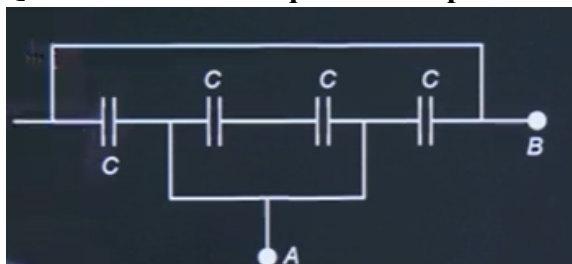


JEE-Main-04-04-2025 (Memory Based)
[MORNING SHIFT]
Physics

Question: Find the equivalent capacitance between A and B, where $C = 16 \mu\text{F}$



Options:

- (a) $48 \mu\text{F}$
- (b) $8 \mu\text{F}$
- (c) $32 \mu\text{F}$
- (d) $16 \mu\text{F}$

Answer: (c)

Question: A ring and a solid sphere released from rest from same height on enough

rough inclined surface. Ratio of their speed when they reach at bottom is $\sqrt{\frac{7}{x}}$ m/s, then x is _____

Options:

- (a) 20
- (b) 15
- (c) 10
- (d) 25

Answer: (c)

Question: Mean free path for an ideal gas is to be observed $20 \mu\text{m}$ while average speed of molecules of gas is observed to be 600 m/s , then frequency of collision is nearby

Options:

- (a) 4×10^7
- (b) 1.2×10^7
- (c) 3×10^7
- (d) 2×10^{-7}

Answer: (c)

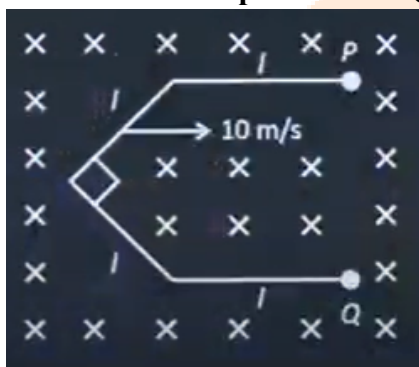
Question: Find the dimension of $\frac{E}{B}$ where, E represents electric field and B represents magnetic field

Options:

- (a) ML^2T^{-1}
- (b) LT^{-1}
- (c) L^2T^{-1}
- (d) LT^{-2}

Answer: (b)

Question: 4 rods of equal length are joined as shown in the figure. Combined system is moving with speed 10 m/s in a perpendicular magnetic field of $\frac{1}{\sqrt{2}}$ tesla. Find emf induced between point P and Q ($l = 10$) cm.



Options:

- (a) 1 volt
- (b) 0.1 volt
- (c) 2 volt
- (d) $\sqrt{2}$ volt

Answer: (a)

Question: A real object placed in front of a spherical mirror forms an image whose magnification is $-\frac{1}{3}$. If the distance between the image and object is 3 cm. The focal length of the mirror is _____ cm.

Options:

- (a) -11.25 cm
- (b) -22.5 cm
- (c) -45 cm
- (d) -60 cm

Answer: (a)

Question: The current in a AC circuit is given as $i = 100\sqrt{2} \sin(100\pi t)$ A. Find rms current and frequency is Hertz.

Options:

- (a) 100 A, 100 Hz
- (b) 50 A, 100 Hz

- (c) 200 A, 50 Hz
(d) 100 A, 50 Hz

Answer: (d)

Question: For a magnification of $\frac{1}{2}$, object is a 40 cm from the mirror. What should be the object distance for $m = \frac{1}{3}$

Options:

- (a) 80 cm
(b) -80 cm
(c) 40 cm
(d) -40 cm

Answer: (b)

Question: There is a closed organ pipe having a certain fundamental frequency. Find the percentage change in fundamental frequency when it is filled one fifth with water.

Options:

- (a) 100 %
(b) 200 %
(c) 300 %
(d) 400 %

Answer: (d)

Question: An electric dipole with charges $2 \mu\text{C}$ and a separation 20 cm is placed close to an infinitely charged non-conducting sheet with surface charge density 100 C/m^2 . Find the torque acting on the dipole if the dipole makes an angle 30° with the normal to the sheet.

Options:

- (a) $\frac{12}{\epsilon_0} \times 10^{-5} \text{ N-m}$
(b) $\frac{2}{\epsilon_0} \times 10^{-5} \text{ N-m}$
(c) $\frac{4}{\epsilon_0} \times 10^{-5} \text{ N-m}$
(d) $\frac{1}{\epsilon_0} \times 10^{-5} \text{ N-m}$

Answer: (d)

Question: The dimensional formula for the ratio of Electric flux & magnetic flux is

$$[M^a L^b T^c A^d]$$

Options:

- (a) $a = 1, b = 2, c = -1, d = 1$
(b) $a = 2, b = -1, c = 1, d = -1$

(c) $a = 0, b = 1, c = -1, d = 0$

(d) $a = 1, b = 3, c = -2, d = 1$

Answer: (c)

Question: Assertion (A): The minimum kinetic energy required to take a body of mass m from surface of earth to infinity is mgR .

