MENIIT

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JEE MAIN-2022

COMPUTER BASED TEST (CBT)

DATE : 29-06-2022 (EVENING SHIFT) | TIME : (3.00 PM to 6.00 PM)

Duration 3 Hours | Max. Marks : 300

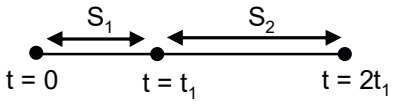
QUESTIONS & SOLUTIONS

PART : PHYSICS

1. A small toy starts moving from the position of rest under a constant acceleration. If it travels a distance of 10m in t s, the distance travelled by the toy in the next t s is will be:

(A) 10m (B) 20m (C) 30m (D) 40m

Ans. **(C)**



$S_1 = \frac{1}{2} a t_1^2$

$\Rightarrow \quad S_1 + S_2 = \frac{1}{2} a (2t_1)^2 = \frac{1}{2} a \quad 4t_1^2$

$\Rightarrow \quad S_1 : S_2 + S_2 = 1 : 4$

$\Rightarrow \quad S_1 : S_2 = 1 : 3$

Here $S_1 = 10$ m

So, $S_2 = 30$ m

2. At what temperature a gold ring of diameter 6.230 cm be heated so that it can be fitted on a wooden bangle of diameter 6.241 cm ? Both the diameter have been measured at room temperature (27°C)

Question : (Given coefficient of linear thermal expansion of gold $\alpha_L = 1.4 \times 10^{-5}\ K^{-1}$)

(A) 125.7°C (B) 91.7°C (C) 425.7°C (D) 152.7°C

Ans. **(D)**

Sol. To fit gold ring of diameter 5.230 cm over wooden bangle of diameter 6.241 cm gold ring expansion is required.

$\ell = \ell_0 [1 + \alpha \Delta T]$

$6.241 = 6.230[1 + 1.4 \times 10^{-5}(T - 27)]$

$\frac{6.241}{6.230} - 1 = 1.4 \times 10^{-5}(T - 27)$

$T = 152.7°C$

3. Two point change Q each are placed at a distance d apart. A third point charge q is placed at a distance x from mid-point on the perpendicular bisector. The value of x at which charge q will experience the maximum Coulomb's force is :

Question :

(A) x = d

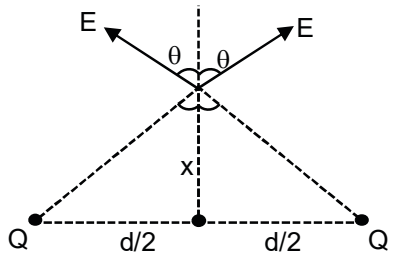
(B) $x = \frac{d}{2}$

(C) $x = \frac{d}{\sqrt{2}}$

(D) $x = \frac{d}{2\sqrt{2}}$

Ans. **(D)**

Sol.



$$F = \frac{1}{4_{\varepsilon_0}} \frac{Q}{\left[x^2 + \left(\frac{d}{2}\right)^2\right]}$$

$E_{net} = 2E\cos\theta$

$$= \frac{2Q}{4\pi\varepsilon_0} \frac{x}{\left[x^2 + \left(\frac{d}{2}\right)^2\right]^{3/2}}$$

$F = qE_{net}$

$$F = \frac{2Q}{4\pi\varepsilon_0} \frac{x}{\left[x^2 + \left(\frac{d}{2}\right)^2\right]^{3/2}}$$

For maximise of F $\frac{dF}{dx} = 0$; $x = \frac{d}{2\sqrt{2}}$

4. The speed of light in media 'A' and 'B' are 2.0×10^{10} cm/s and 1.5×10^{10} cm/s respectively. A ray of light enters from the medium B and A an incident angle 'θ'. If the ray suffers total internal reflection, then.

(A) $q = \sin^{-1}\left(\frac{3}{4}\right)$

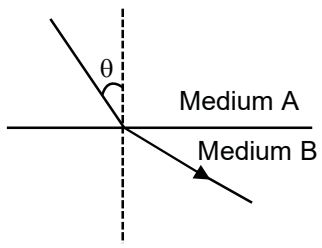
(B) $\theta > \sin^{-1}\left(\frac{2}{3}\right)$

(C) $\theta < \sin^{-1}\left(\frac{3}{4}\right)$

(D) $\theta > \sin^{-1}\left(\frac{3}{4}\right)$

Ans. **(D)**

Sol.



