Newton School of Technology

2026 NSAT

Interview Prep Questions

Note: This document is to help you with interview preparation, it contains 20 sample questions to get you ready for your personal interview round.

1. DIFFERENTIATION

Question

The derivative of $f(x)$ is $f'(x) = 3x^2 - 4x + 1$. The derivative intersects the original function when $x = 2$. What is the value of $f(3)$?

Solution

The function $f(x)$ is given by,

$f(x) = \int f'(x)dx$
$= \int(3x^2 - 4x + 1)dx$
$= 3(x^3/3) - 4(x^2/2) + x + C$
$= x^3 - 2x^2 + x + C$

The value of the derivative when $x = 2$ is:

$f'(2) = 3(2)^2 - 4(2) + 1$
$= 12 - 8 + 1$
$= 5$

Since the derivative and the original function intersect at this point,

$f(2) = 5$
$(2)^3 - 2(2)^2 + 1(2) + C = 5$
$8 - 8 + 2 + C = 5$
$C = 3$

The value of $f(3)$ can be calculated as

$f(3) = (3)^3 - 2(3)^2 + 3 + 3$
$= 27 - 18 + 6$
$= 15$

2. PnC

Question

In how many different ways can the letters of the word 'CORPORATION' be arranged so that the vowels always come together?

Solution

In the word 'CORPORATION', we treat the vowels OOAIO as one letter.
Thus, we have CRPRTN (OOAIO).
This has 7 (6 + 1) letters of which R occurs 2 times and the rest are different.
Number of ways of arranging these letters = 7! / 2! = 2520.
Now, 5 vowels in which O occurs 3 times and the rest are different, can be arranged in
5! / 3! = 20 ways.
∴ Required number of ways = (2520 × 20) = 50400

3. PnC

Question

There are 8 girls and 12 boys in a class of 20 students. Seven students are to comprise a committee, but at least two girls and at least four boys must be on the committee. How many different ways are there to form the committee?

Solution

We need to form a committee of 7 students from 20 students consisting of at least 4 boys and at least 2 girls.

The possible cases are:

- Case 1: 4 boys and 3 girls
- Case 2: 5 boys and 2 girls

Case 1:
The number of ways to select 4 boys from 12 boys is C(12, 4).
The number of ways to select 3 girls from 8 girls is C(8, 3).
The total number of ways for this case is C(12, 4) × C(8, 3).

Case 2: 5 boys and 2 girls
The number of ways to select 5 boys from 12 boys is C(12, 5).
The number of ways to select 2 girls from 8 girls is C(8, 2).
The total number of ways for this case is C(12, 5) × C(8, 2).

The formula for C(n, k) is:

$$\frac{C(n, k) = n!}{(k!(n - k)!)}$$

Now we can calculate the values for each combination, then add the results of the two cases:
Total number of ways = C(12, 4) × C(8, 3) + C(12, 5) × C(8, 2)
= 495 × 56 + 792 × 28
= 49896
Hence, the total number of ways to form the committee is 49896.

4. Differential Equation

Question

If y^y * y' = p * x^4 is satisfied by the equation y = x^3, then the value of p is:

Solution

Consider the equation $y = x^3$.
The derivatives of the equation are
$y' = d/dx [x^3]$
$= 3x^2$
And,
$y'' = 6x$
Plugging these in the given differential equation:
$6x(x^3) = p * x^4$
$6x^4 = p * x^4$
$p = 6$

5. Probability

Question

A seven-digit number is formed using the digit 3, 3, 4, 4, 4, 5, 5. The probability, that number so formed is divisible by 2, is:

Solution

n(S) = 7!/[2! 3! 2!]

n(E) = 6!/[2! 2! 2!]

P(E) = n(E)/n(S)

= [6! / 7!] × [[2! 3! 2!] / [2! 2! 2!]]

