MENIIT

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# JEE MAIN-2022

## COMPUTER BASED TEST (CBT)

DATE : 29-06-2022 (MORNING SHIFT) | TIME : (9.00 AM to 12.00 PM)

Duration 3 Hours | Max. Marks : 300

# QUESTIONS & SOLUTIONS

**PART : PHYSICS**

**1.** Two balls A and B are placed at the top of 180 m tall tower. Ball A is released from the top at t = 0 s. Ball B is thrown vertically down with an initial velocity 'u' at t = 2 s. After a certain time, both meet 100m above the ground. Find the value of 'u' in $ms^{-1}$.
[use g = 10 $ms^{-2}$] :

**Question:**

(A) 10 (B) 15 (C) 20 (D) 30

**Ans** **(D)**

**Sol.** For ball A, $s = 4t + \frac{1}{2}at^2$

$80 = 0 + \frac{1}{2}(10)t^2 \Rightarrow t = 4\,\text{sec}.$

For ball B, $S = 4t + \frac{1}{2}at^2$

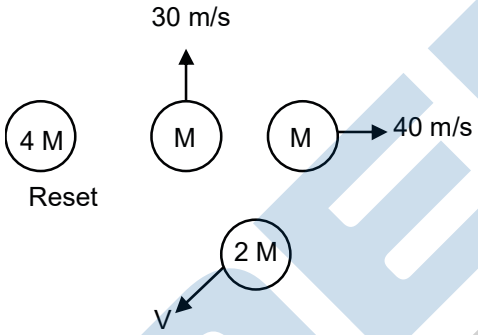
$80 = 4(2) + \frac{1}{2}(10)(2)^2 \Rightarrow 4 = 30\text{m/sec}$

**2.** A body of mass M at rest explodes into three pieces, in the ratio of masses 1 : 1 : 2. Two smaller pieces fly off perpendicular to each other with velocities of 30 $ms^{-1}$ and 40 $ms^{-1}$ respectively. The velocity of the third piece will be:

(A) 15 $ms^{-1}$ (B) 25 $ms^{-1}$ (C) 35 $ms^{-1}$ (D) 50 $ms^{-1}$

**Ans** **(B)**

**Sol.**




$(M\times 30)^2 + (M\times 40)^2 = (2M\times V)^2$

$M\times 50 = 2M\times V$

$V = 25\,\text{m/s}$

**3.** The activity of a radioactive material is $2.56\times10^{-3}$ Ci. If the half life of material is 5 days, after how many days the activity will become $2\times10^{-5}$ Ci?

(A) 30 days (B) 35 days (C) 40 days (D) 25 days

**Ans** **(B)**

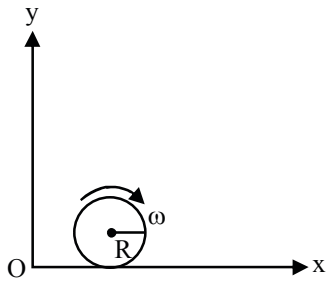
**Sol.**

$R = R_0e^{-\lambda t} = \frac{R_0}{2^{t/t_{\frac{1}{2}}}}$

$2\times10^{-5} = \frac{2.56\times10^{-3}}{2^{t/t_{\frac{1}{2}}}}$

$$\frac{t}{t\frac{1}{2}} = 7; t = 7 \times 5 = 35 \text{ days}$$

**4.** A spherical shell of 1 kg mass and radius R is rolling with angular speed $\omega$ on horizontal plane (as shown in figure). The magnitude of angular momentum of the shell about the Origin O is $\frac{a}{3}R^2\omega$. The value of a will be:




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

**Ans** **(C)**

**Sol.** $L = mvR + I_{cm}\omega$

$= mvR^2 + 2/3\omega R^2\omega$

$L = \frac{5}{3}mR^2\omega$

**5.** A cylinder of fixed capacity of 44.8 liters contains helium gas at standard temperature and pressure. The amount of heat needed to raise the temperature of gas in the cylinder by 20.0°C will be :
(Given gas constant R = 8.3 $JK^{-1}$-$mol^{-1}$)
(A) 249J (B) 415J (C) 498J (D) 830J

**Ans** **(C)**

**Sol.** At STP, $n = \frac{44.8}{22.4} = 2\text{moles}$

$$Q = nC_v\Delta T = (2)\left(\frac{3}{2}R\right)(20) = 3 \times 8.3 \times 20 = 498J$$

**6.** A wire of length T is hanging from a fixed support. The length changes to $L_1$ and $L_2$ When masses 1 kg and 2 kg are suspended respectively from its free end. Then the value of L is equal to:

(A) $\sqrt{L_1L_2}$ (B) $\frac{L_1+L_2}{2}$ (C) $2L_1 - L_2$ (D) $3L_1 - 2L_2$

**Ans** **(C)**

**Sol.** $1 = k(L_1 - L)$

$2 = k(L_2 - L)$

$2 = \frac{L_2 - L}{L_1 - L}$

$2L_1 - 2L = L_2 - L$

$L = 2L_1 - L_2$

**7.** Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R:**
**Assertion A:** The photoelectric effect does not takes place, if the energy of the incident radiation is less than the work function of a metal.

**Reason R:** Kinetic energy of the photoelectrons is zero, if the energy of the incident radiation is equal to the work function of a metal.

In the light of the above statement, 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 explanation of **A**

(C) **A** is correct bur **R** is not correct

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

**Ans** **(B)**

**Sol.** If hv < $\psi$, then the electron will not be able to cross the barrier of work function

**8.** A particle of mass 500 gm is moving in a straight line with velocity $v = bx^{5/2}$. The work done by the net force during its displacement from $\chi = 0$ to $\chi = 4$ m is : (Take b = 0.25$m^{-3/2}s^{-1}$).

(A) 2J (B) 4J (C) 8J (D) 16J

**Ans** **(D)**

**Sol.** $w = \frac{1}{2}mV_f^2 - \frac{1}{2}mv_1 2$

$= \frac{1}{2} \times 0.5 \times \left[0.25 \times 4^5 - 0.25 \times 0^5\right] = 16\,\text{Joule}$

**9.** A charge particle moves along circular path in a uniform magnetic field in a cyclotron. The kinetic energy of the charge particle increases to 4 times its initial value. What will be the ratio of new radius to the original radius of circular path of the charge particle :

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

**Ans** **(C)**

**Sol.** $R = \frac{mv}{qB} = \frac{\sqrt{2m(kE)}}{qB} \Rightarrow R \propto \sqrt{KE}\ ;\ \frac{R_2}{R_1} = \sqrt{\frac{KE_2}{KE_1}} = \frac{2}{1}$

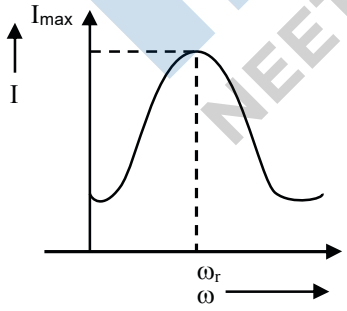
**10.** For a series LCR circuit, I vs $\omega$ curve is shown:

(A) To the left of $\omega_r$ , the circuit is mainly capacitive.

(B) To the left of $\omega_r$ , the circuit is mainly inductive.

(C) At $\omega_r$ , impedance of the circuit is equal to the resistance of the circuit.

(D) At $\omega_r$ , impedance of the circuit is 0.




Choose the most appropriate answer from the option given below.

**Question:**

(A) (a) and (d) only

(B) (b) and (d) only

(C) (a) and (c) only

(D) (b) and (c) only

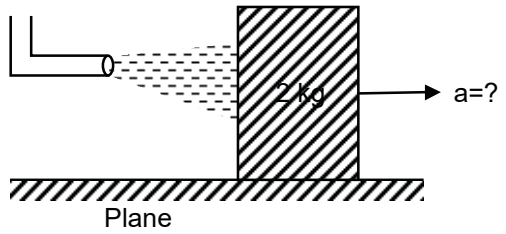
**Ans** **(C)**

**Sol.**

If $\omega < \omega_r, \frac{1}{C\omega} > L\omega$, So the circuit will be capacitive

At $\omega = \omega_r, |Z| = R,$

**11.** A block of metal weighting 2 kg is resting on a frictionless plane (as shown in figure ). It is struck by a jet releasing water at a rate of 1 $kg^{-1}$ and at a speed of 10 $ms^{-1}$ Then, the initial acceleration of the block, in $ms^{-2}$, will be:




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

**Ans (C)**

**Sol.** $F = dt / dt = vdm / dt = 10 \times 1$

Acc. $F / M = 10 / 2 = 5m / s^2$

**12.** In the dar wall equation $\left[P + \frac{a}{V^2}\right][V - b] = RT;$ P is pressure, V is volume, R is universal gas constant and T is temperature. The ratio of constants $\frac{a}{b}$ is dimensionally equal to:

