

BITSAT Solved Paper 2024 Session-I

1. The dimensions of coefficient of self inductance are

- (A) $[ML^2 T^{-2} A^{-2}]$
 (B) $[ML^2 T^{-2} A^{-1}]$
 (C) $[MLT^{-2} A^{-2}]$
 (D) $[MLT^{-2} A^{-1}]$

Correct Option: A

Solution:

Energy stored in an inductor,

$$U = \frac{1}{2} LI^2$$

$$\Rightarrow L = \frac{2U}{I^2}$$

$$[L] = \frac{[ML^2 T^{-2}]}{[A]^2} = [ML^2 T^{-2} A^{-2}]$$

2. When light is incident on a metal surface the maximum kinetic energy of emitted electrons

- (A) vary with intensity of light
 (B) vary with frequency of light
 (C) vary with speed of light
 (D) vary irregularly

Correct Option: B

Solution:

Max. K.E. = $h\nu - W_0$; so Max. K.E. $\propto \nu$

3. The distance travelled by a particle starting from rest and moving with an acceleration $4/3 \text{ ms}^{-2}$, in the third second is:

- (A) 6 m
 (B) 4 m
 (C) $10/3 \text{ m}$
 (D) $19/3 \text{ m}$

Correct Option: C

Solution:

Distance travelled in the n th second is given by

$$t_n = u + \frac{a}{2}(2n - 1)$$

$$\text{put } u = 0, a = \frac{4}{3} \text{ ms}^{-2}, n = 3$$

$$\therefore d = 0 + \frac{4}{3 \times 2}(2 \times 3 - 1) = \frac{4}{6} \times 5 = \frac{10}{3} \text{ m}$$

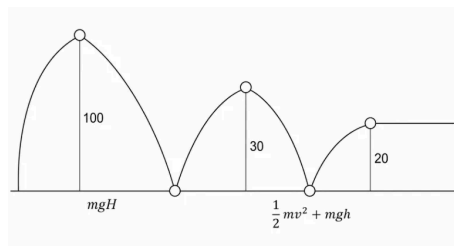
4. A spherical ball of mass 20 kg is stationary at the top of a hill of height 100 m. It rolls down a smooth surface to the ground, then climbs up another hill of height 30 m and fi-

nally rolls down to a horizontal base at a height of 20 m above the ground. The velocity attained by the ball is

- (A) 20 m/s
 (B) 40 m/s
 (C) $10\sqrt{30} \text{ m/s}$
 (D) 10 m/s

Correct Option: B

Solution:



Using conservation of energy,

$$m(10 \times 100) = m(\frac{1}{2}v^2 + 10 \times 20)$$

$$\text{or } \frac{1}{2}v^2 = 800 \text{ or } v = \sqrt{1600} = 40 \text{ m/s}$$

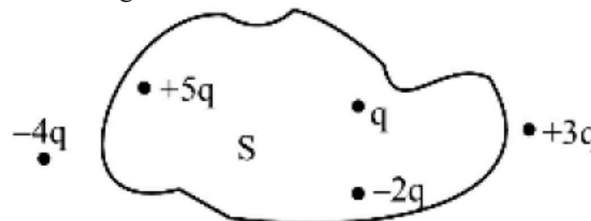
5. For a particle inside a uniform spherical shell, the gravitational force on the particle is

- (A) infinite
 (B) zero
 (C) $\frac{-Gm_1 m_2}{r^2}$
 (D) $\frac{Gm_1 m_2}{r^2}$

Correct Option: B

Solution:

6. Five charges $+q, +5q, -2q, 3q$ and $-4q$ are situated shown in the figure. The electric flux due to this configuration through the surface S is:



- (A) $\frac{4q}{\epsilon_0}$
 (B) $\frac{5q}{\epsilon_0}$
 (C) $\frac{q}{\epsilon_0}$
 (D) $\frac{3q}{\epsilon_0}$

Correct Option: A

Solution:

As per gauss theorem

$$\phi = \frac{q_{\text{in}}}{\epsilon_0} = \frac{q + (-2q) + 5q}{\epsilon_0}$$

$$= \frac{4q}{\epsilon_0}$$

7. A body is thrown with a velocity of 9.8 ms^{-1} making an angle of 30° with the horizontal. It will hit the ground after a time

(A) 3.0 s (B) 2.0 s (C) 1.5 s (D) 1 s

Correct Option: D**Solution:**

8. A person of mass 60 kg is inside a lift of mass 940 kg and presses the button on control panel. Then lift starts moving upwards with an acceleration 1.0 m/s^2 . If $g = 10 \text{ ms}^{-2}$, the tension in the supporting cable is :

(A) 8600 N (B) 9680 N (C) 11000 N (D) 1200 N

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Correct Option: C**Solution:**

$$T = mg + ma = 1000(10 + 1) = 11000 \text{ N}$$

9. Five cells each of emf E and internal resistance r send the same amount of current through an external resistance R whether the cells are connected in parallel or in series.

Then the ratio (R/r) is

(A) 2 (B) $\frac{1}{2}$

(C) $\frac{1}{5}$ (D) 1

Correct Option: D**Solution:**

Given : Number of cells, $n = 5$, emf of each cell = E

Internal resistance of each cell = r

In series, current through resistance R

$$I = \frac{nE}{nr + R} = \frac{5E}{5r + R}$$

In parallel, current through resistance R

$$I' = \frac{E}{\frac{r}{n} + R} = \frac{nE}{r + nR} = \frac{5E}{r + 5R}$$

According to question, $I = I'$

$$\therefore \frac{5E}{5r + R} = \frac{5E}{r + 5R} \Rightarrow 5r + R = r + 5R$$

$$\text{or } R = r \therefore \frac{R}{r} = 1$$

10. A particle of mass 2 kg is on a smooth horizontal table and moves in a circular path of radius 0.6 m. The height of the table from the ground is 0.8 m. If the angular speed of the particle is 12 rads^{-1} , the magnitude of its angular momentum about a point on the ground right under the centre of the circle is

(A) $14.4 \text{ kg m}^2 \text{ s}^{-1}$
(B) $8.64 \text{ kg m}^2 \text{ s}^{-1}$
(C) $20.16 \text{ kg m}^2 \text{ s}^{-1}$
(D) $11.52 \text{ kg m}^2 \text{ s}^{-1}$

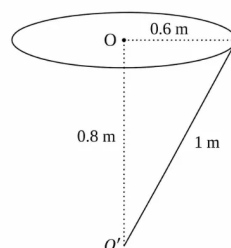
Correct Option: A**Solution:**

$$L_0 = mvr \sin 90^\circ$$

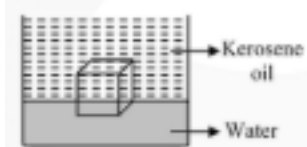
$$= 2 \times 0.6 \times 12 \times 1 \times 1$$

$$[\text{As } V = r\omega, \sin 90^\circ = 1]$$

$$\text{So, } L_0 = 14.4 \text{ kg m}^2/\text{s}$$



11. A cube of ice floats partly in water and partly in kerosene oil. The ratio of volume of ice immersed in water to that in kerosene oil (specific gravity of Kerosene oil = 0.8, specific gravity of ice = 0.9) ?



(A) 8 : 9 (B) 5 : 4 (C) 9 : 10 (D) 1 : 1

Correct Option: D**Solution:**

$$v_1 = \text{volume immersed in water.}$$

$$v_2 = \text{volume immersed in oil.}$$

$$v_1 \rho_w g + v_2 \rho_o g = (v_1 + v_2) \rho_c g$$

$$v_1 + \frac{v_2 \rho_o}{\rho_w} = (v_1 + v_2) \frac{\rho_c}{\rho_w}$$

$$= v_1 + 0.8v_2 = 0.9v_1 + 0.9v_2$$

$$= 0.1v_1 = 0.1v_2$$

$$v_1 : v_2 = 1 : 1$$

12. A source supplies heat to a system at the rate of 1000 W. If the system performs work at a rate of 200 W, the rate at which internal energy of the system increases is:

(A) 1200 W (B) 600 W (C) 500 W (D) 800 W

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Correct Option: D

Solution:

$$dQ = dU + dw$$

$$\frac{dU}{dt} = \frac{dQ}{dt} - \frac{dw}{dt}$$

$$\frac{dU}{dt} = 1000 - 200 = 800 \text{ W}$$

13. The electrostatic force ($\vec{F}_1$) and magnetic force ($\vec{F}_2$) acting on a charge q moving with velocity v can be written:

(A) $\vec{F}_1 = q\vec{v} \cdot \vec{E}$, $\vec{F}_2 = q(\vec{B} \cdot \vec{v})$

(B) $\vec{F}_1 = q\vec{B}$, $\vec{F}_2 = q(\vec{B} \times \vec{v})$

(C) $\vec{F}_1 = q\vec{E}$, $\vec{F}_2 = q(\vec{v} \times \vec{B})$

(D) $\vec{F}_1 = q\vec{E}$, $\vec{F}_2 = q(\vec{B} \times \vec{v})$

Correct Option: C

Solution:

Electrostatic force, $\vec{F}_1 = q\vec{E}$

Magnetic force, $\vec{F}_2 = q(\vec{v} \times \vec{B})$

14. A rectangular loop of length 2.5 m and width 2 m is placed at 60° to a magnetic field of 4T. The loop is removed from the field in 10 sec. The average emf induced in the loop during this time is

(A) -2V (B) +2V (C) +1V (D) -1V

Correct Option: C

Solution:

15. If the kinetic energy of a free electron is doubled, its de-Broglie wavelength changes by the factor:

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

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

Correct Option: A

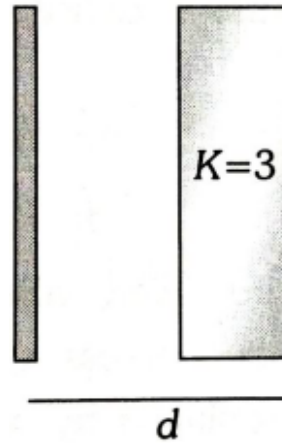
Solution:

Let λ be the de-Broglie wavelength of electron, when its kinetic energy is E , then

$$\lambda = \frac{h}{\sqrt{2mE}}$$

$$\lambda' = \frac{h}{\sqrt{2m \times 2E}} = \frac{1}{\sqrt{2}} \times \frac{h}{\sqrt{2mE}} = \frac{1}{\sqrt{2}} \lambda$$

