MENIIT

NEET | IIT-JEE | FOUNDATION

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JEE MAIN-2022

COMPUTER BASED TEST (CBT)

DATE : 25-06-2022 (EVENING SHIFT) | TIME : (3.00 PM to 6.00 PM)

Duration 3 Hours | Max. Marks : 300

QUESTIONS & SOLUTIONS

PART A : PHYSICS

Single Choice Type

This section contains **20 Single choice questions**. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **Only One** is correct.

1. Given below are two statements. One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A: Two identical ball A and B thrown with same velocity 'u' at two different angles with horizontal attained the same range R. If A and B reached the maximum height h_1 and h_2 respectively, then $R = 4\sqrt{h_1h_2}$

Reason R: Product of said heights.

$$h_1h_2 = \left(\frac{u^2\sin^2\theta}{2g}\right).\left(\frac{u^2\cos^2\theta}{2g}\right)$$

Choose the correct answer:

(A) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**.

(C) **A** is true but **R** is false.

(D) **A** is false but **R** is true.

Ans. **A**

Sol. $R_1 = \frac{u^2\sin 2\theta_1}{g} = R_2 = \frac{u^2\sin 2\theta_2}{g}$

$$H_1 = \frac{u^2\sin^2\theta_1}{2g} \qquad = H_2 = \frac{u^2\cos^2\theta_1}{2g}$$

$$H_1H_2 = \frac{u^4\sin^2\theta\cos^2\theta}{2^2g^2}$$

2. Two buses P and Q start from a point at the same time and move in a straight line and their positions are represented by $X_P(t) = at + \beta t^2$ and $X_Q(t) = ft - t^2$. At what time, both the buses have same velocity?

(A) $\frac{\alpha - f}{1+\beta}$ (B) $\frac{\alpha + f}{2(\beta - 1)}$ (C) $\frac{\alpha + f}{2(1+\beta)}$ (D) $\frac{f - \alpha}{2(1+\beta)}$

Ans. **D**

Sol. $V_p = \frac{dX_p}{dt} = \alpha + 2\beta t$

$$V_Q = \frac{dX_Q}{dt} = f - 2t$$

So $V_p = V_Q$

$$\alpha + 2\beta t = f - 2t$$

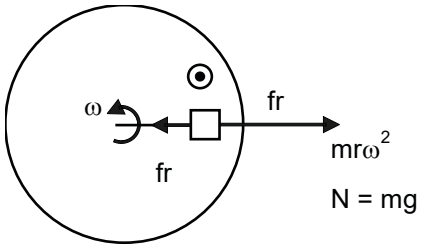
$$t = \frac{f-\alpha}{2(1+\beta)}$$

3. A disc with a flat small bottom beaker placed on it at a distance R from its center is revolving about an axis passing through the center and perpendicular to its plane with an angular velocity ω. The coefficient of statice friction between the bottom of the beaker and the surface of the disc is μ. The beaker will revolve with the disc if:

(A) $R \le \frac{\mu g}{2\omega^2}$ (B) $R \le \frac{\mu g}{\omega^2}$ (C) $R \ge \frac{\mu g}{2\omega^2}$ (D) $R \ge \frac{\mu g}{\omega^2}$

Ans. **B**

Sol. From FBD



for circular motion

$f = m\omega^2 r$

$\mu N \ge m\omega^2 r$

$\mu mg \ge m\omega^2 r$

$r \le \frac{\mu g}{\omega^2}$

4. A solid metallic cube having total surface area $24m^2$ is uniformly heated. If its temperature is increased by 10ºC, calculated the increase in volume of the cube.

(Given $\alpha = 5.0 \times 10^{-4} ºC^{-1}$).

(A) $2.4 \times 10^6\ cm^3$ (B) $1.2 \times 10^5\ cm^3$ (C) $6.0 \times 10^4\ cm^3$ (D) $4.8 \times 10^5\ cm^3$

Ans. **B**

Sol. Given Total surface area $6l^2 = 24 \Rightarrow l = \sqrt{\frac{24}{6}} = 2m$

$$\Delta v = v_0\,\gamma\Delta\theta = l^3(3\alpha)\Delta\theta = 3\times 2^3 \times 5 \times 10^{-4} \times 10 = 12\times 10^{-2} m^3 = 1.2\times 10^5 cm^3$$

5. A copper block of mass 5.0 kg is heated to a temperature of 500ºC and is placed on a large ice block. What is the maximum amount of ice that can melt?

[Specific heat of copper: $0.39 J\ g^{-1}\ ºC^{-1}$ and latent heat of fusion of water: $335\ J\ g^{-1}$]

(A) 1.5kg (B) 5.8kg (C) 2.9kg (D) 3.8kg

Ans. **C**

Sol. Heat given by block = heat received by ice.

$M.S\,(T-O) = M_{ice}.L$

$\therefore \quad M_{ice} = \dfrac{MST}{L} = \dfrac{5\times 500\times 0.39}{335} = 2.9kg$

6. The ratio of specific heats $\left(\dfrac{C_p}{C_v}\right)$ in terms of degree of freedom (f) is given by:

(A) $\left(1+\dfrac{f}{3}\right)$ (B) $\left(1+\dfrac{2}{f}\right)$ (C) $\left(1+\dfrac{f}{2}\right)$ (D) $\left(1+\dfrac{1}{f}\right)$

Ans. **B**

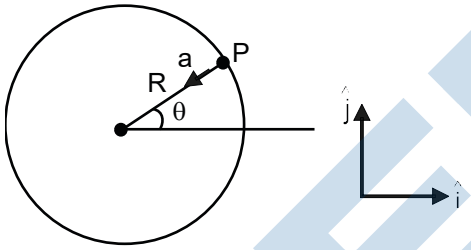
7. For a particle in uniform circular motion. the acceleration $\vec{a}$ at any point P(R,θ) on the circular path of radius R is (when θ is measured from the positive x - axis and v is uniform speed):

(A) $-\dfrac{v^2}{R}\sin\theta\,\hat{i}+\dfrac{v^2}{R}\cos\theta\,\hat{j}$ (B) $-\dfrac{v^2}{R}\cos\theta\,\hat{i}+\dfrac{v^2}{R}\sin\theta\,\hat{j}$

(C) $-\dfrac{v^2}{R}\cos\theta\,\hat{i}-\dfrac{v^2}{R}\sin\theta\,\hat{j}$ (D) $-\dfrac{v^2}{R}\hat{i}+\dfrac{v^2}{R}\hat{j}$

Ans. **C**

Sol.



$a = \dfrac{v^2}{R}$

$\vec{a} = a\cos\theta\left(-\hat{i}\right)+a\sin\theta\left(-\hat{j}\right)$

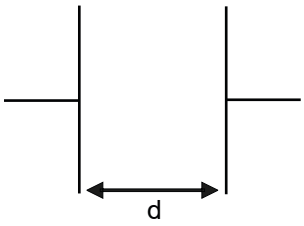
$-\dfrac{v^2}{R}\cos\theta\,\hat{i}-\dfrac{v^2}{R}\sin\theta\,\hat{j}$

8. Two metallic plates from a parallel plate capacitor. The distance between the plate is 'd'. A metal sheet of thickness $\dfrac{d}{2}$ and of area equal to area of each plate is introduced between the plates. What will be the ratio of the new capacitance to the original capacitance of the capacitor?

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

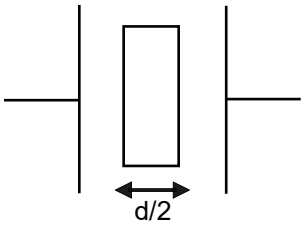
Ans. **A**

Sol. Initial



$$C = \frac{\epsilon_0 A}{d}$$

Final



Final

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

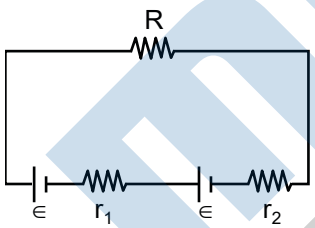
$$\frac{C'}{C} = 2$$

9. Two cells of same emf but different resistance r_1 and r_2 are connected in series with a resistance R. The value of resistance R, for which the potential difference across second cell is zero is:

(A) $r_2 - r_1$ (B) $r_1 - r_2$ (C) r_1 (D) r_2

Ans. **A**

Sol.



$$i = \frac{2\epsilon}{r_1 + r_2 + R}$$

$$\Delta v_2 = \epsilon - ir_2 = 0$$

$$\varepsilon = \frac{2\varepsilon}{r + r_2 + R} \times r_2$$

$$R = r_2 - r_1$$

10. Given below are two statements:

Statement - I : Susceptibilities of paramagnetic and ferromagnetic substances increase with decrease in temperature.

Statement - II : Diamagnetism is a result of orbital motions of electrons developing magnetic moments opposite to the applied magnetic field.