Reason (R): Potential energy at surface of earth is zero.

Options:

(a) (A) and (R) both are correct and (R) is correct explanation of (A)

(b) (A) and (R) both are correct and (R) is not correct explanation of (A)

(c) (A) is correct but (R) is incorrect

(d) (A) is incorrect but (R) is correct

Answer: (c)

Question: Longitudinal sound waves travel in three different gases namely helium, methane and carbon dioxide. Mean temperature of three gases are equal then ratio of speeds of wave in 3 gases respectively is

Options:

(a) $\sqrt{5} : \sqrt{7} : \frac{1}{\sqrt{11}}$

(b) $\sqrt{3} : \sqrt{5} : \frac{1}{\sqrt{11}}$

(c) $\sqrt{5} : 1 : \sqrt{\frac{21}{55}}$

(d) $\frac{1}{\sqrt{3}} : \frac{1}{\sqrt{5}} : \frac{1}{2}$

Answer: (c)

Question: Correct relation for Torque

(1) $\vec{y} = \vec{r} \times \vec{F}$

(2) $\vec{y} = \frac{d}{dt}(\vec{r} \times \vec{P})$

(3) $\vec{y} = \vec{r} \times \frac{d\vec{P}}{dt}$

(4) $\vec{y} = (\vec{r} \times \vec{v})$

(5) $\vec{y} = \vec{r} \times \vec{\omega}$

Options:

(a) 1, 2, 3

(b) 2, 3

(c) 3, 4, 5

(d) 1, 5

Answer: (a)

Question: Assertion: In photoelectric effect, if intensity of monochromatic light is increased then stopping potential increases.

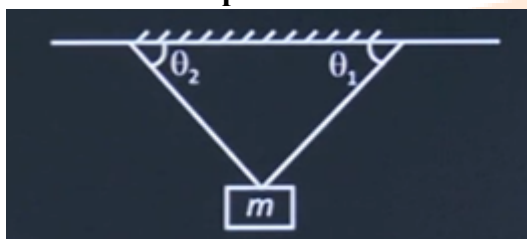
Reason: Increased intensity results in increment of photocurrent.

Options:

- (a) A is correct, R is correct and R is explanation of A
- (b) A is correct, R is correct and R is not explanation of A
- (c) A is incorrect and R is correct
- (d) A is correct and R is incorrect

Answer: (c)

Question: A block of mass m kg is connected to two strings as shown. If $T_1 = \sqrt{3}T_2$, then choose correct option

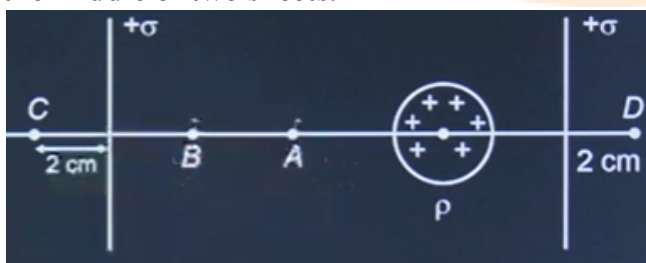


Options:

- (a) $\theta_1 = 60^\circ, \theta_2 = 30^\circ, T_1 = \frac{mg}{2}$
- (b) $\theta_1 = 60^\circ, \theta_2 = 30^\circ, T_2 = \frac{mg}{2}$
- (c) $\theta_1 = 30^\circ, \theta_2 = 60^\circ, T_1 = \frac{3mg}{4}$
- (d) $\theta_1 = 30^\circ, \theta_2 = 60^\circ, T_2 = \frac{3mg}{4}$

Answer: (b)

Question: In arrangement shown, has two non-conducting plane sheets with charge density σ , and a non-conducting sphere with volume charge density ρ . Choose the correct relation between the magnitude of electric fields at A, B, C and D. Point A is at the middle of two sheets.



Options:

- (a) $E_A = E_B, E_C \neq E_D$
- (b) $E_A > E_B, E_C \neq E_D$

(c) $E_A > E_B, E_C = E_D$

(d) $E_A \neq E_B, E_C = E_D$

Answer: (b)

Question: In YDSE setup, distance between slits $d = 0.2$ mm. If d is changed to 0.4 mm, then % change in fringe width

Options:

(a) 25%

(b) 50%

(c) 100%

(d) 75%

Answer: (b)

Question: Two simple pendulums with amplitudes θ_1 and θ_2 have length of strings as l_1 and l_2 respectively. Choose the correct options if the maximum angular accelerations are same.

Options:

(a) $\theta_1 l_1 = \theta_2 l_2$

(b) $\theta_1 l_2 = \theta_2 l_1$

(c) $\theta_1 l_1^2 = \theta_2 l_2^2$

(d) $\theta_1 l_2^2 = \theta_2 l_1^2$

Answer: (b)

Question: The Boolean expression $Y = \overline{A}BC + \overline{A}\overline{C}$ can be realised with which of the following gate configurations

Options:

(a) One-3 input AND gate, 3 NOT gate and one -2 input OR gate, one-2 input AND gate

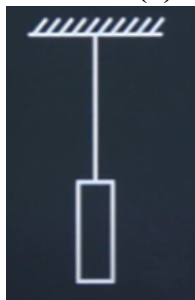
(b) One-3 input OR gate, 1 NOT gate and one -2 input NOR gate, one-2 input OR gate

(c) 3-input OR gate, 3 NOT gate and one -2 input AND gate

(d) 3-input AND gate, 3 NOT gate and one -2 input OR gate

Answer: (a)

Question: A small mirror of mass m is suspended to a fix point with an ideal string of length l . A photon of energy E incident normally on the mirror. Find maximum angular deviation (θ) of the mirror.



