9
3	3
	1

$\sqrt[3]{24389} = \sqrt[3]{29 \times 29 \times 29} = 29$

29	24389
29	841
29	29
	1

5. (i) $45^2 - 44^2$

Using the formula :

$a^2 - b^2 = (a + b)(a - b)$

$= (45 + 44)(45 - 44)$

$= 89 \times 1 = 89$

(ii) $44^3 - 43^3$

Using the formula : $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

$= (44 - 43)(442 + 44 \times 43 + 43^2)$

$= 1 \times (1936 + 1892 + 1849)$

$= 5677$

(iii) $47^2 - 46^2$

$= (47 + 46)(47 - 46)$

$= 93 \times 1 = 93$

(iv) $41^3 - 40^3$

$= (41 - 40)(41^2 + 41 \times 40 + 40^2)$

$= 1 (1681 + 1640 + 1600)$

$= 4921$

So, (ii) $(44)^3 - (43)^2$ correct

Connect and Reflect

[A] Multiple Choice Questions:

1. (A), **2.** (B), **3.** (B), **4.** (B), **5.** (C).

[B] Fill in the blanks:

1. Perfect squares, **2.** 2, 3, 7 or 8, **3.** 44, **4.** 125, **5.** Varga-mula.

[C] State True or False:

1. False, **2.** False, **3.** True, **4.** False, **5.** True .

[D] Subjective Questions:

1. Square of 12 is 12×12 or 144.

2. Cube root of 512 is $\sqrt[3]{8 \times 8 \times 8}$ or 8.

3. To find the LCM of 4, 9, 10 :

LCM $= (2 \times 2) \times (3 \times 3) \times 5$

$= 180$

2	4, 9, 10
2	2, 9, 5
3	1, 9, 5
3	1, 3, 5
5	1, 1, 5
	1, 1, 1

Multiply 180 by 5 to make it a perfect square :

$18 \times 5 = 900$

So, 900 is the smallest perfect square divisible by 4, 9 and 10.

4. The cube of – 6 is $(-6) \times (-6) \times (-6)$ or -216.

5. The symbol for cube root is $\sqrt[3]{\ }$.

6. A perfect square never ends in 2, 3, 7, 8 or an odd number of zeros.

So, (iii) 2053 ends in 3, it is not a perfect square.

(i) $\sqrt{4056} \approx \sqrt{2 \times 2 \times 2 \times 3 \times 13 \times 13}$

$\approx 26\sqrt{6}$, so it is not a perfect square.

7. The last digit of a square depends only on the last digit of the number being squared.

38^2 : last digit $8^2 = 64 \rightarrow 4$.

Among these numbers, only 38 is such a number whose square has 4 as the last digit.

8. Given $127^2 = 16129$

We know the formula :

$(a + 1)^2 = a^2 + 2a + 1$

Here $a = 127$

$128^2 = 127^2 + 2(127) + 1$

$= 16129 + 254 + 1$

$= 16384$

9. Formula : Area of square = $(\text{side})^2$

$$(\text{side})^2 = 529$$
$$\text{side} = \sqrt{529}$$
$$= \sqrt{23 \times 23}$$
$$= 23 \text{ m}$$

10. First, find LCM of 6, 12 and 15.

$$\text{LCM } (6, 12, 5) = (2 \times 2) \times 3 \times 5$$
$$= 60$$

2	6, 12, 5
2	3, 6, 5
3	3, 3, 5
5	1, 1, 5
	1, 1, 1

Multiply 60 by 15 to make it a perfect square :

$$60 \times 15 = 900$$

So, 900 is the smallest square number that is divisible by 6, 12 and 15.

11. We have to prime factorization of 8640.

$8640 = (2 \times 2) \times (2 \times 2) \times (2 \times 2) \times (3 \times 3) \times 3 \times 5$

2	8640
2	4320
2	2160
2	1080
2	540
2	270
3	135
3	45
3	15
5	5
	1

Multiply 8640 by 15 to make it a perfect square :

$$8640 \times 15 = 129600$$
$$\sqrt{129600} = \sqrt{(2 \times 2) \times (2 \times 2) \times (2 \times 2) \, (3 \times 3) \times (15 \times 15)}$$
$$= 2 \times 2 \times 2 \times 3 \times 5$$
$$= 360$$

12. Using the formula :

Between n^2 and $(n + 1)^2 = 2n$ numbers

(i) Here $n = 18$

$$= 2 \times 18 = 36$$

(ii) Here $n = 97$

$$= 2 \times 97 = 194$$

13. Given : $2^2 + 3^2 + 6^2 = 7^2$;

$$3^2 + 4^2 + 12^2 = 13^2$$

Pattern : Third number = 1st number × IInd number

Result = (Third number + 1)^2

- Third number = 4 × 5 = 20
  Result = $(20 + 1)^2 = 21^2$
  $4^2 + 5^2 + 20^2 = \mathbf{21^2}$
- Third number = 8 × 9 = 72
  Result = $(72 + 1)^2 = 73^2$
  $8^2 + 9^2 + \mathbf{72^2} = \mathbf{73^2}$

NCERT Exercise

Figure it Out Questions

Page-10

1. Numbers ending in 2, 3, 7 or 8 are never perfect square.

(i) 2032 : Ends in 2. It is not a perfect square.

(ii) 2048 : Ends in 8. It is not a perfect square.

(iii) 1027 : Ends in 7. It is not a perfect square.

(iv) 1089 : Ends in 9. Since 33 × 33 = 1089. It is a perfect square.

2. The last digit of a square depends on the last digit of the number being squared.

- $64^2 \to 4^2 = 16$ (Ends in 6)
- $108^2 \to 8^2 = 64$ (Ends in 4)
- $292^2 \to 2^2 = 4$ (Ends in 4)
- $36^2 \to 6^2 = 36$ (Ends in 6)

108^2 and 292^2 have the last digit 4.

3. Using the formula $(n + 1)^2 = n^2 + n + (n + 1)$

$\Rightarrow$ Given : $125^2 = 15625$

$\Rightarrow$ here, $n = 125$

$$\Rightarrow (125 + 1)^2 = (125)^2 + 125 + (125 + 1)$$
$$= 15625 + 251$$
$$\Rightarrow 126^2 = 15876$$

4. Area of the square = side × side or s^2

Given : Area = 441

$$\Rightarrow s^2 = 441$$
$$\Rightarrow s = \sqrt{441}$$
$$= 21 \text{ m}$$

So, the side of the square is 21m.

5. To find the LCM of 4, 9 and 10

LCM (4, 9, 10) = $(2 \times 2) \times (3 \times 3) \times 5$

= 180

2	4, 9, 10
2	2, 9, 5
3	1, 9, 5
3	1, 3, 5
5	1, 1, 5
	1, 1, 1

To make 180 a perfect square, every prime factor must be in a pair, 5 is unpaired.

Smallest square number = $180 \times 5 = 900$

6. To find the prime factorization of 9408.

$9408 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 7 \times 7$

The factor 3 is not in pair. So, we multiply by 3.

2	9408
2	4704
2	2352
2	1176
2	588
2	294
3	147
7	49
7	7
	1

Product = $9408 \times 3 = 28224$

Square root = $\sqrt{28224} = 168$

7. Using the formula : numbers between n^2 and $(n + 1)2$ is $2n$.

(i) 16 and 17 : $2 \times 16 = 32$

(ii) 99 and 100 : $2 \times 99 = 198$

8. Pattern : $a^2 + b^2 + (ab)^2 = (ab + 1)^2$

$1^2 + 2^2 + 2^2 = 3^2$

$2^2 + 3^2 + 6^2 = 7^2$

$3^2 + 4^2 + 12^2 = 13^2$

$4^2 + 5^2 + 20^2 = (21)^2$

(Since $4 \times 5 = 20$ and $20 + 1 = 21$)

$9^2 + 10^2 + (90)^2 = (91)^2$

(Since $9 \times 10 = 90$ and $90 + 1 = 91$)

9. To find the total number of tiny squares.

There are 5×5 tiny squares in every block.

Total tiny squares in every block are 25.

There are 9×9 blocks in the image.

So, the tiny square is 25×81 or 2025.

Prime factorization of 2025 :

3	2025
3	675
3	225
3	75
5	25
5	5
	1

$3 \times 3 \times 3 \times 3 \times 5 \times 5 = 3^4 \times 5^2$

Page-16-17

1. $\sqrt[3]{27000} = \sqrt[3]{3 \times 3 \times 3 \times 10 \times 10 \times 10}$

$= 3 \times 10 = 30$

3	27000
3	9000
3	3000
10	1000
10	100
10	10
	1

$\sqrt[3]{10648} = \sqrt[3]{2 \times 2 \times 2 \times 11 \times 11 \times 11}$

$= 2 \times 11 = 22$

2	10648
2	5324
2	2662
11	1331
11	121
11	11
	1

2. Prime factorisation of 1323 :

$3 \times 3 \times 3 \times 7 \times 7$

3	1323
3	441
3	147
7	49
7	7
	1

To make it a perfect cube, every prime factor must be in a group of three.

Therefore, we must multiply the number 1323 by 7.

3. (i) False : The product of three odd numbers is always odd.

(ii) False : $2^3 = 8$ and $12^3 = 1728$; both are perfect cubes ending in 8.

(iii) False : The smallest 2-digit number is 10, and $10^3 = 1000$, which is a 4-digit number.

(iv) False : The largest 2-digit number is 99, and $99^3 = 970299$, which is a 6-digit number.

(v) False : Only perfect squares always have an odd number of factors.

4. 1331 : Ends in 1 $\rightarrow$ unit digit is 1. Between 10^3 (1000) and 20^3(8000) $\rightarrow$ 11

4913 : Ends in 3 $\rightarrow$ unit digit is 7 (since $7^3 = 343$). Between 10^3 and 20^3 $\rightarrow$ 17.

12167 : Ends in 7 $\rightarrow$ unit digit is 3 (since $3^3 = 27$). Between 20^3 (8000) and 30^3 (27000) $\rightarrow$ 23.

32768 : Ends in 8 $\rightarrow$ unit digit is 2 (since $2^3 = 8$). Between 30^3 (27000) and 40^3 (64000) $\rightarrow$ 32.

5. (i) $67^3 - 66^3 = 300763 - 287496 = 13267$

(ii) $43^3 - 42^3 = 79507 - 74088 = 5419$

(iii) $67^2 - 66^2 = 4489 - 4356 = 133$

(iv) $43^2 - 42^2 = 1849 - 1764 = 85$

So, the greatest (i) $67^3 - 66^3$.

2. Power Play

Page-15

Do it Now!

- The number of pixels after n seconds is given by :

$$P = 2^n$$

Assuming we start with 1 pixel at 0 seconds.

(i) **After 30 seconds**

here, $n = 30$

$\Rightarrow$ $2^n = 2^{30} \approx 1073741824$

(ii) **After 45 seconds**

here, $n = 45$

$\Rightarrow$ $2^n = 2^{45}$

≈ 35000000000000

Work it Out-1

1. (i) $7 \times 7 \times 7 \times 7 = 7^4$

(ii) $y \times y \times y = y^3$

(iii) $d \times d \times d \times d \times d = d^5$

(iv) $2 \times 2 \times a \times a \times b = 2^2 a^2 b$

(v) $3 \times 3 \times 3 \times 5 \times 5 \times 7 = 3^2 \times 5^2 \times 7$

(vi) $a \times a \times b \times b \times c \times c \times c = a^2 b^2 c^3$

2. (i) $600 = 2 \times 2 \times 2 \times 3 \times 5 \times 5 = 2^3 \times 3 \times 5^2$

2	600
2	300
2	150
3	75
5	25
5	5
	1

(ii) $720 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5$

$= 2^4 \times 3^2 \times 5$

2	720
2	360
2	180
2	90
3	45
3	15
5	5
	1

(iii) $840 = 2 \times 2 \times 2 \times 3 \times 5 \times 7$

$= 2^3 \times 3 \times 5 \times 7$

2	840
2	420
2	210
3	105
5	35
7	7
	1

(iv) $450 = 2 \times 3 \times 3 \times 5 \times 5 = 2 \times 3^2 \times 5^2$

2	450
3	225
3	75
5	25
5	5
	1

Work it Out-2

1. (i) $x^5 \times x^9 = x^{5+9} = x^{14}$

(ii) $(p^6)^3 = p^{6 \times 3} = p^{18}$

2. (i) $9^8 = (3^2)^8$ or $(3^8)^2$

(ii) $13^6 = (13^2)^3$ or $(13^3)^2$

(iii) $5^{12} = (5^3)^4$ or $(5^4)^3$

Page-20

Do it Now!

(i) PIN codes (6 digits)

A PIN code in India consists of 6 digits (0-9). The first digit cannot be 0. So there are 9 choices for the first digit and 10 choices for the remaining 5.

$= 9 \times 10 \times 10 \times 10 \times 10 \times 10$

= 900000 possible codes.

(ii) Phone number (10 digits)

In India, mobile numbers are 10 digits long and currently start with 6, 7, 8 or 9. For 10 slots with 10 options (0-9) each. So total possible numbers :

$4 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 4 \times 10^9$

Thus, 400 crore numbers are possible.

Work it Out-3

1. (i) $5^{-4} = \dfrac{1}{5^4}$

(ii) $20^{-5} = \dfrac{1}{20^5}$

(iii) $(-9)^{-3} = \dfrac{1}{(-9)^3}$

(iv) $(-3)^{-5} = \dfrac{1}{(-3)^5}$

(v) $(10)^{-10} = \dfrac{1}{10^{10}}$

2. (i) $2^{-3} \times 2^6 = 2^{-3+6} = 2^3$

(ii) $2^4 \times 2^{-7} \times 2^7 = 2^4 \times \dfrac{1}{2^7} \times 2^7 = 2^4$

(iii) $a^4 \times a^{-6} = a^4 \times \dfrac{1}{a^6} = a^4 \times a^{-6}$

$= a^{\{4 + (-6)\}}$

$= a^{-2}$

(iv) $4^5 \times (-6)^{-2} = 4^5 \times \dfrac{1}{(-6)^2}$

(v) $5^a \times 5^b = 5^{a+b}$

Page-21

Do it Now!

(i) Using the law of exponents :

$$\frac{a^m}{a^n} = a^{m-n}$$

$$\text{Ratio} = \frac{5^3}{5^{-3}}$$

$= 5^3 \times 5^3$

$= 5^{3+3} = 5^6$

$= 15,625$

(ii) $36^3 \times x = 1679616$

$$x = \frac{1679616}{36^3} = \frac{1679616}{46656}$$

$= 36 = 6^2$

$36^3 \times x = 6^{-3}$

$$x = \frac{6^{-3}}{36^3} = \frac{6^{-3}}{(6^2)^3} = \frac{6^{-3}}{6^6}$$

$$= \frac{1}{6^3} \times \frac{1}{6^6} = \frac{1}{6^{3+6}} = \frac{1}{6^9}$$

$6^{-2} \times x = 6^2$

$$x = \frac{6^2}{6^{-2}}$$

$= 6^2 \times 6^{+2} = 6^{2+2} = 6^4$

$6^5 \div x = 6^{-2}$

$$\frac{6^5}{x} = 6^{-2}$$

$$\Rightarrow \quad x = \frac{6^5}{6^{-2}}$$

$= 6^5 \times 6^2 = 6^{5+2} = 6^7$

Page-21

Do it Now!

(i) $882 = 800 + 80 + 2$

$= (8 \times 100) + (8 \times 10) + (2 \times 1)$

$= 8 \times 10^2 + 8 \times 10^1 + 2 \times 10^0$

(ii) $9017 = 9000 + 0 + 10 + 7$

$= (9 \times 1000) + (0 \times 100) + (1 \times 10) + (7 \times 1)$

$= 9 \times 10^3 + 0 \times 10^2 + 1 \times 10^1 + 7 \times 10^0$

(iii) $8174 = 8000 + 100 + 70 + 4$

$= (8 \times 1000) + (1 \times 100) + (7 \times 10) + (4 \times 1)$

$= 8 \times 10^3 + 1 \times 10^2 + 7 \times 10^1 + 4 \times 10^0$

Page-23

Do it Now!

1. Distance from Sun to Mars

$= 2.279 \times 10^{11}$m (given)

Average distance from Sun to Earth

$= 1.496 \times 10^{11}$m

Fraction $= \dfrac{1.496}{2.279} \approx \dfrac{2}{3}$

This distance is about $\left(\dfrac{2}{3}\right)^{\text{rd}}$ of the way from the Sun to Mars.

Thus, 1.496×10^{11} m

Sun Earth Mars

2. (i) $74900 = 7.49 \times 10^4$

(ii) $125000 = 1.25 \times 10^5$

(iii) $8849 = 8.849 \times 10^3$

(iv) $602200000000000000000000 = 6.022 \times 10^{23}$

Page-24

Do it Now!

- First, convert Zara's weight into grams.

  42 kg = 42 × 1000 = 42000 g

  Given: Weight of one ₹5 coin = 6g

  Formula used:

  Number of coins = Total weight ÷ Weight of one coin

  Number of coins = 42000 ÷ 6 = 7000

  So, Zara would need seven thousand ₹5 coins to equal her weight.

Page-24

Do it Now!

- Assume that a person walks at an average speed of 5 km per hour, walks 8 hours every day, and has an average lifetime of 70 years.

  Distance walked per day = 5 × 8 = 40 km

  Distance walked per year = 40 × 365

  = 14,600 km

  Distance walked in a lifetime

  = 14,600 × 70 = 1,022,000 km

  Formula used :

  Number of rounds = Total distance ÷ Circumference of Earth

  Number of rounds = 1,022,000 ÷ 40,000

  ≈ 25.55

  So, a person can walk around the Earth about **25.55 times** in their lifetime.

Page-25

Do it Now!

- Linear growth means something increases by the same amount every time.

  Example (Savings):

  Suppose a student saves ₹200 every month.

  $A = a + n \times d$

  After 12 months:

  $A = 0 + 12 \times 200$

  $= ₹2400$

  Example (Plant height):

  A plant grows 3 cm every week.

  After 10 weeks = 3 × 10 = 30 cm

  So, saving money regularly and steady plant growth are examples of linear growth.

  Exponential growth means something increases by multiplying again and again.

  Example (Bacteria):

  If bacteria double every hour and start from 1.

  $A = a \times r^n$

  After 5 hours: $A = 1 \times 2^5 = 32$

  Example (Money in bank):

  If ₹1000 grows at 10% per year.

  After 2 years:

  $$A = 1000 \times \left(1 + \frac{10}{100}\right)^2$$

  $= 1000 \times 1.1^2 = ₹1210$

  So, bacteria growth and money with compound interest are examples of exponential growth.

Work it Out-4

1. Given: Humans $= 9 \times 10^9$,

Ants $= 3 \times 10^{16}$

Number per person = Total ants ÷ Total humans

Ants per human $= (3 \times 10^{16}) \div (9 \times 10^9)$

$= (3 \div 9) \times 10^{16} \times 10^{-9} = 10^{(16-9)}$

$= \frac{1}{3} \times 10^7$

$= 3.33 \times 10^6$

So, there are about three million three hundred thirty thousand ants per human.

2. Given: Total geese $= 2 \times 10^9$,

Geese per flock $= 5000 = 5 \times 10^3$

Number of flocks = Total geese ÷ Geese per flock

Number of flocks $= (2 \times 10^9) \div (5 \times 10^3)$

$= (2 \div 5) \times 10^{(9-3)}$

$= (2 \div 5) \times 10^6$

$= 0.4 \times 10^6 = 4 \times 10^5$

So, four hundred thousand flocks can be formed.

3. Given: Leaves per tree $= 10^4$,

Trees $= 2.5 \times 10^{12}$

Total = Number of trees × leaves per tree.

Total leaves $= (2.5 \times 10^{12}) \times (10^4)$

$= 2.5 \times 10^{16}$

So, there are 2.5×10^{16} leaves in the world.

4. Given: Thickness of one sheet

$= 0.1$ mm $= 10^{-4}$ m

Distance to Moon = 380,000 km

$= 3.8 \times 10^8$ m

Number of sheets = Total distance ÷ Thickness of one sheet

Number of sheets $= (3.8 \times 10^8) \div (10^{-4})$

$= 3.8 \times 10^{12}$

So, about 3.8×10^{12} sheets of paper are needed to reach the Moon.

Page-27

Do it Now!