Choose the correct answer from the options given below :–

(A) Both statement –I and statement–II are true.

(B) Both statement –I and statement–II are false.

(C) Statement –I is true but statement–II are false.

(D) Statement –I is false but statement–II are true.

Ans. **A**

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

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

Ans. **A**

Sol. $B = \mu_0 \left(\frac{N}{\ell}\right) I$ .....(i)

$N' = \frac{N}{2}$ $I' = 2I$

$B = \mu_0 \left(\frac{N/2}{\ell}\right) \cdot 2I$; $B' = B$

12. A sinusoidal voltage V(t) = 210 sin 3000 t volt is applied to a series LCR circuit in which L = 10 mH, C = 25 μF and R = 100Ω. The phase different (ϕ) between the applied voltage and resultant current will be:

(A) $\tan^{-1}(0.17)$ (B) $\tan^{-1}(9.46)$ (C) $\tan^{-1}(0.30)$ (D) $\tan^{-1}(13.33)$

Ans. **A**

Sol. $X_C = \frac{1}{\omega C} = \frac{1}{3000 \times 25 \times 10^{-6}} = \frac{40}{3}\Omega$

$X_L = \omega L = 3000 \times 10 \times 10^{-3} = 30\Omega$

$X = X_L - X_C$

$= 30 - \frac{40}{3} = \frac{50}{3}\Omega$

$\tan\phi = \frac{X}{R} = \frac{50/3}{100} = \frac{1}{6}$

$\tan\phi = \frac{1}{6} = 0.17$

13. The electromagnetic waves travel in a medium at a speed of 2.0×10^8 m/s. The relative permittivity of the medium is 1.0. The relative permittivity of the medium will be:

(A) 2.25 (B) 4.25 (C) 6.25 (D) 8.25

Ans. **A**

Sol. $\frac{1}{\sqrt{\mu_\varepsilon}} = 2\times10^8 = \frac{1}{\sqrt{\mu_r\varepsilon_r}\sqrt{\mu_0\varepsilon_0}} = \frac{3\times10^8}{\sqrt{\varepsilon_r}}$

$\varepsilon_r = 9/4$

14. The interference pattern is obtained with two coherent light source of intensity ration 4 : 1 And the ratio $\frac{I_{max}+I_{min}}{I_{max}-I_{min}}$ is $\frac{5}{x}$. Then. the value of x will be equal to:

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

Ans. **B**

Sol. $\frac{I_1}{I_2} = \frac{4}{1} \Rightarrow \frac{A_1}{A_2} = \frac{2}{1}$

$\frac{(A)_{max}}{(A)_{min}} = \frac{2+1}{2-1} = \frac{3}{1}$

$\frac{(I)_{max}}{(I)_{min}} = \left(\frac{3}{1}\right)^2 = \frac{9}{1}$

$\frac{(I)_{max}+(I)_{min}}{(I)_{max}-(I)_{min}} = \frac{9+1}{9-1} = \frac{10}{8} = \frac{5}{4}$

So, $x = 4$

15. A light whose electric field vectors are completely removed by using a good polaroid, allowed to incident on the surface of the prism at Brewster's angle.

Choose the most suitable option for the phenomenon related to the prism.

(A) Reflected and refracted ray will be perpendicular to each other.

(B) Wave will propagate along the surface of prism.

(C) No refraction. And there will be total reflection of light.

(D) No refection. And there will be total transmission of light.

Ans. **D**

16. A proton, a neutron, an electron and an a– particle have same energy. If λ_p, λ_n, λ_e and λ_a are the be Broglie's wavelength of proton, neutron, electron and a particle respectively. then choose the correct relation from the following:

(A) $\lambda_p = \lambda_n > \lambda_e > \lambda_a$ (B) $\lambda_a < \lambda_n < \lambda_p < \lambda_e$ (C) $\lambda_e < \lambda_p = \lambda_n > \lambda_a$ (D) $\lambda_e = \lambda_p = \lambda_n = \lambda_a$

Ans. **B**

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

$\lambda \propto \frac{1}{\sqrt{m}}$

Let mass of electron = m_e

Let mass of Proton = m

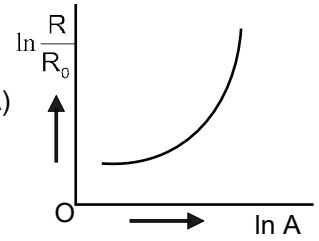
Let mass of Neutron = 2m

Let mass of α Particle = 4m

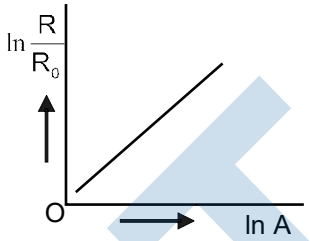
and $m_e < m$

17. Which of the following figure represents the variation of $\ln\left(\frac{R}{R_0}\right)$ with $\ln A$ (if R = radius of a nucleus and A = its mass number)

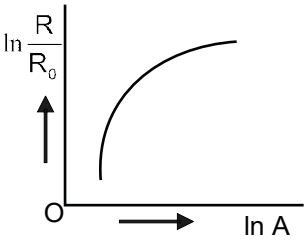
(A)



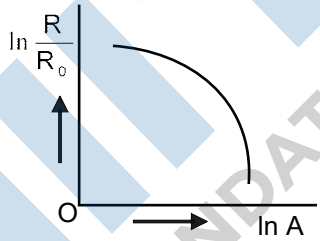
(B)



(C)



(D)



Ans. **B**

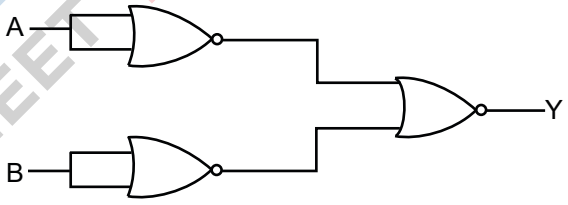
Sol. $R = R_0A^{1/3}$

$$\frac{R}{R_0} = A^{1/3} \quad \Rightarrow \quad \log\left(\frac{R}{R_0}\right) = \frac{1}{3}\log(A)$$

$y = mx$

$$\text{slope} = \frac{1}{3}$$

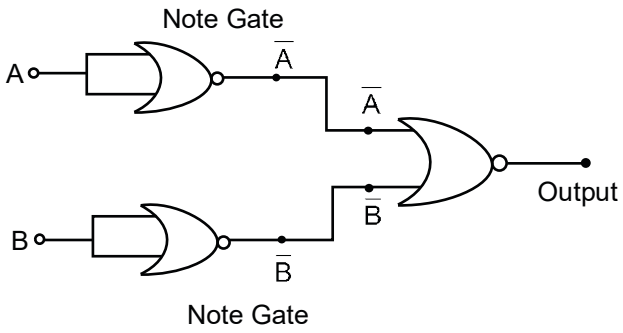
18. Identify the logic operation performed by the given circuit:



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

Ans. **A**

Sol.



$$\text{Output} = \overline{\overline{A} + \overline{B}}$$

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

$$= A \cdot B$$

19. Match List I with List II

List I	List II
(A) Facsimile	I. Static Document Image
(B) Guided media Channel	II. Local Broadcast Ratio
(C) Frequency Modulation	III. Rectangular wave
(D) Digital Signal	IV. Optical Fiber

Choose the correct answer from the following options:

(A) A–IV, B–III, CII, D–I (B) A–I, B–IV, CII, D–III

(C) A–IV, B–II, CIII, D–I (D) A–I, B–II, CIII, D–IV

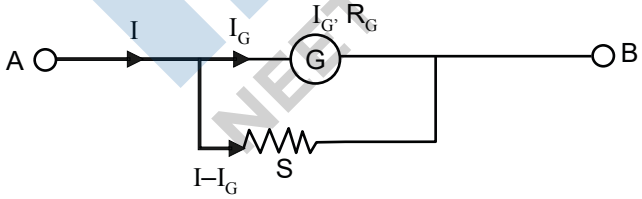
Ans. **B**

20. If n represents the actual number of deflections in a converted galvanometer of resistance G and shunt resistance S. Then the total current I when its figure of merit is K will be:

(A) $\frac{KS}{(S+G)}$ (B) $\left(\frac{G+S}{nKS}\right)$ (C) $\frac{nKS}{(G+S)}$ (D) $\frac{nKS(G+S)}{S}$

Ans. **D**

Sol.



Given figure of merit $K = \frac{I_g}{n}$

$$I = \frac{I_g(R_g + S)}{s}$$

$$I = \frac{nk(G+S)}{s}$$

Numeric Value Type

This Section contains **10 Numeric Value Type question**, out of 10 only 5 have to be done.

