NCERT QUESTIONS WITH SOLUTIONS

FIGURE IT OUT-01

1. Arrange the stick figure cutouts given at the end of the book or draw a height arrangement such that the sequence reads:

(a) 0, 1, 1, 2, 4, 1, 5
(b) 0, 0, 0, 0, 0, 0, 0
(c) 0, 1, 2, 3, 4, 5, 6
(d) 0, 1, 0, 1, 0, 1, 0
(e) 0, 1, 1, 1, 1, 1, 1
(f) 0, 0, 0, 3, 3, 3, 3

Sol. (a) 0, 1, 1, 2, 4, 1, 5

0, 1, 1, 2, 4, 1, 5

The rule says that the given numbers are equal to the number of children in front of each stick figure who are taller than them. That means here 0 means no taller child in front of the stick figure.

1 = 1 child in front of him who is taller than him.

1 = 1 children in front of him who is taller than him.

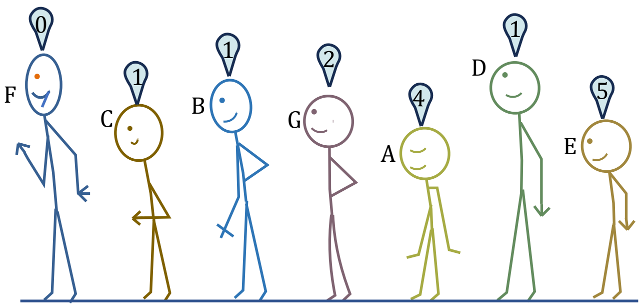
2 = 2 children in front of him who is taller than him.

4 = 4 children in front of him who is taller than him.

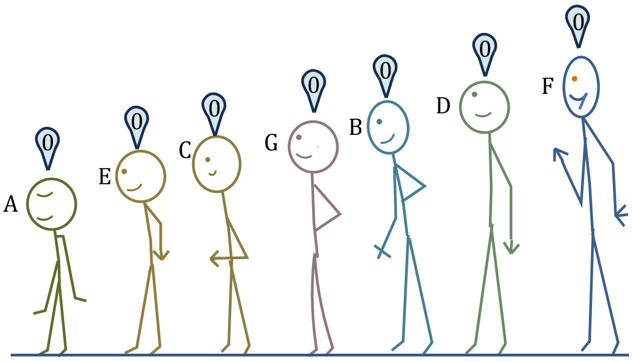
1 = 1 children in front of him who is taller than him.

5 = 5 children in front of him who is taller than him.