= 3/7\

6. Probability

Question

The box contains 6 red, 8 green, 10 blue, 12 yellow and 15 white balls. What is the minimum no. of balls we have to choose randomly from the box to ensure that we get 9 balls of the same color?

Solution

Here in this we cannot blindly apply pigeon principle. First we will see what happens if we apply above formula directly.

From the above formula we have get answer 47 because 6 + 8 + 10 + 12 + 15- 5 + 1 = 47. But it is not correct.

In order to get the correct answer we need to include only blue, yellow and white balls because red and green balls are less than 9.

But we are picking randomly so we include after we apply pigeon principle. i.e., 9 blue + 9 yellow + 9 white – 3 + 1 = 25

Since we are picking randomly so we can get all the red and green balls before the above 25 balls. Therefore we add 6 red + 8 green + 25 = 39

We can conclude that in order to pick 9 balls of same color randomly, one has to pick 39 balls from a box.

7. Sequence and Series

Question

Let X be the set consisting of the first 2018 terms of the arithmetic progression 1, 6, 11, ..., and Y be the set consisting of the first 2018 terms of the arithmetic progression 9, 16, 23, ... Then, the number of elements in the set X ∪ Y is ....

Solution

Here, X = {1, 6, 11, ..., 10086}

and Y = {9, 16, 23, ..., 14128}

nth term found by the following formula : an = a + (n -1)d

$X \cap Y = \{16, 51, 86, ...\}$

tn is the final term of X∩Y and it is less than or equal to 10086

$t_n = 16 + (n - 1) 35 <= 10086$

$n <= 288.7$

$n = 288$

$n(X \cup Y) = n(X) + n(Y) - n(X \cap Y)$

$n(X \cup Y) = 2018 + 2018 - 288 = 3748$

8. Functions

Question

The nth term of a sequence is given by

$$a_n = 2^n + 3^{n-1}$$

Find the sum of the first 7 terms of this sequence and the limit of the sequence as n approaches infinity.

Solution

The nth term of a sequence is given by

$$a_n = 2^n + 3^{n-1}$$

We need to find the sum of the first 7 terms.
Find the individual terms:
$a_1 = 2^1 + 3^0 = 3$
$a_2 = 2^2 + 3^1 = 7$
$a_3 = 2^3 + 3^2 = 17$
$a_4 = 2^4 + 3^3 = 43$
$a_5 = 2^5 + 3^4 = 113$
$a_6 = 2^6 + 3^5 = 307$
$a_7 = 2^7 + 3^6 = 857$

Now, sum these values:

Sum = 3 + 7 + 17 + 43 + 113 + 307 + 857 = 1347

To find the limit of the sequence as $n \to \infty$ we analyze the behavior of the nth term.
As n increases, the term 3^{n-1} grows much faster than 2^n, because 3 > 2

Therefore, the sequence grows without bound as $n \to \infty$ meaning the limit is:
$\lim (n \to \infty)\, a_n = \infty$

9. PnC

Question

The number of numbers between 2,000 and 5,000 that can be formed with the digits 0, 1, 2, 3, 4 (repetition of digits is not allowed) and are multiple of 3 is ?

Solution

There are 4 places to be filled with the given digits. The thousands place can have only 2, 3, and 4 since the number has to be greater than 2000. For the remaining 3 places, we need to pick digits such that the resultant number is divisible by 3. The divisibility criteria for 3 states that the sum of the digits of the number should be divisible by 3.
Case 1: If we pick 2 for the thousands place. The remaining digits we can pick such that the sum of the digits at all places is a multiple of 3 are: 0, 1, and 3, as 2 + 1 + 0 + 3 = 6, which is divisible by 3. 0, 3, and 4, as 2 + 3 + 0 + 4 = 9, which is divisible by 3. In both of the above combinations, the remaining three digits can be arranged in 3! ways. Total number = 2 × 3! = 12
Case 2: If we pick 3 for the thousands place. The remaining digits we can pick such that the sum of the digits at all places is a multiple of 3 are: 0, 1, and 2, as 3 + 1 + 0 + 2 = 6, which is divisible by 3. 0, 2, and 4, as 3 + 2 + 0 + 4 = 9, which is divisible by 3. In both of the above combinations, the remaining three digits can be arranged in 3! ways. Total number = 2 × 3! = 12 Case 3: If we pick 4 for the thousands place. The remaining digits we can pick such that the sum of the digits at all places is a multiple of 3 are: 0, 2, and 3, as 4 + 2 + 0 + 3 = 9, which is divisible by 3. In this combination, the remaining three digits can be arranged in 3! ways. Total number = 3! = 6 Total number of numbers between 2000 and 5000 divisible by 3 is: 12 + 12 + 6 = 30

