NCERT QUESTIONS WITH SOLUTIONS

FIGURE IT OUT-01

1. Express the following in exponential form:

(i) $6 \times 6 \times 6 \times 6$

(ii) $y \times y$

(iii) $b \times b \times b \times b$

(iv) $5 \times 5 \times 7 \times 7 \times 7$

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

(vi) $a \times a \times a \times c \times c \times c \times c \times d$

Sol. (i) $6 \times 6 \times 6 \times 6 = 6^4$

(ii) $y \times y = y^2$

(iii) $b \times b \times b \times b = b^4$

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

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

(vi) $a \times a \times a \times c \times c \times c \times c \times d$

$= a^3 \times c^4 \times d^1$

2. Express each of the following as a product of powers of their prime factors in exponential form.

(i) 648

(ii) 405

(iii) 540

(iv) 3600

Sol. (i) Prime factors of 648

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

Exponential form of 648 $= 2^3 \times 3^4$

(ii) Prime factors of 405

$= 3 \times 3 \times 3 \times 3 \times 5$

Exponential form of 405 $= 3^4 \times 5$

(iii) Prime factors of 540

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

Exponential form of 540

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

(iv) Prime factors of 3600

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

Exponential form of 3600

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

3. Write the numerical value of each of the following:

(i) 2×10^3

(ii) $7^2 \times 2^3$

(iii) 3×4^4

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

(v) $3^2 \times 10^4$

(vi) $(-2)^5 \times (-10)^6$

Sol. (i) $2 \times 10^3 = 2 \times 10 \times 10 \times 10$

$= 2 \times 1000$

$= 2000$

(ii) $7^2 \times 2^3 = 7 \times 7 \times 2 \times 2 \times 2$

$= 49 \times 8$

$= 392$

(iii) $3 \times 4^4 = 3 \times 4 \times 4 \times 4 \times 4$

$= 3 \times 256$

$= 768$

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

$= 9 \times 25$

$= 225$

Negative numbers raised to even powers become positive.

(v) $3^2 \times 10^4 = 3 \times 3 \times 10 \times 10 \times 10 \times 10$

$= 9 \times 10{,}000$

$= 90{,}000$

(vi) $(-2)^5 \times (-10)^6$

$= (-2) \times (-2) \times (-2) \times (-2) \times (-2) \times (-10) \times (-10) \times (-10) \times (-10) \times (-10) \times (-10)$

$= (-32) \times (10{,}00{,}000)$

$= -3{,}20{,}00{,}000$

Odd power of a negative number remains negative, even power becomes positive.

FIGURE IT OUT-02

1. Find out the units digit in the value of $2^{224} \div 4^{32}$? [Hint: $4 = 2^2$]

Sol. The expression is $2^{224} \div 4^{32}$. We can rewrite the base 4 as 2^2.

$4^{32} = (2^2)^{32}$

Using the exponent rule $(a^m)^n = a^{m \times n}$:

$4^{32} = 2^{2 \times 32} = 2^{64}$

Now substitute this back into the division:

$$2^{224} \div 4^{32} = \frac{2^{224}}{2^{64}}$$

Using the exponent rule $\frac{a^m}{a^n} = a^{m-n}$:

$$\frac{2^{224}}{2^{64}} = 2^{224-64} = 2^{160}$$

The units digits of powers of 2 follow a repeating cycle of length 4 as 2, 4, 8, 6

($\because$ $2^1 = 2, 2^2 = 4, 2^3 = 8, 2^4 = 16, 2^5 = 32$)

To find the units digit of 2^{160}, we need to find the remainder of the exponent (160) when divided by the cycle length (4).

Remainder = 160 ÷ 4

We can calculate this:

160 ÷ 4 = 40 with a remainder of 0

When the remainder is 0, the units digit is the **last** digit in the cycle, which corresponds to the units digit of 2^4.

The last digit in the cycle (2,4,8,6) is 6.

Therefore, the units digit of 2^{160} is 6.

The units digit in the value of $2^{224} \div 4^{32}$ is 6.

2. There are 5 bottles in a container. Every day, a new container is brought in. How many bottles would be there after 40 days?

Sol. Start with 1 container having 5 bottles, 1 new container is added every day, so after 40 days.

Number of containers after 40 days = 40 containers × 5 bottles each = 200 bottles

3. Write the given number as the product of two or more powers in three different ways. The powers can be any integers.

(i) 64^3

(ii) 192^8

(iii) 32^{-5}

Sol.