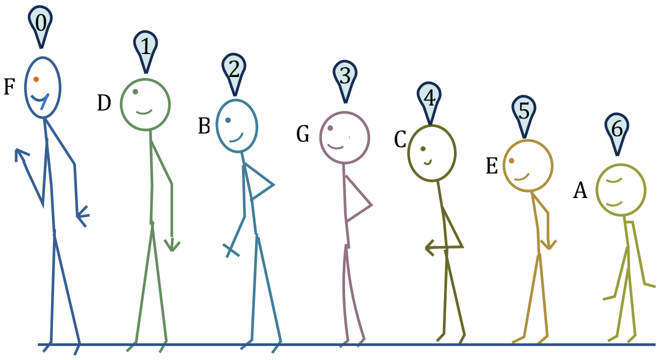
Hence the arrangement will be



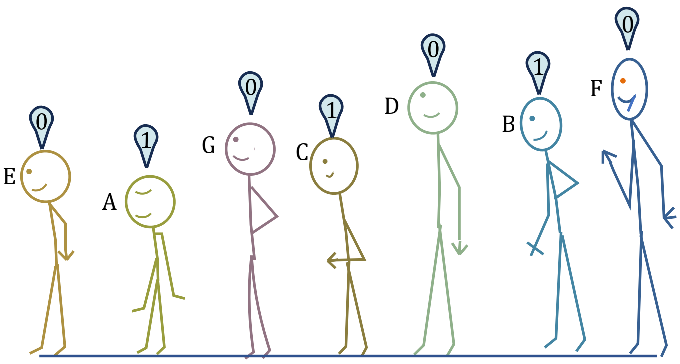
(b) 0, 0, 0, 0, 0, 0, 0



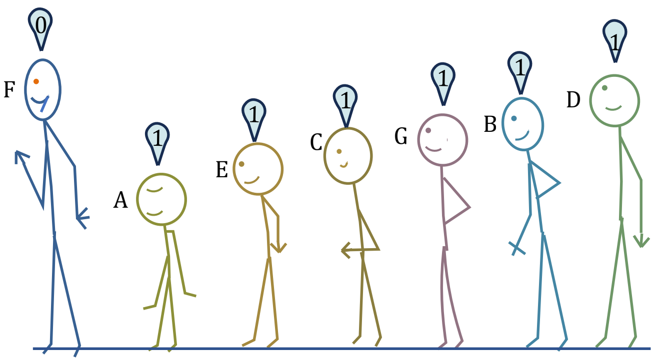
(c) 0, 1, 2, 3, 4, 5, 6



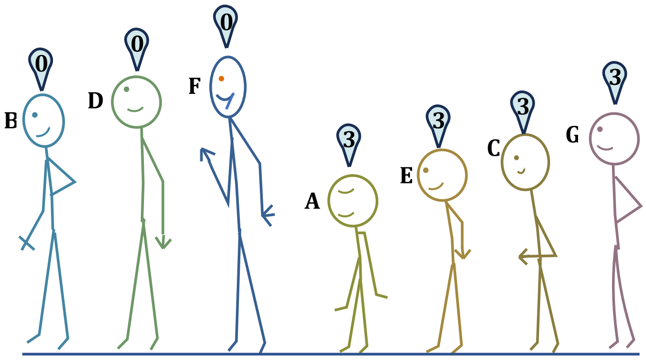
(d) 0, 1, 0, 1, 0, 1, 0



(e) 0, 1, 1, 1, 1, 1, 1



(f) 0, 0, 0, 3, 3, 3, 3



2. For each of the statements given below, think and identify if it is Always True, Only Sometimes True, or Never True. Share your reasoning.

(a) If a person says '0', then they are the tallest in the group.

(b) If a person is the tallest, then their number is '0'.

(c) The first person's number is '0'.

(d) If a person is not first or last in line (i.e., if they are standing somewhere in between), then they cannot say '0'.

(e) The person who calls out the largest number is the shortest.

(f) What is the largest number possible in a group of 8 people?

Sol. (a) Only Sometimes True:

Each person looks ahead to see if anyone taller is in front of them.

If they don't see anyone taller, they say "0".

The tallest person will always say "0" because no one is taller.

But a shorter person might also say "0" — if they are standing at the front, or — if all the people in front are shorter than them.

So, the rule "a person says 0 only if they are the tallest" is not always true. It's only sometimes true.

(b) Always True

If a person is the tallest, that means no one is taller than them.

So, when they look ahead, they will not see anyone taller.

That's why they will always say "0".

So, the statement is always true.

(c) Always True:

Each person gets a number.

This number shows how many taller people are in front of them.

The first person in the line has no one in front.

So, there can't be any taller people there.

That's why the first person's number is always 0.

So, this is always true.

(d) Only Sometimes True:

The statement is only sometimes true. A person standing in between can still be assigned '0' if there are no taller people ahead of them.

(e) Only Sometimes True:

The statement is only sometimes true. A person who calls out the largest number has many taller people in front but may not be the shortest overall.

For example, if the shortest person is standing at the front, they will call out '0'. Meanwhile, the second shortest person could be at the back and might call out the largest number.

(f) If there are 8 people, then the shortest person will see 7 taller people. So, the maximum number someone can say is 7.

FIGURE IT OUT-02

1. Using your understanding of the pictorial representation of odd and even numbers, find out the parity of the following sums:

(a) Sum of 2 even numbers and 2 odd numbers (e.g., even + even + odd + odd)

(b) Sum of 2 odd numbers and 3 even numbers

(c) Sum of 5 even numbers

(d) Sum of 8 odd numbers

Sol. (a) Even + Even = Even

and Odd + Odd = Even

Adding the two results, we get

Even + Even = Even.

The parity of the result is even.