10. Functions

Question

Find the set of all values of x for which

$|f(x)+g(x)|<|f(x)|+|g(x)|$ is true if

$f(x)=x-3$ and $g(x)=4-x$ is given by

Solution

The given inequality is equivalent to
$1<|x-3|+|4-x|$

i.e.$1<|x-3|+|x-4|$.

For x<3, we have
3−x+4−x = 7−2x>1...... (1)
i.e., x<3, which is true in the domain.

For 3≤x<4(1) gives
x−3+4−x =1 >1.......(2)

For 4≤x we have
2x−7>1 ⇒ x>4......(3)

From (1) and (3), we have the solution of the inequality as x<3 or x>4 i.e x ∈]−∞,3[∪]4,∞[which is equal to R−[3,4]

11. Functions

Question

Consider the expression, f(x)[cos g(x) + sin h(x)] + c, where f, g and h are non-negative continuous functions and c is constant.
If cos(ln x) is the derivative of the above expression, then
(1) f(x) = x / 4
(2) g(x) = ln x
(3) h(x) = 2 ln x
(4) f(x) = 1
(5) Both (1) & (2)

Solution

Let
I=∫cos(lnx) dxI = \int \cos (\ln x) \, dxI=∫cos(lnx)dx

Put
lnx=t\ln x = tlnx=t
x=etx = e^tx=et
dx=etdtdx = e^t dtdx=etdt

Then,
I=∫etcost dtI = \int e^t \cos t \, dtI=∫etcostdt
=12et(cos t+sin t)+c= \frac{1}{2} e^t (\cos t + \sin t) + c=21et(cost+sint)+c
=12(cos(lnx)+sin(lnx))+c= \frac{1}{2} (\cos (\ln x) + \sin (\ln x)) + c=21(cos(lnx)+sin(lnx))+c

Consider the above equation:
12(cos(lnx)+sin(lnx))+c=with given expression, f(x)[cos g(x)+sin h(x)]+c\frac{1}{2} (\cos (\ln x) + \sin (\ln x)) + c = \text{with given expression, } f(x)[\cos g(x) + \sin h(x)] + c21(cos(lnx)+sin(lnx))+c=with given expression, f(x)[cos g(x)+sin h(x)]+c

On comparing, we get
f(x)=12,g(x)=lnx and h(x)=lnxf(x) = \frac{1}{2}, \quad g(x) = \ln x \text{ and } h(x) = \ln xf(x)=21,g(x)=lnx and h(x)=lnx

12. PnC

Question

Consider 4 boxes, where each box contains 3 red balls and 2 blue balls. Assume that all 20 balls are distinct. In how many different ways can 10 balls be chosen from these 4 boxes so that from each box at least one red ball and one blue ball are chosen ?