Options:

- (a) $\frac{3E}{mc\sqrt{gl}}$
- (b) $\frac{E}{2mc\sqrt{gl}}$
- (c) $\frac{E}{mc\sqrt{2gl}}$
- (d) $\frac{2E}{mc\sqrt{gl}}$

Answer: (d)

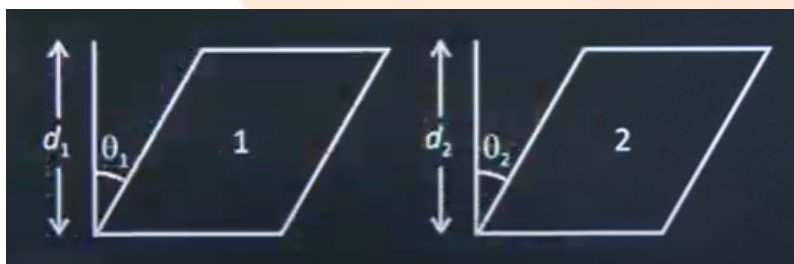
Question: $\vec{L}$ and $\vec{p}$ are angular momentum about origin and linear momentum of a particle. If position vector of particle is given as $\vec{r} = a(\sin \omega t \hat{i} + \cos \omega t \hat{j})$ then direction of force is

Options:

- (a) Opposite to $\vec{L} \times \vec{r}$
- (b) Opposite to $\vec{p} \times \vec{r}$
- (c) Opposite to $\vec{L} \cdot \vec{r}$
- (d) Opposite to $\vec{p} \times \vec{L}$

Answer: (d)

Question: The figure shows two boxes with identical square cross-sections and height h_1 and h_2 ($h_1 = 2h_2$) are made of different materials. An equal force is applied on the square cross-sections such that the deformations θ_1 and θ_2 are realized ($\theta_1 = \theta_2$). If shear modulus of box-1 is $4 \times 10^9 \text{ N/m}^2$ and that of box-2 $x \times 10^9 \text{ N/m}^2$, then x is _____.



Options:

- (a) 3
- (b) 5
- (c) 8
- (d) 10

Answer: (c)

JEE-Main-04-04-2025 (Memory Based)

[MORNING SHIFT]

Chemistry

Question: Which of the following is the ratio of 5th Bohr orbit (r_5) of He^+ & Li^{2+} ?

Options:

- (a) $2/3$
- (b) $3/2$
- (c) $9/4$
- (d) $4/9$

Answer: (b)

Question: Which of the following pair of ions have equal number of unpaired electrons

Options:

- (a) V^{2+} and Ni^{2+}
- (b) Cr^{2+} and Mn^{2+}
- (c) Fe^{2+} and Sc^{2+}
- (d) Mn^{3+} and Fe^{2+}

Answer: (d)

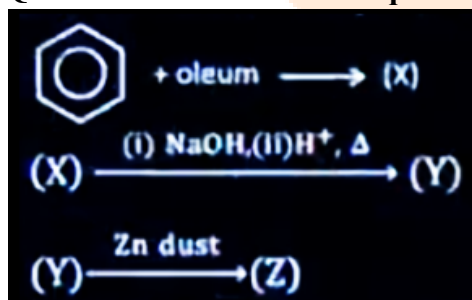
Question: Incorrect order of atomic radius is

Options:

- (a) $\text{B} < \text{Al}$
- (b) $\text{In} < \text{Tl}$
- (c) $\text{In} < \text{Tl}$
- (d) $\text{Ga} < \text{In}$

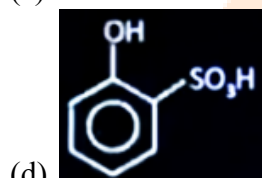
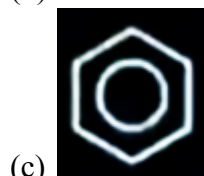
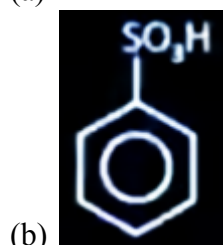
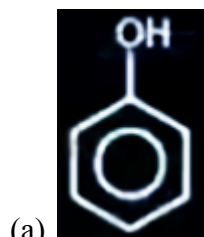
Answer: (c)

Question: In the reaction sequence:



The compound (Z) is

Options:



Answer: (c)

