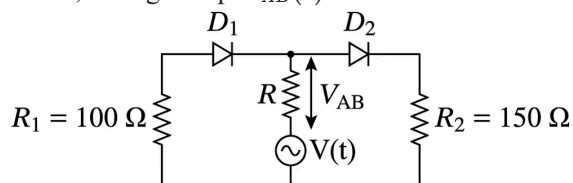


BITSAT Solved Paper 2017

1. In the circuit given below, $V(t)$ is the sinusoidal voltage source, voltage drop $V_{AB}(t)$ across the resistance R is

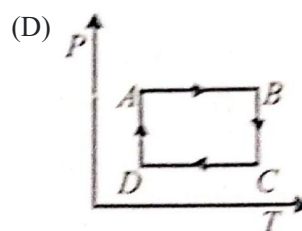
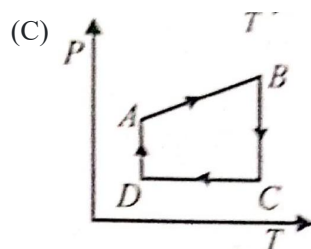
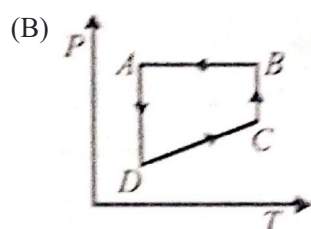
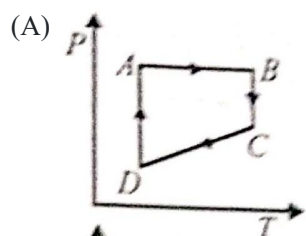
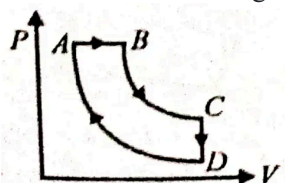


- (A) is half wave rectified
 (B) is full wave rectified
 (C) has the same peak value in the positive and negative half cycles
 (D) has different peak values during positive and negative half cycle

Correct Option: D

Solution:

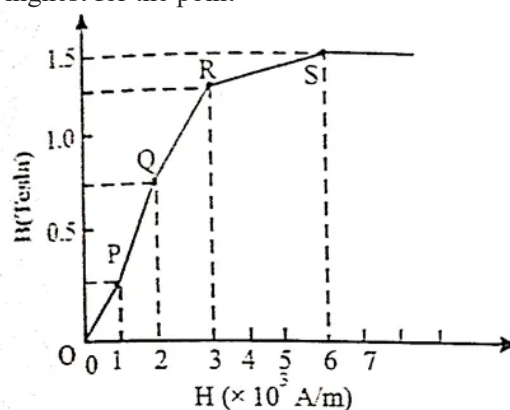
2. A cyclic process ABCD is shown in the figure P-V diagram. Which of the following curves represent the same process



Correct Option: A

Solution:

3. The basic magnetization curve for a ferromagnetic material is shown in figure. Then, the value of relative permeability is highest for the point



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

Correct Option: B

Solution:

4. Given that $\mathbf{A} + \mathbf{B} = \mathbf{R}$ and $\mathbf{A} = \mathbf{B} = \mathbf{R}$. What should be the angle between $\mathbf{A}$ and $\mathbf{B}$?

- (A) 0 (B) $\pi/3$ (C) $2\pi/3$ (D) π

Correct Option: C

Solution:

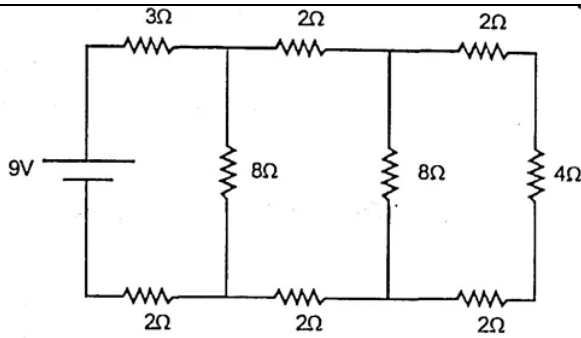
5. A telescope has an objective lens of 10 cm diameter and is situated at a distance of one kilometer from two objects. The minimum distance between these two objects, which can be resolved by the telescope, when the mean wavelength of light is $5000 \text{ \AA}$, is of the order of

- (A) 5 cm (B) 0.5 m (C) 5 m (D) 5 mm

Correct Option: D

Solution:

6. In the circuit shown in figure the current through

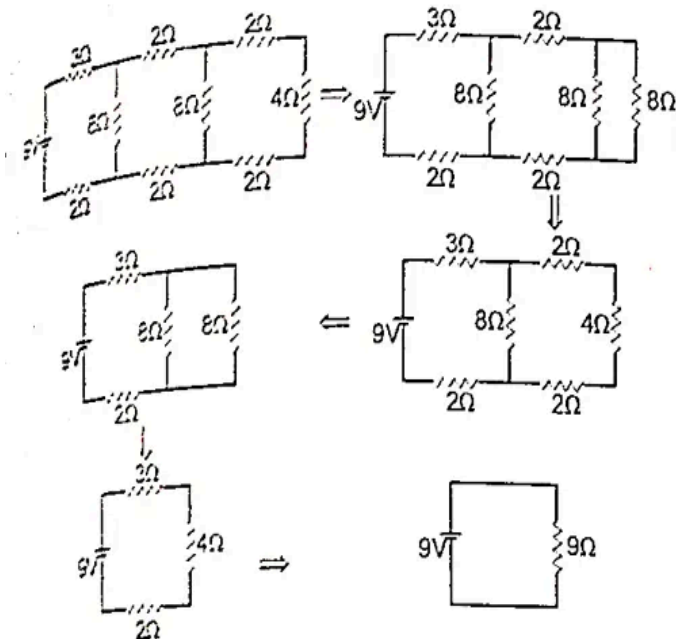


- (A) the 3Ω resistor is 0.50 A.
 (B) the 3Ω resistor is 0.25 A.
 (C) the 4Ω resistor is 0.50 A
 (D) the 4Ω resistor is 0.25 A.

Correct Option: D

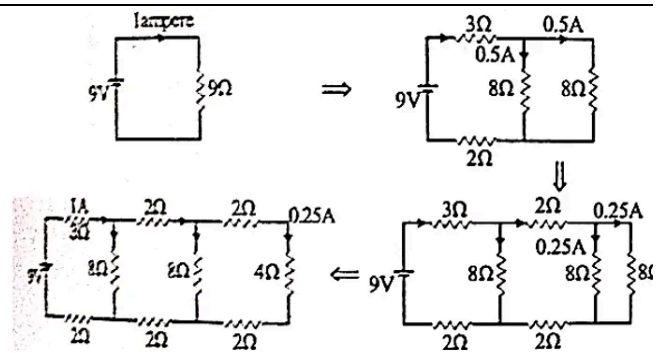
Solution:

The net resistance of the circuit is 9Ω shown in the following figures.



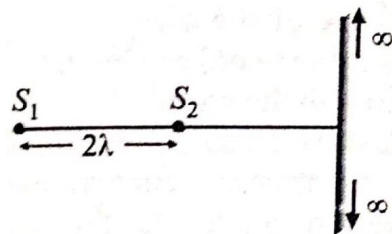
$$I = \frac{V}{R} = \frac{9V}{9\Omega} = 1.0 \text{ A}$$

The flow of current in the circuit is as follows.



The current divides into two equal parts if passes through two equal resistances in parallel. Thus current through 4Ω resistor is 0.25 A.

7. There are two sources kept at distances 2λ . A large screen is perpendicular to line joining the sources. Number maximas on the screen in this case is (λ = wavelength light)



- (A) 1 (B) 3 (C) 5 (D) 7

Correct Option: B

Solution:

8. A steel wire of length 'L' at 40°C is suspended from the ceiling and then a mass 'm' is hung from its free end. The wire is cooled down from 40°C to 30°C to regain its original length 'L'. The coefficient of linear thermal expansion of the steel is $10^{-5}/^\circ\text{C}$, Young's modulus of steel is 10^{11} N/m^2 and radius of the wire is 1 mm. Assume that $L \gg$ diameter of the wire. Then the value of 'm' in kg is nearly:

- (A) 1 (B) 2 (C) 3 (D) 5

Correct Option: C

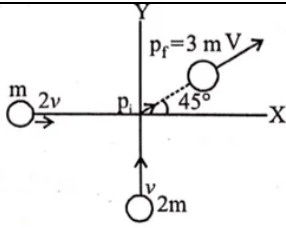
Solution:

9. A particle of mass m moving in the x direction with speed $2v$ is hit by another particle of mass $2m$ moving in the y direction with speed v . If the collision is perfectly inelastic, the percentage loss in the energy during the collision is close to

- (A) 56% (B) 62% (C) 44% (D) 50%

Correct Option: A

Solution:



Initial momentum of the system

$$p_i = m \times 2v\hat{i} + 2m \times v\hat{j}$$

$$= \sqrt{(m \times 2v)^2 + (2m \times v)^2} \quad (\text{magnitude})$$

$$= 2\sqrt{2}mv$$

Final momentum of the system = $3mV$

By the law of conservation of momentum

$$2\sqrt{2}mv = 3mV$$

$$\Rightarrow \frac{2\sqrt{2}v}{3} = V_{\text{combined}}$$

Loss in energy

$$\Delta E = \frac{1}{2}m_1V_1^2 + \frac{1}{2}m_2V_2^2 - \frac{1}{2}(m_1 + m_2)V_{\text{combined}}^2$$

$$\Delta E = 3mv^2 - \frac{4}{3}mv^2 = \frac{5}{3}mv^2 = 55.55\%$$

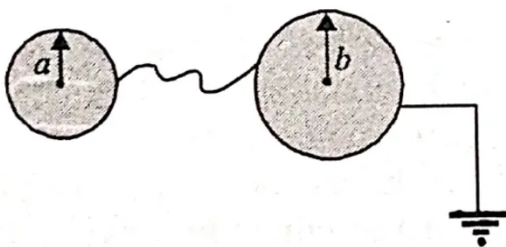
10. Two projectiles A and B thrown with speeds in the ratio $1 : \sqrt{2}$ acquired the same heights. If A is thrown at an angle of 45° with the horizontal, the angle of projection of B will be

(A) 0° (B) 60° (C) 30° (D) 45°

Correct Option: C

Solution:

11. Two conducting shells of radius a and b are connected by conducting wire as shown in figure the capacity of system is :



- (A) $4\pi\epsilon_0 \frac{ab}{b-a}$
 (B) $4\pi\epsilon_0(a+b)$
 (C) zero
 (D) infinite

Correct Option: D

Solution:

12. When a metal surface is illuminated by light of wavelengths 400 nm and 250 nm, the maximum velocities of the photoelectrons ejected are v and $2v$ respectively. The work function of the metal is (h – Planck's constant, c : velocity of light in air)

- (A) $2hc \times 10^6$ J
 (B) $1.5hc \times 10^6$ J
 (C) $hc \times 10^6$ J
 (D) $0.5hc \times 10^6$ J

Correct Option: A

Solution:

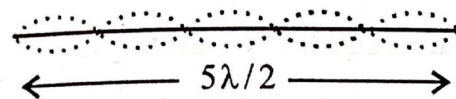
13. A sonometer wire resonates with a given tuning fork forming standing waves with five antinodes between two bridges when a mass of 9 kg is suspended from the wire. When this mass is replaced by a mass M , the wire resonates with the same tuning fork forming three antinodes for the same positions of the bridges. The value M is

- (A) 25 kg (B) 5 kg (C) 12.5 kg (D) 1/25 kg

Correct Option: A

Solution:

$$f = \frac{5}{2l} \sqrt{\frac{F}{\mu}} = \frac{5}{2l} \sqrt{\frac{9g}{\mu}} \quad \dots (i)$$



$$\text{and } f = \frac{3}{2l} \sqrt{\frac{Mg}{\mu}} \quad \dots (ii)$$

From above equations, we get $M = 25$ kg.

14. A charged particle moves through a magnetic field perpendicular to its direction. Then

- (A) kinetic energy changes but the momentum is constant
 (B) the momentum changes but the kinetic energy is constant
 (C) both momentum and kinetic energy of the particle are not constant
 (D) both momentum and kinetic energy of the particle are constant

Correct Option: B

Solution:

15. What is the minimum energy required to launch a satellite of mass m from the surface of a planet of mass M and radius R in a circular orbit at an altitude of $2R$?