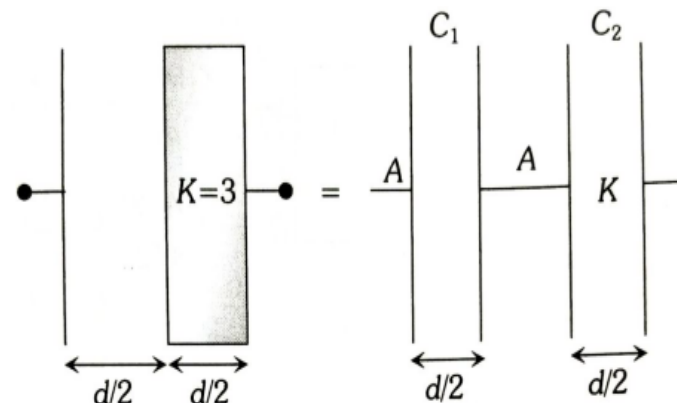
16. A parallel plate capacitor with plate area A and plate separation $d = 2m$ has a capacitance of $4\mu F$. The new capacitance of the system if half of the space between the plates is filled with a dielectric material of dielectric constant $K = 3$ (as shown in figure) will be



(A) $2\mu F$ (B) $32\mu F$ (C) $6\mu F$ (D) $8\mu F$

Correct Option: C

Solution:



$$C_{\text{original}} = \frac{A\epsilon_0}{d}$$

$$C_1 = \frac{A\epsilon_0}{d/2} = \frac{2A\epsilon_0}{d} = C$$

$$C_2 = \frac{KA\epsilon_0}{d/2} = \frac{2KA\epsilon_0}{d} = \frac{6A\epsilon_0}{d} = 3C$$

C_1 and C_2 are in series

$$C_{new} = \frac{C_1 C_2}{C_1 + C_2} = \frac{C \times 3C}{C + 3C} = \frac{3C}{4}$$

$$= \frac{3}{4} \times \frac{2A\epsilon_0}{d} = \frac{3}{2} \times \frac{A\epsilon_0}{d}$$

$$C_{new} = \frac{3}{2} C_{original} = \frac{3}{2} \times 4 = 6\mu F.$$

17. The kinetic energy of a satellite in its orbit around the earth is E . What should be the kinetic energy of the satellite so as to enable it to escape from the gravitational pull of the earth?

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

Correct Option: B

Solution:

We know that $v_e = \sqrt{2}v_0$, where v_0 is orbital velocity. K.E. in the orbit, $E = \frac{1}{2}Mv_0^2$.

$$\text{K.E. to escape} = \frac{1}{2}Mv_e^2 = \frac{1}{2}M(2v_0^2)$$

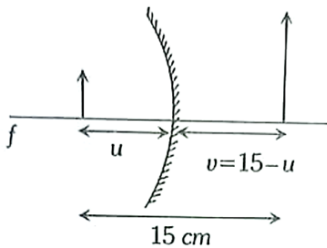
$$= \frac{1}{2}M \times v_0^2 \times 2 = 2E$$

18. If the distance between object and its two times magnified virtual image produced by a curved mirror is 15 cm, the focal length of the mirror must be

(A) 15 cm (B) -12 cm
(C) -10 cm (D) 10/3 cm

Correct Option: C

Solution:



$$m = 2 = \frac{-v}{u}$$

$$2 = \frac{-(15 - u)}{-u}$$

$$2u = 15 - u$$

$$3u = 15 \Rightarrow u = 5 \text{ cm}$$

$$v = 15 - u = 15 - 5 = 10 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$= \frac{1}{10} + \frac{1}{(-5)} = \frac{1 - 2}{10} = \frac{-1}{10}$$

$$f = -10 \text{ cm}$$

19. A plane progressive wave is given by

$$y = 2 \cos 2\pi(330t - x)\text{m}.$$

The frequency of the wave is:

(A) 165 Hz (B) 330 Hz (C) 660 Hz (D) 340 Hz

Correct Option: B

Solution:

$$y = 2 \cos 2\pi(330t - x) \text{ m}$$

$$y = A \cos(\omega t - kx)$$

by comparing $\omega = 2\pi \times 330$

$$2\pi f = 2\pi \times 330$$

$$f = 330$$

20. The property of light which cannot be explained by Huygen's construction of wavefront is

(A) Refraction (B) Reflection
(C) Diffraction (D) Origin of spectra

Correct Option: D

Solution:

The property of light which cannot be explained by Huygen's construction of wave front is origin of spectra.

21. The minimum excitation energy of an electron revolving in the first orbit of hydrogen is

(A) 3.4 eV (B) 8.5 eV (C) 10.2 eV (D) 13.6 eV

Correct Option: C

Solution:

Energy of electron in nth orbit

$$E_n = \frac{-13.6\text{eV}}{n^2}$$

Excitation energy of electron from $n = 1$ to $n = 2$

$$E = -13.6 \left[\frac{1}{2^2} - \frac{1}{1} \right] = -13.6 \left[\frac{1}{4} - 1 \right] = 10.2\text{eV}$$

22. Young's modulus of a material of a wire of length L and cross-sectional area A is Y . If the length of the wire is doubled and the cross-sectional area is halved, then what will be the Young's modulus?

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

Correct Option: C

Solution:

23. When a light ray incidents on the surface of a medium, the reflected ray is completely polarized. Then the angle between reflected and refracted rays is

(A) 45° (B) 90°
(C) 120° (D) 180°

Correct Option: B

Solution:

According to Brewster's law if the reflected ray is completely polarized, then the reflected and refracted ray is perpendicular to each other. Thus, $\theta = 90^\circ$

24. The nucleus having highest binding energy per nucleon is

(A) ^{16}O (B) ^{56}Fe
(C) $^{208}_{84}\text{Pb}$ (D) ^4_2He

Correct Option: B

Solution:

The binding energy per nucleon is practically independent of the atomic number for nuclei of mass number in range $30 < A < 17^\circ$.

So, ^{56}Fe has maximum binding energy per nucleon.

25. A reverse biased zener diode when operated in the breakdown region works as

(A) an amplifier (B) an oscillator
(C) a voltage regulator (D) a rectifier

Correct Option: C

Solution:

In the breakdown region, a reverse biased zener diode works as a voltage regulator.

26. On Celsius scale the temperature of body increases by 40°C . The increase in temperature on Fahrenheit scale is -

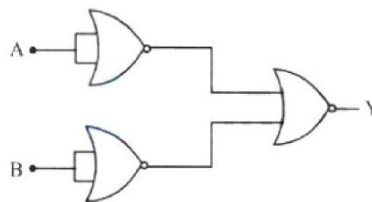
(A) 68°F (B) 70°F
(C) 72°F (D) 75°F

Correct Option: C

Solution:

$$\frac{\Delta t_c}{100} = \frac{\Delta t_F}{180} \Rightarrow \Delta t_F = 1.8 \times \Delta t_c = 1.8 \times 40 = 72^\circ\text{F}$$

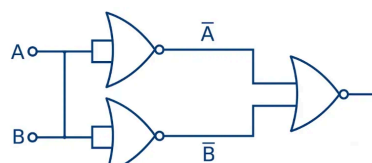
27. Identify the logic operation performed by the following circuit.



(A) OR (B) AND (C) NOT (D) NAND

Correct Option: B

Solution:



$$Y = \overline{\overline{A}} + \overline{\overline{B}}$$

$$= \overline{\overline{A}} \cdot \overline{\overline{B}}$$

$$= A \cdot B$$

$$\text{So, } Y = A \cdot B$$

Therefore gate is AND gate.

28. Two vessels A and B are of the same size and are at same temperature. A contains 1 g of hydrogen and B contains 1 g of oxygen. P_A and P_B are the pressures of the gas in A and B respectively, then $\frac{P_A}{P_B}$ is : [29 January 202 Shift-I]

(A) 16 (B) 8 (C) 4 (D) 32

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Correct Option: A

Solution:

$$\frac{P_A V_A}{P_B V_B} = \frac{n_A R T_A}{n_B R T_B}$$

$$\text{Given } V_A = V_B$$

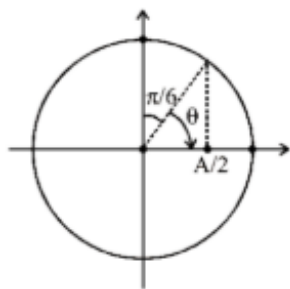
$$\text{And } T_A = T_B$$

$$\frac{P_A}{P_B} = \frac{n_A}{n_B}$$

$$\frac{P_A}{P_B} = \frac{1/2}{1/32} = 16$$

29. An alternating voltage $v(t) = 220 \sin 100\pi t$ volt is applied to a purely resistive load of 50Ω . The time taken for the current to rise from half of the peak value to the peak value is:

(A) 2.2 ms (B) 5 ms (C) 3.3 ms (D) 7.2 ms

Correct Option: C**Solution:**

$$V(t) = 220 \sin(100\pi t) \text{ volt}$$

Time taken

$$t = \frac{\theta}{\omega} = \frac{\frac{\pi}{6}}{100\pi} = \frac{1}{300} \text{ sec} = 3.3 \text{ ms}$$

30. A simple pendulum doing small oscillations at a place R height above earth surface has time period of $T_1 = 4 \text{ s}$. T_2 would be it's time period if is brought to a point which is at a height $2R$ from earth surface. Choose the correct relation [R = radius of Earth]:

- (A) $T_1 = T_2$ (B) $2 T_1 = 3 T_2$
(C) $3 T_1 = 2 T_2$ (D) $2 T_1 = T_2$

JM 2024**Correct Option: C****Solution:**

$$T_1 = 2\pi \sqrt{\frac{\ell}{GM} (2R)^2}$$

$$T_2 = 2\pi \sqrt{\frac{\ell}{GM} (3R)^2}$$

$$\therefore \frac{T_1}{T_2} = \frac{2}{3}$$

31. A photon of wavelength $3000 \text{ \AA}$ strikes a metal surface. The work function of the metal is 2.13 eV . What is the kinetic energy of the emitted photoelectron? ($h = 6.626 \times 10^{-34} \text{ Js}$)

