* **Answer The Following Questions In One Sentence.[1 Marks Each]** [30]

1. Express the following as a product of powers of their prime factors in exponential form. 648

Ans. : $648 = 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 3 = 2^3 \times 3^4$.

2. Express the following as a product of powers of their prime factors in exponential form. 405

Ans. : $405 = 3 \times 3 \times 3 \times 3 \times 5 = 3^4 \times 5$.

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

Ans. : $540 = 2 \times 2 \times 3 \times 3 \times 3 \times 5 = 2^2 \times 3^3 \times 5$.

4. Express the following as a product of powers of their prime factors in exponential form. 3600

Ans. : $3600 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 5 = 2^4 \times 3^2 \times 5^2$.

5. Write the numerical value of the following : 2×10^3

Ans. : 2×10^3

$= 2 \times (10 \times 10 \times 10)$
$= 2 \times 1000$
$= 2000.$

6. Write the numerical value of the following : $7^2 \times 2^3$

Ans. : $7^2 \times 2^3$

$= (7 \times 7) \times (2 \times 2 \times 2)$
$= 49 \times 8$
$= 392$

7. Write the numerical value of the following : 3×4^4

Ans. : 3×4^4

$= 3 \times (4 \times 4 \times 4 \times 4)$
$= 3 \times (16 \times 16)$
$= 3 \times 256$
$= 768$

8. Write the numerical value of the following : $(-3)^2 \times (-5)^2$

Ans. : $3^2 \times 10^4$

$= \{(-3) \times (-3)\} \times \{(-5) \times (-5)\}$
$= 9 \times 25$
$= 225$

9. Write the numerical value of the following : $3^2 \times 10^4$

Ans. : $3^2 \times 10^4$

$= (3 \times 3) \times (10 \times 10 \times 10 \times 10)$
$= 9 \times 10000$
$= 90000$

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

Ans. : $(-2)^5 \times (-10)^6$
$= \{(-2) \times (-2) \times (-2) \times (-2) \times (-2)\}$
$\times \{(-10) \times (-10) \times (-10) \times (-10) \times (-10) \times (-10)\}$

$= \{4 \times 4 \times (-2)\} \times \{100 \times 100 \times 100\}$
$= (-32) \times (1000000)$
$= -32000000.$

11. Write the expressions as a power of a power in at least two different ways :
8^6

Ans. : Two possible ways:

$8^6 = (8^3)^2$
$8^6 = (8^2)^3$

12. Write the expressions as a power of a power in at least two different ways : 7^{15}

Ans. : Two possible ways:

$7^{15} = (7^3)^5$
$7^{15} = (7^5)^3$

13. Write the expressions as a power of a power in at least two different ways :
9^{14}

Ans. : Two possible ways:

$9^{14} = (9^2)^7$
$9^{14} = (9^7)^2$

14. Write the expressions as a power of a power in at least two different ways : 5^8

Ans. : Two possible ways:

$5^8 = \left(5^2\right)^4$

$5^8 = \left(5^4\right)^2$

15. Write equivalent form of the following.

2^{-4}

Ans. : $2^{-4} = \frac{1}{2^4}$

16. Write equivalent form of the following.

10^{-5}

Ans. : $10^{-5} = \frac{1}{10^5}$

17. Write equivalent form of the following.

$(-7)^{-2}$

Ans. : $(-7)^{-2} = \frac{1}{(-7)^2}$

18. Write equivalent form of the following.

$(-5)^{-3}$

Ans. : $(-5)^{-3} = \frac{1}{(-5)^3}$

19. Write equivalent form of the following.

10^{-100}

Ans. : $10^{-100} = \frac{1}{10^{100}}$

20. Simplify and write the answer in exponential form.

$2^{-4} \times 2^7$

Ans. : $2^{-4} \times 2^7 = 2^{-4+7} = 2^3$.

21. Simplify and write the answer in exponential form.

$3^2 \times 3^{-5} \times 3^6$

Ans. : $3^2 \times 3^{-5} \times 3^6 = 3^{2+(-5)+6} = 3^{8+(-5)} = 3^{8-5} = 3^3$.

