📘 CLASS 9 MATHEMATICS

📝 CHAPTER 8 – PREDICTING WHAT COMES NEXT: EXPLORING SEQUENCES AND PROGRESSIONS

🌟 FREE WORKSHEET | New NCERT Ganita Manjari | 2026–27

This worksheet is based on the **actual Chapter 8 of your new Ganita Manjari textbook**. The chapter covers **sequences, explicit and recursive rules, arithmetic progressions (AP), geometric progressions (GP), sums of sequences, Virahānka–Fibonacci sequence, visual patterns, graphs and applications such as bouncing balls and fractals**.

Name: _____
Class: IX **Section:** _____
Date: _____

📌 Instructions

- Attempt all questions.
- Show complete working.
- Write formulas before substituting values.
- **Total Marks: 40**

🟢 SECTION A – MCQs

1 × 8 = 8 marks

1. A sequence is:

A. A random collection of numbers
B. An ordered list of numbers
C. A set containing only natural numbers
D. A list containing only positive numbers

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2. In the sequence:

`5, 8, 11, 14, ...`

the common difference is:

A. 2
B. 3
C. 4
D. 5

---

3. Which of the following is an arithmetic progression?

A. `2, 4, 8, 16, ...`
B. `3, 6, 9, 12, ...`
C. `1, 2, 4, 8, ...`
D. `5, 10, 20, 40, ...`

---

4. The nth term of an AP is:

A. `a + nd`
B. `a + (n-1)d`
C. `ar^(n-1)`
D. `a - nd`

---

5. A geometric progression has a constant:

A. Difference
B. Sum
C. Ratio
D. Product

---

6. The nth term of a GP is:

A. `a + (n-1)d`
B. `ar^(n-1)`
C. `a + nr`
D. `a/r^n`

---

7. Which sequence is the Virahānka–Fibonacci sequence given in the textbook?

A. `1, 2, 4, 8, 16, ...`
B. `1, 3, 6, 10, 15, ...`
C. `1, 2, 3, 5, 8, 13, ...`
D. `1, 4, 9, 16, 25, ...`

---

8. If every term of a sequence is obtained by multiplying the previous term by the same number, the sequence is a:

A. AP
B. GP
C. Random sequence
D. Square sequence

🟡 SECTION B – FILL IN THE BLANKS

1 × 6 = 6 marks

9. Each number in a sequence is called a _____.

10. In an AP, the difference between consecutive terms is called the _____.

11. The first term of an AP is usually represented by _____.

12. In a GP, the constant multiplier is called the common _____.

13. The nth term of an AP is `t_n = __________`.

14. The nth term of a GP is `t_n = __________`.

🔵 SECTION C – SEQUENCES

2 × 5 = 10 marks

15. Write the next three terms:

`4, 7, 10, 13, ...`

---

16. Find the first five terms of the sequence:

`t_n = 3n - 2`

---

17. Find the 10th term of:

`t_n = 5n - 3`

---

18. Determine whether `97` is a term of the sequence:

`t_n = 5n - 3`

Give a reason.

---

19. A sequence is defined recursively by:

`t_1 = -5`

`t_(n+1) = t_n + 3`

Find its first five terms.

🟠 SECTION D – ARITHMETIC PROGRESSIONS

2 × 4 = 8 marks

20. Find the 10th term of the AP:

3, 8, 13, 18, ...

---

21. Find the 26th term of:

3, 8, 13, 18, ...

---

22. Which term of the AP:

21, 18, 15, 12, ...

is -81?

---

23. Find the nth term of:

11, 8, 5, 2, ...

Also write its recursive rule.

🔴 SECTION E – GEOMETRIC PROGRESSIONS

2 × 3 = 6 marks

24. Find the common ratio and the 8th term of:

3, 6, 12, 24, ...

---

25. Find the 10th term of the GP:

5, 25, 125, ...

---

26. Which term of the GP:

`2, 6, 18, 54, ...`

is `4374`?

🌟 SECTION F – APPLICATION-BASED QUESTIONS

2 marks each

27. 🏀 Bouncing Ball

A ball is dropped from a height of `80 m`. After each bounce, it rises to `60%` of the height from which it fell.

Find the height reached after the:

a) 1st bounce
b) 2nd bounce
c) 5th bounce

---

28. 🦠 Bacteria Growth

A culture initially contains `30` bacteria. The number of bacteria doubles every hour.

