

JEE-Main-24-01-2025 (Memory Based)
[EVENING SHIFT]

Physics

Question: If the diameter of earth is reduced to $\frac{1}{3}$ of present diameter keeping the mass same then the ratio of new gravity to old gravity is

Options:

- (a) 9
- (b) $\frac{1}{9}$
- (c) 3
- (d) $\frac{1}{3}$

Answer: (a)

Question: A solid sphere and a hollow sphere of identical dimensions (mass = m , Radius = R) was sliding down an inclined plane without slipping. Time taken by solid sphere = t_1 and time taken by hollow sphere = t_2 . Identify the correct relation b/w them

Options:

- (a) $t_1 > t_2$
- (b) $t_1 < t_2$
- (c) $t_1 = 2t_2$
- (d) $t_1 = t_2$

Answer: (b)

Question: A solid sphere rolls without slipping on a horizontal plane. What is ratio of translational kinetic energy to the rotational kinetic energy of the sphere.

Options:

- (a) $\frac{4}{3}$
- (b) $\frac{3}{4}$
- (c) $\frac{2}{5}$
- (d) $\frac{5}{2}$

Answer: (d)

Question: A cone is rotating about vertical axis and a mass ' m ' is attached to its end. ($\omega = 2\pi$ rev/s). Find tension force in the mass is ' η ' ml. Find ' η '

Options:

- (a) 16
- (b) 12
- (c) 13
- (d) 11

Answer: (a)

Question: If E, p, m and c denote the energy, linear momentum, mass and speed of light, then the equation representing the correct relation could be

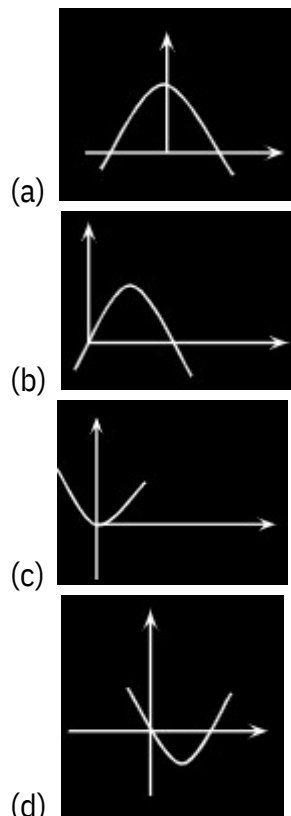
Options:

- (a) $E^2 = p^2c^2 + m^2c^4$
- (b) $E^2 = pc^2 + m^2c^4$
- (c) $E = p^2c^2 + m^2c^2$
- (d) $E^2 = pc^2 + m^2c^2$

Answer: (a)

Question: Plot the graph of k & vs displacement where $x(t) = x_0 \sin^2(\omega t)$

Options:



Answer: (b)

Question: The position of a particle varies with time as

The magnitude and direction of velocity at $t = \frac{1}{2}$ s is

Options:

- (a) $5\sqrt{2}$ m/s, -45° with +X axis
- (b) 5 m/s, -45° with +X axis
- (c) $5\sqrt{2}$ m/s, -45° with +Y axis
- (d) 5 m/s, $+45^\circ$ with +Y axis

Answer: (a)

$$\vec{r} = (5t^2 \hat{i} - 5t \hat{j}) \text{ m.}$$

Question: One sphere is charged with $Q = 4 \times 10^{-8}$ C and other is initially uncharged.

After connecting them with wire they experience a force 9×10^{-3} N. find the distance between them. (Both are identical spheres)



Options: (a) 400 m (b) 100 m (c) 250 m (d) 200 m Answer: (d) Question: Which graph shows a relation between Celsius scale & Fahrenheit scale Options:



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- (a)
- (b)
- (c)
- (d)

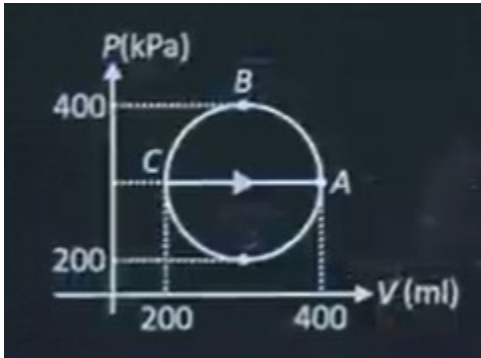
Question: Arrange the following in the correct order of wavelength ultraviolet (λ_1), x-rays (λ_2), Radio waves (λ_3), Gamma rays (λ_4)

Options:

(a) $\lambda_4 < \lambda_2 < \lambda_1 < \lambda_3$ (b) $\lambda_4 < \lambda_1 < \lambda_2 < \lambda_3$ (c) $\lambda_4 < \lambda_2 < \lambda_3 < \lambda_1$ (d) $\lambda_4 < \lambda_3 < \lambda_2 < \lambda_1$

Answer: (a)

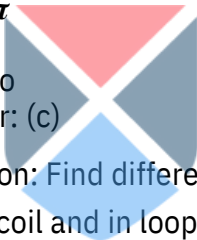
Question: In given thermodynamic process (Circular in nature), find magnitude of work done by the gas in cycle ABCA.



