



RRB NTPC Number Systems Questions Pdf

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Instructions

For the following questions answer them individually

Question 1

Find the number of odd divisor of 900900.

- A 144
- B 36
- C 216
- D 72

Answer: D

Explanation:

We can prime factorise the number in terms of prime numbers.

$$900900 = 2^2 * 3^2 * 5^2 * 7 * 11 * 13$$

We have to find the number odd factors = $(1)*(2+1)*(2+1)*(1+1)*(1+1)*(1+1) = 72$. Hence, option D is the correct answer.

Question 2

What is the total number of even factors of 1143072?

- A 126
- B 105
- C 84
- D 21

Answer: B

Explanation:

The given number (1143072) can be factorized in powers of prime numbers as follows:

$$1143072 = 2^5 * 3^6 * 7^2$$

We can find the number of even factors when we have at least 1 power of 2. Therefore, the number of even factors = $5*(6+1)*(2+1) = 105$.

Hence, option B is the correct answer.

Question 3

$N = -(1!)^1 + (2!)^2 - (3!)^3 + (4!)^4 - \dots - (99!)^{99} + (100!)^{100}$. The digit in the units place of N^{100} will be

Answer:1

Explanation:

$$1! = 1, (1!)^1 = 1$$

$$2! = 2, (2!)^2 = 4$$

$$3! = 3, (3!)^3 = 216$$

$$4! = 24, (4!)^4 = 331776$$

$$5! = 120, (5!)^5 = \text{term which ends with 0.}$$

Any factorial greater than 5 will have at least 1 zero at the end.

As the last term is $(100!)^{100}$, note that the sum of all the terms after $(4!)^4$ will be positive and ending with 0.

Thus, no number greater than 4 will have any effect on the last digit of N.

$$\text{Thus, last digit of } N = \text{last digit of } (-1+4-216+331776) = 3$$

$$\text{Thus, the last digit of } N^{100} = \text{last digit of } 3^{100}$$

3 follows a cyclicity of 4 and thus, the last digit of 3^{100} will be the same as the last digit of $3^4 = 1$

Hence, 1 is the correct answer.

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Question 4

Find the unit digit of $78^{79^{80}}$.

A 8

B 4

C 2

D 6

E 0

Answer: A

Explanation:

We have to find out the unit digit of $78^{79^{80}}$.

We know that cyclicity of 8 is 4. Hence, we have to figure remainder that the exponent 79^{80} leaves when it is divided by 4.

$$\text{Rem.}\left(\frac{79^{80}}{4}\right) = \text{Rem.}\left(\frac{(80-1)^{80}}{4}\right) = 1$$

Hence, we can say that 79^{80} is a $4k+1$ type number.

Therefore, we can write $78^{79^{80}}$ as 78^{4k+1} .

Thus, the unit digit of 78^{4k+1} will be 8. Hence, option A is the correct answer.

Question 5

Find the rightmost non-zero digit in $91!$.

Answer: 2

Explanation:

We know that the rightmost non-zero in $x!$ where $25 < x < 125 = \{4^{a*} [\text{Last non-zero digit of } a!][\text{Last non-zero digit of } b!]\} \bmod 10$, when we write x as $25a+b$.

Here, 91 can be written as $25*3 + 16$, therefore, $a = 3, b = 16$

\therefore The rightmost non-zero in $91! = \{4^3 * [\text{Last non-zero digit of } 3!][\text{Last non-zero digit of } 16!]\} \bmod 10 \dots (1)$

The rightmost non-zero in $x!$ where $5 < x < 25 = \{2^{a*} [\text{Last non-zero digit of } a!][\text{Last non-zero digit of } b!]\} \bmod 10$, when we write x as $5a+b$.

Here, 16 can be written as $5*3 + 1$, therefore, $a = 3, b = 1$

\therefore The rightmost non-zero in $16! = \{2^3 * [\text{Last non-zero digit of } 3!][\text{Last non-zero digit of } 1!]\} \bmod 10 = \{8*6*1\} \bmod 10 = 8 \dots (2)$

Substituting the value of the rightmost non-zero in $16!$ from equation (2) to equation (1),

\therefore The rightmost non-zero in $91! = \{64 * [6] * [8]\} \bmod 10 = 3072 \bmod 10 = 2$.

Question 6

How many factors of 64800 are perfect squares?

