

BITSAT Solved Paper 2026 Session-II

1. A planet of mass m moves around the sun of mass M in an elliptical orbit. The maximum and minimum distance of the planet from the sun are r_1 and r_2 respectively. The time period of the planet is proportional to

- (A) $r_1^{2/5}$
 (B) $\left(\frac{r_1+r_2}{2}\right)^{3/2}$
 (C) $\left(\frac{r_1-r_2}{2}\right)^{3/2}$
 (D) $r^{3/2}$

Correct Option: B

Solution:

2. A particle is travelling 4 times as fast as an electron. Assuming the ratio of de-Broglie wavelength of a particle to that of electron is 2 : 1, the mass of the particle is

- (A) 16 times the mass of e^-
 (B) 8 times the mass of e^-
 (C) $\frac{1}{16}$ times the mass of e^-
 (D) $\frac{1}{8}$ times the mass of e^-

Correct Option: D

Solution:

3. Consider the following statements and select the correct option.

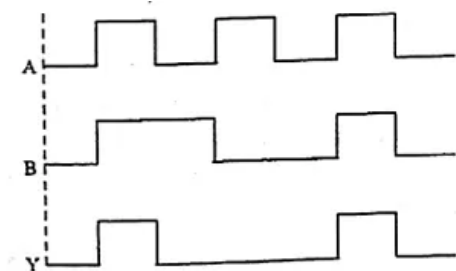
- (i) The ratio of C_P/C_V for a diatomic gas is more than that of a monoatomic gas.
 (ii) The ratio of C_P/C_V is more for helium gas than for hydrogen

- (A) (i) only (B) (ii) only
 (C) (i) and (ii) (D) None of these

Correct Option: B

Solution:

4. A logic gate circuit has two inputs A and B and output Y. The voltage waveforms of A, B and Y are shown below:



The logic gate circuit is

- (A) AND gate (B) OR gate (C) NOR gate (D) NAND gate

Correct Option: B

Solution:

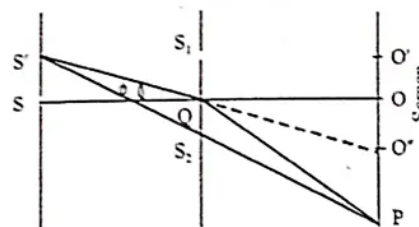
5. If the radius of a nucleus ^{256}X is 8 fermi, then the radius ^4He nucleus will be

- (A) 16 fermi (B) 2 fermi (C) 32 fermi (D) 4 fermi

Correct Option: B

Solution:

6. In the double slit experiment, the monochromatic source shifted to a position S' at an angle ϕ above SQ . The position of central bright fringe will be



- (A) at O' (B) at O
 (C) at O'' (D) at P

Correct Option: C

Solution:

When the source of light shifts by angle ϕ then central fringe appears at angle $-\phi$ as source S' , the mid point Q , and the central fringe are in a straight line.

7. If a thin prism of glass is dipped in water then minimum deviation of light produced by prism will be

$$(a\mu_g = \frac{3}{2}, a\mu_w = \frac{4}{3})$$

- (A) $\frac{1}{5}$ (B) $\frac{1}{8}$
 (C) $\frac{1}{2}$ (D) $\frac{1}{3}$

Correct Option: B

Solution:

8. In a circuit, L , C and R are connected in series with an alternating voltage source of frequency f . The current leads the voltage by 45° . The value of C is

- (A) $\frac{1}{\pi f(2\pi fL - R)}$
 (B) $\frac{1}{2\pi f(2\pi fL - R)}$
 (C) $\frac{1}{\pi f(2\pi fL + R)}$

(D) $\frac{1}{2\pi f(2\pi fL + R)}$

Correct Option: D

Solution:

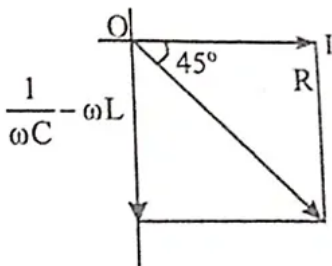
From figure,

$$\tan 45^\circ = \frac{\frac{1}{\omega C} - \omega L}{R}$$

$$\Rightarrow \frac{1}{\omega C} - \omega L = R$$

$$\Rightarrow \frac{1}{\omega C} = R + \omega L$$

$$C = \frac{1}{\omega(R + \omega L)} = \frac{1}{2\pi f(R + 2\pi fL)}$$

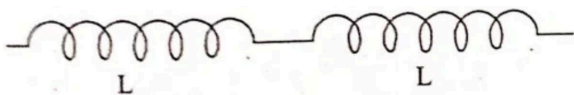


9. Two identical coils each of self-inductance L , are connected in series and placed so close to each other that all the flux from one coil links with the other. The total self-inductance of the system is:

(A) L (B) $2L$ (C) $3L$ (D) $4L$

Correct Option: D

Solution:



$$M = k\sqrt{L_1 L_2} = L$$

$$\phi = LI + LI + 2MI = 4LI = L_{eq}I$$

$$L_{eq} = 4L$$

10. Hail storms are observed to strike the surface of the frozen lake at 30° with the vertical and rebound at 60° with the vertical. Assume contact to be smooth, the coefficient of restitution is :

(A) $e = \frac{1}{\sqrt{3}}$ (B) $e = \frac{1}{3}$

(C) $e = \sqrt{3}$ (D) $e = 3$

Correct Option: B

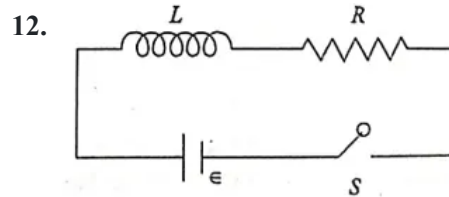
Solution:

11. The following solid objects made of the same material & maintained at a temperature of 300 K in an environment whose temperature is 400 K : a cube of edge r , a sphere of radius r , and a hemisphere of radius r . The object in which the heat exchange is the greatest?

(A) Cube (B) Sphere
(C) Hemisphere (D) Equal in all

Correct Option: B

Solution:



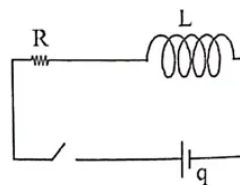
As shown in the figure, a battery of emf ϵ is connected an inductor L and resistance R in series. The switch closed at $t=0$. The total charge that flows from the batte between $t=0$ and $t=t_c$ (t_c is the time constant of the circu is:

(A) $\frac{\epsilon R}{eL^2}$
(B) $\frac{\epsilon L}{R^2} (1 - \frac{1}{e})$
(C) $\frac{\epsilon L}{R^2}$
(D) $\frac{\epsilon R}{eL^2}$

Correct Option: A

Solution:

For series connection of a resistor and inductor, time variation of current is



$$I = I_0 (1 - e^{-t/t_c})$$

Here, $t_c = \frac{L}{R}$

$$q = \int_0^{t_c} i dt$$

$$\Rightarrow q = \int \frac{E}{R} (1 - e^{-t/t_c}) dt$$

$$\Rightarrow q = \frac{E}{R} [t + t_c e^{-t/t_c}]_0^{t_c}$$

$$\Rightarrow q = \frac{E}{R} [t_c + \frac{t_c}{e} - t_c]$$

$$\Rightarrow q = \frac{E}{R} \frac{L}{R e} \therefore q = \frac{EL}{R^2 e}$$

13. Two resistors 400Ω and 800Ω are connected in series across a 6 V battery. The potential difference measured by a voltmeter of $10k\Omega$ across 400Ω resistor is close to:

(A) 2V (B) 1.8 V (C) 2.05V (D) 1.95 V

Correct Option: D

Solution:

14. The average translational energy and the rms speed of molecules in a sample of oxygen gas at 300 K are 6.21×10^{-21} J and 484 m/s respectively. The corresponding values at 600 K are nearly (assuming ideal gas behaviour)

(A) 12.42×10^{-21} J, 968 m/s
 (B) 8.78×10^{-21} J, 684 m/s
 (C) 6.21×10^{-21} J, 968 m/s
 (D) 12.42×10^{-21} J, 684 m/s

Correct Option: D

Solution:

15. A sphere of radius R carries charge density ρ proportional to the square of the distance (r) from the centre such that $\rho = Cr^2$, where C is a positive constant. At a distance $R/2$ from the centre, the magnitude of the electric field is

(A) $\frac{CR^3}{20\epsilon_0}$ (B) $\frac{CR^3}{10\epsilon_0}$
 (C) $\frac{CR^3}{5\epsilon_0}$ (D) None of these

Correct Option: D

Solution:

$$\text{For } r = R/2$$

Using Gauss's law, we have

$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{in}}{\epsilon_0}$$

$$\text{or } E = \frac{Cr^3}{5\epsilon_0} = \frac{CR^3}{40\epsilon_0}$$

16. In an unbiased p-n junction electrons diffuse from n-region to p-region because :

(A) holes in p-region attract them
 (B) electrons travel across the junction due to potential difference
 (C) electron concentration in n-region is more compare to that in p-region
 (D) none of these

Correct Option: C

Solution:

Electrons in an unbiased $p - n$ junction, diffuse from n -region (higher electron concentration) to p -region (low electron concentration region).

17. If a current is passed in a spring, it

(A) gets compressed (B) gets expanded
 (C) oscillates (D) remains unchanged

Correct Option: A

Solution:

The force between two neighbouring turns will be of attractive nature, and so spring will get compressed.

18. An astronomical telescope has a magnifying power 10. The focal length of eyepiece is 20 cm. The focal length objective is

(A) 2 cm (B) 200 cm
 (C) $\frac{1}{2}$ cm (D) $\frac{1}{200}$ cm

Correct Option: B

Solution:

19. A sphere rolls down on an inclined plane of inclination θ . What is the acceleration as the sphere reaches bottom?

(A) $\frac{5}{7}g \sin \theta$ (B) $\frac{3}{5}g \sin \theta$
 (C) $\frac{2}{7}g \sin \theta$ (D) $\frac{2}{5}g \sin \theta$

Correct Option: A

Solution:

Acceleration

$$a = \frac{g \sin \theta}{1 + \frac{K^2}{R^2}} = \frac{g \sin \theta}{1 + \frac{2}{5}} = \frac{5}{7}g \sin \theta$$

20. Under the influence of the Coulomb field of charge $+Q$, charge $-q$ is moving around it in an elliptical orbit. Find out the correct statement(s).

(A) The angular momentum of the charge $-q$ is constant
 (B) The linear momentum of the charge $-q$ is constant

- (C) The angular velocity of the charge $-q$ is constant
 (D) The linear speed of the charge $-q$ is constant

Correct Option: A

Solution:

Conceptual

21. The capacitance of a parallel plate capacitor with air as medium is $6 \mu F$. With the introduction of a dielectric medium, the capacitance becomes $30 \mu F$. The permittivity of the medium is :
 ($\epsilon_0 = 8.85 \times 10^{-12} C^2 N^{-1} m^{-2}$)
- (A) $5.00 C^2 N^{-1} m^{-2}$
 (B) $0.44 \times 10^{-13} C^2 N^{-1} m^{-2}$
 (C) $1.77 \times 10^{-12} C^2 N^{-1} m^{-2}$
 (D) $0.44 \times 10^{-10} C^2 N^{-1} m^{-2}$

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Correct Option: D

Solution:

$$C_m = \epsilon_r C_0$$

$$\epsilon_r = \frac{30}{6} = 5$$

$$\epsilon = \epsilon_0 \cdot \epsilon_r = 8.85 \times 10^{-12} \times 5$$

$$\epsilon = 0.44 \times 10^{-10}$$

22. An ideal black body at room temperature is thrown into a furnace. It is observed that
- (A) Initially it is the darkest body and at later times the brightest
 (B) It is the darkest body at all times
 (C) It cannot be distinguished at all times
 (D) Initially it is the darkest body and at later times it cannot be distinguished

Correct Option: A

Solution:

Initially black body absorbs all the radiant energy incident on it, So it is the darkest one. Black body radiates maximum energy if all other condition are same. So when the temperature of the black body becomes equal to the temperature of furnace it will be brightest of all.

23. Two uniform brass rods A and B of length l and $2l$ and radii $2r$ and r respectively are heated to the same temperature. The ratio of the increase in the volume of A to that of B is

- (A) 1: 1 (B) 1: 2 (C) 2: 1 (D) 1: 4

Correct Option: C

Solution:

Let the original temperature be $0^\circ C$; Volume of

$$A = l \times \pi(2r)^2 = V_1; V_1' = V_1(1 + \gamma \Delta T)$$

$$\frac{(V_1' - V_1)}{V_1} = \gamma \Delta T \Rightarrow V_1' - V_1 \propto V_1 \Rightarrow \frac{(V_2' - V_2)}{V_2} = \gamma \Delta T$$

$$\Rightarrow V_2' - V_2 \propto V_2 \therefore \frac{\Delta V_1}{\Delta V_2} = \frac{l(2r)^2}{2lr^2} = \frac{2}{1}$$

24. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, the new value of magnetic field will be equal to

- (A) B (B) $2B$
 (C) $4B$ (D) $\frac{B}{2}$

Correct Option: A

Solution:

$$B_1 = \mu_0 n I$$

$$B_2 = \mu_0 \left(\frac{n}{2}\right) (2I)$$

$$\Rightarrow B_1 = B_2$$

25. A liquid of density ρ is coming out of a hose pipe of radius a with horizontal speed v and hits a mesh. 50% of the liquid passes through the mesh unaffected. 25% loses all of its momentum and 25% comes back with the same speed. The resultant pressure on the mesh will be :

- (A) pv^2 (B) $\frac{3}{4}pv^2$
 (C) $\frac{1}{2}pv^2$ (D) $\frac{1}{4}pv^2$

Correct Option: B

Solution:

Momentum per second carried by liquid per second is ρav

net force due to reflected

$$\text{liquid} = 2 \times \left[\frac{1}{4}\rho av^2\right]$$

$$\text{net force due to stopped liquid} = \frac{1}{4}\rho av^2$$

$$\text{Total force} = \frac{3}{4}\rho av^2$$

$$\text{net pressure} = \frac{3}{4}\rho v^2$$

26. The energy required to ionise a hydrogen like ion in its ground state is 9 Rydbergs.

What is the wavelength of the radiation emitted when the electron in this ion jumps from the second excited state to the ground state?