1. Given: Number of stars $= 10^{23}$,

Counting rate = 1 star per second

Time = Total number ÷ Rate

Time $= 10^{23} \div 1$

$= 10^{23}$ seconds

1 year $= 3.15 \times 10^7$ seconds

Time in years $= 10^{23} \div (3.15 \times 10^7)$

$\approx 3.17 \times 10^{15}$ years

So, it would take about three quadrillion years to count all the stars.

2. Given: Total water $= 1.4 \times 10^{21}$ litres,

One glass = 250 ml = 0.25 litres,

Time per glass = 12 seconds

Time = Total amount ÷ Rate

Number of glasses $= (1.4 \times 10^{21}) \div 0.25$

$= 5.6 \times 10^{21}$

Total time $= (5.6 \times 10^{21}) \times 12$

$= 67.2 \times 10^{21}$

$= 6.72 \times 10^{22}$ seconds

1 year $= 3.15 \times 10^7$ seconds

Time in years $= (6.72 \times 10^{22}) \div (3.15 \times 10^7)$

$= (6.72 \div 3.15) \times 10^{(22-7)}$

$\approx 2.13 \times 10^{15}$ years

So, it would take about two quadrillion years to drink all the water on Earth.

Work it Out-5

1. Given: $8^{24} \times 2^{12}$, and $8 = 2^3$

So, $8^{24} \times 2^{12} = (2^3)^{24} \times 2^{12}$

$\because \quad a^m \times a^n = a^{m+n}$

$2^{72} \times 2^{12} = 2^{84}$

Units digit of powers of 2 repeats as 2, 4, 8, 6

84 ÷ 4 = 21 remainder 0, so units digit = 6

So, the units digit is 6.

2. Given: Initial bottles = 7,

Daily increase = 7, Days = 50

Total $= a + n \times d$

Total bottles $= 7 + 50 \times 7$

$= 7 + 350 = 357$

So, there will be three hundred fifty-seven bottles after 50 days.

3. Given: Number = 2400

$2400 = 24 \times 100 = 24 \times 10^2$

$2400 = 6 \times 400 = 6 \times 20^2$

$2400 = 3 \times 800$

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

So, three forms are:

$2400 = 24 \times 10^2$,

$2400 = 6 \times 20^2$,

$2400 = 3 \times 2^3 \times 10^2$

So, 2400 can be expressed in different ways using powers.

4. (i) Sometimes True ($64 = 8^2 = 4^3$)

(ii) Always True ($a^4 = (a^2)^2$)

(iii) Always True ($a^3 \div a^3 = a^2$)

(iv) Always True ($(a^2)(b^2) = (ab)^2$)

5. (i) $7^{-3} \times 7^{-4} = 7^{-7}$

(ii) $5^{-8} \div 5^2 = 5^{-10}$

(iii) $P^4Q^3 \times PQ^5 = P^{(4+1)} \times Q^{(3+5)} = P^5Q^8$

(iv) $(11^3)^{-2} = 11^{-6}$

6. Given: $15^2 = 225$

(i) $(1.5)^2 = 2.25$

(ii) $(0.15)^2 = 0.0225$

(iii) $150^2 = 22500$

(iv) $1500^2 = 2250000$

So, the values are: 2.25, 0.0225, 22500, 2250000.

7. $5^4 \times 2^4 = (10)^4 = 10^4$

$10^8 \neq 10^4$

$10^{16} \neq 10^4$

$20^4 \div 2^4 = 10^4$

So, $5^4 \times 2^4$ and $20^4 \div 2^4$ are equivalent.

8. (i) $5^2 = 25, 2^5 = 32 = 5^2 < 2^5$

(ii) $3^5 = 243, 5^3 = 125 \rightarrow 3^5$ is larger

(iii) $1000^3 = 10^9$, 3^{1000} is much larger

So, the answers are: Equal, 3^5, 3^{1000}

9. Given: 8 digits, 8 choices

Total $= n^r$

Total $= 8^8 = 16{,}777{,}216$

So, sixteen million seven hundred seventy-seven thousand two hundred sixteen IDs are possible.

10. Such numbers are sixth powers:

$n^6 = (n^3)^2 = (n^2)^3$

Examples: 64, 729, 4096

So, all numbers of the form n^6 have this property.

11. Given: 26 + 26 + 10 = 62 choices

Total $= n^r$

Total $= 62^6 = 5.68 \times 10^{10}$

So, about fifty-six billion passwords are possible.

12. Total $= 10^{11} + 10^{11} = 2 \times 10^{11}$

So, about two hundred billion uploads.

13. (i) $500000 \times 20 = 10{,}000{,}000 = 1 \times 10^7$

(ii) $(2 \times 10^{15}) : (10^{11}) = 2 \times 10^4$

(iii) $90 \times 10^{23} = 9 \times 10^{22}$

(iv) $13.8 \times 10^9 \times 3.15 \times 10^7 \approx 4.35 \times 10^{17}$

So, the answers are:

1×10^7, 2×10^4, 9×10^{22}, 4.35×10^{17}.

14. Given: 2×10^9 seconds

1 year $= 3.15 \times 10^7$ seconds

Time $= (2 \times 10^9) \div (3.15 \times 10^7)$

≈ 63.5 years

2025-63 ≈ 1962

So, the date is approximately in the year nineteen sixty-two.

Connect and Reflect

[A] Multiple Choice Questions:

1. (B), **2.** (C), **3.** (D), **4.** (B), **5.** (C).

[B] Fill in the blanks:

1. 1, **2.** exponent (or power), **3.** exponential, **4.** $n^{\{a-b\}}$, **5.** billion.

[C] State True or False:

1. False, **2.** False, **3.** True, **4.** True, **5.** True.

[D] Subjective Questions:

1. In the expression $(-4)^3$, the **base** is –4.

2. The number 10^{100} (1 followed by 100 zeros) is called a **googol**.

3. A fixed additive increase, like climbing a ladder, is an example of **linear growth.**

4. The exponential form of $2 \times 2 \times a \times a$ is $2^2 a^2$ or $(2a)^2$.

5. The thickness of a paper doubles after every **fold**.

6. The expression $7 \times 7 \times 7 \times P \times P \times Q \times Q \times Q \times Q$ in exponential form is $7^3 P^2Q^4$.

7. The prime factorization of 720 is $2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5$, which in exponential form is $2^4 \times 3^2 \times 5^1$.

8. Using the power rule, $(-4)^3 \times (-2)^2 = (-64) \times 4 = -256$.

9. Since $2^{10} = 1024$ and $10^3 = 1000$, the greater number is 2^{10}.

10. Using the exponential form, there are 10 choices for each of the 4 digits, so the total number of unique codes is $10 \times 10 \times 10 \times 10$, which is 10^4.

NCERT Exercise

Figure it Out-1

Page-22

1. Using the formula $x \times x \times \ldots$ (n times) $= x^n$:

(i) 6^4

(ii) y^2

(iii) b^4

(iv) $5^2 \times 7^3$

(v) $2^2 \times a^2$

(vi) $a^3 \times c^4 \times d$.

2. By dividing the numbers by prime factors:

(i) $648 = 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3$

$= 2^3 \times 3^4$

(ii) $405 = 3 \times 3 \times 3 \times 3 \times 5 = 3^4 \times 5^1$

(iii) $540 = 2 \times 2 \times 3 \times 3 \times 3 \times 5$
$= 2^2 \times 3^3 \times 5^1$

(iv) $3600 = 2^4 \times 3^2 \times 5^2$

3. Using the formula a^n = multiply a, n times:

(i) $2 \times 1000 = 2000$

(ii) $49 \times 8 = 392$

(iii) $3 \times 256 = 768$

(iv) $9 \times 25 = 225$

(v) $9 \times 10000 = 90000$

(vi) $-32 \times 1000000 = -32{,}000{,}000$

Page-44

1. Using $a^m \div a^n = a^{m-n}$; $2^{224} \div (2^2)^{32}$ $= 2^{224} \div 2^{64} = 2^{160}$. Powers of 2 follow a unit digit cycle (2, 4, 8, 6). Since 160 is a multiple of 4, the **units digit is 6**.

2. Using Multiplication: 5 bottles × 40 days = 200 bottles.

3. Using $(a^m)^n = a^{mn}$;

(i) 64^3 is 2^{18}, 4^9, 8^6, or $2^{12} \times 2^6$, $4^6 \times 2^6$, $8^4 \times 2^6$

(ii) 192^8 is $192^4 \times 192^4$, $(192^2)^4$, $192^7 \times 192^1$ or $2^{48} \times 3^8$, $4^{24} \times 3^8$, $8^{16} \times 3^8$

(iii) 32^{-5} is 2^{-25}, $(2^{-5})^5$, $32^{-2} \times 32^{-3}$ or $2^{-10} \times 2^{-15}$, $2^{-5} \times 2^{-20}$

4. (i) Sometimes True (e.g., $64 = 8^2$ and 4^3).

(ii) Always True ($a^4 = (a^2)^2$),

(iii) Always True ($x^5 \div x^3 = x^2$).

(iv) Always True ($a^3 \times b^3 = (ab)^3$),

(v) Never True (46 is not a multiple of 4 or 6).

5. Using $a^m \times a^n = a^{m+n}$ and $a^m \div a^n = a^{m-n}$.

(i) $10^{(-2-5)} = 10^{-7}$

(ii) $5^{(7-4)} = 5^3$

(iii) $9^{(-7-4)} = 9^{-11}$

(iv) $m^{(5+9)}\, n^{(12+9)} = m^{14}n^{21}$

(v) $(13^{-2})^{-3} = 13^6$.

6. (i) $1.2 \times 1.2 = 1.44$

(ii) $0.12 \times 0.12 = 0.0144$

(iii) $0.012 \times 0.012 = 0.000144$

(iv) $120 \times 120 = 14400$.

7. The same numbers are $2^4 \times 3^6$ and $18^2 \times 6^2$ (both equal 11664).

8. (i) $3^4 = 81 > 4^3 = 64$.

(ii) $8^9 = (2^3)^9 = 2^{27} > 2^8$.

(iii) $2^{100} > 100^2$.

9. 8.5 billion is 8.5×10^9. To have enough unique IDs, the code needs **10 digits** ($10^{10} > 8.5 \times 10^9$).

10. Yes, numbers like $729 = 27^2 = 9^3$. Generally, any number that is a **6th power** (n^6) is both a square and a cube.

11. Total choices = (26 letters + 10 digits)^5 $= 36^5$.

12. $10^9 + 10^9 = 2 \times 10^9$. Correct options are (v) and (vi).

13. Using Scientific Notation $a \times 10^n$:

(i) $8 \times 10^9 \times 30 = 2.4 \times 10^{11}$.

(ii) $10^8 \times 5 \times 10^4 = 5 \times 10^{12}$.

(iii) $8 \times 10^9 \times 3.8 \times 10^{13} = 3.04 \times 10^{23}$.

14. Approx 2.5×10^9 seconds (based on 80-years life).

1 billion seconds is ≈ 31.7 years. Subtracting from Feb 2026, the date was in **June 1994.**

3. A Story of Number

Page-34

Do it Now!

- AA means 1 group of 26 and 1 extra letter, which makes 27. This shows that the alphabet system is working like the place value system.

Work it Out-1

1. Group of 5 sticks = |||||

Group of 3 sticks = |||

Total = ||||| + ||| = 5 + 3 = 8 Answer

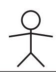
Group of 9 sticks = |||||||||

Remove 4 sticks = ||||

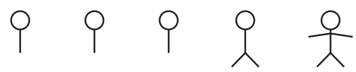
Remaining 5 sticks = |||||

So, 9 – 4 = 5 Answer

2. Let our own number system has :

1	5	10
		

36 = 10 + 10 + 10 + 5 + 1

= 

Work it Out-2

1. Early humans used body parts for counting because they were convenient, always available, and provided a natural physical reference before formal number systems or tools were invented.

2. Tally marks are one of the earliest ways people used to represent numbers by drawing repeated straight lines on surfaces like bones, stones, or number of lines shows the overall quantity of objects.

3. The Gumulgal people represented the number 5 as "meriman", which was a combination based on their counting system that used body parts and specific names for quantities.

4. Counting in groups was better than counting one by one because it made keeping track of large quantities much faster, reduced the chance of making errors, and allowed for easier mental organization.

5. If a number system only counts in groups of a single size like 5s, it becomes very difficult and tedious to represent and communicate extremely large numbers without having larger secondary groupings like 10s, 100s, or 1000s.

Work it Out-3

1. (i) MCCLVI (ii) CCCII
   (iii) MMCMLXXXIX (iv) DCCXV

2. LXXVII + LXXVIII = 77 + 78 = 155, which is CLV

3. V × X = 5 × 10 = 50 (L); X × C = 10 × 100 = 1000 (M); the formula used is Value = Symbol 1 × Symbol 2

4. Roman numerals became less efficient because they lack a symbol for zero and do not use place value, making long calculations like multiplication and division extremely difficult.

5. A tribe might use different sequences to provide more context about the size, shape, or importance of the objects, or because their culture views "five fish" as fundamentally different from "five stones."

6. The Gumulgal system uses 1 = urapon, 2 = ukasar; 6 is (2 + 2 + 2) ukasar-ukasar-ukasar; so 8 is (2 + 2 + 2 + 2) ukasar-ukasar-ukasar-ukasar and 10 is (2 + 2 + 2 + 2 + 2) ukasar-ukasar-ukasar-ukasar-ukasar.

Page-37

Do it Now!

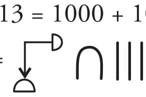
1. The Hindu-Arabic system is better than Roman numerals because it uses place value and zero, needs only ten digits, and makes calculations easy. To improve your own number system, use grouping choose a base, apply place value, and add a zero symbol.

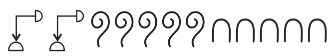
   To refine the number system based on body parts or tally marks and make it easier to represent larger numbers, we can introduce grouping and place value ideas.

   If we are using body parts for counting, instead of counting each number one by one, we can assign fixed values to different body parts.

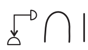
Work it Out-4

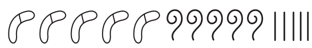
1. (i) 10458
   = 10000 + 100 + 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1
   = 

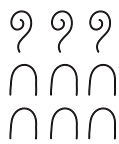
   (ii) 1013 = 1000 + 10 + 1 + 1 + 1.
   = 

   (iii) 2550 = 1000 + 1000 + 100 + 100 + 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10
   = 

   (iv) 584 = 100 + 100 + 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1
   = 

   (v) 1011 = 1000 + 10 + 1
   = 

   (vi) 50505 = 10000 + 10000 + 10000 + 10000 + 10000 + 100 + 100 + 100 + 100 + 100 + 1 + 1 + 1 + 1 + 1
   = 

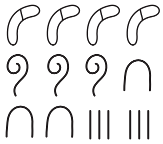
2. (i)  = 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10 + 10

∩ ||| ||

+ 10 + 1 + 1 + 1 + 1 + 1

= 375

(ii)



$10^4 + 10^4 + 10^4 + 10^4$

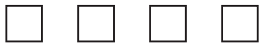
$= + 10^2 + 10^2 + 10^2 + 10$

$+ 10 + 10 + 1 + 1 + 1 + 1 + 1 + 1$

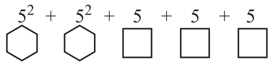
$= 40336$

Work it Out-5

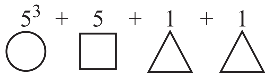
1. (i) 20 = 5 + 5 + 5 + 5



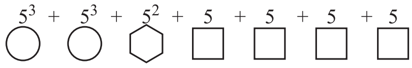
(ii) 65 = $5^2 + 5^2 + 5 + 5 + 5$



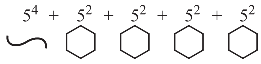
(iii) 132 = $5^3 + 5 + 1 + 1$



(iv) 295 = $5^3 + 5^3 + 5^2 + 5 + 5 + 5 + 5$



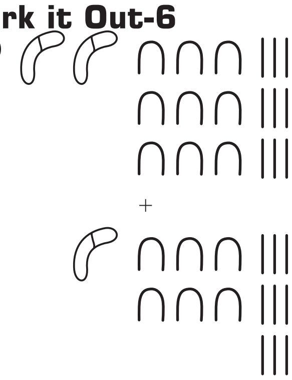
(v) 725 = $5^4 + 5^2 + 5^2 + 5^2 + 5^2$



2. No, every numbr can be written in base 5.

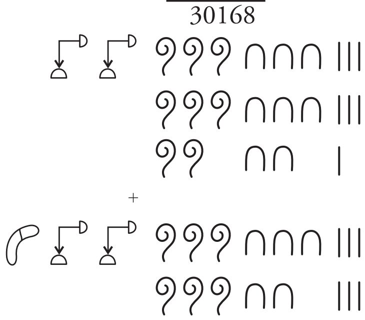
Work it Out-6

1. (i)



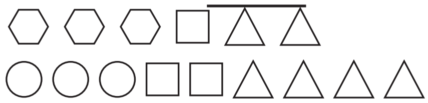
$$\begin{array}{r} 20099 \\ = + 10069 \\ \hline 30168 \end{array}$$

(ii)



$$\Rightarrow \begin{array}{r} 2887 \\ + 12656 \\ \hline 15543 \end{array}$$

2.



$= 5^2 + 5^2 + 5^2 + 5^1 + 5^0 + 5^0$

$+ 5^3 + 5^3 + 5^3 + 5^1 + 5^1 + 5^0 + 5^0 + 5^0$

$+ 5^0$

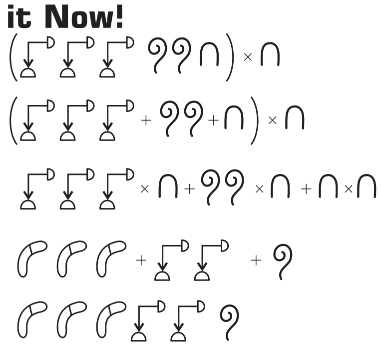
$= 25 + 25 + 25 + 5 + 1 + 1 + 125 + 125$

$+ 125 + 5 + 5 + 1 + 1 + 1 + 1 = 471$

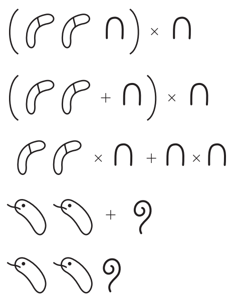
Page-41

Do it Now!

(i)



(ii)



Page-42

Do it Now!

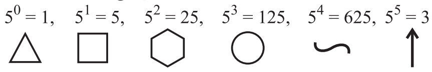
Do yourself.

Work it Out-7

1. No, in the Egyptian numeral system, a symbol is not written more than 9 times. If reaches 10, it is replaced by the next higher symbol.

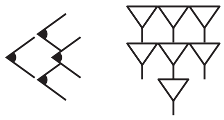
2. The rule for multiplying any number by 5 in base – 5 number system is the land mark number as the Power of 5, i.e., 5^0, 5^1, 5^2, 5^3, 5^4, 5^5, which corresponds to the following symbols.

$5^0 = 1$, $5^1 = 5$, $5^2 = 25$, $5^3 = 125$, $5^4 = 625$, $5^5 = 3125$,

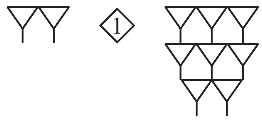


Work it Out-8

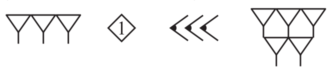
1. (i) 47 = 40 + 7

= 

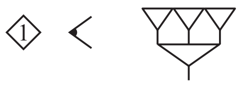
(ii) 128 = 2 × 60 + 8

= 

(iii) 215 = 3 × 60 + 30 + 5

= 

(iv) 74 = 60^1 + 10 + 4

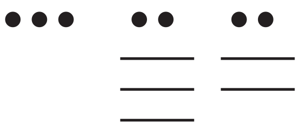
= 

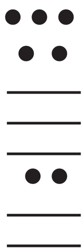
(v) 3825 = 60^2 + 3 × 60 + 40 + 5

= 

Work it Out-9

1. (i) 1432 = 360 × 3 + 20 × 17 + 1 × 12

= 

= 

(ii) 3740 = 360 × 10 + 20 × 7 + 1 × 10

= 

= 

Do it Now!

Page-47

Chinese alternated between vertical and horizontal rods to clearly show different place value and avoid confusion between adjacent digits.

Work it Out-10

1. The Hindu number system is called a place value system because the value of digit changes with its position for example in 642, the digit 6 means 600 while 64, the digit 6 means 60.

2. Brahmagupta gave the first clear rules for using zero in calculations and treated it as a proper number in his book Brahmasphutasiddanta.

