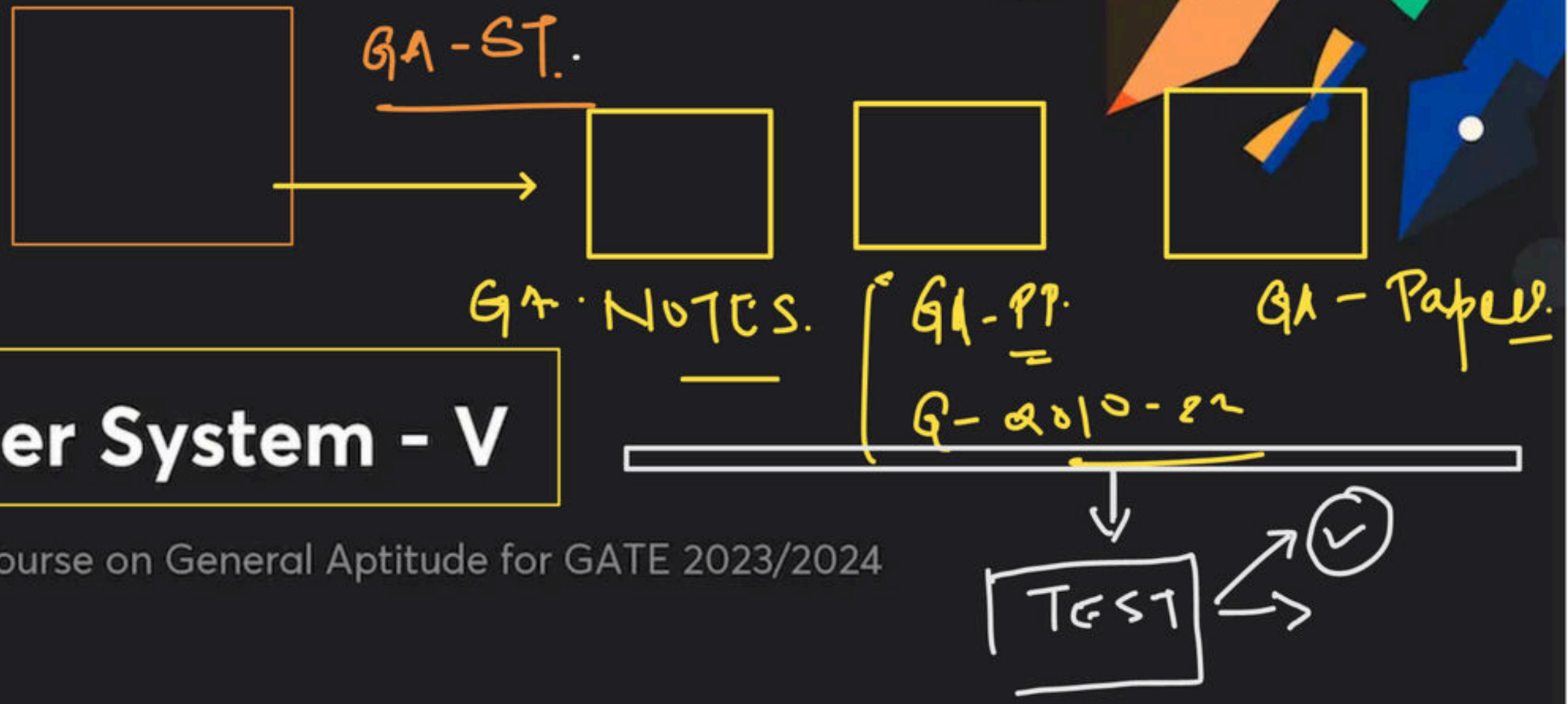

Number System - V

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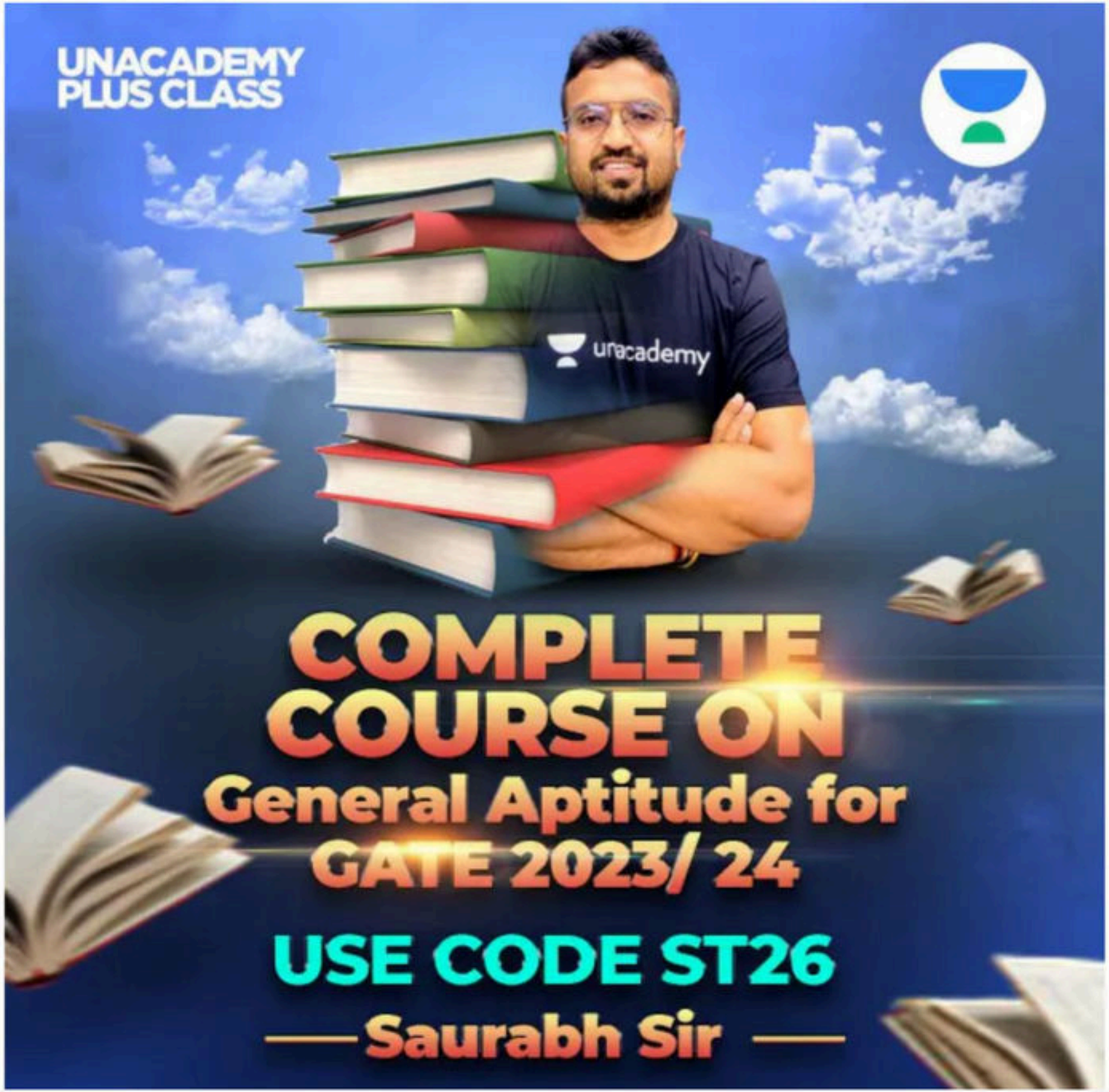
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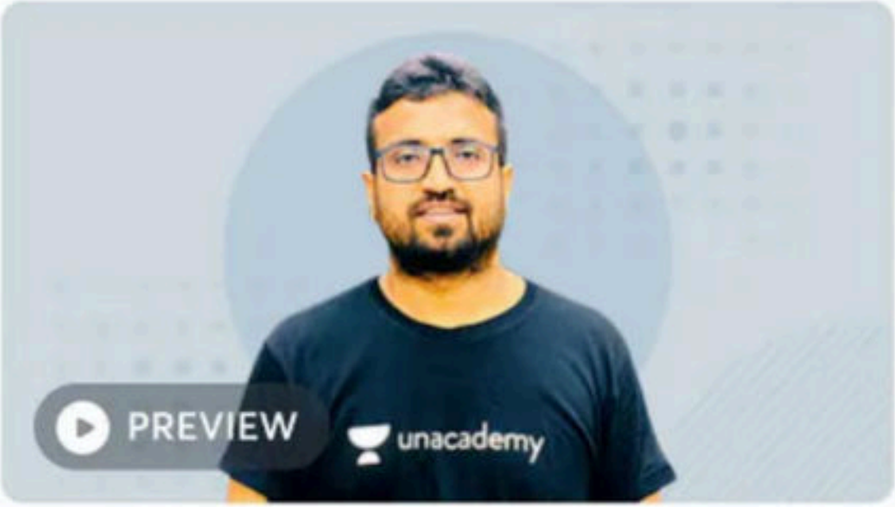