22. Simplify and write the answer in exponential form.

$p^3 \times p^{-10}$

Ans. : $p^3 \times p^{-10} = p^{3+(-10)} = p^{3-10} = p^{-7} = \frac{1}{p^7}$.

23. Simplify and write the answer in exponential form.

$2^4 \times (-4)^{-2}$

Ans. : $2^4 \times (-4)^{-2} = 2^4 \times \frac{1}{(-4)^2} = 2 \times 2 \times 2 \times 2 \times \frac{1}{(-4)\times(-4)} = 16 \times \frac{1}{16} = 1$.

24. Simplify and write the answer in exponential form.

$8^p \times 8^q$

Ans. : $8^p \times 8^q = (8)^{p+q} = (2 \times 2 \times 2)^{p+q} = \left(2^3\right)^{p+q} = 2^{3(p+q)} = (2)^{3p+3q}$.

25. How many times larger than 4^{-2} is 4^2 ?

Ans. :
$$4^2 = 16$$
$$4^{-2} = \frac{1}{4^2} = \frac{1}{16}$$
$$\frac{4^2}{4^{-2}} = 4^2 \times 4^2$$
$$= 4^{2+2}$$
$$= 4^4$$
$$= 256$$

4^2 is $256\left(4^4\right)$ times larger than 4^{-2}.

26. Identify the greater number in the following - 4^3 or 3^4

Ans. : 4^3 or 3^4

$4^3 = 64, 3^4 = 81$

So, 3^4 is greater.

27. Identify the greater number in the following - 2^8 or 8^2

Ans. : $2^8 \text{ or } 8^2$

$2^8 = 256, 8^2 = 64$

So, 2^8 is greater.

28. Identify the greater number in the following - 100^2 or 2^{100}

Ans. : 100^2 or 2^{100}

$100^2 = 10,000$

$2^{100} = \left(2^{10}\right)^{10} = 1024^{10}$, which is far greater than 10,000 .

So, 2^{100} is greater than 100^2.

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

Ans. : Length of passcode $= 5$

Total choices of alphabets and letters for each slot $= 26 + 10 = 36$

Total possible codes $= 36 \times 36 \times 36 \times 36 \times 36 = 36^5$

30. 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) $10^9 + 10^9$

Ans. : Population of sheep $= 10^9$

Population of goats $= 10^9$

Total population of sheep and goats $= 10^9 + 10^9$ or 2×10^9

Therefore, (v) 2×10^9 and (vi) $10^9 + 10^9$ are the correct answers.

*** Questions With Calculation.[2 Marks Each]** **[12]**

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

Ans. : Number of containers added every day = 1
Number of containers after 40 days = 40 containers
Number of bottles in a container = 5
Total bottles in 40 containers = 5 × 40 = 200 bottles
Therefore, there would be 200 bottles after 40 days.

32. Write the given number as the product of two or more powers in three different ways. The powers can be any integers. 64^3

Ans. : 64^3

$64 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6$

$64^3 = \left(2^6\right)^3 = 2^{18}$

Three different ways :

1. $64^3 = 2^{18} = 2^9 \times 2^9$

2. $64^3 = 2^{18} = 2^{10} \times 2^8$

3. $64^3 = 2^{18} = 2^6 \times 2^6 \times 2^6$

33. Write the given number as the product of two or more powers in three different ways. The powers can be any integers. 192^8

Ans. : 192^8

$192 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 = 2^6 \times 3$

$192^8 = \left(2^6 \times 3\right)^8 = 2^{6 \times 8} \times 3^8 = 2^{48} \times 3^8$

Three different ways :

1. $192^8 = 2^{48} \times 3^8 = 2^{40} \times 2^8 \times 3^8 = 2^{40} \times (2 \times 3)^8 = 2^{40} \times 6^8$

2. $192^8 = 2^{48} \times 3^8 = \left(2^{24} \times 3^4\right) \times \left(2^{24} \times 3^4\right)$