Speed of light in A = V_A

Speed of light in B = V_B

$$\frac{V_A}{V_B} = \frac{\mu_B}{\mu_A}$$

$$\frac{2\times10^{10}}{1.5\times10^{10}} = \frac{\mu_B}{\mu_A}$$

$$\frac{\mu_B}{\mu_A} = \frac{3}{4}$$

Critical angle = $\theta c = \sin^{-1}\frac{\mu A}{\mu B} = \sin^{-1}\frac{3}{4}$

When $\theta > \theta_c$ i.e. $\theta > \sin^{-1}\frac{3}{4}$ TIR take place

5. In the following nuclear reaction,

$$D \xrightarrow{\alpha} D_1 \xrightarrow{\beta^-} D_2 \xrightarrow{\alpha} D_3 \xrightarrow{\gamma} D_4$$

Mass number of D is 182 and atomic number is 74. Mass number and atomic number of D_4 respectively will be____

(A) 174 and 71

(B) 174 and 69

(C) 172 and 69

Ans. **(A)**

Sol. $^{182}_{74}D \xrightarrow[\alpha]{} {}^{178}_{72}D_1 \xrightarrow[\beta^-]{} {}^{178}_{73}D_2 \longrightarrow {}^{174}_{71}D_3 \xrightarrow[r]{} {}^{174}_{71}D_4$

The electron field at a point associated with a light wave is given by

$E = 200\ [\ Sin\ (6 \times 10^{15})\ t + \sin\ (9 \times 10^{15})t\ ]Vm^{-1}$

Given : $h = 4.14 \times 10^{-15}$ eVs

6. If this light falls on a metal surface having a work function of 2.50 eV, the maximum kinetic energy of the photoelectrons will be

(A) 1.90 eV (B) 3.27 eV (C) 3.60 eV (D) 3.42 eV

Ans. **(D)**

Sol. $KE_{max.} = E - \phi$

$$= \frac{h\omega}{2\pi} - \phi$$

$$= \frac{4.14\times10^{-15}\times9\times10^{15}}{2\times3.14} - 2.5 = 5.9 - 2.5 = 3.4eV$$

7. A capacitor is discharging through R. Consider in time t_1, the energy stored in the capacitor reduces to half of its initial value and in time t_2, the charge stored reduce to one eighth of its initial value. The ration t_1/t_2 will be

Question :

(A)1/2 (B)1/3 (C)1/4 (D) 1/6

Ans. **(D)**

Sol. $q = Qe^{-\frac{t}{\pi}}$ $U = \frac{q^2}{2C}$

$$\frac{Q}{\sqrt{2}} = Qe^{-\frac{t_1}{\pi}}$$

$$t_1 = \pi\ell n\sqrt{2}$$

$$\frac{Q}{8} = Qe^{-\frac{t_2}{\pi}}$$

$$t_2 = \pi\ell n8$$

$$\frac{t1}{t2} = \frac{\pi\ell n\sqrt{2}}{\pi\ell n8} = \frac{\frac{1}{2}\pi\ell n2}{3\pi\ell n2} = \frac{1}{6}$$

8. Staring with the initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_1 if the process is purely isothermal. W_2, if the process is purely adiabatic and W_3 if the process is purely isobaric. Then, choose the correct option.

Question :

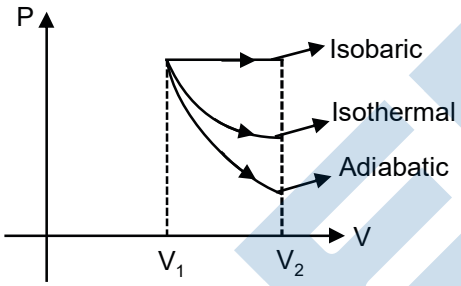
(A) $W_1<W_2<W_3$ (B) $W_2<W_3<W_1$

(C) $W_3<W_1<W_2$ (D) $W_2<W_1<W_3$

Ans. **(D)**

Sol. W = area under P-V curve

So according to graph



$W_3 > W_1 > W_2$

$V_1 \rightarrow V_2$ in three different was

$W_1 \rightarrow$ Isothermal $W_2 \rightarrow$ Adiabatic

$W_3 \rightarrow$ Isobaric

$W_2 < W_1 < W_3$

9. Two long current carrying conductors are placed parallel to each at a distance of 8 cm between them. The magnitude of magnetic field produced at mid-point between the two conductors due to current flowing in them is 300 μT. The equal current flowing in the two conductors is :

(A) 30A in the same direction. (B) 30A in the opposite direction.

(C) 60A in the opposite direction. (D) 300A in the opposite direction.