(A) $\frac{P}{V}$ (B) $\frac{V}{P}$ (C) PV (D) $PV^3$

**Ans (C)**

**Sol.** $[p] = \frac{[a]}{V^2} \text{and} [b] = [V]$

$\frac{[a]}{[b]} = \frac{PV^2}{V} = PV$

**13.** Two vector $\vec{A}$ and $\vec{B}$ have equal magnitudes. If magnitude pf $\vec{A} + \vec{B}$ is equal to two times the magnitude of $\vec{A} - \vec{B}$, then the angle between $\vec{A}$ and $\vec{B}$ will be:

(A) $\sin^{-1}\left(\frac{3}{5}\right)$ (B) $\sin^{-1}\left(\frac{1}{3}\right)$ (C) $\cos^{-1}\left(\frac{3}{5}\right)$ (D) $\cos^{-1}\left(\frac{1}{3}\right)$

**Ans (C)**

**Sol.** $|\vec{A} + \vec{B}| = 2|\vec{A} - \vec{B}|$

$\sqrt{A^2 + B^2 + 2AB\cos\theta} = 2\sqrt{A^2 + B^2 - 2AB\cos\theta}$

$A^2 + B^2 + 2AB\cos\theta = 4\left(A^2 + B^2 - 2AB\cos\theta\right)$

$10AB\cos\theta = 3A^2 + 3B^2$

$\cos\theta = \frac{3\left(A^2 + B^2\right)}{10A.B} = \frac{3 + 2A^2}{10 \times A^2} = \frac{6}{10} = \frac{3}{5}$

$\theta = \cos^{-1}(3/5)$

**14.** The escape velocity of a body on a planet 'A' is 12 $Kms^{-1}$. The escape velocity of the body on another plan 'B', whose density is four times and radius is half of the planet 'A', is :

(A) 12 $kms^{-1}$ (B) 24 $kms^{-1}$ (C) 36 $kms^{-1}$ (D) 6 $kms^{-1}$

**Ans** **(A)**

**Sol.** $V_e = \sqrt{\frac{2GM}{R}} = \sqrt{\frac{2G(\rho)\left(\frac{4}{3}\pi R^2\right)}{R}}$

$V_e \propto R\sqrt{\rho} \propto \frac{1}{2}\sqrt{4} = \text{same}$

**15.** At a certain place the angle of dip is 30° and the horizontal component of each's magnetic field is 0.5G. The each's total magnetic field (in G), at that certain place, is:

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

**Ans** **(A)**

**Sol.** $B_E \cos\delta = B_H$

$B_E \cos 30^\circ = 0.5G \Rightarrow B_e = \frac{1}{\sqrt{3}}G$

**16.** A longitudinal wave is represented by $x = 10\sin 2\pi\left(nt - \frac{x}{\lambda}\right)$ cm. The maximum particle velocity will be four times the wave velocity if the determined values of wavelength is equal to:

(A) $2\pi$ (B) $5\pi$ (C) $\pi$ (D) $\frac{5\pi}{2}$

**Ans** **(B)**

**Sol.** $V_{P\max} = 4\,V_{wave}$

$10 \times \omega = 4 \times 6\lambda$

$10 \times 2\pi f = 4 \times f\lambda \; ; \; \lambda = 5\pi$

17. A parallel plate capacitor filled with a medium of dielectric constant 10, is connected across a battery and is charged. The dielectric slab is replaced by another slab of dielectric constant 15. Then the energy of capacitor will:

(A) increase by 50% (B) decrease by 15%

(C) increase by 25% (D) increase by 33%

**Ans** **(A)**

**Sol.** $U_i = \frac{1}{2}(k_1 C)V^2$

$U_f = \frac{1}{2}(k_2 C)V^2$

$\Delta U = U_f - U_i = \frac{1}{2}(k_2 - k_1)CV^2$

$\frac{\Delta U}{U_1} = \frac{\frac{1}{2} \times 5 \times CV^2}{\frac{1}{2} \times 10 \times CV^2} = \frac{1}{2} \; ; \; \frac{\Delta U}{U_i} \times 100 = 50\%$

18. A positive charge particle of 100 mg is thrown in opposite direction to a uniform electric field of strength $1 \times 10^5 NC^{-1}$. If the change on the particle is 40 $\mu C$ and the initial velocity is $200ms^{-1}$, how much distance it will travel before coming to the rest momentarily:

(A) 1 m (B) 5 m (C) 10 m (D) 0.5 m

**Ans** **(D)**

**Sol.** $a = \frac{qE}{m} = \frac{40\times10^{-6}\times10^{5}}{100\times10^{-6}} = 4\times\times10^{4}$

$v^2 = u^2 + 2as \Rightarrow 0^2 = (200)^2 + 2\left(-4\times10^{4}\right)(s)$

$(s) = 0.5m$

**19.** Using Young's double slit experiment, a monochromatic light of wavelength 5000 $\mathring{A}$ produces fringes of fringe width 0.5 mm. If another monochromatic light of wavelength 6000 $\mathring{A}$ is used and the separation between the slits is doubled, then the new fringe width will be:

**Question**

(A) 0.5 mm (B) 1.0 mm (C) 0.6 mm (D) 0.3 mm

**Ans** **(D)**

**Sol.** $\beta = \frac{\lambda D}{d}$ $\beta = \frac{\lambda D}{2d}$

$\frac{\beta'}{\beta} = \frac{\lambda'}{\lambda\times2} = \frac{6}{5\times2}$

$\frac{\beta'}{\beta} = 0.5 = \frac{6}{10} = 0.3mm$

**20.** Only 2% of the optical source frequency is the available channel bandwidth for an optical communicating system operating at 1000 nm. If an audio signal requires a bandwidth of 8 KHz, how many channel can be accommodated for transmission :

(A) $375\times10^{7}$ (B) $75\times10^{7}$ (C) $375\times10^{8}$ (D) $75\times10^{9}$

**Ans** **(B)**

**Sol.** $F = \frac{c}{\lambda} = \frac{3\times10^{8}}{1000\times10^{-9}} = 3\times10^{14}Hz$

Band width used for transmission $= \frac{2}{100} = 3\times10^{14}Hz = 6\times10^{12}Hz$

Number of channels $= \frac{6\times10^{12}}{8\times10^{3}} = \frac{600}{8}\times10^{7} = 75\times10^{7}$

**21.** Two coil require 20 minutes and 60 minutes respectively to produce same amount of heat energy when connect separately to the same source . If they are connect in parallel arrangement to the same source; the time required to produce same amount of heat by the combination of coil, will be_____ min.

**Ans** **15**

**Sol.** $t = \frac{t_1t_2}{t_1+t_2} = \frac{20\times60}{80} = \frac{120}{8} = 15min$

**22.** The intensity of the light from a blub incident on a surface is 0.22 W/m$^2$. The amplitude of the magnetic field in this light-wave is _____ x $10^{-9}$ T.

(Given : Permittivity of vacuum $\in_0 = 8.85\times10^{-12}C^2N^{-1}-m^{-2}$, speed of light in vacuum $c = 3\times10^{8}ms^{-1}$)

**Ans** **43**

**Sol.** $I = \frac{dE}{Adt}$

$U_d = \frac{dE}{Adx}$

Dividing $\frac{I}{U_d} = \frac{dE}{Adt} = c$

$\Rightarrow U_d = \frac{I}{c} = \frac{0.22}{3\times10^8} = 7.2\times10^{-10}\,J/m^3$

Magnetic energy density $= 3.6\times10^{-10}$

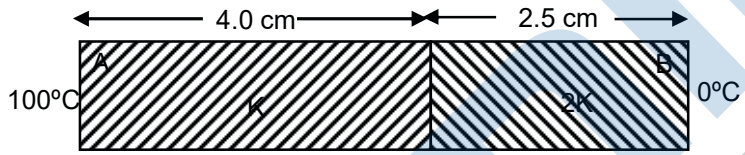
$\frac{B^2rms}{2\mu_0} = 3.6\times10^{-10}$ when $B^2rms = \left(\frac{B_0}{\sqrt{2}}\right) = \frac{B_0^2}{2}$

$\frac{B_0^2}{4\mu_0} = 3.6\times10^{-10}$ $\Rightarrow B_0 = \sqrt{4\times\left(4\pi\times10^{-7}\right)\times3.6\times10^{-10}}$

$B_0 = 4\times6\sqrt{\pi}\times10^{-9}$ Tesla

$B_0 = 42.54 = 43$

**23.** As per the given figure, two plates A and B of thermal conductivity K and 2 K are joined together to from a compound plate. The thickness of plates are 4.0 cm and 2.5 cm respectively and the area of cross-section is 120 $cm^2$ for each plate. The equivalent thermal conductivity of the compound plate is $\left(1+\frac{5}{\alpha}\right)$ K, then the value of $\alpha$ will be _____.