- (A) 35.8 nm (B) 24.2 nm (C) 8.6 nm (D) 11.4 nm

Correct Option: D

Solution:

$$1 \text{ Rydberg energy} = 13.6 \text{ eV}$$

$$\text{So, ionisation energy} = (13.6Z^2) \text{ eV}$$

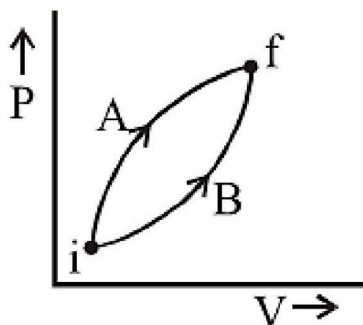
$$= 9 \times 13.6 \text{ eV}$$

$$Z = 3$$

$$\frac{1}{\lambda} = RZ^2 \left(\frac{1}{1^2} - \frac{1}{3^2} \right) = 1.09 \times 10^7 \times 9 \times \frac{8}{9}$$

$$\lambda = 11.4 \text{ nm}$$

27. Following figure shows two processes A and B for a gas. If ΔQ_A and ΔQ_B are the amount of heat absorbed by the system in two cases, ΔU_A and ΔU_B are changes in internal energies, respectively, then:



- (A) $\Delta Q_A = \Delta Q_B$; $\Delta U_A = \Delta U_B$
 (B) $\Delta Q_A > \Delta Q_B$; $\Delta U_A = \Delta U_B$
 (C) $\Delta Q_A > \Delta Q_B$; $\Delta U_A > \Delta U_B$
 (D) $\Delta Q_A < \Delta Q_B$; $\Delta U_A < \Delta U_B$

Correct Option: B

Solution:

Initial and final states for both the processes are same.

Work done during process A is greater than in process B.

By First Law of thermodynamics

$$\Delta Q = \Delta U + W$$

$$\Rightarrow \Delta Q_A > \Delta Q_B$$

28. Consider a planet in some solar system which has a mass double the mass of earth and density equal to the average density of earth. If the weight of an object on earth is W the weight of the same object on that planet will be:

- (A) 2 W (B) W
 (C) $2^{\frac{1}{3}}$ W (D) $\sqrt{2}$ W

JM 2021

Correct Option: C

Solution:

Density is same

$$M = \frac{4}{3}\pi R^3 \rho, 2$$

$$M' = \frac{4}{3}\pi R'^3 \rho$$

$$R' = 2^{1/3} R$$

$$\omega = \left| \frac{GMm}{R^2} \right|$$

$$\omega_2 = \frac{G \cdot 2Mm}{R'^2}$$

$$\omega_2 = 2^{1/3} \omega$$

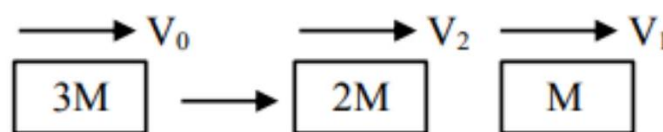
29. A block moving horizontally on a smooth surface with speed of 40 m/s splits into two parts with masses in ratio of 1 : 2. If the smaller part moves at 60 m/s in the same direction, then the fractional change in kinetic energy is :-

- (A) $\frac{1}{3}$ (B) $\frac{2}{3}$
 (C) $\frac{1}{8}$ (D) $\frac{1}{4}$

JM 2021

Correct Option: C

Solution:



$$3M V_0 = 2M V_2 + M V_1$$

$$120 = 2 V_2 + 60 \Rightarrow$$

$$V_2 = 30 \text{ m/s}$$

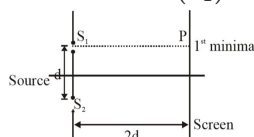
$$\frac{\Delta K.E.}{K.E.} = \frac{\frac{1}{2} M V_1^2 + \frac{1}{2} 2 M V_2^2 - \frac{1}{2} 3 M V_0^2}{\frac{1}{2} 3 M V_0^2}$$

$$= \frac{V_1^2 + 2 V_2^2 - 3 V_0^2}{3 V_0^2}$$

$$= \frac{3600 + 1800 - 4800}{4800}$$

$$= \frac{1}{8}$$

30. Consider a Young's double slit experiment as shown in figure. What should be the slit separation d in terms of wavelength λ such that the first minima occurs directly in front of the slit (S_1)?



[2019 : 10 Jan Shift 2]

- (A) $\frac{\lambda}{2(5-\sqrt{2})}$
 (B) $\frac{\lambda}{(5-\sqrt{2})}$
 (C) $\frac{\lambda}{(\sqrt{5}-2)}$
 (D) $\frac{\lambda}{2(\sqrt{5}-2)}$

Correct Option: D

Solution:

$$\sqrt{5}d - 2d = \frac{\lambda}{2}$$

31. Match the LIST-I with LIST-II

	LIST-I (Reagent)		(Functional Group detected)
A.	Sodium bi-carbonate solution	I.	double bond/ unsaturation
B.	Neutral ferric chloride	II.	carboxylic acid
C.	Ceric ammonium nitrate	III.	phenolic-OH
D.	Alkaline KMnO_4	IV.	alcoholic - OH

- (A) A-II, B-III, C-IV, D-I (B) A-II, B-III, C-I, D-IV
 (C) A-III, B-II, C-IV, D-I (D) A-II, B-IV, C-III, D-I

Correct Option: A

Solution:

32. Identify Z in the following series
 $\text{C}_2\text{H}_5\text{I} \xrightarrow{\text{Alc.KOH}} \text{X} \xrightarrow{\text{Br}_2} \text{Y} \xrightarrow{2\text{KCN}} \text{Z}$

- (A) $\text{CH}_3\text{CH}_2\text{CN}$
 (B) $\text{NCCH}_2 - \text{CH}_2\text{CN}$
 (C) $\text{BrCH}_2 - \text{CH}_2\text{CN}$
 (D) $\text{BrCH} = \text{CHCN}$

Correct Option: B

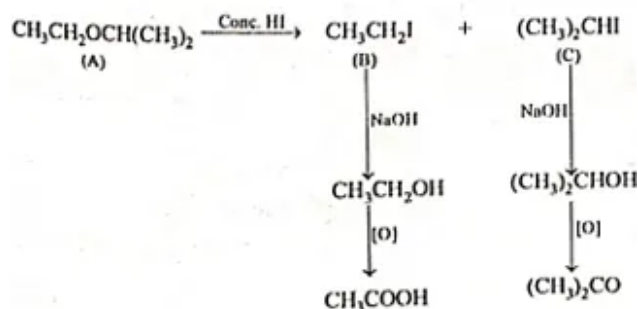
Solution:

33. An ether (A), $\text{C}_5\text{H}_{12}\text{O}$, when heated with excess of hot concentrated HI produced two alkyl halides which when treated with NaOH yielded compounds (B) and (C). Oxidation of (B) and (C) gave a propanone and an ethanoic acid respectively. The IUPAC name of the ether (A) is:

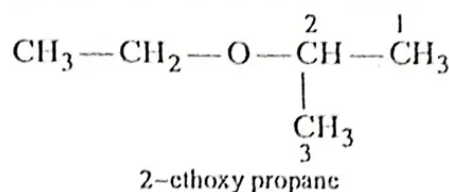
- (A) 2-ethoxypropane (B) ethoxypropane
 (C) methoxybutane (D) 2-methoxybutane

Correct Option: A

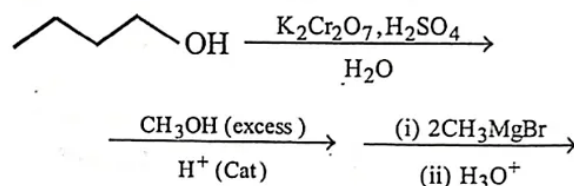
Solution:

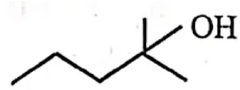


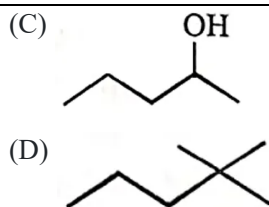
Hence the IUPAC name of compound is



34. The end product of the following sequence of reactions



- (A) 
 (B) 



Correct Option: A

Solution:

35. The correct statement regarding nucleophilic substitution reaction in a chiral alkyl halide is :

- (A) Retention occurs in S_N1 reaction and inversion occurs in S_N2 reaction.
- (B) Racemisation occurs in S_N1 reaction and retention occurs in S_N2 reaction.
- (C) Racemisation occurs in both S_N1 and S_N2 reactions.
- (D) Racemisation occurs in S_N1 reaction and inversion occurs in S_N2 reaction.

Correct Option: D

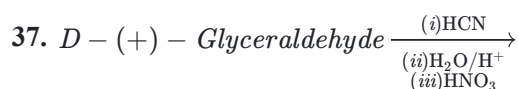
Solution:

36. A substance $C_4H_{10}O$ yields on oxidation a compound, C_4H_8O which gives an oxime and a positive iodoform test. The original substance on treatment with conc. H_2SO_4 gives C_4H_8 . The structure of the compound is

- (A) $CH_3CH_2CH_2CH_2OH$
- (B) $CH_3CHOHCH_2CH_3$
- (C) $(CH_3)_3COH$
- (D) $CH_3CH_2-O-CH_2CH_3$

Correct Option: B

Solution:

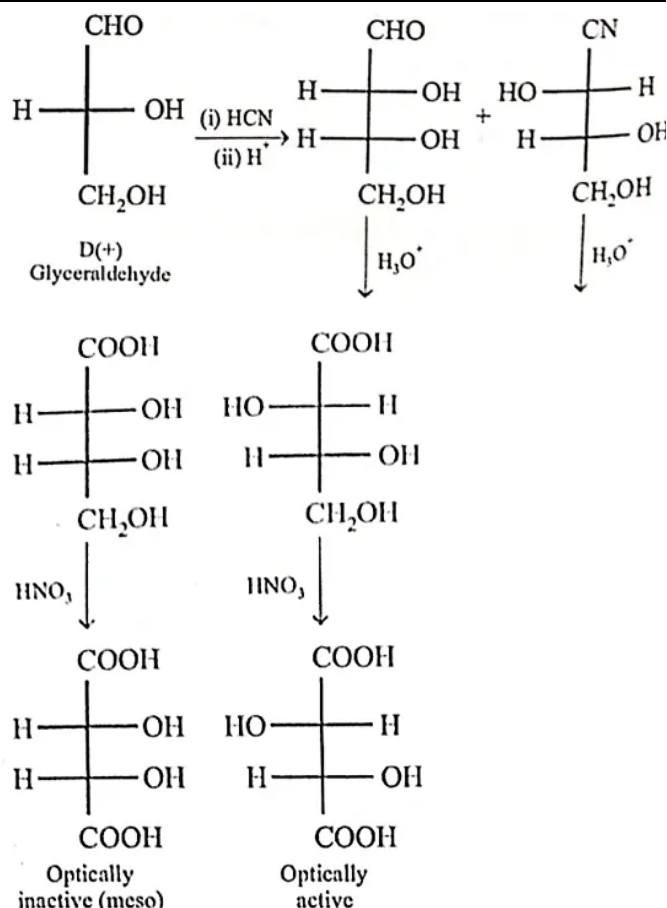


The products formed in the above reaction are:

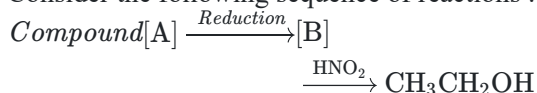
- (A) Two optically active products
- (B) One optically active and one meso product
- (C) One optically inactive and one meso product
- (D) Two optically inactive products

Correct Option: B

Solution:



38. Consider the following sequence of reactions :



The compound [A] is

- (A) CH_3CH_2CN
- (B) CH_3NO_2
- (C) CH_3NC
- (D) CH_3CN

Correct Option: D

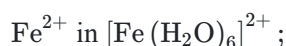
Solution:

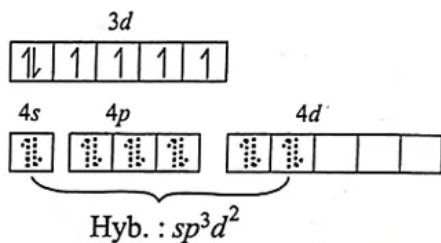
39. $[Fe(H_2O)_6]^{2+}$ and $[Fe(CN)_6]^{4-}$ differ in :

- (A) geometry, magnetic moment
- (B) geometry, hybridization
- (C) magnetic moment, colour
- (D) hybridization, number of d-electrons

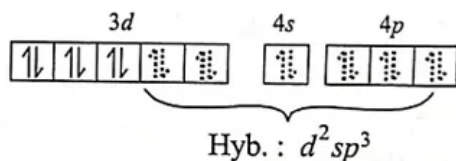
Correct Option: C

Solution:





Colour : Pale green $\mu = 4.9$ B.M.; octahedral Fe^{2+} in $[Fe(CN_6)]^{4-}$;



Colour: Yellow; $\mu = 0$; octahedral

40. Given that : $E_{Ag^+/Ag}^\circ = 0.80$ V and $[Ag^+] = 10^{-3}$ M; $E_{Hg_2^{2+}/Hg}^\circ = 0.785$ V and $[Hg_2^{2+}] = 10^{-1}$ M which is true for the cell reaction
- $$2Hg(l) + 2Ag^+(aq) \rightarrow 2Ag(s) + Hg_2^{2+}(aq)?$$

- (A) The forward reaction is spontaneous
 (B) The backward reaction is spontaneous
 (C) $E_{cell} = 0.163$ V
 (D) $E_{cell} = 1.585$ V

Correct Option: B

Solution:

41. 1.0 M aqueous solution of $CrCl_3 \cdot 6H_2O$ freezes at $-5.58^\circ C$. Assuming complete ionization of the hydrated complex, which of the following isomers conforms to the observation (K_f for water = 1.86 K kg mol $^{-1}$)?