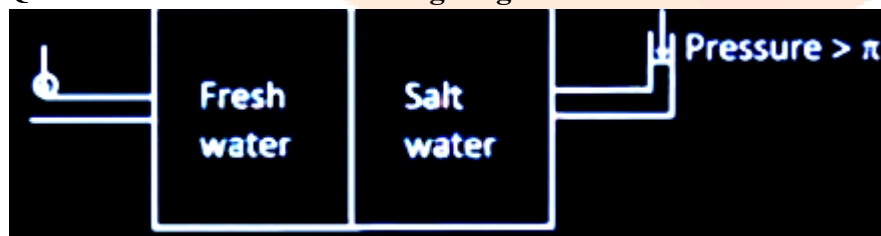
Question: One mole of an ideal gas expands from 10 dm^3 to 20 dm^3 through isothermal reversible process. Find ΔU , q & w

Options:

- (a) $\Delta U = 0$, $q = 0$, $w = 0$
- (b) $\Delta U = 0$, $q \neq 0$, $w \neq 0$
- (c) $\Delta U \neq 0$, $q = 0$, $w \neq 0$
- (d) $\Delta U \neq 0$, $q \neq 0$, $w = 0$

Answer: (b)

Question: Observe the following diagram

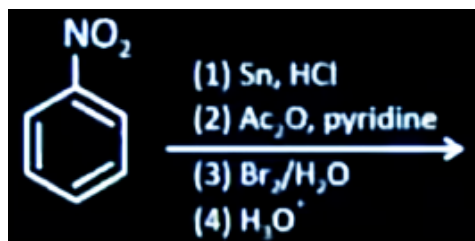


For reverse osmosis, which of the following can be used for porous membrane?

Options:

- (a) Cellulose acetate
- (b) Porous silicate
- (c) Silicone
- (d) Glass membrane

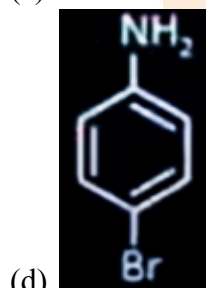
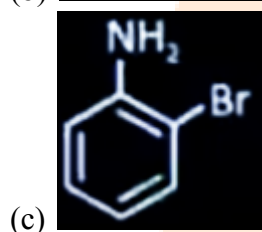
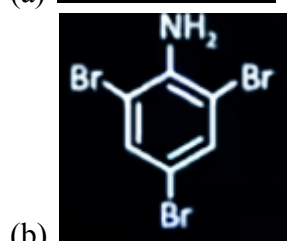
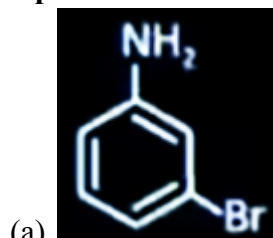
Answer: (a)



Question:

P (major product)

Options:



Answer: (d)

Question: Which of the following is correct option regarding 1s orbital

Options:

- (a) It is symmetrical
- (b) It is non-symmetrical
- (c) It is directional
- (d) It has two radial nodes

Answer: (a)

Question: Total number of stereoisomers possible for complexes $[\text{Cr}(\text{Cl}_3)(\text{Py})_3]$ and $[\text{CrCl}_2(\text{C}_2\text{O}_4)_2]$ respectively are

Options:

- (a) 2, 3

- (b) 3, 2
- (c) 3, 3
- (d) 2, 2

Answer: (a)

Question: In lead storage battery during charging oxidation state of lead show changes

At anode from x_1 to y_1

At cathode from x_2 to y_2

Find value of x_1, y_1, x_2, y_2

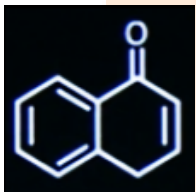
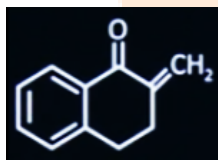
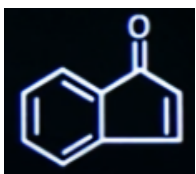
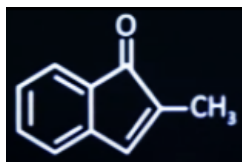
Options:

- (a) $x_1 = +2, y_1 = 0$
 $x_2 = +2, y_2 = +4$
- (b) $x_1 = +4, y_1 = 0$
 $x_2 = +2, y_2 = +4$
- (c) $x_1 = 0, y_1 = +2$
 $x_2 = +4, y_2 = +2$
- (d) $x_1 = +2, y_1 = 0$
 $x_2 = +4, y_2 = 0$

Answer: (a)

Question: Which of the following compound is not a product of intramolecular aldol condensation reaction?

Options:

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

Answer: (b)

Question: If the rate of a reaction is given by $R_1 = k[A]^m [B]^n$, then what will be the ratio R_2/R_1 when the concentration of A is doubled ($2A$) and the concentration of B is halved ($B/2$)?

Options:

- (a) 2^{m+n}

- (b) 2^{n-m}
 (c) 2^{m-n}
 (d) 1

Answer: (c)

Question: The complex ion having crystal field stabilization energy is zero and value of spin only magnetic moment is 5.92 BM.