**Ans** **21**

**Sol.** $R_{eq} = R_1 + R_2$

$\frac{6.5cm}{K_{eq}A} = \frac{4cm}{KA} + \frac{2.5cm}{(2K)A}$

$K_{eq}\frac{6.5cm}{52.5} = \frac{26}{21} = \frac{5}{\alpha}$

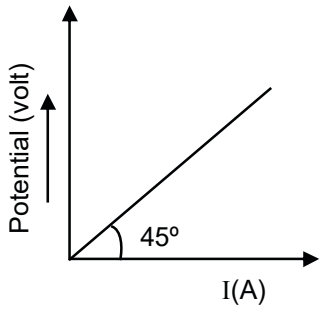
$= \frac{5}{21} = \frac{5}{\alpha} \Rightarrow \alpha = 21$

**24.** A body is performing simple harmonic with an amplitude of 10 cm. The velocity of the body was tripled by air Jet when it is at 5 cm from its mean position. The new amplitude of vibration is $\sqrt{\chi}$ cm. The value of x is _____,

**Ans** **700**

**25.** The variation of applied potential and current flowing through a given wire is shown in figure. The length of wire is 3.14 cm. the diameter of wire is measured as 24 cm. The resistivity of the given wire is measured as $\chi\times10^{-3}\,\Omega$ cm. The value of x is _____.

[Take $\pi = 3.14$ ]




**Ans** **144**

**Sol.** $R = \frac{V}{i} = \tan 45^\circ = 1\Omega$

$R = \frac{\rho i}{A} \Rightarrow \rho = \frac{RA}{i} = \frac{1 \times \pi (1.2)^2}{31.4} = 144 \times 10^{-3} \Omega.cm$

= 144

**26.** 300 cal. Of heat is given to a heat engine and it rejects 225 cal. of heat. If source temperature is 227°C, then the temperature of sink will be _____ °C.

**Ans** **102**

**Sol.** $\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$

$\frac{300}{225} = \frac{500}{T_2}$

$T_2 = 375K = 102^\circ C$

**27.** $\sqrt{d_1}$ and $\sqrt{d_2}$ are the impact parameters corresponding to scattering angles 60° and 90° respectively, when an $\alpha$ particle is approaching s gold nucleus. For $d_1 = \chi d_2$, the value of x will be _____.

**Ans** **3**

**Sol.** The velatron between impect parameter and scattering angle is $b = \frac{kze^2}{E} \cot\left(\frac{\theta}{2}\right)$

$\Rightarrow b \propto \cot\left(\frac{\theta}{2}\right)$

$\sqrt{d_1} \propto \cot\left(\frac{60}{2}\right)$

$\sqrt{d_2} \propto \cot\left(\frac{90}{2}\right)$

$\frac{\sqrt{d_1}}{\sqrt{d_2}} = \sqrt{3} \Rightarrow d_1 = 3d_2 \Rightarrow x = 3,$

**28.** A transistor is used in an amplifier circuit in common emitter mode. If the base current changes by 100 $\mu$A, it brings a change of 10 mA in collector current. If the load resistance is 2 k$\Omega$, and input resistance is 1 k$\Omega$, the value of power gain is $\chi \times 10^4$. The value of x is _____.

**Ans** **2**

Ans. $\beta_{AC} = \frac{\Delta i_c}{\Delta i_B} = \frac{10 \times 10^{-3}}{100 \times 10^{-6}} = 100$

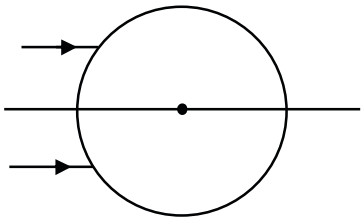
$$A_P = \beta^2{}_{AC} = \frac{R_{out}}{R_{in}} = (100)^2 \times \frac{2\times10^{-3}}{1\times10^{3}} = 2\times10^{4}$$

$x = 2$

**29.** A parallel beam of light is allowed to fall on a transparent spherical globe of diameter 30 cm and refractive index 1.5. The distance from the centre of the globe at which the beam of light can converge is _____ mm.

**Ans** **225**

**Sol.**



$$\frac{1.5}{V_1} - \frac{1}{\infty} = \frac{1.5-1}{+15}$$

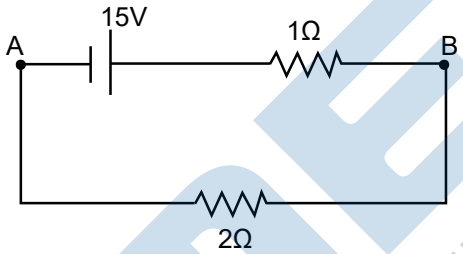
$V_1 = 45$

$$\frac{1}{V_1} - \frac{1.5}{15} = \frac{1-1.5}{-15}$$

$V_2 = 7.5\text{cm}$

From center $15 + 7.5 = 22.5\text{cm}$

**30.** For the network shown below, the value of $V_B - V_A$ is _____V.




**Ans** **10**

## PART : CHEMISTRY

**1.** Production of iron in blast furnace follows the following equation

$Fe_3O_4(S) + 4CO(g) \rightarrow 3Fe(I) + 4CO_2(g)$

When 4.640 kg of $Fe_3O_4$ and 2.520 Kg of CO are allowed to react then the amount of iron (in g) produced is :

[Given : Molar Atomic mass ($g\ mol^{-1}$) : Fe = 56

Molar Atomic mass ($g\ mol^{-1}$) : O = 16

Molar Atomic mass ($g\ mol^{-1}$) : C = 12]

(A) 1400 (B) 2200 (C) 3360 (D) 4200

**Ans.** **(C)**

**Sol.**

$$Fe_3O_4 + 4CO \rightarrow 3Fe + 4CO_2$$

Mole $\left(\frac{4.64\times10^3}{232}\right)$ $\frac{2.52\times10^3}{28}$

20 90Mole LR is $Fe_3O_4$

0 (90–80) 3 × 20

=60 Mole

Mass of Fe = 60 × 56 = 3360 Gram

**2.** Which of the following statements are correct?

(A) The electronic configuration of Cr is [Ar] $3d^5\ 4s^1$.

(B) The magnetic quantum number may have a negative value.

(C) In the ground state of an atom, the orbitals are filled in order of their increasing en

(D) The total number of nodes are given by n – 2

Choose the **most appropriate** answer from the options given below :

(A) (A), (C) and (D) only (B) (A) and (B) only

(C) (A) and (C) only (D) (A), (B) and (C) only

**Ans.** **(D)**

**Sol.** The number of nodes are (n – 1).

**3.** Arrange the following of the decreasing order of their covalent character :

(A) LiCI (B) NaCI (C) KCI (D) CsCI

Choose the **most appropriate** answer from the options given below :

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

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

**Ans.** **(C)**

**Sol.** On moving down the group covalent character is decreasing.

**4.** The solubility of AgCI will be maximum in which of the following ?

(A) 0.01 M KCI (B) 0.01 M HCI (C) 0.01 M $AgNO_3$ (D) Deionised water

**Ans.** **(D)**

**Sol.** In KCl, HCl and $AgNO_3$ solubility decrease due to common ion effect so solubility maximum in deionised water

**5.** Which of the following is a **correct** statement ?

(A) Brownian motion destabilises sols.

(B) Any amount of dispersed phase can be added to emulsion without destabilising it.

(C) Mixing two oppositely charged sols in equal amount neutralizes charges and stabilises colloids.

(D) Presence of equal and similar charges on colloidal provides stability to the colloidal solution.

**Ans.** **(D)**

**Sol.** Similar charge on colloidal particle makes the sol stable

**6.** The electronic configuration of Pt (atomic number 78) is :

(A) [Xe] $4f^{14}$ $5d^9$ $6s^1$ (B) [Kr] $4f^{14}$ $5d^{10}$

(C) [Xe] $4f^{14}$ $5d^{10}$ (D) [Xe] $4f^{14}$ $5d^8$ $6s^2$

**Ans.** **(A)**

**Sol.** Pt (Z = 78) = [Xe] $4f^{14}$ $5d^9$ $6s^1$

**7.** In isolation of which one of the following metals from their ores, the use of cyanide salt commonly involved?

(A) Zinc (B) Gold (C) Silver (D) Copper

**Ans.** **(D)**

**Sol.** Chief extraction of cu is, $cuFeS_2$. In it self reduction is involed.

**8.** which of the following reactions indicates the reducing ability of hydrogen Peron basic medium ?

(A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(B) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

(C) $2MnO_4^- + 3H_2O_2 \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$

(D) $Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^-$

**Ans.** **(C)**

**Sol.** $MnO_4^-$ + $H_2O_2$ → $MnO_2 + O_2 + OH^-$

Oxidising Agent | Reducing agent | (alkaline Medium)

**9.** Match **List I** with **List II**.

| **List - I** **(Metal)** | **List – II** **(Emitted light wavelength (nm))** |
|---|---|
| (A) Li | (I) 670.8 |

(B) Na (II) 589.2

(C) Rb (III) 780.0

(D) Cs (IV) 455.5

Question : Choose the **most appropriate** answer from the options given below :