Solution

Case 1:
Among four bags, from one bag 4 balls are taken. Number of ways of choosing one bag from 4 bags = 4C1
From this bag, number of ways of taking 4 balls are:
(a) 3 Red and 1 Blue balls, which can be chosen in 3C3 × 2C1 ways.
(b) 2 Red and 2 Blue balls, which can be chosen in 3C2 × 2C2 ways.
∴ Total number of ways of choosing this 4 balls from this bag = 4C1 (3C3 × 2C1 + 3C2 × 2C2)
Now, two balls are taken from the remaining three bags.
From each bag, two balls can be taken in 3C1 × 2C1 ways.
So, for three bags, two balls can be taken in $(3C1 \times 2C1)^3$ ways.
∴ Total number of ways of choosing 10 balls from these four bags =
$4C1\,(3C3 \times 2C1 + 3C2 \times 2C2) \times (3C1 \times 2C1)^3$
Among four bags, from two bags 3 balls are taken. Number of ways of choosing two bags from 4 bags = 4C2
From each bag, number of ways of taking 3 balls are:
(a) 2 Red and 1 Blue balls, which can be chosen in 3C2 × 2C1 ways.
(b) 1 Red and 2 Blue balls, which can be chosen in 3C1 × 2C2 ways.
So, for two bags three balls can be taken in $(3C2 \times 2C1 + 3C1 \times 2C2)^2$ ways.
∴ Total number of ways of choosing this 3 balls from this two bags = $4C2\,(3C2 \times 2C1 + 3C1 \times 2C2)^2$
Now, two balls are taken from remaining two bags.
From each bag, two balls can be taken in 3C1 × 2C1 ways.
So, for two bags two balls can be taken in $(3C1 \times 2C1)^2$ ways.
∴ Total number of ways of choosing 10 balls from these four bags =
$4C2\,(3C2 \times 2C1 + 3C1 \times 2C2)^2 \times (3C1 \times 2C1)^2$
From Case 1 and Case 2, total number of ways of choosing 10 balls from these 4 boxes so that from each box at least one red ball and one blue ball are chosen:
$= 4C1\,(3C3 \times 2C1 + 3C2 \times 2C2) \times (3C1 \times 2C1)^3$
$4C2\,(3C2 \times 2C1 + 3C1 \times 2C2)^2 \times (3C1 \times 2C1)^2$

$= 4(5)(6^2) + 6(3 \times 2 + 3)^2(6^2)$
$= 4320 + 17496$
$= 21816$

13. Number Theory

Question

Three numbers which are co-prime to each other are such that the product of the first two is 551 and that of the last two is 1073. The sum of the three numbers is:

Solution

Since the numbers are co-prime, they contain only 1 as the common factor.
Also, the given two products have the middle number in common.
So, middle number = H.C.F. of 551 and 1073 = 29;

First number = (551 / 29) = 19;
Third number = (1073 / 29) = 37.
∴ Required sum = (19 + 29 + 37) = 85.

14. PnC

Question

Let X be a set with exactly 5 elements and Y be a set with exactly 7 elements. If α is the number of one-one functions from X to Y and β is the number of onto functions from Y to X, then the value of (β−α)/120 is _______.

Solution

n(X)=5

n(Y)=7

α→ Number of one-one functions =7C5×5!

β→ Number of onto function Y to X

1,1,1,1,3 1,1,1,2,2

7!/(3!4!)×5!+7!/((2!)^3.3!)×5!=4×7C3×5!

(β−α)/120=4×7C3−7C5=4×35−21=119.

OR

α = 7c5.5! = 2520

β=5^7-5c1*4^7+5c3*2^7+5c4 = 16800

(β-α)/120 = 119

15. PnC

Question

Words of length 10 are formed using the letters A, B, C, D, E, F, G, H, I, J. Let x be the number of such words where no letter is repeated; and let y be the number of such words where exactly one letter is repeated twice and no other letter is repeated. Then, y/9x = ?

