



Kunal Jha
 Course: GATE
 Computer Science Engineering(CS)

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MULTIPLE SUBJECT : ENGINEERING MATHEMATICS + GENERAL APTITUDE (GATE - 2020) - REPORTS

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SOLUTION REPORT

ALL(33) CORRECT(0) INCORRECT(0) SKIPPED(33)

Q. 1
[Have any Doubt ?](#)


Let x be a random variable with probability density function defined as,

$$f(x) = \begin{cases} 0.1 & \text{for } |x| \leq 1 \\ 0.4 & \text{for } 1 < |x| \leq 2 \\ 0 & \text{else} \end{cases}$$

then $P(-1 \leq x \leq 1)$ is

A

$$\frac{1}{5}$$

Correct Option

Solution :
 (d)

$$\begin{aligned} P(-1 \leq x \leq 1) &= \int_{-1}^1 (0.1) dx \\ &= 2 \times \frac{1}{10} = \frac{1}{5} \end{aligned}$$

B

$$\frac{4}{5}$$

C

$$\frac{1}{4}$$

D

$$\frac{3}{4}$$

[QUESTION ANALYTICS](#)

Q. 2
[Solution Video](#)
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Find the value of $\lim_{x \rightarrow 0} \frac{\log x}{\cot x}$

A

$$0$$

Correct Option

Solution :
 (a)

$$\begin{aligned} &\lim_{x \rightarrow 0} \frac{\log x}{\cot x} \\ &= \lim_{x \rightarrow 0} \frac{\frac{1}{x}}{-\csc^2 x} = -\lim_{x \rightarrow 0} \frac{\sin^2 x}{x} \quad \left(\text{from } \frac{0}{0}\right) \\ &= -\lim_{x \rightarrow 0} \frac{2 \sin x \cos x}{1} = 0 \quad \left(\text{from } \frac{0}{0}\right) \end{aligned}$$

B

$$1$$

C

$$\infty$$

D

$$0.5$$

[QUESTION ANALYTICS](#)

Q. 3
[Solution Video](#)
[Have any Doubt ?](#)


Two cards were drawn from a pack of 52 cards. The probability that they are a king and a queen is

A

$$\frac{16}{260}$$

B

$$\frac{16}{2550}$$

C

$$\frac{1}{13}$$

Correct Option

Solution :
(c)

$$\frac{4C_1 \cdot 4C_1}{52C_2} = \frac{16}{\frac{52 \times 51}{2 \times 1}} = \frac{16}{1326}$$

D $\frac{8}{1326}$

QUESTION ANALYTICS +

Q. 4

Solution Video

Have any Doubt ?



If $A = \begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix}$, $B = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ and $C = \begin{bmatrix} 0 & i \\ -i & 0 \end{bmatrix}$, where $i = \sqrt{-1}$, then which one of the following is correct?

A $BA = C$

B $AB = C$

C $A^2 + B^2 = C^2 = I_{2 \times 2}$

D $AB = -C$

Correct Option

Solution :
(d)

$$AB = \begin{bmatrix} i & 0 \\ 0 & i \end{bmatrix} \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} = \begin{bmatrix} 0 & -i \\ i & 0 \end{bmatrix} = -\begin{bmatrix} 0 & i \\ -i & 0 \end{bmatrix} = -C$$

QUESTION ANALYTICS +

Q. 5

Solution Video

Have any Doubt ?



$$\int_{-\pi}^{\pi} \cos(x) \cos(\sin(x)) dx$$

A 1

B 0

C $\cos 1$

D $\sin 1$

Correct Option

Solution :
(d)

$$\begin{aligned} u &= \sin x \\ du &= \cos x dx \\ x &= \frac{\pi}{2} \Rightarrow u = \sin \frac{\pi}{2} = 1 \\ x &= -\pi \Rightarrow u = \sin(-\pi) = 0 \\ \int_{-\pi}^{\pi} \cos(x) \cos(\sin(x)) dx &= \int_0^1 \cos u du \\ &= \left[\sin u \right]_0^1 \\ &= (\sin 1) - \sin(0) = \sin 1 \end{aligned}$$

QUESTION ANALYTICS +

Q. 6

Solution Video

Have any Doubt ?