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

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

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

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

**Ans. (A)**

**Sol.**

| **Metal** | Li | Na | K | Rb | Cs |
|---|---|---|---|---|---|
| **Colour** | Crimson Red | Yellow | Violet /Lilac | Red Violet | Blue |
| **Wave length (λ(nm))** | 670.8 | 589.2 | 766.5 | 766.5 | 766.5 |

**10.** Match **List I** with **List II**.

| | **List - I (Metal)** | **List – II (Application)** |
|---|---|---|
| (A) | Cs | (I) High temperature thermometer |
| (B) | Ga | (II) Water repellent sprays |
| (C) | B | (III) Photoelectric cells |
| (D) | Si | (IV) Bullet proof vest |

Question : Choose the **most appropriate** answer from the options given below :

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

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

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

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

**Ans. (A)**

**Sol.** These are amin use of given elements.

**11.** The oxoacid of phosphorus that is easily obtained from a rection of alkali and white phosphours and has two P–H bonds, is :

(A) Phosphonic acid (B) Phosphonic acid

(C) Pyrophosphorus acid (D) Hyprophosphoric acid

**Ans. (B)**

**Sol.** $P_4$ (white) + Conc. NaOH $\rightarrow$ $Nah_2PO_2 + PH_3$

$\downarrow$

$H_3PO_2$

Phosphinic acid

**12.** The acid that is believed to be mainly responsible for the damage to Taj Mahal is

(A) Sulfuric acid (B) hydrofluoric acid

(C) phosphoric acid (D) hydrochloric acid

**Ans.** **(A)**

**Sol.** The acid rain reacts with marble, $CaCO_3$ of Taj Mahal

($CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$)

Causing damage to this wonderful monument that has attracted people from the world. As a result, the monument is being slowly disfigured and the marble is getting discoloured and lustreless.

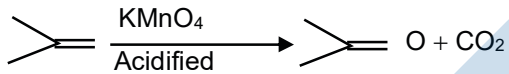
**13.** Two isomers 'A' and 'B' with molecular formula $C_4H_8$ give different products on oxidation with $KMnO_4$ in acidic medium. Isomer 'A' on rection with $kMnO_4/H^+$ results in effervescence of a gas and given ketone. Th compound 'A' is

(A) But-1-ene. (B) cis-But-2-ene.

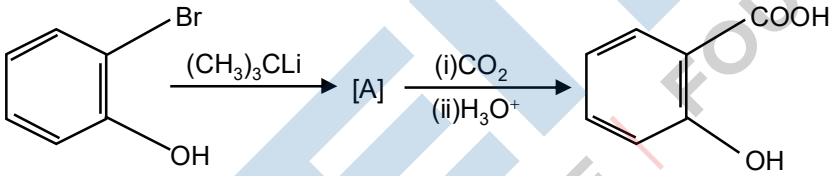
(C) trans-But-2-ene. (D) 2-methyl propene.

**Ans.** **(D)**

**Sol.**

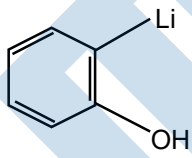



**14.**

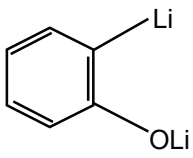



**Question :** In the given conversion the compound A is :

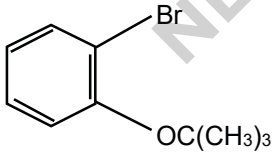
(A)



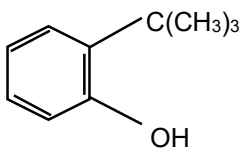

(B)




(C)

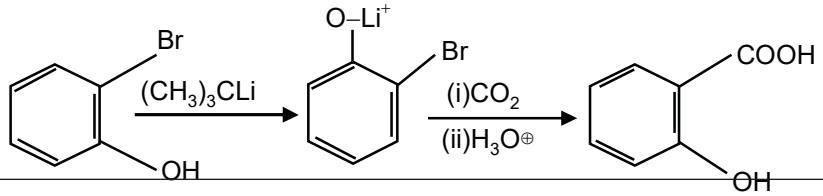



(D)




**Ans.** **(B)**

**Sol.**



**15.** Given the below are two statements :

**Statement I :** The esterification of carboxylic acid with an alcohol is a nucleophilic acyl substitution.

**Statement II :** Electron withdrawing group in the carboxylic acid will increase the rate of esterification reaction.

Choose the **most appropriate** option :

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

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

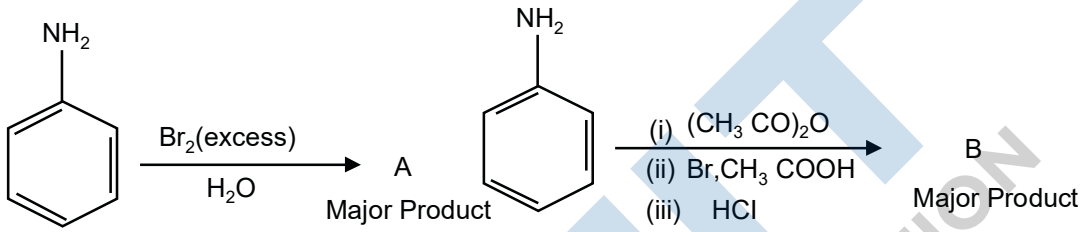
(C) **Statement I** is correct but **Statement II** is incorrect

(D) **Statement I** is incorrect but **Statement II** is correct

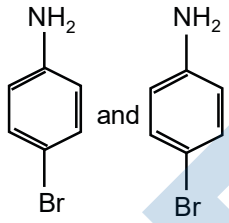
**Ans.** **(A)**

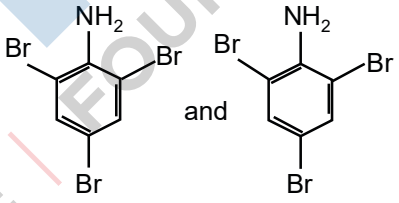
**Sol.** Both Statement-I & Statement-II are correct

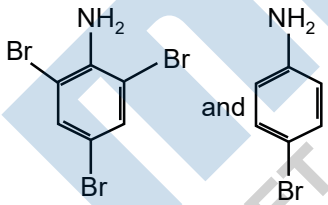
**16.**

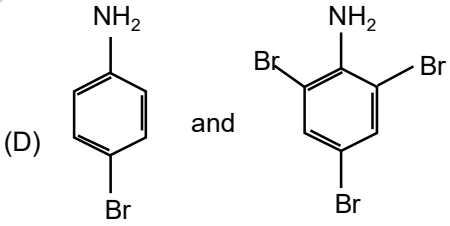



Consider the above reactions, the product A and B respectively are.

(A) 

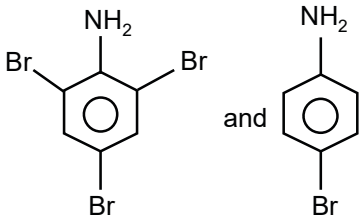

(B) 


(C) 


(D) 


**Ans.** **(C)**

**Sol.**




**17.** The polymer, which can be stretched and retains its original status on releasing the force is

(A) Bakelite. (B) Nylon 6,6. (C) Buna- N (D) Terylene

**Ans.** **(C)**

**Sol.** In elastomeric polymers, the polymer chains are held tighter by the weakest intermolecular force These weak binding forces permit the polymer to be stretched. A few 'crosslinks' are introduced in between the chains, which help the polymer to react to its original position after the force is related as in vulcanized rubber. The examples are buna -S, buna-N, neoprene etc.

**18.** Sugar moiety in DNA and RNA molecules respectively are

(A) β-D-2deoxyribose, β-D-deoxyribose. (B) β-D-2deoxyribose, β-D-ribose.

(C) β-D- ribose, β-D-2deoxyribose. (D) β-D-deoxyribose, β-D-2deoxyribose.

**Ans.** **(B)**

**Sol.** The sugar found in polynucleotides is either ribose (a monosaccharide pentose) or 2' deoxyribose. A nucleic acid containing deoxyribose is called deoxyribonucleic acid (DNA) while that which contains ribose is called ribonucleic acid (RAN).

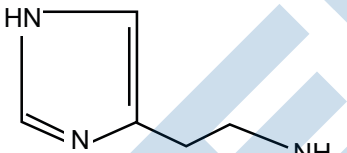
**19.** Which of the following compound **does not** contain sulfur atom?

(A) Cimetidine (B) Ranitidine

(C) Histamine (D) Saccharin

**Ans.** **(C)**

**Sol.** It is fact.




Histamine

**20.** Given below are two Statements.

**Statements I :** Phenols are weakly acidic.

**Statements II :** Therefore they are freely soluble in NaOH solution and are weaker than alcohols and water.

Choose the **most appropriate** option :

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

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

(C) **Statement I** is correct but **Statement II** is incorrect

(D) **Statement I** is incorrect but **Statement II** is correct

**Ans.** **(C)**

**Sol.** Phenol is stronger acid than alcohol and water but weakest acid then organic and mineral acids.

**21.** Geraniol, a volatile organic compound, is a component of rose oil. The density of the vapour is 0.46 $gL^{-1}$ at 257°C and 100 mm Hg. The molar mass of geraniol is _____ $g\ mol^{-1}$.