3. Ancient civilisations created landmark numbers to make counting and calculations easier.

4. If humans had only 8 fingers, they would most naturally have used the base-8 number system, because usually develops from the number of fingers.

Connect and Reflect

Based on the questions provided in the image, here are the direct solutions :

[A] Multiple Choice Questions:

1. (b), **2.** (a), **3.** (c), **4.** (c), **5.** (c)

[B] Fill in the blanks:

1. 0 to 9, **2.** L, **3.** Seashell, **4.** Powers,
5. Decimal (base-10)

[C] State True or False:

1. True, **2.** False, **3.** True, **4.** False, **5.** True

[D] Subjective Questions:

1. Al-Khwarizmi explained the Hindu numerals to the Arab world.

2. Early humans era civilizations (found in modern-day Congo) used the Ishango bone.

3. The Roman numeral for 1000 is M.

4. Aryabhata used zero explicitly in computations around 499 CE.

5. The Hindu numeral system is also sometimes called the Indo-Arabic numeral system.

6. Using the formula Symbols = Total Value:

(i) 7 is represented as ○ + △ + △
= (5 + 1 + 1).

(ii) 14 is represented as □ + △ + △ + △ + △
= (10 + 4)

(iii) 28 is represented
□ + □ + ○ + △ + △ + △
= (10 + 10 + 5 + 3).

7. (i) 7 in base-4 is 13 (since $1 \times 4 + 3 = 7$).

$7 = 4 + 1 + 1 + 1$

= □ ◇ ◇ ◇

(ii) 23 in base-4 is 113 (since $1 \times 16 + 1 \times 4 + 3 = 23$).

$\Rightarrow 23 = 16 + 4 + 1 + 1 + 1$

△ □ ◇ ◇ ◇

(iii) 45 in base-4 is 231 (since $2 \times 16 + 3 \times 4 + 1 = 45$).

$\Rightarrow 45 = 16 + 16 + 4 + 4 + 4 + 1$

△ △ □ □ □ ◇

8. Using the additive and subtractive rules of Roman numerals:

(i) XV + XXV = XXXX

or XL (15 + 25 = 40).

(ii) XL – X = XXX (40 – 10 = 30).

The final answers are XL and XXX.

9. The digit 0 is essential as a placeholder to distinguish between different place values.

For example, without 0, the number 205 and 25 would look exactly the same (25), causing total confusion.

NCERT Exercise

Figure it Out Questions

Page-54

1. Using the formula Sum = Collection A + Collection B, addition is done by placing all sticks from both groups together into one pile.

Using the formula Difference = Collection A - Collection B, subtraction is done by removing one stick from the first pile for every stick present in the second pile.

Using the formula Product = Collection A × Collection B, multiplication is done by laying out the number of sticks in the first pile as many times as there are sticks in the second pile.

Using the formula Quotient = Collection A ÷ Collection B, division is done by repeatedly grouping sticks from the main pile into smaller sets equal to the size of the divisor pile until no more full sets can be made.

The final answers are combining piles, removing matching sticks, repeating piles, and grouping piles.

2. Using the formula Base-26 Positional System, the system can be extended by using a "place value" method similar to our decimal system.

Once "z" is reached at 26, the next number becomes "aa" for 27, "ab" for 28, and so on, adding a new letter to the left each time a cycle of 26 is completed.

The final answer is adding letters to the left to create higher place values.

3. My number system uses dots (.) for 1 and dashes (–) for 5, based on the formula Value = (Total dots × 1) + (Total dashes × 5).

In this system, the number 13 is represented as (- - ...) because $(2 \times 5) + (3 \times 1) = 13$.

The final answer is a dot and dash system where a dash equals five and a dot equals one.

Questions from Page-59

1. (i) Using the formula 1222 = 1000 + 100 + 100 + 10 + 10 + 2, the Roman numeral is MCCXXII.

(ii) Using the formula 2999 = 1000 + 1000 + (1000 – 100) + (100 – 10) + (10 – 1), the Roman numeral is MMCMXCIX.

(iii) Using the formula 302 = 100 + 100 + 100 + 2, the Roman numeral is CCCII.

(iv) Using the formula 715 = 500 + 100 + 100 + 10 + 5, the Roman numeral is DCCXV.

Page-60, 61

1. This likely occurs because different objects hold different cultural or practical values, requiring specialized counting systems for trade or inventory.

2. Using the formula (ukasar = 2, urapon = 1):

(i) $(2 + 2 + 2 + 2 + 1) + (2 + 2 + 2 + 1) = 9 + 7 = 16$, which is ukasar-ukasar-ukasar-ukasar-ukasar-ukasar-ukasar-ukasar.

(ii) $(2 + 2 + 2 + 2 + 1) - (2 + 2 + 2) = 9 - 6 = 3$, which is ukasar-urapon.

(iii) $(2 + 2 + 2 + 2 + 1) \times (2 + 2) = 9 \times 4 = 36$, which is eighteen repetitions of ukasar.

(iv) $(2 + 2 + 2 + 2 + 2 + 2 + 2 + 2) \div (2 + 2)$
$= 16 \div 4 = 4$, which is ukasar-ukasar.

3. The Hindu system is more efficient because it uses the formula Place Value = Digit × Base^n and a symbol for zero.

Unlike the Roman system, which is mainly additive, the Hindu system allows for representing very large numbers with only ten digits.

4. Do your self

Page-62

1. (i) $10458 = 10000 + 100 + 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1$
$= 10^4 + 4 \times 10^2 + 5\ 10^1 + 8 \times 10^0$
= 

(ii) $1023 = 1000 + 10 + 10 + 1 + 1 + 1$
= 

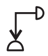
(iii) $2660 = 1000 + 1000 + 100 + 100 + 100 + 100 + 100 + 100 + 10 + 10 + 10 + 10 + 10 + 10$
$= 2 \times 1000 + 6 \times 100 + 6 \times 10$
= 

(iv) $784 = 7 \times 100 + 8 \times 10 + 4 \times 10^0$
= 

(v) $1111 = 1000 + 100 + 10 + 1$
= 

(vi) $70707 = 7 \times 1000 + 7 \times 100 + 7 \times 10^0$
= 

2. (i) 2 ×  + 7 × ∩ + 6 × |
$= 2 \times 10^2 + 7 \times 10 + 6 \times 1 = 276$

(ii) 4 ×  + 3 ×  + 2 × ∩
$= 4 \times 10^3 + 3 \times 10^2 + 2 \times 10 = 4322$

Page-63

1. (i) $15 = 3 \times 5^1 + 0 \times 5^0$
= □ □ □

(ii) $50 = 2 \times 5^2 + 0 \times 5^1 + 0 \times 5^0$
= ⬡ ⬡

(iii) $137 = 1 \times 5^3 + 0 \times 5^2 + 2 \times 5^1 + 2 \times 5^0$
= ○ □ □ △ △

(iv) $293 = 2 \times 5^3 + 1 \times 5^2 + 3 \times 5^1 + 3 \times 5^0$
= ○ ○ ⬡ □ □ □ △ △ △

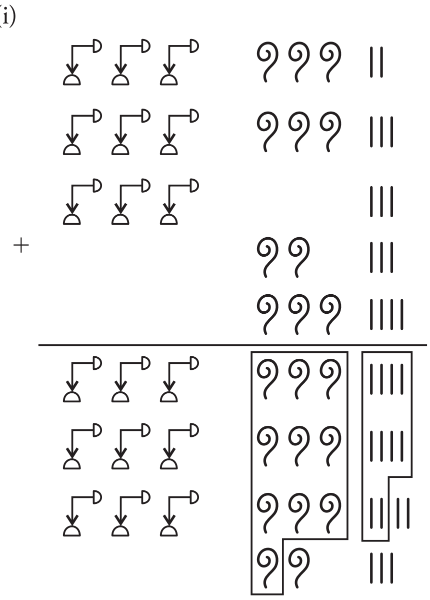
(v) $651 = 1 \times 5^4 + 0 \times 5^3 + 1 \times 5^2 + 0 \times 5^1 + 1 \times 5^0$
= 

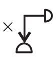
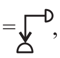
2. No, every number can be written in the base-5 system because any positive integer can be expressed as a sum of power of 5 with digits from 0 to 4. This shows the importance of the positional number system.

3. In a base-7 system, the land mark numbers are the powers of 7,
i.e., $7^0 = 1, 7^1 = 7, 7^2 = 49, 7^3 = 343$ .....

Page-65

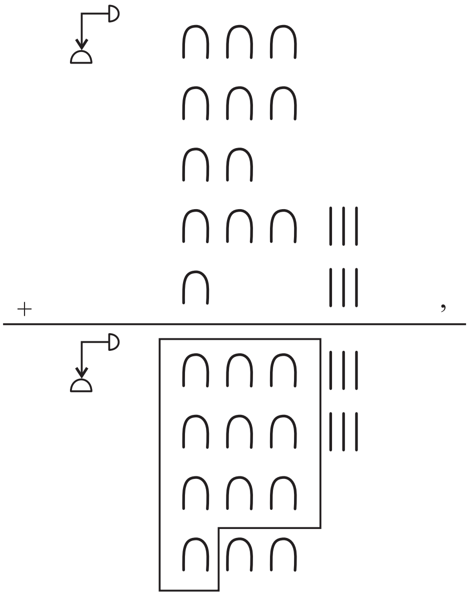
1. (i)

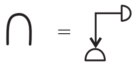


Since, 10×  = , 10 ×  = , 10×1= ∩

Hence, the Sum = 

(ii)



Since, 10 × 

Hence, the Sum = 

Page-69-70

1. No, a number in the Egytian system can not have any symbol repeated 10 or more times. When 10 same symbols occur, they are replaced by the next higher power of 10 symbol.

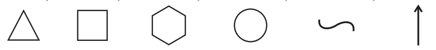
e.g., |||||||||| = ∩

2. In a base-4 system, the digits used are 0, 1, 2 and 3. The place values are powers of 4 : $4^0 = 1$, $4^1 = 4$, $4^2 = 16$ and so on.

Thus, base-10 numbers from 1 to 16 can be written in base-4 using three digits and powers of 4.

3. In base-5 system, the symbols for land mark numbers we use, are

$5^0 = 1$, $5^1 = 5$, $5^2 = 25$, $5^3 = 125$, $5^4 = 625$, $5^5 = 3125$,



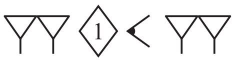
In the base-5 system, multiplying a number by 5 is done by adding a '0' at the end of the number. This follows from the distributive property.

Page-73

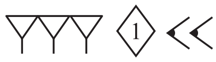
1. (i) 63 = 1 × 60 + 3

= 

(ii) 132 = 2 × 60 + 10 + 2

= 

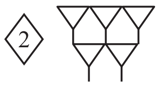
(iii) 200 = 3 × 60 + 2 × 10

= 

(iv) 60 = 1 × 60

= 

(v) 3605 = $60^2 + 5$

= 

Page-80

1. The chinese alternated between Zong (vertical) and Heng (horizontal) symbols to show different place values clearly.

If only vertical rods were used, 41 (four rods and one rod) could look like 5 without proper spacing, so aternation avoided confusion.

2. In a base-2 system, only two symbols, 0 and 1, are used. Here, represent 0 by urapon and 1 by ukasar. Thus, the base-2 system in Gumulgal's style is formed using these two symbols.

Decimal System	New Base-2 System	Gumulgal's style Base-2 System
0	—	urapon
1	—	ukasar
2	$2 = 1 \times 2^1 + 0 \times 2^0 = 10$	ukasar-urapon
3	$3 = 1 \times 2^1 + 1 \times 2^0 = 11$	uksar-ukasar
4	$4 = 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 = 100$	ukasar-urapon-urapon
5	$5 = 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 101$	ukasar-urapon-ukasar
6	$6 = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 110$	ukasar-ukasar-urapon

Comparison :

(i) Out base-2 system can represent unlimited numbers, but the original Gumulgal system could not, as they used "ras" after 6.

(ii) Our base-2 system follows the place value system, while the Gumulgal system does not.

3. Do yourself.

4. Converting number 25 into different bases, the value 25 remains the same, but its representation changes depending on the "base" (number of fingers/symbols) used :

Base System	Symbol	Mathematical Breakdown	Result
Base-10	0–9	$2 \times 10^1 + 5 \times 10^0$	25
Base-8	0–7	$3 \times 8^1 + 1 \times 8^0$	31
Base-5	0–4	$1 \times 5^2 + 0 \times 5^1 + 0 \times 5^0$	100
Base-2	0–1	$1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$	11001

4. Quadrilaterals

Page-51

Do it Now!

- Yes, a rectangle can be defined as a parallelogram with at least one right angle or as a parallelogram whose diagonals are equal in length.

Page-53

Do it Now!

Based on the properties shown in the image, the quadrilateral PQRS is a rectangle.

- **Equal Diagonals :** The markings on the segments indicate that PO = OS = RO = OQ.

  This means the diagonals PR and QS are equal in length and bisect each other.
- **Right Angles** : At each vertex, the two angles add up to 90° (e.g., 40° + 50° = 90°). A quardrilateral with four right angles is a rectangle.
- **Opposite side** : The alternate intenor angles are equal (40° and 40°), proving that opporite sides are plaralle.

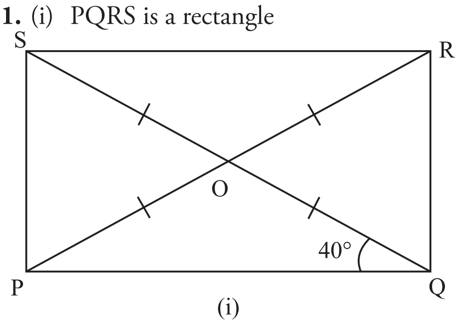
Page-55

Do it Now!

Yes, It will still always form a rectangle. Because if all four angles of a quadrilateral are 90°, then its opposite sides automatically becomes equal and parallel according to geometry.

Work it Out-1

1. (i) PQRS is a rectangle



(i)

$\angle PQR = 90°$

$\angle PQO + \angle RQO = 90°$

$40° + \angle RQO = 90°$

$\angle RQP = 90° - 40° = 50°$

Thus, $\angle PSO = 50°$

(Alternate angle)

and $\angle ORQ = \angle SPO = 50°$

In ΔPOQ,

$OP = OQ$ (given)

So, $\angle Q = \angle P = 40°$

$\angle P + \angle O + \angle Q = 180°$

$40° + \angle O + 40° = 180°$

$\angle O = 180° - 80°$

$= 100°$

In ΔPQS and ΔRSQ

$\angle PQR = \angle RSQ = 40°$

{Alternate opposite angles}

Similarly $\angle QPR = \angle SRP = 40°$

{Alternate opposite angles}

In ΔPOQ and ΔSOR

$\angle POQ = \angle SOR = 100°$

{Vertically opposite angles}

In ΔPOS,

$\angle POS + \angle OSP + \angle SPO = 180°$

$\angle POS + 50° + 50° = 180°$

$\angle POS = 180° - 100 = 80°$

Similarly, $\angle ROQ = 80°$

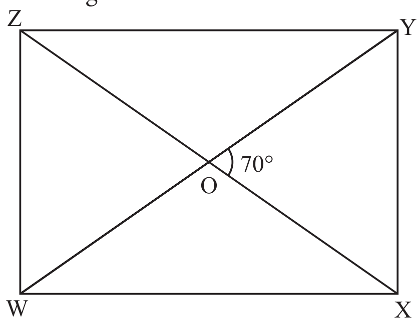
And, $\angle PQR = \angle QRS = \angle RSP$

$= \angle SPQ = 90°$

{All are right angles}

(ii) WXYZ is a rectangle.

Diagonal bisects each other.



Thus, $OW = OX = OY = OZ$

In ΔXOY,

$OX = OY$

In ΔXOY, {Diagonals of ractangle}

So, $\angle X = \angle Y$

$\angle X + \angle Y + \angle O = 180°$

$\angle X + \angle X = 180° - 70°$

$2\angle X = 110°$

$\angle X = 55°$

or $\angle YXO = 55°$

$\angle Y = 55°$

or $\angle XYO = 55°$

Thus, $\angle WZO = 55°$

and $\angle ZWO = 55°$

{Diagonal intersects the parallel lines in rectanlge}

$\angle ZOW = \angle YOX = 70°$

{Vertical opposite angles}

$\angle WXZ = 90°$

{Rectanlge Corner}

$\angle WXO = 90° - \angle YXO$

$= 90° - 55°$

$\angle WXO = 35°$

$\angle WXO = \angle XWO = 35°$

{Opposite angles of equal sides are also equal}

$\angle WXO + \angle XWO + \angle WOX = 180°$

$\angle WOX = 180° - 35° - 35°$

$= 110°$

So, $\angle WOX = \angle YOZ = 110°$

{Vertical opposite angle}

All angles are :

$\angle ZOW = 70°$, $\angle ZOY = 110°$,

$\angle XOW = 110°$,

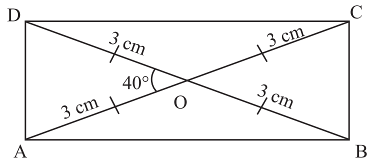
$\angle OYX = \angle OXY = 55°$,

$\angle OWX = \angle OXW = 35°$,

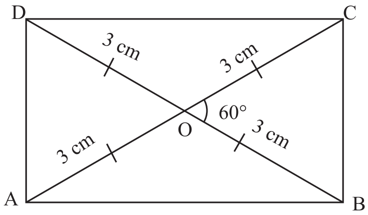
$\angle OZW = \angle OWZ = 55°$,

$\angle OZY = \angle OYZ = 35°$

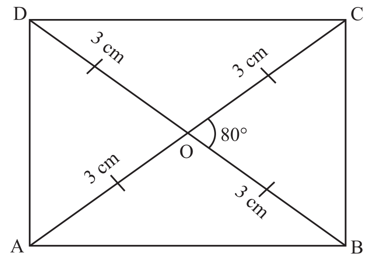
2. (i)



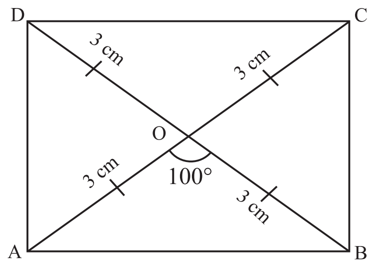
(ii)



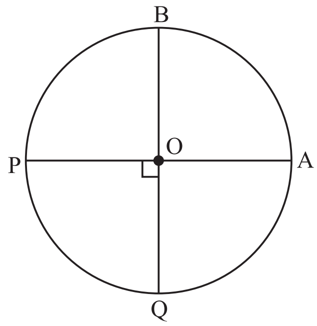
(iii)



(iv)



3. The diagonals of the quadrilateral QPBA are equal and bisect each other at 90°. According to the properties of quadrilaterals, if the diagonals of a quadrilaterals are equal, bisect each other, and are perpendicular, the figure must be a square.



4. Do yourself

Page-61

Do it Now!

- The diagonals of a parallelogram do not intersect each other at a fixed angle; the angle depends on the shape of the parallelogram.

Page-63

Do it Now!

- In a rhombus, both diagonals cut each other into two equal parts and intersect at 90°. If we draw a rhombus and measure the angle where the diagonals meet using a protractor, we will find that it is always a right angle. This shows that the diagonals of a rhombus are perpendicular to each other.

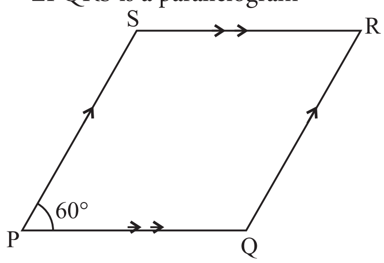
Work it Out-2

1. (i) Given that :

$PQ = RS$

$QR = SP$

□PQRS is a parallelogram



So, $\angle SPQ = \angle SRQ = 60°$

$\angle PQR + \angle SPQ = 180°$

{Sum of co-interior angles}

$\angle PQR + 60° = 180°$

$\angle PQR = 180° - 60° = 120°$

So, $\angle PSR = \angle PQR = 120°$

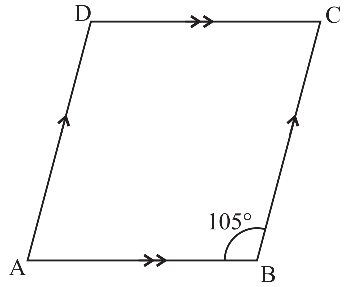
Thus, all angles are $\angle SRQ = 60°$,

$\angle PQR = \angle PSR = 120°$

(ii) Given that:

$AB = CD$

$BC = DA$



□ABCD is a parallelogram.