Ans. **(B)**

Sol. Current is opposite direction

$$B = \frac{2\mu_0 i}{2\pi 4cm} \Rightarrow 300\times10^{-6} = \frac{2\times2\times10^{-7}\times i}{4\times10^{-2}} \Rightarrow 1 = 30\ \text{Amp.}$$

10. The time period of a satellite revolving around earth in a given orbits is 7 hours. If the radius of orbit is increased to three times its previous value, then approximate new time period of the satellite will be.

(A) 40 hours (B) 36 hours (C) 30 hours (D) 25 hours

Ans. **(B)**

Sol. $T^3 \times r^3$

$$\frac{7^2}{T^2} = \left(\frac{R}{3R}\right)^3$$

$$\frac{49}{T^2} = \frac{1}{27}$$

$T^2 = 49 \times 27$

$T = 73\sqrt{3} = 21 \times 1.732$

$=35.7$

11. The TV transmission tower at a particular station has a height of 125 m. For doubling the coverage of its range. the height of the tower should be increased by

(A) 125 m (B) 250 m (C) 375 m (D) 500 m

Ans. **(D)**

Sol. $d = \sqrt{2hR}$

$2d = \sqrt{2h'R}$

$h' = 4h = 4 \times 125 = 500$ m

12. The motion of a simple pendulum executing S.H.M. is represented by the following equation.

$y = A\sin(\pi t + \phi)$, where time is measured in second.

Question : The length of pendulum is

(A) 97.23 cm (B) 25.3 cm (C) 99.4 cm (D) 406.1 cm

Ans. **(C)**

Sol. $\omega = \pi$

$$\sqrt{\frac{g}{t}} = \pi$$

$g = \pi^2 \ell$

$$\ell = \frac{g}{\pi^2} = 1 \text{ m}$$

13. A vessel contains 16g of hydrogen and 128 g of oxygen at standard temperature and pressure. The volume of the vessel in cm^3 is :

(A) 72×10^5 (B) 32×10^5

(C) 27×10^4 (D) 54×10^4

Ans. **(C)**

Sol. Number of moles of Hydrogen $(H_2) = \frac{m}{M} = \frac{16}{2} = 8$

Number of mole of $O_2 = \frac{128}{32} = 4$

$PV = nRT$

Where pressure P = 1 atm 1.01×10^5 Pa (STP)

$T = 0°C = 273$ K (STP)

$1.01 \times 10^5 V = (8 + 4) \times 8.314 \times 273$

$$v = \frac{12 \times 8.314 \times 273}{1.01 \times 10^5} m^3$$

$= 0.27 \times 10^6 \text{ cm}^3 = 27 \times 10^4 \text{ cm}^3$

14. Given below are two statements :

Statement I : The electric force change the charged particle and hence changes its kinetic energy. Whereas the magnetic force does not change the kinetic energy of the charged particle.

Statement II : The electric force accelerates the positively charged particle perpendicular to the direction of electric field. The magnetic force accelerates the moving charged particle along the direction of magnetic field.

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

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

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

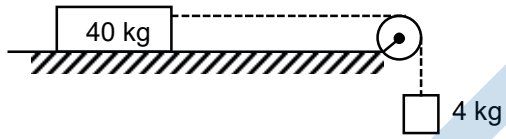
(C) Statement I is correct but Statement II is incorrect.

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

Ans. **(C)**

15. A block of mass 40 kg slides over a surface, when a mass of 4 kg is suspended through an inextensible massless string passing over frictionless pulley as shown below.

The coefficient of kinetic friction between the surface and block is 0.02. The acceleration of block is (Given g = 10ms^{-2})



(A) 1 ms^{-2}

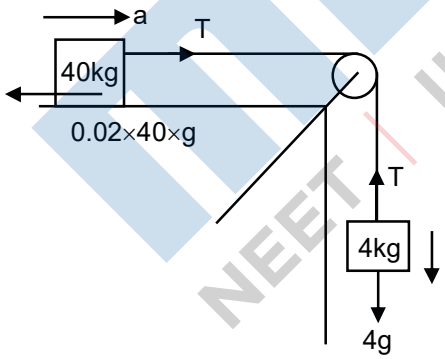
(B) 1/5 ms^{-2}

(C) 4/5 ms^{-2}

(D) 8/11 ms^{-2}

Anc. **(D)**

Sol.



