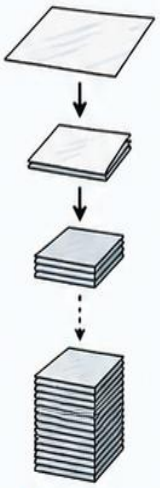
2 POWER PLAY

Just 46 folds of a paper can reach the Moon!

1. THE IDEA

- Fold a sheet of paper. Each time you fold, its thickness doubles.
- This is an example of exponential (multiplicative) growth.
- Amazing fact: After just 46 folds, the thickness is more than 7,00,000 km — enough to reach the Moon!



2. THICKNESS AFTER FOLDS

Initial thickness of paper = 0.001 cm

Thickness doubles after each fold.

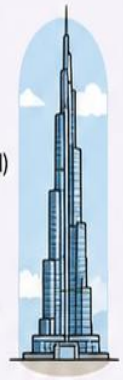
Fold	Thickness	Fold	Thickness	Fold	Thickness
1	0.002 cm	7	0.128 cm	13	8.192 cm
2	0.004 cm	8	0.256 cm	14	16.384 cm
3	0.008 cm	9	0.512 cm	15	32.768 cm
4	0.016 cm	10	1.024 cm	16	65.536 cm
5	0.032 cm	11	2.048 cm	17	≈ 131 cm
6	0.064 cm	12	4.096 cm		

(We use '≈' to mean approximately equal to.)

After 10 folds ≈ **1.024 cm** | After **17 folds** ≈ **131 cm** (a little more than 4 feet)

3. AMAZING GROWTH!

Folds	Approx. Thickness	
After 26 folds	≈ 670 m	(Burj Khalifa is 830 m tall)
After 30 folds	≈ 10.7 km	(Height of planes fly)
After 46 folds	> 7,00,000 km	(Can reach the Moon!)



4. THICKNESS DOUBLE EVERY TIME!

From any point, the thickness after 10 more folds increases by 10^{24} times.

Range of Folds	Thickness (approx.)	Times Increased By
0 to 10	1.023 cm	10^{24}
10 to 20	10.474 m	10^{24}
20 to 30	10.726 km	10^{24}
30 to 40	10984.2 km	10^{24}

5. EXPONENTIAL NOTATION – KEY CONCEPTS

General Form

n^a means n multiplied by itself a times.

Example: $5^4 = 5 \times 5 \times 5 \times 5 = 625$

Base = 5 Exponent (power) = 4

Common Powers

$n^2 = n \times n$ (read as 'n squared')

$n^3 = n \times n \times n$ (read as 'n **cubed**')

$n^4 = n \times n \times n \times n$ (read as 'n to the power 4')

$n^7 = n \times n \times n \times n \times n \times n \times n$'

(read as 'n to the power 7')

and so on...

Examples

- $4^3 = 4 \times 4 \times 4 = 64$
- $(-4)^3 = (-4) \times (-4) \times (-4) = -64$
- $a \times a \times a \times b \times b = a^3b^2$
- $a \times a \times b \times b \times b \times b = a^2b^4$

Remember!

$4 + 4 + 4 = 3 \times 4 = 12$

but

$4 \times 4 \times 4 = 4^3 = 64$

Express as Product of Prime Factors

Example: Express 32400 in exponential form.

$32400 = 2 \times 2 \times 2 \times 2 \times 5 \times 5 \times 3 \times 3 \times 3 \times 3$

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

Try It!

- What is $(-1)^5$? → −1 (negative)
- What is $(-1)^{56}$? → +1 (positive)
- Is $(-2)^4 = 16$? → Yes

6. QUICK FORMULA

If the initial thickness of paper is v cm, then thickness after n folds = $v \times 2^n$

Example: If $v = 0.001$ cm and $n = 10$, then thickness = $0.001 \times 2^{10} = 1.024$ cm

Key Takeaway

Small steps of doubling **create huge results** – that's the **Power Play!**

POWER PLAY

WORKSHEET-1

Section A: MCQs (/Part-1) (10 × 1 = 10 marks)

1.. 81 can be expressed as:
(a) 9^2 (b) 3^4 (c) 27^3 (d) 3^3

2. Which is a perfect sixth power?
(a) 729 (b) 64 (c) 729^6 (d) 1

3. The value of 2^4 is
(a) 8 (b) 4 (c) 16 (d) 32

4. What is the value of $3^0 + 4^0 + 5^0$?

(a) 3 (b) 1 (c) 12 (d) 0 2.