(A) $\frac{5GmM}{6R}$ (B) $\frac{2GmM}{3R}$
(C) $\frac{GmM}{2R}$ (D) $\frac{GmM}{3R}$

Correct Option: A

Solution:

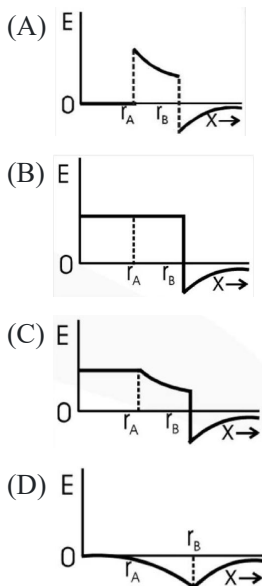
$E = \text{Energy of satellite} - \text{energy of mass on the surface of planet}$

$$= -\frac{GMm}{2r} - \left(-\frac{GMm}{R}\right)$$

Here, $r = R + 2R = 3R$

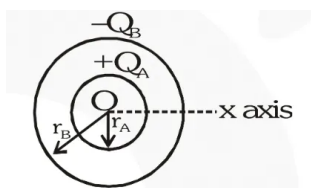
Substituting in above equation we get, $E = \frac{5GMm}{6R}$

16. Two concentric conducting thin spherical shells A and B having radii r_A and r_B ($r_B > r_A$) are charged to Q_A and $-Q_B$ ($|Q_B| > |Q_A|$). The electrical field along a line passing through the centre is:



Correct Option: A

Solution:



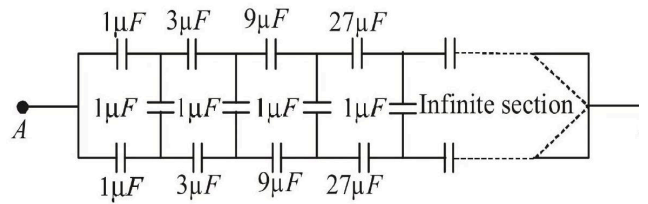
$$|Q_B| > |Q_A|$$

$$E = 0; r < r_A$$

$$E = \frac{kQ_A}{r^2}; r_A < r < r_B \text{ (along +x)}$$

$$E = \frac{-k(Q_B - Q_A)}{r^2}; r > r_B \text{ (along -x)}$$

17. What is equivalent capacitance of circuit between points A and B ?

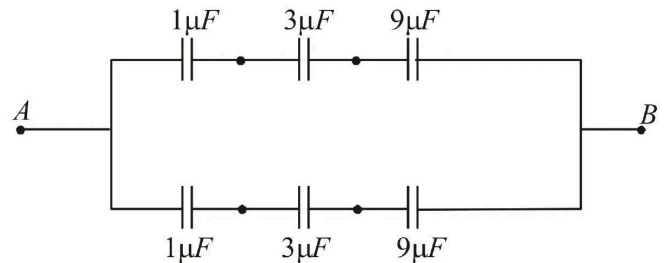


(A) $\frac{2}{3}\mu F$ (B) $\frac{4}{3}\mu F$
(C) Infinite (D) $(1 + \sqrt{3})\mu F$

Correct Option: B

Solution:

The effective circuit is shown in figure.



The capacitance of upper series,

$$\frac{1}{C} = \frac{1}{1} + \frac{1}{3} + \frac{1}{9} + \frac{1}{27} + \dots \infty$$

$$\therefore C = \frac{2}{3}\mu F$$

$$\text{Now } C_{AB} = 2C = \frac{4}{3}\mu F$$

18. Five gas molecules chosen at random are found to have speeds of 500, 600, 700, 800 and 900 m/s:

(A) The root mean square speed and the average speed are the same.
(B) The root mean square speed is 14 m/s higher than the average speed.
(C) The root mean square speed is 14 m/s lower than the average speed.
(D) The root mean square speed is $\sqrt{14}$ m/s higher than the average speed.

Correct Option: B

Solution:

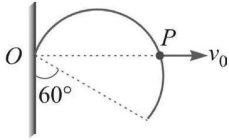
$$v_{av} = \left[\frac{500+600+700+800+900}{5}\right] = 700 \text{ m/s}$$

and

$$v_{rms} = \sqrt{\frac{500^2+600^2+700^2+800^2+900^2}{5}} = 714 \text{ m/s}$$

Thus v_{rms} is greater than average speed by 14 m/s.

19. A thin but rigid semicircular wire frame of radius r is hinged at O and can rotate in its own vertical plane. A smooth peg P starts from O and moves horizontally with constant speed v_0 , lifting the frame upward as shown in figure.



Find the angular velocity ω of the frame when its diameter makes an angle of 60° with the vertical:

- (A) v_0/r (B) $v_0/2r$
(C) $2v_0/r$ (D) v_0r

Correct Option: A

Solution:

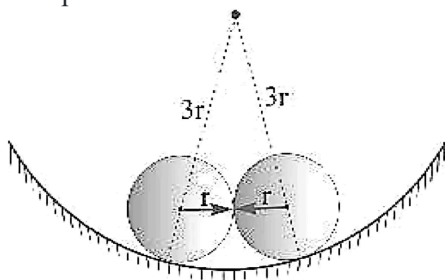
$$\frac{x}{\sin 2\theta} = \frac{r}{\sin(90 - \theta)}$$

$$\Rightarrow x = 2r \sin \theta$$

$$\therefore \frac{dx}{dt} = 2r \cos \theta \times \frac{d\theta}{dt}$$

$$\frac{d\theta}{dt} = \frac{dx/dt}{2r \cos \theta} = \frac{v_0}{2r \cos 60^\circ} = \frac{v_0}{r}$$

20. Two equal heavy spheres, each of radius r , are in equilibrium within a smooth cup of radius $3r$. The ratio of reaction between the cup and one sphere and that between the two spheres is

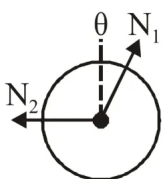


- (A) 1 (B) 2 (C) 3 (D) 4

Correct Option: B

Solution:

$$\sin \theta = \frac{1}{2}$$



$$\text{Thus, } N_1 \sin \theta = N_2$$

$$\therefore \frac{N_1}{N_2} = \frac{1}{\sin \theta} = 2.$$

21. A body moves in a circular orbit of radius R under the action of a central force. Potential due to the central force given by $V(r) = kr$ (k is a positive constant). Period of revolution of the body is proportional to:

- (A) $R^{1/2}$ (B) $R^{-1/2}$
(C) $R^{-3/2}$ (D) $R^{-5/2}$

Correct Option: A

Solution:

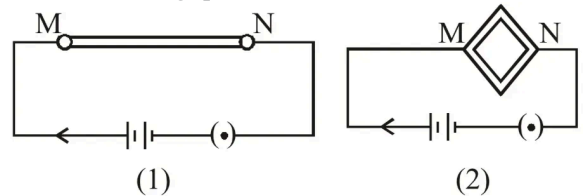
$$U = mV = kmr.$$

$$\text{Force, } F = -\frac{dU}{dr} = -km$$

$$\text{Now, } \frac{mv^2}{r} = km \Rightarrow v \propto r^{1/2}$$

$$\therefore T = \frac{2\pi r}{v} = \frac{2\pi r}{cr^{1/2}} \Rightarrow T \propto r^{1/2}$$

22. A wire is connected to a battery between the points and N as shown in figure (1). The same wire is bent the form of a square and then connected to the battery between the points M and N as shown in figure (2). Which of the following quantities increases?



- (A) Heat produced in the wire and resistance offered by the wire.
(B) Resistance offered by the wire and current through the wire.
(C) Heat produced in the wire, resistance offered by the wire and current through the wire.
(D) Heat produced in the wire and current through the wire.

Correct Option: D

Solution:

When the wire is bent in the form of a square and connected between M and N as shown in fig. (2), the effective resistance between M and N decreases to one fourth of the value in fig. (1). The current increases four times the initial value according to the relation $V = IR$. Since $H = I^2 R t$, the decrease in the value of resistance is more than compensated by the increases in the value of

current. Hence heat produced increases. Percentage loss in energy during the collision $\simeq 56\%$

23. During vapourisation

- I. change of state from liquid to vapour state occurs.
- II. temperature remains constant.
- III. both liquid and vapour states coexist in equilibrium.
- IV. specific heat of substance increases.

Correct statements are

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

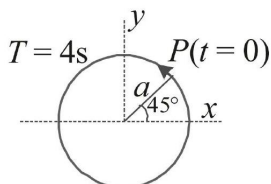
Correct Option: D

Solution:

The change of state from liquid to vapour (for gas) is called vapourisation. It is observed that when liquid is heated, the temperature remains constant until the entire amount of the liquid is converted into vapour.

The temperature at which the liquid and the vapour states of the substance coexists is called its boiling point.

24. The following figure depict a circular motion. The radius of the circle, the period of revolution, the initial position and the sense of revolution are indicated on the figure.

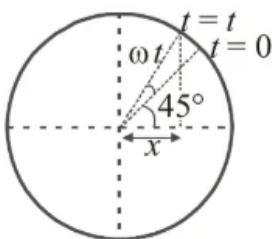


The simple harmonic motion of the x-projection of the radius vector of the rotating particle P can be shown as :

- (A) $x(t) = a \cos(\frac{2\pi t}{4} + \frac{\pi}{4})$
- (B) $x(t) = a \cos(\frac{\pi t}{4} + \frac{\pi}{4})$
- (C) $x(t) = a \sin(\frac{2\pi t}{4} + \frac{\pi}{4})$
- (D) $x(t) = a \cos(\frac{\pi t}{3} + \frac{\pi}{2})$

Correct Option: A

Solution:



$$x = a \cos(\omega t + \frac{\pi}{4})$$

$$\text{or } x = a \cos(\frac{2\pi t}{4} + \frac{\pi}{4})$$

25. Hydrogen (H), deuterium (D), singly ionized helium (He⁺) and doubly ionized lithium (Li⁺⁺) all have one electron around the nucleus. Consider n = 2 to n = 1 transition. The wavelengths of emitted radiations are $\lambda_1, \lambda_2, \lambda_3$ and λ_4 respectively. Then approximately :

- (A) $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$
- (B) $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$
- (C) $\lambda_1 = 2\lambda_2 = 2\sqrt{2}\lambda_3 = 3\sqrt{2}\lambda_4$
- (D) $\lambda_1 = \lambda_2 = 2\lambda_3 = 3\sqrt{2}\lambda_4$

Correct Option: A

Solution:

$$Z_1 = 1, Z_2 = 1, Z_3 = 2 \text{ and } Z_4 = 3.$$

$$\frac{1}{\lambda} = RZ^2 \left(\frac{1}{1^2} - \frac{1}{2^2} \right)$$

$$\text{or } \lambda = \frac{4}{3RZ^2}$$

$$\text{or } \lambda Z^2 = \text{constant}$$

$$\text{So } \lambda_1(1)^2 = \lambda_2(1)^2 = \lambda_3(2)^2 = \lambda_4(3)^2$$

$$\text{or } \lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4.$$

26. A tuning fork of frequency 392 Hz, resonates with 50 cm length of a string under tension (T). If length of the string is decreased by 2%, keeping the tension constant, the number of beats heard when the string and the tuning fork made to vibrate simultaneously is :

- (A) 4
- (B) 6
- (C) 8
- (D) 12

Correct Option: C

Solution:

The frequency of tuning fork, $f = 392 \text{ Hz}$.

$$\text{Also } 392 = \frac{1}{2 \times 50} \sqrt{F/\mu} \quad \dots(i)$$

After decreasing the length by 2%, we have

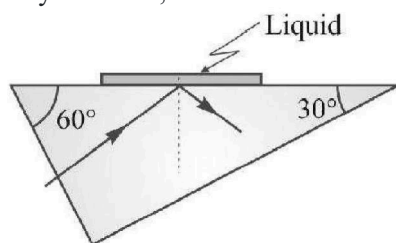
$$f' = \frac{1}{2(49)} \sqrt{F/\mu} \quad \dots(ii)$$

From above equations,

$$f' = 400 \text{ Hz}$$

∴ Beats frequency = 8 Hz.

27. On a hypotenuse of a right prism ($30^\circ - 60^\circ - 90^\circ$) of refractive index 1.50, a drop of liquid is placed as shown in figure. Light is allowed to fall normally on the short face of the prism. In order that the ray of light may get totally reflected, the maximum value of refractive index is :



- (A) 1.30 (B) 1.47 (C) 1.20 (D) 1.25

Correct Option: A

Solution:

$$C_{\max} = 60^\circ$$

$$\therefore r\mu_d = \frac{1}{\sin 60^\circ}$$

$$\text{or } \frac{\mu_g}{\mu_\ell} = \frac{2}{\sqrt{3}}$$

$$\therefore \mu_\ell = \frac{\sqrt{3}}{2} \mu_g = \frac{\sqrt{3}}{2} \times 1.5$$

$$= 1.3$$

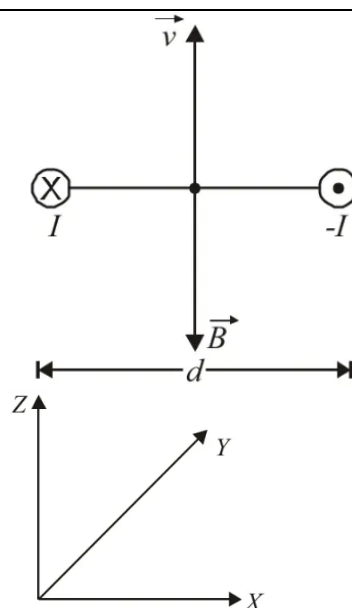
28. Two very long, straight, parallel wires carry steady currents I and $-I$ respectively. The distance between the wires is d . At a certain instant of time, a point charge q is at a point equidistant from the two wires, in the plane of the wires. Its instantaneous velocity $\vec{v}$ is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is

- (A) $\frac{\mu_0 I q v}{2\pi d}$ (B) $\frac{\mu_0 I q v}{\pi d}$
(C) $\frac{2\mu_0 I q v}{\pi d}$ (D) 0

Correct Option: D

Solution:

Net magnetic field due to the wires will be downward as shown below in the figure. Since angle between $\vec{v}$ and $\vec{B}$ is 180° ,



Wires are in X - Y plane and velocity in Z -direction

Therefore, magnetic force $\vec{F}_m = q(\vec{v} \times \vec{B}) = 0$

29. In the formula $X = 3 Y Z^2$, X and Z have dimensions of capacitance and magnetic induction respectively. The dimensions of Y in MKSA system are:

- (A) $[M^{-3}L^{-2}T^{-2}A^{-4}]$
(B) $[ML^{-2}]$
(C) $[M^{-3}L^{-2}A^4T^8]$
(D) $[M^{-3}L^2A^4T^4]$

Correct Option: C

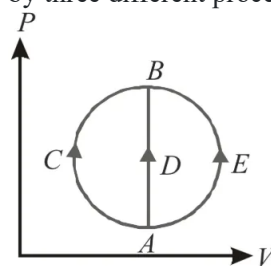
Solution:

Dimensions of $Y = \frac{\text{dimensions of } X}{\text{dimensions of } Z^2}$

$$= \frac{M^{-1}L^{-2}T^4A^2}{(MT^{-2}A^{-1})^2}$$

$$= [M^{-3}L^{-2}T^8A^4]$$

30. One mole of an ideal gas is taken from state A to state B by three different processes,



(i) ACB (ii) ADB (iii) AEB as shown in the P - V diagram. The heat absorbed by the gas is

- (A) greater in process (ii) than in (i)

- (B) the least in process (ii)
 (C) the same in (i) and (iii)
 (D) less in (iii) than in (ii)

Correct Option: D

Solution:

The change in internal energy ΔU is same in all processes.

$$Q_{ACB} = \Delta U + W_{ACB},$$

$$Q_{ADB} = \Delta U,$$

$$Q_{AEB} = \Delta U + W_{AEB}$$

Here W_{ACB} is positive and W_{AEB} is negative.