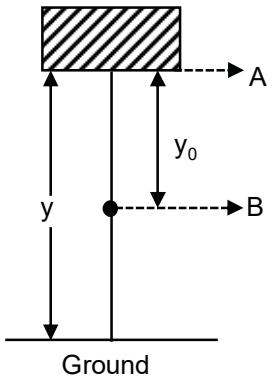
$T - 8 = 40a$

$4g - T = 4a$

$32 = 44a$

$a = \frac{8}{11} m/s^2$

16. In the given figure, the block of mass m is dropped from the point 'A' . The expression for kinetic energy of block when it reaches point 'B' is



(A) $\frac{1}{2}mgy_0^2$

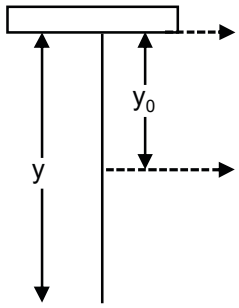
(B) $\frac{1}{2}mgy^2$

(C) $mg\,(y - y_0)$

(D) $mg\,y_0$

Ans. **(D)**

Sol.



Work done by mg = ΔKE

$Mgy_0 = \frac{1}{2}mv^2$

$KE_{final} = mgy_0$

17. A block of mass M placed inside a box descends vertically with acceleration. The block exerts a force equal to one-fourth of its weight on the floor of the

The value of 'a' will be

(A) $\frac{g}{4}$

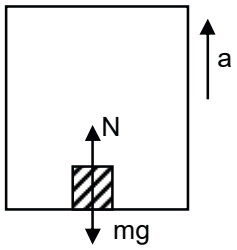
(B) $\frac{g}{2}$

(C) $\frac{3g}{4}$

(D) g

Ans. **(C)**

Sol.



$N - mg = ma$

according of the question $N = \frac{mg}{4}$

$\frac{mg}{4} - mg = ma$

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

$\therefore$ Box is accelerating downward with $\frac{3g}{4}$

18. If the electric potential at any point (x, y, z) m in space is given by $V = 3x^2$ volt. The electric field the point (1, 0, 3) m will be:

(A) 3 Vm^{-1} directed along positive x-axis.

(B) 3Vm^{-1} directed along negative x-axis.

(C) 6Vm^{-1} directed along positive x-axis

(D) 6Vm^{-1} directed along negative x-axis

Ans. **(D)**

Sol. We know that

$E = -\frac{dv}{dx}$

$\Rightarrow \quad E = -\frac{dv}{dx}(3x^2) = -6x$

at (1, 0, 3), $E = -6$

19. The combination of two identical cells, whether connected in series or parallel combination provides the same current through an external resistance of 2Ω. The value of internal resistance of reach cell is:

(A) 2Ω (B) 4Ω (C) 6Ω (D) 8Ω

Ans. **(A)**

Sol. $-\frac{2\varepsilon}{R+2r} = \frac{\varepsilon}{R+\frac{r}{2}}$

$\Rightarrow 2R + r = R + 2r$

$\Rightarrow r = R$

$r = R$

$r = R = 2\Omega$

20. A person can throw a ball upto a maximum range of 100 m. How high above the ground he can throw the same ball?

(A) 25 m (B) 50 m (C) 100 m (D) 200 m

Ans. **(B)**

Sol. $R_{max} = u^2/g = 100m$

$H_{max} = u^2/2g = 50m$

21. The vernier constant of vernier callipers is 0.1 mm and it has zero error of (–0.05 cm. While measuring diameter of a sphere, the main scale reading is 1.7 cm and coinciding vernier division is 5. The corrected diameter will be _____ ×

Ans. **180**

Sol. V.C = 0.1 mm = 0.01 cm

Zero error = –0.05cm

$\therefore$ correction = 0.05 cm

M.S.R = 1.7 cm

V.S.R = 5 × V.C. = 5 × 0.01 = 0.05 cm

diameter = MSR + VSR + correction

1.7 + 0.05 + 0.05 = 1.8 cm

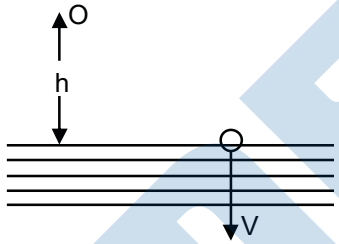
$= 180 \times 10^{-2}$cm

22. A small spherical ball of radius 0.1 mm and density 10^4 kg m^{-3} falls freely under gravity through a distance h before entering a tank of water. If, after entering the water the velocity of ball does not change and it continue to fall with same constant velocity inside water, then the value of h will be _____ m.

(Given g = 10ms^{-2}. viscosity of water = 1.0×10^{-5} N-sm^{-2}).

Ans. **20**

Sol.