Solution

Correct answer is 5

Explanation

The given, formed word is of length 10.
It is given that x is the number of words where no letter is repeated.
Also, it is given that y is the number of words where exactly one letter is repeated twice and no other letter is repeated. Therefore,

$x = 10!$
and
$y = 10C1 \times 10C2 \times 9C8 \times 8!$

Thus, $y/x = (10C1 \times 10C2 \times 9C8 \times 8!) / 10!$
Using $nCr = n! / [(n - r)!\, r!]$, we get
$y/x = [10 \times (10 \times 9 / 2) \times (9! / 1!)] \times 8! / 10!$
$= [10 \times 10 \times 9 / 2 \times 9! \times 8!] / 10!$
$= (10 \times 9 \times 8!) / (9 \times 2 \times 8!)$
$= 90 / 18$
$= 5$ [Using $n! = n(n - 1)(n - 2) \dots 1$]

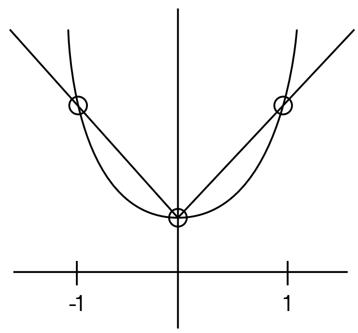
∴ Required sum = (19 + 29 + 37) = 85.

16. PnC

Question

Let f:R→R and g:R→R be respectively given by f(x)=|x|+1and g(x)=x^2+1. Define h:R→R by h(x)={max{f(x),g(x)}, if x≤0 and min{f(x),g(x)},if x>0.The number of points at which h(x) is not differentiable is

Solution



$x^2 + 1$, $x \in (-\infty, -1]$

$-x + 1$, $x \in [-1, 0]$

$x^2 + 1$, $x \in [0, 1]$

$x + 1$, $x \in [1, \infty)$

Hence not differentiable at x = -1, 0, 1

17. Calculus

Question

Consider the given equation.
∫√(1 + sin 4x) dx = −(√2 / 2) cos(ax + b) + c
Then, the value of a is:

A. √2
B. 2
C. 1/√2
D. 4
E. 8

Solution

Consider the given integral.

I=∫1+sin 4x dxI = \int \sqrt{1 + \sin 4x} \, dxI=∫1+sin 4xdx

=∫sin 22x+cos 22x+2sin 2x cos 2x dx= \int \sqrt{\sin^2 2x + \cos^2 2x + 2 \sin 2x \cos 2x} \, dx=∫sin22x+cos22x+2sin2xcos2xdx

=∫(sin 2x+cos 2x) dx= \int (\sin 2x + \cos 2x) \, dx=∫(sin 2x+cos 2x)dx

=2∫(12sin2x+12cos2x)dx= \sqrt{2} \int \left(\frac{1}{\sqrt{2}} \sin 2x + \frac{1}{\sqrt{2}} \cos 2x \right) dx=2∫(21sin2x+21cos2x)dx

=2∫sin(2x+π4)dx= \sqrt{2} \int \sin \left(2x + \frac{\pi}{4} \right) dx=2∫sin(2x+4π)dx

=−22cos(2x+π4)+c= -\frac{\sqrt{2}}{2} \cos \left(2x + \frac{\pi}{4} \right) + c=−22 cos(2x+4π)+c

Now, comparing it with the RHS of the given equation, we get

−22cos(ax+b)+c=−22cos(2x+π4)+c-\frac{\sqrt{2}}{2} \cos (ax + b) + c = -\frac{\sqrt{2}}{2} \cos (2x + \frac{\pi}{4}) + c−22cos(ax+b)+c=−22cos(2x+4π)+c

Therefore,

a=2a = 2a=2

Hence, option B is the required solution.

18. Sequence and Series

Question

What is the number of real solutions for the equation
x^(log(x+3) + log(x+4)) = 1?

Solution

The equation can be rewritten as:

log[x^(log(x+3) + log(x+4))] = log(1)

log(x) × (log(x + 3) + log(x + 4)) = 0

So, we have:

log(x) = 0 or log(x + 3) + log(x + 4) = 0

For log(x) = 0, x = 1.