Hence $Q_{ACB} > Q_{ADB} > Q_{AEB}$.

31. When ${}_{92}\text{U}^{235}$ undergoes fission, 0.1% of its original mass is changed into energy. How much energy is released if 1 kg of ${}_{92}\text{U}^{235}$ undergoes fission?

- (A) 9×10^{10} J (B) 9×10^{11} J
 (C) 9×10^{12} J (D) 9×10^{13} J

Correct Option: D

Solution:

Mass of uranium changed into energy

$$= \frac{0.1}{100} \times 1$$

$$= 10^{-3} \text{ kg.}$$

$$\text{The energy released} = mC^2$$

$$= 10^{-3} \times (3 \times 10^8)^2$$

$$= 9 \times 10^{13} \text{ J.}$$

32. A coil of inductance 300 mH and resistance 2Ω is connected to a source of voltage 2 V. The current reaches half of its steady state value in
- (A) 0.1 s (B) 0.05 s (C) 0.3 s (D) 0.15 s

Correct Option: A

Solution:

The charging of inductance given by,

$$i = i_0 (1 - e^{-\frac{Rt}{L}})$$

$$\frac{i_0}{2} = i_0 (1 - e^{-\frac{Rt}{L}}) \Rightarrow e^{-\frac{Rt}{L}} = \frac{1}{2}$$

Taking log on both the sides,

$$-\frac{Rt}{L} = \log 1 - \log 2$$

$$\Rightarrow t = \frac{L}{R} \log 2 = \frac{300 \times 10^{-3}}{2} \times 0.69$$

$$\Rightarrow t = 0.1 \text{ sec.}$$

33. After two hours, one-sixteenth of the starting amount of certain radioactive isotope remained undecayed. The half-life of the isotope is

- (A) 15 minutes (B) 30 minutes
 (C) 45 minutes (D) 4 hour

Correct Option: B

Solution:

$$N = N_0 \left(\frac{1}{2}\right)^n$$

$$\text{or } \frac{N_0}{16} = N_0 \left(\frac{1}{2}\right)^n$$

$$\text{or } n = 4$$

$$\text{Half-life } t_{1/2} = \frac{t}{n} = \frac{2}{4} = \frac{1}{2} h$$

34. A mercury drop of radius 1 cm is sprayed into 10^6 drops of equal size. The energy expressed in joule is (surface tension of Mercury is $460 \times 10^{-3} \text{ N/m}$)

- (A) 0.057 (B) 5.7
 (C) 5.7×10^{-4} (D) 5.7×10^{-6}

Correct Option: A

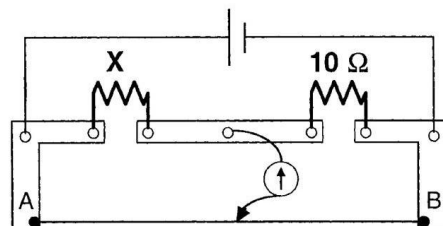
Solution:

$$W = T \Delta A = 4\pi R^2 T (n^{1/3} - 1)$$

$$= 4 \times 3.14 \times (10^{-2})^2 \times 460 \times 10^{-3} [(10^6)^{1/3} - 1]$$

$$= 0.057$$

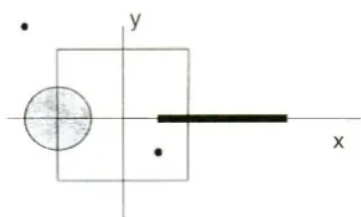
35. A meter bridge is set-up as shown, to determine an unknown resistance 'X' using a standard 10 ohm resistor. The galvanometer shows null point when tapping-key is at 52 cm mark. The end-corrections are 1 cm and 2 cm respectively for the ends A and B. The determined value of 'X' is:



- (A) 10.2 ohm (B) 10.6 ohm (C) 10.8 ohm (D) 11.1 ohm

Correct Option: B**Solution:**

36. A disk of radius $a/4$ having a uniformly distributed charge 6 C is placed in the $x-y$ plane with its centre at $(-a/2, 0, 0)$. A rod of length a carrying a uniformly distributed charge 8 C is placed on the x -axis from $x = a/4$ to $x = 5a/4$. Two point charges -7 C and 3 C are placed at $(a/4, -a/4, 0)$ and $(-3a/4, 3a/4, 0)$, respectively. Consider a cubical surface formed by six surfaces $x = \pm a/2, y = \pm a/2, z = \pm a/2$. The electric flux through this cubical surface is



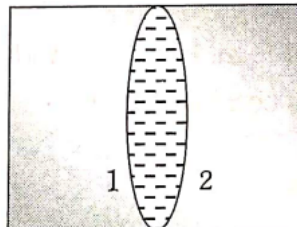
- (A) $\frac{-2C}{\epsilon_0}$
 (B) $\frac{2C}{\epsilon_0}$
 (C) $\frac{10C}{\epsilon_0}$
 (D) $\frac{12C}{\epsilon_0}$

JA 2009**Correct Option: A****Solution:**

37. A long, hollow conducting cylinder is kept coaxially inside another long, hollow conducting cylinder of larger radius. Both the cylinders are initially electrically neutral. Which of the following statements is/are correct?
- (A) A potential difference appears between the two cylinders when a charge density is given to the inner cylinder.
- (B) A potential difference appears between the two cylinders when a charge density is given to the outer cylinder.
- (C) No potential difference appears between the two cylinders when a uniform line charge is kept along the axis of the cylinders.
- (D) No potential difference appears between the two cylinders when same charge density is given to both the cylinders.

JA 2007**Correct Option: A****Solution:**

38. Two plano-concave lenses (1 and 2) of glass of refractive index 1.5 have radii of curvature 25 cm and 20 cm. They are placed in contact with their curved surface toward each other and the space between them is filled with liquid of refractive index $4/3$. Then the combination is

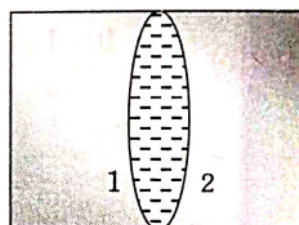


- (A) Convex of focal length 70 cm
 (B) Concave of focal length 70 cm
 (C) Concave of focal length 66.6 cm
 (D) Convex of focal length 66.6 cm

Correct Option: C**Solution:**

As shown in the figure, the system is equivalent to combination of three thin lens in contact

$$\therefore \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$



By lens maker's formula

$$\frac{1}{f_1} = \left(\frac{3}{2} - 1\right) \left(\frac{1}{\infty} - \frac{1}{25}\right) = -\frac{1}{50}$$

$$\frac{1}{f_2} = \left(\frac{4}{3} - 1\right) \left(\frac{1}{25} + \frac{1}{20}\right) = \frac{3}{100}$$

$$\frac{1}{f_3} = \left(\frac{3}{2} - 1\right) \left(\frac{1}{-20} - \frac{1}{\infty}\right) = -\frac{1}{40}$$

$$\frac{1}{f} = \frac{1}{5} \left[-\frac{1}{10} + \frac{3}{20} - \frac{1}{8}\right] = \frac{1}{5} \left[\frac{-8+12-10}{80}\right] = \frac{1}{5} \left[\frac{-6}{80}\right]$$

$$\Rightarrow f = -\frac{400}{6} \text{ cm} = -66.6 \text{ cm}$$

Hence the system behaves as a concave lens of focal length 66.6 cm.

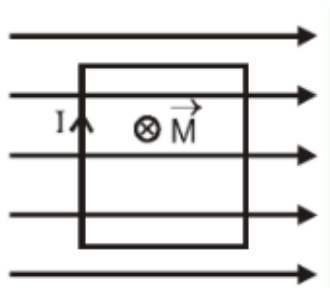
39. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating; it is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to

- (A) Development of air current when the plate is placed
 (B) Induction of electrical charge on the plate
 (C) Shielding of magnetic lines of force as aluminium is a paramagnetic material
 (D) Electromagnetic induction in the aluminium plate giving rise to electromagnetic damping

Correct Option: D

Solution:

$\vec{B}$ Electromagnetic damping

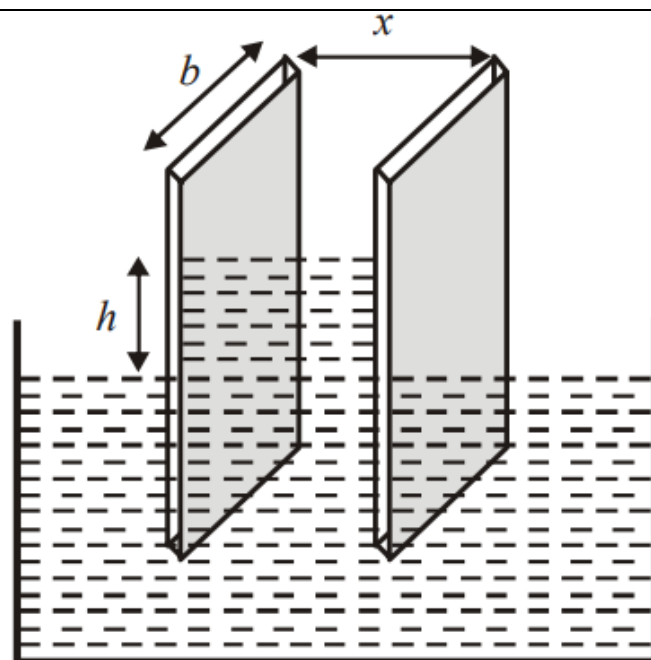


40. A capillary tube of radius R is immersed in water and water rises in it to a height H. Mass of water in the capillary tube is M. If the radius of the tube is doubled, mass of water that will rise in the capillary tube will now be

- (A) M (B) 2M (C) M/2 (D) 4M

Correct Option: B

Solution:



Let the width of each plate is b and due to surface tension liquid will rise upto height h then upward force due to Surface tension

$$= 2Tb \cos \theta \dots\dots(i)$$

Weight of the liquid rises in between the plates

$$= V dg = (bxh) dg \dots\dots(ii)$$

Equating (i) and (ii) we get, $2T \cos \theta = bxh dg$

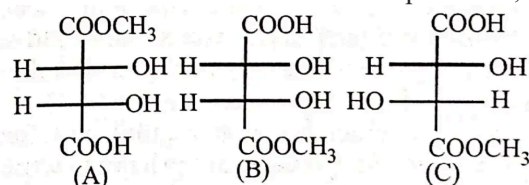
41. Which one of the following is an amine hormone?