(Nearest Integer)

[Given : R = 0.082 L atm $K^{-1}$ $mol^{-1}$]

**Ans.** **152**

**Sol.** $P = \frac{dRT}{M}$ (Liter ATM unit system)

$$\frac{100}{760} = \frac{0.46 \times 0.082 \times 530}{M}$$

M = 151.93 gram/mole ≈ 152

**22.** 17.0 g of $NH_3$ completely vaporises at –33.42°C and 1 bar pressure and the enthalpy change, in the process is 23.4KJ $mol^{-1}$. The enthalpy change for the vaporisation of 85 g of. $NH_3$ under the same condition is _____ kJ.

**Ans.** **117**

**Sol.** $\Delta H_{vap}$ of 17 gram of $NH_3$ = 23.4 gram

$\Delta H_{vap}$ of 85 gram of $NH_3 = \left[\frac{23.4}{17} \times 85\right]$

$= 23.4 \times 5 = 117$ kJ

**23.** 1.2 mL of acetic acid is dissolved in water to make 2.0 L of solution. The depression in freezing point observed for this strength of acid is 0.0198°C. The percentage of dissociate of the acid is _____. (Nearest integer)

[Given : Density of acetic acid is 1.02 g $mL^{-1}$

Molar mass of acetic acid is 60 g $mol^{-1}$

$K_f(H_2O)$ = 1.85 K kg $mol^{-1}$]

**Ans.** **5**

**Sol.** Mass of $CN_3$ COOH = dv = 1.02 × 1.2

= 1.224 gram

Molality of $CH_3COOH$ solution = $\left(\frac{1.224}{60 \times 2}\right)$

$\Delta T_b = ik_f \times m$

$0.0198 = i \times 1.85 \left(\frac{1.224}{60 \times 2}\right)$

i = 1.0493

$i = 1 + (n - 1)\alpha$

$1.0493 = 1 + (2 - 1)\alpha$

$\alpha = 0.0493$

$\%\alpha = 4.93 \approx 5$

**24.** A dilute solution of sulphuric acid is electrolysed using a current of 0.10. A for 2 hours to produce hydrogen and oxygen gas. The total volume of gases produced at STP is _____ $cm^3$. (Nearest integer)

[Given : Faraday constant F = 96500 C $mol^{-1}$ at STP, molar volume of an ideal gas is 227 L $mol^{-1}$]

**Ans.** **127**

**Sol.** Charge = q = it = 0.1 × 2 × 60 × 60

=720C

**Anode :** $2H_2O(l) \longrightarrow O_2(g) + 4H^+ + 4e^-$

**Cathode :** $[2H_2O(l) + 2e^- \longrightarrow H_2(g) + 2OH^-] \times 2$

$2H_2O(l) + 4e^- \longrightarrow 2H_2(g) + O_2$

4F charge produced = 3 mole gas

$\left(\frac{720}{96500}\right)$ F charge produced = $\left(\frac{3}{4}\times\frac{720}{96500}\right)$ mole = $\left(\frac{3\times18}{9650}\right)$ mole

Volume of gas (at NTP) = $\frac{54}{9650}\times22.7=0.127$ lit. = 127 ml

**25.** The activation energy of one of the reactions in a biochemical process is 532611 J $mol^{-1}$, When the temperature falls from 310 K to 300 k, the change in rate constant observed is $K_{300} = x \times 10^{-3} K_{310}$. The value of x is _____.

[Given : In10 = 2.3

R = 8.3 J $K^{-1}$ $mol^{-1}$]

**Ans.** **1**

**Sol.** $\ln\left(\frac{K_{310}}{K_{300}}\right) = \frac{Ea}{R}\left(\frac{1}{300}-\frac{1}{310}\right)$

$= \frac{532611}{8.3}\left(\frac{10}{300\times310}\right) = 6.9$

$\ln\left(\frac{K_{310}}{K_{300}}\right) = 6.9$

$\ln\left(\frac{K_{310}}{K_{300}}\right) = 2.3\times3$

$\ln\left(\frac{K_{310}}{K_{300}}\right) = 3\ \ln(10)$

$\ln\left(\frac{K_{310}}{K_{300}}\right) = 10^3$

$K_{300} = 1 \times 10^{-3} K_{310}$

So X = 1

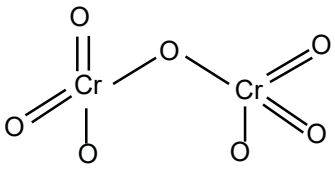
**26.** The number of terminal oxygen atoms present in the product B obtained from the following reaction is_____.

$FeCr_2O_4 + Na_2CO_3 + O_2 \rightarrow A + Fe_2O_3 + CO_2$

$A + H^+ \rightarrow B + H_2O + Na^+$

**Ans.** **6**

**Sol.** A = $Na_2CrO_4$, B = $Cr_2O_7^{-2}$



**27.** An acidified manganate solution undergoes disproportionation reaction. The spin-only magnetic moment value of the product having manganese in higher oxidation state is _____ B.M. (Nearest integer)

**Ans.** **0**

**Sol.** $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

$_{25}Mn^{7+} = 3d^0$ unpaired electron = 0

$\mu_{(Spin\ only)} = 0$

**28.** Kjeldahl's method was used for the estimation of nitrogen in an organic compound. The ammonia evolved from 0.55 g of the compound neutralised 12.5 mL of 1 M $H_2SO_4$ solution.
The percentage of nitrogen in the compound is _____. (Nearest integer)

**Ans.** **(64)**

**Sol.** Organic compound $\rightarrow NH_3(g)$

0.55 g

$NH_3 + H_2SO_4 \rightarrow (NH_4)_2 SO_4$

VF = 1 VF = 2

Eq. of $NH_3$ = eq. of $H_2SO_4$

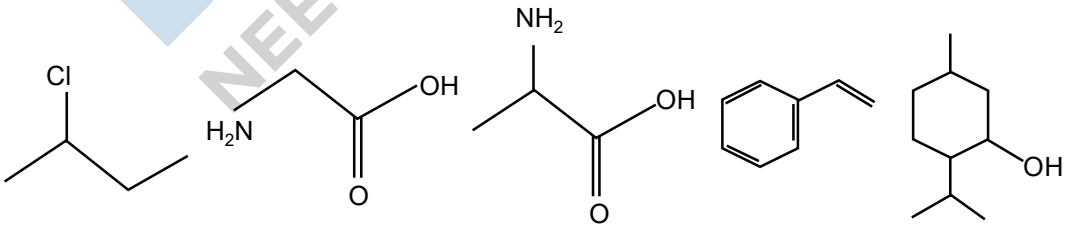
$1(nNH_3) = 2\ [1\times12.5] \times10^{-3}$

$n_{Nitrogen} = 2 \times 12.5 \times 10^{-3}$

$W_{Nitrogen} = [14 \times 2 \times 12.5] \times 10^{-3}$ gram $= 35 \times 10^{-2}$ gram

% of Nitrogen $= \frac{35\times10^{-12}}{55\times10^{-12}} \times 100 = 63.636\% \approx 64\%$

**29.** Observe structures of the following compounds



The total number of structure / compounds which possess asymmetric carbon atom is _____

**Ans.** **(3)**

**Sol.** Structure (i),(iii),(v) have asymmetric carton.

**30.** $C_6H_{12}O_6 \xrightarrow{\text{Zymase}} A \xrightarrow[\Delta]{NaOI} B + CHI_3$

The number of carbon atoms present in the product B is _____.

**Ans.** **1**

**Sol.**

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} C_2H_5OH \xrightarrow[H_3O^{\oplus}]{I_2 / OH^-} HCOOH + CHI_3$$

**PART : MATHEMATICS**

1. The probability that a randomly chosen 2 × 2 matrix with all the enthes from the set of first 10 primes. Is singular, is equal to:

(A) $\frac{133}{10^4}$ (B) $\frac{18}{10^3}$ (C) $\frac{19}{10^3}$ (D) $\frac{271}{10^4}$

**NTA Ans** **C**

**Reso Ans.** **C**

**Sol.**

Let A = $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ where a, b, c, d are prime.

Total number of matrices A formed = $10^4$

Let S be a matrix from set of matrices A such that S is singular.