For log(x + 3) + log(x + 4) = 0, we have:

log((x + 3)(x + 4)) = 0

$(x + 3)(x + 4) = e^0$

(x + 3)(x + 4) = 1

$x^2 + 4x + 3x + 12 = 1$

$x^2 + 7x + 11 = 0$

By using the quadratic formula,

x = [-7 ± √(49 - 44)] / 2

x = (-7 ± √5) / 2

When x = 1,

x^(log(x+3)+log(x+4)) = 1

Hence, x = 1 is a solution.

When x = (-7 ± √5) / 2

x = (-7 + √5)/2

⇒log((-7 + √5)/2) + log(((-7 + √5)/2) + 3) + log(((-7 + √5)/2) + 4)

= log(negative) + log(...)

We know that the logarithm of negative numbers is undefined.

Hence, x = (-7 + √5)/2 is not a real solution to the equation.

Thus, there is only one real solution to the equation.

19. Differentiation

Question

The absolute minimum of a degree 4 polynomial is -253 at x = -4, and the relative minimum is -3 at x = 1. If the relative minimum of the second derivative of the polynomial is about -56 at x = -1, what is the value of the relative maximum of the given polynomial?

Solution

Let's consider the polynomial be:

f(x)=ax4+bx3+cx2+dx+ef(x) = ax^4 + bx^3 + cx^2 + dx +

ef(x)=ax4+bx3+cx2+dx+e

The derivatives of this polynomial are:

f'(x)=4ax3+3bx2+2cx+df'(x) = 4ax^3 + 3bx^2 + 2cx + df'(x)=4ax3+3bx2+2cx+d

f''(x)=12ax2+6bx+2cf''(x) = 12ax^2 + 6bx + 2cf''(x)=12ax2+6bx+2c

f'''(x)=24ax+6bf'''(x) = 24ax + 6bf'''(x)=24ax+6b

It is given that the second derivative of the polynomial has a relative minimum of -56 at x=−1x = -1x=−1, then

f'''(0)=0f'''(0) = 0f'''(0)=0

24a(−1)+6b=024a(-1) + 6b = 024a(−1)+6b=0

6b=24a6b = 24a6b=24a

b=4ab = 4ab=4a

And,

12a(−1)2+6b(−1)+2c=−5612a(-1)^2 + 6b(-1) + 2c = -5612a(−1)2+6b(−1)+2c=−56

12a(−1)+6b(−1)+2c=−5612a(-1) + 6b(-1) + 2c = -5612a(−1)+6b(−1)+2c=−56

12a−6b+2c=−5612a - 6b + 2c = -5612a−6b+2c=−56

12a−(24a)+2c=−5612a - (24a) + 2c = -5612a−(24a)+2c=−56

Solving further,

−12a+2c=−56-12a + 2c = -56−12a+2c=−56

−6a+c=−28-6a + c = -28−6a+c=−28

c=−28+6ac = -28 + 6ac=−28+6a

Also, the polynomial has absolute minimums of −253-253−253 at x=−4x = -4x=−4, then

f'(−4)=0f'(-4) = 0f'(−4)=0

20. Calculus

Question

Suppose that

Box-I contains 8 red, 3 blue and 5 green balls,

Box-II contains 24 red, 9 blue and 15 green balls,

Box-III contains 1 blue, 12 green and 3 yellow balls,

Box-IV contains 10 green, 16 orange and 6 white balls.

A ball is chosen randomly from Box-I; call this ball
. If
is red then a ball is chosen randomly from Box-II, if
is blue then a ball is chosen randomly from Box-III, and if
is green then a ball is chosen randomly from Box-IV. The conditional probability of the event 'one of the chosen balls is white' given that the event 'at least one of the chosen balls is green' has happened, is equal to

Solution

A (one of the chosen ball is white)

B (at least one of the chosen ball is green)

$$P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)}$$

$$= \frac{\frac{5}{16} \times \frac{16}{32}}{\frac{5}{16} \times 1 + \frac{8}{16} \times \frac{15}{48} + \frac{3}{16} \times \frac{12}{16}}$$

$$= \frac{15}{156} = \frac{5}{52}$$