5. The planet Mars is approximately 22, 80, 00,000 km away from the Sun. What is this distance in standard form?
(a)22.8×107 km (b) 2.28×108 km (c) 2.28×107 km (d) 2.28×10−8 km .

6. The value of $(-2)^3 \times (-2)^{-5}$ is:

(a) 2^2 (b) -1/4 (c) −4 (d) 4^4.

7. The scientific notation of 51.26000 is:
(a) 5.126×10^4 (b) 5.126×10^1 (c) 5.126×10^{-4} (d) 5.126×10^{-6}

8. Simplify the expression: $(p^5 \times q^6) / (p^2 \times q^3)$

(a) $p^3 q^3$ (b) $(pq)^7$ (c) $p^7 q^9$ (d) p^3 / q^3 .

9. A virus's DNA is 0.0000000021 meters long. In scientific notation, this length is:

(a) 2.1×10−9 m (b) 2.1×10−8 m (c) 2.1×109 m (d) 2.1×108 m .

10. A magic potion doubles its quantity every minute. If you start with a single drop, how many minutes will it take for the quantity to be 2 15 drops?

(a) 15 minutes (b) 30 minutes (c) 10 minutes (d) 2 minutes

MCQs (/Part-2) (10 × 1 = 10 marks)

11. The hypotenuse of a right triangle with its legs of lengths 3x and 4x is
(a)5x (b) 7x (c) 16x (d) 25x 7.

12. The square of 12.5 is:
(a) 156.25 (b) 125.25 (c) 162.25 (d) 152.25

13. The value of 5^2 x 5^{-2} is
(a) 1 (b) 5 (c) 5^4 (d) 5^{-4}

14. A lock uses 4 slots with digits 0-9. How many combinations are possible?
(a) 10^3 (b) 10^4 (c) 4^{10} (d) 9^4

15. If there are 3×10^{12} trees and each tree has about 10^4 leaves, what is the total number of leaves?
(a) 3×10^{16} (b)3×10^8 (c) 30×10^{12} (d) 10^{18}

16. A bacteria culture doubles every hour. If there are 8 bacteria initially, how many bacteria will be present after 5 hours?
(a) 128 (b) 256 (c) 160 (d) 320

17. Which of the following is equal to $5^8 \div 5^3$?
(a) 5^{24} (b) 5^5 (c) 5^{11} (d) 5^{-5}

18. A city has a population of 8,450,000. Which of the following represents this number in scientific notation?
(a) 84.5×10^5 (b) 8.45×10^6 (c) 0.845×10^7 (d) 845×10^4

19. Simplify $(3^4)^2$.
(a) 3^6 (b) 3^8 (c) 6^4 (d) 9^4

20. A digital lock has 4 positions, and each position can be filled with any one of 10 digits (0–9). How many different passwords are possible?
(a) 4,000 (b) 10,000 (c) 40,000 (d) 1,000

WORKSHEET-2

Section B: Short Answer (10 × 2 =20 marks)

1. Express the following in exponential form:
(i) $5 \times 5 \times 7 \times 7 \times 7$ (ii) $a \times a \times a \times c \times c \times c \times c \times d$

2. Simplify and express the answer in exponential form: $(-4)^5 \text{ X } (-4)^{-10}$

3. Express $(81)^{-2}$ as a power with base 3.

4. What is $(-1)^5$? Is it positive or negative? What about $(-1)^{56}$?

5.Find the value of 126^2 , if $125^2 = 15625$.