For singular matrix |S| = ad – bc = 0 $\Rightarrow$ ad = bc

Case I $a \neq d$

The number of matrices = (10 × 9) × 2! = 180

Case II a = d

Then number of matrices = 10 × 1 = 10

So required probability = $\frac{10\times9\times2!+10}{10^4}=\frac{19}{1000}=0.019$

2. Let the solution curve of the differential equation

$x\frac{dy}{dx}-y=\sqrt{y^2+16x^2}$ , y (1) = 3 be y = y (x). then y(2) is equal to:

(A) 15 (B) 11 (C) 13 (D) 17

**NTA Ans** **A**

**Reso Ans.** **A**

**Sol.**

$$\frac{dy}{dx}=\frac{y+\sqrt{y^2+16x^2}}{x}$$

Let y = vx

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

$$v+x\frac{dy}{dx}=\frac{vx+\sqrt{v^2x^2+16x^2}}{x}=v+\sqrt{v^2+16}$$

$$\int\frac{dv}{\sqrt{v^2+16}}=\int\frac{dx}{x}$$

$$\ell n\left|V+\sqrt{v^2+16}\right|=\ell nx+\ell nc$$

$$\frac{y}{x}+\frac{\sqrt{y^2+16x^2}}{x}=cx$$

$$y+\sqrt{y^2+16x^2}=cx^2$$

y (1) = 3

$\Rightarrow$ C = 8

at x = 2 $y+\sqrt{y^2+64}=32$

$y^2 + 64 = (32 - y)^2$

$64(1+y) = 32 \times 32$

$y = 15$

3. If the mirror image of the point (2, 4, 7) in the plane $3x - y + 4z = 2$ is (a, b, c) then $2a + b + 2c$ is equal to :

(A) 54 (B) 50 (C) –6 (D) –42

**NTA Ans C**

**Reso Ans. C**

**Sol.**

The equation of plane is $3x - y + 4z = 2$

The mirror image of point (2,4,7) in given plane is (a, b, c) then

$$\frac{a-2}{3}=\frac{b-4}{-1}=\frac{c-7}{4}=-\frac{2(6-4+28-2)}{(9+1+16)}$$

$$\frac{a-2}{3}=\frac{b-4}{-1}=\frac{c-7}{4}=-\frac{28}{13}$$

$$\frac{a-2}{3}=-\frac{28}{13}\Rightarrow a=\frac{-28\times3}{13}+2=\frac{-58}{13}$$

$$\frac{b-4}{-1}=\frac{-28}{13}\Rightarrow b=\frac{28}{13}+4=\frac{80}{13}$$

$$\frac{c-7}{4}=\frac{-28}{13}\Rightarrow c=\frac{-28\times4}{13}+7=-\frac{21}{13}$$

The mirror image of point (2, 4, 7) in given plane is $\left(-\frac{58}{13},\frac{80}{13},-\frac{21}{13}\right)$

Hence the value of $(2a + b + 2c) = \frac{-116+80-42}{13}=-\frac{78}{13}=-6$

**4.** Let $f : R \to R$ be a function defined by :

$$f(x)=\begin{cases}\max\{t^3-3t\} & ; \quad x\le 2\\ t\le x & \\ x^2+2x-6 & ; \quad 2<x<3\\ [x-3]+9 & ; \quad 3\le x\le 5\\ 2x+1 & ; \quad x>5\end{cases}$$

Where [t] is the greatest integer less than or equal to t. Let m be the number of points where $f$ is not differentiable and $I=\int_{-2}^{2} f(x)dx$. Then the ordered pair $(m, I)$ is equal to :

(A) $\left(3,\frac{27}{4}\right)$ (B) $\left(3,\frac{23}{4}\right)$ (C) $\left(4,\frac{27}{4}\right)$ (D) $\left(4,\frac{23}{4}\right)$

**NTA Ans C**

**Reso Ans.** **C**

**5.** Let $\vec{a}=\alpha\hat{i}+3\hat{j}-\hat{k}$, $\vec{b}=3\hat{i}-\beta\hat{j}+4\hat{k}$ and $\vec{c}=\hat{i}+2\hat{j}-2\hat{k}$, where $\alpha, \beta \in R$, be three vectors. If the projection of $\vec{a}$ on $\vec{c}$ is $\frac{10}{3}$ and $\vec{b}\times\vec{c}=-6\hat{i}+10\hat{j}+7\hat{k}$, then the value of $\alpha+\beta$ is equal to :

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

**NTA Ans** **A**

**Reso Ans.** **A**

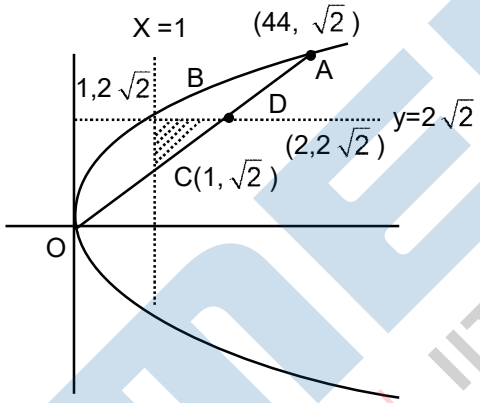
6. The area enclosed by $y^2 = 8x$ and $y=\sqrt{2}x$ that lies outside the triangle formed by $y=\sqrt{2}x, x=1, y=2\sqrt{2}$, is equal to :

(A) $\frac{16\sqrt{2}}{6}$ (B) $\frac{11\sqrt{2}}{6}$ (C) $\frac{13\sqrt{2}}{6}$ (D) $\frac{5\sqrt{2}}{6}$

**NTA Ans** **C**

**Reso Ans.** **C**

**Sol.**




area of $\Delta BCD = \frac{1}{2}\left(\sqrt{2}\right)(1)=\frac{1}{\sqrt{2}}$

area between curves $= \int_0^4\left(2\sqrt{2}x^{\frac{1}{2}}-\sqrt{2}x\right)dx$

$$=\left(\frac{2\sqrt{2}2^{\frac{3}{2}}}{\frac{3}{2}}-\frac{x2}{\sqrt{2}}\right)\Bigg|_0^4 \quad =\left(\frac{4}{3}\sqrt{2}x^{\frac{3}{2}}-\frac{1}{\sqrt{2}}x^2\right)\Bigg|_0^4$$

$$=\frac{32\sqrt{2}}{3}-8\sqrt{2}=\frac{8\sqrt{2}}{3}$$

Required area $= =\left(\frac{8\sqrt{2}}{3}-\frac{1}{\sqrt{2}}\right)=\left(\frac{8\sqrt{2}}{3}-\frac{\sqrt{2}}{2}\right)=\frac{13\sqrt{2}}{6}$

**7.** If the system of linear equations

$2x + y - z = 7$

$X - 3y + 2z = 1$

$X + 4y + \delta z = k$, where $\delta, K \in R$

has infinitely many solutions, then $\delta + K$ is equal to :

(A) –3 (B) 3 (C) 6 (D) 9

**NTA Ans** **B**

**Reso Ans.** **B**

**8.** Let $\alpha$ and $\beta$ be roots of the equation $x^2 + (2i - 1) = 0$. Then, the value of $|\alpha^8 + \beta^8|$ is equal to :

(A) 50 (B) 250 (C) 1250 (D) 1500

**NTA Ans** **A**

**Reso Ans.** **A**

**Sol.**

$X^2 + (2i - 1)\ 0 \begin{cases} \alpha \\ \beta \end{cases}$

$\Rightarrow \alpha^2 = 1 - 2i$ and $\beta^2 = 1 - 2i$

$\Rightarrow \alpha^2 = \beta^2 = 1 - 2i$

$\Rightarrow \alpha^8 = \beta^8$

Hence $\left|\alpha^8 + \beta^8\right| = 2\left|\alpha^2\right|^4 = 2\left(\sqrt{1+4}\right)^4 = 50$

**9.** Let $\Delta \in \{\wedge, \vee, \Rightarrow, \Leftrightarrow\}$ be such that $(p \wedge q)\ \Delta\ ((p \vee q) \Rightarrow q)$ is a tautology. Then $\Delta$ is equal to:

(A) $\wedge$ (B) $\vee$ (C) $\Rightarrow$ (D) $\Leftrightarrow$

**NTA Ans** **C**

**Reso Ans.** **C**

**Sol.**

| p | q | $p \wedge q$ | $(p \vee q) \Rightarrow q$ |
|---|---|---|---|
| T | T | T | T |
| T | F | F | F |
| F | T | F | T |
| F | F | F | T |

**10.** Let $A = [a_{ij}]$ be a square matrix of order 3 such that $a_{ij} = 2^{j-i}$, for all I, j = 1, 2, 3. Then, the matrix $A^2 + A^3 + \ldots\ldots\ldots + A^{10}$ is equal to :

(A) $\left(\frac{3^{10} - 3}{2}\right)A$ (B) $\left(\frac{3^{10} - 1}{2}\right)A$ (C) $\left(\frac{3^{10} + 1}{2}\right)A$ (D) $\left(\frac{3^{10} + 3}{2}\right)A$

**NTA Ans** **A**

**Reso Ans.** **A**

**Sol.**

$$A\begin{bmatrix}1 & 2 & 2^2\\ 2^{-1} & 1 & 2\\ 2^{-2} & 2^{-1} & 1\end{bmatrix} \Rightarrow A^2 = 3A, A^3 = 3^2A, \ldots\ldots\ldots, A^{10} = 3^9A$$

Now,

$A^2 + A^3 \ldots\ldots + A^{10}$

$= 3A + 3^2A \ldots\ldots + 3^9A$

$= (3 + 3^2 + 3^3 \ldots\ldots + 3^9)A$

$= \frac{3(3^9 - 1)}{2}A = \left(\frac{3^{10} - 3}{2}\right)A$

**11.** Let a set $A = A_1 \cup A_2 \cup \ldots \cup A_k$, where $A_i \cap A_j = \phi$ for $i \neq j$, $1 \leq i, j \leq k$. Define the relation R from A to A by $R = \{(x, y) : y \in A_i$ if and only if $x \in A_i, 1 \leq i \leq k\}$. Then, R is :

(A) reflexive, symmetric but not transitive

(B) reflexive, transitive but not symmetric

(C) reflexive but not symmetric and transitive.