There is no glory in war _____ the blood it _____.

A thinking, demands

B considering, sheds

Correct Option

Solution :
(b)

C worth, costs

D comparing, spills

QUESTION ANALYTICS



Q. 7

Solution Video

Have any Doubt?



Somesh _____ me coming to his table, he smiled and _____ me a chair.

A found, signaled

B met, sat

C looked, gave

D saw, offered

Correct Option

Solution :

(d)

QUESTION ANALYTICS



Q. 8

Solution Video

Have any Doubt?



The new Principal _____ stress on routine administration _____ than on academic matters and examination reforms.

A released, only

B began, even

C started, further

D laid, rather

Correct Option

Solution :

(d)

QUESTION ANALYTICS



Q. 9

Solution Video

Have any Doubt?



The rate of a certain chemical reaction is directly proportional to the square of the concentration of chemical A present and inversely proportional to the concentration of chemical B present. If the concentration of chemical B is increased by 100 percent, which of the following is closest to the percent change in the concentration of chemical A required to keep the reaction rate unchanged?

A 40% increase

Correct Option

Solution :

(a)

Put directly proportional in numerator and inversely proportional in denominator.

$$\text{Rate} = k \frac{A^2}{B}, \text{ (}k\text{ is a constant)}$$

We are told that B increased by 100%, hence in denominator we have $2B$. We want the rate to be the same. As rate is directly proportional to the Square of A, A should also increase (nominator) by x percent and increase of A is square should be 2.

Which means $x^2 = 2 \Rightarrow x = 1.41$, which is approximately 40% increase.

$$R = k \frac{A^2}{B} = k \frac{(1.4A)^2}{2B} = k \frac{2A^2}{2B}$$

B 50% decrease

C 40% decrease

D 100% decrease

QUESTION ANALYTICS



Q. 10

Solution Video

Have any Doubt?



For every positive integer n , the n^{th} term of sequence is given by $a_n = \frac{1}{n} - \frac{1}{(n+1)}$. What is the sum of the first 100 terms?

A 1

B $\frac{100}{101}$

Correct Option

Solution :

(b)

$$a_1 = \frac{1}{1} - \frac{1}{2}$$

$$a_2 = \frac{1}{2} - \frac{1}{3}$$

$$a_3 = \frac{1}{3} - \frac{1}{4}$$

$$a_{99} = \frac{1}{99} - \frac{1}{100}$$

$$a_{100} = \frac{1}{100} - \frac{1}{101}$$

Adding all

$$1 - \frac{1}{2} + \frac{1}{2} - \frac{1}{3} + \frac{1}{3} - \frac{1}{4} + \dots + \frac{1}{99} - \frac{1}{100} + \frac{1}{100} - \frac{1}{101} = 1 - \frac{1}{101} = \frac{100}{101}$$

So when we add all the terms, what is left is

$$1 - \frac{1}{101} = \frac{100}{101}$$

C 25

D $\frac{99}{100}$

QUESTION ANALYTICS





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Q. 11
[Have any Doubt ?](#)


Let A be a 2×2 matrix such that, $A = \begin{vmatrix} 1 & 1 \\ 1 & -1 \end{vmatrix}$. Then product of eigen values of matrix A^{10} is

1024
[Correct Option](#)
Solution :

(1024)

Characteristic equation,

$$\begin{vmatrix} 1-\lambda & 1 \\ 1 & -1-\lambda \end{vmatrix} = 0$$

$$\Rightarrow -(1-\lambda)(1+\lambda) - 1 = 0$$

$$\Rightarrow -(1-\lambda^2) - 1 = 0$$

$$\Rightarrow -1 + \lambda^2 - 1 = 0$$

$$\Rightarrow \lambda^2 = 2$$

$$\Rightarrow \lambda = \pm\sqrt{2}$$

 So eigen values of A are $\pm\sqrt{2}$

 Eigen values of A^{10} are $(\pm\sqrt{2})^{10} = 32, 32$

 So product of eigen values of $A^{10} = 32 \times 32 = 1024$
[QUESTION ANALYTICS](#)