Example:

4 + 6 + 3 + 5 = 10 + 8 = 18 (Even)

(b) Odd + Odd = Even

and Even +Even + Even = Even

Adding the two results, we get

Even + Even = Even

The parity of the result is even.

Example:

5+ 7 + 4 + 6 + 8 = 12 + 18 = 30 (Even)

(c) Adding any 5 even numbers always gives an even number.

The parity of the result is even.

Example: 2 + 4 + 6 + 8 + 10 = 30 (Even)

(d) Odd + Odd = Even (4 such pairs).

Adding the 4 such results, we get

Even + Even + Even + Even = Even

The parity of the result is even.

Example: 1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 = 64 (Even)

2. Lakpa has an odd number of ₹1 coins, an odd number of ₹5 coins and an even number of ₹10 coins in his piggy bank. He calculated the total and got ₹205. Did he make a mistake? If he did, explain why. If he didn't, how many coins of each type could he have?

Sol. Lakpa has an odd number of ₹ 1 coins, so, their total value is odd.

He also has an odd number of ₹ 5 coins, so their total is also odd.

The ₹ 10 coins are even in numbers, so their total is even.

Now, adding two odd sums, we get

Odd (from ₹ 1) + Odd (from ₹ 5) = Even

Adding the ₹ 10 coins' total (even sum) to this even sum,

Even + Even = Even

Since 205 is an odd number, the total of ₹ 205 is not possible with an odd number of ₹ 1 and ₹ 5 coins and an even number of ₹ 10 coins. Therefore, Lakpa made a mistake in his calculation.

3. We know that:

(a) even + even = even

(b) odd + odd = even

(c) even + odd = odd

Similarly, find out the parity for the scenarios below:

(d) even – even = ________________

(e) odd – odd = ________________

(f) even – odd = ________________

(g) odd – even = ________________

Sol. (d) even – even = ________________

$8 - 4 = 4 \rightarrow$ even

$10 - 4 = 6 \rightarrow$ even

Parity of result = even

∴ even – even = even

(e) odd – odd = ________________

$5 - 3 = 2 \rightarrow$ even

$9 - 3 = 6 \rightarrow$ even

Parity of result = even

∴ odd – odd = even

(f) even – odd = ________________

6 – 3 = 3

10 – 5 = 5

Parity of result = odd

∴ even – odd = odd

(g) odd – even = ________________

5 – 2 = 3

11 – 6 = 5

Parity of result = odd

∴ odd – even = odd

FIGURE IT OUT-03

1. How many different magic squares can be made using the numbers 1 – 9?

Sol. There are 8 different magic square that can be made using numbers 1–9.

			=15
6	7	2	=15
1	5	9	=15
8	3	4	=15
=15	=15	=15	=15

2	7	6
9	5	1
4	3	8

8	3	4
1	5	9
6	7	2

8	1	6
3	5	7
4	9	2

2	9	4
7	5	3
6	1	8

4	9	2
3	5	7
8	1	6

6	1	8
7	5	3
2	9	4

4	3	8
9	5	1
2	7	6

2. Create a magic square using the numbers 2 – 10. What strategy would you use for this? Compare it with the magic squares made using 1 – 9.

Sol. The numbers 2-10 are 9 consecutive numbers, just like 1-9, but increased by 1. We know that the sum of the numbers from 2 to 10 is

2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 = 54

Magic sum = $\frac{54}{3}$ = 18

7	8	3
2	6	10
9	4	5

3. Take a magic square, and

(a) increase each number by 1

(b) double each number

In each case, is the resulting grid also a magic square? How do the magic sums change in each case?

Sol.

			=15
4	3	8	=15
9	5	1	=15
2	7	6	=15
=15	=15	=15	=15

Original (magic sum = 15)

(a) increase each number by 1

5	4	9
10	6	2
3	8	7

New magic sum=18

(b) double each number

8	6	16
18	10	2
4	14	12

New magic sum = 30

In case (a), adding a constant to every number, → magic sum increases by 3 × that constant.

In case (b), multiplying all by a constant → magic sum multiplied by that constant.