So, $\angle ABC = \angle ADC = 105°$

$\angle DAB + \angle ABC = 180°$

{Sum of co-interior angle}

$\angle DAB + 105° = 180°$

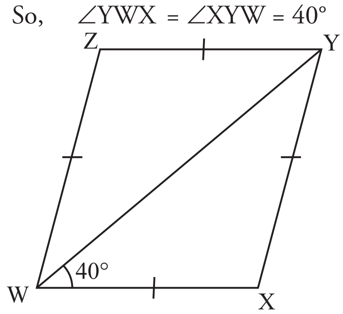
$\angle DAB = 180° - 105° = 75°$

So, $\angle DCB = \angle DAB = 75°$

(iii) Given that :

$WX = XY = YZ = ZW$

So, $\angle YWX = \angle XYW = 40°$



In □WXY,

$\angle WXY + \angle XYW + \angle YWX = 180°$

$\angle WXY + 40° + 40° = 180°$

$\angle WXY = 180° - 80° = 100°$

$\angle WXY = \angle WZY$

{Opposite angles of rhombus}

$\angle WZY = 100°$

In ΔWZY,

$\angle ZWY = \angle ZYW$

{opp. angles of equal side}

$\angle ZWY + \angle ZYW + \angle WZY = 180°$

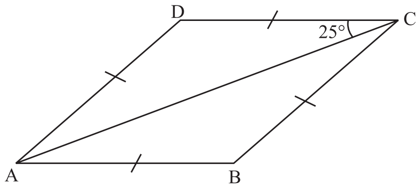
$\angle ZWY + \angle ZWY = 180° - 100° = 80°$

$2\angle ZWY = 80°$

$\angle ZWY = 40°$

Thus, $\boxed{\angle ZWY = \angle ZYW = 40°}$

(iv) Given that : All angles are equal.



Let ▭ABCD is a rhombus.

In ΔADC,

$\angle ACD = 25°$ {given}

$AD = CD$ {given}

Thus, $\boxed{\angle DAC = \angle DCA = 25°}$

and $\angle ACD + \angle CDA + \angle DAC = 180°$

$25° + \angle CDA + 25° = 180°$

$\angle CDA = 180° - 50°$

$\boxed{\angle CDA = 130°}$

$\angle CDA = \angle ABC$

{opposite angles of rhombus}

$\boxed{\angle ABC = 130°}$

In ΔABC,

$AB = BC$ (given)

Then, $\angle BAC = \angle ACB$

So, $\angle ABC + \angle BCA + \angle CAB = 180°$

$130° + \angle BCA + \angle BCA = 180°$

$2\angle BCA = 180° - 130°$

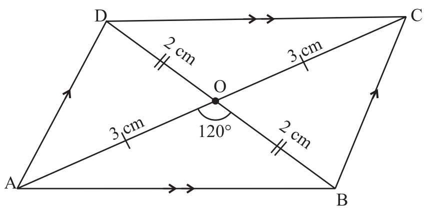
$2\angle BCA = 50°$

$\angle BCA = \dfrac{50°}{2}$

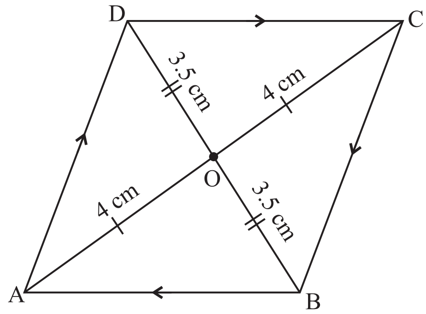
$= 25°$

Thus, $\boxed{\angle BCA = \angle CAB = 25°}$

2.



3.



Page-65

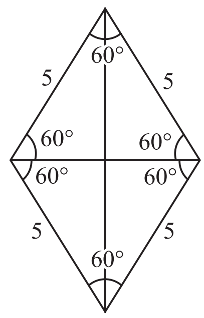
Do it Now!

- In the given kite PQRS, diagonals PR and SQ intersect at point O. So SQ ⊥ PR. Therefore, $\angle POQ = 90°$ and $\angle ROQ = 90°$. Since both angles are equal, $\angle POQ \cong \angle ROQ$.

  So yes, angle POQ is equal to angle ROQ because both are right angles in a kite.

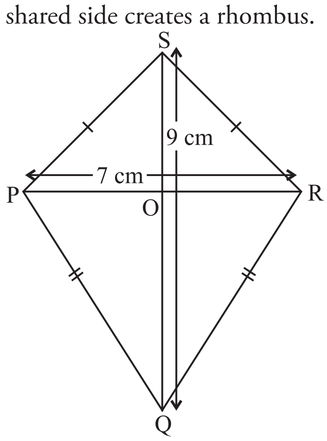
Work it Out-3

1. All four sides are 5 cm. Two angles are 60° and two are 120°.

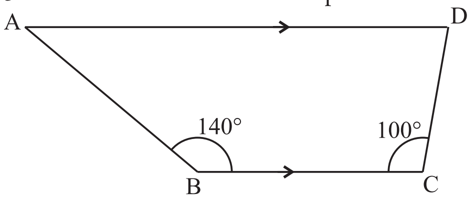


Joining two equilateral triangles along a shared side creates a rhombus.

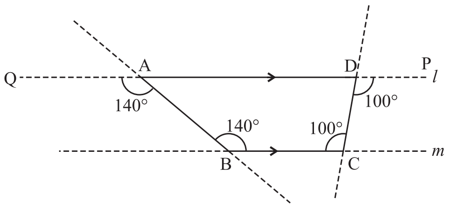
2.



3. Given that : □ABCD is a trapezium.



$$BC \parallel AD$$
$$\angle ABC = 140°$$
and $$\angle BCD = 100°$$



Let the two lines be l and m. Point P and Q are on the line l.

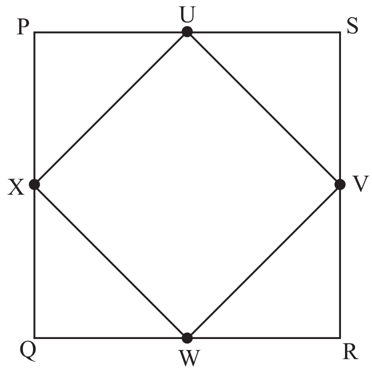
$$\angle PDC = \angle BCD = 100°$$
{Alternate opposite angle}
$$\angle QAB = \angle ABC = 140°$$
{Alternate opposite angles}
$$\angle ADC + \angle PDC = 180°$$
{Linear angles}
$$\angle ADC = 180° - 100° = 80°$$
$$\boxed{\angle ADC = 80°}$$
$$\angle BAQ + \angle BAD = 180° \text{ {Linear angles}}$$
$$\angle BAD = 180° - 140° = 40°$$
$$\boxed{\angle BAD = 40°}$$

4. Given : □PQRS is a rectangle and □QWLY is a rectangle.

So, $\angle QRS = 90°$
{Corner of right angle}

Point Y is on the side RS so 80
$$\angle QRY = 90°$$
In ΔQRY,
$$\angle QRY + \angle RYQ + \angle YQR = 180°$$
$$90° + \angle RYQ + 35° = 180°$$
$$\angle RYQ = 180° - 125°$$
$$\boxed{\angle RYQ = 55°}$$
or $$\boxed{\angle x = 55°}$$

5. Given that : □PQRS is a square and U, V, W, X are the mid points of the square PQRS.



The figure UVWX is a square.

- **Equal Sides :** Since U, V, W, X are midpoints, they form four identical right-angled triangles at the corners. By the Pythagorean theorem, all sides of teh inner figure are equal $\left(s = \dfrac{a}{\sqrt{2}}\right)$.
- **Right Angles :** Each corner of the inner figure is flanked by two 45° angles from the corner triangles. On a straight line (180°) :

  $180° - (45° + 45°) = 90°$

  A quadrilateral with four equal sides and four 90° angles is a square.

Connect and Reflect

[A] Multiple Choice Questions:

1. (C), **2.** (C), **3.** (B), **4.** (B), **5.** (C)

[B] Fill in the blanks:

1. 360, **2.** parallelogram, **3.** Trapezium, **4.** 90°, **5.** Two.

[C] State True or False :

1. True, **2.** False, **3.** True, **4.** True, **5.** False.

[D] Subjective Questions:

1. In a rhombus, the diagonals bisect each other at 90°.

A rhombus has diagonals that bisect each other and intersect at 90°.

So, the required quadrilateral is a rhombus.

2. A quadrilateral with only one pair of parallel sides is called a trapezium.

A trapezium has exactly one pair of parallel sides.

So, the required quadrilateral is a trapezium.

3. A square has properties of both a rectangle and a kite.

A square has all angles 90° like a rectangle and two pairs of equal adjacent sides like a kite.

So, the required quadrilateral is a square.

4. In a parallelogram, opposite sides are parallel and angles are not necessarily equal to 90%.

A parallelogram has opposite sides parallel but angles may be unequal.

So, the required quadrilateral is a parallelogram.

5. In a rectangle, all angles are 90° and adjacent sides are unequal.

A rectangle has all angles equal and adjacent sides are not equal.

So, the required quadrilateral is a rectangle.

6. Sun of interior angles of a quadrilateral = 360°.

Given angles 95° + 85°+ 110° = 290°

Fourth angle : 360 – 290° = 70°

So, the fourth angle is seventy degrees.

7. In a parallelogram, adjacent angles are supplementary and opposite angles are equal.

One angle = 120°

Adjacent angle = 180° – 120° = 60°

Opposite angle - 120%

So, the angles are 120°, 60°, 120°, 60°.

So, the other three angles are sixty degrees, one hundred twenty degrees, and sixty degrees.

8. Perimeter of a kite = 2 × (sum of unequal sides)

Perimeter = 2 × (5 + 7) = 2 × 12 = 24 cm

So, the perimeter of the kite is twenty four centimetres.

9. By Pythagoras theorem,

$$\text{diagonal}^2 = \text{side}_1{}^2 + \text{side}_2{}^2.$$
$$10^2 = 8^2 + \text{side}^2$$
$$100 = 64 + \text{side}^2$$
$$\text{side}^2 = 36$$
$$\text{side} = \sqrt{36} = 6 \text{ cm}$$

So, the other side of the rectangle is six centimetres.

10. In a rhombus, diagonals bisect each other at90° and each side is the hypotenuse of right triangle.

Half of first diagonal = 12 ÷ 2 = 6 cm

Half of secound diagonal = 16 ÷ 2 = 8 cm

$$\text{side}^2 = 6^2 + 8^2$$
$$\text{side}^2 = 100$$
$$\text{side} = \sqrt{100}$$
$$\text{side} = 10 \text{ cm}$$

So, each side of the rhombus is ten centimetres.

NCERT Exercise

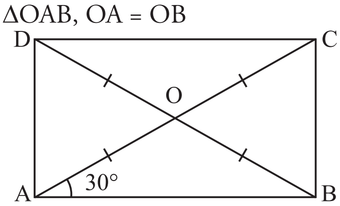
Figure it Out-1

Page-94

(i) **For rectangle ABCD**

Let the diagonals AC and BD intersect at point O.

In ΔOAB, OA = OB



(diagonals bisect and are equal)

∠OBA = ∠OAB = 30° (angles opposite to equal sides)

∠AOB = 180° – (30° + 30°) = 120°

(Angle sum property)

∠BOC = 180° – 120° = 60° (Linear Pair).

∠OAD = 90° – 30° = 60° (corner angle is 90°).

In ΔOAD,

OA = OD,

so ∠ODA = ∠OAD = 60°.

∠AOD = 180° – (60° + 60°)

= 60°

(Angle Sum Property).

∠COD = ∠AOB = 120°

(Vertically opposite angles).

∠ODC = 90° – 60° = 30°.

∠OCD = ∠ODC = 30°

(as triangle ODC is isosceles).

∠OBC = 90° – 30° = 60°.

∠OCB = ∠OBC = 60°

(as triangle OBC is isosceles).

(ii) **For Rectangle PQRS**

Let the diagonals PR and QS intersect at point O.

Given ∠QmR = 110°.

∠PmS = ∠QmR = 110°

(Vertically opposite angles).

$\angle PmQ = 180° - 110° = 70°$ (Linear Pair).
$\angle SmR = \angle PmQ = 70°$
(Vertically opposite angles).

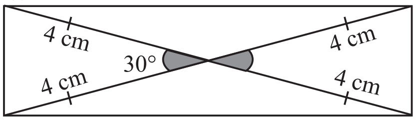
In ΔmQR,
$mQ = mR$,
so $\angle mQR = \angle mRQ$.
$\angle mQR - (180° - 110°) : 2 - 70° \div 2 = 35°$.

In ΔmPQ,
$mP = mQ$,
so $\angle mPQ = \angle mQP$.
$\angle mPQ = (180° - 70°) \div 2$
$= 110° \div 2 = 55°$.
$\angle mRS = 90° - 35° = 55°$.

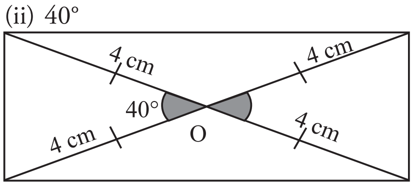
In ΔmSR.
$mS = mR$,
so $\angle mSR = \angle mRS = 55°$.
$\angle mSP = 90° - 55° = 35°$.

In ΔmPS,
$mP = mS$,
so $\angle mPS = \angle mSP = 35°$.

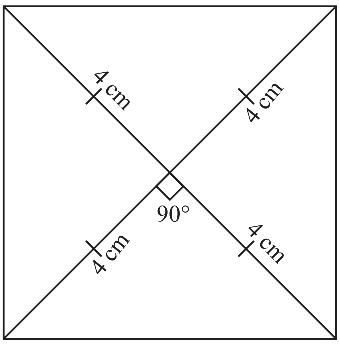
2. (i) 30°



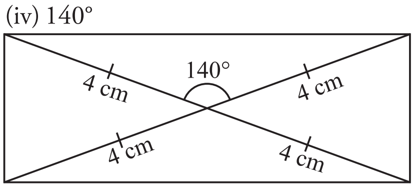
(ii) 40°



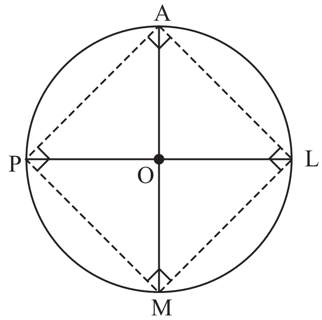
(iii) 90°



(iv) 140°



3. given : A circle with centre O. PL and AM are two diameters of the circle and PL $\perp$ AM. Points A, P, M and L lie on the circle.



Formula used :

(i) All radii of a circle are equal.

(ii) The angle subtended by a diameter at the circumference is 90°.

(iii) If the diagonals of a quadrilateral bisect each other at right angles and are equal, then the quadrilateral is a square.

Since PL $\perp$ AM, so the diagonals of quadrilateral APML intersect at 90°.

Further, OA = OP = OM = OL
(radii of the same circle),

So all sides AP, PM, ML and LA are equal.

Thus, APML has equal sides and its diagonals are equal perpendicular and bisect each other.

Therefore, APML is a square.

4. Given : Two sticks of equal length and a thread are given.

Formula used :

In an isosceles triangle, the line from the top vertex to the midpoint of the base is perpendicular to the base.

Join one end of both sticks with the thread. Fix the other ends apart and stretch the thread to form an isosceles triangle. Mark the midpoint of the thread and join it to the joined ends of the sticks. This line is perpendicular to the thread and makes 90°.

5. No, every quadrilateral with opposite sides parallel and equal is not a rectangle; it is only a parallelogram unless all angles are 90°.

Page-102

(i) In the given quadrilateral, opposite sides are marked parallel, so it is a parallelogram.

Given $\angle EPR = 40°$

So, $\angle AEP$ (adjacent angle) $= 180° - 40°$

$= 140°$

$\angle EAR$ (Opposite angle) $= 40°$

Other opposite angle $= 140°$

Therefore, the four angles are :

$\angle EAR = 40°$,

$\angle ARP = \angle AEP = 140°$

and $\angle EPR = 40°$

(ii) In the given quadrilateral, opposite sides are marked parallel, so it is a parallelogram.

Given : $\angle SPQ = 110°$

So, $\angle PQR = 180° - 110° = 70°$ {adjacent angle}

$\angle QRS = 110°$ {Opposite angle of $\angle SPQ$}

$\angle PSR = 70°$ {Opposite angle of $\angle PQR$}

Therefore, the angles are :

$\angle QRS = 110°$

and $\angle PSR = \angle RQP = 70°$

1. (iii) Given: In quadrilateral XWVU, opposite sides are marked equal, so XW = UV and XU = WV. Therefore, XWVU is a parallelogram.

In parallelogram XWVU, diagonal XV divides it into two congruent triangles ΔXUV and ΔXVW.

Given $\angle UVX = 30°$.

Since $\Delta XUV \cong \Delta XVW$, corresponding angles are equal.

So, $\angle UXV = \angle UVX = 30°$.

Now in ΔXUV,

$\angle UXV + \angle UVX + \angle XUV = 180°$

$30° + 30° + \angle XUV = 180°$

$\angle XUV = 180° - 60° = 120°$

In a parallelogram, opposite angles are equal and adjacent angles are supplementary.

So, $\angle U = \angle W = 120°$

$\angle X = \angle V$

$= 180° - 120° = 60°$

So, the remaining angles are $\angle UXV = 30°$, $\angle U = 120°$, $\angle W = 120°$, $\angle X = 60°$, and $\angle V = 60°$.

(iv) Given: In quadrilateral OIEA, opposite sides are marked equal, So Ol = AE and OA = IE. Therefore, OIEA is a parallelogram.

In parallelogram OIEA, diagonal OE divides it into two congruent triangles ΔOAE and ΔOEI.

Given $\angle AEO = 20°$.

Since $\Delta OAE \cong \Delta OEI$, corresponding angles are equal.

So, $\angle AOE = \angle AEO = 20°$.

Now in ΔOAE,

$\angle AOE + \angle AEO + \angle OAE = 180°$

$20° + 20° + \angle OAE = 180°$

$\angle OAE = 180° - 40° = 140°$

In a parallelogram, opposite angles are equal and adjacent angles are supplementary.

So, $\angle A = \angle 1 = 140°$

$\angle O = \angle E$

$= 180° - 140° = 40°$

Now in ΔOEI,

$\angle EOI + \angle OEI + \angle EIO = 180°$

Also, corresponding angles in congruent triangles are equal, so

$\angle EIO = \angle OAE = 140°$

Therefore.

$\angle EOI + 20° + 140° = 180°$

$\angle EOI = 180° - 140° = 20°$

So, $\angle OEI = 20°$ (given).

So, the remaining angles are $\angle AOE = 20°$, $\angle A = 140°$, $\angle I = 140°$, $\angle O = 40°$, $\angle E = 40°$, $\angle OEI = 20°$ and $\angle EOI = 20°$.

2. Given: The lengths of the diagonals are 7 cm and 5 cm, and the angle between them is 140°.

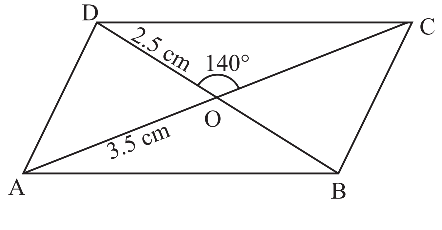
Construction: Draw a line segment AC = 7 cm.

Find its midpoint O.

Through O, draw a line making an angle of 140° with AC.

On this line, mark points B and D on opposite sides of O such that BO = DO = 2.5 cm (since BD=5 cm).

Join A to B. B to C, C to D, and D to A.



3. Given: The lengths of the diagonals are 4 cm and 5 cm.

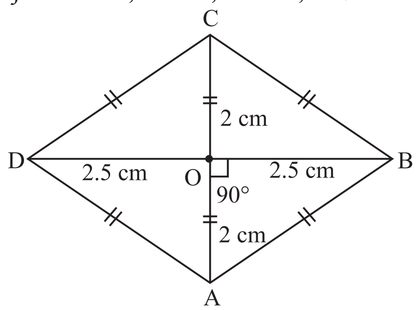
Construction: Draw a line segment AC = 4 cm.

Find its midpoint O.