Answer:18

Explanation:

We can write '64800' as $2^5 \times 3^4 \times 5^2$

For a number to be a perfect square, all the powers of the prime factors have to be even.

Here, 2 can have its powers as 0,2,4 (3 cases)

3 can have its powers as 0,2,4 (3 cases)

5 can have its powers as 0,2 (2 cases)

Number of possibilities = $3*3*2 = 18$

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Question 7

A 3 digit number becomes a perfect square when divided by 3 and becomes a perfect cube when divided by 2. What is the value of the number?

Answer:432

Explanation:

The 3 digit number should be of the form $2^a 3^b 5^c \dots$ and so on.

We can see that the number becomes a perfect square when divided by 3. Therefore, the power of 3 in the number must be one among 1,3 or 5. (3^7 is a four digit number).

The number, on division by 2 becomes a perfect cube. Therefore, the power of 2 can be 1,4 or 7.

Since the number becomes a perfect cube and perfect square on division by 3 and 2, the powers of other numbers should be at least 6.

However, terms such as 5^6 are huge and hence, we can conclude that the number must be composed of powers of 2 and 3.

'a' can take values 1, 4 or 7 and 'b' can take values 1, 3 or 5.

When divided by 2, the remaining term must be a perfect cube. Therefore, the value of b can only be 3.

When divided by 3, the remaining term must be a perfect square. Therefore, the value of a can only be 4.

Therefore, the number is $2^4 * 3^3 = 16 * 27 = 432$.

Therefore, 432 is the right answer.

Question 8

Find the maximum value of x when $1! * 2! * 3! * \dots * 20!$ is completely divisible by 6^x ?

A 77

B 75

C 78

D 83

Answer: C

Explanation:

For finding out maximum value of 6^x .

Since we know that $6 = 2 * 3$ and in any factorial frequency of 2 will be higher as compared to 3. Hence for finding out maximum value of x we have to figure out the maximum power of 3.

Maximum power of 3 in 20!

$$\Rightarrow \left[\frac{20}{3} \right] + \left[\frac{20}{3^2} \right] \quad (\text{Where } [.] \text{ is a greatest integer function.})$$

$$\Rightarrow 6 + 2 = 8$$

This power will remain same for 18! and 19!

For calculating maximum power of 3 in 17!, 16! and 15!

$$\Rightarrow \left[\frac{17}{3} \right] + \left[\frac{17}{3^2} \right]$$

$$\Rightarrow 5 + 1 = 6$$

Similarly, we will calculate for remaining terms.

Hence, for maximum value of ' x ' = $8 * 3 + 6 * 3 + 5 * 3 + 4 * 3 + 2 * 3 + 1 * 3 + 0 * 2 = 78$ (Answer :C)

Question 9

Sum of all digits of the number $10^{68} - 21$?

Answer:610

Explanation:

Let us find out the pattern by using small powers.

$$\Rightarrow 10^4 - 21 = 9979$$

$$\Rightarrow 10^5 - 21 = 99979$$

$$\Rightarrow 10^6 - 21 = 999979$$

We can clearly see the pattern

$$\Rightarrow 10^n - 21 = 9999(n - 2\text{times})79$$

$$\text{So } 10^6 8 - 21 = 9999(66\text{times})79$$

$$\text{Hence, sum of all digits} = 67 \cdot 9 + 7 = 610$$

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Question 10

N is an integer such that $10^8 \leq N \leq 10^9$. If it is known that the sum of the digits of N is 4 then how many values of N are possible?

Answer:165

Explanation:

We have been given that $10^8 \leq N \leq 10^9$. Hence, N must be a 9 digit number. Now, sum of the digits of N is 4.

Hence, the possible cases are

(1, 1, 1, 1), (1, 1, 2), (2, 2), (3, 1), (4, 0)

In case I (1, 1, 1, 1)

One of the 1's will be at first place, the remaining 3 ones can be placed at any of the remaining 8 places. Hence, possible combinations will be ${}^8C_3 = 56$

In case 2(1, 1, 2)

If the first digit is 1, then the remaining two can be placed in 8 positions in ${}^8C_2 \cdot 2 = 56$ ways

If the first digit is 2, then the rest two can be placed in ${}^8C_2 = 28$ ways.

Hence, total possibilities in second case = 84

Now in case III,

First digit can be 3 or 1. The second digits can be placed in any of the remaining 8 possibilities. Hence, total possibilities = $8 \cdot 2 = 16$

In case IV, there will only 8 possibilities.