Options:

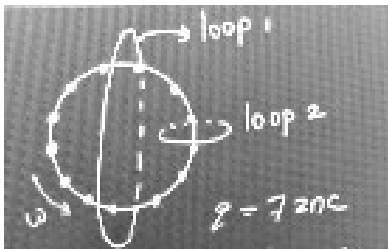
- (a) 2π
- (b) 10π
- (c) 5π
- (d) Zero

Answer: (c)



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Question: Find difference in current enclosed in both loops $|i_1 - i_2|$. Loop 1 encloses entire coil and in loop 2 single segment is enclosed.

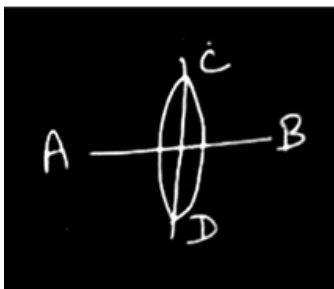


Options:

- (a) $\frac{36\omega}{2\pi} nA$
- (b) $\frac{36\omega}{\pi} nA$
- (c) $\frac{72\omega}{4\pi} nA$
- (d) $\frac{72\omega}{4\pi} mA$

Answer: (b)

Question: Thin equiconvex lens is divided into equal parts, by plane AB and CD and original power of lens is 4D find power of each piece.



Options:

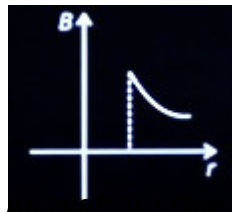
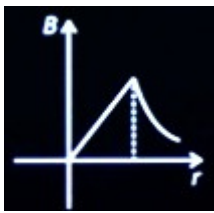
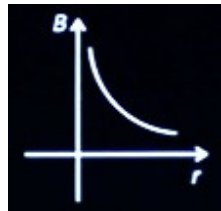
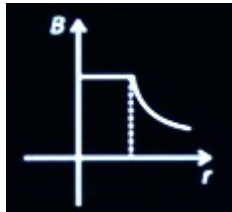
- (a) 4D

- (b) 1D
- (c) 2D
- (d) 8D

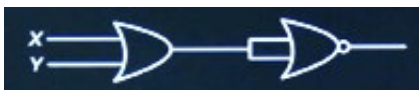
Answer: (c)

Question: There is a line solid cylinder carrying current along the axis with uniform current density. Variation of magnetic field (B) with radial distance from axis of cylinder (r) is best denoted by

Options:



Question: For which of the following input, output of the circuit is zero (A) $x=0, y=0$ (B) $x=0, y=1$ (C) $x=1, y=0$ (D) $x=1, y=1$



- Options: (a) A only
 (b) A, B, C only
 (c) B, C D only
 (d) A and C only

Answer: (c)

Question: There is a conical pendulum of mass m and length l making 60° with vertical. Then tension in thread is

Options:

- (a) mg
- (b) $mg/2$
- (c) $2mg$
- (d) $3mg$

Answer: (c)

Question: A drone having a film of area 4 cm^2 is at a height of 18 km from ground. It covers an area of 400 km^2 on the ground. The focal length of the lens used in lens is

Options:

- (a) $18 \times 10^{-6}\text{ km}$
- (b) $18 \times 10^6\text{ km}$
- (c) $18 \times 10^3\text{ km}$
- (d) 18 km

Answer: (a)

Question: The excess pressure required to decrease the volume of water sample by 0.2% is $P \times 10^5\text{ Pa}$. If the bulk modulus of water is $1.25 \times 10^9\text{ Pa}$. then the value of P is _____.