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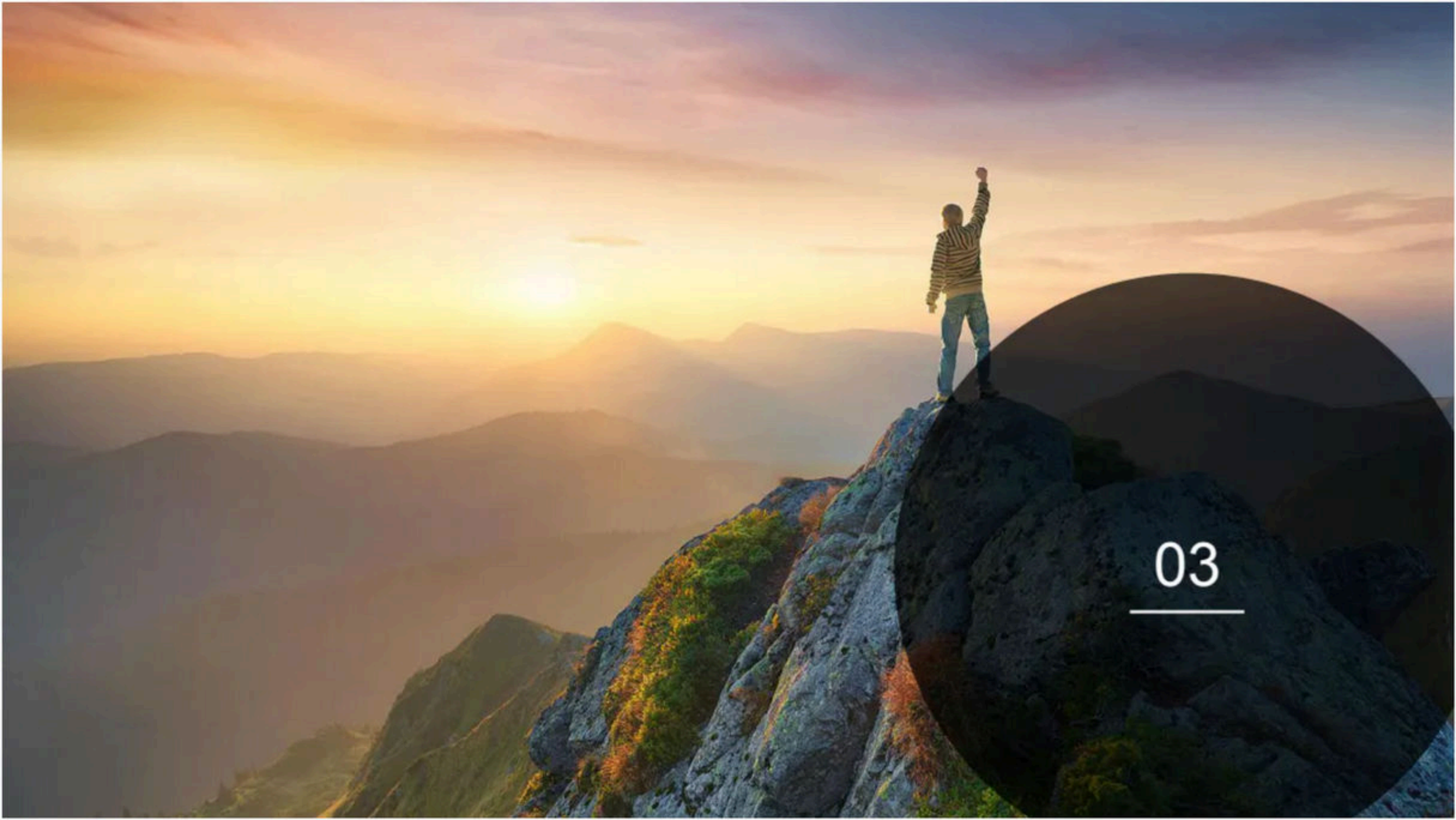
01

100!,150!, 250!

05

$$2^{23}, 2^{51}, 3^{59}, 4^{99}, 3^{171}, 7^{208}$$



03

$$12^{71}, 16^{51}, 21^{99}, 39^{235}, 17^{999}, 37^{897}, 127^{200899}$$

04

$$13^{666} \times 44^{777} \times 616^{333} \times 777^{444}, 8898^{222} \times 999^{555},$$

05

$$1^2 + 2^2 + 3^2 + \ldots\ldots\ldots\ldots\ldots + 99^2 + 100^2$$

06

$$1^1 + 2^2 + 3^3 + \ldots\ldots\ldots\ldots + 9^9 + 10^{10}$$

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07

The numeral in the units position of

$211^{870} + 146^{127} + 3^{424}$ is.....

[GATE 2016 : IISc Bangalore (EE Set - 2)]