Q. 12
[Solution Video](#)
[Have any Doubt ?](#)


Three groups of children contain respectively 3 girls and 1 boy, 2 girls and 2 boys, 1 girl and 3 boys. One child is selected at random from each group. The probability of selecting 1 girl and 2 boys is _____. (Upto 2 decimal places)

(0.41) [0.38 - 0.44]
[Correct Option](#)
Solution :

(0.41) [0.38 - 0.44]

There are 3 ways of selecting 1 girl and 2 boys.

	Group 1	Group 2	Group 3	Probability
Case I	Girl	Boy	Boy	$\frac{3}{4} \times \frac{2}{4} \times \frac{3}{4} = \frac{18}{64}$
Case II	Boy	Girl	Boy	$\frac{1}{4} \times \frac{2}{4} \times \frac{3}{4} = \frac{6}{64}$
Case III	Boy	Boy	Girl	$\frac{1}{4} \times \frac{2}{4} \times \frac{1}{4} = \frac{2}{64}$

$$\text{Total probability} = \frac{18}{64} + \frac{6}{64} + \frac{2}{64} = \frac{26}{64} = 0.40625 \simeq 0.41$$

[QUESTION ANALYTICS](#)

Q. 13
[Solution Video](#)
[Have any Doubt ?](#)


In the mean value theorem $f(b) - f(a) = (b - a) f'(c)$ determining c lying between a and b, if $f(x) = x(x - 1)(x - 2)$, $a = 0$ and $b = \frac{1}{2}$. (Upto 2 decimal places)

(0.23) [0.22 - 0.24]
[Correct Option](#)
Solution :

(0.23) [0.22 - 0.24]

$$f(a) = 0$$

$$f(b) = \frac{1}{2} \left(-\frac{1}{2} \right) \left(-\frac{3}{2} \right) = \frac{3}{8}$$

$$f'(x) = 3x^2 - 6x + 2$$

$$f'(c) = 3c^2 - 6c + 2$$

 Substituting in, $f(b) - f(a) = (b - a) f'(c)$

$$\frac{3}{8} - 0 = \left(\frac{1}{2} - 0 \right) (3c^2 - 6c + 2)$$

 or $12c^2 - 24c + 5 = 0$

$$\text{whence } c = \frac{24 \pm \sqrt{(24)^2 - 12 \times 5 \times 4}}{24}$$

$$= 1 \pm 0.764 = 1.764; 0.236$$

Hence,

$$c = 0.236, \text{ since it only lies between 0 and } \frac{1}{2}.$$

Q. 14

Solution Video

Have any Doubt ?



4 men and 6 women can complete a work in 8 days, while 3 men and 7 women can complete it in 10 days. The number of days that will be taken by 10 women to complete it is _____.

40

Correct Option

Solution :

(40)

Let 1 man's 1 day's work = x and 1 woman's 1 day's work = y

$$\text{Then, } 4a + 6b = \frac{1}{8}$$

$$3a + 7b = \frac{1}{10}$$

$$\text{On solving, we get } b = \frac{1}{400}$$

$$\therefore 10 \text{ women's 1 day's work} = \frac{10}{400} = \frac{1}{40}$$

\therefore 10 women will finish the work in 40 days.

Q. 15

Solution Video

Have any Doubt ?



The ratio of a two digit number to a number formed by reversing its digits is 4 : 7. The sum of all the numbers of all such pairs is _____.