At point O, draw a perpendicular line to AC.

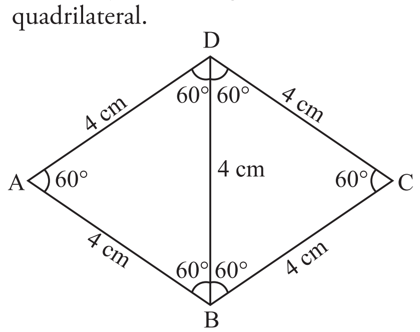
On this perpendicular line, mark points B and D on opposite sides of O such that BO = DO = 2.5 cm (since BD = 5 cm).

Join A to B, B to C, C to D, and D to A.



Page-107-109

1. Given: Two equilateral triangles of side 4 cm are joined along one side to form a quadrilateral.



Formula used:

1. In an equilateral triangle, all sides are equal and each angle = 60°.
2. When two equilateral triangles are joined along one side, the common side is internal.
3. Sum of angles at a point on a straight line = 180°.

   Since each equilateral triangle has all sides = 4 cm, all outer sides of the quadrilateral are also 4 cm.

So, all four sides of the quadrilateral are equal to 4 cm.

At the joined side, two angles of 60° and 60° are formed on a straight line.

So, interior angle at that vertex = (60° + 60°) = 120°.

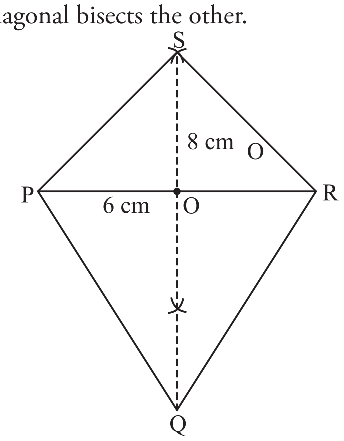
The other two vertices each have only one angle of 60° from one triangle.

So, each interior angle of the quadrilateral = 60°, 60°, 1200° and 120°.

Therefore, the quadrilateral formed is a rhombus.

2. Given: The lengths of the diagonals of a kite are 6 cm and 8 cm.

Formula used: In a kite, the diagonals bisect each other at right angles, and one diagonal bisects the other.



3. (i) Given: In the trapezium, the top side is parallel to the bottom side, and the two bottom angles are 135° and 105°.

Formula used: If two parallel lines are cut by a transversal, then the sum of interior angles on the same side is 180°.

Left side: Top angle + 135° = 180°

Top angle = 180° – 135° = 45°

Right side: Top angle + 105° = 180°

Top angle = 180° – 105° = 75°

Explanation: Since the opposite sides are parallel, the interior angles on the same side of a transversal are supplementary, that is, their sum is 180°.

So the two remaining angles of the trapezium are 45° and 75°.

(ii) Given: The figure is a parallelogram (opposite sides are parallel and equal). One interior angle is 100°.

Formula used: In a parallelogram, adjacent angles are supplementary, that is, their sum is 180°, and opposite angles are equal.

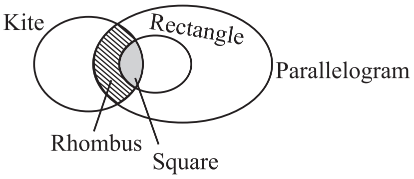
Adjacent angle = 180° – 100° = 80°

Opposite angle = 100°

Explanation: Since adjacent angles of a parallelogram add up to 180°, and opposite angles are equal, the remaining angles can be found using this property.

So the angles of the parallelogram are 100°, 80°, 100°, and 80°.

4. Venn diagram



(i) The quadrilateral that is both a kite and a parallelogram is a **Rhombus**.

As a parallelogram, its opposite sides are equal and parallel.

As a kite, its adjacent sides are equal. Combining these properties results in a figure with four equal sides (a rhombus).

(ii) **Yes**, such a quadrilateral exists and it is a **Square**.

A rectangle must have four right angles.

A kite must have two pairs of equal adjacent sides. A square has both four right angles and equal adjacent sides, making it the unique intersection of these two categories.

(iii) **No**, every kite is not a rhombus.

The correct relationship: A rhombus is a special type of kite. While a kite only requires two pairs of adjacent sides to be equal a rhombus requires all four sides to be equal.

In set theory terms, the set of **Rhombuses is a subset of the set of Kites.** Specifically, a rhombus is a kite that is also a parallelogram.

5. Given: PAIR is a rectangle, which implies $\angle OIR = 90°$.

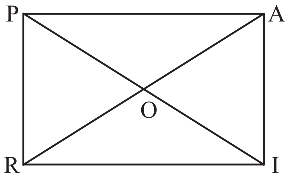
RODS is a rectangle, which implies $\angle ROD = 90°$.

In triangle ROI, $\angle ORI = 30°$.

Formula Used: Angle Sum Property of a Triangle: The sum of all interior angles in a triangle is 180°.

Property of a Rectangle: All interior angles of a rectangle are 90°.

Proof: In triangle ROI, $\angle OIR = 90°$ because it is an interior angle of rectangle PAIR.



By the Angle Sum Property, $\angle ROI + \angle OIR + \angle ORI = 180°$.

Substituting the values,

$\angle ROI + 90° + 30° = 180°$.

$\angle ROI + 120° = 180°$,

so $\angle ROI = 180° - 120° = 60°$.

Since RODS is a rectangle, the total angle $\angle ROD = 90°$.

The angle $\angle ROD$ is the sum of $\angle ROI$ and $\angle IOD$.

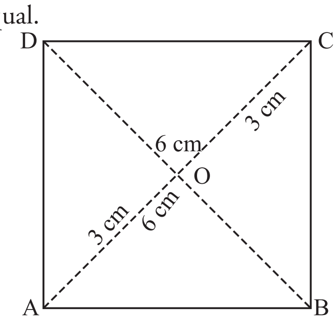
Substituting the values, $90° = 60° + \angle IOD$.

$\angle IOD = 90° - 60° = 30°$.

The final answer is 30°.

6. Given: The length of the diagonal of a square is 6 cm.

Formula used: In a square, the diagonals bisect each other at right angles and are equal.



Proof: Draw a line AC = 6 cm. Find its midpoint O. Through O, draw a line perpendicular to AC. With O as centre and radius OA = 3 cm, cut this perpendicular line at points B and D. Join A to B, B to C, C to D, and D to A. Then ABCD is the required square.

Explanation: Since the diagonals of a square are equal, bisect each other, and intersect at 90°, this construction gives a square without using a protractor.

So the square is constructed by drawing a 6 cm diagonal and erecting its perpendicular bisector to get the other diagonal.

7. (a) Because U, V, W, and X are the midpoints of the sides of square CASE, the figure UVWX is also a square. This can be checked by measuring its sides and angles.

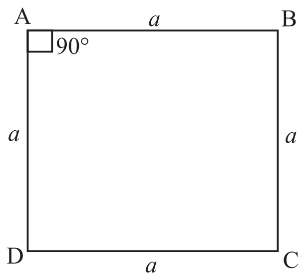
Figure (b) represents another square placed inside square ABCD, where the vertices touch the sides of the outer square but are not exactly at the midpoints.

There are some other ways to construct a square like PQRS :

(i) **Rotation method :** Rotate the inner square about the centre of the outer square by any angle. Even after rotation, its vertices will lie on the sides of the outer square, forming a new square.

(ii) **Diagonal method :** First draw the diagonals of the outer square. Then draw lines parallel to these diagonals so that they intersect the sides of the square. By choosing a suitable distance from the centre, a new inner square can be obtained.

8.



Given: A quadrilateral ABCD such that AB = BC = CD = DA and ∠A = 90°.

To Prove: ABCD is a square.

Construction: Draw AB = BC = CD = DA and make ∠A = 90°. Join BC, CD, and DA to form quadrilateral ABCD.

Proof: We are given AB = BC = CD = DA, so all four sides are equal.

∠A = 90°.

In a quadrilateral with all sides equal, the figure is a rhombus.

A rhombus having one angle equal to 90° becomes a rectangle.

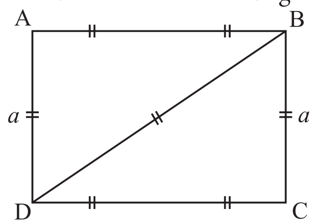
A figure which is both a rhombus and a rectangle is a square.

□ ABCD is a square.

On measuring with a protractor, all angles are 90°.

So, yes, a quadrilateral with four equal sides and one right angle is a square.

9. Let ABCD be a quadrilateral in which AB = CD and AD = BC. Draw diagonal AC.



In triangles ΔABC and ΔCDA:

AB = CD (given)

BC = AD (given)

AC = AC (common side)

By SAS congruence rule, ΔABC ≅ ΔCDA.

So, corresponding angles are equal, that is, ∠ABC = ∠CDA and ∠ACB = ∠CAD.

Therefore, AB || CD and AD || BC.

Hence, both pairs of opposite sides are parallel.

So, ABCD is a parallelogram.

10. Yes, the sum of the angles in this quadrilateral will also be 360°. This shape is a **concave quadrilateral** because one of its interior angles (at vertex D) is a reflex angle (greater than 180°).

11. (i) False. The formula used is the property of a rectangle. If the diagonals are equal and bisect each other, it must be a rectangle, but it only becomes a square if the diagonals are also perpendicular.

(ii) True. The formula used is the Angle Sum Property of a quadrilateral (Total = 360°). If three angles are 90°, the fourth angle is 360° – (90° + 90 + 90°) = 90°. A quadrilateral with all angles 90° is a rectangle.

(iii) True. The formula used is the Diagonal Property of Parallelograms. By definition, a quadrilateral whose diagonals bisect each other is a parallelogram.

(iv) False. The formula used is the Property of a Kite or Rhombus. Diagonals can be perpendicular in a kite or an irregular quadrilateral as well; they must also bisect each other to be a rhombus.

(v) True. The formula used is the Converse of Opposite Angle Property. In any quadrilateral where both pairs of opposite angles are equal, the figure is a parallelogram.

(vi True. The formula used is the Angle Sum Property (360° + 4 = 90°). Since all four angles are equal, each must be 90°, which makes it a rectangle.

(vii) False. The formula used is the definition of a parallelogram (two pairs of parallel sides). An isosceles trapezium has only one pair of parallel sides, so it cannot be a parallelogram.

The final answer is false, true, true, false, true, true, and false.

5. Number Play

Page-71

Do it Now!

1. Take four consecutive numbers: 10, 11, 12, 13.

Using the formula:

Sum of four consecutive numbers = n + (n + 1) + (n + 2) + (n + 3) = 4n + 6

Here, n = 10, so

10 + 11 + 12 + 13 = 46 = even

Now, create a few expressions and check:

1. 10 + 11 + 12 + 13 = 46 (even)

2. (10 × 11) + (12 × 13) = 110 + 156 = 266 (even)

3. (10 + 13) × (11 + 12) = 23 × 23 = 529 (odd)

4. (12 – 10) × (11 + 13) = 2 × 24 = 48 (even)

From the above results, 46, 266, and 48 are even, but 529 is odd.

So, all expressions formed from four consecutive numbers are not always even; some can be odd.

Page-72

Do it Now!

1. The property of parity applies to any number of consecutive terms, not just four. Using the Rule of Parity for addition (Even + Odd = Odd, Odd + Odd = Even), the result depends on how many odd numbers are in the set. For example, the sum of three consecutive numbers alternates between even and odd (1 + 2 + 3 = 6 vs. 2 + 3 + 4 = 9), while the product of any two or more consecutive numbers is always even because at least one even number is always included.

This property extends to other cases and is not limited to sets of four numbers.

Work it Out-1

1. Let four consecutive numbers be n, n + 1, n + 2, n + 3.

Using the formula: Sum = n + (n + 1) + (n + 2) + (n + 3) = 4n + 6

Given: 4n + 6 = 50 → 4n = 44 ⇒ n = 11

Numbers are 11, 12, 13, 14.

So, the four numbers are 11, 12, 13, and 14.

2. Let the largest number be 'Q.

Then the six consecutive numbers are Q-5, Q-4, Q-3, Q-2, Q-1, Q.

3. (i) Two even numbers = 2a, 2b, sum = 2a + 2b = 2(a + b), not always multiple of 4 → Sometimes True.

(ii) Not divisible by k does not mean not divisible by b → Sometimes True.

(iii) Example: 1 and 6 are not divisible by 7, sum = 7 → divisible → Sometimes True.

(iv) Multiple of 4 = 4a, multiple of 6 = 6b, sum = 4a + 6b = 2(2a + 3b) → Always True.

(v) 4 + 6 = 10, not multiple of 12 → Sometimes True.

4. We look for numbers satisfying,

x = 3n + 2 and x = 5m + 1.

Checking multiples of 5 + 1: 6 (rem 0 by 3), 11 (rem 2 by 3). Adding the LCM of 3 and 5, which is 15, gives the next numbers.

The final answer is 11, 36, and 41.

5. Such numbers are of form 7n + 3.

Sum of three = (7a + 3) + (7b + 3) + (7c + 3) = 7(a + b + c) + 9 = 7(a + b + c + 1) + 2, not divisible by 7.

So, Arun's statement is false.

6. 985 ÷ 7 = remainder 5, 245 ÷ 7 = remainder 0

Using (a ± b) mod k = (remainders ±) mod k.

(i) (985 + 245) ÷ 7 ⇒ (5 + 0) = 5

(ii) (985 – 245) ÷ 7 (5 – 0) = 5

So, Remainder is 5 in both cases.

7. The remainders are all I less than the divisors (3 – 2 = 1, 4 – 3 = 1, 5 = 4 = 1).

The formula used is LCM(3, 4, 5) = 1.

The LCM of 3, 4, and 5 is 60.

The number is 60 – 1 = 59.

The final answer is fifty-nine.

Work it Out-2

1. The divisibility rule for 9 states that if a number is divisible by 9, the sum of its digits must also be divisible by 9.

The final answer is true.

2. This is the converse of the divisibility rule for 9, which holds that a sum of digits divisible by 9 confirms the number is divisible by 9.

The final answer is true.

3. According to the divisibility rule for 9, the sum of digits and the number share the same divisibility status; if one is not divisible, the other is not.

The final answer is true.

4. If the sum of the digits fails the divisibility test for 9, the number itself cannot be a multiple of 9.

The final answer is true.

5. We use the formula: Sum of digits ÷ 9.

(i) 2 + 3 + 4 = 9 (Yes),

(ii) 6 + 1 + 2 = 9 (Yes),

(iii) 9 + 9 + 9 + 9 = 36 (Yes),

((iv) 7 + 5 + 2 + 4 + 9 = 27 (Yes),

(v) 6 + 5 + 4 + 0 + 7 + 2 = 24 (No).

The final answer is (i) yes, (ii) yes, (iii) yes, (iv) yes, (v) no.

6. We test even-digit multiples of 9 starting from the smallest. The smallest three-digit even-digit number 200 is not a multiple. Testing 288 (2 + 8 + 8 = 18).

The final answer is two hundred eighty-eight (288).

7. We divide 7100 by 9 to find the remainder: 7100 ÷ 9 = 788 with remainder 8. We use the formula: Number - Remainder. So, 7100 - 8 = 7092.

The final answer is seven thousand ninety-two.

8. We find the first multiple after 5200 (5202) and the last before 8500 (8496). We use the formula: n = ((Last - First) ÷ 9) + 1. Calculation: ((8496 - 5202) ÷ 9) + 1 = (3294 ÷ 9) + 1 366 + 1 = 367.

The final answer is three hundred sixty-seven.

Work it Out-3

1. To check if a number is divisible by 11, find the difference between the sum of digits at odd places and the sum of digits at even places. If the difference is 0 or a multiple of 11, the number is divisible.

Formula: Difference = (Sum of digits at odd places) - (Sum of digits at even places)

(i) 196: (6 + 1) - 9 = 7-9 = -2. Adding 11 gives 9. Not divisible, remainder is 9.

(ii) 891: (1 + 8) – 99 = 9 = 0. Divisible, remainder is 0.

(iii) 572: (2 + 5) – 7 = 7 – 7 = 0. Divisible, remainder is 0.

(iv) 6935: (5 + 9) - (3 + 6) = 14 - 9 = 5. Not divisible, remainder is 5.

(v) 70452: (2 + 4 + 7) - (5 + 0) = 13 – 5 = 8.

Not divisible, remainder is 8.

(vi) 927183: (3 + 1 + 2) - (8 + 7 + 9) = 6 – 24 = – 18. Adding 22 (multiple of 11) gives 4. Not divisible, remainder is 4.

Work it Out-4

1. Using the formula: Digital root of a number = repeated sum of digits until a single digit is obtained.

Take any number, for example 47.

47 ⇒ 4 + 7 = 11 ⇒ 1 + 1 = 2

Digital root of 47 = 2

Now find digital roots of consecutive numbers:

47 ⇒ 2

48 ⇒ 4 + 8 = 12 ⇒ 1 + 2 = 3

49 ⇒ 4 + 9 = 13 ⇒ 1 + 3 = 4

50 ⇒ 5 + 0 = 5

51 $\Rightarrow$ 5 + 1 = 6

52 $\Rightarrow$ 5 + 2 = 7

So, digital roots are 2, 3, 4, 5, 6, 7, which increase by 1 for consecutive numbers.

2. Using the formula: Digital root of a number = remainder when the number is divided by 9, and if remainder = 0, digital root = 9.

The digital root depends on the value of n :

If $n = 1 : 5 - 1 = 4$

If $n = 2 : 5 - 2 = 3$

If $n = 3 : 5 - 3 = 2$

If $n = 4 : 5 - 4 = 1$

If $n = 5 : 5 - 5 = 9$

(since) becomes 9 in digital roots)

If $n = 6 : 5 - 6 = -1$

(Add 9 to keep it positive) $\rightarrow$ 8

The digital root of $8n + 5$ is the same as the digital root of $(5 - n)$. As n increases, the digital root simply counts backward.

Page-82

Do it Now!

1. Using the formula: Product = multiplicand × multiplier.

(i) Let UV = 34.

34 × 3 = 102, so wxy = 102.

One solution is 34 x 3 = 102.

(ii) Take MN = 26.

26 × 5 = 130, which is a three-digit number.

Here, M = 2, N = 6, O = 1, P = 3, Q = 0.

(iii) Let RS = 16.

16 × 16 = 256, so TUV = 256.

Final Answer: One solution is 16 × 16 = 256.

Work it Out-5

1. The first number can be written as 11n + 7 and the second number as (11m + 5). Their sum is

(11n + 7) + (11 m + 5) = 11n + 11 m + 12.

Since 12 divided by 11 leaves a remainder of 1, the total sum leaves a remainder of 1 and is not divisible by 11. Therefore, Ankit's claim is actually incorrect.

2. No, the sum of two multiples of 4 is not always a multiple of 8.

For example, 4 and 12 are both multiples of 4. Their sum is 4 + 12 = 16, which is a multiple of 8. However, 4 and 8 are also multiples of 4, but their sum is 4 + 8 = 12, which is not a multiple of 8.

3. For 4P7Q8 to be divisible by 44, it must follow the divisibility rules for 4 and 11.

For divisibility by 4, the last two digits Q8 must be divisible by 4, so Q can be 0, 2, 4, 6, or 8. For divisibility by 11, the difference between the sum of digits at odd places (8 + 7 + 4 = 19) and even places (Q + P) must be 0 or a multiple of 11.

Thus, 19 - (P + Q) = 11 or 0. If 19 - (P + Q) = 11, then P + Q = 8. Testing our Q values: if Q = 0, P = 8; if Q = 2, P = 6; if Q = 4, P = 4; if Q = 6, P = 2; if Q = 8, P = 0.

4. Consecutive even numbers have a common difference of 2. If the middle (third) number is 2P, the two numbers before it are 2P - 2 and 2P - 4. The two numbers after it are 2P + 2 and 2P + 4.

The final answer is the numbers are 2P - 4, 2P - 2, 2P, 2P + 2, and 2P + 4.

5. (i) AAA x Z = ZZZ can be written as

A × 111 × Z = Z × 111.

Dividing both sides by 111 × Z, we get A = 1.

Z can be any non-zero digit from 1 to 9.

(ii) MOM x D = DOD

MOM = 101M + 100 and DOD = 101D + 100.

(101M + 100) × D = 101D + 100.

This gives 101D(M − 1) + 100(D − 1) = 0.

So, M = 1 and O = 0, with D = 1 to 9.

Final answer: M = 1, O = 0, and D can be any digit from 1 to 9.