- (A) Thyroxine (B) Oxyurin
 (C) Insulin (D) Progesterone

Correct Option: A

Solution:

42. The correct statement about the compounds A, B, and C

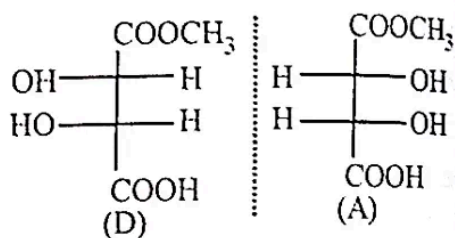
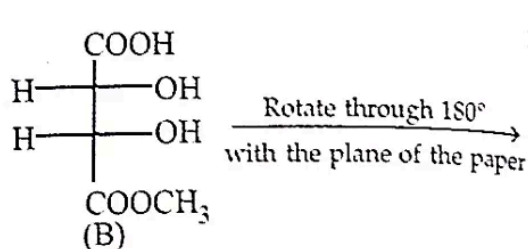


- (A) A and B are identical (B) A and B are diastereomers
 (C) A and C are enantiomers (D) A and B are enantiomers

Correct Option: D

Solution:

Rotation of B through 180° within the plane of the paper gives D which is an enantiomer of A, hence A and B are enantiomers



43. The number of radial nodes of $3s$ and $2p$ orbitals are respectively

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

Correct Option: A

Solution:

44. Which has glycosidic linkage?

(A) amylopectin (B) amylase
(C) cellulose (D) all of these

Correct Option: D

Solution:

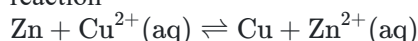
45. The energy of an electron in second Bohr orbit of hydrogen atom is :

(A) $-5.44 \times 10^{-19} \text{ eV}$
(B) $-5.44 \times 10^{-19} \text{ cal}$
(C) $-5.44 \times 10^{-19} \text{ kJ}$
(D) $-5.44 \times 10^{-19} \text{ J}$

Correct Option: B

Solution:

46. E° for the cell, $\text{Zn} | \text{Zn}^{2+}(\text{aq}) || \text{Cu}^{2+}(\text{aq}) | \text{Cu}$ is 1.10 V at 25°C . The equilibrium constant for the cell reaction



is of the order of

(A) 10^{-37} (B) 10^{37} (C) 10^{-17} (D) 10^{17}

Correct Option: B

Solution:

47. Which of the following shows nitrogen with its increasing order of oxidation number?

(A) $\text{NO} < \text{N}_2\text{O} < \text{NO}_2 < \text{NO}_3^- < \text{NH}_4^+$
(B) $\text{NH}_4^+ < \text{N}_2\text{O} < \text{NO}_2 < \text{NO}_3^- < \text{NO}$
(C) $\text{NH}_4^+ < \text{N}_2\text{O} < \text{NO} < \text{NO}_2 < \text{NO}_3^-$
(D) $\text{NH}_4^+ < \text{NO} < \text{N}_2\text{O} < \text{NO}_2 < \text{NO}_3^-$

Correct Option: C

Solution:

48. For the reaction $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$, the experimental data suggest, rate $= k[\text{H}_2][\text{Br}_2]^{1/2}$. The molecularity and order of the reaction are respectively

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

Correct Option: A

Solution:

49. Which of the following can be repeatedly softened on heating?

(i) Polystyrene
(ii) Melamine
(iii) Polyesters
(iv) Polyethylene
(v) Neoprene
(A) (i) and (iii) (B) (i) and (iv)
(C) (iii), (iv) and (v) (D) (ii) and (iv)

Correct Option: B

Solution:

50. Correct formula of the complex formed in the brown ring test for nitrates is

(A) $\text{FeSO}_4 \cdot \text{NO}$
(B) $[\text{Fe}(\text{H}_2\text{O})_5 \text{NO}]^{2+}$
(C) $[\text{Fe}(\text{H}_2\text{O})_5 \text{NO}]^+$
(D) $[\text{Fe}(\text{H}_2\text{O})_5 \text{NO}]^{3+}$

Correct Option: B

Solution:

51. Electrometallurgical process is used to extract

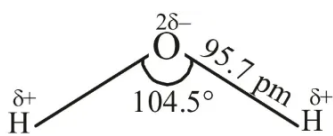
(A) Fe (B) Pb (C) Na (D) Ag

Correct Option: C

Solution:

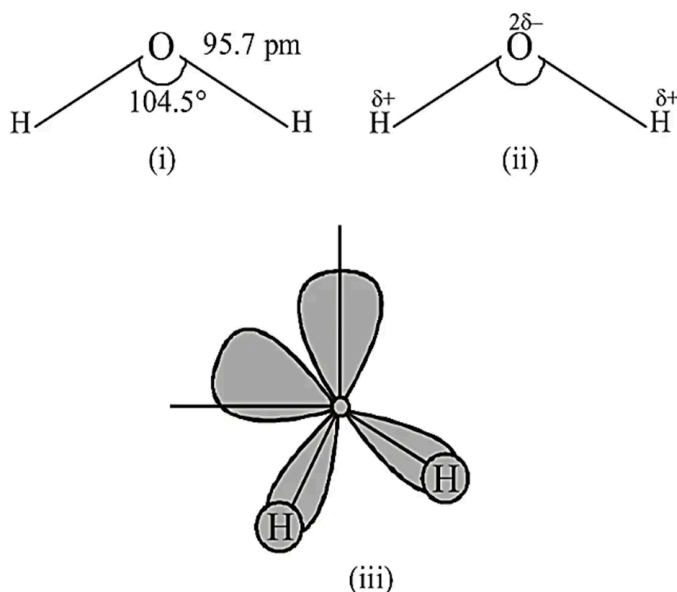
Because Na is very reactive and cannot be extracted by means of the reduction by C, CO etc. So it is extracted by electrolysis.

52. Identify the structure of water in the gaseous phase.

- (A) $\text{H} - \ddot{\text{O}} - \text{H}$
- (B) $\text{H} - \overset{+}{\text{O}} - \text{H}$
|
 H
- (C) 
- (D) None of these

Correct Option: C

Solution:



53. Which of the following can act as both Bronsted acid and Bronsted base?

- (A) Na_2CO_3 (B) OH^-
- (C) HCO_3^- (D) NH_3

Correct Option: C

Solution:



HCO_3^- can donate and accept H^+ .

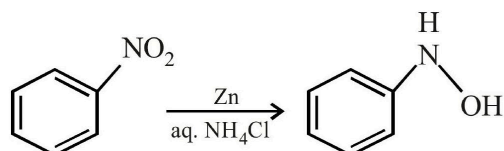
54. Which reagent converts nitrobenzene to N-phenyl hydroxyamine?

- (A) Zn/HCl
- (B) H_2O_2
- (C) $\text{Zn}/\text{NH}_4\text{Cl}$
- (D) LiAlH_4

Correct Option: C

Solution:

Reducing reagent is needed, as shown in given reaction.



55. Cadmium is used in nuclear reactors for?

- (A) absorbing neutrons (B) cooling
- (C) release neutrons (D) increase energy

Correct Option: A

Solution:

Control rods slowdown the motion of neutrons and help in controlling the rate of fission. Cadmium is efficient for this purpose.

56. Which of the following does contain Plane of symmetry

- (A) trans-1,3 dichloro cyclohexane (B) trans-1,2 dichloro cyclohexane
- (C) cis-1,2 dichloro cyclohexane (D) trans-1,3 cyclopentanone

Correct Option: C

Solution:

Meso compounds are characterized by an internal plane of symmetry that renders them achiral.

57. The rate of reaction between two reactants A and B decreases by a factor of 4 if the concentration of reactant A is doubled. The order of this reaction with respect to reactant B is:

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

Correct Option: B

Solution:

$$\text{Rate}_1 = k[\text{A}]^x[\text{B}]^y \quad \dots(1)$$

$$\frac{\text{Rate}_1}{4} = k[\text{A}]^x[2\text{B}]^y \quad \dots(2)$$

$$\text{or Rate}_1 = 4k[A]^x[2B]^y$$

From (1) and (2) we get

$$\frac{k[A]^x[B]^y}{4} = k[A]^x[2B]^y$$

$$\frac{[B]^y}{4} = [2B]^y$$

$$\text{or } \frac{1}{4} = \left(\frac{2B}{B}\right)^y \Rightarrow \frac{1}{4} = 2^y \text{ or } (2)^2 = 2^y$$

$$y = -2.$$

58. Specific conductance of 0.1MHA is $3.75 \times 10^{-4} \text{ ohm}^{-1} \text{ cm}^{-1}$. If $\lambda^\infty(\text{HA}) = 250 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$, the dissociation constant K_a of HA is :

- (A) 1.0×10^{-5} (B) 2.25×10^{-4}
(C) 2.25×10^{-5} (D) 2.25×10^{-13}

Correct Option: C

Solution:

$$\lambda_m = \frac{1000k}{0.1} = \frac{1000 \times 3.75 \times 10^{-4}}{0.1} = 3.75;$$

$$\alpha = \frac{\lambda_m}{\lambda^\infty} = \frac{3.75}{250} = 1.5 \times 10^{-2};$$

$$K_a = C\alpha^2 = 0.1 \times (1.5 \times 10^{-2})^2 = 2.25 \times 10^{-5}$$

59. Which of these compounds are directional?

- (A) NaCl (B) CO₂
(C) BaO (D) CsCl₂

Correct Option: B

Solution:

Ionic bonding is non directional, whereas covalent bonding is directional. So, CO₂ is directional.

60. Which of these doesn't exist?

- (A) PH₃ (B) PH₅
(C) LuH₃ (D) PF₅

Correct Option: B

Solution:

PH₅ does not exist because *d*-orbital of 'P' interacts with *s*-orbital of H. Bond formed is not stable and not energetically favorable. It depends on size and orientation of interaction.

61. The number of atoms per unit cell of *bcc* structure is

- (A) 1 (B) 2 (C) 4 (D) 6

Correct Option: B

Solution:

In *bcc* structure,

$$\text{no. of atoms at corners} = \frac{1}{8} \times 8 = 1$$

$$\text{no. of atoms at the body centre} = 1.$$

Therefore, total number of atoms per unit cell = 2.

62. Find which of the following compound can have mass ratios of C : H : O as 6 : 1 : 24

- (A) HO – (C = O) – OH
(B) HO – (C = O) – H
(C) H – (C = O) – H
(D) H₃CO – (C = O) – H

Correct Option: A

Solution:

Given, mass ratio is C : H : O = 6 : 1 : 24 so, molar ratio will be $\frac{6}{12} : \frac{1}{1} : \frac{24}{16} = 1 : 2 : 3$

therefore, HO – (C = O) – OH has molar ratio 1:2:3

63. If a 25.0 mL sample of sulfuric acid is titrated with 50.0 mL of 0.025 M sodium hydroxide to a phenolphthalein endpoint, what is the molarity of the acid?

- (A) 0.020 M (B) 0.100 M (C) 0.025 M (D) 0.050 M

Correct Option: C

Solution:

$$M_1 V_1 = M_2 V_2$$

$$(0.025M)(0.050 \text{ L}) = (M_2)(0.025 \text{ L})$$

$$M_2 = 0.05M$$

but, there are 2 H 's per H₂SO₄ so [H₂SO₄]

$$= 0.025M$$

64. Which of the following shows correct order of bond length?

- (A) O₂⁺ > O₂ > O₂⁻ > O₂²⁻
(B) O₂⁺ < O₂⁻ > O₂ < O₂²⁻
(C) O₂⁺ > O₂ < O₂⁻ > O₂²⁻
(D) O₂⁺ > O₂ < O₂⁻ > O₂²⁻

Correct Option: B

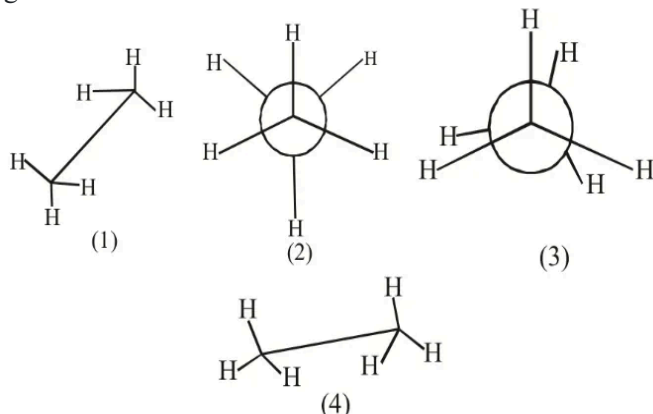
Solution:

Bond length decreases with an increase in bond order.

Therefore, the order of bond length in these species is

$O_2^+ < O_2^- > O_2 < O_2^{2-}$ (bond order - $O_2^+ = 2.5$, $O_2 = 2$, $O_2^- = 1.5$, $O_2^{2-} = 1$)

65. In the following structures, which two forms are staggered conformations of ethane ?



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

Correct Option: C

Solution:

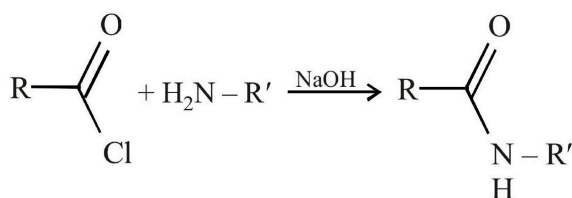
Note that in structures 1 and 2, every two adjacent hydrogen atoms are at maximum possible distance from each other (staggered conformation).

66. Which of the following represents Schotten-Baumann reaction?
- (A) formation of amides from amines and acid chlorides/ NaOH
- (B) formation of amines from amides and $LiAlH_4$
- (C) formation of amines from amides and $Br_2/NaOH$
- (D) formation of amides from oxime and H_2SO_4

Correct Option: A

Solution:

Schotten-Baumann Conditions



The use of added base to drive the equilibrium in the formation of amides from amines and acid chlorides.

67. Which of the following complex shows $sp^3 d^2$ hybridization?
- (A) $[Cr(NO_2)_6]^{3-}$
- (B) $[Fe(CN)_6]^{4-}$
- (C) $[CoF_6]^{3-}$
- (D) $[Ni(CO)_4]$

Correct Option: C

Solution:

Among these ligands, 'F' is a weak field ligand, makes only high spin complexes which has $sp^3 d^2$ hybridization.

68. Which of the following can form buffer solution?
- (A) aq. $NH_3 + NH_4OH$
- (B) $KOH + HNO_3$
- (C) $NaOH + HCl$
- (D) $KI + KOH$

Correct Option: A

Solution:

Ammonia is a weak base and a salt containing its conjugate acid, the ammonium cation, such as NH_4OH functions as a buffer solution when they are present together in a solution.

69. Which of the following is not present in Portland cement?
- (A) Ca_2SiO_4
- (B) Ca_3SiO_5
- (C) $Ca_3(PO_4)_2$
- (D) $Ca_3Al_2O_6$

Correct Option: C

Solution:

There are four chief minerals present in Portland cement: tricalcium silicate (Ca_3SiO_5), dicalcium silicate (Ca_2SiO_4), tricalcium aluminate ($Ca_3Al_2O_6$) and calcium aluminoferrite ($Ca_4Al_nFe_{2-n}O_7$).