- (A) $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$
 (B) $[Cr(H_2O)_4Cl_4]Cl \cdot 2H_2O$
 (C) $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$
 (D) $[Cr(H_2O)_6]Cl_3$

Correct Option: C

Solution:

42. Match the following reactions in Column-I with the corresponding names in Column-II.

	Column-I		Column-II
(A)	$C_2H_6 \xrightarrow[C_2H_5Cl]{Cl_2/UV\ light}$	(p)	Finkelstein reaction

(B)	$C_6H_5NH_2 \xrightarrow[NaNO_2+HCl/Cu_2Cl_2]{273-278\ K} C_6H_5Cl$	(q)	Free radical substitution
(C)	$CH_3Cl + NaI/4^\circ \rightarrow CH_3I + NaCl$	(r)	Swarts reaction
(D)	$CH_3-Br + AgF_3/4^\circ \rightarrow CH_3F + AgBr$	(s)	Sandmeyer's reaction

Choose the correct matching option below:

- (A) A-(q), B-(s), C-(p), D-(r) (B) A-(q), B-(r), C-(p), D-(s)
 (C) A-(r), B-(p), C-(s), D-(q) (D) A-(s), B-(r), C-(p), D-(q)

Correct Option: A

Solution:

43. Which one of the following lanthanide ions does not exhibit paramagnetism?

- (A) Lu^{3+} (B) Ce^{3+}
 (C) Eu^{3+} (D) Yb^{3+}

Correct Option: A

Solution:

44. Magnetic moment of Gd^{3+} ion ($Z = 64$) is

- (A) 3.62 BM (B) 9.72 BM (C) 7.9 BM (D) 10.60 B

Correct Option: C

Solution:

45. What is the decreasing order of strength of the bases OH^- , NH_2^- , $HC \equiv C^-$ and $CH_3CH_2^-$?

- (A) $CH_3CH_2^- > NH_2^- > HC \equiv C^- > OH^-$
 (B) $HC \equiv C^- > CH_3CH_2^- > NH_2^- > OH^-$
 (C) $OH^- > NH_2^- > HC \equiv C^- > CH_3CH_2^-$
 (D) $NH_2^- > HC \equiv C^- > OH^- > CH_3CH_2^-$

Correct Option: A

Solution:

46. Match the following techniques with their applications:

	Column-I (Technique)		Column-II (Application)
--	-------------------------	--	----------------------------

(A)	Distillation	(p)	Separation of glycerol from spentlye
(B)	Fractional distillation	(q)	Aniline-Water mixture
(C)	Steam distillation	(r)	Separation of crude oil fractions
(D)	Distillation under	(s)	Chloroform-Aniline pressure

Choose the correct answer from the options given below:

- (A) (a) A-(s), B-(p), C-(q), D-(r) (B) (b) A-(s), B-(r), C-(q), D-(p)
- (C) (c) A-(p), B-(q), C-(s), D-(r) (D) (d) A-(q), B-(r), C-(p), D-(s)

Correct Option: B

Solution:

47. Acidic hydroxide formed by group 13 is:

- (A) $\text{Al}(\text{OH})_3$ (B) $\text{Ca}(\text{OH})_3$
- (C) $\text{Tl}(\text{OH})_3$ (D) $\text{B}(\text{OH})_3$

Correct Option: D

Solution:

48. The half life period for catalytic decomposition of AB_3 at 50 mm Hg is 4 hrs and at 100 mm Hg it is 2 hrs. The order of reaction is

- (A) 1 (B) 3 (C) 2 (D) 0

Correct Option: C

Solution:

49. The dissociation constant of two acids HA_1 and HA_2 are 3.14×10^{-4} and 1.96×10^{-5} respectively. The relative strength of the acids will be approximately

- (A) 1:4 (B) 4:1 (C) 1:16 (D) 16:1

Correct Option: B

Solution:

50. Match Column-I with Column-II. Choose the correct answer from the options below:

Column-I (Molecule)	Column-II (Shape)
(A) NH_3	(p) Square pyramid
(B) BrF_5	(q) Tetrahedral
(C) PCl_5	(r) Trigonal pyramidal
(D) CH_4	(s) Trigonal bipyramidal

Choose the correct answer from the options below:

- (A) A - (r), B - (p), C - (s), D - (q)
- (B) A - (s), B - (r), C - (p), D - (q)

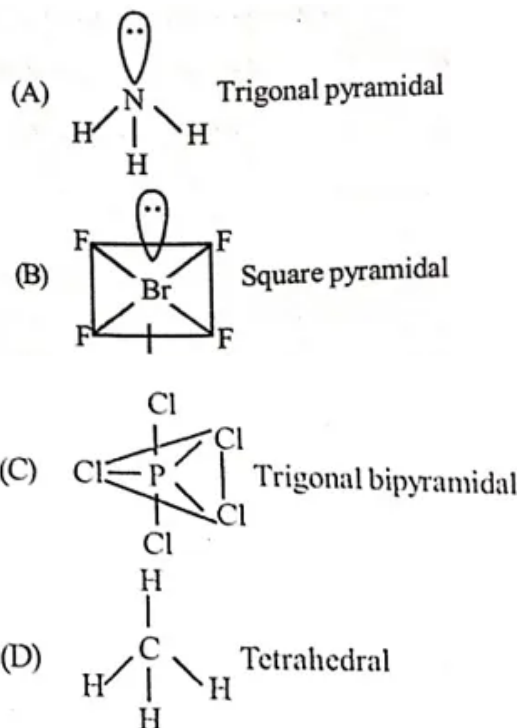
(C) A - (q), B - (s), C - (p), D - (r)

(D) A - (r), B - (s), C - (p), D - (q)

Correct Option: A

Solution:

(C) Molecules and their shapes are:



51. Assertion : Threshold frequency is the minimum frequency required for the ejection of electron from metal surface.

Reason : Threshold frequency is characteristic of a metal.

- (A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
- (B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
- (C) If the Assertion is correct but Reason is incorrect.
- (D) If the Assertion is incorrect but Reason is correct.

Correct Option: D

Solution:

The threshold frequency is the minimum frequency required for the ejection of electron from the metal surface.

52. Statement I : The electron gain process may be exothermic or endothermic whereas ionization is always endothermic.

Statement II : The Lattice Enthalpy of an ionic solid is defined as the energy required to completely separate one mole of a solid ionic compound into gaseous constituent ions.

- (A) Both statement I and II are correct.
 (B) Both statement I and II are incorrect.
 (C) Statement I is correct but statement II is incorrect.
 (D) Statement II is correct but statement I is incorrect.

Correct Option: D

Solution:

The electron gain process may be exothermic or endothermic whereas ionization is always endothermic.

53. Pick out the wrong statement.

- (A) Nitrogen has the ability to form $p\pi - p\pi$ bonds with itself.
 (B) Bismuth forms metallic bonds in elemental state.
 (C) Catenation tendency is higher in nitrogen when compared with other elements of the same group.
 (D) Nitrogen has higher first ionisation enthalpy when compared with other elements of the same group.

Correct Option: C

Solution:

54. In which of the following pairs is there the greatest difference in the oxidation numbers of the underlined elements?

- (A) NO₂ and N₂O₄
 (B) P₂O₅ and P₄O₁₀
 (C) N₂O and NO
 (D) SO₂ and SO₃

Correct Option: D

Solution:

- (1) NO₂ ($x = 4$), N₂O₄ ($x = 4$)

Difference in oxidation state of N = 0

- (2) P₂O₅ and P₄O₁₀ (Difference in oxidation state of P is zero)

- (3) N₂O ($x = 1$) and NO ($x = 2$).

Difference in oxidation state of N = 1.

- (4) SO₂ ($x = 4$) and (SO₃) ($x = 6$)

Difference in oxidation state of S = 2

55. Compound A contains 8.7% Hydrogen, 74% Carbon and 17.3% Nitrogen. The molecular formula of the compound is, Given : Atomic masses of C, H and N are 12, 1 and amu respectively. The molar mass of the compound A 162 g mol⁻¹.

- (A) C₄H₆ N₂
 (B) C₂H₃ N
 (C) C₅H₇ N
 (D) C₁₀H₁₄ N₂

Correct Option: D

Solution:

C	74%	$\frac{74}{12} = 6.16$	$\frac{6.16}{1.23} = 5$
N	17.3%	$\frac{17.3}{14} = 1.23$	$\frac{1.23}{1.23} = 1$
H	8.7%	$\frac{8.7}{1} = 8.7$	$\frac{8.7}{1.23} = 7$

Empirical formula = C₅NH₇

Empirical weight = $(12 \times 5) + (14 \times 1) + (1 \times 7) = 81 \text{amu}$

Given, molecular weight = 162 g/mol

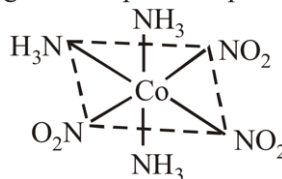
Multiplying factor = $\frac{\text{Molecular weight}}{\text{Empirical weight}}$

$$= \frac{162}{81} = 2$$

Molecular formula = 2 × (Empirical formula)

C₁₀ N₂ H₁₄

56. Which of the following type of isomerism is shown given complex compound?



- (A) Facial
 (B) Meridional
 (C) Cis
 (D) Both b and c

Correct Option: B

Solution:

Given compound shows meridional isomerism.

57. 10 mL of 2 M NaOH solution is added to 20 mL of 1 M HCl solution kept in a beaker. Now, 10 mL of this mixture is poured into a volumetric flask of 100 mL containing 2 moles of HCl and made the volume upto the mark with distilled water. The solution in this flask is :

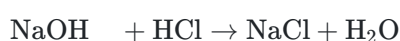
(A) 0.2 M NaCl solution (B) 20 M HCl solution
(C) 10 M HCl solution (D) Neutral solution

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Correct Option: B

Solution:

When 10ml, 2MNaOH solution is added to 20 ml of 1 M HCl solution :



$$\text{Initial : } MV = 2 \times 0.1 \quad MV = 1 \times 0.2$$

$$= 0.2 \text{ mole} \quad = 0.2 \text{ mole}$$

Final 00 $\therefore$ Resulting solution becomes neutral. Now when 10 mol of above solution is poured into a flask containing 2 mole HCl and made solution 100 ml will distilled water.

$$\text{Molarity of HCl} = \frac{2}{100} \times 1000 = 20$$

58. Heat treatment of muscular pain involves radiation of wavelength of about 900 nm . Which spectral line of H atom is suitable for this?

(Given: Rydberg constant $R_H = 10^5 \text{ cm}^{-1}$, $h = 6.6 \times 10^{-34} \text{ J s}$, $c = 3 \times 10^8 \text{ m/s}$)

(A) Paschen series, $\infty \rightarrow 3$
(B) Lyman series, $\infty \rightarrow 1$
(C) Balmer series, $\infty \rightarrow 2$
(D) Paschen series, $5 \rightarrow 3$

Correct Option: A

Solution:

$$\lambda = 900 \text{ nm}$$

$$= 900 \times 10^{-7} \text{ cm} = 9 \times 10^{-5} \text{ cm}$$

$R_H = 10^5 \text{ cm}^{-1}$; For H -atom ($Z = 1$) According to Rydberg eq.

$$\frac{1}{\lambda} = R_H Z^2 \times \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$\Rightarrow \frac{1}{\lambda \times R_H} = \frac{1}{n_1^2} - \frac{1}{n_2^2}$$

$$\Rightarrow \frac{1}{9 \times 10^{-5} \text{ cm} \times 10^5 \text{ cm}^{-1}} = \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$\Rightarrow \frac{1}{n_1^2} - \frac{1}{n_2^2} = \frac{1}{9}$$

It is possible when $n_1 = 3, n_2 = \infty$

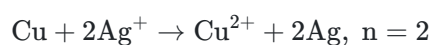
Possible series : $\infty \rightarrow 3$

59. For the reduction of silver ions with copper metals, the standard cell potential was found to be + 0.46 V at 25°C. The value of standard Gibbs energy, ΔG° , will be ($F = 96500 \text{ Cmol}^{-1}$)

(A) -98.0 kJ (B) -89.0 kJ (C) -89.0 J (D) -44.5 kJ

Correct Option: B

Solution:



$$G = -nFE$$

Where G = standard Gibbs energy

$$E = +0.46 \text{ V}$$

$$G = -0.46 \times 96500 \times 2 = -89 \text{ KJ}$$

60. If a reaction involves only solids and liquids which of the following is true ?

(A) $\Delta H < \Delta E$
(B) $\Delta H = \Delta E$
(C) $\Delta H > \Delta E$
(D) $\Delta H = \Delta E + RT\Delta n$

Correct Option: B

Solution:

$$\Delta H = \Delta E + P\Delta V, \text{ for solid and liquid,}$$

$$\Delta V = 0 \text{ or } \Delta H = \Delta E + \Delta nRT, \text{ for solids and liquids}$$

$$\Delta n = 0.$$

61. I. Public spaces influence the way people experience city.

P. Such spaces can encourage interaction among people who might otherwise remain socially separate.

Q. Their significance, however, extends beyond their physical appearance or recreational function.

R. Parks, plazas, libraries, and pedestrian areas often serve as meeting points for diverse groups.

S. They can also contribute to a sense of belonging giving residents places that they collectively recognise part of their community.