330

Correct Option

Solution :

(330)

Number = $10a + b$ and its reverse = $10b + a$

$$\text{So, } (10a + b) : (10b + a) = 4 : 7 \Rightarrow 7(10a + b) = 4(10b + a) \Rightarrow 70a + 7b = 40b + 4a \Rightarrow 66a = 33b \Rightarrow b = 2a$$

So, numbers are 12, 24, 36, 48.

$$\text{Sum} = 12 + 24 + 36 + 48 + 21 + 42 + 63 + 84 = 330$$

Q. 16

Solution Video

Have any Doubt ?



How many different possible arrangements can be obtained from the letters A, T, G, M, I, I, and T, such that there is at least one character between both T's?

900

Correct Option

Solution :

(900)

There are 7 letters A, T, G, M, I, I, and T with I and T repeated twice.

Hence total arrangements/permuations of letters = $7!/(2! \times 2!) = 1260$.

Now, let us say that the two "I" are always together.

So now we have 6 letters G, M, A, T, II, T with T repeated twice.

Hence total arrangements/permuations of letters = $6!/(2!) = 360$.

$$\therefore \text{Required arrangements} = 1260 - 360 = 900$$

Q. 17

Solution Video

Have any Doubt ?



Consider the system of linear equations given below:

$$-2x + y + z = l$$

$$x - 2y + z = m$$

$$x + y - 2z = n$$

If $l + m + n = 0$, then the system of equations has

 A No solution B Trivial solutions C Unique solution D Infinitely many solutions

Correct Option

Solution :

(d)

$$AX = B$$

Augmented matrix, $[A : B] = \begin{bmatrix} -2 & 1 & 1 & : & l \\ 1 & -2 & 1 & : & m \\ 1 & 1 & -2 & : & n \end{bmatrix}$

$R_3 \rightarrow R_3 + R_2 + R_1$:

$$[A : B] = \begin{bmatrix} -2 & 1 & 1 & : & l \\ 1 & -2 & 1 & : & m \\ 0 & 0 & 0 & : & l+m+n \end{bmatrix}$$

Since,

$$l+m+n = 0$$

Rank of $[A : B] = 2$

Rank of $[A] = \text{Rank of } [A : B] = 2 < 3$ (Number of variables)

\Rightarrow Infinitely many solutions are possible.

QUESTION ANALYTICS

Q. 18

Have any Doubt ?



A matrix $A = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$ has three linearly independent eigen vectors X_1, X_2, X_3 corresponding to the three eigen values 1, 2 and 3 respectively. Which of the following is correct?

A X_1 and X_3 are orthogonal

B X_2 and X_3 are orthogonal

C X_1 and X_2 are orthogonal

D None of these

Correct Option

Solution :

(d)

For $\lambda = 1$

$$\begin{bmatrix} 0 & 0 & -1 \\ 1 & 1 & 1 \\ 2 & 2 & 2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = 0$$

$$X_1 = c_1 \begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix}$$

For $\lambda = 2$

$$\begin{bmatrix} -1 & 0 & -1 \\ 1 & 0 & 1 \\ 2 & 2 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = 0$$

$$\begin{aligned} x_1 + x_3 &= 0 \\ 2x_1 + 2x_2 + x_3 &= 0 \end{aligned}$$

$$X_2 = c_2 \begin{bmatrix} -2 \\ 1 \\ 2 \end{bmatrix}$$

For $\lambda = 3$

$$\begin{bmatrix} -2 & 0 & -1 \\ 1 & -1 & 1 \\ 2 & 2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = 0$$

$$x_1 = -x_2$$

$$x_1 = \frac{-1}{2}x_3$$

$$X_3 = c_3 \begin{bmatrix} -1 \\ 1 \\ 2 \end{bmatrix}$$

Since,

$$X_1^T X_2 \neq 0$$

$$X_2^T X_3 \neq 0$$

$$X_3^T X_1 \neq 0$$

None of the above is correct.

QUESTION ANALYTICS

Q. 19

Solution Video

Have any Doubt ?



A function is defined by $f(x) = 2x^3 - 3x^2 - 12x + 5$ for $-2 \leq x \leq 3$. Which one of the following statements is true about this function?

A function is decreasing for $(-2, -1)$.