Options:

- (a) 2.5
- (b) 25
- (c) 3.5
- (d) 35

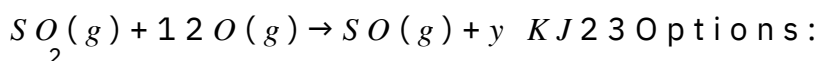
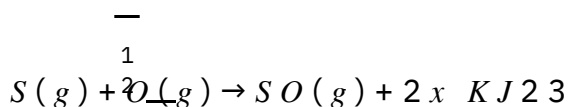
Answer: (b)



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Chemistry

Question: Consider the following reaction



- Options:
- (a) $-(x + y)$
 - (b) $-(2x + y)$
 - (c) x/y
 - (d) $y - 2x$

Answer: (d)

Question: The conditions and consequences that favour the $t_{2g}^3 e_g^1$ configuration in a metal complex are

- Options:
- (a) Strong field ligand; High spin complex
 - (b) Weak field ligand; High spin complex
 - (c) Strong field ligand; Low spin complex
 - (d) Weak field ligand; Low spin complex

Answer: (b)

Question: When ethane-1, 2-diammine is progressively added to aqueous solution of Nickel (II) chloride the sequences of colour change observed will be:

- Options:
- (a) Pale Blue \rightarrow Blue \rightarrow Green \rightarrow Violet
 - (b) Violet \rightarrow Blue \rightarrow Pale Blue \rightarrow Green
 - (c) Pale Blue \rightarrow Blue \rightarrow Violet \rightarrow Green
 - (d) Green \rightarrow Pale Blue \rightarrow Blue \rightarrow Violet

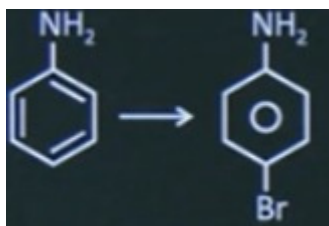
Answer: (d)

Question: S-I: The first ionisation energy of Pb is greater than that of Sn.

S-II: The first ionisation energy of Ge is greater than that of Si.

- Options:
- (a) S-I and S-II both are correct
 - (b) S-I is correct and S-II incorrect
 - (c) S-I is incorrect and S-II correct
 - (d) S-I and S-II both are incorrect

Answer: (b)



Question: Above conversion can be

done by using which reagents among the following

Options:

(a) $\text{Fe}/\text{Br}_2, \text{H}_2\text{O}(\Delta), \text{H}_2\text{SO}_4$

(b) $\text{Ac}_2\text{O}, \text{H}_2\text{SO}_4, \text{Br}_2, \text{NaOH}$

(c) $\text{Ac}_2\text{O}, \text{Fe}/\text{Br}_2, \text{H}_2\text{O}/\text{H}^+$

(d) $\text{Ac}_2\text{O}, \text{Br}/\text{Fe}, \text{NaOH}$

Answer: (c)

Question: Match the column and select the correct option.

Column-I (Ionic species)	Column-II (Spin only magnetic moment (BM))
A. Sc^{3+}	(P) 2.84
B. Ti^{2+}	(Q) 0
C. V^{2+}	(R) 5.92
D. Mn^{2+}	(S) 3.87

Options:

(a) A-P, B-Q, C-R, D-S (b) A-R, B-S, C-P, D-Q (c) A-Q, B-P, C-S, D-R (d) A-Q, B-P, C-R, D-S

Answer: (c) Question: In a compound containing 54.2% carbon, 9.2% of hydrogen and rest are oxygen. What is the molecular formula of compound, if molecular mass is 132 g/mol? Options: (a) $\text{C}_6\text{H}_{12}\text{O}_3$ (b) $\text{C}_4\text{H}_{12}\text{O}_3$ (c) $\text{C}_4\text{H}_{12}\text{O}_6$ (d) $\text{C}_6\text{H}_{13}\text{O}_6$ Answer: (a)

Question: Given below are two statements: Statement-I: First Ionisation energy of Ge is greater than Si. Statement-II: First Ionisation energy of Pb is greater than Sn In the light of the above statements, choose the most appropriate answer from the options given below: Options:

(a) Both Statement I and Statement II are incorrect

- (b) Statement I is correct but Statement II is incorrect
 (c) Both Statement I and Statement II are correct
 (d) Statement I is incorrect but Statement II is correct

Answer: (d)

Question: Arrange the following in order of decreasing wavelength.

- a: Microwave b: Ultraviolet
 c: Infrared d: X-rays

Options:

(a) $a > b > c > d$ (b) $d > c > b > a$ (c) $a > c > b > d$ (d) $c > a > b > d$ Answer: (c) Question: Calculate the degree of unsaturation of Hydrocarbon having Molar mass 80 g/mol containing 90% Carbon. Options:



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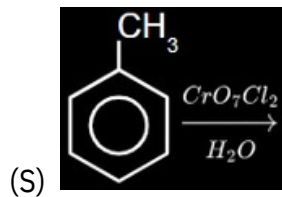
- (a) 3
 (b) 2
 (c) 4
 (d) 6

Answer: (a)

Question: Match the following

List-I (Name)	List-II (Reaction)
A. Gettermann reaction	(P) $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl} \xrightarrow[\text{BaSO}_4]{\text{H}_2/\text{Pd}}$
B. Stephan's reaction	(Q) $\text{C}_6\text{H}_5\text{Cl} \xrightarrow[\text{HCl}]{\text{CO}}$
C. Rosenmund reaction	(R) $\text{R}-\text{C}-\text{N} \xrightarrow[\text{HCl}]{\text{SnCl}_2}$