Connect and Reflect

[A] Multiple Choice Questions:

1. (c), **2.** (a), **3.** (b), **4.** (b), **5.** (b)

[B] Fill in the blank:

1. Digital root, **2.** 36, **3.** Even, **4.** Even, **5.** Cryptorithms.

[C] State True or False:

1. False, **2.** True, **3.** False, **4.** True, **5.** True.

[D] Subjective Questions:

1. Divisibility rule of 9: Any number is divisible by 9 if the sum of its digits is divisible by 9.

10^n = 1 followed by n zeros, so sum of digits = 1.

Remainder = 1.

So, any power of 10 leaves remainder 1 when divided by 9.

2. Place value formula: AB = 10A + B and 6A = 60 + A.

(10A + B) + 37 = 60 + A ⇒ 9A + B = 23.

Possible digit: A = 2, B = 5.

So, a represents the digit 2.

3. Property of consecutive integers: Three consecutive numbers are n, n + 1, n + 2.

One is divisible by 2 and one by 3.

So product is divisible by 6.

So, yes, it is always divisible by 6.

4. Rule of multiples of 9: Sum of digits must be divisible by 9.

Smallest number with only even digits and sum = 9 is 288

So, the smallest such multiple is 288

5. Divisibility rule of 10: Any number ending in 0 is divisible by 10.

Also divisible by 2 and 5.

So, such a number is divisible by 2, 5, and 10.

6. Formula for consecutive odd numbers: x – 2, x, x + 2.

Sum = 3x = 147 ⇒ x = 49.

Numbers = 47, 49, 51.

So, the numbers are 47, 49, and 51.

7. Property of consecutive integers: As proved, the product is always divisible by 2 and 3. So divisible by 6.

So the statement is always true.

8. A remainder of 3 when divided by 4 is the same as saying "multiple of 4 minus 1".

A remainder of 4 when divided by 5 is the same as saying "multiple of 5 minus 1".

The general form is LCM (4, 5) k – 1 = 20 k – 1.

For k = 5 : 20(5 – 1) = 99

(not greater than 100)

For k = 6 : 20(6) – 1 = 199

The number is 119.

9. Divisibility by 72 requires divisibility by 8 and 9.

For 8 : the last three digits (96 y) must be divisible by 8. 960 is 8 × 120, so y must be 0 or 8.

For 9 : The sum of digits (1 + 7 + x + 9 + 6 + y) must be a multiple of 9.

- If y = 0 : 23 + x ⇒ x = 4
- If y = 8 : 31 + x ⇒ x = 5

Possible solutions : (x = 4, t = 0) or (x = 5, y = 8)

10. Digital root formula: Digital root = sum of digits repeatedly until one digit.

Digital root of 1 to 9 = 45 → 4 + 5 = 9.

1 to 18 has two such groups = 18 → 1 + 8 = 9.

Remaining 19, 20 → 1 + 9 + 2 + 0 = 12 → 1 + 2 = 3.

Total digital root = 9 + 9 + 3 = 21 → 2 + 1 = 3.

So, the digital root is 3.

11. Place value formula: AB = 10A + B and BBB = 111B.

(10A + B) × 6 = 111B ⇒ 60A + 6B = 111B ⇒ 60A = 105B ⇒ 12A = 21B ⇒ 4A = 7B.

Possible solution: A = 7, B = 4.

So, A = 7 and B = 4.

12. Formula for consecutive even numbers: 2n, 2n + 2, 2n + 4.

Sum = 6n + 6 = 6(n + 1).

So divisible by 6.

So, the sum is always a multiple of 6.

NCERT Exercise

Figure it Out Questions

Page-122-123

1. Formula for four consecutive numbers: x, x + 1, x + 2, x + 3.

Sum = x + (x + 1) + (x + 2) + (x + 3) = 4x + 6 = 34.

4x = 28⇒ x = 7.

Numbers = 7, 8, 9, 10.

So, the four consecutive numbers are 7, 8, 9, and 10.

2. Formula for five consecutive numbers:

p – 4, p – 3, p – 2, p – 1, p.

So, the other four numbers are p – 4, p – 3, p – 2, and p – 1.

3. (1) Let even numbers be 2a and 2b.

Sum = 2a + 2b = 2(a + b), which is not always divisible by 3.

Example: 2 + 4 = 6 (divisible by 3), 2 + 8 = 10 (not divisible by 3).

The statement is sometimes true.

(ii) Divisibility rule: If a number is divisible by 18, then it is divisible by 9.

So, if it is not divisible by 9, it cannot be divisible by 18.

But if it is divisible by 9 and not by 18, the statement fails.

Example: 9 is not divisible by 18 but 18 is divisible by 9.

The statement is sometimes true.

(iii) Let numbers be a and b, both not divisible by 6.

Example: 2 and 4 are not divisible by 6, but 2 + 4 = 6 is divisible by 6.

The statement is sometimes true.

(iv) Let numbers be 6a and 9b.

Sum = 6a + 9b = 3(2a + 3b), which is divisible by 3.

The statement is always true.

(v) Let numbers be 6a and 3b.

Sum = 6a + 3b = 3(2a + b), which is not always divisible by 9.

Example: 6 + 3 = 9 (divisible by 9), 12 + 3 = 15 (not divisible by 9).

The statement is sometimes true.

4. Remainder formula: Required number = LCM(3,4) × n + common remainder.

LCM(3,4) = 12.

So number = 12n + 2.

Examples: 14, 26, 38, 50.

So, all such numbers are of the form $12n + 2$.

5. Using the Remainder Formula:

Number = LCM(2, 3, 5) × k + 1, the number leaves a remainder of 1 when divided by 2, 3, and 5. The LCM of 2, 3, and 5 is 30, so the numbers are 31, 61, or 91. Among these, only 91 is divisible by 7.

So, the number of pebbles is 91.

6. Using the Remainder Addition Property: (6a + 2) + (6b + 2) + (6c + 2) = 6(a + b + c) + 6.

Since the sum of remainders (2 + 2 + 2 = 6) is exactly divisible by 6, the total sum is always a multiple of 6.

So, yes, Tathagat's claim is true.

7. (i) Using the Remainder Addition Rule: Remainder of (4779 + 661) = (5 + 3) = 8. Since 8 divided by 7 leaves 1, the final remainder is 1.

(ii) Using the Remainder Subtraction Rule: Remainder of (4779 - 661) = (5-3) = 2.

So, the remainders are 1 for the sum and 2 for the difference.

8. Using the Common Difference Method:

Since 3 - 2 = 1, 4 - 3 = 1, and 5 - 4 = 1, the remainder in each case is 1 less than the divisor.

This means the required number is LCM(3, 4,5) 1. The LCM of 3, 4, and 5 is 60.

Therefore, the number is 60 - 1 = 59.

Page-126

Using the Divisibility Rule of 9, a number is divisible by 9 if the sum of its digits is divisible by 9:

1. (i) Sum = 1 + 2 + 3 = 6. Since 6 is not divisible by 9, 123 is not divisible by 9.

(ii) Sum = 4 + 0 + 5 = 9. Since 9 is divisible by 9, 405 is divisible by 9.

(iii) Sum = 8 + 8 + 8 + 8 = 32. Since 32 is not divisible by 9, 8888 is not divisible by 9.

(iv) Sum = 9 + 3 + 5 + 4 + 7 = 28. Since 28 is not divisible by 9, 93547 is not divisible by 9.

(v) Sum = 3 + 5 + 8 + 0 + 9 + 5 = 30. Since 30 is not divisible by 9, 358095 is not divisible by 9.

So, only the number 405 is divisible by 9.

2. Using the Divisibility Rule of 9 and Even Digit Property, we check multiples of 9 consisting only of 0, 2, 4, 6, and 8.

Testing multiples, 288 is the first number where 2 + 8 + 8 = 18 (a multiple of 9) and all digits are even.

So, the smallest multiple of 9 with no odd digits is 288.

3. Using the Division Method, 6000 ÷ 9 gives a remainder of 3. Subtracting the remainder (6000 – 3 = 5997) or adding the difference (6000 + 6 = 6006) gives multiples; 6003 is also a multiple. 6003 and 5997 are equally close.

So, the multiples closest to 6000 are 5997 and 6003.

4. Using the Arithmetic Sequence Formula, the first multiple of 9 after 4300 is 4302 and the last before 4400 is 4392. Number of terms = ((4392 – 4302) ÷ 9) + 1 = 11.

So, there are 11 multiples of 9 between 4300 and 4400.

Page-131

1. Using the Digital Root Addition Property, the digital root of (Original Number + 10) is the digital root of (5 + 1) = 6.

So, the digital root will be 6.

2. Using the Digital Root Sequence Property, adding 11 is like adding 2 to the digital root (1 + 1 = 2). The sequence of digital roots will increase by 2 (cycling through 1, 3, 5, 7, 9, 2, 4, 6, 8).

So, the digital roots will form a repeating sequence increasing by 2.

3. Using the Digital Root Simplification, since 9a and 36b are multiples of 9. They have a digital root of 9 (or 0). The digital root is determined by 13, where 1 + 3 = 4.

So, the digital root is 4.

4. (i) Parity and Digital Root: Odd numbers have odd digital roots (1, 3, 5, 7, 9) and even numbers have even digital roots (2, 4, 6, 8) So, there is no fixed relation between parity of a number and its digital roots.

(ii) Remainder Rule: The digital root of a number is equal to the remainder when divided by 9 (if the root is 9, the remainder is 0).

So, parity matches the root's parity, and the root determines the remainder when divided by 9.

Page-132

1. Using the Divisibility Rule of 9, the sum of digits 3 + 1 + z + 5 = 9 + z must be a multiple of 9.

z can be 0 (9 + 0 = 9) or 9 (9 + 9 = 18).

So, the values for z are 0 and 9.

2. Using the Remainder Formula,

Number 1 = 12n + 8 and Number 2 = 12m - 4 (which is 12m + 8).

Sum = 12n + 12m + 16. Since 12n, 12m, and 16 are all divisible by 4 but not necessarily 8. the claim is false.

Example: 8 + 8 = 16 (divisible by 8), but 20 + 20 = 40 (divisible by 8). Actually, 12n + 12m + 16 = 4(3n + 3m + 4), which is always divisible by 4, and for certain n, m is divisible by 8.

So, Snehal's claim is false as the sum is not always divisible by 8.

3. **Using the Multiples of 3 Property,** the sum of two multiples of 3; (3a + 3b) is 3(a + b). It is a multiple of 6 if (a + b) is even (one odd, one even multiple) and not a multiple if (a + b) is odd (both even or both odd multiples).

So, the sum is a multiple of 6 if one number is an odd multiple of 3 and the other is an even multiple.

4. **(i) Using the Divisibility Rule of 9**, the sum of digits remains the same regardless of order. (ii) Any shuffle of digits will result in the same sum of digits, so the number remains a multiple of 9.

So, yes, the conjecture is true and any digit shuffle works.

5. **Using Divisibility Rules for 2 and 9**, b must be even (0, 2, 4, 6, 8) and 4 + 8 + a + 2 + 3 + b = 17 + a + b must be a multiple of 9. Pairs (a,b) are (1,0), (8,2), (6,4), (4,6), (2,8).

So, possible pairs (a,b) are (1,0), (8,2), (6,4), (4,6), and (2,8).

6. **Using Divisibility Rules for 4 and 11**, q8 must be divisible by 4 (q = 0, 2, 4, 6, 8) and (8 + 7 + 3)-(q + p) = 18 - (p + q) must be 0 or 11. If 18 - (p + q) = 11, p + q = 7. Pairs (p,q) are (7,0), (5,2), (3,4), (1,6). If 18 - (p + q) = 0, p + q = 18, so (9,9) but q must be even, so no solution there.

So, Possible pairs (p,q) are (7,0), (5,2), (3,4), and (1,6).

7. **Using the LCM Method**, we seek n such that n = 2k, n + 1 = 3m, n + 2 = 4j. The first such set is 8, 9, 10. These occur every LCM(2,3,4) = 12 numbers.

So, the numbers are 8, 9, 10; they occur every 12 numbers.

8. **Using the Division Method**, 45000 ÷ 36 = 1250. The multiples are 36 × 1251, 1252, etc.

So, five multiples are 45036, 45072, 45108, 45144, and 45180.

9. **Using the Consecutive Even Number Property**, if the middle is 5p, the others are 5p – 4, 5p – 2, 5p + 2, and 5p + 4.

So, the numbers are 5p – 4, 5p – 2, 5p, 5p + 2, and 5p + 4.

10. **Using Divisibility Rules**, the number must end in 5 or 0 as it is divisible by 15 and its reverse is even).

For the reverse to be divisible by 6, it must end in an even digit and the sum of digits must be a multiple of 3.

Example: 500010 (divisible by 15), reverse 010005 (not divisible by 6).

Example: 420150 (divisible by 15), reverse 051024 = 51024 (divisible by 6). A valid number is 420150.

So, one such 6-digit number is 100020.

11. **Using the Multiples of 11 Property**, 11n × 2 = 22n, which is always 11 × (2n). Thus, doubling any multiple of 11 always results in a multiple of 11.

So, Deepak's conjecture is false; all multiples of 11 remain multiples of 11 when doubled.

12. (i) Always True (6a × 3b = 18ab, divisible by 9).

(ii) Always True (sum is 6n).

(iii) Always True (sum of digits and last digit parity for 2 and 3 remains same).

(iv) Always True (56b - 24-44b - 4 = 12b - 28, which is not always divisible by 12).

So, (i) Always True, (ii) Always True, (iii) Always True, (iv) Never True.

13. **Using the Remainder Property**, the sum of three numbers is divisible by : if all three have the same remainder when divided by 3, or if they all have different remainders (0, 1, and 2).

So, sum is divisible by 3 if remainders are either all same or all different.

14. **Using the Product of Consecutive Integers Property**: Product of 2 is always divisible by 2! (2). Product of 3 is always divisible by 3! (6). Product of 4 is always divisible by 4! (24). Product of 5 is always divisible by 5! (120).

So, product of 2 is divisible by 2, 3 by 6, 4 by 24, and 5 by 120.

15. (i) **Using the Cryptarithm Multiplication Method**, EF × E = GGG implies E must be 3 (37 × 3 = 111) or E could be 1 or 2, but 37 x 3 = 111 is the standard solution.

(ii) WOW × 5 = MEOW implies W = 5 and O = 7. For MEOW, if W = 5, 575 × 5 = 2875. Here W = 5, O = 7, M = 2, E = 8.

16. Rule of multiples: If a number is a multiple of 32, then it is also a multiple of 8, and if it is a multiple of 8, then it is also a multiple of 4.

So, Multiples of 32 ⊂ Multiples of 8 ⊂ and Multiples of 4.

Among the given diagrams, only diagram (iv) shows Multiples of 32 inside Multiples of 8, and Multiples of 8 inside Multiples of 4.

So, the correct Venn diagram is (iv).

6. We Distribute, Yet Things Multiply

Page-86

Do it Now!

1. First, read the question carefully and understand it properly.

Given two numbers a and b.

Formula used: Product = a × b

Original product = a × b

- If a is changed to a + 1, new product
  = (a + 1) × b = a × b + b
  Increase = b
- If b is changed to b + 1, new product
  = a × (b + 1) = a × b + a
  Increase = a
- If both are changed to (a + 1) and (b + 1),
  New product = (a + 1) × (b + 1)
  = a × b + a + b + 1
  Increase = a + b + 1

So, when a increases by 1, the product increases by b, when b increases by 1, the product increases by a, and when both increase by 1, the product increases by a + b + 1.

Page-87

Do it Now!

1. To find examples where the product decreases, we apply the **Distributive Property:**

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

The product decreases whenever we reduce the value of the factors a or b.

Example 1: If a = 10 and b = 5, the product is 10 × 5 = 50. If we change b to b - 1 (4), the product is 10 × 4 = 40, which is a decrease.

Example 2: If a = 6 and b = 8, the product is 6 × 8 = 48. If we change a to a - 1 (5), the product is 5 × 8 = 40, which is a decrease.

Example 3: If a = 4 and b = 4, the product is 4 x 4 = 16. If we change both to a - I and b - 1 (3 and 3), the product is 3 × 3 = 9, which is a decrease.

The product decreases whenever one or both of the original numbers are reduced to a smaller value.

Work it Out-1

1. In the multiplication grid, each cell is the product of a row number m and a column number n.

For a 3 × 3 frame with the center cell as mn, the row numbers are (m – 1), m, and (m + 1), while the column numbers are (n – 1), n, and (n + 1).

The top row from left to right consists of (m – 1) × (n – 1), (m – 1) × n, and (m – 1) × (n + 1).

The middle row from left to right consists of m × (n – 1), mn, and m × (n + 1).

The bottom row from left to right consists of (m + 1) × (n – 1), (m + 1) × n, and (m + 1) × (n + 1).

The formula being used is the product of row and column headers: Product = Row × Column.

The expressions for the other numbers are (m – 1)(n – 1), (m – 1)n, (m – 1)(n + 1), m(n – 1), m(n + 1), (m + 1)(n – 1), (m + 1)n, and (m + 1)(n + 1).

The expressions for the other numbers in the grid are (m – 1)(n – 1), (m – 1)n, (m – 1)(n + 1), m(n – 1), m(n + 1), (m + 1)(n – 1), (m + 1)n, and (m + 1)(n + 1).

2. Expanding the products using the **Distributive Property Formula:** (a + b)(c + d) = a(c + d) + b(c + d).

(i) $(5 + x)(y - 5) = 5(y - 5) + x(y - 5) = 5y - 25 + xy - 5x$.

(ii) $\frac{4}{5}(20 + 5a) = (\frac{4}{5} \times 20) + (\frac{4}{5} \times 5a)$

$= 16 + 4a$.

(iii) $(20x + y)(20z + A) = 20x(20z + A) + y(20z + A) = 400xz + 20xA + 20yz + yA$.

(iv) $(8 - a)(a - 16) = 8(a - 16) - a(a - 16) = 8a - 128 - a^2 + 16a = a^2 + 24a - 128$.

(v) $(-4x + y)(a + b) = -4x(a + b) + y(a + b) = -4xa - 4xb + ya + yb$.

(vi) $(5 + a)(b + 12) = 5(b + 12) + a(b + 12) = 5b + 60 + ab + 12a$.

3. To find where (a + 2)(b-4) = ab, we use the Distributive Property Formula: ab – 4a + 2b - 8 = ab, which simplifies to 2b – 4a 8 or b – 2a = 4.

Example 1: If a = 2,

then b – 2(2) = 4, so b = 8. Checking: 2 × 8 = 16 and (2 + 2) × (8 – 4) = 4 × 4 = 16.

Example 2: If a = 3, then b – 2(3) = 4, so b = 10. Checking: 3 × 10 = 30 and (3 + 2) × (10 – 4) = 5 × 6 = 30.

4. Expanding using the Distributive Property Formula: (a + b + c)(d + e) = a(d + e) + b(d + e) + c(d + e).

(i) $(x + xy - 2y^2)(2 + y) = x(2 + y) + xy(2 + y) - 2y^2(2 + y) = 2x + xy + 2xy + xy^2 - 4y^2 - 2y^3 = 2x + 3xy + xy^2 - 4y^2 - 2y^3$.

(ii) $(3x + 5)(x + 7y - 5) = 3x(x + 7y - 5) + 5(x + 7y - 5) = 3x^2 + 21xy - 15x + 5x + 35y - 25 = 3x^2 + 21xy - 10x + 35y - 25$.

Page-90

Do it Now!

1. To multiply a number by values like 1001 or 10001, we use the **Distributive Property:** a × (b + c) = (a × b) + (a × c).

For 1001, the general rule is n × (1000 + 1) = 1000n + n, and for 10001, it is n × (10000 + 1) = 10000n + n.

2. (i) 78 × (100 + 1) = 7800 + 78 = 7878.

(ii) $845 \times 101 = 845 \times (100 + 1) = 84500 + 845 = 85345$.

(iii) $165831 \times 1001 = 165831 \times (1000 + 1) = 165831000 + 165831 = 165996831$.

(iv) $8654 \times 999 = 8654 \times (1000 - 1) = 8654000 - 8654 = 8645346$.

(v) $1247 \times 99 = 1247 \times (100 - 1) = 124700 - 1247 = 123453$.