21. For $z = a^2x^3y^{1/2}$, where 'a' is a constant. If percentage error in measurement of 'x' and 'y' are 4% and 12%. respectively, then the percentage error for 'z' will be_____%

Ans **18.00**

Sol. $R = a^2x^3y^{1/2}$

$$\left|\frac{\Delta R}{R}\right|_{max.} \times 100 = 3\left(\frac{\Delta x}{x}\times 100\right) + \frac{1}{2}\left(\frac{\Delta y}{y}\right)\times 100$$

$$= 3.(4) + \frac{1}{2}\times(12)$$

= 12 + 6 = 18%

22. A curved in a level road has a radius 75m. The maximum speed of a car turning this curved road can be 30m/s without skidding. If radius of curved road is changed to 48m and the coefficient of friction between the tyres and the road remains same, then maximum allowed speed would be _____ m/s.

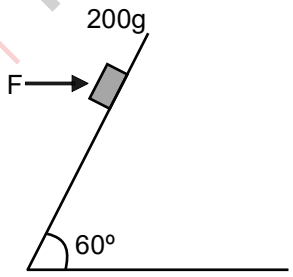
Ans. **24.00**

Sol. $\tan\theta = \frac{v^2}{Rg}$, then $v \propto \sqrt{r}$

$$\frac{v_2}{v_1} = \frac{\sqrt{r_2}}{\sqrt{r_1}} = \sqrt{\frac{48}{75}}$$

$$v_2 = \frac{4}{5}\times 30 = 24 m/s$$

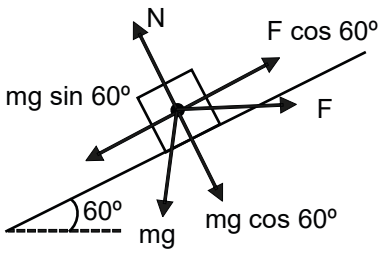
23. A block of mass 200g is kept stationary on a smooth inclined plane by applying a minimum horizontal force $F = \sqrt{xN}$ as shown in figure.



The value of x = _____.

Ans. **12.00**

Sol.



A long surface

$F\cos 60^\circ = mg\sin 60^\circ$

$F = mg\tan 60^\circ$

$200\times 10\times\sqrt{3}\times 10^{-3} = 2\sqrt{3} = \sqrt{12}N$

24. Moment of Inertia (M.I.) of four bodies having same mass 'M' and radius '2R' are as follow:

I_1 = M.I. of solid sphere about its diameter

I_2 = M.I. of solid cylinder about its axis

I_3 = M.I. of solid circular disc about its diameter

I_4 = M.I. of thin circular ring about its diameter

If $2(I_2 + I_3) + I_4 = x \cdot I_1$ then the value if χ will be_____

Ans. **05.00**

Sol. $2(I_2 + I_3) + I_4 = x.\ I_1$

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

$$2MR^2 = \times\left[\frac{2}{5}MR^2\right]$$

$x = 5$

25. Two satellites S_1 and S_2 are revolving in circular orbits a planet with radius R_1 = 3200Km and R_2 = 800Km respectively. The ratio of speed of satellite S_1 and S_2 in their respective orbits would be $\frac{1}{x}$ where x =

Ans. **2.00**

Sol. $v \propto \frac{1}{\sqrt{R}}$

$$\frac{v_1}{v_2} = \sqrt{\frac{R_2}{R_1}} = \sqrt{\frac{800}{3200}} = \frac{1}{2}$$

26. When a gas filled in a closed vessel is heated by raising the temperature by 1°C its pressure increases by 0.4%. The initial temperature of the gas is _____ K.

Ans. **250**

Sol. Given $\Delta T = 1, \Delta P = 0.4\%$

$P \propto T$

$\frac{\Delta P}{P} = \frac{\Delta T}{T}$

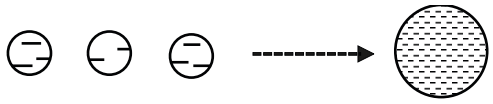
$0.4 = \frac{1 \times 100}{T}$

$T = 250$

27. 27 identical drops are charged at 22V each. They combine to from a bigger drop. The potential of the bigger drop will be_____ V.

Ans. **198**

Sol.



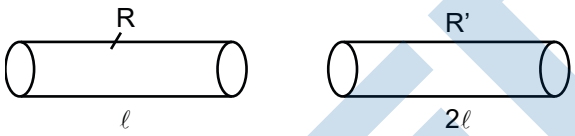
$R = (27)^{1/3} r = 3r$

$V = \frac{KQ}{R} = \frac{K(27q)}{3r} = 9 \times v = 9 \times 22 = 198 \text{ Volt}$

28. The length of a given cylindrical wire is increased to double of its original length. The percentage increase in the resistance of the wire will be_____%

Ans. **300**

Sol.

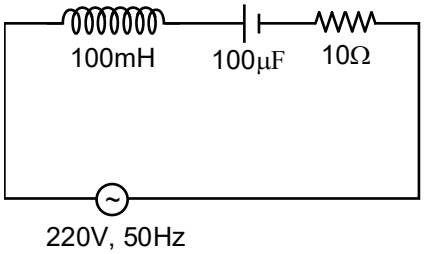


$R' = n^2 R$

$R' = 4R$

$\% \text{ change} = \left(\frac{R' - R}{R}\right) \times 100 = \left(\frac{4R - R}{R}\right) \times 100 = 300\%$

29. In a series LCR circuit the inductance, capacitance and resistance are L = 100 mH, C = 100 μF and R = 10Ω respectively. They are connected to an AC source of voltage 220V and frequency of 50 Hz. The approximate value of current in the circuit will be_____ A.



Ans. **22.00**

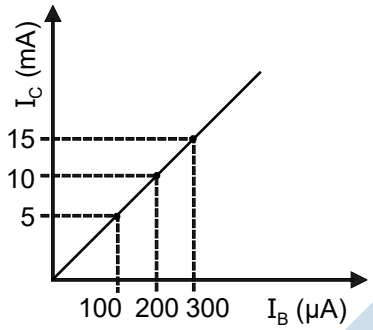
Sol. $X_C = \frac{1}{\omega C} = \frac{1}{2\pi \times 50 \times 100 \times 10^{-6}} = \frac{100}{\pi} = 10\pi\Omega$

$X_L = \omega L = 2\pi \times 50 \times 100 \times 10^{-3} = 10\pi\Omega$

$$X = X_C - X_L = 10\pi - 10\pi = 0$$

$$\text{Current} = i = \frac{V}{Z} = \frac{V}{\sqrt{R^2+x^2}} = \frac{220}{10} = 22A$$

30. In an experiment of CE configuration of n–p–n transistor. the transfer characteristics are observed as given in figure.



If the input resistance is 220Ω and output resistance is 60Ω, the voltage gain in this experiment will be_____.

Ans. **15.00**

Sol. $$\beta_{AC} = \frac{\Delta i_C}{\Delta i_B} = \frac{5\times10^{-3}}{100\times10^{-6}} = 50$$

$$A_V = \beta_{AC} = \frac{R_{out}}{R_{in}} = (50)\left(\frac{60}{200}\right) = 15$$

PART B : CHEMISTRY

Single Choice Type

This section contains **20 Single choice questions**. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **Only One** is correct.

1. The minimum energy that must be possessed by photons in order to produce the photoelectric effect with platinum metal is:

[Given : The threshold frequency of platinum is $1.3\times10^{15}\,s^{-1}$ and $h = 6.6\times10^{-34}\,J\,s$]

(A) 3.21×10^{-14} J (B) 6.24×10^{-16} J (C) 8.58×10^{-19} J (D) 9.76×10^{-20} J

Ans **(C)**

Sol. $E = E_0 + KE$

For minimum energy $E = E_0$

$$E = \left(\frac{hc}{\lambda}\right) = hv$$

$$= 6.6\times10^{-34}\times1.3\times10^{+15}$$

$= 8.58 \times 10^{-19}$ J

2. At 25°C and 1 atm pressure, the enthalpy of combustion of benzene (I) and acetylene (g) are – 3268 KJ mol^{-1}, and –1300KJmol^{-1}, respectively. The change in enthalpy for the reaction $3C_2H_2(g) \rightarrow C_6H_6(I)$, is

(A) +324 kJ mol^{-1} (B) +632 kJ mol^{-1} (C) – 632 kJ mol^{-1} (D) –732 kJ mol^{-1}

Ans **(C)**

Sol. $\Delta H_r = (\Delta H_C)_{reactant} - (\Delta H_C)_{product}$

$= 3[\Delta H_C(C_2H_2, g)] - [\Delta H_C(C_6H_6, \ell)]$

$= 3 \times (-1300) - (-3268)$

$= -3900 + 3268 = -632$ kJ/mole

3. Solute A associates in water. When 0.7g of solute A is dissolved in 42.0g of water. It depresses the freezing point by 0.2°C. The percentage association of solute A in water, is:

[Given : Molar mass of A = 93g mol^{-1}. Molal depression constant of water is 1.86 K Kg mol^{-1}.]