Options:

- (a) $[\text{FeF}_6]^{4-}$
 (b) $[\text{Mn}(\text{SCN})_6]^{4-}$
 (c) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (d) $[\text{Fe}(\text{CN})_6]^{3-}$

Answer: (b)

Question: Statement-I: (A) $\text{C}_2\text{H}_5 - \text{CH} = \overset{2}{\text{C}}\text{H} - \overset{1}{\text{C}}\text{HO}$ has higher dipole moment than

(B) $\text{C}_2\text{H}_5 - \overset{2}{\text{C}}\text{H}_2 - \overset{1}{\text{C}}\text{HO}$.

Statement-II: C1 — C2 bond length in (A) is longer than (B)

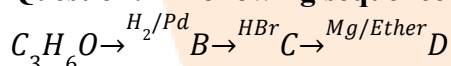
In the light of above statements, choose the correct option:

Options:

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

Answer: (c)

Question: In following sequence of reaction. A is converted to D



D is treated with A followed by hydrolysis to give 2,3-dimethyl-butan-2-ol. Then identify A, B, C.

Options:

- (a) A = CH_3COCH_3 , B = $\text{CH}_3 - \text{CH}(\text{OH})\text{CH}_3$, C = $\text{CH}_3 - \text{CH}(\text{Br})\text{CH}_3$
 (b) A = $\text{CH}_3\text{CH}_2\text{CHO}$, B = $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, C = $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$
 (c) A = $\text{CH}_2 = \text{CH} - \text{CH}_2\text{OH}$, B = $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, C = $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$
 (d) A Cyclopropane, B-Cyclopropanone, C-bromo propane

Answer: (a)

Question: In the following, the number of paramagnetic molecules are: O_2 , N_2 , F_2 , B_2 , Cl_2

Options:

Answer: (2)

Question: 0.01 M HX ($K_a = 4 \times 10^{-10}$) is diluted till the solution has pH = 6. If the new concentration is $x \times 10^{-4}$ M then find x.

Options:

Answer: (25)

JEE-Main-04-04-2025 (Memory Based)

[MORNING SHIFT]

Maths

Question: Solve $\int_{-1}^1 \frac{1+2x}{e^{-x} + e^x} dx$.

Options:

- (a) $2\left(\tan^{-1}e - \frac{\pi}{4}\right)$
- (b) $2\left(\tan^{-1}e - \frac{\pi}{3}\right)$
- (c) $2\left(\tan^{-1}e - \frac{\pi}{2}\right)$
- (d) $2\left(\frac{\pi}{2} - \tan^{-1}e\right)$

Answer: (a)

$$\begin{aligned} & \int_{-1}^1 \frac{1+2x}{e^{-x} + e^x} \\ &= \int_{-1}^1 \frac{1}{e^{-x} + e^x} + \int_{-1}^1 \frac{2x}{e^{-x} + e^x} \\ &= 2 \int_{-1}^1 \frac{e^x dx}{e^{2x} + 1} \\ &= 2 \int_{-1}^e \frac{dt}{t^2 + 1} \quad e^x = t, e^x dx = dt, x = \ln t \\ &= \tan^{-1} t \Big|_1^e \\ &= 2\left[\tan^{-1}e - \frac{\pi}{4}\right] \end{aligned}$$

Question: If the equation of an ellipse E is $\frac{x^2}{9} + \frac{y^2}{16} = 1$, then the length of latus rectum of E is

Options:

- (a) $\frac{32}{5}$
- (b) $\frac{9}{2}$
- (c) $\frac{16}{3}$
- (d) $\frac{9}{5}$

Answer: (b)

$$\frac{x^2}{9} + \frac{y^2}{16} = 1$$

$$a^2 = 16 \quad b^2 = 9$$

$$\begin{aligned} \text{Now } LR &= \frac{2b^2}{a} = \frac{2 \times 9}{4} \\ &= \frac{9}{2} \end{aligned}$$

Question: The sum of the series $1 + 3 + 5^2 + 7 + 9^2 + \text{upto terms}$ is

Options:

- (a) 328160
- (b) 338160
- (c) 339400
- (d) 326870

Answer: (b)

$$\begin{aligned} S &= (1^2 + 5^2 + 9^2 + 13^2 + \dots - 40 \text{ terms}) + (3 + 7 + \dots + 15a) 40 \text{ terms} \\ &= \sum_{r=1}^{40} (4r-3)^2 + \frac{40}{2} (3 + 15a) \\ &= 16 \sum_{r=1}^{40} r^2 - 24 \sum_{r=1}^{40} r + a \sum_{r=1}^{40} (1) + 20 \times 162 \\ &= \frac{16 \times 40 \times 41 \times 81}{6} - \frac{24 \times 40 \times 41}{2} + a \times 40 + 3240 \\ &= 354240 - 19680 + 360 + 3240 \\ &= 338160 \end{aligned}$$

Question: Let there be two A.P.'s with each having 2025 terms. Find the number of distinct terms in union of these two A.P.'s. I.e, AUB if first A.P. is 1, 6, 11, and second A.P. is 9, 16, 23,.....