- (A) 4.0 eV (B) 3.0 eV (C) 2.0 eV (D) 1.0 eV

Correct Option: C**Solution:**

$$\lambda = 3000 \text{ \AA} \dots = 3 \times 10^{-7} \text{ m}, \phi = 2.13 \text{ eV}$$

$$\begin{aligned} K.E. &= hv - hv_0 = hv - \phi = \frac{hc}{\lambda} - \phi \\ &= \frac{(6.626 \times 10^{-34} \times 3 \times 10^8)}{3 \times 10^{-7}} - (2.13 \times 1.6 \times 10^{-19}) \\ &= \frac{1.98 \times 10^{-25}}{3 \times 10^{-7}} - (3.408 \times 10^{-19}) \\ &= (6.60 \times 10^{-19}) - (3.408 \times 10^{-19}) \\ &= 3.192 \times 10^{-19} \text{ J} = 2.0 \text{ eV} \end{aligned}$$

32. Ferrocene is :-

- (A) $\text{Fe}(\eta^5 - \text{C}_5\text{H}_5)_2$
(B) $\text{Cr}(\eta^6 - \text{C}_6\text{H}_6)_2$
(C) $\text{K}[\text{PtCl}_3(\eta^2 - \text{C}_2\text{H}_4)]$
(D) $(\text{C}_2\text{H}_5)_4 \text{ Pb}$

Correct Option: A**Solution:**

33. The chemical name of calgon is

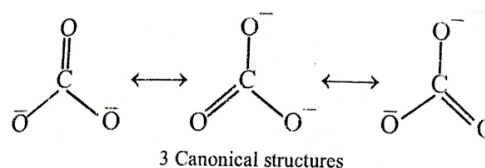
- (A) Sodium hexametaphosphite (B) Potassium hexametaphosphate
(C) Calcium hexametaphosphate (D) Sodium hexametaphosphate

Correct Option: D**Solution:**

Calgon is sodium hexametaphosphate with the formula $\text{Na}_6\text{P}_6\text{O}_{18}$:

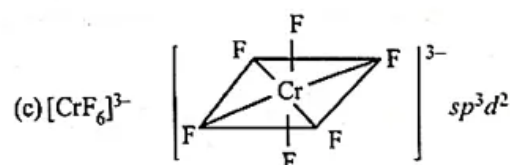
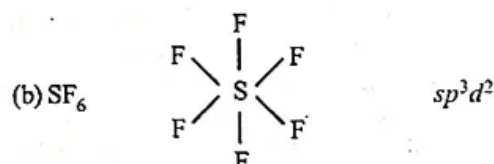
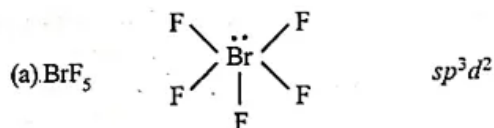
34. Identify the species having one π -bond and maximum number of canonical forms from the following:

- (A) SO_3 (B) O_2
(C) SO_2 (D) CO_3^{2-}

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35. Which of the following does *not* display $sp^3 d^2$ hybridisation?

- (A) BrF_5
(B) SF_6

(C) $[\text{CrF}_6]^{3-}$ (D) PF_5 **Correct Option: D****Solution:**

36. A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V volt. If ' e ' and m are charge and mass of an electron, respectively, then the value of h/λ (where λ is wavelength associated with electron wave) is given by:

- (A) $\sqrt{meV}$ (B) $\sqrt{2meV}$
(C) meV (D) $2 meV$

Correct Option: B**Solution:**

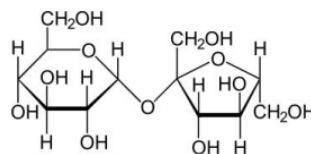
As electron of charge ' e ' is passed through ' V ' volt, kinetic energy of electron will be eV .

$$\text{Wavelength of electron wave } (\lambda) = \frac{h}{\sqrt{2m \cdot KE}}$$

$$\lambda = \frac{h}{\sqrt{2meV}} \quad \therefore \frac{h}{\lambda} = \sqrt{2meV}$$

37. Glycosidic linkage between C_1 of α -glucose and C_2 of β -fructose is found in

- (A) maltose (B) sucrose (C) lactose (D) amylose

Correct Option: B**Solution:****Theoretical**

38. Thermal decomposition of lithium nitrate gives

- (A) Li_2O , O_2 , NO_2
(B) Li_2O , O_2 , N_2O
(C) Li_2O , O_2 , N_2
(D) Li_2O , O_2 , NO_2

Correct Option: D**Solution:**

39. In the reaction, $A \rightarrow \text{products}$, if the concentration of A reactant is doubled rate of the reaction remains unchanged. The order of the reaction with respect to A is

- (A) 1 (B) 2 (C) 0.5 (D) 0

Correct Option: D**Solution:**

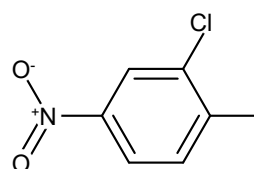
40. In which of the following molecules, all bond lengths are not equal?

- (A) SF_6 (B) PCl_5
(C) BCl_3 (D) CCl_4

Correct Option: B**Solution:**

In PCl_5 bond length of axial bond is greater than the length of equatorial bond.

41. The IUPAC name of the following molecule is



- (A) 2-Methyl-5 nitro-1-chlorobenzene
(B) 3-Chloro-4 methyl-1-nitrobenzene
(C) 2-Chloro-1 methyl-4-nitrobenzene
(D) 2-Chloro-4 nitro-1-methylbenzene

Correct Option: C

Solution:

42. The complex with highest magnitude of crystal field splitting energy (Δ_0) is

- (A) $[\text{Cr}(\text{OH}_2)_6]^{3+}$
 (B) $[\text{Ti}(\text{OH}_2)_6]^{3+}$
 (C) $[\text{Fe}(\text{OH}_2)_6]^{3+}$
 (D) $[\text{Mn}(\text{OH}_2)_6]^{3+}$

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Correct Option: A**Solution:** $\text{Ti}^{3+} = 67\text{pm}$ radius $\text{Cr}^{3+} = 62\text{pm}$ radius $\text{Mn}^{3+} = 65\text{pm}$ radius $\text{Fe}^{3+} = 65\text{pm}$ radiusSo, Cr^{3+} has highest tendency to attract ligand.

43. The combustion of benzene (I) gives $\text{CO}_2(\text{g})$ and $\text{H}_2\text{O}(\text{l})$. Given that heat of combustion of benzene at constant volume is $-3263.9 \text{ kJ mol}^{-1}$ at 25°C ; heat of combustion (in kJ mol^{-1}) of benzene at constant pressure will be : ($R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)

- (A) 4152.6 (B) -452.46 (C) 3260 (D) -3267.6

Correct Option: D**Solution:**

44. In a first order reaction, the concentration of the reactant, decreases from 0.8 to 0.4 M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M is

- (A) 30 minutes (B) 15 minutes
 (C) 7.5 minutes (D) 60 minutes

Correct Option: A**Solution:**

$$t_{1/2} = 15 \text{ min}$$

$$0.1 \xrightarrow{t_{75\%}} 0.025$$

$$t_{75\%} = 2t_{1/2}$$

$$= 2 \times 15 = 30 \text{ min}$$

45. Arrange the following free radicals in the correct order their stability:

- (i) $\text{CH}_2 = \dot{\text{C}}\text{H}$
 (ii) CH_3
 (iii) $\text{CH}_3 - \dot{\text{C}}\text{H} - \text{CH}_3$
 (iv) $(\text{CH}_3)_3\dot{\text{C}}$

(A) $i > ii > iii > iv$ (B) $iv > iii > ii > i$ (C) $i < ii < iii < iv$ (D) $iv > iii > i > ii$ **Correct Option: B****Solution:**

46. In which mode of expression, the concentration of a solution remains independent of temperature?

- (A) Molarity (B) Normality (C) Formality (D) Molality

Correct Option: D**Solution:**

Molality is defined in terms of weight, hence independent of temperature. Remaining three concentration units are defined in terms of volume of solution, they depend on temperature.

47. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following.

(A) $q \neq 0, \Delta T = 0, w = 0$ (B) $q = 0, \Delta T \neq 0, w = 0$ (C) $q = 0, \Delta T = 0, w = 0$ (D) $q = 0, \Delta T < 0, w \neq 0$ **Correct Option: C****Solution:**

For the free expansion of an ideal gas under adiabatic conditions:

1. Adiabatic condition: $q = 0$
2. Free expansion (into a vacuum): External pressure is zero, so $w = -P_{ext}\Delta V = 0$
3. First Law of Thermodynamics: $\Delta U = q + w$. Since $q = 0$ and $w = 0$, $\Delta U = 0$.
4. Ideal gas: For an ideal gas, ΔU is only a function of temperature. If $\Delta U = 0$, then $\Delta T = 0$. *

Therefore, the correct option is (C.) $q = 0$, $\Delta T = 0$, $w = 0$.

48. An unknown alcohol is treated with the "Lucas reagent" to determine whether the alcohol is primary, secondary or tertiary. Which alcohol reacts fastest and by what mechanism :

- (A) secondary alcohol by S_N1
- (B) tertiary alcohol by S_N1
- (C) secondary alcohol by S_N2
- (D) tertiary alcohol by S_N2

Correct Option: B

Solution:

The reaction of alcohol with Lucas reagent is mostly an S_N1 mechanism reaction and the rate of reaction is directly proportional to the carbocation stability formed in the reaction, hence tertiary alcohol will react fastest.

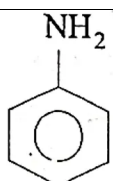
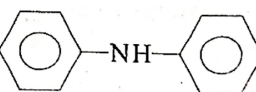
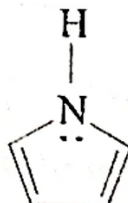
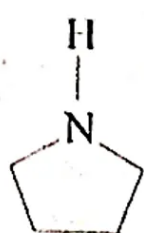
49. IUPAC name of $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NH}_2\text{CH}_3)]\text{Cl}$ is

- (A) (Amino methane) chloro (diammine) platinum (II) chloride.
- (B) Chlorodiammine (methanamine) platinum(II) chloride.
- (C) Diamminechloro(methanamine) platinum(II) chloride.
- (D) Diamminechloro (methylamine) platinum (IV) chloride.