	No.	Way-1	Way-2	Way-3
(i)	64^3	2^{18}	8^6	4^9
(ii)	192^8	$2^{48} \times 3^8$	$64^8 \times 3^8$	$16^8 \times 12^8$
(iii)	32^{-5}	2^{-25}	$8^{-5} \times 4^{-5}$	$\frac{1}{2^{25}}$

4. Examine each statement below and find out if it is 'Always True', 'Only Sometimes True', or 'Never True'. Explain your reasoning.

(i) Cube numbers are also square numbers.

(ii) Fourth powers are also square numbers.

(iii) The fifth power of a number is divisible by the cube of that number.

(iv) The product of two cube numbers is a cube number.

(v) q^{46} is both a 4^{th} power and a 6^{th} power (q is a prime number).

Sol. (i) Cube numbers are also square numbers only sometimes true reason:

(a) $64 = 4^3 = 8^2 \rightarrow$ both cube and square

(b) $8 = 2^3 \rightarrow$ not a square.

A number must be both a square and a cube, i.e., a sixth power, to satisfy both.

Not all cubes are sixth powers.

(ii) Fourth powers are also square numbers - Always True

Reason: Any fourth power is the form of $a^4 = (a^2)^2$, which is clearly a square. Fourth powers are squares because squaring a square gives a fourth power.

(iii) The fifth power of a number is divisible by the cube of that number. — Always True

Reason: $a^5 \div a^3 = a^{5-3} = a^2$, which is valid for any $a \neq 0$.

The fifth power contains at least three powers of the base, so it's divisible by its cube.

(iv) The product of two cube numbers is a cube number. — Always True

Reason: The product of two cubes is also a cube, just raise the product of their bases to the third power.

(v) q^{46} is both a 4^{th} power and a 6^{th} power (q is a prime number)- Never True

Reason: 46 is not divisible by 4 or 6 → can't be a 4^{th} or 6^{th} power.

5. Simplify and write these in the exponential form.

(i) $10^{-2} \times 10^{-5}$

(ii) $5^7 \div 5^4$

(iii) $9^{-7} \div 9^4$

(iv) $(13^{-2})^{-3}$

(v) $m^5\, n^{12}\, (mn)^9$

Sol. (i) $10^{-2} \times 10^{-5} = 10^{-2-5} = 10^{-7}$

$(a^m \times a^n = a^{m+n})$

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

$(a^m \div a^n = a^{m-n})$

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

$(a^m \div a^n = a^{m-n})$

(iv) $(13^{-2})^{-3} = (13)^{-2 \times (-3)} = (13)^6$

$[(a^m)^n = a^{mn}]$

(v) $m^5n^{12}(mn)^9 = m^5n^{12}m^9n^9$

$= m^{5+9}\cdot n^{12+9}$

$= m^{14}n^{21}$

$[(a^m)^n = a^{mn}\ \&\ a^m \times a^n = a^{m+n}]$

6. If $12^2 = 144$, what is

(i) $(1.2)^2$

(ii) $(0.12)^2$

(iii) $(0.012)^2$

(iv) 120^2

Sol. (i) $(1.2)^2 = \left(\frac{12}{10}\right)^2 = \frac{144}{100} = 1.44$

(ii) $(0.12)^2 = \left(\frac{12}{100}\right)^2 = \frac{144}{10000} = 0.0144$

(iii) $(0.012)^2 = \left(\frac{12}{1000}\right)^2 = \frac{144}{1000000}$

$= 0.000144$

(iv) $120^2 = (12 \times 10)^2$

$= 144 \times 100 = 14400$

7. Circle the numbers that are the same

- $2^4 \times 3^6$
- $6^4 \times 3^2$
- 6^{10}
- $18^2 \times 6^2$
- 6^{24}

Sol.

$6^4 \times 3^2 = (2 \times 3)^4 \times 3^2$
$= 2^4 \times 3^4 \times 3^2 = 2^4 \times 3^6$

$6^{10} = (2 \times 3)^{10}$

$18^2 \times 6^2 = (3^2 \times 2)^2 \times (2 \times 3)^2$

$= 3^4 \times 2^2 \times 2^2 \times 3^2 = 24 \times 3^6$

$6^{24} = (2 \times 3)^{24} = 2^{24} \times 3^{24}$

8. Identify the greater number in each of the following:

(i) 4^3 or 3^4

(ii) 2^8 or 8^2

(iii) 100^2 or 2^{100}

Sol. (i) $4^3 = 64; 3^4 = 81$

$81 > 64$

$\therefore$ $3^4 > 4^3$

(ii) $2^8 = 256; 8^2 = (2^3)^2 = 2^6 = 64$

$256 > 64$

$\therefore$ $2^8 > 8^2$

(iii) $100^2 = 10,000$

$2^{100} \sim 1.27 \times 10^{30}$

A number with 30 zeros is much larger than 10,000.