6. Express the following as a product of powers of their prime factors in exponential form. -540

7. What is $2^{100} \div 2^{25}$ in powers of 2?

8. Simplify and write the answers in exponential form.

(i) $2^{-4} \times 2^{7}$ (ii) $3^{2} \times 3^{-5} \times 3^{6}$

9. Express the following numbers in standard form. (Page 32)
(i) 59,853 (ii) 65,950

10. If you have lived for a million seconds, how old would you be?

Section C: Short Answer (6 × 3 = 18 marks)

11. Write the numerical value of each of the following: $(-2)^{5} \times (-10)^{6}$

12. If $3x = 9^{2} \times 2^{7}$, find the value of x.

13. A dairy plans to produce 8.5 billion packets of milk in a year. They want a unique ID (identifier) code for each packet. If they choose to use the digits 0-9, how many digits should the code consist of?

14. Estu and Roxie came across a safe containing old stamps and coins that their great-grandfather had collected. It was secured with a 5-digit password.

(i) How many passwords did they end up checking?
(ii) If we have a 2-digit lock and try to find out how many passwords are possible.

15. Find the value of each of the following. $8^3 - 7^3$

16. The students of class 8 of a school donated ₹ 1296 to PM's relief fund. Each student donated as many rupees as the number of students in the class. Find the number of students in the class.

Section D: Long Answer (4 × 5 = 20 marks)

17. Find the value of (i) $(3^2 \times 3^4) \div 3^6$ (ii) $(5^8 \div 5^3) \times 5^2$

18. Numbers between the squares of the following pairs:
(i) 25 and 26 (ii) 77 and 78

19. Find the greatest value among the following. Give a reason.
(i) $74^3 - 73^3$ (ii) $66^3 - 65^3$ (iii) $74^2 - 73^2$ (iv) $66^2 - 65^2$

20. Evaluate $\sqrt[3]{1331} + \sqrt[3]{2744} + \sqrt[3]{1728}$

Case Study Based Questions (2 × 4 = 8 marks)

21. The King's Gold Coins: A king distributes his gold coins to his three ministers. Each minister receives three large chests. Each chest contains three medium-sized boxes. Each medium-sized box contains three small pouches, and each small pouch contains three gold coins. The king asks his ministers to calculate the total number of gold coins, but they must use exponential notation to present their answer

Q1. Express the number of gold coins each minister receives in exponential form.

Q2. How many gold coins were distributed in total by the king? Express your answer in exponential form.
Q3. If the number of ministers was four instead of three, and the number of chests, boxes, pouches, and coins per pouch remained the same, how many total coins would have been distributed? Express your answer in exponential form.
Q4**.** The king takes back a portion of the total coins equal to 3 4 . What is the number of coins remaining with the ministers? Express your answer in exponential form.

22. The Virus Spread: A new virus strain is discovered that infects people at an alarming rate. Initially, there is only one person infected on Day 0. The number of infected people doubles every day. The government wants to track the spread of this virus using exponential notation to manage resources efficiently.

Self Assessment:

I understood all concepts: ☐ Yes ☐ No

I need more practice: ☐ Yes ☐ No

Name of Concepts having doubts/Not Cleared: _____

Parent's Assessment:

My ward understood the all the concepts ☐ Yes ☐ No

He/She need more practice ☐ Yes ☐ No

Name of Concepts having doubts/Not Cleared: _____

Signature of Parent:

Teacher's Assessment

Answers of Worksheet-1:

Q	1	2	3	4	5	6	7	8	9	10
Ans	b		c	a	b	b	b	a	b	a
Q	11	12	13	14	15	16	17	18	19	20
Ans	a	a	a	b	a	b	b	b	b	b

Answers of Worksheet-2:

Q	1	2	3	4	5	6
Ans	(i)52x73 ii)a3xc4xd	$(-4)^{-5}$	(3)-8	-1,1	15876	$-(2^2x3^3x5^1)$
Q	7	8	9	10	11	12
Ans	2^{75}	2^2,3^3	(i)$5.9853x10^4$ (ii)$6.595x10^4$	11.57days	-32000000	3,456
Q	13	14	15	16	17	18
Ans	10digits	(i)100000 (ii)100	169	36	(i)1 (ii)78125	(i)50 (ii)154
Q	19	20	21		22	
Ans	(i)	37	3^4, 3^5, $4x3^4$		2^5, 8, 27	