VI. Consequently, the design of public spaces can shape not only movement through a city but also the social relationships within it.

(A) PQRS (B) QRSP (C) RPSQ (D) RQPS

Correct Option: D

Solution:

The correct sequence is R-Q-P-S. R provides examples of public spaces and their social function. Q shifts the discussion beyond their physical appearance. P explains their role in encouraging social interaction, while S develops this idea by describing how such spaces create a sense of belonging.

62. Choose the word opposite in meaning to the word given in capital.

RETICENT

(A) Reserved (B) Taciturn
(C) Communicative (D) Reluctant

Correct Option: C

Solution:

Reticent means reserved or unwilling to speak freely. Communicative means willing and able to express thoughts or information openly, making it the correct antonym. Reserved, taciturn, and reluctant are related to the meaning of reticent.

63. Choose the word which is nearest in meaning to the given word.

INIMICAL

(A) Hostile (B) Beneficial
(C) Impartial (D) Compatible

Correct Option: A

Solution:

Inimical means hostile, unfriendly, or harmful to someone or something. Therefore, hostile is its closest synonym. Beneficial is actually an opposite, while impartial and compatible have unrelated meanings.

64. Choose the most effective word from the given options to fill in the blank and to make the sentence meaningfully complete.

The historian remained ____ about attributing the manuscript to a particular author, citing the absence of conclusive evidence.

(A) categorical (B) circumspect

(C) credulous

(D) emphatic

Correct Option: B

Solution:

Circumspect means cautious and careful, especially when making judgments in the absence of complete evidence. Since the historian avoids making a definite attribution because the evidence is inconclusive, circumspect is the most appropriate choice.

65. Choose the most effective word from the given options fill in the blank and to make the sentence meaningfully complete.

The proposed legislation was intended to _____ the disparity between the privileges enjoyed by urban residents and those available to people in remote regions.

(A) exacerbate (B) perpetuate
(C) mitigate (D) accentuate

Correct Option: C

Solution:

Mitigate means to reduce the severity, intensity, or harmful effect of something. The legislation is intended to reduce the disparity, so mitigate fits precisely. Exacerbate and accentuate would increase or emphasise the disparity, while perpetuate means to maintain it.

66. In the questions given below, find out the part of the sentence which contains an error.

(A) Neither the revised guidelines nor the supplementary instructions
(B) was circulated among the regional offices
(C) before the inspection team arrived
(D) at the end of the month.

Correct Option: B

Solution:

With the construction "neither...nor," the verb generally agrees with the subject closer to it. Here, "supplementary instructions" is plural, so the verb should be "were circulated," not "was circulated." Therefore, the error is in (b).

67. In the sentences given below, find out the part which contains an error:

(A) The report recommends that the department should reconsider
(B) its current policy in view of the evidence

(C) that has emerged since the investigation began.

(D) No error

Correct Option: D

Solution:

The sentence is grammatically acceptable: "The report recommends that the department should reconsider its current policy..." The use of *should* after *recommend* is a recognised construction, particularly in British English and formal usage. Therefore, there is no error.

68. In the question below, a part of the sentence is underlined. Below are given alternatives to the underlined part which may improve the sentence. Choose the correct alternative. In case no improvement is needed, mark your answer as option (d).

The manager is accustomed to work under considerable pressure during the final stages of a project.

- (A) is accustomed to working under considerable pressure
- (B) has accustomed to working under considerable pressure
- (C) is accustomed for working under considerable pressure
- (D) No improvement

Correct Option: A

Solution:

The expression "be accustomed to" is followed by a noun or gerund (-ing form) because to functions as a preposition here. Therefore, "accustomed to working" is correct, not "accustomed to work."

69. I. Scientific progress rarely follows the neat and predictable path that is often presented in retrospect.
P. Unexpected observations can therefore become more valuable than results that merely confirm an existing hypothesis.

Q. Researchers may initially regard such findings as irrelevant or even troublesome.

R. Yet some of the most significant discoveries have emerged from anomalies that challenged prevailing assumptions.

S. Their significance becomes apparent only when investigators are willing to examine why the results differ from expectations.

VI. Thus, scientific advancement often depends not only on confirmation but also on the willingness to investigate the unexpected.

- (A) R-Q-S-P (B) Q-R-S-P (C) R-Q-P-S (D) Q-S-R-P

Correct Option: A

Solution:

The correct sequence is R-Q-S-P. R introduces discoveries emerging from unexpected anomalies. Q refers back to these findings and explains how researchers may initially dismiss them. S explains when their significance becomes apparent, while P draws the conclusion about the value of unexpected observations.

70. The committee's decision to reject the proposal opened a can of worms that the administration had hoped to keep closed.

- (A) Resolved several complicated issues at once
- (B) Created an opportunity to reconsider an old decision
- (C) Revealed a number of unexpected problems
- (D) Prevented a minor disagreement from becoming serious

Correct Option: C

Solution:

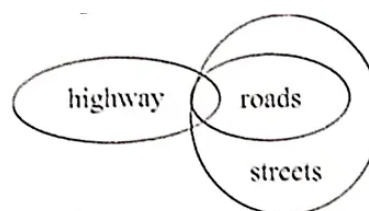
The idiom "open a can of worms" means to create or uncover a complicated set of problems or difficulties that may be difficult to control or resolve. Hence, (c) is the correct meaning.

71. In each question below are given statements followed by two conclusions numbered I and II. You have to take both given statements to be true even if they seem to be in variance with commonly known facts. Read the conclusions logically and choose the one that follows from the given statements disregarding commonly known facts. Give answer.

- (A) Conclusion I follows
- (B) Conclusion II follows
- (C) Either Conclusion I or II follows
- (D) Neither Conclusion I nor II follows
- (E) Both Conclusions I and II follow

Correct Option: A

Solution:



Conclusion:-

(I) All high ways being streets is a possibility (P)

(II) Some streets are not highways (O)

72. In each question bellow are given statements followed by two conclusions numbered I and II. You have take the two given statements to be true even if they seem to be at variance with commonly known facts. Read the conclusions logically follows from the given statements disregarding commonly known facts. Give answer:

Statement:

Some wars are battle.

All fights are wars.

Conclusion:

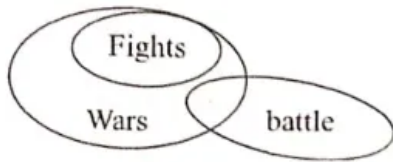
I. All fights being battle is a possibility.

II. No fight is a battle.

- (A) Conclusion I follows
(B) Conclusion II follows
(C) Either Conclusion I or II follows
(D) Neither Conclusion I nor II follows
(E) Both Conclusions I and II follow

Correct Option: A

Solution:

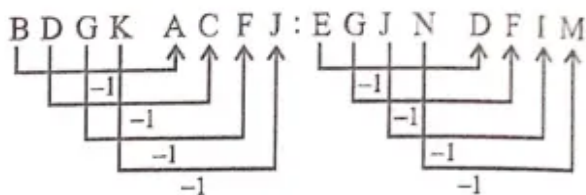


Conclusion:-

- (I) All fights being battle is a possibility. (P)
(II) No fight is a battle. (O)
73. BDGK : ACFJ :: ? : DFIM
(A) FKGH (B) EGJN (C) EGIK (D) FGHI

Correct Option: B

Solution:



74. From the given alternatives select the word which cannot be formed using the letters of the given word ADMINISTRATOR.

(A) ADMIT (B) NEST (C) MANIA (D) ROAD

Correct Option: B

Solution:

There is no 'E' letter in the given word.

75. In a certain code language 'La Ke Ta' means 'go and swim', 'Ne La Se' means 'you swim here' and 'Pe Ke Ne Ta' means 'he and you go'. Which of the following is the code for 'here' in that code language?

- (A) Cannot be determined (B) La
(C) Ne (D) None of these

Correct Option: D

Solution:

La Ke Ta → go and swim

Ne La Se → you swim here

Pe ke Ne Ta → he and you go

Hence, the code for 'here' is 'Se'

76. P is father of J. S is mother of N who is brother of J. B son of S. C is sister of B. How J is related to C?

- (A) Data inadequate (B) Cousin
(C) Brother (D) Sister

Correct Option: A

Solution:

P(+) ↔ S(-)

J - N(+) B(+) - C(-)

The gender of J is unknown, therefore J may be brother or sister of C.

77. YONEX : DUUMG :: JASPO : ?

- (A) OGZXY (B) OXXZF (C) OZTYT (D) OZXXC

Correct Option: A

Solution:

As,

Y	O	N	E	X
+5↓	+6↓	+7↓	+8↓	+9↓
D	U	U	M	G

Similarly

J	A	S	T	O
+5↓	+6↓	+7↓	+8↓	+9↓
O	G	Z	X	Y

78. Arrange the following words according to the dictionary order:

extol
extinct
extra
extort

(A) 4, 3, 1, 2

(B) 1, 4, 2, 3

(C) 1, 2, 3, 4

(D) 2, 1, 4, 3

Correct Option: D**Solution:**

79. In the following question, select the missing number from the given series.

49	169	484
81	144	625
16	25	?

(A) 37

(B) 47

(C) 48

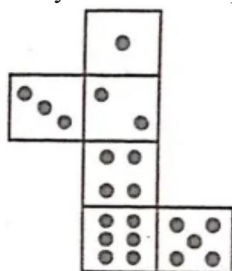
(D) 25

Correct Option: B**Solution:**

$$(b) \begin{array}{lll} \sqrt{49} = 7 & \sqrt{169} = 13 & \sqrt{484} = 22 \\ \sqrt{81} = \frac{+9}{16} & \sqrt{144} = \frac{+12}{25} & \sqrt{625} = \frac{+25}{47} \end{array}$$

So, Answer is 47.

80. When the following figure is folded to form a cube, how many dots will lie opposite to the face bearing five dots?



(A) 1

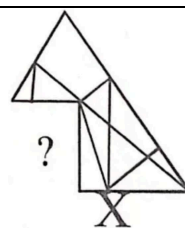
(B) 2

(C) 3

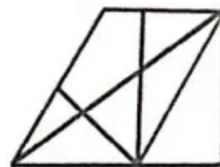
(D) 4

Correct Option: C**Solution:**

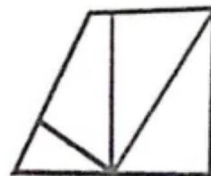
When this figure is folded to form a cube then the face bearing **three dots** will lie opposite the face bearing five dots.

81. Question Figure:

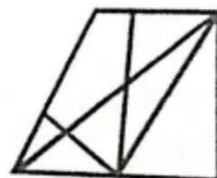
(A)



(B)



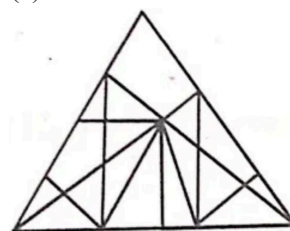
(C)



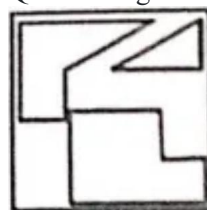
(D)

**Correct Option: A****Solution:**

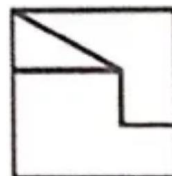
(a)

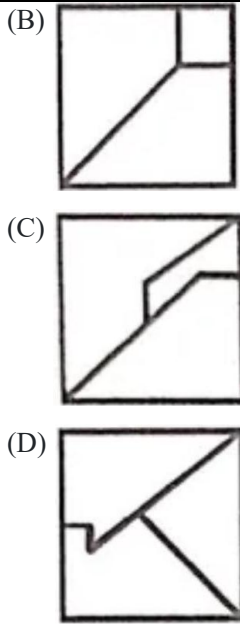


82. Problem figure is given and four answer figures, mark (a), (b), (c), (d) are given. Select the answer figure which can be formed from the cut-off pieces given in the Question figure.