Correct Option: C

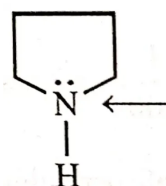
Solution:

50. Which of the following is strongest Bronsted base?

- (A) 
- (B) 
- (C) 
- (D) 

Correct Option: D

Solution:



localised lone pair & sp^2 makes it easier to lose electron pair or getting protonated.

51. Calamine, malachite, magnetite and cryolite, respective are:

- (A) ZnSO_4 , CuCO_3 , Fe_2O_3 , AlF_3
- (B) ZnCO_3 , $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$, Fe_3O_4 , Na_3AlF_6
- (C) ZnSO_4 , $\text{Cu}(\text{OH})_2$, Fe_3O_4 , Na_3AlF_6
- (D) ZnCO_3 , CuCO_3 , Fe_2O_3 , Na_3AlF_6

JA 2019

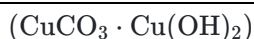
Correct Option: B

Solution:

Fact based (CuCO_3) malachite

($\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$), magnetic (Fe_3O_4)

cryolite



52. The naturally occurring amino acid that contains only one basic functional group in its chemical structure is

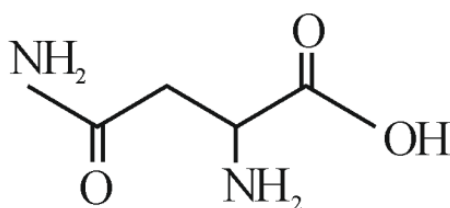
(A) arginine (B) lysine
(C) asparagine (D) histidine

JM 2023

Correct Option: C

Solution:

Asparagine has only one basic functional group in its chemical structure.



Others are basic amino acid with more than one basic functional group.

53. Which of the following substances show the highest colligative properties?

(A) 0.1M BaCl₂
(B) 0.1M AgNO₃
(C) 0.1 M urea
(D) 0.1M (NH₄)₃ PO₄

Correct Option: D

Solution:

Colligative property depends on the number of particles or ions. Option (d) consists 4 of ions due to which it shows highest colligative property.

54. The ratio $\frac{K_P}{K_C}$ for the reaction $\text{CO}_{(g)} + \frac{1}{2} \text{O}_{2(g)} \rightleftharpoons \text{CO}_{2(g)}$ is:

(A) $(RT)^{1/2}$ (B) RT
(C) 1 (D) $\frac{1}{\sqrt{RT}}$

Correct Option: D

Solution:

55. The metal that shows highest and maximum number of oxidation state is:

(A) Fe (B) Mn (C) Ti (D) Co

Correct Option: B

Solution:

Mn shows highest oxidation state of +7 in 3d series metals. Ti, Co and Fe shows oxidation state of +4, +4 and +6 respectively.

56. _____ is a potent vasodilator.

(A) Histamine (B) Serotonin
(C) Codeine (D) Cimetidine

Correct Option: A

Solution:

57. Which of the following complexes will exhibit maximum attraction to an applied magnetic field?

(A) $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$
(B) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
(C) $[\text{Co}(\text{en})_3]^{3+}$
(D) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$

JM 2023

Correct Option: B

Solution:

Complex with maximum number of unpaired electron will exhibit maximum attraction to an applied magnetic field.

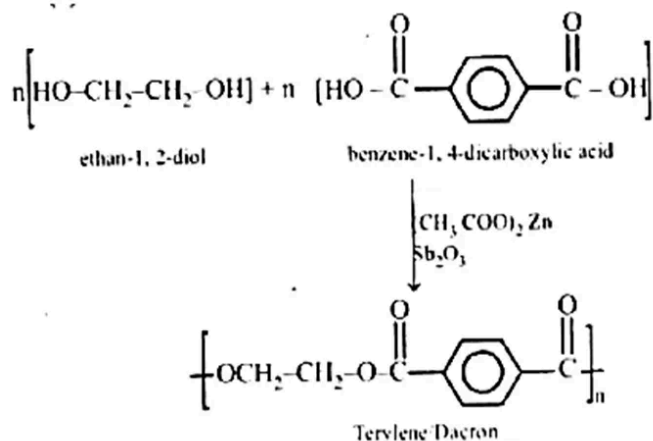


58. Zinc acetate - antimony trioxide catalyst is used in the preparation of which polymer?

(A) High density polythene (B) Teflon
(C) Terylene (D) PVC

Correct Option: C

Solution:



59. The sol formed in the following unbalanced equation is
 $\text{As}_2\text{O}_3 + \text{H}_2\text{S} \rightarrow$

- (A) As_2S_2
 (B) As_2S_3
 (C) As
 (D) S

Correct Option: B

Solution:



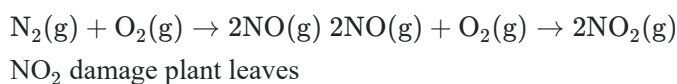
60. Dinitrogen is a robust compound, but reacts at high altitude to form oxides. The oxide of nitrogen that can damage plant leaves and retard photosynthesis is :

- (A) NO (B) NO_3^-
 (C) NO_2 (D) NO_2^-

JM 2022

Correct Option: C

Solution:



61. Having lived in Kerala for ten years, my friend is used to speak Malayalam with his friends.

- (A) used to speak (B) is used to speaking
 (C) was used to speak (D) use to speaking

Correct Option: C

Solution:

62. He was so filled with contempt for the prisoner that he gave him a _____ look.

- (A) humiliated (B) derisive

(C) pitying

(D) hurtful

Correct Option: A

Solution:

63. He likes people to call him Sir.
 (A) He likes to be called Sir by people.
 (B) He likes to be call Sir by people.
 (C) He likes people who call him Sir.
 (D) To call him Sir is liked by people.

Correct Option: A

Solution:

64. Choose the correct spelling of the word:
 (A) Sovereignty (B) Soveriegnity
 (C) Sovereignity (D) Soveriegnity

Correct Option: A

Solution:

65. Based on the passage, what can be inferred about Samantha's attitude towards the charity event?
 (A) Samantha was indifferent about the outcome of the charity dinner.
 (B) Samantha was willing to make personal sacrifices to ensure the charity event's success.
 (C) Samantha was dissatisfied with the financial outcome of the event.
 (D) Samantha preferred to host simple events rather than elaborate ones.

Correct Option: B

Solution:

66. I am afraid my computer will _____ if I try to run it too high a speed.
 (A) break down (B) break out
 (C) break even (D) break away

Correct Option: A

Solution:

67. ISLAND : OCEAN ::
 (A) Hill : Stream (B) Forest : Valley
 (C) Tree : Field (D) Oasis : Desert

Correct Option: D

Solution:

68. Which of the following should be the FIRST sentence after rearrangement?

(A) A (B) B (C) C (D) D

Correct Option: D

Solution:

69. Which of the following best summarizes the passage?
- (A) Urban gardening is mainly about growing plants for decorative purposes in cities.
- (B) Urban gardening helps city dwellers enjoy fresh produce and build community connections, while also contributing to environmental sustainability.
- (C) Urban gardening is an expensive hobby that requires significant investment and space.
- (D) Urban gardening is primarily practiced by people in rural areas who want to experience city life.

Correct Option: B

Solution:

70. The telegraph wires have been cut.
- (A) Someone has been cut the telegraph wires
- (B) No one has cut the telegraph wires.
- (C) The telegraph wires have cut someone.
- (D) Someone has cut the telegraph wires.

Correct Option: D

Solution:

71. Select the option figure that will complete the series of question figures. Question figures:

* < Δ >	> Δ * Λ Δ *	?
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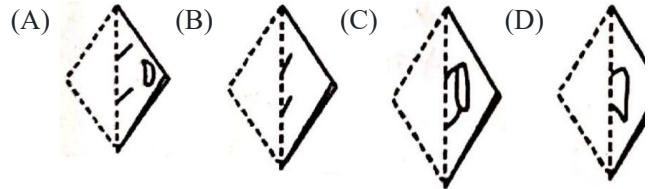
A	B	C	D
Λ > ▲ *	Λ > * ▼	* Λ > ◀	▼ Λ > *

(A) B (B) D (C) C (D) A

Correct Option: B

Solution:

72. Which pattern will the given transparent sheet resemble when it is folded at the dotted line ?



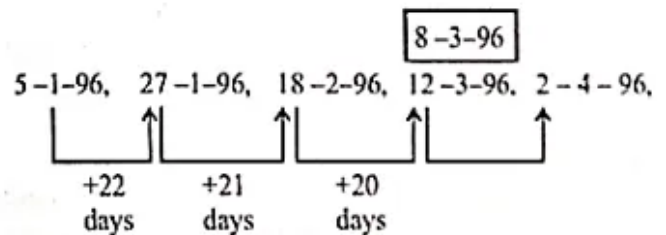
Correct Option: A

Solution:

73. Which of the following doesn't fit into the series? 5-1-96, 27-1-96, 18-2-96, 12-3-96, 2-4-96.

(A) 18-2-96 (B) 27-1-96 (C) 12-3-96 (D) 5-1-96

Correct Option: C

Solution:

74. If 'Q' means '+', 'J' means '÷', 'T' means '-' and '!' means '×', then what is the value of 18K3Q7J2T8?

(A) 15 (B) 10 (C) 18 (D) 12

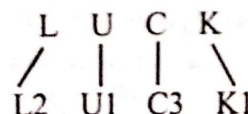
Correct Option: D

Solution:

75. In a code language, if LUCK is written as L2U1C3K1, then what is the last digit for the code for XEROX in the same language?

(A) 4 (B) 3 (C) 2 (D) 1

Correct Option: A

Solution:

where the place value of L is 12, U is 21, C is 3 and K is 11, So the last number is written with the present letter.

Same as,

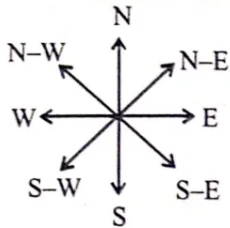
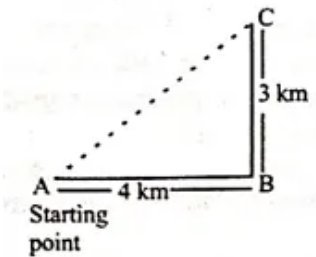
X E R O X
| | | | |
X4 E5 R8 O5 X4

76. Raju walks 4 km towards East. Then, he turns left and walks another 3 km. In which direction and at what distance is he from his initial position?