08

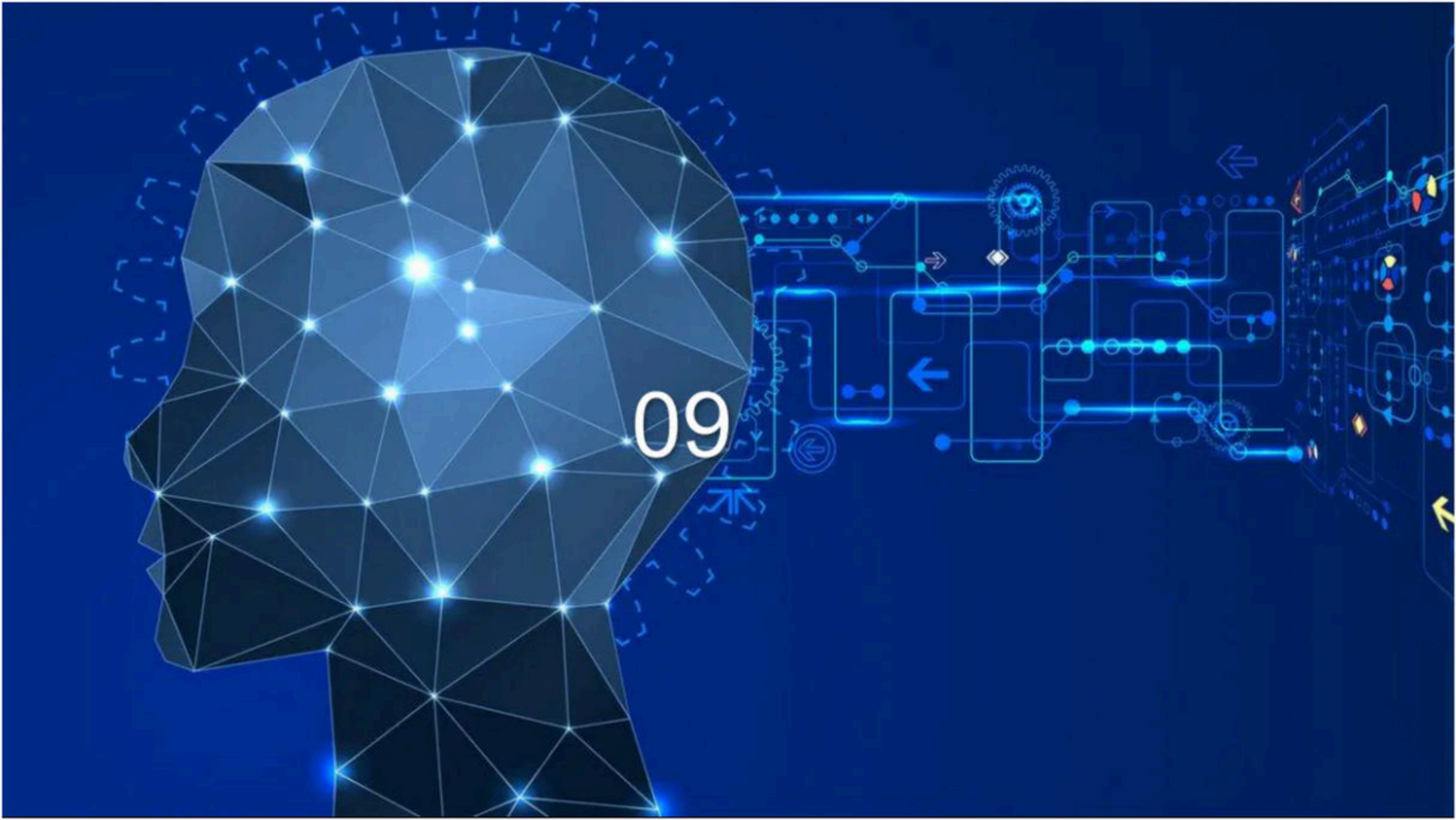
The last digit of

$(2171)^7 + (2172)^9 + (2173)^{11} + (2174)^{13}$ is

(A) 2 (B) 4

(C) 6 (D) 8

[GATE 2017 : IIT Roorkee (CH, CE, Set - 1)]


09

$$21^{23}, 31^{53}, 51^{93}$$

10

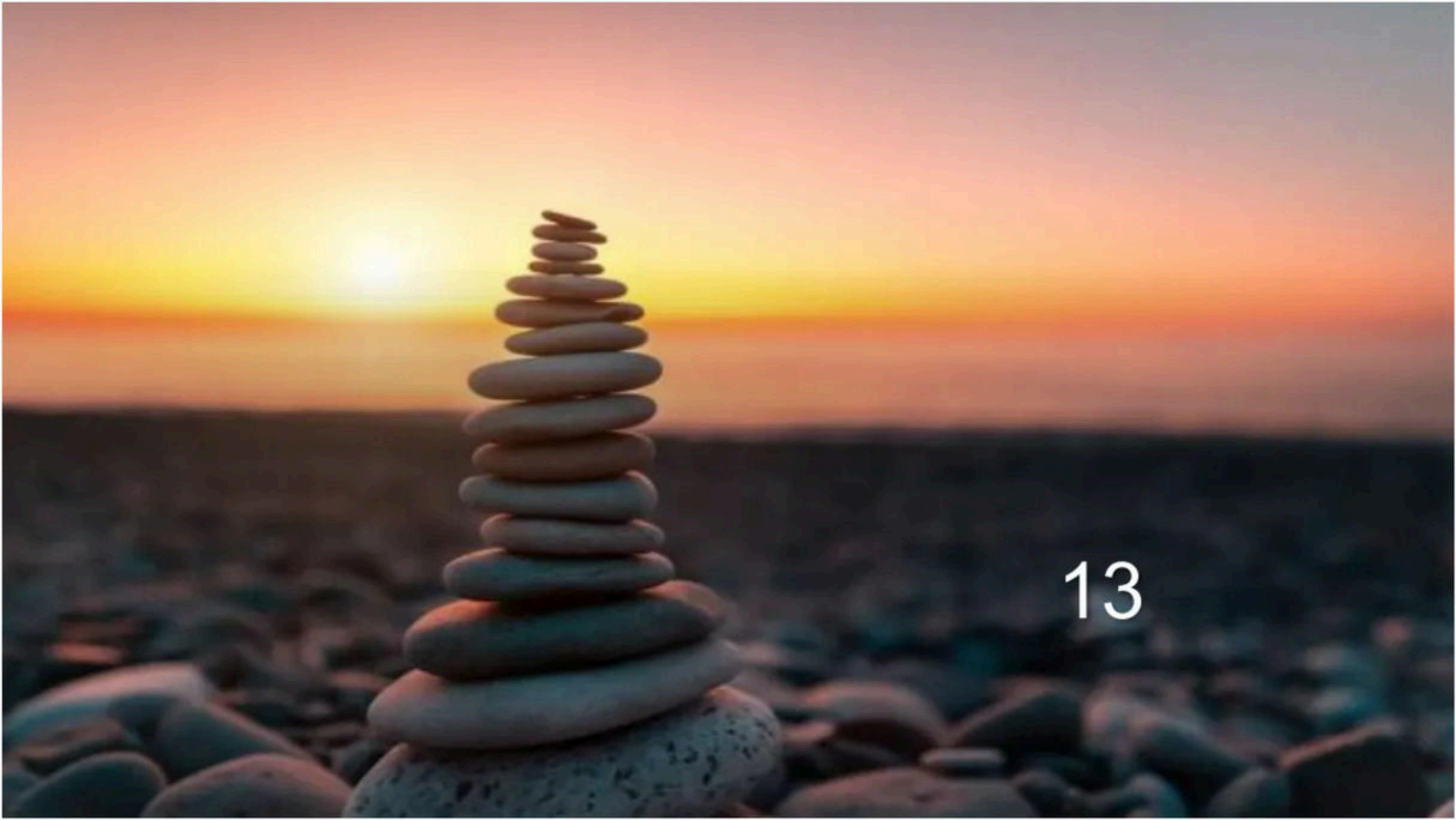
$3^{53}, 7^{53}, 9^{93}$

11

$$2^{53}, 4^{83}, 8^{93}$$

12

$$\frac{(123\ 1234)}{15}$$


13

$$\frac{15 \times 17}{4} \Rightarrow \frac{3 \times 1}{4} \Rightarrow \boxed{3}$$

$$\frac{15 \times 17 \times 19}{4} \Rightarrow \frac{3 \times 1 \times 3}{4} \Rightarrow \boxed{1}$$

TEST

1. $\dfrac{21 \cdot 23 \cdot 25}{4} \Rightarrow \dfrac{1 \cdot 3 \cdot 1}{4} \Rightarrow \dfrac{\boxed{3}}{4}$ or $\boxed{-1}$

2. $\dfrac{41 \cdot 43 \cdot 47 \cdot 49}{5} \Rightarrow \dfrac{1 \cdot \cancel{3} \cdot \cancel{2} \cdot 4}{5} \Rightarrow \dfrac{4}{5}$ or -1