70. Which of the following is not involved in the formation of photochemical smog?

- (A) Hydrocarbon (B) NO
(C) SO₂ (D) O₃

Correct Option: C

Solution:

Photochemical smog does not involve SO₂.

71. Which of the following order is wrong?

- (A) NH₃ < PH₃ < AsH₃ - Acidic
(B) Li < Be < B < C - IE₁
(C) Al₂O₃ < MgO < Na₂O < K₂O - Basic
(D) Li⁺ < Na⁺ < K⁺ < Cs⁺ - Ionic radius

Correct Option: B

Solution:

The right sequence of I.E₁ of Li < B < Be < C.

72. For the reaction CO(g) + $\frac{1}{2}$ O₂(g) → CO₂(g), which one of the statements is correct at constant T and P?

- (A) ΔH = ΔE
(B) ΔH < ΔE
(C) ΔH > ΔE
(D) ΔH is independent of physical state of the reactants

Correct Option: B

Solution:

$$\Delta n = -\frac{1}{2}; \quad \Delta H = \Delta E - \frac{1}{2}RT; \Rightarrow \Delta E > \Delta H$$

73. Which of the following represents Gay Lussac's law?

- I. $\frac{P}{T} = \text{constant}$
II. P₁ T₂ = P₂ T₁
III. P₁ V₁ = P₂ V₂

Choose the correct option.

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

Correct Option: D

Solution:

$$\frac{P}{T} = \text{constant (Gay Lussac's law)}$$

$$\Rightarrow \frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow P_1 T_2 = P_2 T_1$$

$$PV = \text{constant}$$

$$P_1 V_1 = P_2 V_2 \quad [\text{Boyle's law}]$$

74. Raoult's law becomes a special case of Henry's law when

- (A) $K_H = p_1^\circ$ (B) $K_H > p_1^\circ$
(C) $K_H < p_1^\circ$ (D) $K_H \geq p_1^\circ$

Correct Option: A

Solution:

Raoult's law becomes special case of Henry's law when K_H become equal to p_1° .

75. Which of the following relation represents correct relation between standard electrode potential and equilibrium constant?

- I. $\log K = \frac{nFE^\circ}{2.303RT}$
II. $K = e^{\frac{nFE^\circ}{RT}}$
III. $\log K = \frac{-nFE^\circ}{2.303RT}$
IV. $\log K = 0.4342 \frac{nFE^\circ}{RT}$

Choose the correct statement(s).

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

Correct Option: C

Solution:

$$\Delta G = -2.303RT \log K$$

$$-nFE^\circ = -2.303RT \log K$$

$$\log K = \frac{nFE^\circ}{2.303RT}$$

$$= 0.4342 \frac{nFE^\circ}{RT} \quad \dots(i)$$

$$\ln K = \frac{nFE^\circ}{RT}$$

$$K = e^{\frac{nFE^\circ}{RT}} \quad \dots(ii)$$

76. Stronger is oxidising agent, more is

- (A) standard reduction potential of that species
(B) the tendency to get it self oxidised
(C) the tendency to lose electrons by that species
(D) standard oxidation potential of that species

Correct Option: A

Solution:

More is E_{RP}^o, more is the tendency to get itself reduced or more is oxidising power.

77. Dead burn plaster is

- (A) CaSO₄ · 2H₂O

- (B) $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
 (C) $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
 (D) CaSO_4

Correct Option: D

Solution:



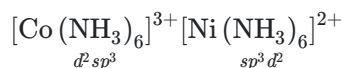
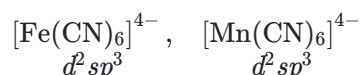
78. Which one of the following complexes is an outer orbital complex?

- (A) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (B) $[\text{Mn}(\text{CN})_6]^{4-}$
 (C) $[\text{Fe}(\text{CN})_6]^{4-}$
 (D) $[\text{Ni}(\text{NH}_3)_6]^{2+}$

Correct Option: D

Solution:

hybridisation :



Hence $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is outer orbital complex.

79. For a given reaction, $\Delta H = 35.5 \text{ kJ mol}^{-1}$ and $\Delta S = 83.6 \text{ JK}^{-1} \text{ mol}^{-1}$. The reaction is spontaneous at :
 (Assume that ΔH and ΔS do not vary with temperature)
- (A) $T > 425 \text{ K}$ (B) All temperatures
 (C) $T > 298 \text{ K}$ (D) $T < 425 \text{ K}$

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Correct Option: A

Solution:

$$\Delta G = \Delta H - T\Delta S < 0$$

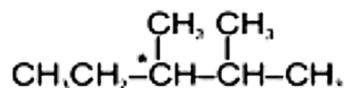
$$\Delta H < T\Delta S$$

$$T > \frac{\Delta H}{\Delta S} = \frac{35.5 \times 1000}{83.6} = 425 \text{ K}$$

80. A compound with molecular formula, C_7H_{16} shows optical isomerism, the compound will be :
- (A) 2, 3-dimethylpentane (B) 2,2-dimethylpentane
 (C) 2-methylhexane (D) None of these

Correct Option: A

Solution:



2, 3-dimethylpentane

81. In questions, some parts of the sentences have errors and some are correct. Find out which part of a sentence has error. If a sentence is free from error, mark (d) in your answer.

The teacher as well as his students, all left for the trip.

- (A) The teacher as well as his students
 (B) all left
 (C) for the trip
 (D) No error

Correct Option: B

Solution:

82. The treasure was hidden _____ a big shore.

- (A) on (B) underneath
 (C) toward (D) off

Correct Option: D

Solution:

83. To write well you have to be able to write clearly and logically, and you cannot do this unless you can think clearly and logically. If you cannot do this yet you should try to do it by taking particular problems and following them through, point by point, to a solution, without leaving anything out and without avoiding any difficulties that you meet.

At first you find clear, step-by-step thought very difficult. You may find that your mind is not able to concentrate. Several unconnected ideas may occur together. But practice will improve your ability to concentrate on a single idea and think about it clearly and logically. In order to increase your vocabulary and to improve your style, you should read widely and use a good dictionary to help you find the exact meanings and correct usages of words.

Always remember that regular and frequent practice is necessary if you want to learn to write well. It is no good waiting until you have an inspiration before you write. Even with the most famous writers, inspiration is rare. Someone said that writing is ninety-nine percent hard work and one percent inspiration, so the sooner you get into the habit of disciplining your-self to write, the better. Famous writers have achieved success by

- (A) using their linguistic resources properly

- (B) disciplining their skill
- (C) following only one idea
- (D) waiting for inspiration

Correct Option: B

Solution:

84. To write well you have to be able to write clearly and logically, and you cannot do this unless you can think clearly and logically. If you cannot do this yet you should train yourself to do it by taking particular problems and following them through, point by point, to a solution, without leaving anything out and without avoiding any difficulties that you meet.

At first you find clear, step-by-step thought very difficult. You may find that your mind is not able to concentrate. Several unconnected ideas may occur together. But practice will improve your ability to concentrate on a single idea and think about it clearly and logically. In order to increase your vocabulary and to improve your style, you should read widely and use a good dictionary to help you find the exact meanings and correct usages of words.

Always remember that regular and frequent practice is necessary if you want to learn to write well. It is no good waiting until you have an inspiration before you write. Even with the most famous writers, inspiration is rare. Someone said that writing is ninety-nine percent hard work and one percent inspiration, so the sooner you get into the habit of disciplining your-self to write, the better. According to the passage, writing style can be improved by

- (A) thinking logically
- (B) writing clearly
- (C) undergoing training
- (D) reading widely

Correct Option: D

Solution:

85. To write well you have to be able to write clearly and logically, and you cannot do this unless you can think clearly and logically. If you cannot do this yet you should train yourself to do it by taking particular problems and following them through, point by point, to a solution, without leaving anything out and without avoiding any difficulties that you meet.

At first you find clear, step-by-step thought very difficult. You may find that your mind is not able to concentrate. Several unconnected ideas may occur together. But practice will improve your ability to concentrate on a single idea and think about it clearly and logically. In order to increase your vocabulary and to improve your style, you should read widely and use a good dictionary to help you find the exact meanings and correct usages of words.

Always remember that regular and frequent practice is necessary if you want to learn to write well. It is no good waiting until you have an inspiration before you write. Even with the most famous writers, inspiration is rare. Someone said that writing is ninety-nine percent hard work and one percent inspiration, so the sooner you get into the habit of disciplining your-self to write, the better. Initially it is difficult to write because

- (A) a good dictionary is not used
- (B) ideas occur without any sequence
- (C) aids to correct writing are not known
- (D) exact usages of words are not known

Correct Option: B

Solution:

86. To write well you have to be able to write clearly and logically, and you cannot do this unless you can think clearly and logically. If you cannot do this yet you should train yourself to do it by taking particular problems and following them through, point by point, to a solution, without leaving anything out and without avoiding any difficulties that you meet. At first you find clear, step-by-step thought very difficult. You may find that your mind is not able to concentrate. Several unconnected ideas may occur together. But practice will improve your ability to concentrate on a single idea and think about it clearly and logically. In order to increase your vocabulary and to improve your style, you should read widely and use a good dictionary to help you find the exact meanings and correct usages of words. Always remember that regular and frequent practice is necessary if you want to learn to write well. It is no good waiting until you have an inspiration before you write. Even with the most famous writers, inspiration is rare. Someone said that writing is ninety-nine percent hard work and one percent inspiration, so the sooner you get into the habit of disciplining your-self to write, the better.

To write well a person must train himself in

- (A) dealing with a difficult problem
- (B) not leaving anything out
- (C) thinking clearly and logically
- (D) following a step-by-step approach

Correct Option: C

Solution:

87. "Meticulous".

- (A) Forgetful
- (B) Destructive
- (C) Careless
- (D) Flagrant

Solution:

The figure that correctly completes the matrix is Option (B).

96. Statement :

The human organism grows and develops through stimulation and action.

Conclusions:

- I. Inert human organism cannot grow and develop.
- II. Human organisms do not react to stimulation and action.

- (A) Neither conclusion I nor II follows
- (B) Both conclusions I and II follow
- (C) Only conclusion I follows
- (D) Only conclusion II follows

Correct Option: A**Solution:**

Growth and development of human organism is a continuous process. Some changes take place in human body now and then. Therefore, neither Conclusion I nor II follows.

97. Statements:

- 1. Temple is a place of worship.
- 2. Church is also a place of worship.

Conclusions :

- I. Hindus and Christians use the same place for worship.
- II. All churches are temples.

- (A) Neither conclusion I and II follows
- (B) Both conclusions I and II follow
- (C) Only conclusion I follows
- (D) Only conclusion II follows

Correct Option: A**Solution:**

Temple and Church are places of worship. It does not imply that Hindus and Christians use the same place for worship. Church is different temple. Therefore, neither Conclusion I nor II follows.

- 98.** Two statements are given followed by four conclusions, I, II, III and IV. You have to consider the statements to be true, even if they seem to be at variance from commonly known facts. You have to decide which of the given conclusions can definitely be drawn from the given statements. Indicate your answer.

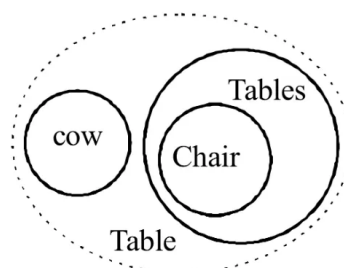
Statements :

- (A) No cow is a chair
- (B) All chairs are tables.

Conclusions :

- I. Some tables are chairs.
- II. Some tables are cows
- III. Some chairs are cows
- IV. No table is a cow

- (A) Either II or III follow
- (B) Either II or IV follow
- (C) Only I follows
- (D) None of these

Correct Option: D**Solution:**

Conc I: True

Conc II: False

Conc III: False

Conc IV: False

or

- 99. Statements:** Politicians become rich by the votes of t people.

Assumptions :

- I. People vote to make politicians rich.
- II. Politicians become rich by their virtue.

- (A) Only I is implicit
- (B) Only II is implicit
- (C) Both I and II are implicit
- (D) Both I and II are not implicit

Correct Option: D**Solution:**

The statement implies that politicians win elections by the votes of people. Therefore, neither of the assumptions is implicit in the statement.

- 100.** Vinod introduces Vishal as the son of the only brother his father's wife. How is Vinod related to Vishal?

- (A) Cousin
- (B) Brother
- (C) Son
- (D) Uncle

Correct Option: A**Solution:**

Wife of Vinod's father means the mother of Vinod.

Only brother of Vinod's mother means maternal uncle of Vinod.

Therefore, Vinod is cousin of Vishal.

101. M is the son of P. Q is the granddaughter of O who is the husband of P. How is M related to O?

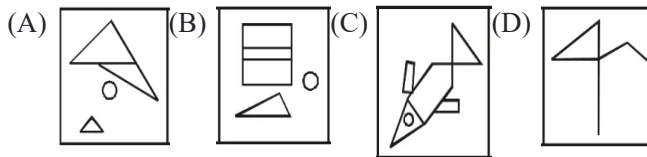
(A) Son (B) Daughter (C) Mother (D) Father

Correct Option: A

Solution:

O is the husband of P. M is the son of P. Therefore, M is the son of O.

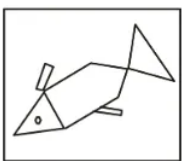
102. Which of the answer figures include the separate components found in the question figure?