(A) South-West, 5 km (B) North-East, 5 km
(C) South-East, 5 km (D) North-West, 5 km

Correct Option: B

Solution:



According to the question,

by Pythagoras theorem,

$$AC^2 = BC^2 + AB^2$$

$$AC^2 = 3^2 + 4^2$$

$$AC^2 = 9 + 16$$

$$AC = \sqrt{25} = 5 \text{ Km}$$

So, Raju is 5 Km far from his initial point and Raju is in North-East direction from initial point.

77. Read the given statements and the following conclusions carefully and select which of the conclusions logically follow(s) from the statements.

Statements :

All blue are colours.

All colours are shades.

Conclusion :

1. All blue are shades.
2. Some shades are colors.

(A) All the conclusions follow (B) Only conclusion 1 follows

(C) Only conclusion 2 follows (D) No conclusions follow

Correct Option: A

Solution:

78. Read the given statement(s) and conclusions carefully and select which of the conclusions logically follow from the statement(s):

Statement :

All razors are blades

All blades are metal

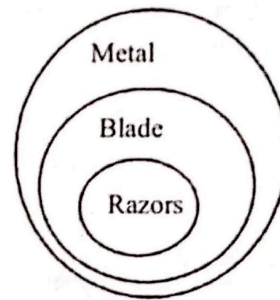
Conclusions :

1. All metals are razors
2. Some metals are blades.

(A) All the conclusions follow (B) Neither conclusion follows
(C) Only conclusion 2 follows (D) Only conclusion 1 follows

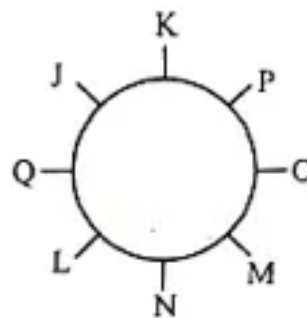
Correct Option: C

Solution:



Only conclusion 2 follows.

Seating arrangement is as follows



79. Which of the following is correct about decomposition process?

(A) Decomposition rate is faster if detritus is rich in lignin and chitin
(B) Decomposition is largely an aerobic process
(C) Decomposition rate is slower if detritus is rich in nitrogen and water-soluble substances like sugars
(D) Low temperature faster the rate of decomposition

Correct Option: B

Solution:

Decomposition is an oxygen requiring process. Its rate is faster when detritus is rich in nitrogen and simple sugars.

80. Which of the following pair of persons represent O's neighbours?

(A) L&N (B) P&K (C) M&P (D) N&P

Correct Option: C

Solution:

81. Which of the following groups has the first person sitting between the other two persons?

(A) PKJ (B) JQL
(C) QNL (D) None of these

Correct Option: D

Solution:

82. In a joint family, there are father, mother, 3 married sons and one unmarried daughter. Of the sons two married sons have 2 daughters each, and one has a son. How many female members are there in the family?

(A) 2 (B) 3 (C) 6 (D) 9

Correct Option: D

Solution:

The female members in the family are mother, wives of 3 married sons, unmarried daughter and 2 daughters of each of the two sons. $(1 + 3 + 1 + 2 \times 2) = 9$

83. Pointing towards a woman in a photograph Vijay said, "She is the daughter of the father of sister of my brother". How is the lady in the photograph related to Vijay?

(A) Wife (B) Mother (C) Sister (D) Daughter

Correct Option: C

Solution:

84. If 'yellow' means 'green', 'green' means 'white', white means 'red', 'red' means 'black', 'black' means 'blue' and 'blue' means 'violet', which of the following represents the colour of human blood?

(A) black (B) violet
(C) red (D) None of these

Correct Option: D

Solution:

85. Which one of the letters when sequentially placed at the gaps in the given letter series shall complete it? m ____
l m ____ mm ____ l

(A) mlhl (B) mimll (C) lmlm (D) mmml

Correct Option: B

Solution:

86. Who amongst the following is most likely to have score 87% marks?

(A) A (B) B (C) D (D) E

Correct Option: C

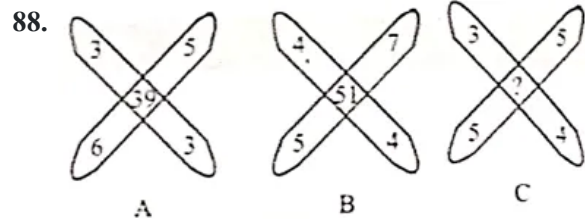
Solution:

87. Which of the following percentages is most likely to be B's percentage in the exam?

(A) 68% (B) 71% (C) 84% (D) 97%

Correct Option: D

Solution:

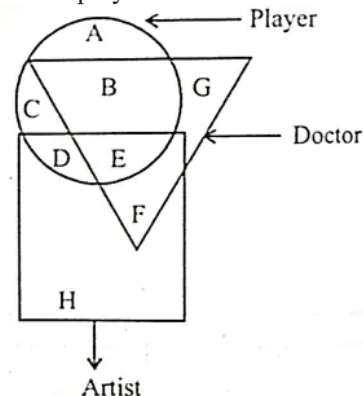


(A) 47 (B) 45 (C) 37 (D) 35

Correct Option: C

Solution:

89. In the following Venn diagram identify the letter which denotes players who are also doctors but not artists.

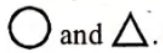


(A) B + E (B) E
(C) B (D) A

Correct Option: C

Solution:

Area common to



90. In the following questions, there are two words set of letters/numbers to the left of the sign :: which are connected in some way. The same relationship obtains between the third words/ set of letters/numbers and one of the four alternatives under it. Find the correct alternative.
TOMATO : MTOOTA :: 123412 : ?

(A) 312214 (B) 123456 (C) 321124 (D) 213314

Correct Option: A

Solution:

91. For two events A and B , if $P(A) = P\left(\frac{A}{B}\right) = \frac{1}{4}$ and $P\left(\frac{B}{A}\right) = \frac{1}{2}$, then which of the following is not true?

(A) A and B are independent

(B) $P\left(\frac{A'}{B}\right) = \frac{3}{4}$

(C) $P\left(\frac{B'}{A'}\right) = \frac{1}{2}$

(D) None of these

Correct Option: D

Solution:

92. The population $p(t)$ at time t of a certain mouse species satisfies the differential equation $\frac{dp(t)}{dt} = 0.5p(t) - 450$. If $p(0) = 850$, then the time at which the population becomes zero is:

(A) $2 \ln 18$

(B) $\ln 9$

(C) $\frac{1}{2} \ln 18$

(D) $\ln 18$

Correct Option: A

Solution:

93. The value of $\int e^{\tan \theta} (\sec \theta - \sin \theta) d\theta$ is

(A) $e^{\tan \theta} \sec \theta + c$

(B) $e^{\tan \theta} \sin \theta + c$

(C) $e^{\tan \theta} (\sec \theta + \sin \theta) + c$

(D) $e^{\tan \theta} \cos \theta + c$

Correct Option: D

Solution:

94. $\int_0^{\frac{\pi}{2}} \frac{\sin\left(\frac{\pi}{4}+x\right)+\sin\left(\frac{3\pi}{4}+x\right)}{\cos x+\sin x} dx =$

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

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

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

(D) $\frac{\pi}{4\sqrt{2}}$

Correct Option: B

Solution:

95. $f(x) = \begin{cases} 4 & -\infty < x < -\sqrt{5} \\ x^2 - 1 & -\sqrt{5} \leq x \leq \sqrt{5} \\ 4 & \sqrt{5} \leq x < \infty \end{cases}$ If k is the number

of points where $f(x)$ is not differentiable then $k - 2 =$

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

Correct Option: C

Solution:

96. $\int \sqrt{x + \sqrt{x^2 + 2}} dx =$

(A) $\frac{3}{2}(x + \sqrt{x^2 + 2})^{3/2} - 2(x + \sqrt{x^2 + 2})^{1/4} + C$

(B) $\frac{1}{3}(x + \sqrt{x^2 + 2})^{3/2} - 2(x + \sqrt{x^2 + 2})^{1/4} + C$

(C) $(x + \sqrt{x^2 + 2})^{-3/2} - 2(x + \sqrt{x^2 + 2})^{-1/2} + C$

(D) $\frac{(x + \sqrt{x^2 + 2})^2 - 6}{3\sqrt{x + \sqrt{x^2 + 2}}} + C$

Correct Option: D

Solution:

97. If p : It is raining today, q : I go to school, r : I shall meet any friends, and s : I shall go for a movie, then which of the following is the proposition: 'If it does not rain or if do not go to school, then I shall meet my friend and go for a movie'?

(A) $\sim (p \wedge q) \Rightarrow (r \wedge s)$

(B) $\sim (p \wedge \sim q) \Rightarrow (r \wedge s)$

(C) $\sim (p \wedge q) \Rightarrow (r \vee s)$

(D) None of these

Correct Option: A

Solution:

98. The altitude of a cone is 20 cm and its semi-vertical angle is 30° . If the semi-vertical angle is increasing at the rate of 2° per second, then the radius of the base is increasing at the rate of

(A) 30 cm/sec

(B) $\frac{160}{3}$ cm/sec

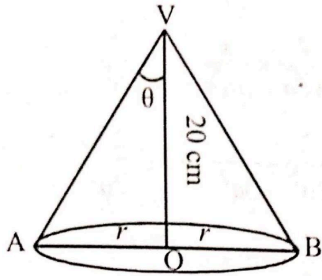
(C) 10 cm/sec

(D) 160 cm/sec

Correct Option: B

Solution:

Let θ be the semi-vertical angle and r be the radius of the cone at time t . Then, $r = 20 \tan \theta$



$$\Rightarrow \frac{dr}{dt} = 20 \sec^2 \theta \frac{d\theta}{dt}$$

$$\Rightarrow \frac{dr}{dt} = 20 \sec^2 30^\circ \times 2$$

$$[\because \theta = 30^\circ \text{ and } \frac{d\theta}{dt} = 2]$$

$$\Rightarrow \frac{dr}{dt} = 20 \times \frac{4}{3} \times 2 \text{ cm/s} = \frac{160}{3} \text{ cm/s}$$