In case V, there will be only 1 possibility.

Hence, the required number of ways = $56 + 84 + 16 + 8 + 1 = 165$

Question 11

The LCM of $(17)_n$ and $(14)_n$ is $(330)_4$. Their GCD is $(11)_2$. Find n.

Answer:8

Explanation:

Given,

$$\text{LCM} = (330)_4 = (60)_{10}$$

$$\text{GCD} = (11)_2 = (3)_{10}$$

Product of the numbers = LCM * HCF

$$(17)_n = n + 7$$

$$(14)_n = n + 4$$

$$(n + 4)(n + 7) = 180$$

$$n^2 + 11n - 152 = 0$$

$$(n - 8)(n + 19) = 0$$

$$n = 8$$

Question 12

Two numbers, 297_B and 792_B , belong to base B number system. If the first number is a factor of the second number then the value of B is:

A 11

B 12

C 15

D 17

E 19

Answer: E

Explanation:

In Base B, $297_B = 2B^2 + 9B + 7$

and $792_B = 7B^2 + 9B + 2$

It is given that 297_B is a factor of 792_B

$$\Rightarrow \frac{7B^2 + 9B + 2}{2B^2 + 9B + 7} \text{ must be an integer}$$

$$\Rightarrow \frac{(2B^2 + 9B + 7) + (5B^2 - 5)}{2B^2 + 9B + 7}$$

$$\Rightarrow \frac{5B^2 - 5}{2B^2 + 9B + 7} + 1 = k$$

$$\Rightarrow 5B^2 - 5 = (2B^2 + 9B + 7)k \quad (\text{where } k \text{ is factor})$$

Put $k = 1$

$$\Rightarrow 5B^2 - 5 = 2B^2 + 9B + 7$$

$$\Rightarrow B^2 - 3B - 4 = 0$$

$$\Rightarrow (B - 4)(B + 1) = 0$$

$$\Rightarrow B = 4, -1$$

Since, B is a base, so B must be greater than 9. Hence, it is not possible

Put $k = 2$

$$\Rightarrow 5B^2 - 5 = 4B^2 + 18B + 14$$

$$\Rightarrow B^2 - 18B - 19 = 0$$

$$\Rightarrow (B - 19)(B + 1) = 0$$

$$\Rightarrow B = 19, -1$$

$$\therefore B = 19$$

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Question 13

If a, b, c and d are four different positive integers selected from 1 to 25, then the highest possible value of $((a + b) + (c + d))/((a + b) + (c - d))$ would be:

- A 47
- B 49
- C 51
- D 96
- E None of the above

Answer: C

Explanation:

Expression : $\frac{a+b+c+d}{a+b+c-d}$

To maximize the above expression, we have to minimize the denominator

Minimum value of the denominator = 1

So we can make $a + b + c = 26$ and $d = 25$ (as maximizing d will give denominator the least value).

So required maximum value = $\frac{a+b+c+d}{a+b+c-d}$

$$= \frac{26+25}{26-25} = 51$$

Question 14

What is the largest five digit number which is divisible by 16, 28 and 42?

- A 97792
- B 99772
- C 97992
- D 99792

Answer: D

Explanation:

The LCM of 16 and 28 is 112.

The LCM of 112 and 42 is 336.

Hence, we need to find the largest five digit number which is divisible by 336.

Note that $336 \times 300 = 100800$ and hence the largest five digit number which is divisible by 336 is $100800 - 3 \times 336 = 99792$

Question 15

A three digit number xyz has '4' factors. Which of the following will be the number of factors of the 6 digit number ' $xyzxyz$ '?

- A 20
- B 24
- C 32
- D More than one of the above are possible.

Answer: D

Explanation:

$$xyzxyz = xyz \cdot 1001$$

$$\Rightarrow xyzxyz = xyz \cdot 7 \cdot 11 \cdot 13$$

$\Rightarrow xyz$ has four factors so, xyz can be of the form p^3 where p is a prime number or, xyz can be of the form $a \cdot b$, where a and b are prime numbers.

So in case I, the total number of factors of $xyzxyz$ will be

$$(3 + 1) \cdot (1 + 1) \cdot (1 + 1) \cdot (1 + 1) = 32, \text{ when } xyz \text{ is not } 7^3$$

If $xyz = 7^3$, then total number of factors of $xyzxyz$ will be given by $5 \cdot 2 \cdot 2 = 20$.