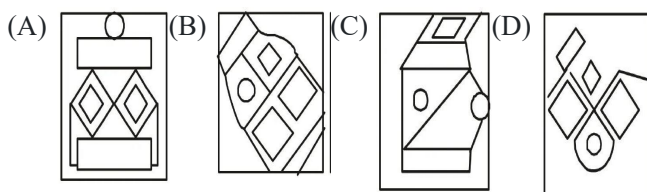
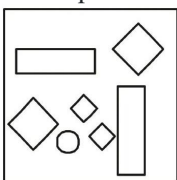
Correct Option: C

Solution:

All the components of question figure are present in Answer Figure (c)

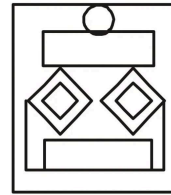


103. Which answer figure includes all the components given in the question figure?

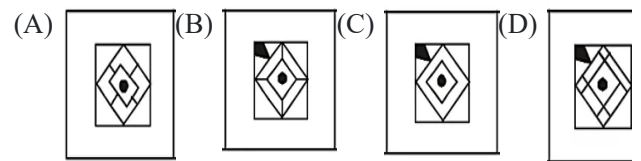
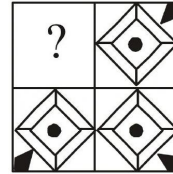


Correct Option: A

Solution:



104. Which answer figure complete the form in question figure?

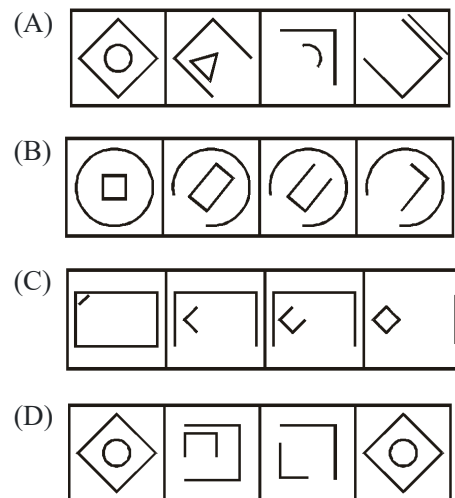


Correct Option: B

Solution:

105. **Direction :** Choose set of the figures which follows the given rule.

Rule : Closed figures gradually become open and open figures gradually become closed.



Correct Option: C

Solution:

Solution not required

106. The dot product of a vector with the vectors $\hat{i} + \hat{j} - 3\hat{k}$, $\hat{i} + 3\hat{j} - 2\hat{k}$ and $2\hat{i} + \hat{j} + 4\hat{k}$ are 0, 5 and 8 respectively. The vector is

(A) $\hat{i} + 2\hat{j} + \hat{k}$

(B) $-\hat{i} + 3\hat{j} - 2\hat{k}$

(C) $\hat{i} + 2\hat{j} + 3\hat{k}$

(D) $\hat{i} - 3\hat{j} - 3\hat{k}$

Correct Option: A

Solution:

107. Value of $\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$ is

- (A) $\frac{\pi}{2}$ (B) $\frac{-\pi}{2}$
(C) $\frac{\pi}{4}$ (D) None of these

Correct Option: C

Solution:

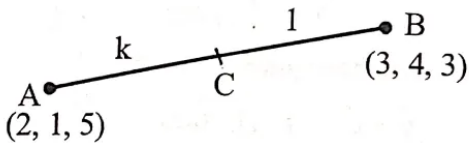
108. The ratio in which the join of $(2, 1, 5)$ and $(3, 4, 3)$ is divided by the plane $(x + y - z) = \frac{1}{2}$ is :

- (A) 3 : 5 (B) 5 : 7 (C) 1 : 3 (D) 4 : 5

Correct Option: B

Solution:

As given, the plane $x + y - z = \frac{1}{2}$ divides the line joining the points $A(2, 1, 5)$ and $B(3, 4, 3)$ at a point C in the ratio $k : 1$.



Then coordinates of C

$$\left(\frac{3k+2}{k+1}, \frac{4k+1}{k+1}, \frac{3k+5}{k+1} \right)$$

Point C lies on the plane, $\begin{matrix} \text{---} \\ \text{---} \end{matrix} \Rightarrow$
Coordinates of C must satisfy the equation of plane. So,

$$\left(\frac{3k+2}{k+1} \right) + \left(\frac{4k+1}{k+1} \right) - \left(\frac{3k+5}{k+1} \right) = \frac{1}{2}$$

$$\Rightarrow 3k + 2 + 4k + 1 - 3k - 5 = \frac{1}{2}(k + 1)$$

$$\Rightarrow 4k - 2 = \frac{1}{2}(k + 1)$$

$$\Rightarrow 8k - 4 = k + 1 \Rightarrow 7k = 5$$

$$\Rightarrow k = \frac{5}{7}$$

$\end{matrix}$

Ratio is 5 : 7.

109. If $\sum_{r=0}^n (-1)^r \frac{{}^nC_r}{{}^{n+3}C_r} = \frac{3}{a+3}$, then $a - n$ is equal to

- (A) 0 (B) 1
(C) 2 (D) None of these

Correct Option: A

Solution:

110. $2^{1/4} \cdot 2^{2/8} \cdot 2^{3/16} \cdot 2^{4/32} \dots \infty$ is equal to-

- (A) 1 (B) 2 (C) 3/2 (D) 5/2

Correct Option: B

Solution:

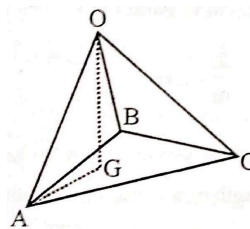
111. Let $\vec{a}$, $\vec{b}$ & $\vec{c}$ be non-coplanar unit vectors equally inclined to one another at an acute angle θ . Then $|\vec{a} \times \vec{b} \times \vec{c}|$ in terms of θ is equal to

- (A) $(1 + \cos \theta) \sqrt{\cos 2\theta}$
(B) $(1 + \cos \theta) \sqrt{1 - 2 \cos \theta}$
(C) $(1 - \cos \theta) \sqrt{1 + 2 \cos \theta}$
(D) None of these

Correct Option: C

Solution:

$\vec{OA} = \vec{a}$, $\vec{OB} = \vec{b}$ & $\vec{OC} = \vec{c}$ are unit vectors and equally inclined to each other at an acute angle θ .



$$\begin{aligned} AB &= \sqrt{OA^2 + OB^2 - 2OA \cdot OB \cdot \cos \theta} \\ &= \sqrt{2 - 2 \cos \theta} = \sqrt{2} \sqrt{1 - \cos \theta} \end{aligned}$$

Area of $\triangle ABC$

$$= \frac{\sqrt{3}}{4} AB^2 = \frac{\sqrt{3}}{4} \cdot 2(1 - \cos \theta) = \frac{\sqrt{3}}{2} (1 - \cos \theta)$$

If G is the centroid of the $\triangle ABC$, then

$$\begin{aligned} OG &= \frac{1}{3} |\vec{a} + \vec{b} + \vec{c}| \\ &= \frac{1}{3} \sqrt{a^2 + b^2 + c^2 + 2\vec{a} \cdot \vec{b} + 2\vec{b} \cdot \vec{c} + 2\vec{c} \cdot \vec{a}} \\ &= \frac{1}{\sqrt{3}} \sqrt{1 + 2 \cos \theta} \end{aligned}$$

$$\begin{aligned} \therefore [\vec{a} \vec{b} \vec{c}] &= \text{Volume of parallelepiped} \\ &= OG \times 2 \text{ar}(\triangle ABC) \\ &= 2 \cdot \frac{1}{\sqrt{3}} \sqrt{1+2\cos\theta} \times \frac{\sqrt{3}}{2} (1-\cos\theta) \\ &= (1-\cos\theta) \sqrt{1+2\cos\theta} \end{aligned}$$

112. If $\int x \log(1 + \frac{1}{x}) dx = f(x) \log(x+1) + g(x)x^2 + Lx + C$, then
- (A) $f(x) = \frac{1}{2}x^2$ (B) $g(x) = \log x$
 (C) $L = 1$ (D) None of these

Correct Option: D

Solution:

113. If $R(t) = \begin{bmatrix} \cos t & \sin t \\ -\sin t & \cos t \end{bmatrix}$, then $R(s)R(t)$ equals
- (A) $R(s+t)$ (B) $R(s-t)$
 (C) $R(s)+R(t)$ (D) None of these

Correct Option: A

Solution:

114. The equation of one of the common tangents to the parabola $y^2 = 8x$ and the circle $x^2 + y^2 - 12x + 4 = 0$ is
- (A) $y = -x + 2$ (B) $y = x - 2$
 (C) $y = x + 2$ (D) None of these

Correct Option: C

Solution:

115. Statement 1 : A five digit number divisible by 3 is to be formed using the digits 0, 1, 2, 3, 4 and 5 with repetition. The total number formed are 216.
 Statement 2 : If sum of digits of any number is divisible by 3 then the number must be divisible by 3. Which of the following is correct?
- (A) Statement-1 is true, Statement-2 is true, Statement-2 is a correct explanation for Statement-1
 (B) Statement -1 is true, Statement-2 is true ; Statement-2 is NOT a correct explanation for Statement-1
 (C) Statement-1 is true, Statement-2 is false
 (D) Statement-1 is false, Statement-2 is true

Correct Option: D

Solution:

Number form by using 1, 2, 3, 4, 5 = $5! = 120$ Number formed by using 0, 1, 2, 4, 5

4	4	3	2	1	$= 4 \cdot 4 \cdot 3 \cdot 2 \cdot 1 = 96$
---	---	---	---	---	--

Total number formed, divisible by 3 (taking numbers without repetition) = 216

Statement 1 is false and statement 2 is true.

116. If $f(z) = \frac{7-z}{1-z^2}$, where $z = 1 + 2i$, then $|f(z)|$ is equal to
- (A) $\frac{|z|}{2}$ (B) $|z|$
 (C) $2|z|$ (D) None of these

Correct Option: A

Solution:

117. The maximum value of $z = 3x + 2y$ subject to $x + 2y \geq 2$, $x + 2y \leq 8$, $x, y \geq 0$ is :
- (A) 32 (B) 24
 (C) 40 (D) None of these

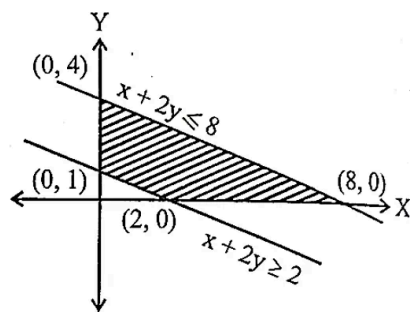
Correct Option: B

Solution:

Given : $x + 2y \geq 2$... (i)

$x + 2y \leq 8$... (ii)

and $x, y \geq 0$



For equation (1)

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

and for equation (2)

$$\frac{x}{8} + \frac{y}{4} = 1$$

Given : $z = 3x + 2y$

At point (2, 0); $z = 3 \times 2 + 0 = 6$

At point (0, 1); $z = 3 \times 0 + 2 \times 1 = 2$

At point $(8, 0)$; $z = 3 \times 8 + 2 \times 0 = 24$

At point $(0, 4)$; $z = 3 \times 0 + 2 \times 4 = 8$

maximum value of z is 24 at point $(8, 0)$.

118. If $f(x) = \begin{cases} \frac{x \log \cos x}{\log(1+x^2)}, & x \neq 0 \\ 0, & x = 0 \end{cases}$ then $f(x)$ is

- (A) continuous as well as differentiable at $x = 0$
 (B) continuous but not differentiable at $x = 0$
 (C) differentiable but not continuous at $x = 0$
 (D) neither continuous nor differentiable at $x = 0$

Correct Option: A

Solution:

119. The number of roots of equation $\cos x + \cos 2x + \cos 3x = 0$ in the interval $0 \leq x \leq 2\pi$ is

- (A) 4 (B) 5 (C) 6 (D) 8

Correct Option: C

Solution:

120. A random variable X has the probability distribution:

X	1	2	3	4	5	6	7	8
p(X)	0.15	0.23	0.12	0.10	0.20	0.08	0.07	0.05

For the events $E = \{X \text{ is a prime number}\}$ and $F = \{X < 4\}$, find $P(E \cup F)$.