$\therefore$ $2^{100} > 100^2$

9. 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?

Sol. Total no. of packets produced in a year

= 8.5 billion

$\therefore$ Number of codes required

$= 8.5 \times 10^9$ codes

For ID digits to be taken from 0 to 9.

So, each digit has 10 choices.

To make code with n digits, the total number of possible codes = 10^n

$\therefore$ $10^n \geq 8.5 \times 10^9$

$10^9 = 1,00,00,00,000$

The smallest value of n that satisfies $10^n \geq 8.5 \times 10^9$ is 10.

Hence number of digits the code should consist of 10^{10}.

10. 64 is a square number (8^2) and a cube number (4^3). Are there other numbers that are both squares and cubes? Is there a way to describe such numbers in general?

Sol.

No.	Form	Square of	Cube of
1	1^6	1^2	1^3
64	2^6	8^2	4^3
729	3^6	27^2	9^3
4096	4^6	64^2	16^3
15625	5^6	125^2	25^3

Yes, other numbers are both squares and cubes.

General Rule: A number is both a perfect square and a perfect cube if and only if it is a perfect sixth power, i.e., it can be written as x^6 for some integer x.

11. A digital locker has an alphanumeric (it can have both digits and letters) pass code of length 5. Some example codes are G89P0, 38098, BRJKW, and 003AZ. How many such codes are possible?

Solution:

Number of letters (A-Z) = 26

Number of digits (0-9) = 10

So, each character in the passcode can be any of the 36 alphanumeric characters. Also, each of the 5 positions has 36 options.

Total codes = 36^5 = 6,04,66,176

Hence number of possible 5-character alphanumeric passcodes is 6,04,66,176.

12. The worldwide population of sheep (2024) is about 10^9, and that of goats is also about the same. What is the total population of sheep and goats?

(i) 20^9 (ii) 10^{11}

(iii) 10^{10} (iv) 10^{18}

(v) 2×10^9 (vi) $10^9 + 10^9$

Sol. Sheep population = 10^9

Goat population = 10^9

Total population of sheep and goats = $10^9 + 10^9 = 2 \times 10^9$

13. Calculate and write the answer in scientific notation:

(i) If each person in the world had 30 pieces of clothing, find the total number of pieces of clothing.

(ii) There are about 100 million bee colonies in the world. Find the number of honeybees if each colony has about 50,000 bees.

(iii) The human body has about 38 trillion bacterial cells. Find the bacterial population residing in all humans in the world.

(iv) Total time spent eating in a lifetime in seconds.

Sol. (i) World population = 8.2 billion

$= 8.2 \times 10^9$

Pieces of clothing = 30 pieces per person

Total pieces of clothing

$= 8.2 \times 10^9 \times 30$

$= 246 \times 10^9$

$= 2.46 \times 10^{11}$ pieces of clothing

(ii) No. of bee colonies = 100 million

$= 1 \times 10^8$

No. of bee per colony = 50,000

$= 5 \times 10^4$

Total no. of bees = $1 \times 10^8 \times 5 \times 10^4$

$= 5 \times 10^{8+4}$

$= 5 \times 10^{12}$ honeybees

(iii) No. of bacterial cells per human body

= 38 trillion = 3.8×10^{13}

World population (approx.)

= 8.2 billion = 8.2×10^9

Total bacterial population

$= 3.8 \times 10^{13} \times 8.2 \times 10^9$

$= 31.16 \times 10^{13+9}$

$= 31.16 \times 10^{22}$

(iv) Let average eating time per day

= 1.5 hours

In seconds = $1.5 \times 60 \times 60 = 5400$

$= 5.4 \times 10^3$

and an average person's lifetime (approx.) = 70 years

In seconds = $70 \times 365 \times 24 \times 60 \times 60$

= 161,148,960,000

$= 1.61 \times 10^{11}$

Total time spent in eating

$= 5.4 \times 10^3 \times 1.61 \times 10^{11}$

$= 8.694 \times 10^{3+11}$

$= 8.7 \times 10^{14}$ seconds

14. What was the date 1 arab/1 billion seconds ago?

Sol. 1 arab / 1 billion = 10^9

minutes = 1,000,000,000/60

hours = 1,000,000,000/(60×60)

days = 1,000,000,000/(60×60×24)

years = 1,000,000,000/(365×60×60×24)

Now, we go back to the calendar.

So, it is approx. 31 years, 8 months, and 15 days.

Let today's date = 1 Jan, 2026

After 31 years and 8 months and 15 days before the date was 24th April, 1994 (approx.)