Thus, in case one the possible values are 20 and 32.

Consider case II, where xyz is a product of two prime numbers.

In case xyz is co-prime to 7, 11 and 13, the total number of factors of $xyzxyz$ will be

$$(1 + 1) \cdot (1 + 1) \cdot (1 + 1) \cdot (1 + 1) \cdot (1 + 1) = 32$$

We know that $xyz = a \cdot b$ where a and b are distinct primes. Now if one among a or b is equal to 7, 11 or 13, then the number of factors of $xyzxyz$ will be

$$3 \cdot 2 \cdot 2 \cdot 2 = 24.$$

In case both ' a ' and ' b ' are chosen from 7, 11 and 13, then the number of factors of $xyzxyz$ will be $(2+1) \cdot (2+1) \cdot 2 = 18$.

Hence, the total possible number of factors of $xyzxyz$ can be 18, 20, 24 or 32.

Hence, the correct answer is option D.

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Question 16

p and q are positive numbers such that $p^q = q^p$, and $q = 9p$. The value of p is

- A $\sqrt{9}$
- B $\sqrt[6]{9}$
- C $\sqrt[9]{9}$
- D $\sqrt[8]{9}$

E $\sqrt[3]{9}$

Answer: D

Explanation:

$$p^q = q^p.$$

It has been given that $q = 9p$.

Substituting, we get,

$$p^{9p} = (9p)^p$$

$$(p^p)^9 = 9^p * p^p$$

$$\Rightarrow (p^p)^8 = 9^p$$

$$p^{8p} = 9^p$$

Raising the power to $\frac{1}{p}$ on both sides, we get,

$$p^8 = 9$$

$$p = \sqrt[8]{9}.$$

Therefore, option D is the right answer.

Question 17

The HCF of 2 numbers is 4 and the LCM is 1008. Further, it is known that one of the 2 numbers has an odd number of factors. The largest among the 2 numbers is

A 144

B 112

C 1008

D Cannot be determined

Answer: D

Explanation:

We know that the product of 2 numbers = HCF * LCM

Let the 2 numbers be X and Y.

$$XY = 4 * 1008$$

$$= 2^4 * 6^2 * 7$$

We know that one of the numbers has an odd number of factors. Therefore, one of the numbers must be a perfect square.

However, the 2 numbers can be split as $2^2 * 6^2$ and $2^2 * 7$ or 2^2 and $2^2 * 6^2 * 7$.

Therefore, we cannot determine the 2 numbers. Option D is the right answer.

Question 18

Find the number of zeroes in 53!.

A 10

B 12

C 14

D 13

Answer: B

Explanation:

The number of zeroes is determined by the maximum power of 2 and 5.

Since the exponent of 2 in 53! Will definitely be greater than that of 5, it is sufficient to find the maximum power of 5 in 53!.

$$\text{Highest power of 5 in } 53! = \left[\frac{53}{5} \right] + \left[\frac{53}{25} \right] = 10 + 2 = 12$$

Hence there are 12 zeroes in 53!

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Question 19

Mr Surtur lives on a planet Greip, where all the citizens use base 'n' (where $n > 2$) for calculations. Surtur once sold his watch for a particular amount (in the local currency), which was a two digit number, but received double the amount because the digits got mistakenly interchanged. For the least possible value of 'n', what is the decimal representation of the amount which Surtur should've actually received by selling his watch (in the local currency)?

Answer:8

Explanation:

The base used by the citizens of Greip is 'n'.

Let the amount in local currency for which the Surtur sold his watch be $(ab)_n$

Decimal representation of this original amount = $na + b \dots(1)$

The amount actually received by Surtur in local currency = $(ba)_n$

Decimal representation of this amount = $nb + a \dots(2)$

We know that Surtur received double the amount because the digits got mistakenly interchanged.

Hence,

$$nb + a = 2*(na + b)$$

$$(n-2)b = (2n - 1)a$$

We know that $n > 2$.

Let's consider that $n = 3$, we get,

$$b = 5a$$

As 'a' cannot be equal to 0; minimum value of b will be 5. This is not possible as in base 3 we don't have digit 5. Hence, $n=3$ is not possible.