99. If $y = \tan^{-1} \frac{1}{x^2+x+1} + \tan^{-1} \frac{1}{x^2+3x+3} + \tan^{-1} \frac{1}{x^2+5x+7} + \dots$ to n terms, then $\frac{dy}{dx} =$

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

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

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

(D) None of these

Correct Option: B

Solution:

100. If the function $f(x)$, defined below, is continuous on the interval $[0, 8]$, then find the values of a and b .

$$f(x) = \begin{cases} x^2 + ax + b, & 0 \leq x < 2 \\ 3x + 2, & 2 \leq x \leq 4 \\ 2ax + 5b, & 4 < x \leq 8 \end{cases}$$

(A) $a = 3, b = -2$ (B) $a = -3, b = 2$

(C) $a = -3, b = -2$ (D) $a = 3, b = 2$

Correct Option: A

Solution:

101. If the system of linear equations $2x + y - z = 7$, $x - 3y + 2z = 1$, $x + 4y + \delta z = k$, where $\delta, k \in \mathbb{R}$, has infinitely many solutions, then $\delta + k$ is equal to:

(A) -3 (B) 3 (C) 6 (D) 9

Correct Option: B

Solution:

102. If A is a square matrix of order 3, then $\text{Adj}(\text{Adj}(A^2))$:

- (A) $|A|^2$ (B) $|A|^4$
(C) $|A|^x$ (D) $|A|^{16}$

Correct Option: C

Solution:

103. If $\cos \cot^{-1}(\frac{1}{2}) = \cot(\cos^{-1} x)$, then the value of x is

- (A) $\frac{1}{\sqrt{6}}$ (B) $\frac{-1}{\sqrt{12}}$
(C) $\frac{2}{\sqrt{6}}$ (D) $\frac{-2}{\sqrt{6}}$

Correct Option: A

Solution:

104. Let $f(x) = \sin x$, $g(x) = \cos x$, $h(x) = x^2$ then

$$\lim_{x \rightarrow 1} \frac{f(g(h(x))) - f(g(h(1)))}{x - 1} =$$

- (A) 0 (B) $-2 \sin 1 \cos(\cos 1)$
(C) ∞ (D) $-2 \sin 1 \cos 1$

Correct Option: B

Solution:

105. If $A = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$, $P = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ and $X = APA'$, the

$$A^T X^{50} A =$$

- (A) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$
(B) $\begin{bmatrix} 2 & 1 \\ 0 & -1 \end{bmatrix}$
(C) $\begin{bmatrix} 25 & 1 \\ 1 & -25 \end{bmatrix}$
(D) $\begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix}$

Correct Option: D

Solution:

106. $\lim_{n \rightarrow \infty} \prod_{r=3}^n \frac{r^3-8}{r^3+8}$ equals to

- (A) $\frac{2}{7}$ (B) $\frac{3}{7}$
(C) $\frac{4}{7}$ (D) $\frac{6}{7}$

Correct Option: A

Solution:

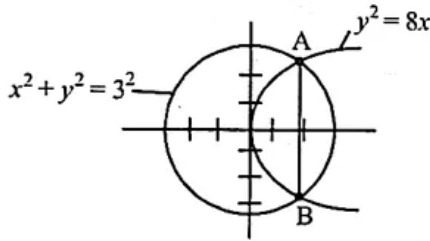
107. Let L_1 be the length of the common chord of the curve $x^2 + y^2 = 9$ and $y^2 = 8x$, and L_2 be the length of the latus rectum of $y^2 = 8x$, then:

(A) $L_1 > L_2$

(B) $L_1 = L_2$

(C) $L_1 < L_2$

(D) $\frac{L_1}{L_2} = \sqrt{2}$

Correct Option: C**Solution:**

We have : $x^2 + (8x) = 9$

$$\Rightarrow x^2 + 9x - x - 9 = 0$$

$$\Rightarrow x(x+9) - 1(x+9) = 0$$

$$\Rightarrow (x+9)(x-1) = 0 \Rightarrow x = -9, 1$$

for $x = 1, y = \pm 2\sqrt{2}x = \pm 2\sqrt{2}$

$$L_1 = \text{Length of } AB =$$

$$\sqrt{(2\sqrt{2} + 2\sqrt{2})^2 + (1 - 1)^2} = 4\sqrt{2}$$

$$L_2 = \text{Length of latus rectum} = 4a = 4 \times 2 = 8$$

$$L_1 < L_2$$

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108. The range of $(8 \sin \theta + 6 \cos \theta)^2 + 2$ is

(A) $(0, 2)$

(B) $[2, 102]$

(C) $(-\infty, \infty)$

(D) $(2, 1)$

Correct Option: B**Solution:****109.** If arithmetic mean of two distinct positive real numbers a and b ($a > b$) is twice their geometric mean, then find the ratio $a : b$.

(A) $(2 + \sqrt{3}) : (2 - \sqrt{3})$

(B) $(2 + \sqrt{5}) : (2 - \sqrt{5})$

(C) $(2 + \sqrt{2}) : (2 - \sqrt{2})$

(D) None of these

Correct Option: A**Solution:****110.** If $\tan 15^\circ$ and $\tan 30^\circ$ are the roots of the equation $x^2 + px + q = 0$, then find pq .

(A) $\frac{6\sqrt{3}+10}{\sqrt{3}}$

(B) $\frac{10-6\sqrt{3}}{3}$

(C) $\frac{10+6\sqrt{3}}{3}$

(D) $\frac{10-6\sqrt{3}}{\sqrt{3}}$

Correct Option: B**Solution:****111.** Number of subsets of set of letter of word 'MONOTONE'.

(A) 8

(B) 256

(C) 64

(D) 32

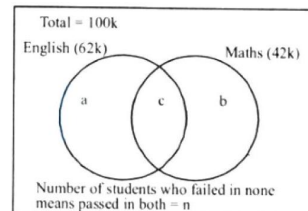
Correct Option: A**Solution:****112.** In an examination, 62% of the candidates failed English, 42 in Mathematics and 20 in both. The number of those who passed in both the subjects is

(A) 11

(B) 16

(C) 18

(D) None of these

Correct Option: B**Solution:**

From the given condition,

$$a + c = 62k; b + c = 42k \text{ and } c = 20k$$

Hence $a = 42k$ and $b = 22k$

Number of students who failed in none means passed in both = $n = 100k - (a + b + c)$

$$= 100k - (42k + 22k + 20k) = 16k. \text{ or } 16\%$$

113. The variance of 20 observations is 5. If each observation is multiplied by 2, then the new variance of the resulting observation is

(A) $2^3 \times 5$

(B) $2^2 \times 5$

(C) 2×5

(D) $2^4 \times 5$

Correct Option: B**Solution:**Let the observations be $x_1, x_2, \dots, x_{20}$ and $\bar{x}$ be their mean. Given that, variance = 5 and $n = 20$. We know that,

$$\text{Variance } (\sigma^2) = \frac{1}{n} \sum_{i=1}^{20} (x_i - \bar{x})^2$$

$$\text{i.e. } 5 = \frac{1}{20} \sum_{i=1}^{20} (x_i - \bar{x})^2$$

$$\text{or } \sum_{i=1}^{20} (x_i - \bar{x})^2 = 100$$

If each observation is multiplied by 2 and the new resulting observations are

y_i , then

$$y_i = 2x_i \text{ i.e., } x_i = \frac{1}{2} y_i$$

Therefore,

$$\bar{y} = \frac{1}{n} \sum_{i=1}^{20} y_i = \frac{1}{20} \sum_{i=1}^{20} 2x_i = 2 \cdot \frac{1}{20} \sum_{i=1}^{20} x_i$$

$$\text{i.e., } \bar{y} = 2\bar{x} \text{ or } \bar{x} = \frac{1}{2}\bar{y}.$$

On substituting the values of x_i and $\bar{x}$ in eq. (i), we get

$$\sum_{i=1}^{20} \left(\frac{1}{2} y_i - \frac{1}{2} \bar{y} \right)^2 = 100$$

i.e., $\sum_{i=1}^{20} (y_i - \bar{y})^2 = 400$ Thus, the variance of new observations

$$= \frac{1}{20} \times 400 = 20 = 2^2 \times 5$$

114. From a point A(0, 3) on the circle $(x+2)^2 + (y-3)^2 = 4$, a chord AB is drawn and it is extended to a point Q such that $AQ = 2AB$. Then the locus of Q is

(A) $(x+4)^2 + (y-3)^2 = 16$ (B) $(x+1)^2 + (y-3)^2 = 32$

(C) $(x+1)^2 + (y-3)^2 = 4$ (D) $(x+1)^2 + (y-3)^2 = 1$

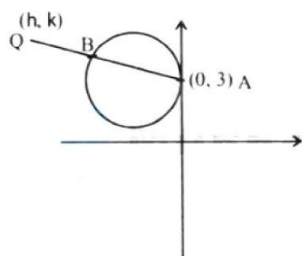
Correct Option: A

Solution:

Given equation of circle

$$(x+2)^2 + (y-3)^2 = 4$$

Let the coordinates of Q is (h, k).



Coordinate of B which is midpoint of AQ because $AQ = 2AB$.

$$\text{Then, } B = \left(\frac{0+h}{2}, \frac{k+3}{2} \right) \rightarrow \left(\frac{h}{2}, \frac{k+3}{2} \right)$$

Point B also satisfy the equation of circle.

$$(x+2)^2 + (y-3)^2 = 4 \left(\frac{h}{2} + 2 \right)^2 + \left(\frac{k+3}{2} - 3 \right)^2 = 4$$

$$\frac{(h+4)^2}{4} + \frac{(k-3)^2}{4} = 4$$

$$(h+4)^2 + (k-3)^2 = 16 \text{ Replace } (h, k) \text{ by } (x, y),$$

$$\text{then, the required equation is } (x+4)^2 + (y-3)^2 = 16$$

115. A(3, 2, 0), B(5, 3, 2), C(-9, 6, -3) are three points forming a triangle. AD, the bisector of angle BAC meets BC in D. Find the co-ordinates of D.