(A) 50% (B) 60% (C) 70% (D) 80%

Ans **(D)**

Sol. $\Delta T_f = i[K_f \times m]$

$$2.0 = i\left[1.86\times\frac{7\times1000}{93\times42}\right]$$

$2.0 = i[3.33]$

$i = 0.6$

$$i = 1 + \left[\frac{1}{n} - 1\right]\beta$$

$$0.6 = 1 + \left[\frac{1}{2} - 1\right]\beta$$

b = 0.8

$\%\beta = 80$

4. The K_{sp} for bismuth sulphide (Bi_2S_3) is 1.08×10^{-73}. The solubility of (Bi_2S_3) in mol L^{-1} at 298 K is

(A) 1.0×10^{-15} (B) 2.7×10^{-12} (C) 3.2×10^{-10} (D) 4.2×10^{-8}

Ans **(A)**

Sol. $Bi_2S_3(s) \rightleftharpoons 2Bi^{3} + 3S^{2-}$

$2S \quad 3S$

$K_{SP}(Bi_2S_3) = (2S)^2 (3S)^3$

$= (2)^2 (3)^3 (S)^5$

$1.08 \times 10^{-73} = 4 \times 27 (S)^5$

$108 \times 10^{-75} = 108 (S)^5$

$S = 1 \times 10^{-15}$

5. Match List I with List II.

List I	List II
A. Zymase	I. Stomach
B. Diastase	II. Yeast
C. Urease	III. Malt
D. Pepsin	IV. Soyabean

Choose the correct answer from the options given below:–

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

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

Ans. **(B)**

6. The correct order of electron gain enthalpies of Cl, F, Te and Po is

(A) 1.0×10^{-15} (B) 2.7×10^{-12} (C) 3.2×10^{-10} (D) 4.2×10^{-8}

Ans **(B)**

Sol.

Element	Electron Gain Enthalpies ($kJmol^{-1}$)
F	–328

Cl	–349
Te	–190
Po	–174

7. Given the below are two statements.

Statement I : During electrolytic refining, blister copper deposits precious metals.

Statement II : In the process of obtaining pure copper by electrolysis method, copper blister is used to make the anode.

In the light of the above statement, Choose the correct answer from the options given below.

(A) Both Statement I and Statement II are **true.**

(B) Both Statement I and Statement II are **false.**

(C) Statement I is **true** but Statement II are **false.**

(D) Statement I is **false** but Statement II are **true.**

Ans **(A)**

Sol. Impure Cu obtained from ores is converted to pure Cu in an electrolyte cell that the impure copper as the anode an pure copper as the cathode. The electrolyte is an aqueous solution of $CuSO_4$. At the impure Cu anode, Cu is oxidized along with the more easily oxidized metallic impurities such as Zn and Fe. The less easily oxidized impurities such as Ag, Au, and Pt fall to the bottom of the cell as anode mud, which is reprocessed to recover the precious metals. At the pure Cu cathode, Cu^{2+} ions get reduced to pure copper metal

Anode (oxidation) : $M(S) \rightarrow M^2 + (aq) + 2e^- \quad (M = Cu, Zn, Fe)$

Cathode (reduction) : $Cu^{2+}(aq) + 2e^- \rightarrow Cu(S)$

Thus, the cell reaction simply involves transfer of Cu metal from the impure anode to the pure cathode, Cu obtained by this process is 99.95% pure.

8. Given below are two Statement one is labelled as **Assertion A** and the other is labelled as **Reason R**:

Assertion A : The amphoteric nature of water is explained by using Lewis acid/base concept.

Reason R: Water acts as an acid with NH_3 and as a base with H_2S.

In the light of the above statement choose the **correct** answer from the options given below:

(A) Both **A** and **R** are true and **R** is the correct explanation of **A.**

(B) Both **A** and **R** are true but **R** Is **NOT** the correct explanation of **A**.

(C) **A** is true but **R** is false.

(D) **A** is false but **R** is true.

Ans **(D)**

Sol. According to Lewis concept water act as Base.

9. The correct order of reduction potentials of the following pairs is

(A) Cl_2 / Cl^- (B) I_2 / I^- (C) Ag^+ / Ag (D) Na^+ / Na

(E) Li^+ / Li

Choose the correct answer from the options given below.

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

Ans **(A)**

Sol. $E^0_{Cl_2/Cl^-} = 1.36V$

$E^0_{I_2/I^-} = +0.54V$

$E^0_{Ag^+/Ag} = +0.80V$

$E^0_{Na^+/Na} = -2.71V$

$E^0_{Li^+/Li} = -3.50V$

10. The number of bridged oxygen atoms present in compound B formed from the following reactions is

$$Pb(NO_3)_2 \xrightarrow{673} A + PbO + O_2$$

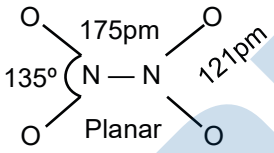
$$A \xrightarrow{\text{Dimerise}} B$$

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

Ans **(A)**

Sol. $2Pb(NO_3)_2 \xrightarrow[673k]{\Delta} 2PbO + 4NO_2 + O_2$

$$2NO_2 \xrightarrow{\text{Dimerisation}} N_2O_4$$



11. The metal ion (in gaseous state) with lowest spin–only magnetic moment values is :

(A) V^{2+} (B) Ni^{2+} (C) Cr^{2+} (D) Fe^{2+}

Ans **(B)**

Sol.

	Ion	Electronic Configuration	No. of unpaired electron
(1)	Cr^{2+}	$3d^4$	4
(2)	V^{2+}	$3d^3$	3
(3)	Fe^{2+}	$3d^6$	4
(4)	Ni^{2+}	$3d^8$	2

Less is no. of unpaired electron less is magnetic moment (Spin only).

12. Given below are two statements; One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A : Polluted water may have a value of BOD of the order of 17 ppm.

Reason R : BOD is a measure of oxygen required to oxidise both the bio–degradable organic material in water.

In the light of the above statements. Choose the **most appropriate** answer from the options given below.

(A) Both **A** and **R** are correct and R is the correct explanation of **A.**

(B) Both **A** and **R** are correct but R is Not the correct expatiation of **A**.

(C) **A** is correct but **R** is not correct.

(D) **A** is not correct but **R** is correct.

Ans **(C)**

Sol. The amount of BOD in the water is a measure of the amount of organic material in the water, in terms of how much oxygen will be required to break it down biologically. Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

13. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A : A mixture contains benzoic acid and napthalene. The pure benzoic acid can be separated out by the use of benzene.

Reason R : Benzoic acid is soluble in hot water.

In the light of the above statement. Choose the **most appropriate** answer from the options given below:

(A) Both **A** and **R** are true and **R** is the correct explanation of **A**.

(B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A.**

(C) **A** is true but **R** is false.

(D) **A** is false But **R** is true.

Ans **(D)**

Sol. Aromatic acids are insoluble in water but soluble in aqueous $NaHCO_3$ solution or NaOH solution, due to salt formation.

14. During halogen test, sodium fusion extract is boiled with concentrated HNO_3 to

(A) remove unreacted sodium

(B) decompose cyanide or sulphide of sodium

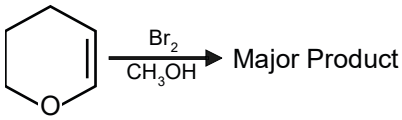
(C) extract halogen from organic compound

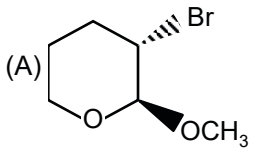
(D) maintain the pH of extract.

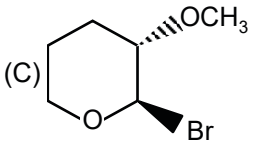
Ans **(B)**

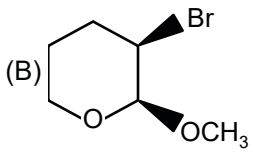
Sol. The sodium fusion extract is first boiled with concentrated nitric acid to decompose cyanide or sulphide of sodium formed during Lassaigne's test. These ions would otherwise interfere with silver nitrate test for halogens.