Let's consider that $n = 4$, we get,

$$2b = 7a$$

As 'a' cannot be equal to 0; minimum value of b will be 7. This is not possible as in base 4 we don't have digit 7. Hence, $n=4$ is not possible.

Let's consider that $n = 5$, we get,

$$3b = 9a$$

$$b = 3a$$

Hence, value of (a,b) satisfying the equation is (1,3)

As, the base is 5, value of (a,b) = (2,6) and onwards is not possible.

Hence, least value of n which satisfies the given condition is 5.

Also, the only value of (a,b) which satisfies is (1,3)

Hence, amount in local currency for which the Surtur sold his watch is $= (13)_5$

Decimal representation of this value $= 5 \times 1 + 3 = 8$

Question 20

A function F_n is defined as $F_n = 11^n + 13^n$. What is the remainder when F_{105} is divided by 144.

A 72

B 108

C 96

D 120

Answer: A

Explanation:

We need to calculate the remainder when $11^{105} + 13^{105}$ is divided by 144.

Note that this equals $(12 - 1)^{105} + (12 + 1)^{105}$ being divided by 144.

$$(12 - 1)^{105} = 12^{105} - 105 \times 12^{104} + \dots + 105 \times 12 - 1$$

$$(12 + 1)^{105} = 12^{105} + 105 \times 12^{104} + \dots + 105 \times 12 + 1$$

The even terms of both the expressions cancel each other.

Hence, the only term where the power of 12 is less than 2 is $105 \times 12 + 105 \times 12 = 210 \times 12 = 2520$

The remainder when this is divided by 144 is 72

Question 21

Hardik wrote first 215 natural numbers in base 6. How many times did he write '4'?

Answer:108

Explanation:

$$215 = 6^3 - 1$$

Thus 215 is the largest 3 digit number in base 6.

Now we consider all the numbers upto greatest 'n' digit number in base 6. Then there will be total $n \times 6^n$ digits in total.

One-sixth of these digits will be digit '4'.

Thus the number of 4's will be $\frac{n \cdot 6^n}{6} = n \cdot 6^{n-1}$

Here for 215, $n=3$ as it is the greatest 3 digit number in base 6.

So number of 4's are $3 \cdot 6^2 = 108$

Hence 108 is the right answer.

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Question 22

Find the smallest four digit number which when divided by 7, 13 and 23 leaves remainders 4, 10 and 5 respectively.

Answer: 1362

Explanation:

We see that the number when divided by 7 and 13, leaves a remainder of -3 in both cases.

Thus, the number should be of the form $91k - 3$.

The number $91k - 3$ when divided by 23 leaves a remainder of 5.

Thus $91k - 3 - 5$ should be divisible by 23.

$$\text{Rem}\left(\frac{91k-8}{23}\right) = 0$$

$$\text{Rem}\left(\frac{92k-k-8}{23}\right) = 0$$

$$\text{Rem}\left(\frac{92k-(k+8)}{23}\right) = 0$$

Hence,

$$\text{Rem}\left(\frac{k+8}{23}\right) = 0$$

$k = 15$ is one such number.

Hence, the required number will be $91k - 3$, which is $91 \cdot 15 - 3 = 1362$

Question 23

A rod is cut into 3 equal parts. The resulting portions are then cut into 12, 18 and 32 equal parts, respectively. If each of the resulting portions have integer length, the minimum length of the rod is

A 6912 units

B 864 units

C 288 units

D 240 units

Answer: B

Explanation:

The rod is cut into 3 equal parts thus the length of the rod will be a multiple of 3.

Each part is then cut into $12 = 2^2 * 3$

$18 = 2 * 3^2$ and $32 = 2^5$ parts and thus, each part of rod has to be a multiple of $2^5 * 3^2 = 288$

Thus, the rod will be a multiple of $288 * 3 = 864$

Thus, the minimum length of the rod is 864 units.

Hence, option B is the correct answer.

Question 24

In a Green view apartment, the houses of a row are numbered consecutively from 1 to 49. Assuming that there is a value of 'x' such that the sum of the numbers of the houses preceding the house numbered 'x' is equal to the sum of the numbers of the houses following it. Then what will be the value of 'x'?