(A) $\frac{19}{8}, \frac{57}{15}, \frac{57}{15}$

(B) $\frac{19}{8}, \frac{57}{16}, \frac{17}{16}$

(C) (2, 3, 0)

(D) (4, 5, 6)

Correct Option: B

Solution:

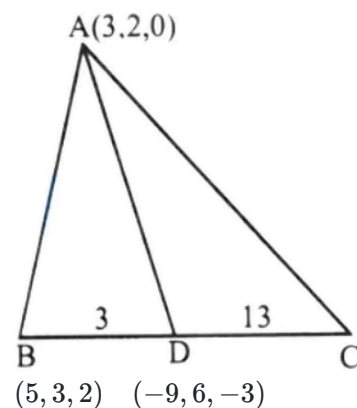
Since AD is the bisector of $\angle BAC$.

$$\Rightarrow \frac{BD}{DC} = \frac{AB}{AC} \dots (i)$$

Now,

$$AB = \sqrt{(5-3)^2 + (3-2)^2 + (2-0)^2}$$

$$= \sqrt{4+1+4} = \sqrt{9} = 3$$



$$AC = \sqrt{(-9-3)^2 + (6-2)^2 + (-3-0)^2}$$

$$= \sqrt{144+16+9} = 13$$



$$\therefore \frac{BD}{DC} = \frac{3}{13}$$

Hence, D divides BC in the ratio 3 : 13 The co-ordinates of D are

$$\left(\frac{3(-9) + 13(5)}{3 + 13}, \frac{3(6) + 13(3)}{3 + 13}, \frac{3(-3) + 13(2)}{3 + 13} \right)$$

$$= \left(\frac{19}{8}, \frac{57}{16}, \frac{17}{16} \right)$$

116. The distance from the origin to the image of (1, 1) with respect to the line $x + y + 5 = 0$ is

(A) $7\sqrt{2}$ (B) $3\sqrt{2}$ (C) $6\sqrt{2}$ (D) $4\sqrt{2}$

Correct Option: C

Solution:

As we know that the image of (1, 1) with respect to line $x + y + 5 = 0$ is

$$\frac{x-1}{1} = \frac{y-1}{1} = \frac{2(1+1+5)}{1+1}$$

$$\Rightarrow x - 1 = -7, y - 1 = -7$$

$$\Rightarrow x = -6, y = -6$$

$\therefore$ Image of point (1, 1) is (-6, -6)

Now, distance from origin

This is the required transformed equation.

$$D = \sqrt{(0+6)^2 + (0+6)^2}$$

$$D = \sqrt{72} = 6\sqrt{2}$$

117. If the 17th and the 18th terms in the expansion of $(2 + a)^{50}$ are equal, then the coefficient of x^{35} in the expansion of $(a + x)^{-2}$ is

(A) -35 (B) 3 (C) 36 (D) -36

Correct Option: D

Solution:

Given, 17th and 18th terms in the expansion $(2 + a)^{50}$ are equal

$$\therefore T_{17} = T_{18}$$

$$\Rightarrow {}^{50}C_{16}(2)^{34}(a)^{16} = {}^{50}C_{17}(2)^{33}(a)^{17}$$

$$\Rightarrow a = \frac{{}^{50}C_{16}}{{}^{50}C_{17}} \times 2 = 1$$

$\therefore$ Now, coefficient of x^{35} in the expansion

$$(1 + x)^{-2} = -36$$

$\therefore$ Coefficient of x^r is $(r + 1)$ in $(1 - x)^{-2}$.

118. The number of arrangements of all digits of 12345 such that at least 3 digits will not come in its position is

(A) 89 (B) 109 (C) 78 (D) 57

Correct Option: B

Solution:

Total number of ways such that at least 3 digits will not come in its position

$$= {}^5C_3 \{3! - {}^3C_1 2! + {}^3C_2 1! - {}^3C_3 0!\}$$

$$+ {}^5C_4 \{4! - {}^4C_1 (3!) + {}^4C_2 (2!) - {}^4C_3 (1!) + {}^4C_4 (0!)\}$$

$$+ {}^5C_5 \{5! - {}^5C_1 4! + {}^5C_2 3! - {}^5C_3 2! + {}^5C_4 1! - {}^5C_5 (0!)\}$$

$$= 10(2) + 5(9) + (44) = 20 + 45 + 44 = 109$$

119. If $|z_1| = 2, |z_2| = 3, |z_3| = 4$ and $|2z_1 + 3z_2 + 4z_3| = 4$ then absolute value of $8z_2 z_3 + 27z_3 z_1 + 64z_1 z_2$ equals

(A) 24 (B) 48 (C) 72 (D) 96

Correct Option: D

Solution:

$$|8z_2 z_3 + 27z_3 z_1 + 64z_1 z_2| = |z_1| |z_2| |z_3|$$

$$\left| \frac{8}{z_1} + \frac{27}{z_2} + \frac{64}{z_3} \right|$$

$$= (2)(3)(4) \left| \frac{8\bar{z}_1}{|z_1|^2} + \frac{27\bar{z}_2}{|z_2|^2} + \frac{64\bar{z}_3}{|z_3|^2} \right|$$

$$= 24 |2\bar{z}_1 + 3\bar{z}_2 + 4\bar{z}_3|$$

$$= 24 |2z_1 + 3z_2 + 4z_3|$$

$$= 24 |2z_1 + 3z_2 + 4z_3| = (24)(4) = 96$$

120. The domain of the real valued function

$$f(x) = \sqrt{\frac{2x^2 - 7x + 5}{3x^2 - 5x - 2}}$$
 is

(A) $(-\infty, -\frac{1}{3}) \cup [1, 2) \cup [\frac{5}{2}, \infty)$

(B) $(-\infty, 1) \cup (2, \infty)$

(C) $(-\frac{1}{3}, \frac{5}{2}]$

(D) $(-\infty, \frac{-1}{3}] \cup [\frac{5}{2}, \infty)$

Correct Option: A

Solution:

$$\text{Given function } f(x) = \sqrt{\frac{2x^2 - 7x + 5}{3x^2 - 5x - 2}}$$

Here, $f(x)$ should be greater than or equal to 0 .

$$\text{So, } 2x^2 - 7x + 5 = 0$$

$$\Rightarrow 2x^2 - 5x - 2x + 5 = 0$$

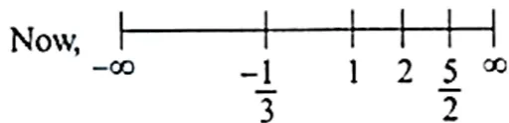
$$\Rightarrow (x-1)(2x-5) = 0$$

$$\Rightarrow x = 1, \frac{5}{2}$$

$$3x^2 - 5x - 2 = 0 \Rightarrow 3x^2 - 6x + x - 2 = 0$$

$$3x(x-2) + 1(x-2) = 0 \Rightarrow (x-2)(3x+1) = 0$$

$$\Rightarrow x = 2, -\frac{1}{3}$$



When we include $x = -1/3, 2$ then $f(x)$ would give not define value so, we will exclude these values from the domain.

When we take values between $(-\frac{1}{3}, 1)$ and

$$\text{So, domain is } (-\infty, -\frac{1}{3}) \cup [1, 2) \cup [\frac{5}{2}, \infty)$$

121. If a function $f: \mathbb{R} - \{l\} \rightarrow \mathbb{R} - \{m\}$ defined by $f(x) = \frac{x+3}{x-2}$ is a bijection, then $3l + 2m =$

- (A) 10 (B) 12 (C) 8 (D) 14

Correct Option: C

Solution:

$$f(x) = \frac{x+3}{x-2}$$

$\therefore f(x)$ is not defined for $x = 2$

i.e. domain of $f(x)$ is $\mathbb{R} - \{2\}$

$$\therefore l = 2$$

Now,

$$y = \frac{x+3}{x-2}$$

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

$$x(y-1) = 2y + 3$$

$$x = \frac{2y+3}{y-1}$$

y can take any value except $y = 1$

$$\text{Co-domain} = \mathbb{R} - \{1\}$$

$$m = 1$$

$$3l + 2m = 3(2) + 2(1) = 8$$

122. $f(x) = \sin x + \cos x$, $g(x) = x^2 - 1$, then $g(f(x))$ is invertible if

(A) $-\frac{\pi}{4} \leq x \leq \frac{\pi}{4}$

(B) $-\frac{\pi}{2} \leq x \leq 0$

(C) $-\frac{\pi}{2} \leq x \leq \pi$

(D) $0 \leq x \leq \frac{\pi}{2}$

Correct Option: A

Solution:

$$\text{Given that, } f(x) = \sin x + \cos x$$

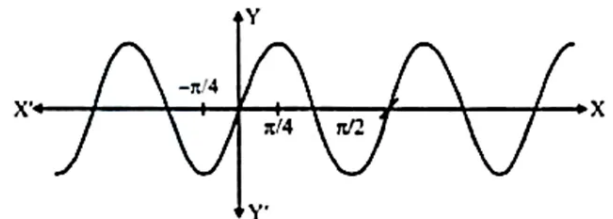
$$g(x) = x^2 - 1$$

$$g[f(x)] = (\sin x + \cos x)^2 - 1$$

$$= \sin^2 x + \cos^2 x + 2 \sin x \cos x - 1$$

$$= 1 + \sin 2x - 1 = \sin 2x$$

$$(\because \sin^2 x + \cos^2 x = 1, \sin x = 2 \sin x \cos x)$$



Among the given options, $\sin 2x$ is monotonous

(here strictly increasing) in $-\frac{\pi}{4} \leq x \leq \frac{\pi}{4}$.

So, $g(f(x))$ is invertible in $-\frac{\pi}{4} \leq x \leq \frac{\pi}{4}$.