3. $192^8 = 2^{48} \times 3^8 = \left(2^6\right)^8 \times 3^8$

34. Write the given number as the product of two or more powers in three different

ways. The powers can be any integers. 32^{-5}

Ans. : 32^{-5}

$32 = 2 \times 2 \times 2 \times 2 \times 2 = 2^5$

$32^{-5} = \left(2^5\right)^{-5} = 2^{-25}$

Three different ways :

1. $32^{-5} = 2^{-25} = 2^{-15} \times 2^{-10}$
2. $32^{-5} = 2^{-25} = 2^{-5} \times 2^{-5} \times 2^{-5} \times 2^{-5} \times 2^{-5}$
3. $32^{-5} = 2^{-25} = 2^{-5} \times 2^{-20}$

35. Circle the numbers that are the same -

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

Ans. : (i) $2^4 \times 3^6$

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

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

(iv) $18^2 \times 6^2 = (2 \times 3 \times 3)^2 \times (2 \times 3)^2 = 2^2 \times 3^2 \times 3^2 \times 2^2 \times 3^2 = 2^4 \times 3^6$

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

Therefore, $2^4 \times 3^6, 64 \times 32$, and $18^2 \times 6^2$ are the same.

36. 64 is a square number $\left(8^2\right)$ and a cube number $\left(4^3\right)$. Are there other numbers that are both squares and cubes? Is there a way to describe such numbers in general?

Ans. : Yes, there are other numbers that are both squares and cubes. For example :

$729 = 9^3 \text{ (cube number) } = 27^2 \text{ (perfect square)}$

$4096 = 16^3 \text{ (cube number) } = 64^2 \text{ (perfect square)}$

General Rule: The sixth power of any number (i.e., n^6) is both a square and a cube. i.e.

$1^6 = 1$

$2^6 = 64$

$3^6 = 729$

$4^6 = 4096$

$5^6 = 15,625$

*** Questions With Calculation.[3 Marks Each]** **[15]**

37. Express the following in exponential form :

(i) 6 × 6 × 6 × 6

(ii) y × y

(iii) b × b × b × b

Ans. : (i) 6 × 6 × 6 × 6 = 6^4

(ii) y × y = y^2

(iii) b × b × b × b = b^4

38. Express the following in exponential form :

(i) 5 × 5 × 7 × 7 × 7

(ii) 2 × 2 × a × a

(iii) a × a × a × c × c × c × c × d

Ans. : (i) 5 × 5 × 7 × 7 × 7 = $5^2 \times 7^3$.

(ii) 2 × 2 × a × a = $2^2 \times a^2$.

(iii) a × a × a × c × c × c × c × d = $a^3 \times c^4 \times d$.

39. Find out the units digit in the value of 2224 ÷ 432 ?

Ans. : $2^{224} \div 4^{32}$

$$= 2^{224} \div \left(2^2\right)^{32}$$
$$= 2^{224} \div 2^{2\times 32}$$
$$= 2^{224} \div 2^{64}$$
$$= 2^{224-64} = 2^{160}$$

$2^1 = 2$ (units digit 2)

$2^2 = 4$ (units digit 4)

$2^3 = 8$ (units digit 8)

$2^4 = 16$ (units digit 6)

$2^5 = 32$ (units digit 2)

$2^6 = 64$ (units digit 4)

$2^7 = 128$ (units digit 8)

....

....

Here, the pattern repeats after every 4 steps.

So, the unit's digit of 2^{160} is the same as that of 2^4, which is 6 .

40. 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) $\left(13^{-2}\right)^{-3}$

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

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

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

(iii) $9^{-7} \div 9^4 = 9^{-7+4} = 9^{-3}$

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

(v) $m^{5}n^{12}(mn)^{9}=m^{5}n^{12}\times m^{9}n^{9}=m^{5+9}n^{12+9}=m^{14}n^{21}$

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

Ans. : 1 billion seconds $=1,000,000,000$ seconds

$1,000,000,000\div(60\times60\times24\times365)=31.71$ years

31.71 years $=31$ full years and $0.71\times365=259$ days

Today is : 28 July 2025

Subtracting 31 years $\rightarrow 28$ July 1994

Going back 259 days from 28 July $1994\rightarrow 11$ November 1993.