Find the number of bacteria after:

a) 2 hours
b) 4 hours
c) `n` hours

⭐ BONUS CHALLENGE

29. 🧠 Virahānka–Fibonacci Sequence

The sequence is:

`1, 2, 3, 5, 8, 13, 21, ...`

Each term is obtained by adding the previous two terms.

Find the next **five terms**.

Then write the recursive rule.

🏆 SUPER CHALLENGE

30. 🔢 Sum of Consecutive Natural Numbers

Find the smallest value of `n` such that:

`1 + 2 + 3 + ... + n > 1000`

Use:

`1 + 2 + ... + n = n(n+1)/2`

✅ ANSWER KEY

🟢 SECTION A

1. **B** – An ordered list of numbers
2. **B** – 3
3. **B** – `3, 6, 9, 12, ...`
4. **B** – `a + (n-1)d`
5. **C** – Ratio
6. **B** – `ar^(n-1)`
7. **C** – `1, 2, 3, 5, 8, 13, ...`
8. **B** – GP

🟡 SECTION B

9. **term**
10. **common difference**
11. **a**
12. **ratio**
13. **a + (n−1)d**
14. **ar^(n−1)**

The textbook defines an AP using first term `a` and common difference `d`, with `t_n = a + (n-1)d`. It defines a GP using first term `a`, common ratio `r`, and `t_n = ar^(n-1)`.

🔵 SECTION C

15.

`4, 7, 10, 13, ...`

Common difference = `3`

Next terms:

`16, 19, 22`

16.

`t_n = 3n - 2`

For `n = 1`:

`t_1 = 3(1) - 2 = 1`

For `n = 2`:

`t_2 = 6 - 2 = 4`

Therefore:

1, 4, 7, 10, 13

17.

$t_n = 5n - 3$

For $n = 10$:

$t_{10} = 5(10) - 3$

$= 50 - 3$

$= 47$

18.

Given:

$t_n = 5n - 3$

We need:

$5n - 3 = 97$

$5n = 100$

$n = 20$

Since n is a positive integer:

✅ Yes, 97 is the 20th term.

19.

$t_1 = -5$

$t_{(n+1)} = t_n + 3$

Therefore:

```
t_1 = -5

t_2 = -5 + 3 = -2

t_3 = -2 + 3 = 1

t_4 = 1 + 3 = 4

t_5 = 4 + 3 = 7
```

✅ **-5, -2, 1, 4, 7**

🟠 SECTION D

20.

AP:

```
3, 8, 13, 18, ...

a = 3

d = 5
```

Formula:

```
t_n = a + (n-1)d

t_10 = 3 + 9(5)

= 3 + 45
```

✅ **48**

21.

```
t_26 = 3 + 25(5)

= 3 + 125
```

✅ 128

The textbook's Exercise Set 8.2 directly asks for the 10th and 26th terms of this same AP.

22.

$a = 21$

$d = -3$

We need:

$t_n = -81$

$21 + (n-1)(-3) = -81$

$21 - 3n + 3 = -81$

$24 - 3n = -81$

$-3n = -105$

$n = 35$

✅ -81 is the 35th term.

23.

Sequence:

$11, 8, 5, 2, \ldots$

$a = 11$

$d = -3$

Therefore:

$t_n = 11 + (n-1)(-3)$

$t_n = 14 - 3n$

Recursive rule:

t_1 = 11

t_(n+1) = t_n - 3

🔴 SECTION E

24.

3, 6, 12, 24, ...

Common ratio:

r = 6/3 = 2

Therefore:

a = 3

r = 2

8th term:

t_8 = 3(2^7)

= 3 × 128

✅ 384

25.

GP:

5, 25, 125, ...

a = 5

r = 5

$$t_{10} = 5 \times 5^9$$

$$= 5^{10}$$

✅ 9,765,625

26.

$$2, 6, 18, 54, \ldots$$

Here:

$$a = 2$$

$$r = 3$$

We need:

$$2 \times 3^{(n-1)} = 4374$$

$$3^{(n-1)} = 2187$$

$$2187 = 3^7$$

Therefore:

$$n - 1 = 7$$

n = 8

✅ 4374 is the 8th term.

The textbook uses this same GP in Exercise Set 8.3.