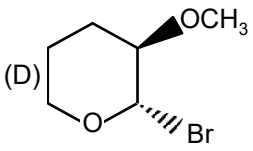
15. Amongst the following, the major product of the given chemical reaction is



(A) 

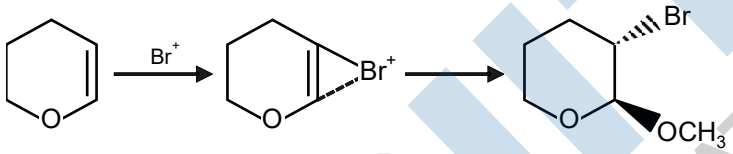
(C) 

(B) 

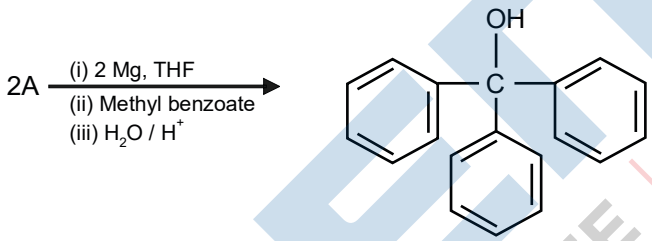
(D) 

Ans **(A)**

Sol. The reaction proceed via cyclic bromonium ion with anti–addition mechanism.



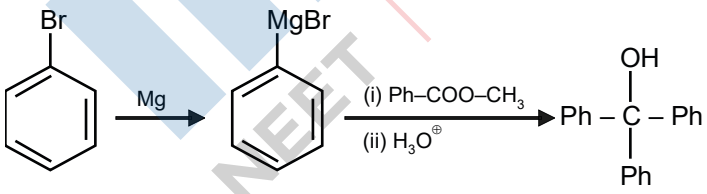
16. In the given reaction



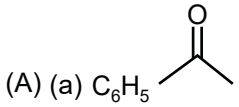
'A' can be

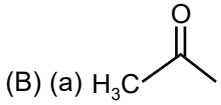
(A) benzyl bromide (B) bromobenzene (C) cyclohexyl bromide (D) methyl bromide

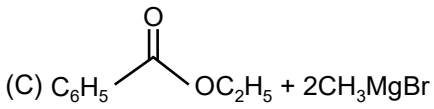
Ans **(B)**

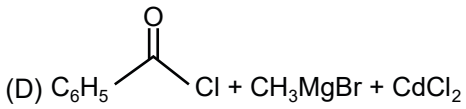
Sol. 

17. Which of the following conditions or reaction sequence will **NOT** give acetophenone as the major product?

(A) (a)  (b) $Na_2Cr_2O_7$, H^+

(B) (a)  (b) PCC, DCM

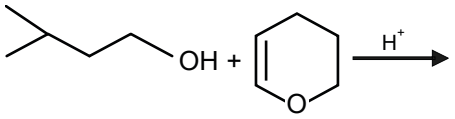
(C) 

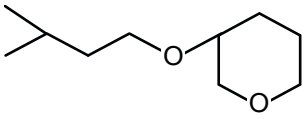
(D) 

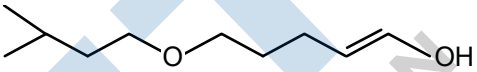
Ans **(C)**

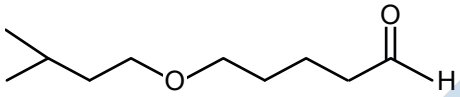
Sol. $Ph-COO-C_2H_5+CH_3MgBr \longrightarrow PhCOCH_3 \xrightarrow{CH_3MgBr} PhC(CH_3)_2OH$

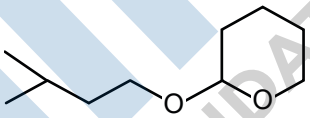
18. The major product formed in the following rection, is



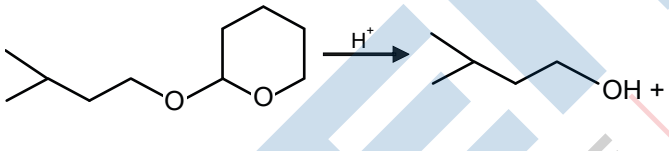
(A) 

(B) 

(C) 

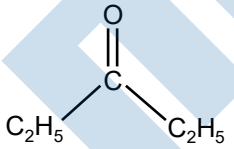
(D) 

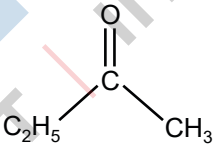
Ans. **(D)**

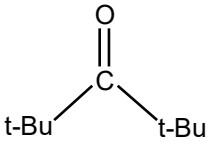
Sol. 

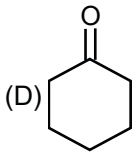
19. Which of the following Ketone will **NOT** give enamine on treatment with secondary amines?

[where t-Bu is $C(CH_3)_3$]

(A) 

(B) 

(C) 

(D) 

Ans **(C)**

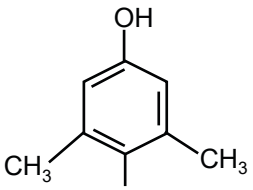
Sol. t-Bu –  – t-Bu neither has α H, as well as sterically crowded for any nucleophilic attack by 2° amine.

20. An antiseptic dettol is a mixture of two compound for any 'A' and 'B' where A has 6π electrons and B 2π electrons. What is 'B'?

(A) Bithionol (B) Terpineol (C) Chloroxylenol (D) Chloramphenicol

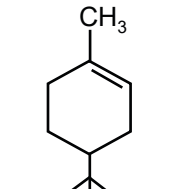
Ans **(B)**

Sol.



Chloroxylenol

and



Terpineol

Numeric Value Type

This Section contains **10 Numeric Value Type question**, out of 10 only 5 have to be done.

21. A protein 'A' contains 0.30% of glycine (molecular weight 75). The minimum molar mass of the protein 'A' is _____ $\times 10^3$ g mol^{-1}

Ans **(25)**

Sol. % of glycine $= \left[\frac{75 \times 1}{GMM}\right] \times 100 = 0.3$

$$GMM = \left[\frac{75 \times 100}{0.3}\right] = 25 \times 10^3$$

22. A rigid nitrogen tank stored inside a laboratory has a pressure of 30atm at 06.00am when the temperature is 27ºC. At 03.00 pm. When the temperature is 45ºC, the pressure in the tank will be _____ atm.

Ans **(32)**

Sol. At Constant volume and mole

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

$$\frac{30}{300} = \frac{P_2}{318}$$

$$P_2 = \left(\frac{30}{300}\right) \times 318 = 31.8 \approx 32$$

23. Amongst BeF_2, BF_3, H_2O, NH_3, CCl_4 and HCl, the number of molecules with non–zero dipole moment is _____.

Ans **(3)**

Sol. Polar molecules = H_2O, NH_3, HCl

Non–Polar molecules = BeF_2, BF_3, CCl_4

24. At 345 K, the half life for the decomposition of a sample of a gaseous compound initially at 55.5 KPa was 340s. When the pressure was 27.8 KPa, the half life was found to be 170s. The order of the reaction is _____.

Ans **(0)**

Sol. $\frac{(t_{1/2})_1}{(t_{1/2})_2} = \left(\frac{P_1}{P_2}\right)^{1-n} \Rightarrow \frac{340}{170} = \left(\frac{55.5}{27.8}\right)^{1-n}$

$(2)^1 = (2)^{1-n}$

$1 = 1 - n \Rightarrow n = 0$

25. A solution of $Fe_2(SO_4)_3$ is electrolyzed for 'x' min with a current of 1.5 A to deposit 0.3482g Fe. The value of X is _____.

Given : 1F = 96500 C mol^{-1}

Atomic mass of Fe = 56g mol^{-1}

Ans **(20)**

Sol. $Fe_2(SO_4)_3 \longrightarrow 2Fe\mathbb{S}$

$W = Zit$

$W = \left(\frac{E}{96500}\right)it$

$0.3482 = \left(\frac{56}{3 \times 96500}\right) \times 1.5 \times t$

$t = 1200$ sec = 20 min

26. Consider the following reactions :

$PCl_3 + H_2O \longrightarrow A + HCl$

$A + H_2O \longrightarrow B + HCl$

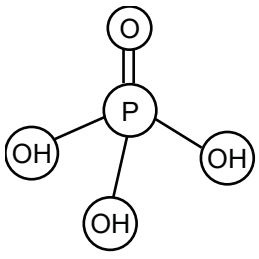
The number of ionisable protons presents in the product B is _____.

Ans **(2)**

Sol. $PCl_5H_2O \longrightarrow POCl_3 + 2HCl$

$POCl_3\,3H_2O \longrightarrow H_3PO_4 + 3HCl$

No. of ionisable hydrogen =3



H_3PO_4

Orthophosphoric acid

27. Amongst $FeCl_3$, $3H_2OK_3$, $K_3[Fe(CN)_6]$ and $[Co(NH_3)_6]Cl_3$, the spin–only magnetic moment value of the inner–orbital complex that absorbs light at shortest wavelength is _____ B.M

Ans **(2)**

Sol.