$5 \Rightarrow \boxed{5 \text{ or } -2}$

$11 \rightarrow 11 \text{ or } -2$

TEST

1. 11 · 13 · 17 19 ⇒ 2 · 1 · 2 · 1 ⇒ 1 OR 0 2

3 3 3

2. 51 | 52 · 53 · 54 · 55 ⇒ 0

3

$$\frac{91 \cdot 92 \cdot 93 \cdot 94 \cdots 98 \cdot 99}{9} \Rightarrow R = 0$$

DS $\Rightarrow$ 3

$$\frac{\cancel{1}2\cancel{3}\cancel{4}\cancel{5}\cancel{6}7}{3} = 108 - 2$$

$4/3$

$$(1218 \times 1220 \times 1222 \times 1224) \div 9$$

R = 0

CAT

$$\frac{7}{4} \longrightarrow 3$$

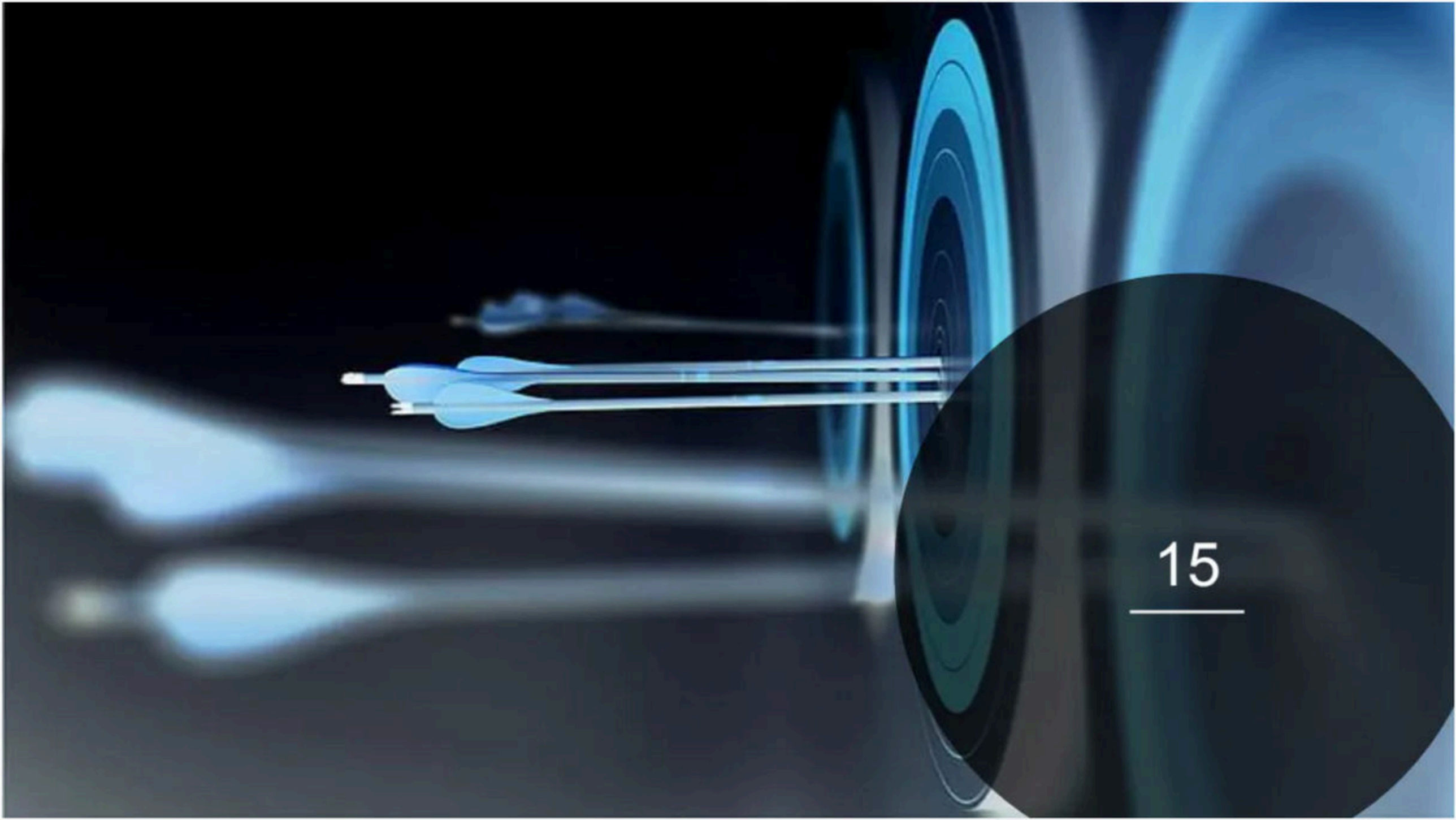
$$\boxed{7^{101}/4}$$

$$\frac{(7^{2})^{50} \times 7}{4}$$

$$\frac{7 \times 7}{4} \Rightarrow \frac{3 \times 3}{4} \Rightarrow 1$$

14

$$(1719 \times 1721 \times 1723 \times 1725 \times 1727) \div 18$$


15

$7^1 = 7/342 \rightarrow 7$

$7^2 = 49/342 \rightarrow 49$

$7^3 = \boxed{343}/342 \rightarrow 1$

$7^4 = 2401$

$7^{84}/342$

$(7^2)/342 \Rightarrow 49$

$7^4/342 \Rightarrow \dfrac{7^3 \times 7}{342} = 7$

$$N = 1! + 2! + 3!$$

$$\boxed{N/3} \Rightarrow \frac{1! + 2! + 3!}{3} = \frac{1+2+6}{3} = 9/3 \Rightarrow 0$$

$$\boxed{1!/3 + 2!/3} + 3!/3$$

$$\frac{3!}{3} = \frac{3 \cdot 2 \cdot 1}{3}$$

$$1/3 + 2/3 \Rightarrow R = 0$$

$$N = 1! + 2! + \underbrace{3! + 4! + \dots + 100!}_{0}$$

$R = 0$

$N/3 \Rightarrow$

$$1!/3 + 2!/3$$

$$(1+2)/3 \quad \boxed{R = 0}$$

$$N = 1! + 2! + 3! + 4! + 5! + 6! + \dots + 100!$$

$$\frac{N}{5}$$

$$\frac{30}{5}$$

5

$$\frac{24}{5}$$

$$\frac{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{5}$$

$$1 + 2 + 1 + 4$$

$$\frac{}{5}$$

3 or 2

$R = 0$

TEST

$$N = 1! + 2! + 3! + \underbrace{\boxed{4! + \dots + 1000!}}_{\div 4}$$

$R = 0$

$$\boxed{N/4} \Rightarrow \frac{1 + \cancel{2} + \cancel{2}}{4}$$

$$1 \quad 0 \quad \boxed{-3}$$

$$N = \frac{1!}{6} + \frac{2!}{6} + \boxed{3! + \dots + 100!}$$

$$\frac{1+2}{6} \rightarrow 3$$

$$\frac{100!}{6} \rightarrow R = 0$$

$N/\boxed{6}$

composite No.

Prime Factors.

$\boxed{2 \times 3}$

$3! = 3 \cdot 2 \cdot 1$

$N = 1! + 2! + 3! + \boxed{4! + \cancel{\cdots} + 1000!}$

$R = 0$

$\frac{1!}{12} + \frac{2!}{12} + \frac{3!}{12}$

$\frac{1 + 2 + 6}{12} \Rightarrow 9$ or -3

N

12

$\boxed{2^2 \times 3}$

$3! = 3 \cdot 2 \cdot 1$

$4! = 4 \cdot 3 \cdot 2 \cdot 1$

$\frac{1! + 2! + 3! + 4! + 5}{18}$

$N/18 = \boxed{2 \times 3^2}$

$6! = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

2×1

$$\frac{1! + 2! + 3! + 4! + 5!}{18} \rightarrow \frac{120}{18}$$

$$24/18$$

$$\frac{\boxed{1 + 2 + 6} + 6 + 12}{18}$$

Q 02 - 3

$24/20$

$2^2 \times 5$

The remainder when S is divided by 20,

where S = 1! + 2! + 3! + 4! + 5! + 6! + ... + 19! + 20!