B function has a minima for $x = -1$.

C function has a maxima for $x = 2$.

Correct Option

D function is decreasing for $(-1, 2)$.

Solution :

(d)

$$f(x) = 2x^3 - 3x^2 - 12x + 5$$

$$f'(x) = 6x^2 - 6x - 12$$

For minima/maxima, $f'(x) = 0$

$$6x^2 - 6x - 12 = 0$$

$$x^2 - x - 2 = 0$$

$$(x+1)(x-2) = 0$$

$$x = -1, 2$$

$$f''(x) = 12x - 6$$

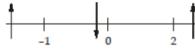
$$f''(-1) = -12 - 6 = -18 < 0 \Rightarrow \text{maxima}$$

$$f''(2) = 24 - 6 = 18 > 0 \Rightarrow \text{minima}$$

The function has maxima at $x = -1$ and minima at $x = 2$.

Critical point $(-1, 2)$ draw plot on line graph:

Since $0 \in (-1, 2)$ and $f'(0) = 6 \times 0^2 - 6 \times 0 - 12 = -12 < 0$



The function is decreasing between -1 and 2 .

QUESTION ANALYTICS



Q. 20

Have any Doubt ?



Correct Option

A 0.5

Solution :

(a)

Given,

$$\lim_{x \rightarrow \frac{\pi}{4}} \frac{\sec^2 x - 2 \tan x}{1 + \cos 4x} : \frac{0}{0} \text{ Form}$$

Applying L' hospital rule

$$\begin{aligned} &= \lim_{x \rightarrow \frac{\pi}{4}} \frac{\frac{d}{dx}(\sec^2 x - 2 \tan x)}{\frac{d}{dx}(1 + \cos 4x)} \\ &= \lim_{x \rightarrow \frac{\pi}{4}} \frac{(2 \sec x \sec x \tan x - 2 \sec^2 x)}{-4 \sin 4x} \\ &= \lim_{x \rightarrow \frac{\pi}{4}} \frac{\sec^2 x (\tan x - 1)}{-2 \sin 4x} : \frac{0}{0} \text{ Form} \end{aligned}$$

Applying L' hospital's rule

$$\begin{aligned} &= \lim_{x \rightarrow \frac{\pi}{4}} \frac{2 \sec x \sec x \tan x (\tan x - 1) + \sec^2 x \sec^2 x}{-8 \cos 4x} \\ &= \frac{2.2.1(1-1) + 2.2}{-8(-1)} = \frac{1}{2} \end{aligned}$$

B 0.25

C 1

D 2

QUESTION ANALYTICS





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OVERALL ANALYSIS COMPARISON REPORT **SOLUTION REPORT**

ALL(33) CORRECT(0) INCORRECT(0) SKIPPED(33)

Q. 21

Solution Video

Have any Doubt ?



How many different value of x exist for the following equation:

$$\begin{vmatrix} x+2 & 2x+3 & 3x+4 \\ 2x+3 & 3x+4 & 4x+5 \\ 3x+5 & 5x+8 & 10x+17 \end{vmatrix} = 0$$

A 2

Correct Option

Solution :

(a)

Operating $R_3 - (R_1 + R_2)$ we get

$$\begin{vmatrix} x+2 & 2x+3 & 3x+4 \\ 2x+3 & 3x+4 & 4x+5 \\ 0 & 1 & 3x+8 \end{vmatrix} = 0 \quad (\text{Operating } R_2 - R_1 \text{ and } R_1 + R_3)$$

or $\begin{vmatrix} x+2 & 2x+4 & 6x+12 \\ x+1 & x+1 & x+1 \\ 0 & 1 & 3x+8 \end{vmatrix} = 0$

or $(x+1)(x+2) \begin{vmatrix} 1 & 2 & 6 \\ 1 & 1 & 1 \\ 0 & 1 & 3x+8 \end{vmatrix} = 0$

To bring one more zero in C_1 , operate $R_1 - R_2$.

$$\therefore (x+1)(x+2) \begin{vmatrix} 0 & 1 & 5 \\ 1 & 1 & 1 \\ 0 & 1 & 3x+8 \end{vmatrix} = 0$$

Now expand by C_1 ,

$$\therefore -(x+1)(x+2)(3x+8-5) = 0 \text{ or } -3(x+1)(x+2)(x+1) = 0$$

Thus, $x = -1, -1, -2$.