A 21

B 30

C 35

D 42

Answer: C

Explanation:

It is given that sum of the first $(x - 1)$ numbers is equal to sum of the numbers from $(x + 1)$ to 49

or, sum of $(x - 1)$ numbers = sum of first 49 numbers - sum of first x numbers

$$\frac{x(x - 1)}{2} = \frac{49 * 50}{2} - \frac{x(x + 1)}{2}$$

On solving, we get $x = 35$

Hence, option C is the correct answer.

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Question 25

'n' is the greatest possible number that leaves the same remainder on dividing 6912 and 9216. How many factors of 'n' will become a perfect square or perfect cube on multiplying by 6?

A 6

B 7

C 12

D 8

Answer: B

Explanation:

Since the number leaves the same remainder on dividing both 6912 and 7680, the difference between them must be divisible by the number.

$$9216 - 6912 = 2304$$

The greatest possible value of 'n' is 2304.

$$2304 = 9 * 256$$

$$= 3^2 * 2^8$$

Now, 6 can be split as $3 * 2$.

$3^2 * 2^8$, $3^2 * 2^5$, $3^2 * 2^2$ will become a perfect cube on multiplying by 6.

$3^1 * 2^1$, $3^1 * 2^3$, $3^1 * 2^5$ and $3^1 * 2^7$ will become a perfect square on multiplying by 6.

Hence, there are 7 factors in total.

Question 26

How many proper fractions $f = \frac{p}{q}$ exist such that $0 < f < 1$ and $p + q = 800$. It is known that p and q are relatively prime.

A 160

B 200

C 216

D 108

Answer: A

Explanation:

As it is given that $f < 1$, we know that $p < q$ and as $p + q = 800$, it implies that $400 < q < 800$

Note that $800 = 2^5 \times 5^2$

Hence, p and q will be relatively prime if q is not divisible by either 2 or 5. Note that in this case, even p will not be divisible by 2 or 5.

Hence, we need to find the number of numbers between 400 and 800 which are not divisible by 2 and 5.

The total number of numbers between 400 and 800 is 399.

The number of such numbers which are divisible by 2 is 199.

The number of such numbers which are divisible by 5 is 79.

The number of such numbers which are divisible by 10 is 39.

Hence, the required number is $399 - 199 - 79 + 39 = 160$.

Question 27

If the last 6 digits of $[(M)! - (N)!]$ are 999000, which of the following option is not possible for $(M) \times (M - N)$?

Both (M) and (N) are positive integers and $M > N$. $(M)!$ is factorial M .

A 150

B 180

C 200

D 225

E 234

Answer: B

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Question 28

A is the smallest even natural number such that it is

- a) 19% less than a natural number
- b) 34% greater than another natural number.

What is the remainder when A is divided by 17? (Enter -1 if the answer can't be determined)

Answer:8

Explanation:

Let the two natural numbers in the question be M and N

$$\text{Therefore, } M \times \frac{81}{100} = A$$

$$\text{and, } N \times \frac{134}{100} = A$$

$$\text{Or, } M = A \times \frac{100}{81} \text{ and } N = A \times \frac{50}{67}$$

LCM of 67 and 81 is 5427.

It is given that A is the smallest even natural number which satisfies the above conditions. Hence, $A = 5427 * 2 = 10854$

It leaves a remainder of 8 when divided by 17.

Question 29

What is the minimum value of 'n' (natural number) for which the remainders obtained when 325^n and 326^n are divided by 9 equal?

Answer:6

Explanation:

The remainder when 325 divided by 9 is "1".

The remainder when 326 divided by 9 is "2".

For any value of 'n' the remainder when 325^n divided by 9 will be 1.

The remainder when 326^n divided by 9 should be 1 for to be equal.

$$326 \bmod 9 = 2$$

The remainder when 326^n divided by 9 is equal to the remainder when 2^n divided by 9

The least value at which the remainder is 1 is for $n = 6$.

Question 30

The HCF of two numbers (a, b) is 7. How many ordered pairs (a, b) exist such that the $a + b = 1540$?

Answer:80

Explanation:

Let the two numbers be $7m$ and $7n$ where m and n are coprime.

So we have

$$7m + 7n = 1540$$

$$\Rightarrow m + n = 1540/7 = 220$$

So we have to write 220 as the sum of two co-prime numbers.

Total numbers below 220 which are also co-prime to 220 are given by the euler no. of 220 = $220 * \frac{1}{2} * \frac{4}{5} * \frac{10}{11} = 80$.