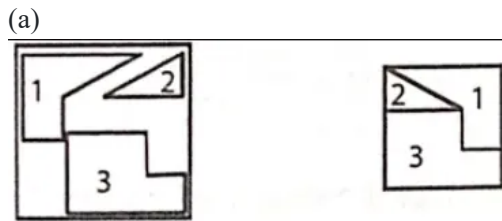
(A)



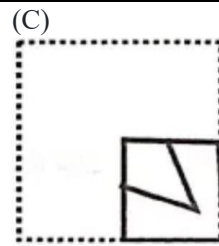
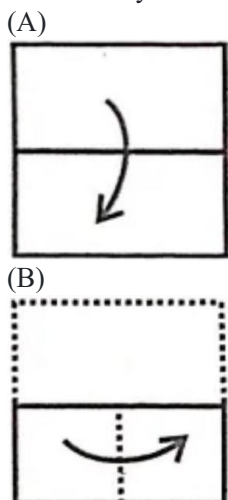


Correct Option: A

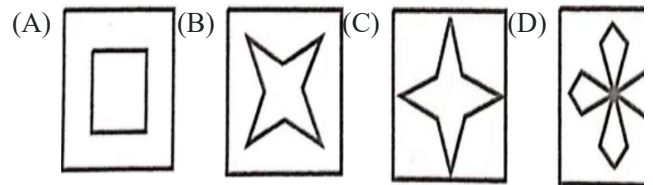
Solution:



83. In the following question, a set of three figures A, B, and C show a sequence of folding of a piece of paper. Fig. (C) shows the manner in which the folded paper has been cut. These three figures are followed by four answer figures from which you have to choose a figure which would most closely resemble the unfolded form of fig. (C).



Answer Figures:



Correct Option: B

Solution:

84. In the following question, select the number which can be placed at the sign of question mark (?) from the given alternatives.

63		64		245	
7	21	4	16	5	?

- (A) 45 (B) 30 (C) 40 (D) 35

Correct Option: D

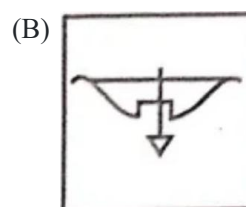
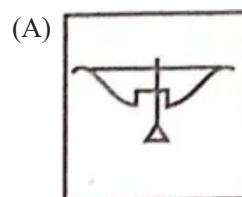
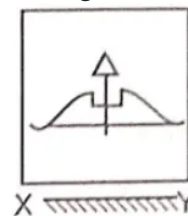
Solution:

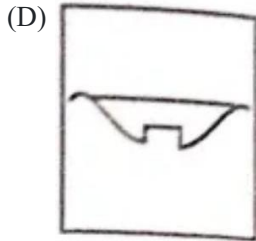
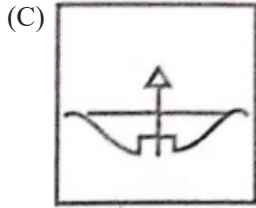
$$7 \xrightarrow{\times 3} 21 \xrightarrow{\times 3} 63$$

$$4 \xrightarrow{\times 4} 16 \xrightarrow{\times 3} 64$$

$$5 \xrightarrow{\times 7} 35 \xrightarrow{\times 7} 245$$

85. In the question, there is a problem figure and four answer figures marked (a), (b), (c), (d) are given. Select the answer figure which is exactly the mirror image of the problem figure.





Correct Option: B

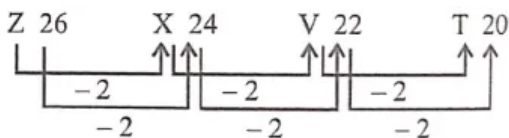
Solution:

86. Find the next term in the following series: Z26, X24, V22, _____

- (A) T20 (B) W23 (C) K15 (D) J10

Correct Option: A

Solution:



87. Which one set of letters when sequentially placed at the gaps in the given letter series shall complete it?
_bbm_amb_m_a_bb

- (A) mbabm (B) abmab (C) mabam (D) ambbm

Correct Option: C

Solution:

mbb/maa/mbb/maa/mbb

88. In the following question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one.

- (A) scalpel : Surgeon (B) Chisel: Soldier
(C) Awl : Cobbler (D) Knife : Thief

Correct Option: B

Solution:

In all other pairs, first is a tool used by the second.

89. Select the odd word from the given alternatives.

- (A) Legislator (B) Lawyer

(C) Mayor

(D) Governor

Correct Option: B

Solution:

Legislator and Mayor are elected representatives of people. Governor is appointed by the President. Lawyer is a person who pleads in the court.

90. Introducing a boy Ankit said, "He is the son of daughter of my grandfather's son". How is that boy related to Ankit?

- (A) Cousin (B) Brother
(C) Father-in-law (D) Nephew

Correct Option: D

Solution:

Nephew

91. If A and B are the domain and range of a real valued function $f(x) = \frac{|x|}{\sqrt{1-|x|}}$, then $A \cup B =$

- (A) $(1, \infty)$ (B) $[0, \infty)$
(C) $(-1, \infty)$ (D) R

Correct Option: C

Solution:

For domain:

$$1 - |x| > 0 \Rightarrow -1 < x < 1$$

$$A = (-1, 1)$$

For range: $t = |x|, 0 \leq t < 1$

$$\text{Then, } y = \frac{t}{\sqrt{1-t}}$$

For $0 \leq t < 1$,

$$\text{At } t = 0, y = 0$$

$$\text{As } t \rightarrow 1^-, y \rightarrow \infty$$

Also, y is increasing on $[0, 1)$, hence $B = [0, \infty)$

$$A \cup B = (-1, \infty)$$

92. If $\alpha, \beta \in (-\frac{\pi}{2}, \frac{\pi}{2})$, $\cos^4 \alpha = \frac{1}{16}$, $\sin^4 \beta = \frac{1}{16}$ then $\cos \alpha + \cos \beta =$

- (A) $\sqrt{2} \cos 15^\circ$ (B) $\sqrt{2} \sin 15^\circ$
(C) $-\sqrt{2} \cos 15^\circ$ (D) $-\sqrt{2} \sin 15^\circ$

Correct Option: A**Solution:**

(a) Given $\cos^4 \alpha = \frac{1}{16}$

$$\Rightarrow \cos \alpha = \left(\frac{1}{16}\right)^{1/4} = \left(\frac{1}{24}\right)^{1/4} = \frac{1}{2} \text{ and } \sin^4 \beta = \frac{1}{16}$$

$$\Rightarrow \sin^2 \beta = \left(\frac{1}{16}\right)^{1/2} = \left(\frac{1}{42}\right)^{1/2} = \frac{1}{4}$$

$$\text{Now, } \cos^2 \beta = 1 - \sin^2 \beta = 1 - \frac{1}{4} \Rightarrow \cos^2 \beta = \frac{3}{4}$$

$$\text{Now, } \cos \beta = \pm \frac{\sqrt{3}}{2} \Rightarrow \cos \beta = \frac{\sqrt{3}}{2}$$

$$[\because \alpha, \beta \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) \Rightarrow \cos \beta > 0]$$

$$\text{Thus, } \cos \alpha + \cos \beta = \frac{1}{2} + \frac{\sqrt{3}}{2} = \frac{\sqrt{3}+1}{2}$$

$$\text{Since, } \sqrt{2} \cos 15^\circ = \sqrt{2} \left(\frac{\sqrt{3}+1}{2\sqrt{2}}\right) = \frac{\sqrt{3}+1}{2}$$

$$\text{So, } \cos \alpha + \cos \beta = \sqrt{2} \cos 15^\circ$$

93. If $2 \cos \theta + 3 \sin \theta = 3$ and $\tan \theta$ is defined, then $\tan \theta =$

- (A) $\frac{5}{12}$ (B) $-\frac{5}{12}$
(C) $\frac{12}{5}$ (D) $-\frac{12}{5}$

Correct Option: A**Solution:**

$$2 \cos \theta + 3 \sin \theta = 3 \dots (i)$$

$$2 \cos \theta = 3(1 - \sin \theta) = \frac{3(1 - \sin^2 \theta)}{1 + \sin \theta}$$

$$2 \cos \theta = \frac{3 \cos^2 \theta}{1 + \sin \theta}$$

$$2 + 2 \sin \theta = 3 \cos \theta$$

$$3 \cos \theta - 2 \sin \theta = 2 \dots (ii)$$

$$(i) \times 3 - 2 \times (ii)$$

$$13 \sin \theta = 9 - 4 = 5$$

$$\sin \theta = \frac{5}{13}$$

$$2 \cos \theta = 3 - \frac{15}{13} = \frac{39 - 15}{13} = \frac{24}{13}$$

$$\cos \theta = \frac{12}{13}$$

$$\tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{\frac{5}{13}}{\frac{12}{13}} = \frac{5}{12}$$

94. If $z_1 = x + iy$, $z_2 = a + ib$ and $x^2 + y^2 = a^2 + b^2$, then $Z_2 =$

- (A) $|z_1| \operatorname{cis}(\tan^{-1}(\frac{b}{a}))$
(B) $|\bar{z}_2| z_1$
(C) $z_1 \operatorname{cis}(\tan^{-1}(\frac{y}{x}))$
(D) z_1

Correct Option: A**Solution:**Given, $z_1 = x + iy$, $z_2 = a + ib$ and

$$x^2 + y^2 = a^2 + b^2$$

$$|z_1| = \sqrt{x^2 + y^2} = \sqrt{a^2 + b^2} = |z_2|$$

$$\text{Argument of } z_2 : \theta = \tan^{-1}\left(\frac{b}{a}\right)$$

Polar form of z_2 :

$$z_2 = |z_2| \operatorname{cis}(\theta) = |z_1| \operatorname{cis}(\tan^{-1}(\frac{b}{a}))$$

95. Let a point P in the Argand plane represent the complex number z . If $\operatorname{Arg}\left(\frac{2z-i}{z-2}\right) = \frac{\pi}{4}$, then the locus of P is

- (A) $4x^2 - 2xy + 2y^2 + 6x - 5y + 2 = 0$
(B) $2x^2 + 2y^2 - 3x + 3y - 2 = 0$
(C) $x^2 + 2y^2 - 3x + 2y - 2 = 0$
(D) $2x^2 + xy + 2y^2 - 3x - y - 2 = 0$

Correct Option: B**Solution:**

$$\frac{2z-i}{z-2} = \frac{2x^2+2y^2-4x-y}{(x-2)^2+y^2} + i\left[\frac{-x-4y+2}{(x-2)^2+y^2}\right]$$

$$\text{Given } \operatorname{Arg}\left(\frac{2z-i}{z-2}\right) = \frac{\pi}{4}$$

$$\tan\left(\frac{\pi}{4}\right) = 1 = \frac{\text{Imaginary part}}{\text{Real part}}$$

$$\Rightarrow \text{Imaginary part} = \text{Real part}$$

$$\Rightarrow -x - 4y + 2 = 2x^2 + 2y^2 - 4x - y$$

$$\Rightarrow 2x^2 + 2y^2 - 3x + 3y - 2 = 0$$

96. All possible 3 digit numbers are formed using the digits 0, 2, 3, 5, 7, 9 without repeating any digit. Then the number of numbers among them which are divisible by 15 is

- (A) 11 (B) 14 (C) 16 (D) 36

Correct Option: A**Solution:**



A number is divisible by 15 if it is divisible by both 3 and 5, so last digit is 0 or 5 and some in divisible by 3.

Possible ways,

$$(2, 7, 0) \rightarrow 2! = 2 \text{ ways}$$

$$(3, 9, 0) \rightarrow 2! = 2 \text{ ways}$$

$$(5, 7, 0) \rightarrow 2! = 2 \text{ ways}$$

$$(9, 0, 5) \rightarrow 1 \text{ ways}$$

$$(3, 7, 5) \rightarrow 2! = 2 \text{ ways}$$

$$(7, 9, 5) \rightarrow 2! = 2 \text{ ways}$$

Total = 11 ways.

97. If a and b are the greatest values of ${}^{2n}C_r$ and ${}^{(2n-1)}C_r$ respectively, then

$$(A) a = 2b$$

$$(B) b = 2a$$

$$(C) a = b$$

$$(D) a^2 = 2b^2$$

Correct Option: A

Solution:

Maximum value occurs at the middle term.