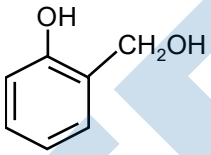
	Complex	EC	Hybridisation	No. of unpaired e^-
(i)	$FeCl_3.3H_2O$	$Fe^{3+} = 3d^5$	sp^3d^2	5
(ii)	$K_3[Fe(CN)_6]$	$Fe^{3+} = 3d^5$	d^2sp^3	1
(iii)	$[Co(NH_3)_6]^{3+}$	$Co^{3+} = 3d^6$	d^2sp^3	0

CN^- is strong ligand than NH_3 so splitting in $K_3[Fe(CN)_6$ is higher and it absorb light of shortest wave length]

μ (spine only) $= \sqrt{n(n/2)} = \sqrt{3} = 1.73BM \approx 2BM$

28. The Novolac polymer has mass of 963g. The number of monomer units present in it are :

Ans **(9)**

Sol. Monomer of NOVOLAC is  with molar mass 124.

Let there is no. of monomer unit, therefore in Novalac formation (n–1) unit of water is removed.

or $n \times 124 = 963 + (n - 1) \times 18$

$n = 9$.

29. How many of the given compounds will give a positive Biuret test _____?

Glycine, Glycylalanine, Tripeptide, Biuret.

Ans **(2)**

Sol. Tripeptide, only species with peptide bond give biureate test.

30. The neutralization occurs when 10mL of 0.1M acid 'A' is allowed to react with 30mL of 0.05 m base $M(OH)_2$. The basicity of the acid 'A' is_____.

[M is a metal]

Ans **(3)**

Sol. Let basicity of acid is x

$A + M(OH)_2 \rightarrow$ salt + water

At complete neturization.

Milli eq. of acid = Milli eq. of base

$n[0.1 \times 10] = 2[0.05 \times 30]$

$n = 3$

PART C : MATHEMATICS

Single Choice Type

This section contains **20 Single choice questions**. Each question has 4 choices (A), (B), (C) and (D) for its answer, out of which **Only One** is correct.

1. Let $A = \{x \in R : |x + 1| < 2\}$ and $B = \{x \in R : |x - 1| \geq 2\}$. Then which one the following statements is **NOT** true?

(A) $A - B = (-1, 1)$ (B) $B - A = R - (-3, 1)$ (C) $A \cap B = (-3, -1]$ (D) $A \cup B = R - [1, 3)$

Ans **(B)**

Sol. $|x+1| < 2 \Rightarrow -2 < x+1 < 2 \Rightarrow x \in (-3, 1) = A$

$|x+1| \geq 2 \Rightarrow x-1 \leq -2 \cup x-1 \geq 2$

$\Rightarrow x \leq -1 \cup x \geq 3 \Rightarrow x \in (-\infty, -1] \cup [3, \infty)$

$A = (-3, 1)$ $B = (-\infty, -1] \cup [3, \infty)$

$A' = (-\infty, -3] \cup [1, \infty)$ $B' = (-1, 3)$

$A - B = A \cap B' = (-1, 1)$

$B - A = A' \cap B' = (-\infty -3] \cup [3, \infty)$

$A \cup B = (-\infty, 1] \cup [3, \infty)$

$A \cup B = (-3 -1]$

2. Let $a, b \in R$ be such that the equation $ax^2 - 2bx + 15 = 0$ has a repeated root α. If α and β are the roots of the equation $x^2 - 2bx + 21 = 0$, then $\alpha^2 + \beta^2$ is equal to:

(A) 37 (B) 58 (C) 68 (D) 92

Ans **(B)**

Sol. Equation

$ax^2 - 2bx + 15 = 0$ $\begin{matrix}\alpha \\ \alpha\end{matrix}$

Sum of root $\alpha + \alpha = \frac{2b}{a} \Rightarrow \alpha = b/a$

Product of root $\alpha.\alpha = \frac{15}{a} \Rightarrow a = \frac{15}{\alpha^2}$

Since roots are repeated $\Rightarrow D = 0$

$\Rightarrow 4b^2 - 4a \cdot 15 = \Rightarrow b^2 = 15a = \frac{15^a}{\alpha^2} \Rightarrow b = \pm\frac{15}{a}$

Equation

$x^2 - 2bx + 21 = 0 \begin{matrix} \nearrow \alpha \\ \searrow \beta \end{matrix}$

Sum of root $\alpha + \beta = 2b,$

Product of root $\alpha\beta = 21$

$\alpha + \frac{21}{\alpha} = 2\left(\frac{15}{\alpha}\right) \Rightarrow \alpha^2 = 9 \Rightarrow a = \pm 3$

$\Rightarrow \beta = \pm 7$

The value of

$\alpha^2 + \beta^2 = 9 + 49 = 58$

3. Let z_1 and z_2 be two complex numbers such that $\bar{z}_1 = i\bar{z}_2$ and $\arg\left(\frac{z_1}{z_2}\right) = \pi$. Then

(A) $\arg z_2 = \frac{\pi}{4}$ (B) $\arg z_2 = \frac{3\pi}{4}$ (C) $\arg z_1 = \frac{\pi}{4}$ (D) $\arg z_1 = \frac{3\pi}{4}$

Ans **(C)**

Sol. $\arg\left(\frac{z_1}{z_2}\right) = \pi \Rightarrow \arg z_1 - \arg\bar{z}_2 = \pi$

$\Rightarrow \arg z_1 + \arg z_2 = \pi$ ... (1)

$\because \bar{z}_1 + i\bar{z}_2 \Rightarrow z_1 = -iz_2$

$\Rightarrow \arg z_1 = \arg(-iz_2)$

$\Rightarrow \arg z_1 = \arg(-i) + \arg z_2$

$\Rightarrow \arg z_1 - \arg z_2 = -\frac{\pi}{2}$ .... (2)

$\text{from}(1)\text{and}(2)\arg z_1 = \frac{\pi}{4}\text{and}\arg z_2 = \frac{3\pi}{4}$

4. The system of equation

$-kx + 3y + 14z = 25$

$-15x + 4y - kz = 3$

$-4x + y + 3z = 4$

is consistent for all k in the set

(A) $\mathbb{R}$ (B) $\mathbb{R} - \{-11, 13\}$ (C) $\mathbb{R} - \{13\}$ (D) $\mathbb{R} - \{-11, 11\}$

Ans **(D)**

Sol. $\begin{vmatrix} -k & 3 & -14 \\ -15 & 4 & -k \\ -4 & 1 & 3 \end{vmatrix} \neq 0$

$= k^2 + 121 \neq 0 \Rightarrow k \neq \pm 11$

$= R - \{-11, 11\}$

5. $\lim\limits_{x \to \frac{\pi}{2}} \left(\tan^2 x \left(\left(2\sin^2 x + 3\sin x + 4\right)^{\frac{1}{2}} - \left(\sin^2 x + 6\sin x + 2\right)^{\frac{1}{2}} \right) \right)$ is equal to

(A) $\frac{1}{12}$ (B) $-\frac{1}{18}$ (C) $-\frac{1}{12}$ (D) $\frac{3}{4}$

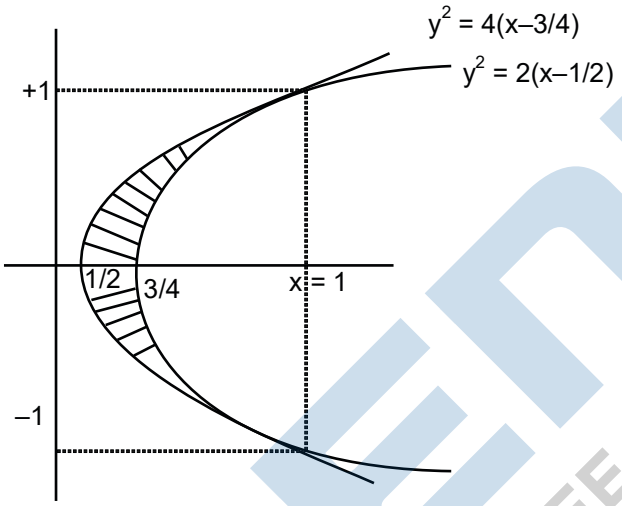
Ans **(A)**

6. The area of the region enclosed between the parabolas $y^2 - 2x - 1$ and $y^2 = 4x - 3$ its :

(A) $\frac{1}{3}$ (B) $\frac{1}{6}$ (C) $\frac{2}{3}$ (D) $\frac{3}{4}$

Ans **(A)**

Sol.