For each of these numbers, there will be a corresponding number such that the sum is 220. For example, $3 + 217$, $7 + 213$, $13 + 207$ and so on.

Since the question asks for ordered pairs so both a and b can take 80 values each. Hence the required answer is 80.

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Question 31

Kishor intended to multiply a two-digit natural number and a three-digit natural number, but he left out the multiplication sign and simply placed the two-digit number to the left of the three-digit number, thereby forming a five-digit number. This number is exactly nine times the product Kishor would have obtained. What is the sum of the two-digit number and the three-digit number?

A 126

B 147

C 151

D 159

Answer: A

Explanation:

Let x be the two-digit number, y be the three-digit number. Putting together the given, we have

$$1000x + y = 9xy$$

$$\Rightarrow 9xy - 1000x - y = 0$$

$$\Rightarrow (9x - 1)\left(y - \frac{1000}{9}\right) = \frac{1000}{9}$$

$$\Rightarrow (9x - 1)(9y - 1000) = 1000$$

We know that x is a two digit number hence $89 \leq (9x - 1) \leq 890$.

Hence, we have to check the solution for every divisor of 1000 which is greater than 89 and less than 890.

Divisors of 1000, which are greater than 89 and less than 890 = (100, 125, 200, 250, 500)

We can see that only at $(9x - 1) = 125$, $(9y - 1000) = 8$

i.e. $y = 112$ also $(9x - 1) = 125$, i.e. $x = 14$

For any other value of $(9x - 1)$ we get non integer values of y which is not possible because y is a three digit number.

Hence, the required sum = $x + y = 14 + 112 = 126$.

Therefore, option A is the correct answer.

Question 32

How many factors of the number 24696 are perfect squares?

Answer:8

Explanation:

$$24696 = 2^3 * 3^2 * 7^3$$

All factors of 24696 are in the form of $2^a * 3^b * 7^c$

To be a perfect square, a can take values 0,2

b can take values 0,2

c can take values 0,2

Therefore, total number of factors of 24696 which are perfect squares = $2*2*2 = 8$

Question 33

'k' represents the set of natural numbers whose total number of factors are odd. 'm' represents the set of all odd natural numbers. How many elements will be there in the set $k \cap m$ if it is known that $0 \leq k \leq 1000$ and $0 \leq m \leq 900$

Answer:15

Explanation:

'k' represents the set of natural numbers which have odd number of factors. We know that the total number of factors is odd only for perfect squares. Hence 'k' is essentially the set of all perfect squares while m is the set of all odd natural numbers.

$$0 \leq k \leq 1000$$

The number of perfect squares between 1 and 1000 = 31 {Since $32^2 = 1024$ }

Out of these 31, 15 will be even numbers ($2^2, 4^2, 6^2, 8^2, 10^2, \dots, 30^2$)

The remaining 16 will be odd ($1^2, 3^2, 5^2, 7^2, 9^2, \dots, 31^2$)

However, we know that $0 \leq m \leq 900$. Hence, 31^2 will be outside the range of m. Hence $k \cap m$ will only have 15 elements.

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Question 34

L is a seven digit Integer with a digit sum of 55, how many values are possible for L?

A 4005

B 2747

C 2447

D 3003

Answer: D

Explanation:

let $lmnopqr$ be the number.

Each of the digits can take a value between 0 and 9. So let

$$l = 9 - a, m = 9 - b, n = 9 - c, o = 9 - d, p = 9 - e, q = 9 - f, r = 9 - g$$

We have been given that

$$l + m + n + o + p + q + r = 55$$

$$\Rightarrow 9 - a + 9 - b + 9 - c + 9 - d + 9 - e + 9 - f + 9 - g = 55. \text{ (Here, } b, c, d, e, f, g \text{ are non negative integers less than or equal to 9 and } a \text{ is a non negative integer less than or equal to 8)}$$

$$\Rightarrow a + b + c + d + e + f + g = 8$$

The number of non negative solutions for this equation can be obtained by using the formula $(n+r-1)C(r-1)$

So the required number of solutions would be $(8+7-1)C(7-1) = 14C6 = 3003$.

Hence 3003 seven digit numbers are there with a digit sum of 55.

Question 35

If a number K has 8 as its Total number of factors, Which of the following cannot be the Total number of factors of K^2 ?