4. What other operations can be performed on a magic square to yield another magic square?

Sol. A magic square is a square grid where the sums of numbers in each row, column, and both diagonals are all the same — that's called the magic constant.

There are several operations we can do on a magic square that still preserve its magic properties. Here are some common ones:

(i) Rotation

We can rotate the square by:

- 90° clockwise
- 180°
- 270° clockwise

Each rotation gives us a new magic square.

(ii) Reflection (Flipping)

We can reflect (flip) the square:

- Horizontally (left ↔ right)
- Vertically (top ↔ bottom)
- Diagonally (across either main diagonal)

Each reflection also gives us a new magic square.

Adding or multiplying every number

- Add the same number to every cell (e.g., +5 to each) → Still a magic square, but with a new magic constant.
- Multiply every number by the same non-zero value (e.g., ×2) → Also gives a new magic square.

Note: This doesn't preserve the original numbers, but the magic structure remains.

5. Discuss ways of creating a magic square using any set of 9 consecutive numbers (like 2 – 10, 3 – 11, 9 – 17, etc.).

Sol.

2	9	4
7	5	3
6	1	8

Original for number 1-9

After adding 1 in each number we get

The magic square for number 2-10

3	10	5
8	6	4
7	2	9

Here, magic sum = 18

The magic square for number 3-11 is formed by adding 2 to each no. of the original magic square using no. 1 to 9.

4	11	6
9	7	5
8	3	10

Here, magic sum = 21

The magic square for number 9-17 is formed by adding 8 to each no. of the original magic square.

10	17	12
15	13	11
14	9	16

Here, magic sum = 39

FIGURE IT OUT-04

1. Using the generalised form, find a magic square if the centre number is 25.

Sol. A magic square with the center value 25, where other numbers in the grid are expressed in relation to 25.

25+3	25–4	25+1
25–2	25	25+2
25–1	25+4	25–3

➡

28	21	26
23	25	27
24	29	22

2. What is the expression obtained by adding the 3 terms of any row, column or diagonal?

Sol. Row sum (1st row) = 28 + 21 + 26 = 75

Column sum (1st column) = 28 + 23 + 24 = 75

Diagonal sum (1st column) = 28 + 25 + 22 = 75

The expression obtained = 3 × m

where m is the letter-number representing the number in the centre.

3. Write the result obtained by—

(a) adding 1 to every term in the generalised form.

(b) doubling every term in the generalised form

Sol.

m+3	m–4	m+1
m–2	m	m+2
m–1	m+4	m–3

original

(a)

m+4	m–3	m+2
m–1	m+1	m+3
m	m+5	m–2

(b)

2m+6	2m–8	2m+2
2m–4	2m	2m+4
2m–2	2m+8	2m–6

4. Create a magic square whose magic sum is 60.

Sol. A 3 × 3 magic square's sum is 3 × the middle element.

So, for a sum of 60, the middle element should be $\frac{60}{3} = 20$

To get a magic sum of 60, we will multiply the original magic square by 4, i.e.,

8	1	6
3	5	7
4	9	2

➡

8×4	1×4	6×4
3×4	5×4	7×4
4×4	9×4	2×4

⬇

32	4	24
12	20	28
16	36	8

5. Is it possible to get a magic square by filling nine non-consecutive numbers?

Sol. Yes, it is possible. Let us consider the two magic squares with a magic sum 45.

9 consecutive numbers:

16	17	12
11	15	19
18	13	14

9 non consecutive numbers:

18	21	6
3	15	27
24	9	12

FIGURE IT OUT-05

1. A light bulb is ON. Dorjee toggles its switch 77 times. Will the bulb be on or off? Why?

Sol. Dorjee toggles the switch 77 times.

Now, let's break it down:

Starting from the initial ON state of the bulb:

1st toggle → OFF

2nd toggle → ON

3rd toggle → OFF

...and so on.

Each time you toggle the switch, the state changes. So, the key is determining whether the number of toggles is **odd** or **even**:

- If the number of toggles is **odd**, the light bulb will end up in the **opposite** state from where it started (which was ON).
- If the number of toggles is **even**, the light bulb will end up in the **same** state (ON).

Since 77 is **odd**, after 77 toggles, the light bulb will be in the **opposite** state to its starting position. So, it will be **OFF**.