When $y^2 = 2x - 1$

$y^2 = 4x - 3$

$4x - 3 = 2x - 1$

$x = 1,\ y = \pm 1$

Point of intersection are (1,1), (1, –1)

Required area $= \int_{-1}^{1} (x_1 - x_2)dy = \int_{-1}^{1} \left(\frac{y^2 + 3}{4} - \frac{y^2 + 1}{2} \right) dy = \int_{-1}^{1} \left(\frac{-y^2 + 1}{4} \right) dy$

$$= \frac{1}{4}\left(\frac{-y^3}{3} + y \right)_{-1}^{1} = \frac{1}{4}\left(\left(1 - \frac{1}{3}\right) - \left(\frac{1}{3} - 1\right) \right) = \frac{1}{3}$$

7. The coefficient of x^{101} in the expression :

$(5 + x)^{500} + x(5 + x)^{499} + x^2(5 + x)^{498} + \ldots\ldots\ldots + x^{500}$, $x > 0$, is

(A) ${}^{501}C_{101}(5)^{399}$ (B) ${}^{501}C_{101}(5)^{400}$ (C) ${}^{501}C_{100}(5)^{400}$ (D) ${}^{500}C_{101}(5)^{399}$

Ans **(A)**

Sol. $(5+x)^{500}\dfrac{\left(1-\left(\dfrac{x}{5+x}\right)^{501}\right)}{1-\dfrac{x}{5+x}}$

$(5+x)^{501}\dfrac{\left(1-\dfrac{x^{501}}{(5+x)^{501}}\right)}{5}$

$\dfrac{1}{5}\left[(5+x)^{501}-x^{501}\right]$

Coefficient of x^{101} is $\dfrac{1}{5}\times {}^{501}C_{101}5^{400} = {}^{501}C_{101}5^{399}$

8. The sum $1 + 2 \cdot 3 + 3 \cdot 3^2 + \ldots\ldots + 10 \cdot 3^9$ is equal to :

(A) $\dfrac{2\cdot 3^{12}+10}{4}$ (B) $\dfrac{19\cdot 3^{10}+1}{4}$ (C) $5 \cdot 3^{10} - 2$ (D) $\dfrac{19\cdot 3^{10}+1}{2}$

Ans **(B)**

Sol. $1+2\cdot 3^1+3.3^2+4\cdot 3^3+\ldots\ldots\ldots+10\cdot 3^9$

$3S_n = 1\cdot 3^1+2\cdot 3^2+3\cdot 3^2+\ldots\ldots\ldots\ldots+10\cdot 3^{10}$

$-2S_n = 1+3+3^2+\ldots\ldots\ldots\ldots+3^9-10.3^{10}$

$=\dfrac{1\left(3^{10}-1\right)}{3-1}-10\cdot 3^{10}$

$=\dfrac{1}{2}.3^{10}-\dfrac{1}{2}-3^{10}\cdot 10$

$-2S_n = -\dfrac{1}{2}-\dfrac{19}{2}\cdot 3^{10}$

$S_n = -\dfrac{19}{4}3^{10}+\dfrac{1}{4}$

9. Let P be the plane passing through the intersection of the planes $\vec{r}\cdot\left(\hat{i}+3\hat{j}-\hat{k}\right)=5$ and $\vec{r}\cdot\left(2\hat{i}-\hat{j}+\hat{k}\right)=3$, and the point (2, 1, –2). Let the position vectors of the points X and Y be, $\hat{i}-2\hat{j}+4\hat{k}$ and $5\hat{i}-\hat{j}+2\hat{k}$ respectively. Then the points

(A) X and X + Y are on the same side of P. (B) Y and Y – X on the opposite side of P.

(C) X and Y are on the opposite sides of P. (D) X + Y And X – Y are on the same side of p.

Ans **(C)**

10. A circle touches both they y–axis and the line x + y = 0. Then the locus of its center

(A) $y=\sqrt{2}x$ (B) $x=\sqrt{2}x$ (C) $y^2-x^2=\sqrt{2}x$ (D) $x^2-y^2=\sqrt{2}x$

Ans **(D)**

Sol. Let center of circle be C(h, k)

$\because$ circle touches y – axis $\Rightarrow$ radius = |h|

$\because$ circle touches x – y = 0

$$\Rightarrow \frac{|h-k|}{\sqrt{2}} = |h|$$

$$\Rightarrow (h-k)^2 = 2h^2$$

$$\Rightarrow h^2 + k^2 - 2hk = 2h^2$$

$$\Rightarrow h^2 + 2hk - k^2 = 0$$

Locus of $\Rightarrow (h, k) \rightarrow x^2 + 2xy - y^2 = 0$

11. Water is being filled at the rate of $1cm^3$ / sec in a right circular conical vessel (vertex downwords) of height 35cm and diameter 14cm. When the height of the water level is 10cm. the rate (in cm^2 / sec) at which the wet conical surface area of the vessel increase is

(A) 5 (B) $\frac{\sqrt{21}}{5}$ (C) $\frac{\sqrt{26}}{5}$ (D) $\frac{\sqrt{26}}{10}$

Ans **(C)**

12. If $b_n = \int_0^{\frac{\pi}{2}} \frac{\cos^2 nx}{\sin x} dx$, $n \in \square$, then

(A) $b_3 - b_2$, $b_4 - b_3$, $b_5 - b_4$ are in an A.P. with common difference –2

(B) $\frac{1}{b_3 - b_2}, \frac{1}{b_4 - b_3}, \frac{1}{b_5 - b_4}$ are in an A.P. with common difference 2

(C) $b_3 - b_2$, $b_4 - b_3$, $b_5 - b_4$ are in G.P.

(D) $\frac{1}{b_3 - b_2}, \frac{1}{b_4 - b_3}, \frac{1}{b_5 - b_4}$ are in an A.P. with common difference –2

Ans **(D)**

Sol. $$b_n - b_{n-1} = \int_0^{\frac{\pi}{2}} \frac{\cos^2 nx - \cos^2 (n-1)x}{\sin x} = \int_0^{\frac{\pi}{2}} \frac{\sin(2n-1)x \sin(-x)}{\sin x}$$

$$= -\int_0^{\frac{\pi}{2}} \sin(2n-1)x \, dx = \frac{1}{2n-1}\left[\cos(2n-1)x\right]_0^{\frac{\pi}{2}} = -\frac{1}{2n-1}$$

$$b_n - b_{n-1} = -\frac{1}{2n-1}$$

$$\frac{1}{b_n - b_{n-1}} = -(2n-1)$$

$$\frac{1}{b_3 - b_2} = -5, \quad \frac{1}{b_4 - b_3} = -7, \quad \frac{1}{b_5 - b_4} = -9$$

Common difference = –2

13. If y = y(x) is the solution of the differential equation $2x^2\frac{dy}{dx}-2xy+3y^2=0$ such that $y(e)=\frac{e}{3}$, then y(1) is equal to

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

Ans **(B)**

Sol. $2x^2\frac{dy}{dx}-2xy+3y^2=0$

$\frac{1}{y^2}\frac{dy}{dx}-\frac{1}{xy}+\frac{3}{2x^2}=0$

Let $\frac{1}{y}=t$

Difference of

$-\frac{1}{y^2}\frac{dy}{dx}=\frac{dt}{dx}$

$-\frac{dy}{dx}-\frac{1}{x}t+\frac{3}{2x^2}=0$

$\frac{dy}{dx}+\frac{1}{x}t+\frac{3}{2x^2}$

$I.F.=e^{\int\frac{1}{x}dx}=x$

$x.t.=\int x.\frac{3}{2x^2}dx$

$x.t.=\frac{3}{2}\ell nx+c$

$x=e,\ y=e/3$

$\frac{e}{e/3}=\frac{3}{2}.1+c$

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

$\frac{x}{y}=\frac{3}{2}\ell nx+\frac{3}{2}$

$\Rightarrow x=1$

$\Rightarrow \frac{1}{y}=\frac{3}{2}$

y = 2/3

14. If the angle made by the tangent at the point (x_0, y_0) on the carve $x = 12(t + \sin t \cos t)$, $y = 12(1+\sin t)^2, 0 < t < \frac{\pi}{2}$, with the positive x–axis is $\frac{\pi}{3}$, then y_0 is equal to:

(A) $6\left(3+2\sqrt{2}\right)$ (B) $3\left(7+4\sqrt{3}\right)$ (C) 27 (D) 48

Ans **(C)**

15. The value of 2sin(12°) – sin(72°) is :

(A) $\frac{\sqrt{5}\left(1-\sqrt{3}\right)}{4}$ (B) $\frac{1-\sqrt{5}}{8}$ (C) $\frac{\sqrt{3}\left(1-\sqrt{5}\right)}{2}$ (D) $\frac{\sqrt{3}\left(1-\sqrt{5}\right)}{4}$

Ans **(D)**

Sol. $2\left(\sin\left(72^\circ - 60\right)\right) - \sin 72^\circ$

$2\left(\sin 72^\circ \frac{1}{2} - \cos 72^\circ . \frac{\sqrt{3}}{2}\right) - \sin 72^\circ$

$-\sqrt{3}\cos\left(72^\circ\right)$

$-\sqrt{3}\sin\left(18^\circ\right) = -\sqrt{3}\left(\frac{\sqrt{5}-1}{4}\right) = \sqrt{3}\left(\frac{1-\sqrt{5}}{4}\right)$