So, 1 billion seconds ago was November 11, 1993.

*** Questions With Calculation.[5 Marks Each]** **[5]**

42. 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) q46 is both a 4th power and a 6th power (q is a prime number).

Ans. : (i) Only sometimes true.

Explanation: $64=2^{6}=\left(2^{3}\right)^{2}=\left(2^{2}\right)^{3}$ is both a cube and a square.

But $8=2^{3}$ is a cube, not a square.

(ii) Always true.

Eplanation: $3^{4}=\left(3^{2}\right)^{2}=9^{2}$.

$5^{4}=\left(5^{2}\right)^{2}=25^{2}$.

(iii) Always true.

Explanation: $a^{5}=a^{3}\times a^{2}$ and is divisible by a^{3}.

(iv) Always true.

Explanation: $8=2^{3},27=3^{3}$

$8\times27=216$, which is 6^{3}.

(v) Never true.

Explanation: Since 46 is not divisible by 4 or 6 . Therefore, there is no prime number q such that q^{46} is both a perfect fourth power and a perfect sixth power.

*** Questions With Calculation.[4 Marks Each]** **[16]**

43. Express the following numbers in standard form.

(i) 59,853

(ii) 65,950

(iii) 34,30,000

(iv) 70,04,00,00,000

Ans. : (i) $59853 = \frac{59853}{10000} \times 10000 = 5.9853 \times 10^4$

(ii) $65950 = \frac{65950}{10000} \times 10000 = 6.595 \times 10^4$

(iii) $3430000 = \frac{3430000}{1000000} \times 1000000 = 3.43 \times 10^6$

(iv) $70040000000 = \frac{70040000000}{10000000000} \times 10000000000 = 7.004 \times 10^{10}$

44. If $12^2 = 144$ what is

(i) $(1.2)^2$

(ii) $(0.12)^2$

(iii) $(0.012)^2$

(iv) 120^2

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

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

(iii) $(0.012)^2 = \left(\frac{12}{1000}\right)^2 = \frac{12^2}{1000^2} = \frac{144}{1000000} = 0.000144$

(iv) $120^2 = 120 \times 120 = 14,400$

45. 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?

Ans. : 8.5 billion = 8,500,000,000

Number of Digits	Max Unique Numbers
1	10 (0 to 9)
2	10 x 10 = 100
3	10 x 10 x 10 = 1,000
4	10,000
5	100,000
6	1,000,000
7	10,000,000
8	100,000,000
9	1,000,000,000
10	10,000,000,000

Therefore, the code should contain at least 10 digits to get a unique ID for each packet.

46. 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.

Ans. : (i) Estimated world population: ≈ 8 billion $= 8 \times 10^9$

Number of pieces of clothing each person had $= 30$ pieces

Total number of pieces of clothing $= 8 \times 10^9 \times 30 = 2.4 \times 10^{11}$

(ii) Number of bee colonies in the world $= 100$ million $= 1 \times 10^8$

Number of bees in each colony $= 50,000 = 5 \times 10^4$

Total number of honeybees $= 1 \times 10^8 \times 5 \times 10^4 = 5 \times 10^{12}$

(iii) World population $\approx 8 \times 10^9$

Number of bacterial cells in human body $= 38$ trillion $= 3.8 \times 10^{13}$

Total bacterial population residing in all humans in the world $= (3.8 \times 10^{13}) \times (8 \times 10^9) = 30.4 \times 10^{22} = 3.04 \times 10^{23}$

(iv) Average person's lifespan $= 80$ years

Time spent eating daily $= 1.5$ hours

Total eating time per day in seconds $= 1.5 \times 3600 = 5400$ seconds

Number of days in 80 years $= 80 \times 365 = 29,200$

Total seconds spent eating in a lifetime in seconds $= 5400 \times 29,200 = 1.5768 \times 10^8$

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