B 3

C 1

D 4

QUESTION ANALYTICS



Q. 22

Solution Video

Have any Doubt ?



Mammals cannot digest cellulose and therefore cannot directly obtain glucose from wood. Mushrooms can, however, and some mushrooms use cellulose to make highly branched polymers, the branches of which are a form of glucose called beta-glucans. Beta-glucan extracts from various types of mushrooms slow, reverse, or prevent the growth of cancerous tumors in mammals, and the antitumor activity of beta-glucans increases as the degree of branching increases. These extracts prevent tumor growth not by killing cancer cells directly but by increasing immune-cell activity.

Which one of the following is most strongly supported by the information above?

A Mammals obtain no beneficial health effects from eating cellulose .

B If extracts from a type of mushroom slow, reverse, or prevent the growth of cancerous tumors in mammals, then the mushroom is capable of using cellulose to make beta-glucans.

C The greater the degree of branching of beta-glucans, the greater the degree of immune-cell activity it triggers in mammals

Correct Option

Solution :

(c)

- Some mushrooms use cellulose to make highly branched polymers, the branches of which are a form of glucose called beta-glucans.
- Beta-glucan extracts from various types of mushrooms slow, reverse, or prevent the growth of cancerous tumors in mammals
- The antitumor activity of beta-glucans increases as the degree of branching increases.
- These extracts prevent tumor growth NOT by killing cancer cells directly BUT BY increasing immune-cell activity.

The premises tell us that the antitumor activity increases as degree of branching increases. They also tell us that antitumor activity is "increasing immune-cell activity". So we can deduce that degree of immune cell activity increases as degree of branching increases.

Thus option (c) and is correct.

D Immune-cell activity in mammals does not prevent tumor growth by killing cancer cells

QUESTION ANALYTICS



Q. 23

[▶ Solution Video](#)[Have any Doubt ?](#)

Not all life depends on energy from sunlight. Microbial life has been found in bedrock more than five kilometers below the surface of the Earth, and bacteria have been found on the deep ocean floor feeding on hydrogen and other gases rising from the interior of the Earth through vents in the ocean floor. The statements above, if true, best support which of the following as a conclusion?

A The location in the bedrock where microbial life was found was not near a system of volcanic vents through which hydrogen and other gases rose from the interior of the Earth.

B Bacteria are able to exist at the molten center of the Earth.

C A thorough survey of a planet's surface is insufficient to establish beyond a doubt that the planet contains no life

Correct Option

Solution :

(c)
C is correct here. It captures the essence of the premises. Since organisms have been found to survive beyond the surface of earth, it could be the case of any other planet as well. Hence, a survey on the surface of any planet is insufficient to ascertain the non-existence of life in that planet

D Life probably exists on Sun-orbiting comets, which are cold agglomerations of space dust and frozen gases

[QUESTION ANALYTICS](#)

Q. 24

[▶ Solution Video](#)[Have any Doubt ?](#)

A solution of salt and water is 10 percent salt by weight. After a period of time under pressure and heat, a portion of the water evaporates so that the solution is 40 percent salt by weight. What is the ratio of the initial weight of water to the final weight of water in the solution?

A 6 to 1

Correct Option

Solution :

(a)
Say our solution is 100 units by weight. Then there is 10 units salt and 90 units water.
After the evaporation, these 10 units of salt are now 40% of the solution so the total volume is

$$\frac{10}{40\%} = \frac{10 \times 100}{40} = 10 \times 2.5 = 25 \text{ units}$$

So we have $100 - 10 = 90$ units of water at the start and $25 - 10 = 15$ units of water at the end.
So the ratio is $90 : 15 = 6 : 1$

B 1 to 4

C 1 to 3

D 1 to 6

[QUESTION ANALYTICS](#)

Q. 25

[▶ Solution Video](#)[Have any Doubt ?](#)

Shalini was not _____ by the criticism and paid no _____ even when her best friend talked against her.