Work it Out-2

1. First, read the question carefully and understand it properly.

Formula used: $(a + b)^2 = a^2 + 2ab + b^2$

(i) Use identity A to find the value of 103^2:

$103^2 = (100 + 3)^2$

$= 100^2 + 2 \times 100 \times 3 + 3^2$

$= 10000 + 600 + 9$

$= 10609$

(ii) Expand the expression $(5p + 4q)^2$:

$(5p + 4q)^2 = (5p)^2 + 2 \times 5p \times 4q + (4q)^2$

$= 25p^2 + 40pq + 16q^2$

Work it Out-3

First, read the question carefully and understand it properly. Formula used:

$(a - b)^2 = a^2 - 2ab + b^2$

(i) Use identity B to find the value of 97^2:

972 = (100-3)2

$= 100^2 - 2 \times 100 \times 3 + 3^2$

$= 10000 - 600 + 9$

$= 9409$

(ii) No, Now compare $(x - y)^2$ and $(y - x)^2$.

$(x - y)^2 = x^2 - 2xy + y^2$

$(y - x)^2 = y^2 - 2yx + x^2$

$= x^2 - 2xy + y^2$

So, $(x - y)^2 = (y - x)^2$

Work it Out-4

1. First, read the question carefully and understand it properly.

Formula used: $(a + b)(a - b) = a^2 - b^2$

(i) Use identity C to calculate 105×95:

$105 \times 95 = (100 + 5)(100 - 5)$

$= 100^2 - 5^2$

$= 10000 - 25$

$= 9975$

(ii) Use identity C to calculate 32×28:

$32 \times 28 = (30 + 2)(30 - 2)$

$= 30^2 - 2^2$

$= 900 - 4$

$= 896$

So, using the identity $(a + b)(a - b)$, the values of 105×95 and 32×28 are 9975 and 896 respectively.

Work it Out-5

1. First, read the question carefully and understand it properly.

Formula used: $a^2 - b^2 = (a + b)(a - b)$

(i) Express 44 as a difference of two squares:

$44 = 11 \times 4$

$= (11 + 4)(11 - 4)$

$= 15 \times 7$

So, $44 = 15 \times 7 = 8^2 - 1^2$

Because, $8^2 - 1^2 = 64 - 20 = 44$

So, $44 = 8^2 - 1^2$

Formula used: $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$

(ii) Given: $\frac{p - 1}{p} = 7$

Square both sides:

$(p - \frac{1}{p})^2 = (7)^2$

$p^2 - 2 + \frac{1}{p^2} = 49$

$p^2 + \frac{1}{p^2} = 51$

So, the number 44 can be written as $8^2 - 1^2$ and the value of $\frac{p^2 + 1}{p^2}$ is 51.

Work it Out-6

1. To verify these statements, we apply algebraic identities and properties of even and odd numbers.

(i) Expanding $(k + 2)(k + 4) - (k + 6)$ gives $k^2 + 6k + 8 - k - 6 = k^2 + 5k + 2$; if $k = 1$, the value is $1 + 5 + 2 = 8$ (even),

but if $k = 2$, it is $4 + 10 + 2 = 16$ (even), so $k(k + 5) + 2$ is always even because k and $k + 5$ have different parities making their product even.

(ii) For $3t(2t - 1)$, if $t = 1$, $3(1)(2 - 1) = 3$, which is odd; therefore, the statement that it is always even. It is false.

(iii) Using the formula for an even number $(2n)^2$, we get $(2n)^2 = 4n^2$, which is clearly a multiple of 4; thus, the statement is true.

(iv) Using the identity $(a + b)^2 – (a – b)^2 = 4ab$, the expression $(5m + 1)^2 – (5m – 1)^2 = 4(5m)(1) = 20m$; since 20m can be a perfect square (e.g., if m = 5, 20 × 5 = 100), the statement that it is always less than a perfect square is false.

2. Let the first number be 5m + 4 and the second number be 5n + 2, where m and n are any integers.

The sum of the numbers is (5m + 4) + (5n + 2) = 5m + 5n + 6 = 5(m + n + 1) + 1.

The difference of the numbers is (5m + 4) – (5n + 2) = 5m – 5n + 2 = 5(m – n) + 2.

The product of the numbers is (5m + 4) × (5n + 2) = 25mn + 10m + 20n + 8 = 5(5mn + 2m + 4n + 1) + 3.

The formula being used is the Division Algorithm: Dividend = (Divisor × Quotient) + Remainder.

The remainder for the sum is 1, the remainder for the difference is 2, and the remainder for the product is 3.

3. To find the pattern, we let the middle number be (n + 1) and the other two numbers be n and (n + 2).

The mathematical expression for the given condition is $(n + 1)^2 – (n × (n + 2))$.

We use the Identity I: $(a + b)^2 = a^2 + 2ab + b^2$ and the Distributive Property: a(b + c) = ab + ac.

Expanding the expression gives $(n^2 + 2n + 1) – (n^2 + 2n)$.

Subtracting the terms results in $n^2 + 2n + 1 – n^2 – 2n = 1$.

The calculation shows that regardless of the value of n, the result is always 1.

4. First, read the question carefully and understand it properly.

Formula used: $(a + b)^2 = a^2 + 2ab + b^2$ and distributive property.

Let the two numbers be p and q.

Sum = p + q

Half of the sum = (p + q) ÷ 2

Product = $\dfrac{(p + q) \times (p + q)}{2}$

$= (p + q)^2 \div 2$

So, the result is half of the square of the sum.

Pattern: The result is always equal to $(p + q)^2 \div 2$.

5. Tell which is larger without computing directly.

Formula used: $(a + b)(a - b) = a^2 – b^2$ and comparison by balancing numbers.

(i) 12 × 28 and 14 × 26

12 × 28 = (20 – 8) (20 + 8)

14 × 26 = (20 – 6) (20 + 6)

Since 6 < 8, (20 – 6) (20 + 6) is greater than (20 – 8) (20 + 8)

So, 14 × 26 is larger.

(ii) 36 × 65 and 39 × 62

36 × 65 = (50 – 14)(50 + 15)

39 × 62 = (50 – 11)(50 + 12)

Here, the numbers in 39 × 62 are closer to 50 than in 36 x 65, so their product is larger.

So, 39 × 62 is larger.

6. From the given figures, the number of squares in each pattern increases regularly.

Pattern 1 has 3 squares

Pattern 2 has 5 squares

Pattern 3 has 7 squares

So, the numbers form the sequence: 3, 5, 7, ...

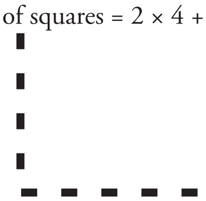
Formula used: General term of odd numbers = 2n + 1

For pattern n,

Number of squares = 2n + 1

Next figure (Pattern 4):

Number of squares = 2 × 4 + 1 = 9



So, Pattern 4 will have 9 squares arranged in the same L-shape form.

(ii) General expression:

Number of squares in pattern n = 2n + 1

So, the next figure will have 9 squares, and in general, the number of squares in the nth pattern is given by 2n + 1.

Connect and Reflect

[A] Multiple Choice Questions:

1. (b), **2.** (b), **3.** (c), **4,** (b), **5.** (c)

[B] Fill in the blank:

1. ab + ac, **2.** 2ab, **3.** $x^2 - y^2$
4. an + bm + mn, **5.** 1

[C] State True or False:

1. False, **2.** False, **3.** True, **4.** True, **5.** True

[D] Subjective Questions:

1. The property that connects multiplication and addition is called the **Distributive Property.**

2. The identity that helps in expanding $(a + b)^2$ is Identity I: $(a + b)^2 = a^2 + 2ab + b^2$.

3. Brahmagupta was the first to explicitly state the distributive law in India.

4. The general form of multiplying two binomials is $(a + b)(c + d) = ac + ad + bc + bd$.

5. The product of (a + b) and (a – b) is known as the difference of two squares.

6. (i) $56^2 = (50 + 6)^2 = 50^2 + 2(50)(6) + 6^2 = 2500 + 600 + 36 = 3136$ using Identity I.

(ii) $94 \times 106 = (100 - 6)(100 + 6) = 100^2 - 6^2 = 10000 - 36 = 9964$ using Identity III.

(iii) $87^2 = (90 - 3)^2 = 90^2 - 2(90)(3) + 3^2 = 8100 - 540 + 9 = 7569$ using Identity II.

(iv) $205 \times 195 = (200 + 5)(200 - 5) = 200^2 - 5^2 = 40000 - 25 = 39975$ using Identity III.

7. (i) $(p + 4)(p - 5) = p(p - 5) + 4(p - 5) = p^2 - 5p + 4p - 20 = p^2 - p - 20$ using **Distributive Property.**

(ii) $(3a + 7b)(3a - 7b) = (3a)^2 - (7b)^2 = 9a^2 - 49b^2$ using Identity III.

(iii) $(2x - 3y)^2 = (2x)^2 - 2(2x)(3y) + (3y)^2 = 4x^2 - 12xy + 9y^2$ using Identity II.

(iv) $(4m + 9)^2 = (4m)^2 + 2(4m)(9) + 9^2 = 16m^2 + 72m + 81$ using Identity I.

8. (i) Three less than the square of a number n is $n^2 - 3$.

(ii) Let the odd numbers be (2n – 1) and (2n + 1); their sum of squares is $(2n - 1)^2 + (2n + 1)^2 = 4n^2 + 4n + 1 + 4n^2 + 4n + 1 = 8n^2 + 2$.

9. Let a 2 × 2 square be n, n + 1, n + 7, n + 8; the difference of diagonal products is $(n + 1)(n + 7) - n(n + 8) = (n^2 + 8n + 7) - (n^2 + 8n) = 7$.

10. Let the numbers be 8m + 5 and 8n + 4;

(i) Sum: $(8m + 5) + (8n + 4) = 8(m + n + 1) + 1$;

(ii) Difference: $(8m + 5) - (8n + 4) = 8(m - n) + 1$;

(iii) Product: $(8m + 5)(8n + 4) = 64mn + 32m + 40n + 20 = 8(8mn + 4m + 5n + 2) + 4$.

NCERT Exercise

Figure it Out Questions

Page-142-143

1. Same as work it out – 1 question 1.

2. The formula being used is the distributive property: $(a + b)(c + d) = ac + ad + be + bd$.

(i) $(3 + u)(v - 3) = 3v - 9 + uv - 3u$.

(ii) $\frac{2}{3}(15 + 6a) = (\frac{2}{3} \times 15) + (\frac{2}{3} \times 6a) = 10 + 4a$.

(iii) $(10a + b)(10c + d) = 100ac + 10ad + 10bc + bd$.

(iv) $(3 - x)(x - 6) = 3x - 18 - x^2 + 6x = 9x - 18 - x^2$.

(v) $(-5a + b)(c + d) = -5ac - 5ad + bc + bd$.

(vi) $(5 + z)(y + 9) = 5y + 45 + zy + 9z$.

3. Let the numbers be x and y; the condition $(x + 2)(y - 4) = xy$ simplifies to $-4x + 2y - 8 = 0$ or $y = 2x + 4$.

Three examples are (x = 1, y = 6)

So $1 \times 6 = (1 + 2)(6 - 4) = 6$;

(x = 2, y = 8)

So $2 \times 8 = (2 + 2)(8 - 4) = 16$;

(x = 3, y = 10)

So $3 \times 10 = (3 + 2)(10-4) = 30$.

4. (i) $(a + ab - 3b^2)(4 + b) = 4a + ab + 4ab + ab^2 - 12b^2 - 3b^3 = 4a + 5ab + ab^2 - 12b^2 - 3b^3$.

(ii) $(4y + 7)(y + 11z - 3) = 4y^2 + 44yz - 12y + 7y + 77z - 21 = 4y^2 + 44yz - 5y + 77z - 21$.

5. (i) $(a - b)(a + b) = a^2 - b^2$.

(ii) $(a - b)(a^2 + ab + b^2) = a^3 + a^2b + ab^2 - ba^2 - ab^2 - b^3 = a^3 - b^3$.

(iii) $(a-b)(a^3+a^2b+ab^2+b^3) = a^4+a^3b+a^2b^2+ab^3-ba^3-a^2b^2-ab^3-b^4 = a^4-b^4$.

The pattern shows that the product is $a^n - b^n$; the next identity is $(a-b)(a^4+a^3b+a^2b^2+ab^3+b^4) = a^5-b^5$.

Page-149

1. Using the identity $(a-b)^2 = (b-a)^2$, $(a-b)^2 = a^2-2ab+b^2$ and $(b-a)^2 = b^2-2ab+a^2 = a^2-2ab+b^2$.

   So, $(a-b)^2 = (b-a)^2$.

   So, both are equal.

2. Using the identity $a^2-b^2 = (a-b)(a+b)$, $26^2-24^2 = (26-24)(26+24) = 2 \times 50 = 100$.

3. Using the identity $(a+b)^2 = a^2+2ab+b^2$ and $(a-b)^2 = a^2-2ab+b^2$,

   $406^2 = (400+6)^2 = 160000+4800+36 = 164836$.

   $72^2 = (70+2)^2 = 4900+280+4 = 5184$.

   $145^2 = (150-5)^2 = 22500-1500+25 = 21025$.

   $1097^2 = (1100-3)^2 = 1210000-6600+9 = 1203409$.

   $124^2 = (120+4)^2 = 14400+960+16 = 15376$.

4. Using the identities $(a+b)^2 = a^2+2ab+b^2$ and $(a-b)^2 = a^2-2ab+b^2$, these formulas are true for all real numbers.

   They hold for counting numbers, negative integers, and fractions.

   So, the patterns are true for all numbers, including negative numbers and fractions.

Page-154-156

1. **(i) Using Identity IA:** $(a+b)^2 = a^2+2ab+b^2$,

   $46^2 = (40+6)^2 = 1600+480+36 = 2116$.

   (ii) Using Identity IC: $(a+b)(a-b) = a^2-b^2$, $397 \times 403 = (400-3)(400+3) = 400^2-3^2 = 160000 - 9 = 159991$.

   (iii) Using Identity 1B: $(a-b)^2 = a^2-2ab+b^2$,

   $91^2 = (100-9)^2 = 10000-1800+81 = 8281$.

   (iv) Using Identity IC: $(a+b)(a-b) = a^2-b^2$,

   $43 \times 45 = (44-1)(44+1) = 44^2-1^2 = 1936-1 = 1935$.

2. **(i) Using distributive property:** $(a+b)(c+d) = ac+ad+bc+bd$,

   $(p-1)(p+11) = p^2+11p-p-11 = p^2+10p-11$.

   (ii) Using $(a+b)(a-b) = a^2-b^2$,

   $(3a-9b)(3a+9b) = 9a^2-81b^2$.

   (iii) Using distributive property,

   $-(2y+5)(3y+4) = -(6y^2+8y+15y+20) = -6y^2-23y-20$.

   (iv) Using $(a+b)^2 = a^2+2ab+b^2$,

   $(6x+5y)^2 = 36x^2+60xy+25y^2$.

   (v) Using $(a-b)^2 = a^2-2ab+b^2$,

   $(2x-\frac{1}{2})^2 = 4x^2-2x+1/4$.

   (vi) Using associative and distributive property,

   $(7p)(3r)(p+2) = 21pr(p+2) = 21p^2r+42pr$.

3. (i) Two more than a square number, let the number be s,

   Using s^2+2, the expression is s^2+2.

   (ii) The sum of the squares of two consecutive numbers, let the numbers be m and m + 1,

   Using $m^2+(m+1)^2 = m^2+m^2+2m+1 = 2m^2+2m+1$.

   So, the expression is $2m^2+2m+1$.

4. Using the calendar pattern, label the 2×2 square as a, a + 1, a + 7, a + 8.

   Using multiplication and expansion formula: $(x+m)(x+n) = x^2+(m+n)x+mn$,

   First diagonal product = $a(a+8) = a^2+8a$.

   Second diagonal product = $(a+1)(a+7) = a^2+8a+7$.

   Difference = $(a+1)(a+7) - a(a+8)$
   $= (a^2+8a+7) - (a^2+8a)$
   $= 7$.

   So, the difference of diagonal products is always 7.

5. **(i) Using distributive property:**

   $(k+1)(k+2) - (k+3) = k^2+3k+2-k-3 = k^2+2k-1$, which is not always 2.

   So, the statement is **false**.

   (ii) Using $(a+b)(a-b) = a^2-b^2$,

   $(2q+1)(2q-3) = 4q^2-6q+2q-3 = 4q^2-4q-3$, which is not divisible by 4.

   So, the statement is **false**.

(iii) Using even number = 2n, $(2n)^2 = 4n^2$, a multiple of 4,

Using odd number = 2n + 1, $(2n + 1)^2 = 4n(n + 1) + 1$, which is I more than a multiple of 8.

So, the statement is **true**.

(iv) Using $a^2 - b^2 = (a - b)(a + b)$,

$(6n + 2)^2 - (4n + 3)^2 = (2n - 1)(10n + 5) = 5(2n - 1)(2n + 1) = 5(4n^2 - 1) = 20n^2 - 5$,

which is 5 less than $\left(\sqrt{20n^2}\right)^2$.

So, the statement is **true**.

6. Let the numbers be 7a + 3 and 7b + 5.

Sum = 7a + 3 + 7b + 5 = 7(a + b + 1) + 1, remainder

So, the remainder of the sum is 1.

Difference = (7a + 3) (7b + 5) = 7(a – b) – 2 = 7(a – b – 1) + 5, remainder = 5.

So, the remainder of the difference is 5.

Product = (7a + 3)(7b + 5) = 49ab + 35a + 21b + 15 = 7(7ab + 5a + 3b + 2) + 1, remainder = 1.

So, the remainder of the product is 1.

7. Let the three consecutive numbers be x – 1, x, x + 1.

Using identity $(a - b)(a + b) = a^2 - b^2$,

$x^2 - (x - 1)(x + 1) = x^2 - (x^2 - 1) = 1$.

So, the result is always 1.

8. Let the two numbers be a and b.

Using $(a + b)^2 = a^2 + 2ab + b^2$,

Expression = $(a + b) \times \frac{(a+b)}{2} = \frac{(a+b)^2}{2}$

So, the result is half of the square of the sum.

9. (i) Using $a^2 - b^2 = (a - b)(a + b)$,

$14 \times 26 = (20 - 6)(20 + 6) = 20^2 - 6^2 = 364$,

$16 \times 24 = (20 - 4)(20 + 4) = 20^2 - 4^2 = 384$,

So 16 × 24 is larger.

(ii) Using $a^2 - b^2 = (a - b)(a + b)$,

$25 \times 75 = (50 - 25)(50 + 25) = 50^2 - 25^2 = 1875$,

$26 \times 74 = (50 - 24)(50 + 24) = 50^2 - 24^2 = 1924$,

So, 26 × 74 is larger.

10. Using the formula : Area of square = $side^2$,

Area of each green square = g^2, so side = g.

From the figure, total length = g + g + 4w = 2g + 4w,

Total breadth = g + 2w.

Using the formula,

Area of rectangle = length breadth,

Total area = (2g + 4w)(g + 2w).

Using (a + b)(c + d) = ac + ad + bc + bd,

Total area = $2g^2 + 4gw + 4gw + 8w^2$

$= 2g^2 + 8gw + 8w^2$.

Area of two green squares = $2g^2$.

Area to be tiled = $(2g^2 + 8gw + 8w^2) - 2g^2$

$= 8gw + 8w^2$.

11. Do yourself

7. Proportional Reasonign–1

Work it Out-1

1. State whether the given statements of proportion are true or false:

Formula used:

a : b : : c : d ⇒ a ÷ b = c ÷ d or a × d = b × c

(i) 3 : 8 : : 12 : 32

3 ÷ 8 = 12 ÷ 32

3 × 32 = 8 × 12

96 = 96

So, the statement is **true**.

(ii) 5 : 4 : : 20 : 15

5 ÷ 4 ≠ 20 ÷ 15

5 × 15 ≠ 4 × 20

75 ≠ 80

So, the statement is **false**.

(iii) 9 : 10 : : 10 : 9

9 ÷ 10 ≠ 10 ÷ 9

9 × 9 ≠ 10 × 10

81 ≠ 100

So, the statement is **false**.

(iv) 15 : 18 : : 5 : 6

15 ÷ 18 = 5 ÷ 6

15 × 6 = 18 × 5

90 = 90

So, the statement is **true**.

(v) 14 : 21 : : 2 : 3

14 ÷ 21 = 2 ÷ 3

$14 \times 3 = 21 \times 2$

$42 = 42$

So, the statement is **true**.

(vi) 30 : 10 : : 3 : 1

$30 \div 10 = 3 \div 1$

$30 \times 1 = 10 \times 3$

$30 = 30$

So, the statement is **true**.