Options:

- (a) 3761
- (b) 4035
- (c) 3022
- (d) 2025

Answer: (a)

$$AP_1 \Rightarrow 1, 6, 11, \dots, 1021 \Rightarrow 2025 \text{ terms}$$

$$T_n = 5n - 4$$

$$AP_2 \Rightarrow 9, 16, 23, \dots, 14177$$

$$T_n = 7n + 2$$

Common terms AP

$$16, 61, 86, \dots$$

$$16 + (n-1)35 \leq 10121$$

$$n \leq 289.71$$

$$n = 289$$

$$M(A \cup B) = (2025 + 2025) - 289$$

$$= 3761$$

Question: Foci of ellipse are (2, 5) and (2, -3), eccentricity is $\frac{4}{5}$. Find the length of latus rectum.

Options:

- (a) $9/5$
- (b) $2/5$
- (c) $18/5$
- (d) $1/5$

Answer: (c)

$$e = \frac{4}{5}$$

$$e^2 = \left(1 - \frac{a^2}{b^2}\right)$$

$$\frac{16}{25} = 1 - \frac{a^2}{25}$$

$$\frac{a^2}{25} = \frac{9}{25}$$

$$a^2 = 9$$

$$2be = 8$$

$$be = 4$$

$$b \cdot \frac{4}{5} = 4$$

$$b = 5$$

$$L = \frac{2a^2}{b}$$

$$= \frac{2 \cdot 9}{5}$$

$$= \frac{18}{5}$$

Question: In the expansion of $\left(2^{\frac{1}{3}} + 3^{-\frac{1}{3}}\right)^n$. The ratio of 15th term from beginning and ending is $1/6$, we need to find n

Options:

- (a) 20
- (b) 25
- (c) 30
- (d) 35

Answer: (b)

Let the general term be:

$$T_{k+1} = \binom{n}{k} \cdot 2^{(n-k)/3} \cdot 3^{-k/3}$$

- 15th term from beginning: $T_{15} = T_{k+1}$ where $k = 14$
- 15th term from end: $T_{n-14+1} = T_{k+1}$ where $k = n - 14$

Now take ratio:

$$\frac{T_{15}}{T_{n-14+1}} = \frac{2^{(n-14)/3} \cdot 3^{-14/3}}{2^{14/3} \cdot 3^{-(n-14)/3}} = \left(\frac{2 \cdot 3}{1}\right)^{(n-28)/3}$$

Set equal to given ratio:

$$6^{(n-28)/3} = \frac{1}{6} = 6^{-1} \Rightarrow \frac{n-28}{3} = -1 \Rightarrow n = \boxed{25}$$

Question:

Options:

- (a) $1/2$
- (b) $1/5$
- (c) $3/5$
- (d) $2/5$

Answer: (d)

$$10t^2 + (15(1-t)^2) = 6$$

$$25t^2 - 30t + 9 = 0$$

$$(5t - 3)^2 = 0$$

$$t = \frac{3}{5}$$

$$\sin^2 \theta = \frac{3}{5} \cos^2 = \frac{2}{5}$$

$$\cos^2 \theta = \frac{5}{3} \sec^2 = \frac{5}{2}$$

$$= \frac{27 \times \left(\frac{5}{3}\right)^3 + 8 \left(\frac{5}{2}\right)^3}{16 \times \left(\frac{5}{2}\right)^4}$$

$$= \frac{125+125}{625}$$

$$= \frac{2}{5}$$

Question: Consider a committee of 12 members is formed randomly out of 4 Engineers, 2 Doctors and 10 professors. Find the probability that the committee has exactly 3 Engineers and 1 Doctor.

Options:

- (a) $\frac{17}{91}$

(b) $\frac{18}{91}$

(c) $\frac{91}{18}$

(d) $\frac{71}{18}$

Answer: (b)

$4 - E$

$2 - D$

$10 - P$

$$\frac{{}^4C_3 {}^2C_1 \times {}^{10}C_8}{{}^{16}C_{12}} = \frac{\frac{4 \times 2 \times 45}{416 \times 15 \times 14 \times 13}}{246}$$

$$= \frac{8 \times 45}{10 \times 14 \times 13}$$

$$= \frac{8 \times 9}{2 \times 14 \times 13} = \frac{2 \times 9}{7 \times 13}$$

$$= \frac{18}{91}$$

Question: Let $|x - 5| \leq y \leq 4\sqrt{x}$. If the Area enclosed is A, then 3A equals to

Options:

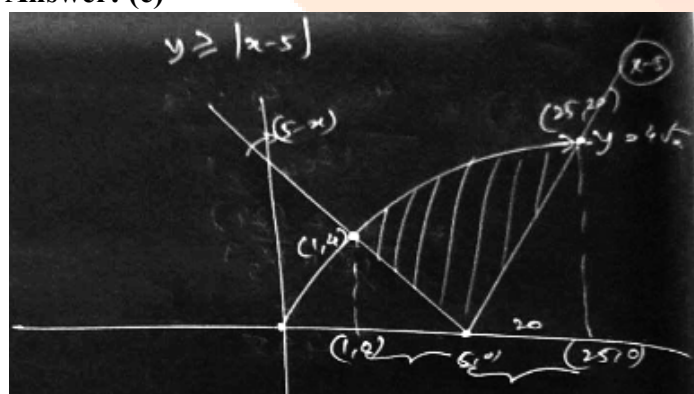
(a) 124

(b) 308

(c) 368

(d) 624

Answer: (c)