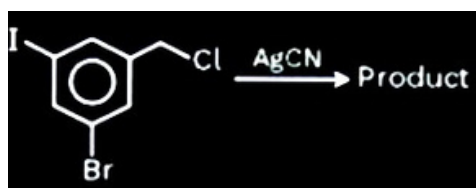
D. Etard Reaction



Options:

(a) A-Q, B-R, C-P, D-S (b)
A-R, B-P, C-Q, D-S (c) A-
Q, B-P, C-R, D-S (d) A-Q,
B-R, C-S, D-Q

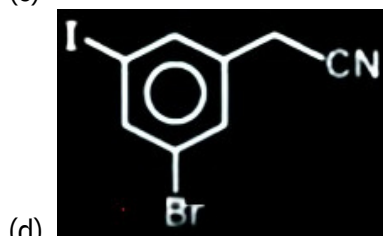
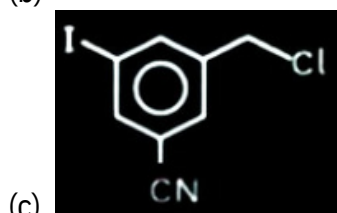
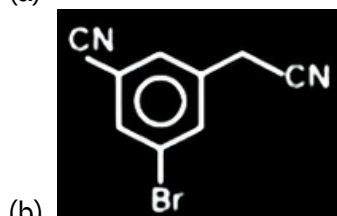
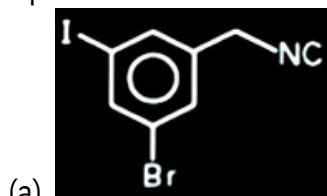
Answer: (a)



Question:

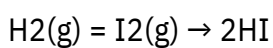
What will be the final product?

Options:



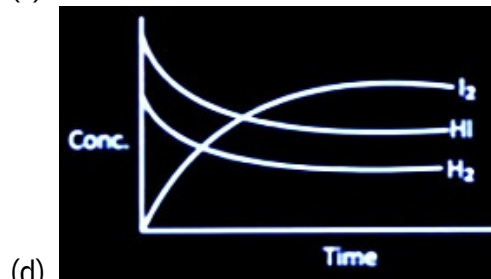
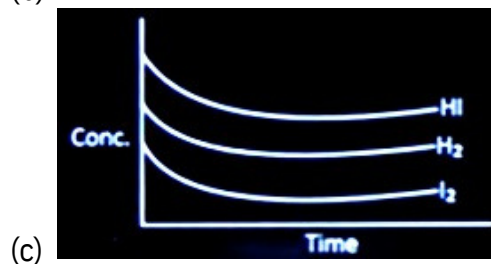
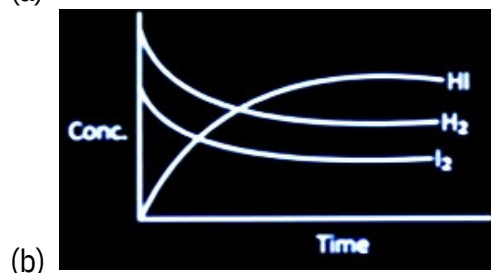
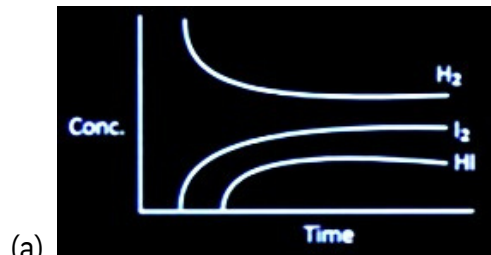
Answer: (d)

Question: Consider the following gaseous reaction



The above reaction is started with 'a' moles of H_2 and 'b' moles I_2 in a closed container at a certain temperature $T(K)$ till the equilibrium is established. Which one of the following plots correctly describes the progress of reaction?

Options:



Answer: (b)

Question: Match the following nitrogenous bases present in List-I with their structures present in List-II



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	List-I		List-II
A.	Thymine	(i)	
B.	Adenine	(ii)	
C.	Cytosine	(iii)	
D.	Uracil	(iv)	

Options:

(a) A-i, B-ii, C-iii, D-iv (b) A-ii, B-i, C-iv, D-iii (c) A-ii, B-i, C-iii, D-iv (d) A-iii, B-iv, C-i, D-ii

Answer: (b) Question: In the given compound no. of Sp and Sp² hybridised carbon are



Options:

(a) 4 and 5
 (b) 4 and 6
 (c) 3 and 6
 (d) 3 and 3

Answer: (d)

Question: The successive ionisation energy (I.E.) of an element 'X' is given

I.E1

I.E2

I.E3

I.E4

I.E5

X → 500 600 2000 2200 2600

Find out the group number of element X.