2. Give any two ratios that are proportional to 6 : 5.

Formula used:

Multiply both terms of a ratio by the same number.

$6 : 5 \times 2 = 12 : 10$

$6 : 5 \times 3 = 18 : 15$

So, two ratios proportional to 6:5 are 12 : 10 and 18 : 15.

3. Fill in the missing numbers for ratios proportional to 20:28.

Formula used:

$a : b = c : d \Rightarrow a \div b = c \div d$

First simplify:

20 : 28 = 5 : 7

(i) 5 : ______

5 : 7

So, missing number = 7

(ii) ______ : 14

5 : 7 = x:14

$7 \times 2 = 14$, so $5 \times 2 = 10$

So, missing number = 10

(iii) 40 : ______

5 : 7 = 40 : x

$5 \times 8 = 40$, so $7 \times 8 = 56$

So, missing number = 56

(iv) ______ : 70

5 : 7 = x : 70

$7 \times 10 = 70$, so $5 \times 10 = 50$

So, missing number = 50

4. Given : Original screen A ratio = 6 : 10

Formula used: a: b = c : d

$a \div b = c \div d$

Or a : b and c : d are proportional if their simplest forms are equal.

First find the simplest form of screen A:

$6 : 10 = 6 \div 2 : 10 \div 2$

3 : 5

So, simplest ratio of A = 3 : 5

Now simplify other screen ratios:

Screen B = 5 : 12

$5 \div 1 : 12 \div 1 = 5 : 12$

Simplest form = $5 : 12 \neq 3 : 5$

So, B is not proportional.

Screen C = 3 : 5

$3 \div 1 : 5 \div 1 = 3 : 5$

Simplest form = 3 : 5 = 3 : 5

So, C is proportional.

Screen D = 8 : 8

$8 \div 8 : 8 \div 8 = 1 : 1$

Simplest form = $1 : 1 \neq 3 : 5$

So, D is not proportional.

Screen E = 9 : 15

$9 \div 3 : 15 \div 3 = 3 : 5$

Simplest form = 3 : 5 = 3 : 5

So, E is proportional.

So, only screens C and E have the same simplest ratio as A.

Thus, screens C and E are proportional to the original screen A.

5. Do yourself

6. (a) Given : Green pixels = 80

Black pixels = 24

White pixels = 40

Required ratio = 80 : 24 : 40

Formula used: To find simplest form of a ratio, divide all terms by their HCF.

HCF of 80, 24, and 40 = 8

$80 \div 8 : 24 \div 8 : 40 \div 8$

= 10 : 3 : 5

So, simplest ratio = 10 : 3 : 5

(b) Given: Green pixels = 80

Black pixels = 24

White pixels = 40

Total pixels = 80 + 24 + 40 = 144

Required ratio = Green : Total

= 80 : 144

Formula used:

To find simplest form of a ratio, divide both terms by their HCF.

HCF of 80 and 144 = 16

$80 \div 16 : 144 \div 16$

= 5 : 9

So, simplest ratio = 5:9

5 : 9.

So, the ratio of green pixels to total pixels is 5 : 9.

Work it Out-2

1. Distance in one year = 960,000,000 km

Number of weeks in a year = 52

Formula: Distance in a week = Total distance ÷ Number of weeks

960,000,000 ÷ 52 = 18,461,538.46 km

So, the Earth will travel 18.46 million kilometres (approx.) in a week.

2. Given: Main rectangle length = 20 ft, breadth = 12 ft, small extension = 7 ft × 3 ft, inner wall = 12 ft.

Formula used: Perimeter of rectangle = 2 × (l + b),

Total bricks = Total wall length × Bricks per ft.

Perimeter of main rectangle = 2 × (20 + 12) = 2 × 32 = 64 ft.

Extra outer wall due to extension = 2 × 7 = 14 ft.

Total outer wall length = 64 + 14 = 78 ft.

Inner wall length = 12 ft.

Total wall length = 78 + 12 = 90 ft.

Bricks used for 10 ft = 1800, so bricks per ft = 1800 ÷ 10 = 180.

Total bricks needed = 90 × 180 = 16,200.

So, the builder needs 16200 bricks to build all the walls of the house.

3. Given: Speed = 60 km/h

Time = 3 hours

Formula Used: Distance = Speed × Time

Distance = 60 × 3

Distance = 180 km

So, Roy's father travelled from Agra to Kanpur = 180 km.

Page-105

Do it Now!

(i) Yes, the prices are proportional to the volume because when the volume increases, the price also increases in the same ratio.

(ii) Companies do this to attract more customers, increase sales, and encourage people to buy larger quantities.

(iii) No, the largest size is not always the better choice because sometimes smaller sizes are cheaper per unit and suit the customer's need better.

Work it Out-3

1. Given ratio = 5 : 7

Total parts = 5 + 7 = 12

Formula Used: First part = (First ratio ÷ Total ratio) × Total quantity, Second part = (Second ratio ÷ Total ratio) × Total quantity

First part = (5 ÷ 12) × 7200 = ₹ 3000

Second part = (7 ÷ 12) × 7200 = ₹ 4200

So, the two parts are ₹ 3000 and ₹ 4200.

2. Given ratio of acid to water = 2 : 3

Formula Used : Required quantity = (Given part ÷ Corresponding part) × Known quantity

Water = (3 ÷ 2) × 20 = 30 ml

So, the required quantity of water is 30 ml.

3. Given ratio of red to blue = 4 : 6

Let red = 4x and blue = 6x

4x + 6x = 50

10x = 50

x = 5

Red = 4 × 5 = 20 litres

Blue = 6 × 5 = 30 litres

New red = 20 + 10 = 30 litres

New ratio = 30 : 30 = 1 : 1

So, the new ratio of red to blue paint is 1 : 1.

4. Given ratio of flour to milk = 3 : 2

Total parts = 3 + 2 = 5

Formula Used: Required quantity = (Given part ÷ Total parts) x Total mixture

Flour = (3 ÷ 5) × 15 = 9 cups

Milk = (2 ÷ 5) × 15 = 6 cups

So, the required flour is 9 cups and milk is 6 cups.

5. Given ratio of red to yellow = 4 : 5

Let red = 4x and yellow = 5x

First mixture = 4x + 5x = 9x

Added yellow = 9x

New red = 4x

New yellow = 5x + 9x = 14x

New ratio of red to yellow = 4x: 14x = 2:7

So, the new ratio of red paint to yellow paint is 2 : 7.

Work it Out-4

1. Ratio of mercury weight to oil weight = 25 : 3

Weight of 1 litre of oil = 900 g

Formula: Mass of mercury = (Weight of oil ÷ Oil ratio part) × Mercury ratio part

Mass of mercury = (900 ÷ 3) × 25 = 300 × 25 = 7500 g

So, the mass of one litre of mercury is 7.5 kilograms.

2. Area of first field = 300 x 200 = 60,000 sq ft

Area of second field = 450 x 300 = 135,000 sq ft

Formula: Compost needed = (Compost used ÷ First area) × Second area

Compost needed = (15 ÷ 60,000) × 135,000 = 0.00025 × 135,000 = 33.75 tonnes

So, the farmer will need 33.75 tonnes of compost.

3. Volume of bucket = 12 litres,

Time taken = 18 seconds

Volume of tank = 120 litres

Formula: Time required = (Total volume Volume of bucket) × Time for bucket

Time required = (120 ÷ 12) × 18 = 10 × 18 = 180 seconds

So, it will take 180 seconds to fill the tank.

4. Area of 1 acre = 43,650 sq ft, Cost = 20,00,000

Target area = 3600 sq ft

Formula: Cost of area = (Total cost ÷ Total area in sq ft) × Target area

Cost = (20,00,000 ÷ 43,650) × 3600 = 45.819 × 3600 ₹ 1,64,948.45

The cost of 3600 sq feet will be ₹ 1,64,948.45.

Connect and Reflect

[A] Multiple Choice Questions:

1. (c), **2.** (b), **3.** (b), **4.** (c), **5.** (b)

[B] Fill in the blank:

1. : :, **2.** ad = bc, **3.** 3 : 4, **4.** ₹ 240, 5. two

[C] State True or False:

1. False, **2.** True, **3.** False, **4.** True, **5.** True

[D] Subjective Questions:

1. Given: Meaning of the quantity of two ratios.

The equality of two ratios is called **proportion.**

2. Given: Checking whether two ratios are proportional.

Formula used: a : b = c : d ⇒ a × d = b × c

Cross multiplication is used to check proportion.

3. Given: Ratio = 7 : 9

Formula used: a : b, where a = first term, b = second term

7 is antecedent and 9 is consequent.

So, 7 is antecedent and 9 is consequent.

4. Given: Ratio = 25 : 50

Formula used: Simplest form = Divide by HCF

HCF of 25 and 50 = 25

25 ÷ 25 : 50 ÷ 25 = 1 : 2

So, the simplest form is 1 : 2.

5. Given: Rule of three (Trairasika).

Formula used: Direct proportion rule

It was described by **Aryabhata**.

So, Aryabhata described the rule of three.

6. Given: Check by cross multiplication.

Formula used : a : b = c : d ⇒ a × d = b × c

(i) 5 : 8 : : 15 : 24

5 × 24 = 120, 8 × 15 = 120 → **True**

(ii) 9 : 6 : : 18 : 12

9 × 12 = 108, 6 × 18 = 108 → **True**

(iii) 7 : 4 : : 14 : 10

7 × 10 = 70, 4 × 14 = 56 → **False**

(iv) 12 : 15 : : 24 : 30

12 × 30 = 360, 15 × 24 = 360 → **True**

(v) 6 : 9 : : 10 : 12

6 × 12 = 72, 9 × 10 = 90 → **False**

Final Answer: Statements (i), (ii), and (iv) are true.

7. Given: Ratio = 7:5

Formula used: Multiply both terms by same number

7 × 2 : 5 × 2 = 14 : 10

7 × 3 : 5 × 3 = 21 : 15

7 × 4 : 5 × 4 = 28 : 20

So, three proportional ratios are 14 : 10, 21 : 15, and 28 : 20.

8. Given: 4 cups flour, 2 cups sugar for 16 muffins

Formula used: Direct proportion

Flour needed = 4 ÷ 16 × 40 = 10 cups

Sugar needed = 2 ÷ 16 × 40 = 5 cups

So, they need 10 cups of flour and 5 cups of sugar.

9. Given: Boys: Girls 3 : 5, Total = 72

Formula used: Part = (Given ratio ÷ Total ratio) × Total

Total ratio = 3 + 5 = 8

Boys = 3 ÷ 8 × 72 = 27

Girls 5 ÷ 8 × 72 = 45

So, there are 27 boys and 45 girls.

10. Given: 120 km in 2 hours

Formula used: Distance ∞ Time

Speed = 120 ÷ 2 = 60 km/h

Distance in 5 hours = 60 × 5 = 300 km

So, the car will travel 300 km.

11. Given: Apple: Grape 3 : 2, Total = 1 litre

Formula used: Part = (Given ratio ÷ Total ratio) × Total

Total ratio = 3 + 2 = 5

Apple juice = 3 ÷ 5 × 1 = 0.6 litre

Grape juice = 2 ÷ 5 × 1 = 0.4 litre

So, apple juice is 0.6 = litre and grape juice is 0.4 litre.

NCERT Exercise

Figure it Out Questions

Page-165-167

1. Given: Check which statements are proportional.

Formula used: a : b = c : d ⇒ a × d = b ×c

(i) 4 : 7 : : 12 : 21

4 × 21 = 84, 7 × 12 = 84 → **True**

(ii) 8 : 3 : : 24 : 6

8 × 6 = 48, 3 × 24 = 72 → **False**

(iii) 7 : 12 : : 12 : 7

7 × 7 = 49, 12 × 12 = 144 → **False**

(iv) 21 : 6 : : 35 : 10

21 × 10 = 210, 6 × 35 = 210 → **True**

(v) 12 : 18 : : 28 : 12

12 × 12 = 144, 18 × 28 = 504 → **False**

(vi) 24 : 8 : : 9 : 3

24 × 3 = 72, 8 × 9 = 72 → **True**

2. Given: Ratio = 4 : 9

Formula used: Multiply both terms by same number

4 × 2 : 9 × 2 = 8 : 18

4 × 3 : 9 × 3 = 12 : 27

4 × 4 : 9 × 4 = 16 : 36

Three proportional ratios are 8 : 18, 12 : 27, and 16 : 36.

3. Given: Ratio = 18 : 24

Formula used: a : b = c: d ⇒ a ÷ b = c ÷ d

18 ÷ 24 = 3 ÷ 4

So, b = a × 4 ÷ 3

3 × 4 ÷ 3 = 4

12 × 4 ÷ 3 = 16

20 × 4 ÷ 3 = 80 ÷ 3

27 × 4 ÷ 3 = 36

The required ratios are 3 : 4, 12 : 16, 20 : 80 ÷ 3, and 27 : 36.

4. Do yourself

5. Do yourself

6. (a) Number of coloured bricks = 18

Number of grey bricks = 33

The ratio of grey bricks to coloured bricks = 33 : 18 = 11 : 6

(b) Number of coloured bricks = 48

Number of grey bricks = 71

The ratio of grey bricks to coloured bricks = 71 : 48

7. Do yourself

Page-170

1. Distance in one year = 940,000,000 km

Number of weeks in a year = 52

Formula: Distance in a week = Total distance ÷ Number of weeks

940,000,000 ÷ 52 = 18,076,923.08 km

The Earth will travel 18076923.08 in a week.

2. To find the total number of bricks, we first determine the total length of all the walls (both outer and inner).

The total length of the walls is calculated as 108 feet.

(This includes the three vertical walls of 12 feet, the two vertical extension walls of 9 feet, the top and bottom horizontal walls of 24 feet each, and the extension's bottom wall of 6 feet).

Formula being used: Total Bricks = (Total Length ÷ 10 feet) × Bricks per 10 feet.

Total bricks = (108 feet ÷ 10 feet) × 1450 bricks

Total bricks = 10.8 × 1450 = 15660 bricks.

So, the mason would need 15660 to build the house.

Page-175

1. Total amount = 4,500

Ratio = 2 : 3

Sum of ratio parts = 2 + 3 = 5

Formula: Part = (Ratio of part ÷ Sum of ratio parts) × Total amount

First part = (2 ÷ 5) × 4,500 = 1,800

Second part = (3 ÷ 5) × 4,500 = 2,700

The two parts are 1,800 and 2,700.

2. Total solution = 240 mL

Ratio of acid to water = 1 : 5

Sum of ratio parts = 1 + 5 = 6

Amount of acid = (1 ÷ 6) × 240 = 40 mL

Amount of water = (5 ÷ 6) × 240 = 200 mL

The solution contains 40 mL of acid and 200 mL of water.

3. Total green paint = 40 mL

Ratio of blue to yellow = 3 : 5

Sum of ratio parts = 3 + 5 = 8

Blue paint needed = (3 ÷ 8) × 40 = 15 mL

Yellow paint needed = (5 ÷ 8) × 40 = 25 mL

New amount of yellow paint = 25 + 20 = 45 mL

New ratio of blue to yellow = 15 : 45 = 1 : 3

The initial amounts were 15 mL of blue and 25 mL of yellow, and the new ratio is 1 : 3.

4. Total mixture needed = 6 cups

Ratio of rice to urad dal = 2 : 1

Sum of ratio parts = 2 + 1 = 3

Rice needed = (2 ÷ 3) × 6 = 4 cups

Urad dal needed = (1 ÷ 3) × 6 = 2 cups

You will need 4 cups of rice and 2 cups of urad dal.

5. Initial ratio of red to yellow = 3 : 5

Let the amount of red be 3x and yellow be 5x

Total amount in one bucket = 3x + 5x = 8x

Amount of yellow added (one bucket) = 8x

New amount of yellow = 5x + 8x = 13x

New ratio of red to yellow = 3x : 13x = 3 : 13

Page-176

1. Orange juice = 600 mL,

Apple juice = 900 mL

Ratio = 600000

Formula: Simplest Form = Ratio ÷ Highest Common Factor (HCF)

HCF of 600 and 900 is 300

Simplest ratio = (600 ÷ 300): (900 ÷ 300) = 2 : 3

The ratio of orange juice to apple juice in its simplest form is 2 : 3.

2. Total people last year = 162,

Buses used = 3

Formula: Capacity per bus = Total people ÷ Number of buses

Capacity per bus = 162 ÷ 3 = 54 people

Total people this year = 204

Buses needed = 204 ÷ 54 = 3.77

Since we cannot have a fraction of a bus, 4 buses are needed

Total capacity of 4 buses = 4 × 54 = 216

The number of buses needed is four and they will not all be full.

3. Delhi: Population = 30,000,000, Area = 1,484 sq. km

Mumbai: Population = 20,000,000, Area = 550 sq. km

Formula: Population Density = Total Population ÷ Total Area

Delhi density = 30,000,000 ÷ 1,484 = 20,215.63 people per sq. km

Mumbai density = 20,000,000 ÷ 550 = 36,363.63 people per sq. km

Mumbai is more crowded because it has a higher population density.

4. Crane height = 155 cm, Ratio of neck and the rest of its body = 4 : 6

Total ratio parts = 4 + 6 = 10

Assume your height is 150 cm

Formula: Part Value = (Ratio of part ÷ Total ratio) × Total height

Neck height = (4 ÷ 10) × 150 = 60 cm

If your height is 150 cm, your neck would be 60 cm tall.

5. Saffron quantity = $2\frac{1}{2}$ = 2.5 palas, Cost =

= $\frac{3}{7}$ niskas

Formula: Quantity (Initial Quantity ÷ initial Cost) × New Cost

Quantity for 9 niskas = (2.5 ÷ $\frac{3}{7}$) × 9

Quantity = 2.5 × (7 ÷ 3) × 9 = 2.5 × 7 × 3 = 52.5 palas

52.5 palas of saffron can be bought for nine niskas.

6. Harmain's age = 1, Brother's age = 5

Age difference = 5 – 1 = 4 years (constant)

Let Harmain's age be x, then brother's age is x + 4

Formula: x = (x + 4) = 1 ÷ 2

2x = x + 4, so x = 4

Harmain will be 4 years old when the ratio is 1 : 2.

7. Ratio of Gold to Water = 37 : 2

Mass of 1 litre water = 1 kg

Formula: Mass of Gold = (Ratio of Gold ÷ Ratio of Water) × Mass of Water

Mass of Gold = (37 ÷ 2) × 1 = 18.5 kg

The mass of one litre of gold is 18.5 kilograms.

8. Plot size = 200 ft × 500 ft = 100,000 sq. ft

1 acre = 43,560 sq. ft

Area in acres = 100,000 ÷ 43,560 = 2.296 acres

Formula: Total Manure = Area in acres Manure per acre

Total Manure = 2.296 × 10 = 22.96 tonnes

The farmer should buy 22.96 tonnes of manure.

9. Time for 500 mL = 15 seconds

Volume of bucket = 10 litres = 10,000 mL

Formula: Total Time = (Total Volume ÷ Unit Volume) × Unit Time

Total Time = (10,000 ÷ 500) × 15 = 20 × 15 = 300 seconds

300 seconds = 300 ÷ 60 = 5 minutes

The tap will take 5 minutes to fill the bucket.

10. Cost of 1 acre (43,560 sq. ft) = 15,00,000

Formula: Cost = (Total Price ÷ Total Area) × Required Area

Cost of 2,400 sq. ft = (15,00,000 ÷ 43,560) × 2,400

Cost = 34.435 × 2,400 = 82,644.63

The cost of 2400 square feet of land is 82644.63.

11. Field = 20 acres, Oxen speed = 6 hours per acre

Formula: Total time = Area × Time per acre

Time for oxen = 20 × 6 = 120 hours

Tractor speed = 4 times faster than oxen

Tractor time = 120 ÷ 4 = 30 hours

Oxen take 120 hours and the tractor takes 30.

12. Coin mass = 7.74 g, Ratio Copper to Nickel = 3 : 1

Sum of ratio = 4

Copper mass = (3 ÷ 4) × 7.74 = 5.805 g = 0.005805 kg

Nickel mass = (1 ÷ 4) × 7.74 = 1.935 g = 0.001935 kg

Formula: Total Cost = (Mass 1 × Rate 1) + (Mass 2 × Rate 2)

Cost = (0.005805 × 906) + (0.001935 × 1,341) = 5.259 + 2.595 = ₹ 7.854

So, the cost of the metals in the coin is ₹ 7.854.