$$4\sqrt{x} = x - 5$$

$$16x = x^2 - 10x + 25$$

$$x^2 - 26x + 25$$

$$x = 21, 23$$

$$A = I_1 - \left[\frac{1}{2} \times 4 \cdot 4, 0 + \frac{1}{2} 20 \cdot 20 \right]$$

$$= I_1 - [8 + 200]$$

$$= \frac{8}{3}(124) - 208$$

$$\int_1^{25} 4\sqrt{x}$$

$$= \frac{4}{3} \cdot 2 x^{\frac{3}{2}} \Big|_1^{25}$$

$$= \frac{8}{3} [5^3 - 1]$$

$$= \frac{8}{3} [124]$$

$$3A = 8.124 - 624$$

$$= 992 - 625$$

$$= 3A = 368$$

Question: In 10 balls, 3 are defective. If 2 are chosen at random, find variance (σ^2) of the defective balls.

Answer: ($\frac{28}{75}$)

$$x = 1 \rightarrow \frac{{}^3C_1 \times {}^7C_1}{{}^{10}C_2}$$

$$= \frac{2}{45} = \frac{7}{15}$$

$$x = 2 \rightarrow \frac{{}^3C_2}{{}^{10}C_2}$$

$$= \frac{3}{45} = \frac{1}{15}$$

$$\sigma^2 = \varepsilon(x^2) - \varepsilon(x)^2$$

$$= \sum_{i=1}^1 x_i^2 p_i - \left(\sum_{i=1}^1 x_i p_i \right)^2$$

$$= \left(1 \cdot \frac{7}{15} + 4 \cdot \frac{1}{15} \right) - \left(\frac{7}{15} + 2 \cdot \frac{1}{15} \right)^2$$

$$= \frac{11}{15} - \frac{81}{225}$$

$$= \frac{165-81}{225}$$

$$= \frac{84}{225} = \frac{28}{75}$$

$$A = \begin{bmatrix} \cos \theta & 0 & -\sin \theta \\ 0 & 1 & 0 \\ \sin \theta & 0 & \cos \theta \end{bmatrix} . \text{ Here } A^2 = A^T . \text{ Then}$$

Question: Let
find Trace $[(A + I)^3 + (A - I)^3 - 6A]$.

Answer: (6)

$$(A + I)^3 + (A - I)^3 - 6A$$

$$(A^3 + 3A^2 + 3A + I) + A^3 - 3A^2 + 3A - I - 6A$$

$$2A^3 + 6A - 6A = 2A^3$$

$$Tr(2A^3) = 2Tr(A^3)$$

$$= 2Tr(AA^T) \quad \because A^2 = A^T$$

$$AA^T \begin{bmatrix} \cos \theta & 0 & -\sin \theta \\ 0 & 1 & 0 \\ \sin \theta & 0 & \cos \theta \end{bmatrix} \begin{bmatrix} \cos \theta & 0 & \sin \theta \\ 0 & 1 & 0 \\ -\sin \theta & 0 & \cos \theta \end{bmatrix}$$

$$2 \times Tr(AA^T) = 2 \times 3 = 6$$

Question: If $\lim_{x \rightarrow 1+} \frac{(x-1)[6 + \lambda \cos(x-1)] + \mu \sin(x-1)}{(x-1)^3} = -1$ Then the value of $\lambda + \mu$ is

Options:

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

Answer: (-6)

$$\lim_{x \rightarrow 1+} \frac{(x-1)[6 + \lambda \cos(x-1)] + \mu \sin(x-1)}{(x-1)^3} = -1$$

$$\lim_{x \rightarrow 1+} \frac{6 + \lambda \cos(x-1) + \mu}{(-1)^2} = -1$$

$$\lim_{x \rightarrow 1+} \frac{(\mu + 6) + \lambda \cos(x-1)}{(x-1)^2}$$

$$\Rightarrow \lambda + \mu + 6 = 0$$

$$\lambda + \mu = -6$$

Question: $\int_{-1}^1 \frac{[1 + \sqrt{|x| - x}]e^x + (\sqrt{|x| - x})e^{-x}}{e^x + e^{-x}}$

Answer: $(= 2 + \frac{2\sqrt{2}}{3})$

$$\begin{aligned}
 & \int_{-1}^1 \frac{[1+\sqrt{|x|-x}]e^x + (\sqrt{|x|-x})e^{-x}}{e^x + e^{-x}} dx \\
 & \int_{-1}^1 \frac{e^x}{e^x + e^{-x}} dx + \int_{-1}^1 \frac{\sqrt{|x|-x}(e^x + e^{-x})}{e^x + e^{-x}} dx \\
 & \frac{1}{2} \int_{-1}^1 2dx + \int_{-1}^1 \sqrt{|x|-x} dx \\
 & 2 + \int_{-1}^0 \sqrt{-2x} dx + 0 \\
 & 2 + \frac{2}{3} \left(\frac{(-2x)^{\frac{3}{2}}}{-\frac{3}{2}} \right)_{-1}^0 \\
 & 2 + \frac{2}{3} \left[0 - \frac{2^{\frac{3}{2}}}{(-2)} \right] \\
 & 2 + \frac{2 \cdot 2^{\frac{3}{2}}}{6} = 2 + \frac{2^{\frac{5}{2}}}{3 \times 2} \\
 & = 2 + \frac{2\sqrt{2}}{3}
 \end{aligned}$$