A 27

B 18

C 15

D 21

Answer: B

Explanation:

Given that there are 8 factors for K . There are 3 different cases in which 8 can be factorized into

$$\text{Case 1: } (1 + 1) * (1 + 1) * (1 + 1) = 8$$

When K is squared all its factors are also squared, number of factors of $K^2 = (2 + 1)(2 + 1)(2 + 1) = 27$

$$\text{Case 2 : } (1 + 1) * (3 + 1) = 8$$

$$\text{Number of factors of } K^2 = (2 + 1)(6 + 1) = 21$$

Case 3:

$$1 * (7 + 1) = 8$$

$$\text{Number of factors of } K^2 = (14 + 1) = 15$$

Question 36

How many factors of 36288 are perfect cubes?

A 9

B 4

C 6

D 8

Answer: C

Explanation:

$$36288 = 2^6 * 3^4 * 7$$

For any perfect cube, all the powers of its prime numbers have to be multiples of 3.

So, if the factor is of form $2^a * 3^b * 7^c$, a can take values 0, 3, 6

And b can take values 0, 3

And c can take value 0.

==> There are $3*2*1 = 6$ possibilities.

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Question 37

How many 4 digit numbers have their cubes ending with 44?

- A 180
- B 90
- C 45
- D 120
- E 0

Answer: A

Explanation:

If the unit digit of the cube is 4, the unit digit of the number must definitely be 4.

=> The number must be of the form 'abc4'

Since a and b are the thousandth and the hundredth digit number, they won't contribute to the tens digit number of the cube. Let us find how many values c can assume.

$(10c + 4)^3$ gives 44 in the end.

=> $1000c^3 + 64 + 400c^2 + 480c$ ends in 44.

Again $1000c^3$ and $400c^2$ won't contribute to the last 2 digits.

=> $64+80c$ ends in 44. This only happens when $c=1$ or $c=6$

=> a can assume 1-9 i.e 9 values, b can assume 0-9 i.e. 10 values, and c can assume 2 values. Total numbers= 180.

Question 38

X is the smallest number which leaves a remainder of 2 when divided by 7 and a remainder of 1 when divided by 19. What is the remainder when X is divided by 23?

- A 12
- B 9
- C 13
- D 17

Answer: A

Explanation:

X on division by 7 leaves a remainder of 2. So X is of the form $7k+2$

Same number on division by 19 leaves a remainder of 1, So X is also of the form $19m + 1$

Thus

$$7k+2 = 19m + 1$$

If we put $m = 3$, we get a number which is of the form $7k+2$. Thus the smallest number which fits the given criteria is $19 \times 3 + 1 = 58$

When 58 is divided by 23, the remainder would be 12.

Question 39

What will be the number of zeroes in $(2000!)_{34}$. Here 34 is the base in which the number is written.

A 122

B 123

C 124

D 125

Answer: B

Explanation:

$$34 = 17 \times 2$$

So we have to find the highest power of 17 in $2000!$. We need not find the power of 2 because of 2 will be greater than the power of 17. Thus the power of 17 will act as the limiting value.

Thus the highest power of 17 in $2000!$ is

$$[2000/17] + [2000/289] + [2000/4913], [] \text{ is greatest integer function}$$
$$= 117 + 6 + 0 = 123$$

Thus the required number of zeroes is 123.

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Question 40

Consider the series where $S_n = 200 + n^2$ for all natural numbers n . Therefore, $S_1 = 201, S_2 = 204, S_3 = 209$ and so on.

Let GCD_n be the greatest common divisor of S_n and S_{n+1} . Then, what is the maximum value of GCD_n

Answer: 801

Explanation:

To solve this problem, we will use the below property multiple times.

$$GCD(a, b) = GCD(a - k * b, b) \text{ for any integer } k.$$

$$GCD_n = GCD(200 + n^2, 200 + (n + 1)^2) = GCD(200 + n^2, 200 + n^2 + 2n + 1)$$

$$\text{Therefore, } GCD_n = GCD(200 + n^2, 2n + 1) = GCD(400 + 2n^2, 2n + 1)$$

Therefore, $GCD_n = GCD(400 + 2n^2 - n * (2n + 1), 2n + 1) = GCD(400 - n, 2n + 1)$

Therefore, $GCD_n = GCD(800 - 2n, 2n + 1) = GCD(801, 2n + 1)$

Hence, the maximum value of $GCD_n = 801$ when $2n + 1 = 801$ or $n = 400$

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