A bothered, money

B troubled, mind

C threatened, warning

D deterred, heed

Correct Option

Solution :

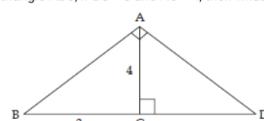
(d)

[QUESTION ANALYTICS](#)

Q. 26

[▶ Solution Video](#)[Have any Doubt ?](#)

In triangle ABC, if $BC = 3$ and $AC = 4$, then what is the length of segment CD?



A 3

B $\frac{15}{4}$

C 5

D $\frac{16}{3}$

Correct Option

Solution :

(d)

Important property : perpendicular to the hypotenuse will always divide the triangle into two triangles with the same properties as the original triangle.

Thus, the perpendicular AC divides right triangle ABD into two similar triangles ACB and DCA (which are also similar to big triangle ABD). Now, in these three triangles the ratio of the corresponding sides will be equal (corresponding sides are the sides opposite the same angles)

$$\text{So, } \frac{CD}{AC} = \frac{AC}{BC}$$

$$\frac{CD}{4} = \frac{4}{3}$$

$$CD = \frac{16}{3}$$

QUESTION ANALYTICS



Q. 27

Have any Doubt ?



A matrix $B = A^8 - 11A^7 - 4A^6 + A^5 + A^4 - 11A^3 - 4A^2 + A + I$

If $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$ then the determinant of the matrix B is _____.

1

Correct Option

Solution :

(1)

Given,

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$$

The characteristic equation of A is

$$|A - \lambda I| = \begin{bmatrix} 1-\lambda & 2 & 3 \\ 2 & 4-\lambda & 5 \\ 3 & 5 & 6-\lambda \end{bmatrix}$$

$$= (1-\lambda)[(4-\lambda)(6-\lambda)-25] - 2[2(6-\lambda)-15] + 3[10-3(4-\lambda)]$$

$$\lambda^3 - 11\lambda^2 - 4\lambda + 1 = 0$$

$$\therefore A^3 - 11A^2 - 4A + I = 0$$

Given,

$$B = A^8 - 11A^7 - 4A^6 + A^5 + A^4 - 11A^3 - 4A^2 + A + I$$

$$= A^3(A^3 - 11A^2 - 4A + I) + A(A^3 - 11A^2 - 4A + I) + I$$

$$B = I$$

\therefore Determinant of matrix B is 1.

QUESTION ANALYTICS



Q. 28

Have any Doubt ?



If probability density function of a random variable X is

$f(x) = x^3$ for $-1 \leq x \leq 1$, and

= 0 for any other value of x

then, the probability $P\left(-\frac{1}{2} \leq x \leq \frac{1}{2}\right)$ is _____.

0

Correct Option

Solution :

0

Given,

$$f(x) = x^3 \quad -1 \leq x \leq 1$$

$$= 0 \quad \text{elsewhere}$$

$$P\left(-\frac{1}{2} \leq x \leq \frac{1}{2}\right) = \int_{-\frac{1}{2}}^{\frac{1}{2}} f(x) dx = \int_{-\frac{1}{2}}^{\frac{1}{2}} x^3 dx = 0 \quad [\text{because it is odd function}]$$

QUESTION ANALYTICS



Q. 29

Have any Doubt ?