- (A) 0.50 (B) 0.77 (C) 0.35 (D) 0.87

Correct Option: B

Solution:

121. If $\int \frac{\cos x - 1}{\sin x + 1} e^x dx$ is equal to:

- (A) $\frac{e^x \cos x}{1 + \sin x} + C$ (B) $C - \frac{e^x \sin x}{1 + \sin x}$
 (C) $C - \frac{e^x}{1 + \sin x}$ (D) $C - \frac{e^x \cos x}{1 + \sin x}$

Correct Option: A

Solution:

122. The value of $\cot^{-1} 7 + \cot^{-1} 8 + \cot^{-1} 18$ is

- (A) π (B) $\frac{\pi}{2}$
 (C) $\cot^{-1} 5$ (D) $\cot^{-1} 3$

Correct Option: D

Solution:

123. If a system of equations $-ax + y + z = 0$,
 $x - by + z = 0$

$$x + y - cz = 0 \quad (a, b, c \neq -1)$$

has a non-zero solution then $\frac{1}{1+a} + \frac{1}{1+b} + \frac{1}{1+c} =$

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

Correct Option: B

Solution:

124. If $\frac{4^n}{n+1} < \frac{(2n)!}{(n!)^2}$, then $P(n)$ is true for

- (A) $n \geq 1$ (B) $n > 0$ (C) $n < 0$ (D) $n \geq 2$

Correct Option: D

Solution:

125. The function $f(x) = x - |x - x^2|$, defined for $-1 \leq x \leq 1$, is continuous on the interval

- (A) $[-1, 1]$ (B) $(-1, 1)$
 (C) $\{-1, 1\} - \{0\}$ (D) $(-1, 1) - \{0\}$

Correct Option: A

Solution:

126. After striking the floor a certain ball rebounds $\frac{4}{5}$ th of its height from which it has fallen. The total distance that the ball travels before coming to rest if it is gently released from a height of 120 m is:

- (A) 900 m (B) 1000 m (C) 1080 m (D) Infinite

Correct Option: C

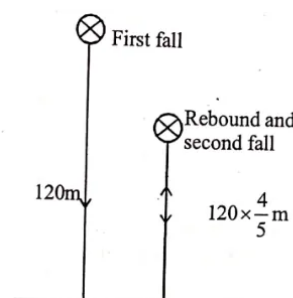
Solution:

Clearly, the total distance described

$$= 120 + 2 \left[120 \times \frac{4}{5} + 120 \times \frac{4}{5} \times \frac{4}{5} + 120 \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5} \right]$$

Except in the first fall the same ball will travel twice in each step the same distance one upward and second downward travel.

Distance travelled



$$= 120 + 2 \times 120 \left[\frac{4}{5} + \left(\frac{4}{5} \right)^2 + \dots \text{to } \infty \right]$$

$$= 120 + 240 \left[\frac{\frac{4}{5}}{1 - \frac{4}{5}} \right] = 120 + 240 \times 4 = 1080 \text{ m}$$

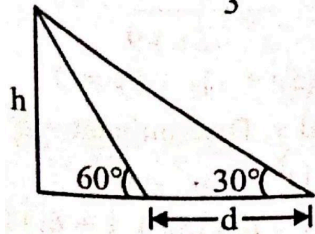
127. An observer on the top of a tree finds the angle of depression of a car moving towards the tree to be 30° . After 3 minutes this angle becomes 60° . After how much more time will the car reach the tree?

(A) 4 min. (B) 4.5 min (C) 1.5 min (D) 2 min.

Correct Option: C

Solution:

$$d = h \cot 30^\circ - h \cot 60^\circ \text{ and time} = 3 \text{ min. } \therefore \text{Speed} = \frac{h(\cot 30^\circ - \cot 60^\circ)}{3} \text{ per minute.}$$



It will travel distance $h \cot 60^\circ$ in

128. If A, B, C are the angles of a triangle and e^{iA}, e^{iB}, e^{iC} are in A.P. Then the triangle must be

(A) right angled (B) isosceles
(C) equilateral (D) None of these

Correct Option: C

Solution:

129. The domain of the function $f(x) = \sin^{-1} \{ \log_2 (\frac{1}{2} x^2) \}$ is

(A) $[-2, -1] \cup [1, 2]$ (B) $(-2, -1] \cup [1, 2]$
(C) $[-2, -1] \cup [1, 2]$ (D) $(-2, -1) \cup (1, 2)$

Correct Option: C

Solution:

130. How many different nine digit numbers can be formed from the number 223355888 by rearranging its digits so that the odd digits occupy even positions?

(A) 16 (B) 36 (C) 60 (D) 180

Correct Option: C

Solution:

131. Let f and g be functions from $\mathbb{R}$ to $\mathbb{R}$ defined as

$$f(x) = \begin{cases} 7x^2 + x - 8, & x \leq 1 \\ 4x + 5, & 1 < x \leq 7 \\ 8x + 3, & x > 7 \end{cases}, \quad g(x) = \begin{cases} |x|, & \\ 0, & \\ x^2 + \end{cases}$$

Then:

(A) $(f \circ g)(-3) = 8$ (B) $(f \circ g)(9) = 683$
(C) $(g \circ f)(0) = -8$ (D) $(g \circ f)(6) = 427$

Correct Option: B

Solution:

132. If the line through the points $A(k, 1, -1)$ and $B(2k, 0, 1)$ is perpendicular to the line through the points B and $C(2 + 2k, k, 1)$, then what is the value of k ?

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

Correct Option: D

Solution:

Given points are $A(k, 1, -1)$, $B(2k, 0, 2)$ and $C(2 + 2k, k, 1)$

Let r_1 = length of line

$$AB = \sqrt{(2k - k)^2 + (0 - 1)^2 + (2 + 1)^2} \\ = \sqrt{k^2 + 10}$$

and r_2 = length of line BC

$$= \sqrt{(2)^2 + k^2 + (-1)^2} \\ = \sqrt{k^2 + 5}$$

Now, let ℓ_1, m_1, n_1 be direction-cosines of line AB and ℓ_2, m_2, n_2 be the direction cosines of BC .

Since AB is perpendicular to BC

$$\therefore \ell_1 \ell_2 + m_1 m_2 + n_1 n_2 = 0$$

$$\text{Now, } \ell_1 = \frac{k}{\sqrt{k^2 + 10}}, m_1 = \frac{-1}{\sqrt{k^2 + 10}},$$

$$n_1 = \frac{3}{\sqrt{k^2 + 10}}$$

$$\text{and } \ell_2 = \frac{2}{\sqrt{k^2 + 5}}, m_2 = \frac{k}{\sqrt{k^2 + 5}}, n_2 = \frac{1}{\sqrt{k^2 + 5}}$$

$$\text{So, } \ell_1 \ell_2 + m_1 m_2 + n_1 n_2 = 0$$

$$\Rightarrow \frac{2k}{\sqrt{k^2 + 10}\sqrt{k^2 + 5}} - \frac{k}{\sqrt{k^2 + 10}\sqrt{k^2 + 5}} - \frac{3}{\sqrt{k^2 + 10}\sqrt{k^2 + 5}} \\ \Rightarrow 2k - k - 3 = 0 \\ \Rightarrow k = 3$$



For $k = 3$, AB is perpendicular to BC .

133. The angle between the lines whose intercepts on the axes are $a, -b$ and $b, -a$ respectively, is

- (A) $\tan^{-1} \frac{a^2 - b^2}{ab}$
 (B) $\tan^{-1} \frac{b^2 - a^2}{2}$
 (C) $\tan^{-1} \frac{b^2 - a^2}{2ab}$
 (D) None of these

Correct Option: C

Solution:

Equation of lines are $\frac{x}{a} - \frac{y}{b} = 1$ and

$$\frac{x}{b} - \frac{y}{a} = 1$$

$$\Rightarrow m_1 = \frac{b}{a} \text{ and } m_2 = \frac{a}{b}$$

Therefore

$$\theta = \tan^{-1} \frac{\frac{b}{a} - \frac{a}{b}}{1 + \frac{b}{a} \cdot \frac{a}{b}} = \tan^{-1} \frac{b^2 - a^2}{2ab}$$

134. An urn contains five balls. Two balls are drawn and found to be white. The probability that all the balls are white is

- (A) $\frac{1}{10}$ (B) $\frac{3}{10}$
 (C) $\frac{3}{5}$ (D) $\frac{1}{2}$

Correct Option: D

Solution:

Let $A_i (i = 2, 3, 4, 5)$ be the event that urn contains 2, 3, 4, 5 white balls and let B be the event that two white balls have been drawn then we have to find $P(A_5/B)$.

Since the four events A_2, A_3, A_4 and A_5 are equally likely we have $P(A_2) = P(A_3) = P(A_4) = P(A_5) = \frac{1}{4}$.

$P(B/A_2)$ is probability of event that the urn contains 2 white balls and both have been drawn.

$$P(B/A_2) = \frac{{}^2C_2}{{}^5C_2} = \frac{1}{10}$$

$$\text{Similarly } P(B/A_3) = \frac{{}^3C_2}{{}^5C_2} = \frac{3}{10},$$

$$P(B/A_4) = \frac{{}^4C_2}{{}^5C_2} = \frac{3}{5}$$

$$P(B/A_5) = \frac{{}^5C_2}{{}^5C_2} = 1.$$

By Baye's theorem,

$$P(A_5/B) = \frac{P(A_5)P(B/A_5)}{P(A_2)P(B/A_2) + P(A_3)P(B/A_3) + P(A_4)P(B/A_4) + P(A_5)P(B/A_5)}$$

$$= \frac{\frac{1}{4} \cdot 1}{\frac{1}{4} [\frac{1}{10} + \frac{3}{10} + \frac{3}{5} + 1]} = \frac{10}{20} = \frac{1}{2}.$$

135. If $\begin{vmatrix} p & q-y & r-z \\ p-x & q & r-z \\ p-x & q-y & r \end{vmatrix} = 0$, then the value of $\frac{p}{x} + \frac{q}{y} + \frac{r}{z}$ is

- (A) 0 (B) 1 (C) 2 (D) 4 pqr

Correct Option: C

Solution:

$$\begin{vmatrix} p & q-y & r-z \\ p-x & q & r-z \\ p-x & q-y & r \end{vmatrix} = 0$$

Apply $R_1 \rightarrow R_1 - R_3$ and $R_2 \rightarrow R_2 - R_3$, we get

$$\begin{vmatrix} x & 0 & -z \\ 0 & y & -z \\ p-x & q-y & r \end{vmatrix} = 0$$

$$\Rightarrow x[yr + z(q-y)] - z[0 - y(p-x)] = 0$$

[Expansion along first row]

$$\Rightarrow xy r + xz q - xzy + yzp - zyx = 0$$

$$\Rightarrow xy r + xz q + yzp = 2xyz \Rightarrow \frac{p}{x} + \frac{q}{y} + \frac{r}{z} = 2$$

136. If $f(x) = \cos^{-1} \left[\frac{1 - (\log x)^2}{1 + (\log x)^2} \right]$ then the value of $f'(e)$ is equal to

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

Correct Option: B

Solution:

$$\text{Let } f(x) = \cos^{-1} \left[\frac{1 - (\log x)^2}{1 + (\log x)^2} \right]$$

Put $\log x = t$ in $f(x)$:

$$\therefore f(x) = \cos^{-1} \left[\frac{1 - t^2}{1 + t^2} \right]$$

Now, put $t = \tan \theta$, we get



$$f(x) = \cos^{-1} \left[\frac{1 - \tan^2 \theta}{1 + \tan^2 \theta} \right]$$

$$= \cos^{-1} [\cos 2\theta] = 2\theta = 2 \tan^{-1} t = 2$$

$$\tan^{-1}(\log x)$$

Diff. both side w.r.t 'x', we get

$$f'(x) = 2 \cdot \frac{1}{1 + (\log x)^2} \cdot \frac{1}{x}$$

Now,

$$f'(e) = 2 \cdot \frac{1}{1 + (\log e)^2} \cdot \frac{1}{e} = \frac{1}{e}$$

$$(\because \log e = 1)$$

137. Let A, B, C be finite sets. Suppose that $n(A) = 10$, $n(B) = 15$, $n(C) = 20$, $n(A \cap B) = 8$ and $n(B \cap C) = 9$. Then the possible value of $n(A \cup B \cup C)$ is

- (A) 26
(B) 27
(C) 28
(D) Any of the three values 26, 27, 28 is possible

Correct Option: D

Solution:

We have

$$n(A \cup B \cup C) = n(A) + n(B) + n(C)$$

$$- n(A \cap B) - n(B \cap C) - n(C \cap A)$$

$$+ n(A \cap B \cap C)$$

$$= 10 + 15 + 20 - 8 - 9 - n(C \cap A)$$

$$+ n(A \cap B \cap C)$$

$$= 28 - \{n(C \cap A) - n(A \cap B \cap C)\} \quad \dots(i)$$

Since $n(C \cap A) \geq n(A \cap B \cap C)$

We have $n(C \cap A) - n(A \cap B \cap C) \geq 0$

From (i) and (ii)

$$n(A \cup B \cup C) \leq 28 \quad \dots(ii)$$

Now, $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$$= 10 + 15 - 8 = 17 \quad \dots(iii)$$

and $n(B \cup C) = n(B) + n(C) - n(B \cap C)$

$$= 15 + 20 - 9 = 26$$

Since, $n(A \cup B \cup C) \geq n(A \cup C)$ and

$n(A \cup B \cup C) \geq n(B \cup C)$, we have

$$n(A \cup B \cup C) \geq 17 \text{ and } n(A \cup B \cup C) \geq 26$$

$$\text{Hence } n(A \cup B \cup C) \geq 26 \quad \dots(iv)$$

From (iii) and (iv) we obtain

$$26 \leq n(A \cup B \cup C) \leq 28 \quad \dots(iv)$$

Also $n(A \cup B \cup C)$ is a positive integer

$$\therefore n(A \cup B \cup C) = 26 \text{ or } 27 \text{ or } 28$$

138. A cylindrical gas container is closed at the top and open at the bottom. If the iron plate of the top is $\frac{5}{4}$ times thick as the plate forming the cylindrical sides, what the ratio of the radius to the height of the cylinder using minimum material for the same capacity is

- (A) $\frac{2}{3}$ (B) $\frac{1}{2}$
(C) $\frac{4}{5}$ (D) $\frac{1}{3}$

Correct Option: C

Solution:

$V = \pi r^2 h = \text{constant}$. If k be the thickness of the sides then that of the top will be $(5/4)k$.