$\because 2n$ is even, so, greatest value of ${}^{2n}C_r$ is ${}^{2n}C_n = a$

$\because 2n-1$ is odd, so greatest value of ${}^{2n-1}C_r$ is $b = {}^{2n-1}C_{n-1}$

$$\frac{(2n-1)!}{(n-1)!n!} = b \Rightarrow \frac{2n(2n-1)!}{2n(n-1)!n!} = b$$

$$\Rightarrow \frac{(2n)!}{2n!n!} = b \Rightarrow \frac{a}{2} = b \Rightarrow a = 2b$$

98. Bag A contains 4 white, 3 red and 2 black balls and bag B contains 2 white, 4 red and 3 black balls. If a bag is chosen at random and two balls are drawn at random from that bag, then the probability of drawing a white ball and a black ball is

$$(A) \frac{7}{18}$$

$$(B) \frac{2}{9}$$

$$(C) \frac{7}{36}$$

$$(D) \frac{1}{6}$$

Correct Option: C

Solution:

$$P(\text{Bag A}) = \frac{1}{2} \dots (i)$$

$$P(\text{Bag B}) = \frac{1}{2} \dots (ii)$$

Probability of drawing 1 white and 1 black ball from Bag A.

$$P(W \& B | \text{Bag A}) = \frac{{}^4C_1 \times {}^2C_1}{{}^9C_2} = \frac{8}{36} = \frac{2}{9} \dots (iii)$$

Probability of drawing 1 white and 1 black ball from Bag B.

$$P(W \& B | \text{Bag B}) = \frac{{}^2C_1 \times {}^4C_1}{{}^9C_2} = \frac{6}{36} = \frac{1}{6} \dots (iv)$$

$$\begin{aligned} P(\text{Total}) &= eq.(i) \times eq.(iii) + (eq.(ii) \times eq.(iv)) \\ &= \left(\frac{1}{2} \times \frac{2}{9}\right) + \left(\frac{1}{2} \times \frac{1}{6}\right) = \frac{7}{36} \end{aligned}$$

$$99. \int \frac{1}{\sin x \cos 2x} dx =$$

$$(A) \frac{1}{2} \log \left| \frac{\cos x+1}{\cos x-1} \right| - \frac{1}{\sqrt{2}} \log \left| \frac{\sqrt{2} \cos x+1}{\sqrt{2} \cos x-1} \right| + c$$

$$(B) \frac{1}{2} \log \left| \frac{\cos x+1}{\cos x-1} \right| + \frac{1}{\sqrt{2}} \log \left| \frac{\sqrt{2} \cos x+1}{\sqrt{2} \cos x-1} \right| + c$$

$$(C) \frac{1}{2} \log \left| \frac{\cos x-1}{\cos x+1} \right| - \frac{1}{\sqrt{2}} \log \left| \frac{\sqrt{2} \cos x-1}{\sqrt{2} \cos x+1} \right| + c$$

$$(D) \frac{1}{2} \log \left| \frac{\cos x-1}{\cos x+1} \right| + \frac{1}{\sqrt{2}} \log \left| \frac{\sqrt{2} \cos x-1}{\sqrt{2} \cos x+1} \right| + c$$

Correct Option: C

Solution:

$$\begin{aligned} I &= \int \frac{\sin x dx}{\sin^2 x (2 \cos^2 x - 1)} \\ \cos x &= t \Rightarrow dt = -\sin x dx \end{aligned}$$

$$\begin{aligned} I &= \int \frac{dt}{(t^2-1)(2t^2-1)} \\ &= {}^{2n-1}C_n \left(\frac{1}{t^2-1} - \frac{2}{2t^2-1} \right) dt \end{aligned}$$

$$= \frac{1}{2} \ln \left(\frac{t-1}{t+1} \right) - \frac{1}{\sqrt{2}} \ln \left(\frac{\sqrt{2}t-1}{\sqrt{2}t+1} \right) + C$$

$$I = \frac{1}{2} \ln \left(\frac{\cos x-1}{\cos x+1} \right) - \frac{1}{\sqrt{2}} \ln \left(\frac{\sqrt{2} \cos x-1}{\sqrt{2} \cos x+1} \right) + C$$

100. If $\frac{2x^6+3x^4+1}{(x^2+2)^4} = \frac{Ax+P}{x^2+2} + \frac{Bx+Q}{(x^2+2)^2} + \frac{Cx+R}{(x^2+2)^3} + \frac{Dx+T}{(x^2+2)^4}$, then $3P+2Q+R+4T =$

$$(A) -12$$

$$(B) 30$$

$$(C) -3$$

$$(D) 24$$

Correct Option: A

Solution:

$$\text{Let } y = x^2 + 2 \Rightarrow x^2 = y - 2$$

Put $x^2 = y - 2$ into the numerator.

$$\text{Numerator} = 2(y-2)^3 + 3(y-2)^2 + 1$$

$$= 2y^3 - 3y^2 + 12y - 3$$

Taking L.H.S. of the given equation



$$\frac{2y^3 - 9y^2 + 12y - 3}{y^4} = \frac{2}{y} - \frac{9}{y^2} + \frac{12}{y^3} - \frac{3}{y^4}$$

$$= \frac{2}{(x^2 + 2)} - \frac{9}{(x^2 + 2)^2} + \frac{12}{(x^2 + 2)^3} - \frac{3}{(x^2 + 2)^4}$$

Comparing it with co-efficient of R.H.S.

$$Ax + P = 2 \Rightarrow A = 0, P = 2$$

$$Bx + Q = -9 \Rightarrow B = 0, Q = -9$$

$$Cx + R = 12 \Rightarrow C = 0, R = 12$$

$$Dx + T = -3 \Rightarrow D = 0, T = -3$$

$$\text{So, } 3P + 2Q + R + 4T = 3(2) + 2(-9) + 12 + 4(-3) = -12$$

101. $\int_0^2 |2x^2 - 9x + 9| dx =$

(A) $\frac{27}{4}$ (B) $\frac{171}{4}$

(C) $\frac{16}{3}$ (D) $\frac{71}{12}$

Correct Option: D

Solution:

$$I = \int_0^2 |2x^2 - 9x + 9| dx$$

$$I = \int_0^2 |(2x - 3)(x - 3)| dx$$

Since, $2x^2 - 9x + 9$ changes its sign at $x = 1.5$

So,

$$I = \int_0^{1.5} (2x^2 - 9x + 9) dx - \int_{1.5}^2 (2x^2 - 9x + 9) dx$$

$$= \left[\frac{2}{3}x^3 - \frac{9x^2}{2} + 9x \right]_0^{1.5} - \left[\frac{2}{3}x^3 - \frac{9x^2}{2} + 9x \right]_{1.5}^2$$

$$= \left[\frac{45}{8} - 0 \right] - \left[\frac{16}{3} - \frac{45}{8} \right] = \frac{71}{12}$$

102. The function $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) = x|x+2|$ is

- (A) one one but not onto (B) onto but not one one
(C) both one one and onto (D) neither one one nor onto

Correct Option: B

Solution:

$$f(x) = 0$$

$$\Rightarrow x|x+2| = 0$$

$$\Rightarrow x = 0, -2.$$

Hence f is not one one.

$f(x)$ is continuous function.

$$\lim_{x \rightarrow \infty} f(x) = \infty$$

$$\lim_{x \rightarrow -\infty} f(x) = -\infty$$

Range = Codomain as f takes all real values.

Hence f is onto.

f is onto but not one one.

103. The coefficient of x^5 in the expansion of

$$(x + \sqrt{x^2 - x})^6 + (x - \sqrt{x^2 - x})^6 \text{ is}$$

- (A) 96 (B) 48 (C) -48 (D) -96

Correct Option: D

Solution:

$$(x + \sqrt{x^2 - x})^6 + (x - \sqrt{x^2 - x})^6$$

$$= 2 [x^6 + {}^6C_2 x^4 (x^2 - x) + {}^6C_4 x^2 (x^2 - x)^2 + {}^6C_6 (x^2 - x)^3]$$

$$= 2 [x^6 + 15x^6 - 15x^5 + 15x^6 - 30x^5 + 15x^4 + x^6 - x^3 -$$

$$= 2[-15 - 30 - 3] = -96$$

104. If A(1, 2), B(2, 1), C(1, -2) and a variable point P, taken in that order, form a quadrilateral of area 9 square units, then the locus of P is

- (A) $4x^2 - 8x - 45 = 0$
(B) $4x^2 + y^2 - 4xy - 12x - 6y + 9 = 0$
(C) $y^2 + 6y + 9 = 0$
(D) $4x^2 - 16x - 65 = 0$

Correct Option: D

Solution:

Given, A(1, 2), B(2, 1), C(1, -2), P(x, y)

Area =

$$\frac{1}{2} |(x_1 y_2 - y_1 x_2) + (x_2 y_3 - y_2 x_3) + (x_3 y_4 - y_3 x_4) + (x_4 y_1 - y_4 x_1)|$$

$$\text{Area} = \frac{1}{2} |(1 - 4) + (-4 - 1) + (y + 2x) + (2x - y)|$$

$$\Rightarrow 9 = \frac{1}{2} |4x - 8|$$

$$\Rightarrow |2x - 4| = 9 \Rightarrow (2x - 4)^2 = 81$$



$$\Rightarrow 4x^2 - 16x - 65 = 0$$

105. A straight line passes through a point $A(2, 5)$ and makes an angle of 45° with the positive X-axis when measured in the positive direction. If this straight line intersects the line passing through the points $(1, -2)$ and $(3, -4)$ at B , then $AB =$

(A) $2\sqrt{2}$ (B) $5\sqrt{2}$ (C) $4\sqrt{2}$ (D) $\sqrt{82}$

Correct Option: C

Solution:

$$L_1 = y - 5 = (\tan 45^\circ)(x - 2)$$

$$x - y = -3$$

$$L_2 = \frac{y + 2}{x - 1} = \frac{-4 + 2}{2} = -1$$

$$x + y = -1; x = -2, y = 1$$

$$B(-2, 1); AB = \sqrt{[2 - (-2)]^2 + (5 - 1)^2}$$

$$AB = 4\sqrt{2}$$

106. The variance of the following continuous frequency distribution is

Class interval	0-10	10-20	20-30
Frequency	3	4	3

(A) 15 (B) 30 (C) 45 (D) 60

Correct Option: D

Solution:

	x_i	f_i	$x_i f_i$	$x_i^2 f_i$
0-10	5	3	15	75
10-20	15	4	60	900
20-30	25	3	75	1875
		$\Sigma f_i = 10$	150	2850

$$\mu = \frac{150}{10} = 15$$

$$\Sigma x_i^2 f_i = 2850$$

$$\sigma^2 = \frac{\Sigma x_i^2 f_i}{\Sigma f_i} - \mu^2 = 285 - 15^2 = 60$$

107. The standard deviation of the data 2, 3, 4, 5, 6, 7, 10, 11, 13, 19 is

(A) $\sqrt{13}$ (B) $\sqrt{8}$ (C) 5 (D) 8

Correct Option: C

Solution:

$$n = 10$$

$$\mu = \frac{2 + 3 + 4 + 5 + 6 + 7 + 10 + 11 + 13 + 19}{10} = 8$$

Mean of squares

$$\frac{\Sigma x_i^2}{n} = \frac{4 + 9 + 16 + 25 + 36 + 49 + 100 + 121 + 169 + 361}{10}$$

$$= \frac{890}{10} = 89$$

$$\sigma = \sqrt{\frac{\Sigma x_i^2}{n} - \mu^2}$$

$$\sigma = \sqrt{89 - (8)^2} = \sqrt{25} = 5$$

108. In three dimensional space the path of a point whose distance from the x -axis is 3 times its distance from the yz -plane is:

(A) $y^2 + z^2 = 9x^2$

(B) $x^2 + y^2 = 3z^2$

(C) $x^2 + z^2 = 3y^2$

(D) $y^2 - z^2 = 9x^2$

Correct Option: A

Solution:

Let $P(x_1, y_1, z_1)$ be the point.

Then distance of P from x -axis = $\sqrt{y_1^2 + z_1^2}$

Given plane is $x = 0$ (yz -plane)

Distance of $P(x_1, y_1, z_1)$ from yz -plane is $\frac{x_1}{\sqrt{1}}$

From the given condition, distance of P from x -axis = $3 \times$ distance of P from yz -plane

$$\sqrt{y_1^2 + z_1^2} = 3x_1 \text{ Squaring, } y_1^2 + z_1^2 = 9x_1^2$$

Thus, path of $P(x_1, y_1, z_1)$ is got by putting x, y, z in place of x_1, y_1, z_1 as $y^2 + z^2 = 9x^2$

109. Which of the following is/are true?

I. If A is a subset of the universal set U , then its complement A' is also a subset of U .

II. If $U = \{1, 2, 3, \dots, 10\}$ and $A = \{1, 3, 5, 7, 9\}$, then $(A')' = A$.

(A) Only I is true (B) Only II is true

(C) Both I and II are true (D) None of these

Correct Option: C

Solution:

If A is a subset of the universal set U , then its complement A' is also a subset of U .



We have, $A' = \{2, 4, 6, 8, 10\}$

Hence, $(A')' = \{x : x \in U \text{ and } x \notin A'\} = \{1, 3, 5, 7, 9\} = A$

It is clear from the definition of the complement that for any subset of the universal set U , we have $(A')' = A$

110. The locus of the midpoints of the chords of the circle $x^2 + y^2 - 2x - 2y + 1 = 0$ which are parallel to the line $x + y + 2 = 0$ is

- (A) $x - y = 2$ (B) $2x - 3y = 4$
(C) $3x + 4y = 2$ (D) $x - y = 0$

Correct Option: D

Solution:

Given, equation of the circle is:

$$x^2 + y^2 - 2x - 2y + 1 = 0$$

$$\text{Center} = C = \left(\frac{-(-2)}{2}, \frac{-(-2)}{2}\right) = (1, 1)$$

Since, the chords are parallel to the line

$$x + y + 2 = 0$$

Thus, the slope of chords $= m_1 = -1$

So, the perpendicular diameter passing through the chord has slope:

$$m_1 m_2 = -1 \Rightarrow m_2 = 1$$

Thus, the equation of line passing through $(1, 1)$ with slope $m_2 = 1$ is :

$$y - 1 = 1(x - 1) \Rightarrow x - y = 0$$

111. $P \equiv y^2 + 2y - x + 6 = 0$ a parabola. $S = 0$ is another parabola such that the axes of $S = 0$ and $P = 0$ are same and the distance between their foci is $\frac{5}{4}$. If the foci of these parabolas are on either side of the vertex of $S = 0$ and the vertex of $S = 0$ is on directrix of $P = 0$, then the length of latus rectum of $S = 0$ is

- (A) 1 (B) 3
(C) $\frac{18}{4}$ (D) 4

Correct Option: B

Solution:

$$y^2 + 2y - x + 6 = 0$$

$$\Rightarrow (y + 1)^2 = x - 5$$

Vertex of P: $(5, -1)$

$$4a = 1, \quad a = \frac{1}{4}$$

$$\text{Focus of P: } F_1 = \left(5 + \frac{1}{4}, -1\right) = \left(\frac{21}{4}, -1\right)$$

$$\text{Directrix of P: } x = 5 - \frac{1}{4} = \frac{19}{4}$$

The vertex of S lies on the directrix of P.

$$\text{So, } V_2 = \left(\frac{19}{4}, -1\right)$$

Since both parabolas have the same axis, the axis is $y = -1$

Now, the distance between the two foci is $\frac{5}{4}$

Also the foci lie on opposite sides of the vertex of S.