(D) an equivalence realtion.

**NTA Ans** **D**

**Reso Ans.** **D**

**12.** Let $\{a_n\}_{n=0}^{\infty}$ be a sequence such that $a_0 = a_1 = 0$ and $a_{n+2} = 2a_{n+1} - a_n + 1$ for all $n \geq 0$.

Then, $\sum_{n=2}^{\infty}\frac{a_n}{7^n}$ is equal to :

(A) $\frac{6}{343}$ (B) $\frac{7}{216}$ (C) $\frac{8}{343}$ (D) $\frac{49}{216}$

**NTA Ans** **D**

**Reso Ans.** **D**

**13.** The distance between the two points A and A' which lie on $y = 2$ such that both the line segments AB and A'B (Where B is the point (2, 3)) subtend angle $\frac{\pi}{4}$ at the origin, is equal to :

(A) 10 (B) $\frac{48}{5}$ (C) $\frac{52}{5}$ (D) 3

**NTA Ans** **C**

**Reso Ans.** **C**

**14.** A wire of length 22 m is to be cut into two pieces. One of the pieces is to be made into a square and the other into an equilateral triangle. Then, the length of the side of the equilateral triangle, so that the combined area of the square and the equilateral tringle is minimum, is :

(A) $\frac{22}{9+4\sqrt{3}}$ (B) $\frac{66}{9+4\sqrt{3}}$ (C) $\frac{22}{4+9\sqrt{3}}$ (D) $\frac{66}{4+9\sqrt{3}}$

**NTA Ans** **B**

**Reso Ans.** **B**

**15.** The domain of the function $\cos^{-1}\left(\frac{2\sin^{-1}\left(\frac{1}{4x^2-1}\right)}{\pi}\right)$ is :

**Question :**

(A) $R-\left\{-\frac{1}{2},\frac{1}{2}\right\}$ (B) $(-\infty,-1)\cup[1,\infty)\cup\{0\}$

(C) $\left(-\infty\frac{-1}{2}\right)\cup\left(\frac{1}{2},\infty\right)\cup\{0\}$ (D) $\left[-\infty,\frac{-1}{\sqrt{2}}\right)\cup\left(\frac{1}{\sqrt{2}},\infty\right)\cup\{0\}$

**NTA Ans** **D**

**Reso Ans.** **D**

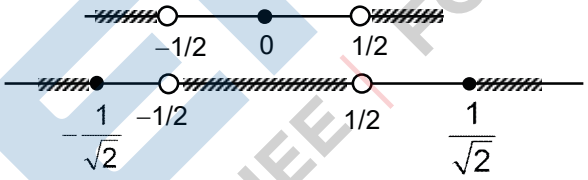
**Sol.**

$$-1\le\frac{2\sin^{-1}\left(\frac{1}{4x^2-1}\right)}{\pi}\le 1$$

$$\Rightarrow -\frac{\pi}{2}\le\sin^{-1}\left(\frac{1}{4x^2-1}\right)\le\frac{\pi}{2}$$

$$\Rightarrow -1\le\frac{1}{4x^2-1}\le 1$$

$$\Rightarrow 0\le\frac{X^2}{(2X-1)(2X+1)}\text{ and }\frac{\left(\sqrt{2}x-1\right)\left(\sqrt{2}x-1\right)}{(2x-1)(2x+1)}\ge 0$$




$$\text{Domain}\left(-\infty,-\frac{1}{\sqrt{2}}\right]\cup\{0\}\cup\left[\frac{1}{\sqrt{2}},\infty\right)$$

**16.** If the constant term in the expansion of $\left(3x^3-2x^2+\frac{5}{x^5}\right)^{10}$ is $2^K.\ell$, where $.\ell$ is an odd integer, then the value of k is equal to:

(A) 6 (B) 7 (C) 8 (D) 9

**NTA Ans** **D**

**Reso Ans.** **D**

**Sol.**

$$\left(3x^3-2x^2+\frac{5}{x^5}\right)^{10}=x^{-50}(3x^8-2x^7+5)^{10}$$

constant term in $x^{-50}(3x^8-2x^7+5)^{10}$

Coefficient of $x^{50}$ in $(3x^8-2x^7+5)^{10}$

Coefficient of $x^{50}$ in $\sum\frac{10!}{r_1!r_2!r_3!}(3)^{r_1}(-2)^{r_2}(5)^{r_3}.x^{8r_1+7r_2}$

Such that $r_1+r_2+r_3=10$ and $8r_1+7r_2=50$

$\Rightarrow r_1 = 1; r_2 = 6$ and $r_3 = 3$

Hence constant term is $= \frac{10!}{1!6!3!}(3)(-2)^6(5)^3 = \frac{10!}{6!3!}(3)(2)^6(5)^3 = 2^9 \times 5^4 \times 21$

Hence K = 9

**17.** $\int_0^5 \cos\left(\pi\left(\chi - \left[\frac{\chi}{2}\right]\right)\right)dx,$

where [t] denotes greatest integer less than or equal to, is equal to :

(A) –3 (B) –2 (C) 2 (D) 0

**NTA Ans** **D**

**Reso Ans.** **D**

**Sol.**

$$\int_0^5 \cos\left(\pi\left(x - \left[\frac{x}{2}\right]\right)\right)dx,$$

$$= \int_0^2 \cos\left(\pi\left(x - \left[\frac{x}{2}\right]\right)\right)dx + = \int_2^4 \cos\left(\pi\left(x - \left[\frac{x}{2}\right]\right)\right)dx + \int_4^5 \cos\left(\pi\left(x - \frac{x}{2}\right)\right)dx$$

$$= \int_0^2 \cos(\pi x - 0)dx + \int_2^4 \cos(\pi x - \pi)dx + \int_4^5 \cos(\pi x - 2\pi)dx$$

$$= \left[\frac{\sin \pi x}{\pi}\right]_0^2 - \left[\frac{\sin \pi x}{\pi}\right]_2^4 + \left[\frac{\sin \pi x}{\pi}\right]_4^5$$

= 0

**18.** Let PQ be a focal chord of the parabola $y^2 = 4x$ such tat its subtends an angle of $\frac{\pi}{2}$ at the point (3 , 0).

Let the line segment PQ be also a focal chord of the ellipse $E : \frac{x^2}{y^2} + \frac{y^2}{b^2} = 1, a^2 > b^2$. If e is the

eccentricity of the ellipse E, then the value of $\frac{1}{e^2}$ is equal to :

(A) $1+\sqrt{2}$ (B) $3+2\sqrt{2}$ (C) $1+2\sqrt{3}$ (D) $4+5\sqrt{3}$

**NTA Ans** **B**

**Reso Ans.** **B**

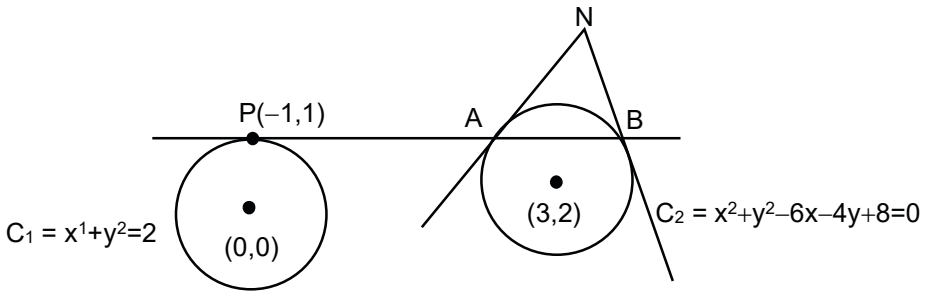
**19.** Let the tangent to the circle $C_1 : x^2 + y^2 = 2$ at the point M (–1, 1) interested the circle $C_2 : (x - 3)^2 + (y-2)^2 = 5$, at two district points A and B. If the tangents to $C_2$ at the points A and B interested at N, then the area of the triangle ANB is equal to :

(A) $\frac{1}{2}$ (B) $\frac{2}{3}$ (C) $\frac{1}{6}$ (D) $\frac{5}{3}$

**NTA Ans** **C**

**Reso Ans.** **C**

**Sol.**




Equation of tangent to circle $x^2 + y^2 = 2$ at point P(–1,1) is

T = 0

X(–1) + y(1) =2

–x +y = 2

x – y + 2 = 0 ……..(1)