$$\therefore S = (2\pi rh)k + (\pi r^2) \cdot (5/4)k$$

('S' is vol. of material used)

$$\text{or } S = 2\pi rk \cdot \frac{V}{\pi r^2} + \frac{5}{4}\pi r^2 k = k \left(\frac{2V}{r} + \frac{5}{4}\pi r^2 \right)$$

$$\therefore \frac{dS}{dr} = k \left(-\frac{2V}{r^2} + \frac{5}{2}\pi r \right), \therefore r^3 = 4V/5\pi$$

$$\frac{d^2 S}{dr^2} = k \left(\frac{4V}{r^3} + \frac{5}{2}\pi \right), = \frac{15}{2}k\pi = \text{positive}$$

When $r^3 = 4V/5\pi$ or $5\pi r^3 = 4V$

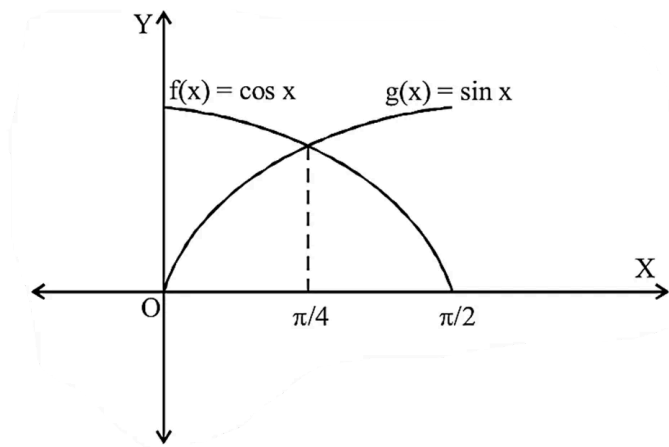
$$\therefore \frac{r}{h} = \frac{4}{5}.$$

139. The area under the curve $y = |\cos x - \sin x|$, $0 \leq x \leq \pi$, and above the x -axis is:

- (A) $2\sqrt{2}$ (B) $2\sqrt{2} - 2$
(C) $2\sqrt{2} + 2$ (D) 0

Correct Option: B**Solution:**

$$y = |\cos x - \sin x|$$



$$\begin{aligned} \text{Required area} &= 2 \int_0^{\pi/4} (\cos x - \sin x) dx \\ &= 2[\sin x + \cos x]_0^{\pi/4} \\ &= 2\left[\frac{2}{\sqrt{2}} - 1\right] = (2\sqrt{2} - 2) \text{ sq. units} \end{aligned}$$

140. The value of

$$\lim_{x \rightarrow \infty} \left(\frac{a_1^{1/x} + a_2^{1/x} + \dots + a_n^{1/x}}{n} \right)^{nx} \quad a_i > 0, i = 1, 2, \dots, n, \text{ is}$$

- (A) $a_1 + a_2 + \dots + a_n$
 (B) $e^{a_1 + a_2 + \dots + a_n}$
 (C) $\frac{a_1 + a_2 + \dots + a_n}{n}$
 (D) $a_1 a_2 a_3 \dots a_n$

Correct Option: D**Solution:**

Putting $x = \frac{1}{y}$, we get

$$L = \lim_{y \rightarrow 0} \left(\frac{a_1^y + a_2^y + \dots + a_n^y}{n} \right)^{n/y}$$

($\because x \rightarrow \infty \Rightarrow y \rightarrow 0$)

$$\begin{aligned} \therefore \log_e L &= \lim_{y \rightarrow 0} \frac{n}{y} \cdot \log_e \frac{1}{n} (a_1^y + a_2^y + \dots + a_n^y) \left(\frac{0}{0} \right) \\ &= n \lim_{y \rightarrow 0} \frac{\left(\frac{a_1^y \log a_1 + a_2^y \log a_2 + \dots + a_n^y \log a_n}{a_1^y + a_2^y + \dots + a_n^y} \right)}{1} \quad [\text{using L'Hopital rule}] \\ &= n \cdot \frac{\log(a_1 a_2 \dots a_n)}{n} \\ \therefore \log L &= \log(a_1 \cdot a_2 \dots a_n) \Rightarrow L = a_1 \cdot a_2 \cdot a_3 \dots a_n \end{aligned}$$

141. If x is a real number, then $\frac{x}{x^2 - 5x + 9}$ must lie between

(A) $\frac{1}{11}$ and 1

(B) -1 and $\frac{1}{11}$

(C) -11 and 1

(D) $-\frac{1}{11}$ and 1

Correct Option: D**Solution:**

$$\text{Let } y = \frac{x}{x^2 - 5x + 9}$$

$$\Rightarrow x^2 y - (5y + 1)x + 9y = 0$$

for real x , Discriminant $= b^2 - 4ac \geq 0$

$$(5y + 1)^2 - 36y^2 \geq 0$$

$$\Rightarrow (5y + 1 - 6y)(5y + 1 + 6y) \geq 0$$

$$\Rightarrow (-y + 1)(11y + 1) \geq 0$$

$$\Rightarrow (y - 1)(11y + 1) \leq 0 \Rightarrow y \in \left[-\frac{1}{11}, 1 \right]$$

142. If $f(x) = x^x$, then $f(x)$ is increasing in interval:

- (A) $[0, e]$
 (B) $[0, \frac{1}{e}]$
 (C) $[0, 1]$
 (D) None of these

Correct Option: B**Solution:**

A function $f(x)$ is said to be increasing function in

$[a, b]$ if $f'(x) > 0$ in $[a, b]$.

Given $f(x) = x^x \dots (i)$

Differentiate equation (i)

$$f'(x) = x^x(1 + \log x)$$

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

$$0 = x^x(1 + \log x)$$

$$\Rightarrow x = 0, \log x = -1 \Rightarrow x = e^{-1}$$

$$\Rightarrow x = \frac{1}{e}, 0$$

Now, in $[0, \frac{1}{e}]$, $f'(x) > 0$

$\therefore f(x)$ is increasing in interval $[0, \frac{1}{e}]$

143. An equilateral triangle is inscribed in the circle $x^2 + y^2 = a^2$ with one of the vertices at $(a, 0)$. What is the equation of the side opposite to this vertex?

(A) $2x - a = 0$

(B) $x + a = 0$

(C) $2x + a = 0$

(D) $3x - 2a = 0$

Correct Option: C**Solution:**

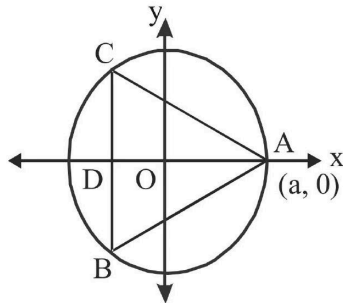
Since the equilateral triangle is inscribed in the circle with centre at the origin, centroid lies on the origin.

$$\text{So, } \frac{AO}{OD} = \frac{2}{1} \Rightarrow OD = \frac{1}{2}AO = \frac{a}{2}$$

So, other vertices of triangle have coordinates,

$$\left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}\right) \text{ and } \left[-\frac{a}{2}, -\frac{\sqrt{3}a}{2}\right]$$

$$\left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}\right)$$



$$\left(-\frac{a}{2}, \frac{\sqrt{3}a}{2}\right)$$

$\therefore$ Equation of line BC is :

$$x = -\frac{a}{2} \Rightarrow 2x + a = 0$$

144. The marks obtained by 60 students in a certain test are given below :

Marks	No. of students	Marks	No. of students
10-20	2	60-70	12
20-30	3	70-80	14
30-40	4	80-90	10
40-50	5	90-100	4
50-60	6		

Median of the above data is

(A) 68.33

(B) 70

(C) 68.11

(D) None of these

Correct Option: A**Solution:**

Class	x_i	f_i	c.f.	$u_i = \frac{x_i - a}{10}$	$f_i u_i$
10-20	15	2	2	-4	-8
20-30	25	3	5	-3	-9

30-40	35	4	9	-2	-8
40-50	45	5	14	-1	-5
50-60	55	6	20	0	0
60-70	65	12	32	1	12
70-80	75	14	46	2	28
80-90	85	10	56	3	30
90-100	95	4	60	4	16
Total		60			56

$$\begin{aligned} \therefore \text{The mean} &= a + \frac{\sum f_i u_i}{\sum f_i} \times h \\ &= 55 + \frac{56}{60} \times 10 = 55 + \frac{56}{6} = 64.333 \end{aligned}$$

Here $n = 60 \Rightarrow \frac{n}{2} = 30$, therefore, 60 – 70 is the median class

Using the formula :

$$\begin{aligned} M &= l + \frac{\frac{n}{2} - C}{f} \times c = 60 + \frac{30 - 20}{12} \times 10 \\ &= 60 + \frac{100}{12} = 60 + 8.333 = 68.333 \end{aligned}$$

145. The integer just greater than $(3 + \sqrt{5})^{2n}$ is divisible by (where $n \in \mathbb{N}$)

(A) 2^{n-1}

(B) 2^{n+1}

(C) 2^{n+2}

(D) Not divisible by 2

Correct Option: B**Solution:**

$$R = (3 + \sqrt{5})^{2n}, G = (3 - \sqrt{5})^{2n}$$

Let $[R] + I = I$ ($\because$ $[.]$ greatest integer function)

$$\Rightarrow R + G = I (\because 0 < G < 1)$$

$$\Rightarrow (3 + \sqrt{5})^{2n} + (3 - \sqrt{5})^{2n} = I$$

seeing the option put $n = 1$

$$I = 28 \text{ is divisible by 4 i.e. } 2^{n+1}$$

146. One mapping is selected at random from all mappings of the set $S = \{1, 2, 3, \dots, n\}$ into itself. The probability that it is one-one is $\frac{3}{32}$. Then the value of n is

(A) 3

(B) 4

(C) 5

(D) 6

Correct Option: B**Solution:**

$$\frac{n!}{n^n} = \frac{3}{32} \Rightarrow \frac{n!}{n^n} = \frac{8 \times 3}{8 \times 32} = \frac{4!}{4^4}$$

$$\therefore n = 4$$

147. Given the system of straight lines $a(2x + y - 3) + b(3x + 2y - 5) = 0$, the line of the system situated farthest from the point $(4, -3)$ has the equation

- (A) $4x + 11y - 15 = 0$ (B) $7x + y - 8 = 0$
(C) $4x + 3y - 7 = 0$ (D) $3x - 4y + 1 = 0$

Correct Option: D

Solution:

The given system of lines passes through the point of intersection of the straight lines

$$2x + y - 3 = 0 \text{ and } 3x + 2y - 5 = 0$$

$[L_1 + \lambda L_2 = 0 \text{ form}]$, which is $(1, 1)$.

The required line will also pass through this point. Further, the line will be farthest from point $(4, -3)$ if it is in direction perpendicular to line joining $(1, 1)$ and $(4, -3)$.

$\therefore$ The equation of the required line is

$$y - 1 = \frac{-1}{\frac{-3-1}{4-1}}(x - 1) \Rightarrow 3x - 4y + 1 = 0$$

148. The length of the semi-latus rectum of an ellipse is one third of its major axis, its eccentricity would be

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

Correct Option: C

Solution:

Let eq. of ellipse be $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, length of semi-latus rectum

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

$$\text{Given } a(1-e^2) = \frac{1}{3}(2a)$$

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

149. If $\sum_{k=1}^n k(k+1)(k-1) = pn^4 + qn^3 + tn^2 + sn$, where p, q, t and s are constants, then the value of s is equal to

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

Correct Option: B

Solution:

$$\begin{aligned} \sum_{k=1}^n k(k+1)(k-1) &= \sum_{k=1}^n k(k^2-1) = \sum_{k=1}^n (k^3-k) \\ &= \left(\frac{n(n+1)}{2}\right)^2 - \frac{n(n+1)}{2} \\ &= \frac{n(n+1)}{2} \left(\frac{n(n+1)}{2} - 1\right) \\ &= \frac{n^2+n}{2} \left(\frac{n^2+n-2}{2}\right) = \frac{n^4+n^3-2n^2+n^3+n^2-2n}{4} \\ &= \frac{n^4}{4} + \frac{n^3}{2} - \frac{n^2}{4} - \frac{n}{2} \Rightarrow s = -\frac{1}{2} \end{aligned}$$

150. If α and β are roots of the equation $x^2 + px + \frac{3p}{4} = 0$ such that $|\alpha - \beta| = \sqrt{10}$, then p belongs to the set:

- (A) $\{2, -5\}$ (B) $\{-3, 2\}$
(C) $\{-2, 5\}$ (D) $\{3, -5\}$

Correct Option: C

Solution:

Given quadratic eqn. is

$$x^2 + px + \frac{3p}{4} = 0$$

$$\text{So, } \alpha + \beta = -p, \alpha\beta = \frac{3p}{4}$$

$$\text{Now, given } |\alpha - \beta| = \sqrt{10} \Rightarrow \alpha - \beta = \pm\sqrt{10}$$

$$\Rightarrow (\alpha - \beta)^2 = 10 \Rightarrow \alpha^2 + \beta^2 - 2\alpha\beta = 10$$

$$\Rightarrow (\alpha + \beta)^2 - 4\alpha\beta = 10$$

$$\Rightarrow p^2 - 4 \times \frac{3p}{4} = 10 \Rightarrow p^2 - 3p - 10 = 0$$

$$\Rightarrow p = -2, 5 \Rightarrow p \in \{-2, 5\}$$

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

Que.	131	132	133	134	135	136	137	138	139	140
Ans.	B	D	C	D	C	B	D	C	B	D
Que.	141	142	143	144	145	146	147	148	149	150
Ans.	D	B	C	A	B	B	D	C	B	C