$R = 0$

$5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

$1 + 2 + 6 + 4$

20

$\Rightarrow 13$ or -7

16

The rightmost non- zero digit of the number 30^{2720}.

17

$1 + 2 = 03.$

$15/4 \rightarrow \boxed{R = 3}$

$\frac{5+10}{4} \Rightarrow 5/4 + 10/4$

$\frac{6+9}{4} \Rightarrow 2 + 1 \Rightarrow 03.$

$\frac{3 \times 5}{4} \Rightarrow 3 \times 1 \Rightarrow \boxed{03.}$

$7^{77} \div 4$

$7/4 \rightarrow \frac{R}{3}$

$7^2/4 \Rightarrow \frac{7 \times 7}{4}$

$\frac{49}{4} \Rightarrow \boxed{1}$

$\frac{3 \times 3}{4} \Rightarrow 1$

$\frac{(7^2)^{38} \times 7^1}{4} \Rightarrow \boxed{3}$

1

(4)

$$\frac{11^{100}}{7}$$

$$11/7 \rightarrow \overset{R}{\boxed{4}}$$

$$\frac{(11^3)^{33} \times 11}{7} \Rightarrow \frac{1 \cdot 11}{7} \quad \boxed{4}$$

$$11^2/7 \rightarrow \begin{cases} \boxed{121/7} \Rightarrow \\ \frac{11 \cdot 11}{7} \Rightarrow \frac{4 \cdot 4}{7} \Rightarrow \boxed{2} \end{cases}$$

$$11^3/7 \Rightarrow \frac{11^2 \times 11}{7} \Rightarrow \frac{2 \times 4}{7}$$

1

$$\boxed{11^{88} \div 7}$$

$11/7 \rightarrow \boxed{4}$

$11^{2}/7 \Rightarrow \frac{11 \cdot 11}{7} \Rightarrow \frac{4 \cdot 4}{7} \Rightarrow 2$

$\frac{11^{2} \times 11}{7} \leftarrow \left[11^{3}/7 = \frac{1331}{7} \Rightarrow \frac{11 \cdot 11 \cdot 11}{7} \right.$

$\frac{2 \cdot 4}{7} = 1$

$\frac{(11^{3})^{29} \cdot 11}{7}$

$1 \cdot 11/7 \Rightarrow 4$

19

$$5^{123} \div 7$$

7^{1500}

$R = ?$

$7^1 = 7$

$7^2 = 49$

$\boxed{48}$

$7/48 \longrightarrow \frac{R}{7}$

$(7^2)^{500}/48$

$\boxed{1}$

$7^2/48 \longrightarrow 49/48 \longrightarrow 1$

fear

4 × (7×4) = 28×4

112

+ | −

8 | 12 | 16

7

CAT

$7^{84} \div 342$

$7^3 = 343$

$\frac{(7^3)^{28}}{342} \Rightarrow \boxed{1}$

$7/342 \rightarrow \frac{R}{\boxed{7}}$

$7^2/342 \rightarrow \boxed{49}$

$7^3/342 \Rightarrow \boxed{\frac{343}{342}}$

$\boxed{1}$

21

Find : Number of factors, Sum of factors and Product of factors of the following :

12, 24, 288.

22

How many factors of 12 are divisible by : 2, 3 , 4, 6 , 12.

23

How many factors of 24 are divisible by : 2, 3 , 4, 6 , 8.

24

Find the smallest number y such that : $y \times 162$ is a perfect cube.

(A) 24 (B) 27
(C) 32 (D) 36

[GATE 2017 : IIT Roorkee (EE, CS, Set - 1)]

25

If all the natural numbers starting from 1 are written side by side then find the :

25th, 50th, 100th, digit of the sequence.

26

In the above question find the remainder when the sequences are divided by : 2, 4,8,16 , 5 , 25 , 125 , 3 ,9

27

If the number $715 \blacksquare 423$ is divisible by 3 ($\blacksquare$ denotes the missing digit in the thousandths place), then the smallest whole number in the place of $\blacksquare$ is _____.

A. 0
B. 2
C. 5
D. 6

[GATE 2018 : IIT Guwahati (EC Set – 1)]

28

How many numbers less than 21 are co-primes to 21?

(A) 24 (B) 96
(C) 11 (D) 12

29

If a and b are integers and a - b is even, which of the following must always be even?

(A) ab

(B) $a^2 + b^2 + 1$

(C) $a^2 + b + 1$

(D) ab - b

[GATE 2017 : IIT Roorkee (ME Set – 2)]

30

Given that a and b are integers and $a + a^2 b^3$ is odd then, which one of the following statements is correct?

(A) a and b are both odd
(B) a and b are both even
(C) a is even and b is odd
(D) a is odd and b is eve

[GATE 2018 : IIT Guwahati (ME Set – 1)]

31

If x = - 0.5, then which of the following has the smallest value?

(A) $2^{1/x}$

(B) $\frac{1}{x}$

(C) $\frac{1}{x^2}$

(D) 2x

32

The sum of the digits of a two-digit number is 12. If the new number formed by reversing the digits is greater than the original number by 54, find the original number.

(A) 39
(B) 57
(C) 66
(D) 93

33

A number is as much greater than 75 as it is smaller than 117. The number is:

(A) 91 (B) 93
(C) 89 (D) 96

[GATE 2013 : IIT Bombay (CE)]

34

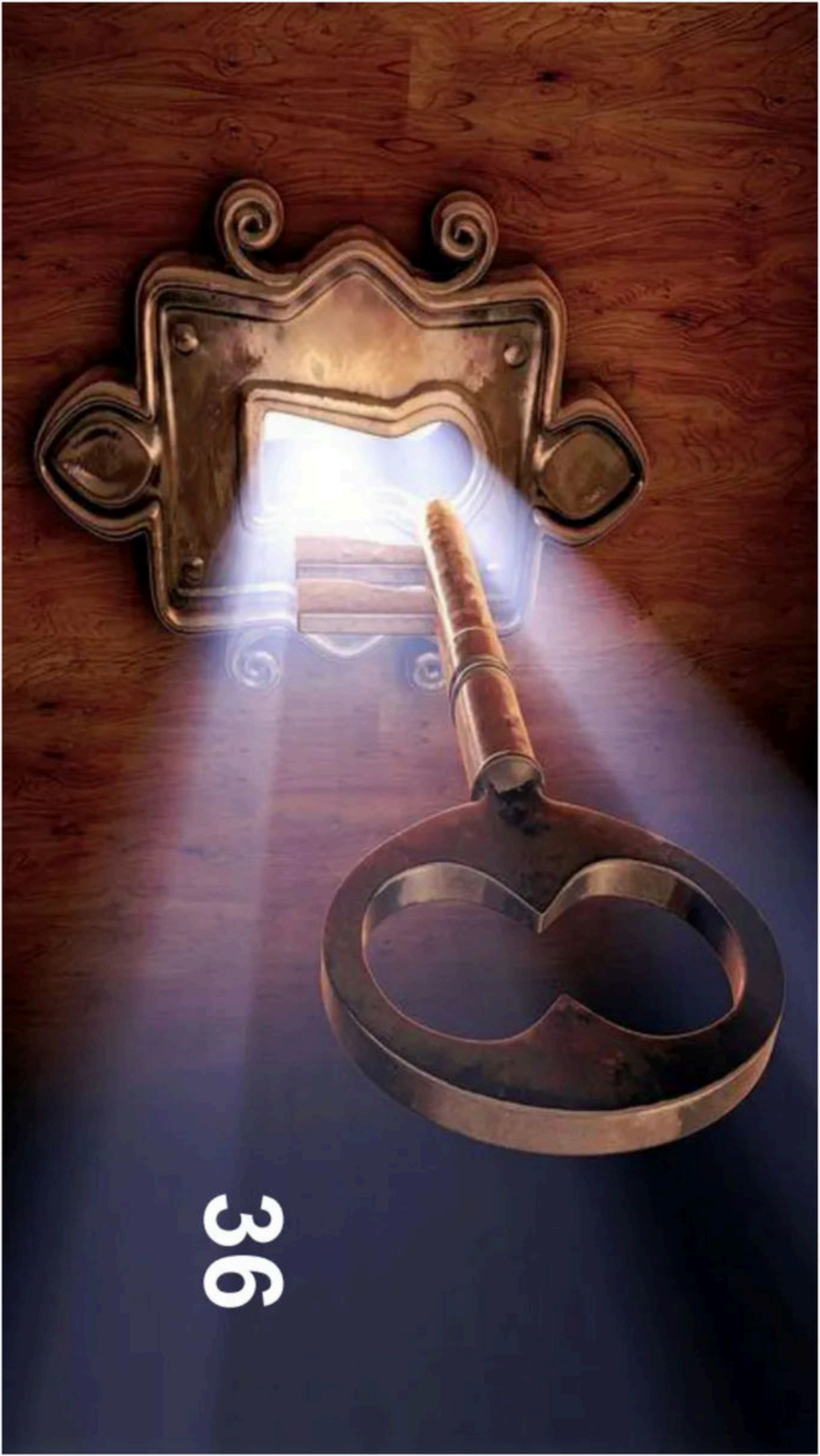
A number consists of two digits, the sum of digits is 9. If 45 is subtracted from the number, its digits are interchanged. What is the number?