123. $\lim_{n \rightarrow \infty} \prod_{r=3}^{\infty} \frac{r^3-8}{r^3+8}$ equals to

(A) $\frac{2}{7}$ (B) $\frac{3}{7}$

(C) $\frac{4}{7}$ (D) $\frac{6}{7}$

Correct Option: A

Solution:

$$\lim_{n \rightarrow \infty} \prod_{r=3}^{\infty} \frac{r^3-8}{r^3+8} = \left(\frac{3^3-8}{3^3+8}\right) \left(\frac{4^3-8}{4^3+8}\right) \dots \dots \dots \left(\frac{n^3-8}{n^3+8}\right)$$

$$\begin{aligned}
 &= \lim_{n \rightarrow \infty} \left[\frac{(3-2)(3^2+2^2+3.2)}{(3+2)(3^2+2^2-3.2)} \right] \left[\frac{(4-2)(4^2+2^2+4.2)}{(4+2)(4^2+2^2-4.2)} \right] \\
 &\quad \dots \dots \dots \left[\frac{(n-2)(n^2+2^n+n.2)}{(n+2)(n^2+2^n-n.2)} \right] \\
 &= \lim_{n \rightarrow \infty} \left[\frac{(3-2)(4-2) \dots \dots (n-2)}{(3+2)(4+2) \dots \dots (n+2)} \right] \\
 &\quad \left[\frac{(3^2+2^2+3.2)(4^2+2^2+4.2) \dots \dots (n^2+2^n+n.2)}{(3^2+2^2-3.2)(4^2+2^2-4.2) \dots \dots (n^2+2^n-n.2)} \right] \\
 &= \left[\frac{1.2 \cdot 3.4.5.6 \dots \dots}{5-6.7.8 \dots \dots} \right] \left[\frac{19.28.39.52.63 \dots \dots}{7-12 \cdot 19.28.39.52 \dots \dots} \right] \\
 &= \frac{2}{7}
 \end{aligned}$$

124. If the area bounded by the curves $y = ax^2$ and $x = ay^2$, ($a > 0$) is 3 sq units, then the value of a is
- (A) $2/3$ (B) $1/3$ (C) 1 (D) 4

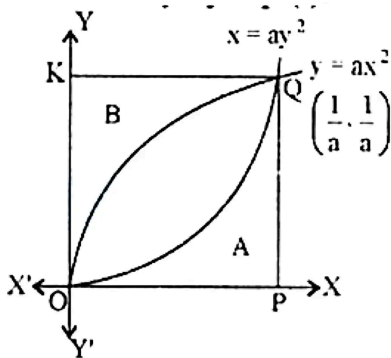
Correct Option: B

Solution:

We have given, $y = ax^2 \dots (i)$.

and $x = ay^2 \dots (ii)$

Put the value of y by Eq. (i) in Eq. (ii), we get



$$\begin{aligned}
 x &= a \times a^2 x^4 \Rightarrow x^4 a^3 - x = 0 \\
 x(x^3 a^3 - 1) &= 0 \Rightarrow x = 0, \frac{1}{2}
 \end{aligned}$$

$$\text{When, } x = 0 \Rightarrow y = 0 \text{ and } x = \frac{1}{a} \Rightarrow y = \frac{1}{a}$$

Here, points of intersection of curves $y = ax^2$

and $x = ay^2$ are $(0, 0)$ and $(\frac{1}{a}, \frac{1}{a})$.

$\therefore$ Required area

$$\begin{aligned}
 A &= \int_{x=a}^{x=b} [f_2(x) - f_1(x)] dx \\
 3 &= \int_0^{1/a} \left(\frac{\sqrt{x}}{\sqrt{a}} - ax^2 \right) dx
 \end{aligned}$$

$$\begin{aligned}
 3 &= \left[\frac{1}{\sqrt{a}} \times \frac{2}{3} x^{3/2} - \frac{ax^3}{3} \right]_0^{1/a} \\
 3 &= \frac{2}{3\sqrt{a}} \left[\left(\frac{1}{a} \right)^{3/2} \right] - \frac{a}{3} \left[\left(\frac{1}{a} \right)^3 \right] \\
 3 &= \frac{2}{3\sqrt{a}} \times \frac{1}{a\sqrt{a}} - \frac{a}{3} \times \frac{1}{a^3} \\
 3 &= \frac{2}{3a^2} - \frac{1}{3a^2} \Rightarrow 3 = \frac{2-1}{3a^2} \Rightarrow 9a^2 = 1 \\
 a^2 &= \frac{1}{9} \Rightarrow a = \frac{1}{3}
 \end{aligned}$$

125. The mean of n items is $\bar{x}$. If the first term is increased by 1, second by 2 and so on, then the new mean is
- (A) $\bar{X} + n$ (B) $\bar{x} + \frac{n}{2}$
- (C) $\bar{x} + \frac{n+1}{2}$ (D) None of these

Correct Option: C

Solution:

Let $x_1, x_2, \dots, x_n$ be n items. Then, $\bar{x} = \frac{1}{n} \sum x_i$.

Let $y_1 = x_1 + 1, y_2 = x_2 + 2, y_3 = x_3 + 3, \dots, y_n = x_n + n$. Then the mean of the new series is

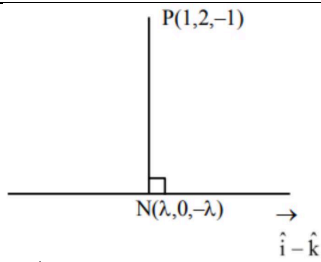
$$\begin{aligned}
 \frac{1}{n} \sum_{i=1}^n y_i &= \frac{1}{n} \sum_{i=1}^n (x_i + i) \\
 &= \frac{1}{n} \sum_{i=1}^n x_i + \frac{1}{n} (1 + 2 + 3 + \dots + n) \\
 &= \bar{x} + \frac{1}{n} \cdot \frac{n(n+1)}{2} = \bar{x} + \frac{n+1}{2}
 \end{aligned}$$

126. Let the foot of perpendicular from a point $P(1, 2, -1)$ to the straight line $L: \frac{x}{1} = \frac{y}{0} = \frac{z}{-1}$ be N . Let a line ℓ drawn from P parallel to the plane $x + y + 2z =$ which meets L at point Q . If α is the acute angle between the lines PN and PQ , then $\cos \alpha$ is equal
- (A) $\frac{1}{\sqrt{5}}$ (B) $\frac{\sqrt{3}}{2}$
- (C) $\frac{1}{\sqrt{3}}$ (D) $\frac{1}{2\sqrt{3}}$

JM 2021

Correct Option: C

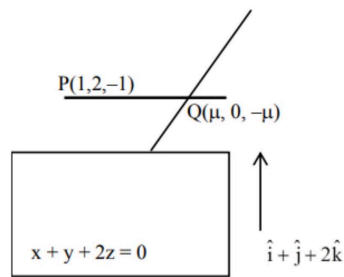
Solution:



$$\overrightarrow{PN} \cdot (\hat{i} - \hat{k}) = 0$$

$$\Rightarrow N(1, 0, -1)$$

Now,



$$\overrightarrow{PQ} \cdot (\hat{i} + \hat{j} + 2\hat{k}) = 0$$

$$\Rightarrow \mu = -1$$

$$\Rightarrow Q(-1, 0, 1)$$

$$\overrightarrow{PN} = 2\hat{j} \text{ and } \overrightarrow{PQ} = 2\hat{i} + 2\hat{j} - 2\hat{k}$$

$$\Rightarrow \cos \alpha = \frac{1}{\sqrt{3}}$$

127. Consider the following two propositions:

$$P1 : \sim (p \rightarrow \sim q)$$

$$P2 : (p \wedge \sim q) \wedge ((\sim p) \vee q)$$

If the proposition $p \rightarrow ((\sim p) \vee q)$ is evaluated as FALSE, then:

- (A) P1 is TRUE and P2 is FALSE
 (B) P1 is FALSE and P2 is TRUE
 (C) Both P1 and P2 are FALSE
 (D) Both P1 and P2 are TRUE

JM 2022

Correct Option: C

Solution:

p	q	$\sim p$	$\sim q$	$\sim p \vee q$	$p \rightarrow (\sim p \vee q)$	$p \rightarrow \sim q$	$\sim (p \rightarrow \sim q)$	$p \wedge \sim q$	P_2
T	T	F	F	T	T	F	T	F	F

T	F	F	T	F	F
F	T	T	F	T	T
F	F	T	T	T	T

$p \rightarrow (\sim p \vee q)$ is F when p is true q is false

From table

P1 & P2 both are false

128. Let p, q, r be three logical statements. Consider the compound statements

$$S_1 : ((\sim p) \vee q) \vee ((\sim p) \vee r) \text{ and}$$

$$S_2 : p \rightarrow (q \vee r).$$

Then, which of the following is NOT true?

- (A) If S_2 is True, then S_1 is True
 (B) If S_2 is False, then S_1 is False
 (C) If S_2 is False, then S_1 is True
 (D) If S_1 is False, then S_2 is False

JM 2022

Correct Option: C

Solution:

$$s_1 : (\sim p \vee q) \vee (\sim p \vee r)$$

$$\equiv \sim p \vee (q \vee r)$$

$$s_2 : p \rightarrow (q \vee r)$$

$$\equiv \sim p \vee (q \vee r) \rightarrow \text{By conditional law}$$

$$s_1 \equiv s_2$$

129. Let the function $g : (-\infty, \infty) \rightarrow (-\frac{\pi}{2}, \frac{\pi}{2})$ be given by $g(u) = 2 \tan^{-1}(e^u) - \frac{\pi}{2}$. Then, g is -

- (A) even and is strictly increasing in $(0, \infty)$
 (B) odd and is strictly decreasing in $(-\infty, \infty)$

(C) odd and is strictly increasing in $(-\infty, \infty)$

(D) neither even nor odd, but is strictly increasing in $(-\infty, \infty)$

JA 2008

Correct Option: C



Solution:

$$g(u) = 2 \tan^{-1}(e^u) - \frac{\pi}{2} \quad \forall u \in (-\infty, \infty)$$

$$g(-u) = 2 \tan^{-1}(e^{-u}) - \frac{\pi}{2} = 2 (\cot^{-1} e^u) - \frac{\pi}{2} = 2 \left(\frac{\pi}{2} - \tan^{-1} e^u \right) - \frac{\pi}{2} = \pi - 2 \tan^{-1} e^u - \frac{\pi}{2} = \frac{\pi}{2} - 2 \tan^{-1} e^u$$

$$\therefore g(-u) = -g(u) \Rightarrow g(u) \text{ is an odd function.}$$

$$g'(u) = 2 \frac{1 \times e^u}{1 + e^{2u}} > 0$$

$g(u)$ is strictly increasing function.

130. The point of inflexion for the curve $y = (x - a)^n$, where n is an odd integer and $n \geq 3$ is

- (A) $(a, 0)$ (B) $(0, a)$
(C) $(0, 0)$ (D) None of these

Correct Option: A

Solution:

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BITSAT Solved Paper 2024 Session-I - ANSWER KEY

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