Answer: The light bulb will be **OFF** after 77 toggles.

2. Liswini has a large old encyclopaedia. When she opened it, several loose pages fell out of it. She counted 50 sheets in total, each printed on both sides. Can the sum of the page numbers of the loose sheets be 6000? Why or why not?

Sol. Total sheets = 50

Each sheet has one even and one odd page number.

Thus, the total of 50 sheets consists of 50 even numbers and 50 odd numbers.

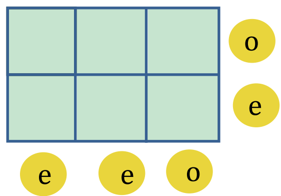
The sum of the even numbers is even. (because adding any number of even numbers is even).

The sum of the odd numbers is even. (because adding an even number of odd numbers is even).

Thus, the total sum is even + even = even.

Since 6000 is an even number, it is possible for the sum of the page numbers of the loose sheets to be 6000.

3. Here is a 2 × 3 grid. For each row and column, the parity of the sum is written in the circle; '*e*' for even and 'o' for odd. Fill the 6 boxes with 3 odd numbers ('*o*') and 3 even numbers ('*e*') to satisfy the parity of the row and column sums.



Sol.

o	e	e
o	e	o

as

1	2	4	o
3	6	9	e
e	e	o	

4. Make a 3 × 3 magic square with 0 as the magic sum. All numbers can not be zero. Use negative numbers, as needed.

Sol. One Solution to this problem could be:

$$\begin{bmatrix} -1 & 4 & -3 \\ -2 & 0 & 2 \\ 3 & -4 & 1 \end{bmatrix}$$

Let's check the row, column, and diagonal sums to ensure everything adds up to 0:

(i) Row sums**:**

$-1 + 4 + (-3) = 0$

$-2 + 0 + 2 = 0$

$1 + 3 + (-4) = 0$

(ii) Column sums**:**

$(-1) + (-2) + 3 = 0$

$4 + 0 + (-4) = 0$

$3 + (-4) + 1 = 0$

(iii) Diagonal sums**:**

$(-1) + 0 + 1 = 0$

$3 + 0 + (-3) = 0$

Conclusion: This 3 × 3 magic square works, and the sum of the numbers in each row, column, and diagonal is 0.

5. Fill in the following blanks with 'odd' or 'even':

(a) Sum of an odd number of even numbers is _____

(b) Sum of an even number of odd numbers is _____

(c) Sum of an even number of even numbers is _____

(d) Sum of an odd number of odd numbers is _____

Sol. (a) Even

(b) Even

(c) Even

(d) Odd

6. What is the parity of the sum of the numbers from 1 to 100?

Sol. There are 100 numbers from 1 to 100.

Parity: odd, even, odd, even...There are exactly 50 odd numbers and 50 even numbers.

Adding 50 odd numbers gives an even sum (because an even number of odd numbers sums to even).

Adding 50 even numbers gives an even sum.

Total sum: even + even = even.

Therefore, the parity of the sum of numbers from 1 to 100 is even.

7. Two consecutive numbers in the Virahāṅka sequence are 987 and 1597. What are the next 2 numbers in the sequence? What are the previous 2 numbers in the sequence?

Sol. In the Virahanka sequence, the next number is obtained by adding the two previous numbers.

Given that two consecutive numbers in sequence are 987 and 1597.

The next two numbers are:

987 + 1597 = 2584.

1597 + 2584 = 4181.

The previous two numbers are:

1597 – 987 = 610.

987 – 610 = 377.

the sequence is .....,377, 610, 987, 1597, 2584, 4181,.....

8. Angaan wants to climb an 8-step staircase. His playful rule is that he can take either 1 step or 2 steps at a time. For example, one of his paths is 1, 2, 2, 1, 2. In how many different ways can he reach the top?