(A) 63
(B) 72
(C) 81
(D) 90

SUCCESS
35

The sum of eight consecutive odd numbers is 656. The average of four consecutive even numbers is 87. What is the sum of the smallest odd number and second largest even number?

[GATE 2014 : IIT Kharagpur (EC Set – 2, ME Set - 2)]



36

In a sequence of 12 consecutive odd numbers, the sum of the first 5 numbers is 425. What is the sum of the last 5 numbers in the sequence?

[GATE 2014 : IIT Kharagpur (EC Set - 4, ME Set - 4)]

Direction (37 – 40) : Given, $m = 1! + 2! + 3! + 4! + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + 99! + 100!$

37
MALIK

Given, $m = 1! + 2! + 3! + 4! + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + 99! + 100!$

Find the unit digit of “m”

38

Given, $m = 1! + 2! + 3! + 4! + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + 99! + 100!$

Find the last two digits of ‘m’

39

$N = 1! + 2! + \ldots + 10{,}000!$

N

$\boxed{144} \Rightarrow$

$144 =$ Prime Factors

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

$6! = 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$

$2 \quad 2^2 \quad 2^1$

Given, $m = 1! + 2! + 3! + 4! + \ldots\ldots\ldots\ldots\ldots\ldots + 99! + 100!$

Find the remainder, when 'm' is divided by 168.

$168 = 2^3 \times 3 \times 7$

40

Given, $m = 1! + 2! + 3! + 4! + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + 99! + 100!$

If N is a natural number such that $10^{12} < N < 1013$ and the sum of the digits of n is 2 , then the number of values n take is :

41

$2 < 3$

$6 \times \frac{1}{2}$ $\quad$ $\frac{1}{3} \times 6$

$2 < 3$

$LCM(2, 3) = 6$

$2^3 < 3^2$

$6 < 12$

$6^{\frac{1}{6}} > 12^{\frac{1}{12}}$ $\quad | \times 12$

$6^2 > 12^1$

$4 > 3$

$\frac{1}{4} \times 12$ $\quad$ $\frac{1}{3} \times 12$

$4 < 3$

$64 = 4^3 < 3^4 = 81$

$12 > 3$

$12^{\frac{1}{12}} < 3^{\frac{1}{3}}$ $\quad \times 12$

$12^1 < 3^4$

5! → 4

Which among $2^{1/2}$, $3^{1/3}$, $4^{1/4}$, $6^{1/6}$ and $12^{1/12}$ is the largest ?

(A) $2^{1/2}$
(B) $3^{1/3}$
(C) $4^{1/4}$
(D) $6^{1/6}$

$\times 12$

$3^{1/3} > 2^{1/2} = 4^{1/4} > 6^{1/6} > 12^{1/12}$

LCM (2, 3, 4, 6, 12) => 12

2^6, 3^4, 4^3, 6^2, 12^1

64, 81, 64, 36, 12

unacademy

▲ 2 • Asked by Kumar

Sir question 40

Direction (37 – 40) : Given, m = 1! + 2! + 3! + 4! + _____ + 99! + 100!

Q.37 Find the unit digit of "m"

Q.38 Find the last two digits of 'm'

Q.39 Find the remainder, when 'm' is divided by 168.

Q.40 If N is a natural number such that $10^{12} < N < 10^{13}$ and the sum of the digits of n is 2, then the number of values n take is :

Q.41 Which among 2^{12}, 3^{12}, 4^{12}, 6^{12} and 12^{12} is the

$10^{12} < N < 10^{13}$

11 | 20

$10^2 < N < 10^3$

10

110 | 200

42

If $\frac{a}{b} = \frac{1}{3}$, $\frac{b}{c} = 2$, $\frac{c}{d} = \frac{1}{2}$, $\frac{d}{e} = 3$ and $\frac{e}{f} = \frac{1}{4}$, then what is the value of $\frac{abc}{def}$?

(A) $\frac{3}{8}$

(B) $\frac{27}{8}$

(C) $\frac{3}{4}$

(D) $\frac{27}{4}$

(2006)

43

S is a 6 digit number beginning with 1 . If the digit 1 is moved from the leftmost place to the rightmost place the number obtained is three times of S . Then the sum of the digits of S is-

If N = 15 × 30 × 45 × 60 × .....× 1500, what will be the number of zeroes at the end of N?

(A) 63
(B) 55
(C) 97
(D) 124

[GATE 2016 : IISc Bangalore (CE Set – 2)]

Let x, y and z be distinct integers, that are odd and positive. Which one of the following statements cannot be true?

(A) xyz^2 is odd
(B) $(x-y)^2z$ is even
(C) (x+y-z) (x+y) is even
(D) (x-y) (y+z) (x+y-z) isodd
(E) None of these

01

If P, Q and R are three consecutive integers, then which of the following is always true?

(A) P + Q + R is always even.
(B) P + Q + R is always odd.
(C) P + 2Q + R is always even.
(D) P + 2Q + R is always odd.

ANS.- (C) The sum of two extreme numbers (whether both odd/even) and twice the 3rd number is always even. Therefore, their sum is always even.