Focus of P is at $\frac{21}{4}$

Let focus of S be at $(x, -1)$.

$$\text{Since, } V_2 = \frac{19}{4} \Rightarrow \frac{21}{4} - x = \frac{5}{4} \Rightarrow x = 4$$

$$\text{Thus, } F_2 = (4, -1)$$

Distance between the vertex and focus of S :

$$a = \frac{19}{4} - 4 = \frac{3}{4}$$

$$\text{Length of latus rectum} = 4a = 4 \times \frac{3}{4} = 3$$

112. If the length of minor axis of an ellipse is $\frac{1}{3}$ times the sum of the distances of any point on the ellipse from its foci, then eccentricity of the ellipse is

- (A) $\frac{1}{\sqrt{2}}$ (B) $\frac{2\sqrt{2}}{3}$
(C) $\frac{\sqrt{2}}{\sqrt{3}}$ (D) $\frac{2\sqrt{2}}{5}$

Correct Option: B

Solution:

$$\text{Length of minor axis of ellipse} = 2b$$

Also, the sum of the distances of any point from the foci is equal to the length of the major axis $= 2a$

$$\text{So, } 2b = \frac{1}{3}(2a) \Rightarrow \frac{b}{a} = \frac{1}{3}$$



Since $e = \sqrt{1 - \frac{b^2}{a^2}}$

$$\Rightarrow e = \sqrt{1 - \frac{1}{9}} = \sqrt{\frac{8}{9}} = \frac{2\sqrt{2}}{3}$$

113. If the foci of the ellipse $\frac{x^2}{25} + \frac{y^2}{k^2} = 1$ ($k^2 < 25$) and the hyperbola $\frac{x^2}{k} - \frac{y^2}{5} = 1$ are same then the product of the length of the latus rectum of the ellipse and that of hyperbola is

(A) 25 (B) 50 (C) 16 (D) 32

Correct Option: D

Solution:

$$k^2 = 25(1 - e_1^2)$$

$$e_1 = \sqrt{1 - \frac{k^2}{25}}$$

$$\text{focus} = (\pm\sqrt{25 - k^2}, 0)$$

$$k(e_2^2 - 1) = 5$$

$$e_2 = \sqrt{\frac{5}{k} + 1}$$

$$\text{focus} = (\pm\sqrt{5 + k}, 0)$$

$$5 + k = 25 - k^2$$

$$k^2 + k - 20 = 0 \Rightarrow (k + 5)(k - 4) = 0$$

$$k = 4(k > 0)$$

$$\text{Required value} = \frac{2k^2}{5} \times \frac{2 \times 5}{\sqrt{k}}$$

$$= \frac{2 \times 16}{5} \times \frac{2 \times 5}{2} = 32$$

114. $\lim_{x \rightarrow 0} \frac{x^{2^x} - x}{1 - \cos x} =$

(A) $\log 2$ (B) $\frac{1}{2} \log 2$
(C) $2 \log 2$ (D) $\frac{1}{2 \log 2}$

Correct Option: C

Solution:

$$\lim_{x \rightarrow 0} \frac{x^{(2^x - 1)}}{1 - \cos x} = \lim_{x \rightarrow 0} \frac{x^{(2^x - 1)}}{2 \sin^2 \frac{x}{2}}$$

$$= \lim_{x \rightarrow 0} \frac{2^x - 1}{x} \times \frac{\frac{x}{2} \times 4}{2 \sin^2 \frac{x}{2}} = \log 2 \times 2 = 2 \log 2$$

115. From a set containing four positive numbers and four negative numbers, four numbers are chosen at random and they are multiplied. The probability that the obtained product is positive, is

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$
(C) $\frac{19}{35}$ (D) $\frac{23}{35}$

Correct Option: C

Solution:

$$\text{Total outcome} = {}^8C_4 = 70$$

Favorable outcome

$$0 \text{ negative, } 4 \text{ positive : } {}^4C_0 \times {}^4C_4 = 1$$

$$2 \text{ negative, } 2 \text{ positive : } {}^4C_2 \times {}^4C_2 = 36$$

$$4 \text{ negative, } 0 \text{ positive : } {}^4C_4 \times {}^4C_0 = 1$$

$$\text{Total favorable} = 1 + 36 + 1 = 38$$

$$\text{Probability} = \frac{38}{70} = \frac{19}{35}$$

116. If $\tan^{-1}\left(\frac{1}{2\sqrt{2}}\right) - \cos^{-1}\left(\frac{1}{\sqrt{3}}\right) + \sin^{-1}(x) = 0$, then $x =$

(A) $\frac{1}{\sqrt{3}}$ (B) $\frac{2}{3\sqrt{3}}$
(C) $\frac{1}{2\sqrt{3}}$ (D) $\frac{\sqrt{2}}{\sqrt{3}}$

Correct Option: A

Solution:

$$\sin^{-1}(x) = \cos^{-1}\left(\frac{1}{\sqrt{3}}\right) - \tan^{-1}\left(\frac{1}{2\sqrt{2}}\right)$$

$$= \beta - \alpha (\text{Let})$$

$$\Rightarrow x = \sin(\beta - \alpha)$$

$$\text{For } \alpha, \tan \alpha = \frac{1}{2\sqrt{2}} \Rightarrow \sin \alpha = \frac{1}{3}, \cos \alpha = \frac{2\sqrt{2}}{3}$$

$$\text{For } \beta, \cos \beta = \frac{1}{\sqrt{3}} \sin \beta = \frac{\sqrt{2}}{\sqrt{3}}$$

$$\text{So, } x = \left(\frac{\sqrt{2}}{\sqrt{3}}\right)\left(\frac{2\sqrt{2}}{3}\right) - \left(\frac{1}{\sqrt{3}}\right)\left(\frac{1}{3}\right) = \frac{1}{\sqrt{3}}$$

117. If $A = \begin{bmatrix} 0 & 2q & r \\ p & q & -r \\ p & -q & r \end{bmatrix}$ and $AA^T = I_3$, then

(A) $|p| = |q||r|$ (B) $|r| = 2|p||q|$
(C) $|q| = |p||r|$ (D) $|p| + |q| = |r|$

Correct Option: C

Solution:

$$\text{Since } AA^T = I_3,$$

$$\Rightarrow \text{Matrix } A \text{ is orthogonal}$$

$$\Rightarrow \text{Rows are orthonormal.}$$

$$\text{So, Row 1}$$



$$0^2 + (2q)^2 + r^2 = 1$$

$$\Rightarrow 4q^2 + r^2 = 1 \quad \dots(i)$$

Row 2

$$p^2 + q^2 + (-r)^2 = 1$$

$$\Rightarrow p^2 + q^2 + r^2 = 1 \quad \dots(ii)$$

Now dot product of Row 1 and Row 2

$$\Rightarrow 0(p) + (2q)q + r(-r) = 0$$

$$\Rightarrow 2q^2 - r^2 = 0 \quad \dots(iii)$$

Substitute (iii) in (i)

$$\Rightarrow 4q^2 + 2q^2 = 1$$

$$\Rightarrow 6q^2 = 1 \Rightarrow q^2 = \frac{1}{6}$$

$$\text{Thus, } r^2 = 2\left(\frac{1}{6}\right) = \frac{1}{3}$$

$$\text{and } p^2 = 1 - q^2 - r^2 = 1 - \frac{1}{6} - \frac{1}{3} = \frac{1}{2}$$

$$\text{Now } |r| = \frac{1}{\sqrt{3}} \text{ and } 2|p||q|$$

$$= 2 \cdot \frac{1}{\sqrt{2}} \cdot \frac{1}{\sqrt{6}} = \frac{2}{\sqrt{12}} = \frac{2}{2\sqrt{3}} = \frac{1}{\sqrt{3}} = |r|$$

$$\Rightarrow |r| = 2|p||q|$$

118. If $A = \begin{bmatrix} 1 & 7 & 49 \\ 2 & 16 & 130 \\ 2 & 18 & 170 \end{bmatrix}$, then $\det A =$

(A) 2^3 (B) 2^4 (C) 2^5 (D) 2^6

Correct Option: B

Solution:

$$(b) \begin{bmatrix} 1 & 7 & 49 \\ 2 & 16 & 130 \\ 2 & 18 & 170 \end{bmatrix}$$

$$R_3 \rightarrow R_3 - R_2 \Rightarrow R_2 \rightarrow R_2 - 2R_1$$

$$= \begin{bmatrix} 1 & 7 & 49 \\ 0 & 2 & 32 \\ 0 & 2 & 40 \end{bmatrix} \Rightarrow 1|A| = 80 - 64 = 16$$

119. If $P(x, y, z)$ is the intersection of the lines

$$\vec{r} = (2\hat{i} - 2\hat{j} + 3\hat{k}) + t(\hat{i} - 3\hat{j} + \hat{k}) \text{ and}$$

$$\vec{r} = (2\hat{j} - \hat{k}) + s(\hat{i} - \hat{j} + 3\hat{k}), \text{ then } x + y + z =$$

(A) 2 (B) 5 (C) 3 (D) 4

Correct Option: D

Solution:

$$(2 + t, -2 - 3t, 3 + t) = (S, 2 - S, -1 + 3S)$$

on solving we get, $t = -1$

$$\therefore P(x, y, z) = (1, 1, 2) \Rightarrow x + y + z = 4$$

120. In a triangle ABC , if

$$\vec{AB} = \hat{i} - 2\hat{j} + 3\hat{k}, \quad \vec{BC} = 3\hat{i} + 2\hat{j} - 2\hat{k}$$

then the triangle is

(A) obtuse angled triangle

(B) isosceles triangle

(C) isosceles right angled triangle

(D) equilateral triangle

Correct Option: B

Solution:

$$\vec{AB} + \vec{BC} + \vec{CA} = 0$$

$$(\hat{i} - 2\hat{j} + 3\hat{k}) + (3\hat{i} + 2\hat{j} - 2\hat{k}) + \vec{CA} = 0$$

$$\vec{CA} = -4\hat{i} - \hat{k}$$

$$AB^2 = 14$$

$$BC^2 = 17$$

$$CA^2 = 17$$

$$BC = CA$$

$$AB^2 \neq BC^2 + CA^2$$

$$BC^2 \neq AB^2 + CA^2$$

$$CA^2 \neq AB^2 + BC^2$$

Triangle is isosceles.

121. $\vec{a}, \vec{b}, \vec{c}$ are the position vectors of three points A, B,

respectively. If $\angle ABC = \frac{\pi}{2}$, $\vec{AB} = \hat{i} + 4\hat{j} + (4 - \lambda)\hat{k}$,

$\vec{AC} = (\lambda - 1)\hat{i} + 6\hat{j} + (2 - \lambda)\hat{k}$, then $\lambda =$

(A) 0 (B) $-\frac{1}{3}$

(C) $-\frac{3}{4}$ (D) $\frac{2}{3}$

Correct Option: D

Solution:

Given,

$$\vec{AB} = \hat{i} + 4\hat{j} + (4 - \lambda)\hat{k}, \vec{AC} =$$

$$= (\lambda - 1)\hat{i} + 6\hat{j} + (2 - \lambda)\hat{k}$$

$$\text{Now, } \vec{BC} = \vec{AC} - \vec{AB}$$



$$= (\lambda - 1)\hat{i} + 6\hat{j} + (2 - \lambda)\hat{k} - \hat{i} - 4\hat{j} - (4 - \lambda)\hat{k}$$

$$= (\lambda - 2)\hat{i} + 2\hat{j} - 2\hat{k}. \text{ Also, } \angle ABC = 90^\circ$$

So, $\overrightarrow{AB}$ & $\overrightarrow{BC}$ are perpendicular

$$\Rightarrow \overrightarrow{AB} \cdot \overrightarrow{BC} = 0$$

$$\Rightarrow 1(\lambda - 2) + 4(2) + (4 - \lambda)(-2) = 0$$

$$\Rightarrow \lambda - 2 + 8 - 8 + 2\lambda = 0$$

$$\Rightarrow 3\lambda = 2 \Rightarrow \lambda = \frac{2}{3}$$

$$122. \begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix} =$$

- (A) $a^2b^2c^2$ (B) $2a^2b^2c^2$
(C) $3a^2b^2c^2$ (D) $4a^2b^2c^2$

Correct Option: D

Solution:

Given determinant

$$\begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix} = abc \begin{vmatrix} -a & b & c \\ a & -b & c \\ a & b & -c \end{vmatrix}$$

$$= (abc)(abc) \begin{vmatrix} -1 & 1 & 1 \\ 1 & -1 & 1 \\ 1 & 1 & -1 \end{vmatrix}$$

$$= (abc)^2 [-1(1 - 1) - 1(-1 - 1) + 1(1 + 1)]$$

$$= (abc)^2 [0 + 2 + 2] = 4a^2b^2c^2$$

$$123. \text{ If } A = \begin{bmatrix} 2 & -3 & 1 \\ -3 & 1 & -2 \\ 1 & -2 & 3 \end{bmatrix}, \text{ then } \text{Adj}(A) =$$