Let point N(h,k)

Equation of chord of contact of circle (2) drawn from point N(h, k) is

T = 0

$hx + ky – 3(x + h) – 2(y + k) + 8 = 0$

$(h – 3) x + (k – 2) y – 3h – 2k + 8 = 0$ ….(2)

By comparing (1) and (2)

$$\frac{h-3}{1} = \frac{k-2}{-1} = \frac{3h+2k-8}{-2}$$

$–h + 3 = k – 2$ and $–2h + 6 = 3h + 2k – 8$

h + k = 5 5h + 2k = 14

So, $N\left(\frac{4}{3},\frac{11}{3}\right)$

Point of intersection of chord AB and circle (2)

$(x–3)^2 + x^2 = 5$

$2x^2 – 6x + 4 = 0$

$X^2 – 3x + 2 = 0$

$\Rightarrow x = 1, 2$

So, A(1,3) And B(2,4)

Now area of Δ ANB $= \frac{1}{2} = \begin{vmatrix} 1 & 3 & 1 \\ 2 & 4 & 1 \\ \frac{4}{3} & \frac{11}{3} & 1 \end{vmatrix} = \frac{1}{2}\left[1\left(4-\frac{11}{3}\right)-3\left(2-\frac{4}{3}\right)+1\left(\frac{22}{3}-\frac{16}{3}\right)\right]$

$= \frac{1}{2}\left[\frac{1}{3}-\frac{6}{3}+\frac{6}{3}\right] = \frac{1}{6}$ square unit.

**20.** Let the mean and the variance of 5 observation $x_1,x_2,x_3,x_4,x_5$ be $\frac{24}{5}$ and $\frac{194}{25}$ respectively.

If the mean and variance of the first 4 observation are $\frac{17}{2}$ and a respectively, then $(4a+ x_5)$ is equal to :

(A) 13 (B) 15 (C) 17 (D) 18

**NTA Ans B**

**Reso Ans.** **B**

**Sol.** $\frac{x_1+x_2+x_3+x_4+x_5}{5}=\frac{24}{5}$

$\Rightarrow x_1+x_2+x_3+x_4+x_5=24$ .....(1)

and $\frac{x_1^2+x_2^2+x_3^2+x_4^2+x_5^2}{5}=-\left(\frac{24}{5}\right)^2=\frac{194}{25}$

$\frac{x_1^2+x_2^2+x_3^2+x_4^2+x_5^2}{5}=\frac{194}{25}+\frac{576}{25}=\frac{770}{25}$

$x_1^2+x_2^2+x_3^2+x_4^2+x_5^2=154$ .....(2)

Now $\frac{x_1+x_2+x_3+x_4+x_5}{4}=\frac{7}{2}$

$\Rightarrow x_1+x_2+x_3+x_4+x_5=14$ .....(3)

$\Rightarrow \frac{x_1^2+x_2^2+x_3^2+x_4^2+x_5^2}{4}-\left(\frac{7}{2}\right)^2=a$

$\frac{15\times x_5^2}{4}-\frac{49}{4}=a$

$\frac{15}{4}-\frac{49}{4}-\frac{x_5^2}{4}=a$

$4a+x_5^2=105$

from equation (1) and (3)

$x_5=10,\ 4a=5$

$\Rightarrow$ $4a+x_5=5+10=15$

**21.** Let $S=\{z\in C:|z-2\le 1, z(1+i)\bar{z}(1-i)+\bar{z}(1-i)\le 2\}$. Let $|z-4i|$ attains minimum and maximum values, respectively, at $z_1\in S$ and $z_2\in S$. If $5(|z_1|^2+|z_2|^2)=\alpha+\beta\sqrt{5}$, where $\alpha$ and $\beta$ are integers, then the values od $\alpha+\beta$ is equal to _____.

**NTA Ans** **26**

**Reso Ans.**

**22.** Let y = y(x) be the solution of the differential equation.

$\frac{dy}{dx}+\frac{\sqrt{2}y}{2\cos^4 x-\cos 2x}=xe^{\tan^{-1}(\sqrt{2}\cot 2x)}, 0<x<\pi/2$ with $y\left(\frac{\pi}{4}\right)=\frac{\pi^2}{32}$

If $y\left(\frac{\pi}{3}\right)=\frac{\pi^2}{18}e^{-\tan^{-1}(\alpha)}$, then the value of $3\alpha^2$ is equal to _____.

**NTA Ans** **2**

**Reso Ans.**

**23.** Let d the distance between the foot of perpendicular of the points P (1, 2, −1) and Q (2, −1,3) on the plane $-x+y+z=1$. Then $d^2$ is equal to

**NTA Ans** **26**

**Reso Ans.**

**24.** The number of elements in the set S = $\{\theta \in [-4\pi, 4\pi] : 3\cos^2 2\theta + 6\cos 2\theta - 10\cos^2\theta + 5 = 0\}$ is _____.

**NTA Ans** **32**

**Reso Ans.**

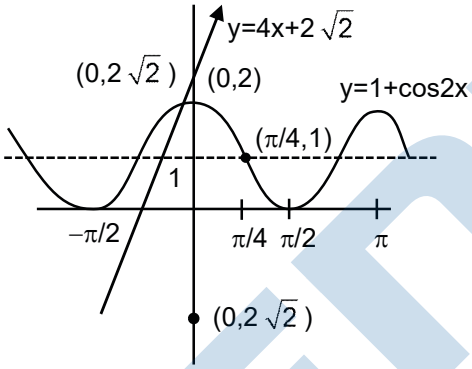
**25.** The number of solutions $2\theta - \cos^2\theta + \sqrt{2} = 0$ in R is equation to _____.

**NTA Ans** **1**

**Reso Ans.** **1**

**Sol.** $40 - (1 + \cos 2\theta) + 2\sqrt{2} = 0$

$1 + \cos 2\theta = 40 + 2\sqrt{2}$




by graph clearly only one solution

**26.** $50\tan\left(3\tan^{-1}\left(\frac{1}{2}\right) + 2\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)\right) + 4\sqrt{2}\tan\left(\frac{1}{2}\tan^{-1}\left(2\sqrt{2}\right)\right)$ is equal to _____.

**NTA Ans** **29**

**Reso Ans.** **29**

**27.** Let C, k $\in$ R. If f(x) = ( c+ss1) $x^2$ + (1 – $c^2$ ) x + 2x and f (x + y) = f(x) + f(y) – xy, for all x, y $\in$R, the value of |2 (f(1) + f(2) +f(3) +……+ f(20))| is equal to _____.

**NTA Ans** **3395**

**Reso Ans.** **3359**

**28.** Let H : $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1, a > 0, b > 0$, be a hyperbola such that the sum of lengths of the transverse and the conjugate axes is $4\left(2\sqrt{2} + \sqrt{14}\right)$. If the eccentricity H is $\frac{\sqrt{11}}{2}$, then the value of $a^2 + b^2$ is equal to _____.

**NTA Ans** **88**

**Reso Ans.** **88**

**Sol.**

$e^2 = 1+\frac{b^2}{a^2} \Rightarrow \frac{11}{4} = 1+\frac{b^2}{a^2}$

$\Rightarrow 7a^2 = 4b^2$

$\Rightarrow b^2 = \frac{7}{4}a^2$ .....(1)

So hyperbola is $\frac{x^2}{a^2} - \frac{y^2}{\left(\frac{7}{4}a^2\right)} = 1$

Sum of lengths of transverse axis and conjugate axis

$\Rightarrow 2a + \sqrt{7}a = \left(2\sqrt{2} + \sqrt{14}\right)4$

$\left(2+\sqrt{7}\right)a = 4\sqrt{2}\left(2+\sqrt{7}\right)$

$\Rightarrow a = 4\sqrt{2}$

and $b^2 = 56$

Hence $a^2 + b^2 = 32 + 56 = 88$

**29.** Let $P_1 : \vec{r}.\left(2\hat{i}+\hat{j}-3\hat{k}\right) = 4$ be a plane. Let $P_2$ be another plane which passes through the point (2, –3,2),(2, –2,-3) and (1,–4,2). If the direction rations of the line of intersection of $P_1$ and $P_2$ be 16, $\alpha$,$\beta$, them the value of $\alpha + \beta$ is equal to _____.

**NTA Ans** **28**

**Reso Ans.** **28**

**30.** Let $b_1b_2b_3b_4$ be a 4-element permutation will bi $\in$ {1,2,3,……, 100} for $1 \le l \le a$ and $b_i \neq b_j$ for $i \neq j$ , such that either $b_1,b_2,b_3$ are consecutive integers od $b_2,b_3,b_4$ are consecutive integers. Then the number if such permutations $b_1b_2b_3b_4$ is equal to _____.

**NTA Ans** **18915**

**Reso Ans.** **18915**