🌟 SECTION F

27. 🏀 Bouncing Ball

Initial height:

```
80 m
```

Common ratio:

```
60/100 = 0.6
```

This is a GP:

```
80, 48, 28.8, 17.28, ...
```

a) 1st bounce

```
80 × 0.6
```

= 48 m

b) 2nd bounce

```
48 × 0.6
```

= 28.8 m

c) 5th bounce

```
80(0.6)^5
```

```
≈ 6.2208
```

✅ 6.2208 m

The textbook uses bouncing-ball heights as a real-life GP application.

---

28. 🦠 Bacteria Growth

Initial number:

```
30
```

Each hour it doubles.

So:

```
30, 60, 120, 240, ...
```

This is a GP with:

```
a = 30
```

```
r = 2
```

Formula:

```
t_n = 30 × 2^n
```

because n here represents the number of hours after the initial amount.

a) After 2 hours

```
30 × 2² = 120
```

✅ 120 bacteria

b) After 4 hours

```
30 × 2⁴
```

```
= 30 × 16
```

✅ 480 bacteria

c) After n hours

✅ 30 × 2^n

⭐ BONUS

Sequence:

```
1, 2, 3, 5, 8, 13, 21, ...
```

Next:

```
13 + 21 = 34
```

$21 + 34 = 55$

$34 + 55 = 89$

$55 + 89 = 144$

$89 + 144 = 233$

✅ Next five terms:

34, 55, 89, 144, 233

Recursive rule:

$$V_1 = 1$$

$$V_2 = 2$$

$$V_n = V_{(n-1)} + V_{(n-2)} \text{ for } n \geq 3$$

The textbook identifies this as the **Virahānka–Fibonacci sequence** and notes its historical connection to Virahānka, Gopāla, Hemachandra and Fibonacci.

🏆 SUPER CHALLENGE

We need:

$n(n+1)/2 > 1000$

Try $n = 44$:

$44 \times 45 / 2$

$= 990$

Not enough.

Try $n = 45$:

$45 \times 46 / 2$

```
= 1035
```

Therefore:

✅ Smallest value of n = 45

📌 CHAPTER 8 FORMULA BOX

🔢 Sequence

A sequence is an **ordered list of terms**.

Example:

```
2, 4, 6, 8, ...
```

🟠 Arithmetic Progression (AP)

A sequence in which the difference between consecutive terms is constant.

General form:

```
a, a+d, a+2d, ...
```

nth term:

`t_n = a + (n-1)d`

🔵 Geometric Progression (GP)

A sequence in which the ratio between consecutive terms is constant.

General form:

```
a, ar, ar², ar³, ...
```

nth term:

$$t_n = ar^{(n-1)}$$

🧠 Recursive Rule

A rule that defines a term using one or more previous terms.

Example:

$$t_1 = 2$$

$$t_{(n+1)} = 3t_n - 2$$

➕ Sum of First n Natural Numbers

$$1 + 2 + 3 + \ldots + n = n(n+1)/2$$

The textbook connects this result with **Āryabhaṭa's Āryabhaṭīya**.

🔺 Triangular Numbers

$$1, 3, 6, 10, 15, \ldots$$

$$T_n = n(n+1)/2$$

⬛ Square Numbers

$$1, 4, 9, 16, 25, \ldots$$

$$n^2$$

The textbook notes that square numbers can be expressed as sums of consecutive odd numbers.

🧬 Virahānka–Fibonacci Sequence

`1, 2, 3, 5, 8, 13, 21, ...`

`V_n = V_(n-1) + V_(n-2)`

🏆 STUDENT SELF-CHECK

☐ I understand what a sequence is.
☐ I can identify patterns in sequences.
☐ I can find an nth term.
☐ I can use recursive rules.
☐ I can identify an AP.
☐ I can find the common difference.
☐ I can find the nth term of an AP.
☐ I can identify a GP.
☐ I can find the common ratio.
☐ I can find the nth term of a GP.
☐ I can solve real-life GP problems.
☐ I understand the Virahānka–Fibonacci sequence.
☐ I can use the sum of natural numbers formula.

⭐ MY SCORE: _____ / 40

35–40: 🌟 Sequence Master!
28–34: 👏 Very Good!
20–27: 👍 Good – keep practising!
Below 20: 📚 Revise Chapter 8 and try again!