The probability of a shooter hitting a target is $\frac{3}{4}$. The minimum number of times must he fire so that the probability of hitting the target atleast once is more than 0.99 will be

4

Correct Option

Solution :

(4)

Given,

$$p = \frac{3}{4}; q = \frac{1}{4}$$

$$p(X = x) = n_{C_x} q^{n-x} p^x$$

Now, given that

P(hitting the target atleast once) > 0.99

i.e.

$$P(x \geq 1) > 0.99$$

Therefore,

$$1 - P(x = 0) > 0.99$$

$$1 - n_{C_0} \left(\frac{1}{4}\right)^n > 0.99$$

$$n_{C_0} \left(\frac{1}{4}\right)^n < 0.01$$

i.e.

$$\left(\frac{1}{4}\right)^n < 0.01$$

$$4^n > \frac{1}{0.01}$$

$$4^n > 100$$

The minimum value of n to satisfy the given condition is 4.

QUESTION ANALYTICS



Q. 30

► Solution Video

⌚ Have any Doubt ?



How many five digit numbers can be formed from 1, 2, 3, 4, 5 (without repetition), when the digit at the unit's place must be greater than that in the ten's place?

60

Correct Option

Solution :

(60)

According to the question, the digit in the unit's place should be greater than that in the ten's place.

Hence, if 5 is placed at the unit place, then remaining four places can be filled with any of the four digits 1, 2, 3 and 4, hence total numbers = $4!$

However, if digit 4 is placed at the unit place then 5 cannot occupy the ten's place.

Hence, the digits at the ten's place can be 1, 2 or 3. This can happen in 3 ways.

The remaining 3 digits can be filled in the remaining three places in $3!$ ways.

Hence, in all we have $(3 \times 3!)$ numbers ending in 4.

Similarly, if we have 3 in the unit's place, the ten's place can be either 1 or 2.

This can happen in 2 ways. The remaining 3 digits can be arranged in the remaining 3 places in $3!$ ways.

Hence, we will have $(2 \times 3!)$ numbers ending in 3. Similarly, we have $3!$ numbers ending in 2 and no number ending with 1. Hence total number of numbers = $4! + 3 \times 3! + 2 \times 3! + 3! = 24 + 18 + 12 + 6 = 60$.

QUESTION ANALYTICS



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Q. 31
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Adam and John simultaneously begin to write out a booklet containing 537 lines. Adam starts with the first line, writing at the rate of 100 lines an hour, and John starts with the last line and moves backward, proceeding at the rate of 50 lines an hour. The line at which they will meet is _____.

358

[Correct Option](#)
Solution :

(358)

Adam writes at twice the rate of John. Therefore in the time that John covers x , Adam will cover $2x$.

They will meet at $(2/3)$ of the length of the book.

They will meet at page $537 \times 2/3 = \text{page } 358$


Q. 32
[▶ Solution Video](#)
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There are twenty-five identical marbles to be divided among four brothers such that each one of them gets no less than three marbles. The number of ways in which the marbles can be divided among four brothers is _____.

560

[Correct Option](#)
Solution :

(560)

Since each brother must get at least 3 marbles, let's first distribute the marbles such that each has 3. This makes us lose $3 \times 4 = 12$ marbles.

Now the remaining 13 marbles must be distributed in such a way that any one can get any share. Alternatively this can be calculated using the formula $\binom{n+r-1}{r-1}$ when n identical items are distributed among r participants such that any participant may receive any number of items.

$$(13+4-1)\binom{16}{3} = 560$$


Q. 33
[▶ Solution Video](#)
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Two oranges, three bananas and four apples cost ₹ 15. Three oranges, two bananas and one apple cost ₹ 10. I bought 3 oranges, 3 bananas and 3 apples. The amount in ₹ paid by me is _____.

15

[Correct Option](#)
Solution :

(15)

It is given that

$$2O + 3B + 4A = 15 \quad \dots\dots(1)$$

$$3O + 2B + A = 10 \quad \dots\dots(2)$$

The answer to this question seems to be 'cannot be determined' as we are given three variables but we can form two equations only. But the question is not asking about the individual price of 3 oranges, 3 bananas and 3 apples but it asks the cost of $3O + 3B + 3A$. For that, if we add the two equations, we get

$$5O + 5B + 5A = 25$$

$$O + B + A = 5$$

$$\therefore 3O + 3B + 3A = 3 \times 5 = 15$$