16. A biased die is marked with number 2, 4, 8, 16, 32, 32 on its faces and the probability of getting a face with mark n is $\frac{1}{n}$. If the die is thrown thrice, then the probability, that the sum of the number obtained is 48, is:

(A) $\frac{7}{2^{11}}$ (B) $\frac{7}{2^{12}}$ (C) $\frac{3}{2^{10}}$ (D) $\frac{13}{2^{12}}$

Ans **(D)**

Sol. Given $P(n) = \frac{1}{n}$

Favourable Cases (16, 16, 16), (32, 8, 8), (8, 32, 8), (8, 32, 8), (8, 8, 32)

Prob = $\left(\frac{1}{16}\times\frac{1}{16}\times\frac{1}{16}\right) + 3\times\left(\frac{1}{8}\times\frac{1}{8}\times\frac{1}{32}\right) = \frac{1}{2^{12}} + \frac{3}{2^{11}} = \frac{7}{2^{12}}$

17. The negation of the Boolean expression $((\sim q) \wedge p) \Rightarrow ((\sim p) \vee q)$ is logically equivalent to:

(A) $p \Rightarrow q$ (B) $q \Rightarrow p$ (C) $\sim (p \Rightarrow q)$ (D) $\sim (q \Rightarrow p)$

Ans **(C)**

Sol. $(p \wedge \square q) \wedge (p \vee \square q)$

$= (p \wedge \square q)$

$= \square (p \rightarrow q)$

18. If the line $y = 4 + kx$, $k > 0$, is the tangent to the parabola $y = x - x^2$ at the point P and V is the vertex of the parabola, then the slope of the line through P and V is:

(A) $\frac{3}{2}$ (B) $\frac{26}{9}$ (C) $\frac{5}{2}$ (D) $\frac{23}{6}$

Ans **(C)**

Sol. $y = kx + 4$

$y = x - x^2$

$kx + 4 = x - x^2$ .....(1)

$x^2 + (k-1)x + 4 = 0$

$k - 1 = \pm 4$

If $k = 5$

now put the value of $k = 5$

$5x + 4 = x - x^2$

$x^2 + 4x + 4 = 0$

$(x+2)^2 = 0$

$x = -2$

$y = -6$

If $k = -3$

now put the value of $k = -3$ in equation (1)

$-3x + 4 = x - x^2$

$x^2 - 4x + 4 = 0$

$x = 2y = -2$

then the point of P is $(2,-2)$ and $(-2,-6)$

and vertex of parabola $'O' = y - \frac{1}{4} = -\frac{1}{4} + x - x^2$

$y - \frac{1}{4} = -\left(x - \frac{1}{2}\right)^2$

point P is $(2,-2)$

slope of $OP = \frac{-2 - \frac{1}{4}}{2 - \frac{1}{2}} = -\frac{9}{3 \times 2} = -\frac{3}{2}$

point P is $(-2,-6)$ slope of $OP \frac{-6 - \frac{1}{4}}{2 - \frac{1}{2}} = \frac{5}{2}$

19. The value of $\tan^{-1}\left(\frac{\cos\left(\frac{15\pi}{4}\right)-1}{\sin\left(\frac{\pi}{4}\right)}\right)$ is equal to :

(A) $-\frac{\pi}{4}$ (B) $-\frac{\pi}{8}$ (C) $-\frac{15\pi}{12}$ (D) $-\frac{4\pi}{9}$

Ans **(B)**

Sol. $\tan^{-1}\left(\frac{\frac{1}{\sqrt{2}}-1}{\frac{1}{\sqrt{2}}}\right)=\tan^{-1}\left(1-\sqrt{2}\right)=-\tan^{-1}\left(\sqrt{2}-1\right)=-\frac{\pi}{8}$

20. The line y = x + 1 meets the ellipse $\frac{x^2}{4}+\frac{y^2}{2}=1$ at two points P and Q. If r is the radius of the circle with PQ as diameter then $(3r)^2$ is equal to :

(A) 20 (B) 12 (C) 11 (D) 8

Ans **(A)**

Sol. $\frac{x^2}{4}+\frac{(x+1)^2}{2}=1$

$x^2+2(x+1)^2=4$

$3x^2+4x-2=0$

$(x_1-x_2)=\sqrt{(x_1+x_2)^2-4x_1x_2}$

$=\sqrt{\frac{16}{9}+\frac{8}{3}}$

$=\sqrt{\frac{40}{9}}$

also $(y_1-y_2)=|x_1-x_2|=\sqrt{\frac{40}{9}}$

radius $=\frac{1}{2}\sqrt{(x_1-x_2)^2+(y_1-y_2)^2}$

$=\frac{1}{2}\sqrt{2\times\frac{40}{9}}$

$=\frac{1}{2}\frac{\sqrt{80}}{3}$

$r=\frac{\sqrt{80}}{6}$

$(3r)^2=9r^2=9\times\frac{80}{36}=20$

Numeric Value Type

This Section contains **10 Numeric Value Type question**, out of 10 only 5 have to be done.

21. Let $A = \begin{pmatrix} 2 & -2 \\ 1 & -1 \end{pmatrix}$ and $\begin{pmatrix} -1 & 2 \\ -1 & 2 \end{pmatrix}$. Then the number of elements in the

Set {(n, m) : n, m $\in$ {1, 2, ……., 10} and $nA^n + mB^m = I$} is _____.

Ans **(1)**

22. Let f(x) = $[2x^2 + 1]$ and $g(x) = \begin{cases} 2x-3, & x<0 \\ 2x+3, & x \geq 0 \end{cases}$, where [t] is the greatest integer $\leq$ t. Then in the open interval (–1, 1) the number of points where fog is discontinuous is equal to_____.

Ans **62**

23. The value of b > 3 for which $12\int_3^b \frac{1}{(x^2-1)(x^2-4)}dx = \log_e\left(\frac{49}{40}\right)$, is equal to_____.

Ans **6**

24. if the sum of the co–efficients of all the positive even power of x in the binomial expression of $\left(2x^3 + \frac{3}{x}\right)^{10}$ is $15^{10} - \beta \cdot 3^9$, then β is equal to _____.

Ans **83**

25. If the mean deviation about the mean of the number 1, 2, 3, ……. n where n is odd, is $\frac{5(n+1)}{n}$, then n is equal to _____.

Ans **21**

Sol. $\bar{x} = \frac{1+2+3+.....+n}{n} = \frac{\frac{n(n+1)}{2}}{n} = \frac{n+1}{2}$ (Which is middle term)

$M.D. = \frac{\sum|x_i - \bar{x}|}{n} = \frac{5(n+1)}{n}$

$\Rightarrow \frac{2\left(1+2+3+...+\frac{(n-1)}{2}\right)}{n} = \frac{5(n+1)}{n}$

$\Rightarrow \frac{2.\left(\frac{(n-1)}{2}\left(\frac{(n-1)}{2}+1\right)\right)}{2} = \frac{5(n+1)}{n}$

$\Rightarrow \frac{(n-1)(n+1)}{4n} = \frac{5(n-1)}{n}$

n = 21

26. Let $\vec{b} = \hat{i} + \hat{j} + \lambda\hat{k}, \lambda \in \square$. If $\vec{a}$ is a vector such that $\vec{a} \times \vec{b} = 13\hat{i} - \hat{j} - 4\hat{k}$ and $\vec{a} \cdot \vec{b} + 21 = 0$, then $(\vec{b} - \vec{a}) \cdot (\hat{k} - \hat{j}) + (\vec{b} + \vec{a}) \cdot (\hat{i} - \hat{k})$ is equal to

Ans **14**

27. The total number of three– digit number, with one digit repeated exactly two times, is _____.

Ans **243**

28. Let $f(x) = |(x-1)(x^2-2x-3)| + x - 3$, $x \in \square$. If m and M are respectively the number of points of local minimum and local maximum of f in the interval $(0,4)$, then m + M is equal to_____.

Ans **3**

29. Let the eccentricity of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ be $\frac{5}{4}$. If the equation of the normal at the point $\left(\frac{8}{\sqrt{5}},\frac{12}{5}\right)$ on the hyperbola is $8\sqrt{5}x+\beta y=\lambda$, then $\lambda-\beta$ is equal to _____.

Ans **85**

30. Let ℓ_1 be the line in xy–plane with x and y intercepts $\frac{1}{8}$ and $\frac{1}{4\sqrt{2}}$ respectively. and ℓ_2 be the line in zx–plane with x and z intercepts $-\frac{1}{8}$ and $-\frac{1}{6\sqrt{3}}$ respectively. If d is the shortest distance between the line ℓ_1 and ℓ_2, then d^{-2} is equal to _____.

Ans **51**