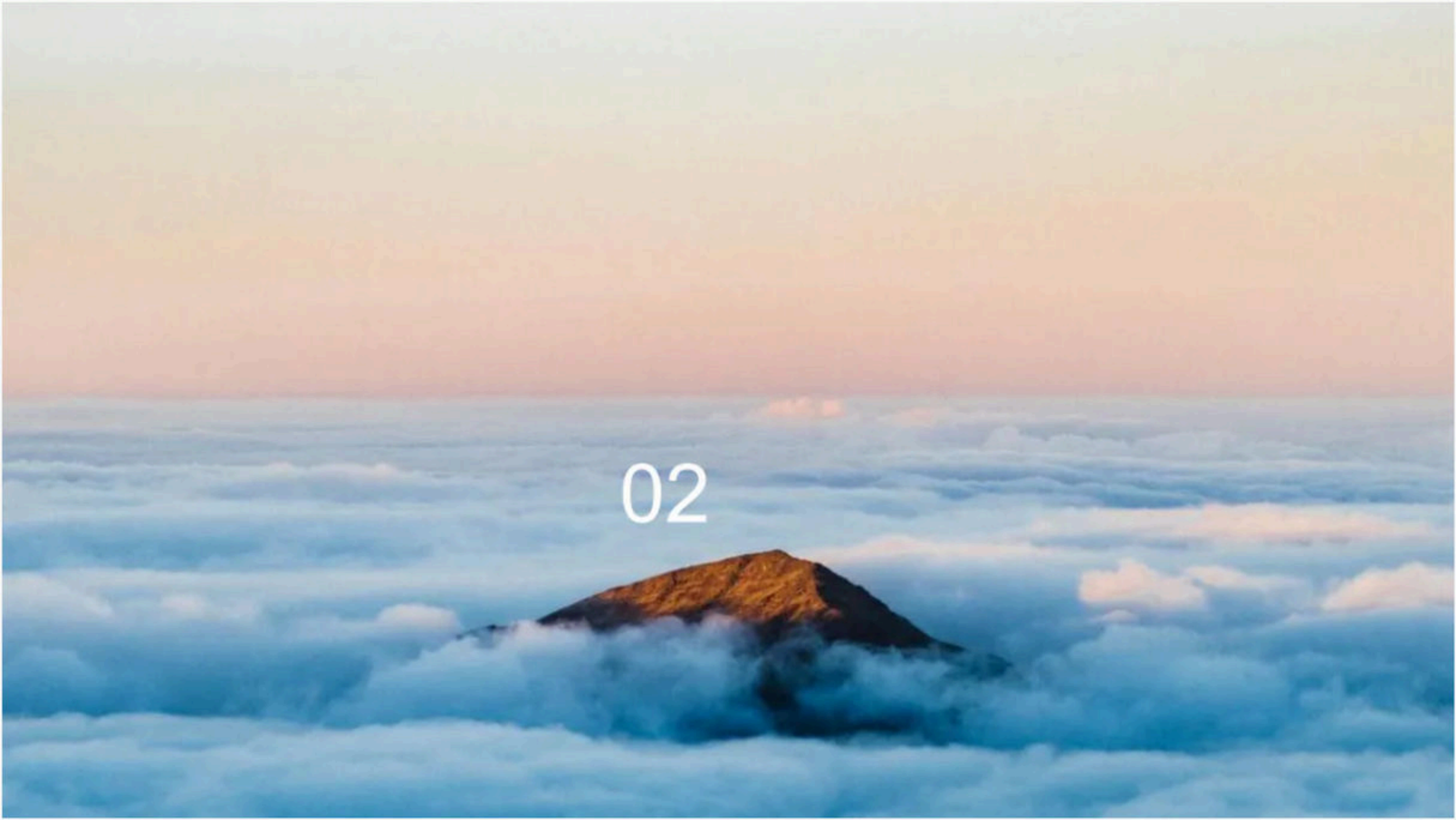
Alternative:

If P and R are odd and Q is even, then P + R is even and 2Q is even.

P + 2Q + R is even

If P and R is even and Q is odd, then P + R is even and 2Q is even.

P + 2Q + R is even.


02

By which of the following numbers must 34300 be multiplied in order to make it a perfect square?

(A) 7

(B) 5

(C) 6

(D) 14

ANS.- (A) $34300 = 7 \times 7 \times 7 \times 5 \times 5 \times 2 \times 2 = 7^3 \times 5^2 \times 2^2$

To make 34300 a perfect square, multiply it by 7.

03

Find the last digit of $(100008)^{12500}$.

(A) 8 (B) 6

(C) 4 (D) 2

ANS.- (B) There will be a cycle of last digits, i.e. 8, 4, 2, 6,... and this cycle consists of 4 numbers.

To find the last digit, divide the required power by 4 and find the remainder.

The last digits corresponding to remainders 1, 2, 3 and 0 are 8, 4, 2 and 6, respectively.

So, when 12,500 is divided by 4, it gives 0 as the remainder. Therefore, the last digit required would be 6.

04

Let $N = 10^3 + 10^4 + 10^5 + 10^6 + 10^7 + 10^8 + 10^9$. Find the sum of the digits of N.

(A) 12

(B) 9

(C) 8

(D) 7

ANS.- (D) Since N is written as a sum of powers of 10; N can be written as 1111111000.
So, the sum of the digits is 7.

05

How many zeros are there at the end of the product $33 \times 175 \times 180 \times 12 \times 44 \times 80 \times 66$?

(A) 2

(B) 4

(C) 6

(D) 6

ANS.- (B)

$33 = 3 \times 11$

$44 = 2^2 \times 11$

$175 = 5^2 \times 7$

$80 = 2^4 \times 5$

$180 = 5 \times 2^2 \times 3^2$

$66 = 2 \times 3 \times 11$

$12 = 2^2 \times 3$

Multiplying all, we get

$2^{11} \times 5^4 \times 3^5 \times 7 \times 11^3 = 10^4 \times 2^7 \times 3^5 \times 7 \times 11^3$

Look out for the number of tens, making total number of zeros.

Number of zeros = 4

06

Find the last digit of $(173)^{99}$.

(A) 9 (B) 7

(C) 1 (D) 3

ANS.- (B)

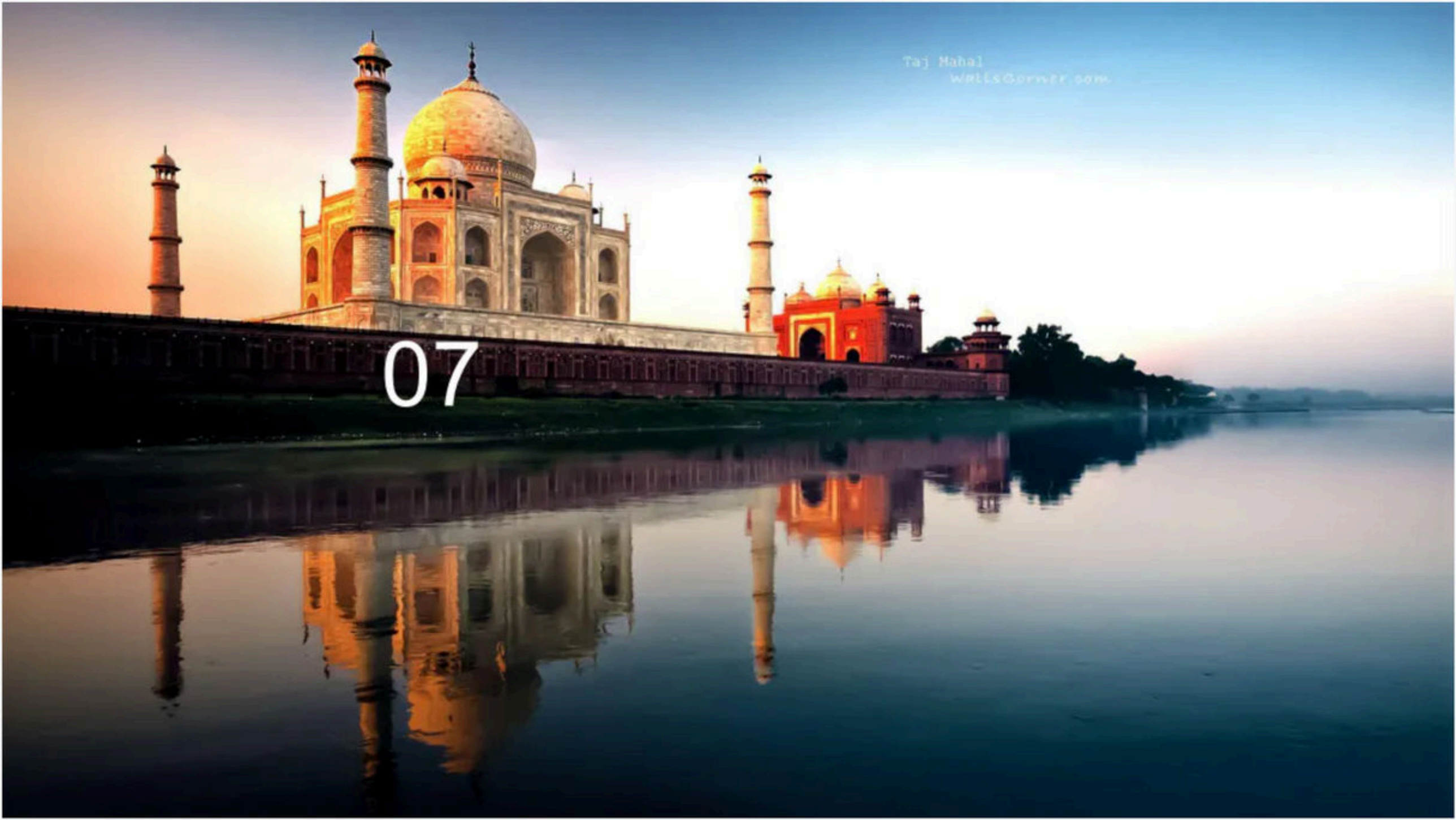
$3^1 = 3$, $3^2 = 9$, $3^3 = 27$, $3^4 = 81$ and $3^5 = 81 \times 3 = 243$.