Question: Let $f, g : (1, \infty) \rightarrow \mathbb{R}$ be defined as $f(x) = \frac{2x+3}{5x+2}$ and $g(x) = \frac{2x-3}{1-x}$. If the range of the function $f \circ g : [2, 4] \rightarrow \mathbb{R}$ is $[\alpha, \beta]$ then $\frac{1}{\beta - \alpha}$ is equal to

Answer: (56)

$$f, g : (1, \infty) \rightarrow \mathbb{R}, f(x) = \frac{2x+3}{5x+2}, g(x) = \frac{2-3x}{1-x}$$

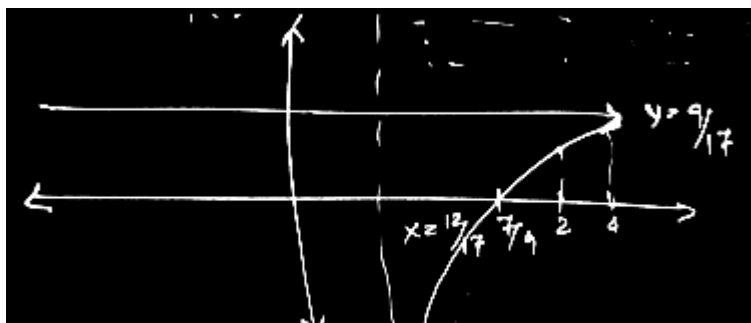
$$f(g(x)) : [2, 4] \rightarrow \mathbb{R}$$

$$f \circ g(x) = \frac{2g(x)+3}{5g(x)+2} \quad \alpha = \frac{11}{22} = \frac{1}{2}$$

$$= \frac{2(\frac{2-3x}{1-x})+3}{5(\frac{2-3x}{1-x})+2} \quad \beta = \frac{29}{56}$$

$$= \frac{4-6x+3-3x}{10-15x+2-2x} \quad \beta - \alpha = \frac{29}{56} - \frac{1}{2} = \frac{-1}{2} = \frac{1}{56} = \frac{1}{\beta - \alpha} = 56$$

$$f(g(x)) = \frac{7-9x}{12-17x} = \left(\frac{9x-7}{17x-12} \right)$$



Question: $f(x) = \max \{x, x^3, x^5, \dots, x^{21}\}$

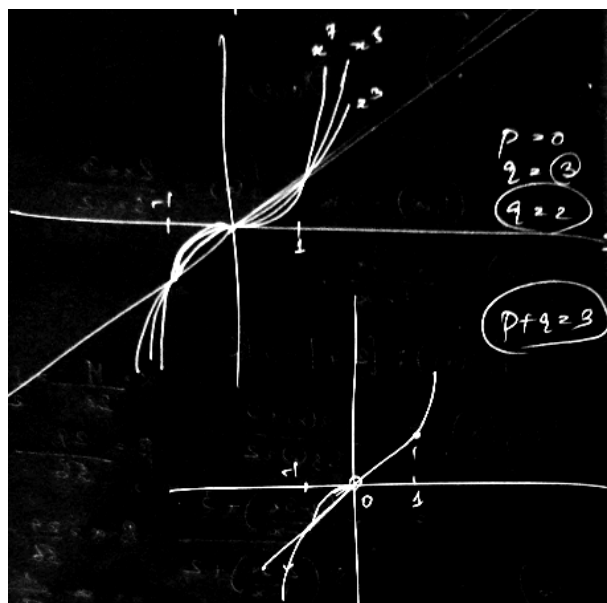
Number of points where $f(x)$ is discontinuous = p

Number of points where $f(x)$ is not differentiable = q

Find $p + q = ?$

Answer: $f(x) = \max\{x, x^3, \dots, x^{21}\}$

$$f(x) = \max\{x, x^3, \dots, x^{21}\}$$



Question: If $A = \{x, y \in \mathbb{Z} : x^2 + y^2 = 25\}$

$B = \{x, y \in \mathbb{Z} : x^2 + 9y^2 = 144\}$

$D = A \cap B$

$C = \{(x, y) : x^2 + y^2 \leq 4, x, y \in \mathbb{Z}\}$

Find the number of one-one function from $D \rightarrow C$

Answer: (17160)

$D = A \cap B$

$$n(D) = 4$$

$$C = \{x, y \in \mathbb{Z} : x^2 + y^2 \leq 4\}$$

$$C = \{(0, 0), (\pm 1, 0), (\pm 2, 0), (0, \pm 1), (0, \pm 2)\}$$

$$n(C) = 13$$

no. of one-one function ${}^{13}P_4 < 4$

$$= \frac{13 \times 12 \times 11 \times 10}{<4} \times <4$$

$$= 156 \times 110$$

$$= 17160$$