Options:

- (a) Group → 3
- (b) Group → 14
- (c) Group → 2
- (d) Group → 13

Answer: (c)

Question: Consider the following statements:

S-I: Oxygen-oxygen bond length in O₃ is greater than O₂.

S-II: O – O bond order in O₃ is 1.5 and O – O bond order in O₂ is 2.

Options:

- (a) Both S-I and S-II are correct
- (b) Both S-I and S-II are incorrect
- (c) S-I is correct, S-II is incorrect
- (d) S-I is incorrect, S-II is correct

Answer: (d)

Question: In the Carius method of estimation of halogen, 0.25 g of an organic compound gave 0.16 g of AgBr. What is the percentage of bromine in the compound (Given molar mass of Ag = 108, Br = 80)

Answer: (27.23)

Question: Let k_1 , k_2 and k_3 be the rate constant of reaction and the activation energy of the overall reaction.

(Given:

$$= 60 \text{ kJ/mol} \quad k = \sqrt{\frac{k_2}{k_3}}$$

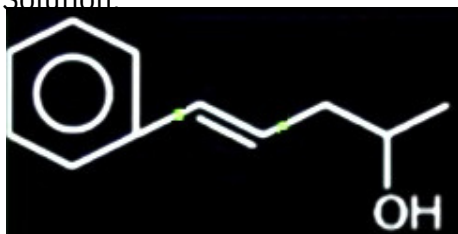
Then find

Answer: $E_1 = 10 \text{ kJ/mol}$, $E_2 = 60 \text{ kJ/mol}$, $E_3 =$

Question: How many stereoisomers are possible for 5-phenylpent-4-en-2-ol?

Answer: (4)

Solution:



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[EVENING SHIFT]

Maths

$$7 = 5 + \frac{1}{7}(5 + \alpha) + \frac{1}{7^2}(5 + 2\alpha) + \dots\infty$$

Question: If equal to

Options:

- (a) 6
- (b) 6/7
- (c) 1/7
- (d) 1

Answer: (a)

$$S_{\infty} = a + (a + d)r + (a + 2d)r^2 + \dots\infty$$

$$S_{\infty} = \frac{a}{1-r} + \frac{rd}{(1-r)^2}$$

$$s = 7, a = 5, r = \frac{1}{7}, d = \alpha$$

$$7 = \frac{5}{1-\frac{1}{7}} + \frac{\frac{1}{7}ga}{(1-\frac{1}{7})^2}$$

$$7 = \frac{35}{6} + \frac{7\alpha}{36}$$

$$1 = \frac{5}{6} + \frac{\alpha}{36}$$

$$36 = 30 + \alpha$$

$$\alpha = 6.$$

Question: If A and B are binomial coefficients of 30th and 12th term of binomial expansion $(1 + x)^{2n-1}$. If $2A = 5B$, then the value of n is

Options:

- (a) 20
- (b) 21
- (c) 14
- (d) 20

Answer: (b)

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$$(1+x)^{2n-1}$$

$$T_{30} = {}^{2n-1}C_{29} x^{29}$$

$$T_{12} = {}^{2n-1}C_{11} x^{11}$$

$$A = {}^{2n-1}C_{29}$$

$$B = {}^{2n-1}C_{11}$$

$$2 \times \frac{{}^{(2n-1)}C_{29}}{{}^{29}C_{29}} = \frac{{}^{5 \times (2n-1)}C_{11}}{11! \times (2n-12)!}$$

$$\frac{2}{29! \times 10!} = \frac{5}{11! \times 28!}$$

$$\frac{2}{29x} = \frac{5}{11}$$

$$n = 21$$

$$\frac{2}{29! \times 12!} = \frac{5}{11! \times 30!}$$

$$\frac{1}{6} = \frac{1}{6}$$

$$\therefore n = 21$$

Question: The equation of chord of the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$ with (3,1) as mid-point is

Options:

(a) $48x + 25y - 169 = 0$

(b) $25x + 5y - 125 = 0$

(c) $65x + 2y - 12 = 0$

(d) $45x + 4y - 135 = 0$

Answer: (a)

$$t = s$$

$$\frac{3x}{25} + \frac{y}{16} - 1 = \frac{9}{25} + \frac{1}{16} - 1$$

$$\frac{(3x)16 \times 25}{25 \times 16} = \frac{(9)(16) \times (25)}{25 \times 16}$$

$$48x + 25y - 169 = 0$$

Question: If system of equations

$$x + 2y - 3z = 2$$

$$2x + \lambda y + 5z = 5$$

$$4x + 3y + \mu z = 33$$

has infinite solutions, then $\lambda + \mu$ is equal to

Options:

(a) $\frac{1334}{5}$

(b) $\frac{1269}{5}$

(c) $\frac{261}{5}$

(d) $\frac{1063}{5}$

Answer: (a)

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$$D_2 = 0 \begin{vmatrix} 1 & 2 & -3 \\ 2 & 5 & 5 \\ 4 & 33 & \mu \end{vmatrix} = 0$$

$$4(25) - 33(11) + \mu(1) = 0$$

$$= 363 - 100\mu = 263$$

$$D_3 = 0 \begin{vmatrix} 1 & 2 & 2 \\ 2 & \lambda & 5 \\ 4 & 3 & 33 \end{vmatrix} = 0$$

$$-2(46) + \lambda(25) - 3(1) = 0$$

$$25\lambda = 85$$

$$\lambda = \frac{85}{25} = \frac{19}{5} = \lambda$$

$$\lambda + \mu = \frac{19}{5} + 263$$

$$= \frac{1334}{5}$$

Question: Let S_n denotes the sum of first n terms of an arithmetic progression. If $S_{40} = 1030$ and $S_{12} = 57$, then the value of $S_{30} - S_{10}$ is

Options:

- (a) 505
- (b) 510
- (c) 515
- (d) 520

Answer: (c)

$$S_{10} = 1030, S_{12} = 57$$

$$\frac{40}{2}(2a + 39d) = 103$$

$$2a + 39d = \frac{103}{2}$$

$$\frac{12}{2}(2a + 11d) = 57$$

$$2a + 11d = \frac{19}{2}$$

$$2a + 39d = \frac{103}{2}$$

$$2a + 11d = \frac{19}{2}$$

$$28d = 42$$

$$d = \frac{42}{28}$$

$$d = \frac{3}{2}$$

$$2a + \frac{33}{2} = \frac{19}{2}$$

$$2a = -7$$

$$a = \frac{-7}{2}$$

$$S_{30} - S_{10}$$

$$= 15(2a + 2ad) - 5(2a + 9d)$$

$$= 20a + 390d$$

$$= 20\left(\frac{-7}{2}\right) + 390\left(\frac{3}{2}\right)$$

$$= -70 + 585$$

$$= 515$$

Question: Consider an event E such that a matrix of order 2×2 is invertible with entries 0 or 1. Then, $P(E)$ is (where $P(X)$ denotes the probability of event X)

Options:

$$\frac{5}{8}$$

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

(b) $\frac{1}{8}$

(c) $\frac{7}{8}$

(d) $\frac{1}{8}$

(d) $\frac{1}{8}$

(d) $\frac{1}{8}$

Answer: (b)

$2 \times 2 \rightarrow$ Matrix

$$|A| \neq 0$$

$$n(s) = 2 \times 2 \times 2 \times 2 \Rightarrow 16$$

A can't be

$$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}, \begin{bmatrix} 0 & 0 \\ 1 & 1 \end{bmatrix}$$

So, total \Rightarrow 10 types of matrix

we can't take

$$\therefore P(\bar{A}) = \frac{10}{16} = \frac{5}{8}$$

$$\therefore P(A) = 1 - P(\bar{A}) = 1 - \frac{5}{8} \Rightarrow \frac{3}{8}$$

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} \neq 0 \quad ad \neq bc$$

$$ad = 1 \quad bc = 0 \quad 3 \text{ways}$$

$$ad = 0 \quad bc = 1 \quad 3 \text{ways}$$

$$\text{So } \frac{6}{16} = \frac{3}{8}$$

Question: Two groups A consists of 5 boys and 3 girls and B have 4 boys and 2 girls, we need to select 4 boys and 4 girls in total such that there must be 5 members of A and 3 of B.

Solution :

A \Rightarrow 5B, 3G B \Rightarrow 4B, 2G 4B, 4G Total 5 Members A, 3 Members of B

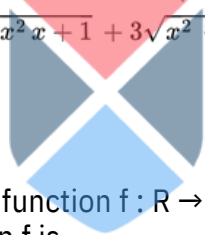
A	B
3B 2G	1B 2G
2B 3G	2B 1G

$$\begin{aligned}
& {}^5C_3 {}^3C_4 {}^2C_2 + {}^5C_3 {}^3C_2 {}^2C_1 \\
& 10 \cdot 3 \cdot 4 \cdot 1 + 10 \cdot 1 \cdot 6 \cdot 2 \\
& 120 + 120 \\
& = 240
\end{aligned}$$