- (A) $\begin{bmatrix} 1 & -7 & 5 \\ -7 & 5 & -1 \\ 5 & -1 & 7 \end{bmatrix}$
(B) $\begin{bmatrix} 1 & 7 & -5 \\ 7 & 5 & 1 \\ -5 & 1 & 7 \end{bmatrix}$
(C) $\begin{bmatrix} -1 & 7 & 5 \\ 7 & 5 & 1 \\ 5 & 1 & -7 \end{bmatrix}$
(D) $\begin{bmatrix} -1 & 7 & -5 \\ 7 & -5 & 1 \\ -5 & 1 & -7 \end{bmatrix}$

Correct Option: C

Solution:

$$\text{Adj}(A) =$$

$$\begin{vmatrix} + & \begin{vmatrix} 1 & -2 \\ -2 & 3 \end{vmatrix} & - & \begin{vmatrix} -3 & -2 \\ 1 & 3 \end{vmatrix} & + & \begin{vmatrix} -3 & 1 \\ 1 & -2 \end{vmatrix} \\ - & \begin{vmatrix} -3 & 1 \\ -2 & 3 \end{vmatrix} & + & \begin{vmatrix} 2 & 1 \\ 1 & 3 \end{vmatrix} & - & \begin{vmatrix} 2 & -3 \\ 1 & -2 \end{vmatrix} \\ + & \begin{vmatrix} -3 & 1 \\ 1 & -2 \end{vmatrix} & - & \begin{vmatrix} 2 & 1 \\ -3 & -2 \end{vmatrix} & + & \begin{vmatrix} 2 & -3 \\ -3 & 1 \end{vmatrix} \end{vmatrix}$$

$$= \begin{bmatrix} -1 & 7 & 5 \\ 7 & 5 & 1 \\ 5 & 1 & -7 \end{bmatrix}$$

124. If a metallic circular plate of radius 50 cm is heated so that its radius increases at the rate of 1 mm per hour, then the rate at which the area of the plate increases (in cm^2/hour) is

- (A) 5π (B) 10π (C) 100π (D) 50π

Correct Option: B

Solution:

Let $A = \pi r^2$ be the area of the metallic circular plate of $r = 50$ cm.

Also, given $\frac{dr}{dt} = 1 \text{ mm} = \frac{1}{10} \text{ cm}$

$$\therefore A = \pi r^2 \Rightarrow \frac{dA}{dt} = 2\pi r \frac{dr}{dt} = 2\pi \cdot 50 \cdot \frac{1}{10} = 10\pi$$

Hence, area of plate increases by $10\pi \text{ cm}^2/\text{hour}$.

125. If $f(x) = x^3 + bx^2 + cx + d$ and $0 < b^2 < c$, then in $(-\infty, \infty)$,

- (A) $f(x)$ is a strictly increasing function
(B) $f(x)$ has local maxima
(C) $f(x)$ is a strictly decreasing function
(D) $f(x)$ is bounded

Correct Option: A

Solution:

$$f(x) = x^3 + bx^2 + cx + d, 0 < b^2 < c$$

$$\therefore f'(x) = 3x^2 + 2bx + c$$

$$\text{Discriminant} = 4b^2 - 12c = 4(b^2 - 3c) < 0$$

$$\therefore f'(x) > 0 \forall x \in R$$

Thus, $f(x)$ is strictly increasing $\forall x \in R$

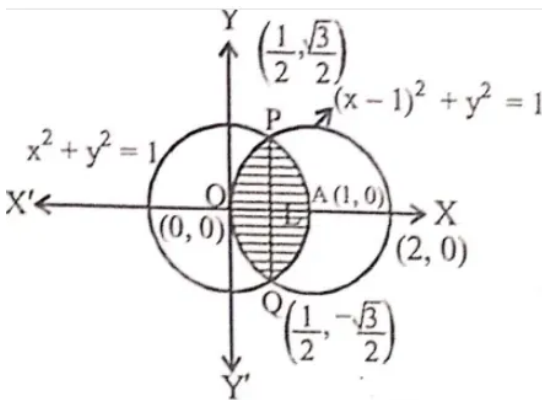
126. The area bounded by curves $(x - 1)^2 + y^2 = 1$ and $x^2 + y^2 = 1$ is

(A) $(\frac{2\pi}{3} - \frac{\sqrt{3}}{2})$

(B) $\frac{2\pi}{3}$

(C) $\frac{\sqrt{3}}{2}$

(D) $\frac{2\pi}{3} + \frac{\sqrt{3}}{2}$

Correct Option: A**Solution:**Given circles are $x^2 + y^2 = 1$...(i)and $(x-1)^2 + y^2 = 1$...(ii)Centre of (i) is $O(0, 0)$ and radius = 1

Both these circles are symmetrical about x-axis.

solving (i) and (ii), we get, $-2x + 1 = 0 \Rightarrow x = \frac{1}{2}$ then $y^2 = 1 - (\frac{1}{2})^2 = \frac{3}{4} \Rightarrow y = \frac{\sqrt{3}}{2}$ $\therefore$ The points of intersection are $P(\frac{1}{2}, \frac{\sqrt{3}}{2})$ and $Q(\frac{1}{2}, -\frac{\sqrt{3}}{2})$

It is clear from the figure that the shaded portion is the region whose area is required.

 $\therefore$ Required area = area OQAPO $= 2 \times$ area of the region OLAP $= 2 \times (\text{area of the region OLPO} + \text{area of LAPL})$

$$= 2 \left[\int_0^{1/2} \sqrt{1 - (x-1)^2} dx + \int_{1/2}^1 \sqrt{1 - x^2} dx \right]$$

$$= 2 \left[\frac{(x-1)\sqrt{1 - (x-1)^2}}{2} + \frac{1}{2} \sin^{-1}(x-1) \right]_{1/2}^1$$

$$+ 2 \left[\frac{x\sqrt{1 - x^2}}{2} + \frac{1}{2} \sin^{-1} x \right]_{1/2}^1$$

$$= -\frac{1}{2} \cdot \frac{\sqrt{3}}{2} + \sin^{-1}(-\frac{1}{2}) - \sin^{-1}(-1) + 0$$

$$+ \sin^{-1}(1) - (\frac{1}{2} \cdot \frac{\sqrt{3}}{2} + \sin^{-1}(\frac{1}{2})) = (\frac{2\pi}{3} - \frac{\sqrt{3}}{2})$$

sq. units.

127. The differential equation corresponding to the family of curves $y = ae^{2x} + bx^2$, where a and b are parameters is

$$(x - x^2) \frac{d^2y}{dx^2} + y(2 - 4x) = 0$$

(A) $(1 - 2x^2) \frac{dy}{dx}$

(B) $(2 - 4x^2) \frac{dy}{dx}$

(C) $(1 - 2x) \frac{dy}{dx}$

(D) $(2 - 4x) \frac{dy}{dx}$

Correct Option: A**Solution:**

$$y = ae^{2x} + bx^2$$

$$\frac{dy}{dx} = 2ae^{2x} + 2bx \dots(i)$$

$$\Rightarrow 2ae^{2x} = \frac{dy}{dx} - 2bx \dots(ii)$$

$$\frac{d^2y}{dx^2} = 4ae^{2x} + 2b = 2 \left[\frac{dy}{dx} - 2bx \right] + 2b$$

$$\Rightarrow \frac{d^2y}{dx^2} - 2 \frac{dy}{dx} = 2b(1 - 2x) \dots(iii) \text{ [using (i)]}$$

Compute $2y - \frac{dy}{dx}$ for a equation in 'b'

$$2y - \frac{dy}{dx} = 2bx(x-1) \dots(iv)$$

Eq. (iii) $\div$ Eq. (iv),

$$\frac{\frac{d^2y}{dx^2} - 2 \frac{dy}{dx}}{2y - \frac{dy}{dx}} = \frac{1-2x}{x(x-1)}$$

$$(x^2 - x) \left(\frac{d^2y}{dx^2} - 2 \frac{dy}{dx} \right) = (1 - 2x) \left(2y - \frac{dy}{dx} \right)$$

$$(x^2 - x) \frac{d^2y}{dx^2} + y(2 - 4x) = [2(x - x^2) - 2(2x) - 1] \frac{dy}{dx}$$

$$(x^2 - x) \frac{d^2y}{dx^2} + y(2 - 4x) = (1 - 2x^2) \frac{dy}{dx}$$

128. The general solution of the differential equation $(2xy + y^2) dy = (x^2 - y^2) dx$ is

- (A) $x^3 - 3x^2y - y^3 = c$ (B) $x^3 - 3x^2y + y^3 = c$
 (C) $x^3 - 3xy^2 + y^3 = c$ (D) $x^3 - 3xy^2 - y^3 = c$

Correct Option: D

Solution:

$$\frac{dy}{dx} = \frac{x^2 - y^2}{2xy + y^2}$$

$$y = vx \Rightarrow \frac{dy}{dx} = v + x \frac{dv}{dx}$$

$$v + x \frac{dv}{dx} = \frac{x^2 - v^2x^2}{2x^2v + v^2x^2} = \frac{1 - v^2}{2v + v^2}$$

$$\frac{x dv}{dx} = \frac{1 - v^2}{2v + v^2} - v = \frac{1 - 3v^2 - v^3}{2v + v^2}$$

$$\frac{(2v + v^2) dv}{1 - 3v^2 - v^3} = \frac{dx}{x} \dots (i)$$

$$1 - 3v^2 - v^3 = t \Rightarrow dt = (6v - 3v^2) dv$$

$$\frac{-dt}{3} = (v^2 + 2v) dv$$

$$(i) \quad \frac{-1}{3} \frac{dt}{t} = \frac{dx}{x}$$

$$\ln(1 - 3v^2 - v^3) = -3 \ln x + C$$

$$\ln \left[x^3 \left(x - \frac{3y^2}{x^2} - \frac{y^3}{x^3} \right) \right] = C$$

$$x^3 - 3xy^2 - y^3 = C$$

129. The sum of the absolute minimum and the absolute maximum values of the function $f(x) = |3x - x^2 + 2| - x$ in the interval $[-1, 2]$ is:

- (A) $\frac{\sqrt{17}+3}{2}$ (B) $\frac{\sqrt{17}+5}{2}$
 (C) 5 (D) $1 + \frac{9-\sqrt{17}}{2}$

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Correct Option: A

Solution:

$$f(x) = \begin{cases} x^2 - 4x - 2, & \forall x \in (-1, \frac{3-\sqrt{17}}{2}) \\ -x^2 + 2x + 2, & \forall x \in (\frac{3-\sqrt{17}}{2}, 2) \end{cases}$$

$$f'(x) \text{ when } x \in (-1, \frac{3-\sqrt{17}}{2})$$

$$f'(x) = 2x - 4 = 0 \Rightarrow x = 2$$

$$f'(x) = 2(x - 2) \Rightarrow f'(x) \text{ is always } \downarrow$$

$$f(2) = 2$$

$$f(-1) = 3$$

$$f\left(\frac{3-\sqrt{17}}{2}\right) = \frac{\sqrt{17}-3}{2}$$

$$f'(x) \text{ when } x \in \left(\frac{3-\sqrt{17}}{2}, 2\right)$$

$$f'(x) = -2x + 2$$

$$f'(x) = -2(x - 1)$$

$$f'(x) = 0 \text{ when } x = 1$$

$$f(1) = 3$$

$$\text{absolute minimum value} = \frac{\sqrt{17}-3}{2}$$

$$\text{absolute maximum value} = 3$$

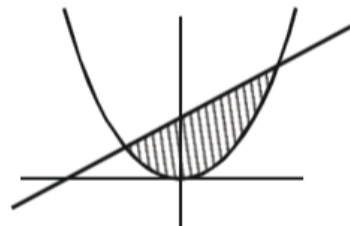
$$\text{Sum} = \frac{\sqrt{17}-3}{2} + 3 = \frac{\sqrt{17}+3}{2}$$

130. The area (in sq. units) of the region bounded by the curve $x^2 = 4y$ and the straight line $x = 4y - 2$: -
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- (A) $\frac{5}{4}$ (B) $\frac{9}{8}$
 (C) $\frac{3}{4}$ (D) $\frac{7}{8}$

Correct Option: B

Solution:



$$x = 4y - 2 \text{ and } x^2 = 4y \Rightarrow x^2 = x + 2 \Rightarrow x^2 - x - 2 = 0$$

$$x = 2, -1 \text{ So,}$$

$$\int_{-1}^2 \left(\frac{x+2}{4} - \frac{x^2}{4} \right) dx = \frac{9}{8}$$

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	B	D	B	B	B	C	B	D	D	B
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	B	A	D	D	D	C	A	B	A	A
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	D	A	C	A	B	D	B	C	C	D
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	A	B	A	A	D	B	B	D	C	B
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	C	A	A	C	A	B	D	C	B	A
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	D	D	C	D	D	B	B	A	B	B
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	D	C	A	B	C	B	D	A	A	C
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	A	A	B	B	D	A	A	D	B	C
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	A	A	B	D	B	A	C	B	B	D
Que.	91	92	93	94	95	96	97	98	99	100
Ans.	C	A	A	A	B	A	A	C	C	A
Que.	101	102	103	104	105	106	107	108	109	110
Ans.	D	B	D	D	C	D	C	A	C	D
Que.	111	112	113	114	115	116	117	118	119	120
Ans.	B	B	D	C	C	A	C	B	D	B
Que.	121	122	123	124	125	126	127	128	129	130
Ans.	D	D	C	B	A	A	A	D	A	B