Use the concept of power cycle (units digit repeats after the power of 4 and then after all powers that are multiples of 4).

Now, $99 = 24 \times 4 + 3$

Thus, 99 has 24 complete cycles of 4 and 3 is left as the remainder.

So, units digit of $(173)^{99}$ will be units digit of 3^3, which is 7.



07

Find the units digit of $51 \times 52 \times 53 \times \ldots \times 59$.

(A) 4

(B) 3

(C) 2

(D) 0

ANS.- (D)

This is a product of all the integers from 51 to 59. In this product, there is one 5 (at units place of 55) and at least one even number (at units place of 52, 54, 56 or 58). When 5 is multiplied with any even number, it always ends with 0. So, the units digit is 0.

08

What is the right most non-zero digit of $13780000^{13780000}$?

(A) 8 (B) 4

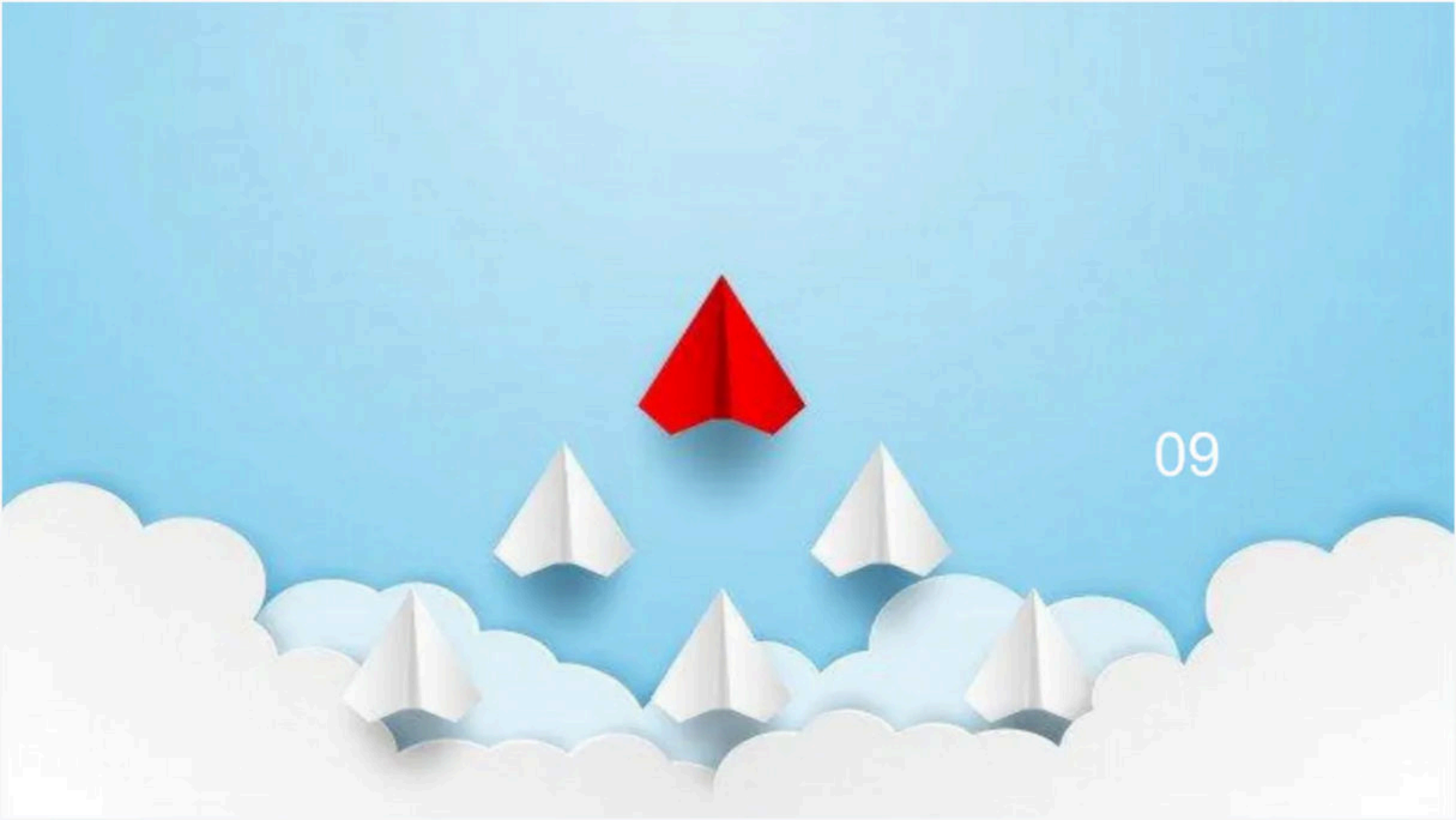
(C) 2 (D) 6

ANS.- (D) The required answer is nothing but the last digit of $8^{13780000}$.

We know that, the cyclicity of 8 is 4.

As 13780000 is divisible by 4 (cyclicity of 8).

That is, the last digit of $8^4 = 6$


09

How many factors of 1260 end with a zero?

(A) 6 (B) 8

(C) 10 (D) 12

ANS.- (D)

$1260 = 4 \times 315$

$= 4 \times 5 \times 63$

$= 2^2 \times 3^2 \times 5 \times 7$

The factor has to end with a zero means it should have 2 and 5 necessarily.

So, if we take out 2 and 5, then we will have $2 \times 3^2 \times 7$.

The required answer is the number of factors of $2 \times 3^2 \times 7$.

$\Rightarrow (1 + 1)(2 + 1)(1 + 1)$

$= 12$

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Find the last digit of the following expression.

$(15)^{256} + (19)^{138} + (32)^{97}$

(A) 8 (B) 6

(C) 5 (D) 3

ANS.- (A)

Unit digit of $(15)^{256} = 5$.
As any number with 5 at the units place will always have a 5 at its units place, irrespective of the positive natural number power.

Now, $9^1 = 9$, $9^2 = 81$, $9^3 = 729$, $9^4 = 6561$
So, basically, a number with 9 at its units place raised to an even number, will have 1 at its units place and a number with 9 at its units place raised to an odd number, will have 9 at its units place.
Thus, the units digit of 19^{138} is a 1.

Now, $2^1 = 2$, $2^2 = 4$, $2^3 = 8$, $2^4 = 16$ and $2^5 = 32$
So, basically after every 4th power, the units digit repeats itself.
Now, $97 = 96 + 1 = 24 \times 4 + 1$
Thus, we have 24 sets of 4 and then 1 more.
So, the number should have 2 at the units place.

Thus, the digit at the units place is $5 + 1 + 2 = 8$
Hence, option 1 is correct.