Sol. Different ways by which Angaan can climb the 8-step staircase by taking either 1 step or 2 steps at a time are:

Steps	Different ways			Number of Ways
n=8	No 2s	1+1+1+1+1+1+1+1	1	1+7+15+10+1 =34
	One 2s	2+1+1+1+1+1+1 1+2+1+1+1+1+1 1+1+2+1+1+1+1 1+1+1+2+1+1+1 1+1+1+1+2+1+1 1+1+1+1+1+2+1 1+1+1+1+1+1+2	7	
	Two 2s	2+2+1+1+1+1 2+1+2+1+1+1 2+1+1+2+1+1 2+1+1+1+2+1 2+1+1+1+1+2 1+2+2+1+1+1 1+2+1+2+1+1 1+2+1+1+2+1 1+2+1+1+1+2 1+1+2+2+1+1 1+1+2+1+2+1 1+1+2+1+1+2 1+1+1+2+2+1 1+1+1+2+1+2 1+1+1+1+2+2	15	
	Three 2s	2+2+2+1+1 2+2+1+2+1 2+2+1+1+2 2+1+2+2+1 2+1+2+1+2 2+1+1+2+2 1+2+2+2+1 1+2+2+1+2 1+2+1+2+2 1+1+2+2+2	10	
	Four 2s	2+2+2+2	1	

So, the total ways in which Angaan reaches the top = 1 + 7 + 15 + 10 + 1
= 34 ways

9. What is the parity of the 20th term of the Virahāṅka sequence?

Sol. Virahāṅka sequence:

1, 2, 3, 5, 8, 13, 21, 34, 55, 89,...

1(odd), 2(even), 3(odd), 5(odd), 8(even), 13(odd), 21(odd), 34(even), 55(odd), 89(odd),...

Parity cycle: odd, even, odd

This pattern repeats every 3 terms.

20 ÷ 3 = 6 remainder 2.

This means the 20^{th} term corresponds to the second position in the parity cycle, which is: odd, even, odd

Thus, the parity of the 20^{th} term is even.

10. Identify the statements that are true.

(a) The expression $4m - 1$ always gives odd numbers.

(b) All even numbers can be expressed as $6j - 4$.

(c) Both expressions $2p + 1$ and $2q - 1$ describe all odd numbers.

(d) The expression $2f + 3$ gives both even and odd numbers.

Sol. (a) Substituting m = 1 in 4m – 1

$\Rightarrow 4(1) - 1 = 4 - 1 = 3$ (odd).

Substituting m = 3 in 4m –1

$\Rightarrow 4(3) - 1 = 12 - 1 = 11$ (odd).

4m is always even, so 4m – 1 is always odd. Thus, the statement is True.

(b) Substituting j = 1 in 6j – 4

$\Rightarrow$ 6(1) – 4 = 2 (even).

Substituting j = 2 in 6j – 4

$\Rightarrow$ 6(2) – 4 = 12 – 4 = 8 (even).

Substituting j = 3 in 6j – 4

$\Rightarrow$ 6(3) – 4 = 18 – 4 = 14 (even).

Since, some even numbers can be expressed in the form 6j – 4 but not all. Thus, the statement is False.

(c) For 2p + 1:

If p = 1, 2(1) + 1 = 2 + 1 = 3 (odd)

If p = 2, 2(2) + 1 = 4 + 1 = 5 (odd)

If p = 3, 2(3) + 1 = 6 + 1 = 7 (odd)

Similarly, for 2q – 1:

If q = 1, 2(1) – 1 = 2 – 1 = 1 (odd)

If q = 2, 2(2) – 1 = 4 – 1 = 3 (odd)

If q = 3, 2(3) – 1 = 6 – 1 = 5 (odd)

Thus, the statement is True.

(d) For 2f + 3:

If f = 1, 2(1) + 3 = 2 + 3 = 5 (odd)

If f = 2, 2(2) + 3 = 4 + 3 = 7 (odd)

If f = 3, 2(3) + 3 = 6 + 3 = 9 (odd)

This is always odd because 2f is always even and adding 3 makes it odd. Thus, the statement is False.

11. Solve this cryptarithm:

$$\begin{array}{r} UT \\ +\ TA \\ \hline TAT \end{array}$$

Sol. Let T = 1 and A = 0 then U = 9

$$\begin{array}{r} 91 \\ +\ 10 \\ \hline 101 \end{array}$$

Here, T = 1, A = 0 and U = 9