Question: Solve $\int \frac{2x^2 + 5x + 1}{\sqrt{x^2 + x + 1}} dx$

Solution :

$$\begin{aligned}
& \int \sqrt{x^2 + x + 1} dx + \int \frac{3x - 1}{\sqrt{x^2 + x + 1}} dx \\
& \int 2\sqrt{\left(x + \frac{1}{2}\right)^2 + \frac{3}{4}} dx + \frac{3}{2} \int \frac{2x + 1}{\sqrt{x^2 + x + 1}} dx - \frac{5}{2} \int \frac{1}{\sqrt{\left(x + \frac{1}{2}\right)^2 + \frac{3}{4}}} dx \\
& = 2\left[\frac{\left(x + \frac{1}{2}\right)}{2} \sqrt{x^2 + x + 1} + \frac{3}{8} \ln\left(\sqrt{x^2 + x + 1} + x + \frac{1}{2}\right)\right] \\
& + \frac{3}{2} \times 2\sqrt{x^2 + x + 1} - \frac{5}{2} \ln\left(\sqrt{x^2 + x + 1} + x + \frac{1}{2}\right) \\
& = \left(x + \frac{1}{2}\right) \sqrt{x^2 + x + 1} + 3\sqrt{x^2 + x + 1} - \frac{7}{2} \ln\left(x + \frac{1}{2}\right) + \sqrt{x^2 + x + 1} + C
\end{aligned}$$



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$$f(x) = \frac{2^x - 2^{-x}}{2^x + 2^{-x}}$$

Question: A function $f: \mathbb{R} \rightarrow (-1, 1)$ such that The function f is

Options:

- (a) Both one-one and onto
- (b) Only one-one
- (c) Only onto
- (d) Both many - one and onto

Answer: (a)

$$f(x) = \frac{2^x - 2^{-x}}{2^x + 2^{-x}} f_{\mathbb{R}} \rightarrow (1, 1)$$

$$f(2) = \frac{2^{2x} - 1}{2^{2x} + 1}$$

$$\Rightarrow \frac{1 - 2^{2x}}{1 + 2^{2x}}$$

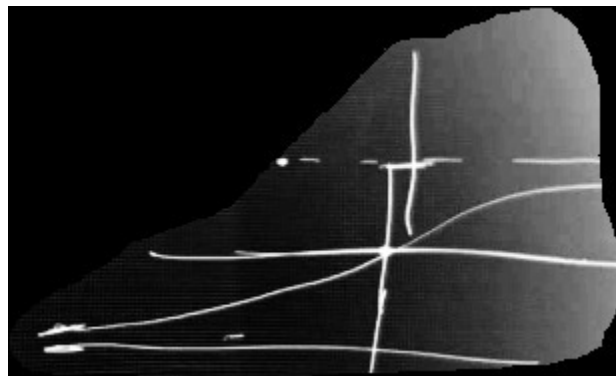
$$\frac{1 - \infty}{1 + \infty}$$

$$f'(x) = \frac{2^{2x} \ln 4 (2^{2x} + 1) - 2^{2x} \ln 4}{(2^{2x} + 1)^2}$$

$$\Rightarrow \frac{2 \times 2^{2x} \ln 4}{1}$$

\therefore one - one

onto



Question: The area of region enclosed by the curves $y = e^x$, $y = |e^x - 1|$ and y -axis is (in sq. units)

Options:

- (a) 1
- (b) $1 - \ln 2$
- (c) $1 + \ln 2$
- (d) $\ln 2$

Answer: (b)

$$y = e^x, y = |e^x - 1|$$

$$\therefore \text{Area} = \int_{-\ln 2}^0 e^x - (-e^x + 1) dx$$

$$= 2 \int_{-\ln 2}^0 e^x - \int_{-\ln 2}^0 1 dx$$

$$= 2[e^x]_{-\ln 2}^0 - [x]_{-\ln 2}^0$$

$$\Rightarrow 2 \left(1 - \frac{1}{2} \right) - [0 + \ln 2]$$

$$\Rightarrow 1 - \ln 2$$

$$e^x = -e^x + 1$$

$$2e^x = 1$$

$$e^x = \frac{1}{2}$$

$$x = \ln\left(\frac{1}{2}\right)$$

Question: The number of real roots of the equation $x^2 + 3x + 2 = \min(|x+2|, |x+3|)$

Options:

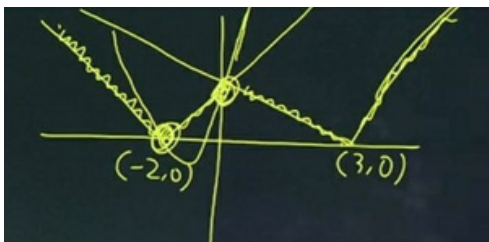
- (a) 0
- (b) 1
- (c) 2
- (d) 3

Answer: (2)

$$x^2 + 3x + 2 = \min(|x+2|, |x-3|)$$

Point of intersection = 2 points

\therefore no. of soln = 2



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$$f(x) = \begin{vmatrix} a + \frac{\sin x}{x} & 1 & b \\ a & 1 + \frac{\sin x}{x} & b \\ a & 1 & b + \frac{\sin x}{x} \end{vmatrix},$$

Question:

$$\lim_{x \rightarrow 0} f(x) = \lambda + \alpha a + \beta b \text{ then } (\lambda + \alpha + \beta)^2 =$$

Solution :

$$\begin{aligned} \lim_{x \rightarrow 0} f(x) &= \begin{vmatrix} a+1 & 1 & b \\ a & 2 & b \\ a & 1 & b+1 \end{vmatrix} \\ &= \begin{vmatrix} 1 & 0 & -1 \\ 0 & 1 & -1 \\ a & 1 & b+1 \end{vmatrix} \end{aligned}$$

$$= (b+1) + a + 1 = 2 + a + b$$

$$(\lambda + \alpha + \beta)^2 = 4^2 = 16$$

Question: Let $\vec{a} = 3\hat{i} + 2\hat{j} - \hat{k}$, $\vec{b} = \vec{a} \times (\hat{i} - 2\hat{j})$ and $\vec{c} = \vec{b} \times \hat{k}$, then projection

of $\vec{c} - 2\hat{i}$ on \vec{a} is equal to

Options:

(a) $2\sqrt{14}$

(b) $3\sqrt{7}$

(c) $2\sqrt{7}$

(d) $\frac{3\sqrt{14}}{14}$

Answer: (d)

$$\begin{aligned} \vec{c} &= (\vec{a} \times (\hat{i} - 2\hat{j})) \times \hat{k} \\ &= (\vec{a} \cdot \hat{k}) \cdot (\hat{i} - 2\hat{j}) - 0 \\ &= -i + 2\hat{j} \\ \vec{c} - 2\hat{j} &= -\hat{j} \end{aligned} \quad \text{Proj} = \frac{-\hat{j} \cdot \vec{a}}{|\vec{a}|} = \frac{-3}{\sqrt{14}}$$

Question: If $\alpha > \beta > \gamma > 0$, then find $\cot^{-1}\left(\frac{1+\alpha\beta}{\alpha-\beta}\right) + \cot^{-1}\left(\frac{1+\beta\gamma}{\beta-\gamma}\right) + \cot^{-1}\left(\frac{1+\gamma\alpha}{\gamma-\alpha}\right)$

Options:

(a) π

(b) zero

(c) $\frac{\pi}{2} - (\alpha + \beta + \gamma)$

(d) 3π

Answer: (a)

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$$\begin{aligned} & \tan^{-1} \frac{\alpha - \beta}{1 + \alpha\beta} + \tan^{-1} \frac{\beta - \gamma}{1 + \beta\gamma} + \pi + \tan^{-1} \frac{\gamma - \alpha}{1 + \gamma\alpha} \\ &= \tan^{-1} \alpha - \tan^{-1} \beta + \tan^{-1} \beta - \tan^{-1} \gamma + \pi \\ &+ \tan^{-1} \gamma - \tan^{-1} \alpha = \pi \end{aligned}$$

$$P\left(\frac{11}{2}, \alpha\right)$$

Question: The point $P\left(\frac{11}{2}, \alpha\right)$ lies on or inside the triangle formed by the lines $x + y = 11$, $x + 2y = 16$ and $2x + 3y = 29$, then minimum value of 10α is equal to

Solution :

$$y = \frac{11}{2} = 3.5$$

$$2y = 16 - \frac{11}{2}$$

$$y = \frac{21}{4}$$

$$y = \frac{21}{4} = 5.25$$

$$3y = 29 - 11 = 18$$

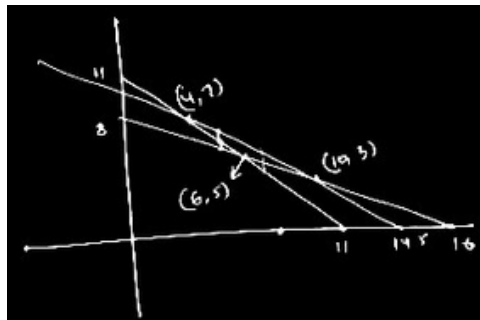
$$y = 6$$

$$\left. \begin{aligned} x + y &= 11 \\ x + 2y &= 16 \\ 2x + 3y &= 29 \end{aligned} \right\}$$

$$(6, 5)$$

$$(10, 3)$$

$$(4, 7)$$



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