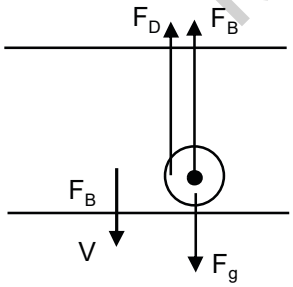


$V^2 = U^2 + 2as$

$V^2 = 0 + 2(-g)(-h)$

$V^2 = 2gh$

$V = \sqrt{2gh} = \sqrt{20h}$



As ball move with constant velocity 'V' so its acceleration is zero $\therefore F_{net} = 0$

$F_D + F_B + Fg = 0$

$$6\eta rv = \frac{4}{3}gr^3[P - \rho_w]$$

$$6\times1\times10^{-5}V=\frac{4}{3}\times10\times\left(0.1\times10^{-3}\right)^2\left[10^4-10^3\right]$$

$$6\times10^{-5}V=\frac{4}{3}\times10\times10^{-8}\times10^3\left[10^{-1}\right]$$

$$6\times1\times10^{-5}V=\frac{4}{3}\times10^{-4}\times9$$

$$\sqrt{20h}=2\times10$$

$20h = 400 \quad \therefore h = 20$ m

23. In an experiment to determine the velocity of sound in air at room temperature using a resonance tube, the first resonance is observed when the air column has a length of 20.0 cm for a tunning fork of frequency 400 Hz is used. The velocity of the sound at room temperature is 336 ms^{-1}. The third resonance is observed when the air column has a length of _____ cm

Ans. **104**

Sol. Wavelength of wave $\Rightarrow \lambda=\frac{V}{t}=\frac{336}{400}=84$cm

At first resonance

$$\frac{\lambda}{4}=\ell+e\Rightarrow\frac{84}{4}=20+e$$

$\Rightarrow e = 1$

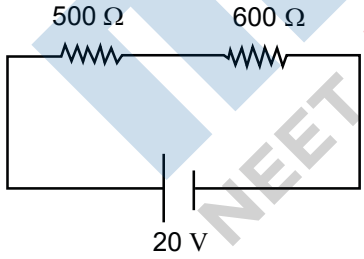
So third resonance length

$$5\frac{\lambda}{4}=\ell+e$$

$5(21) = \ell_2+1$

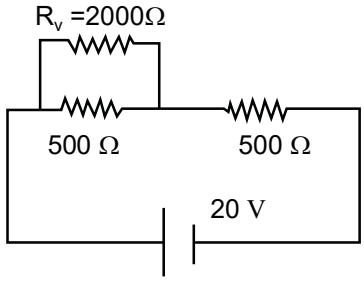
$\ell_2 + 104$ cm

24. Two resistors are connected in series across a battery as shown in figure. If a voltmeter of resistance 2000 Ω is used to measure the potential, difference across 500 Ω resister. the reading of the voltmeter will be _____ V

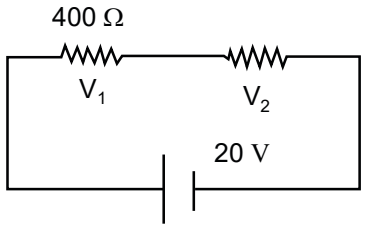


Ans. **8**

Sol.



Parallel equivalent of 2000, 500 $\Rightarrow \frac{2000\times500}{2000+500} = 400\Omega$



Reading of V = V_1

$V_1 = \frac{400}{400+600}\times 20$

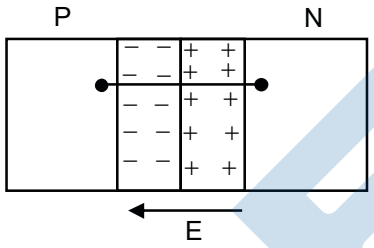
$\frac{400}{1000}\times 20 \Rightarrow \frac{400\times20}{1000} = 8V$

25. A potential barrier of 0.4 V exists across a p-n junction. An electron enters the junction from the n-side with a speed of 6.0×10^5 ms^{-1}. The speed with which electron enters the p side will be $\frac{x}{3}\times10^5$ ms^{-1} the value of x is _____.

(Given mass of electron = 9×10^{-31} kg. change on electron = 1.6×10^{-19} C.)

Ans. **14**

Sol.



$-e \times V_N + \frac{1}{2}mv_1^2 = -eV_P + \frac{1}{2}mv_f^2$

We known $V_N - V_P$ = potential barrier = 0.4V

$-e(V_N - V_P) + \frac{1}{2}mV'^2 = \frac{1}{2}mv_f^2$

$-1.6 \times 10^{-19} \times 0.4 + \frac{1}{2} \times 9 \times 10^{-31} \times 36 \times 10^{10} = \frac{1}{2} \times 9 \times 10^{-31} v_f^2$

$-0.64 \times 10^{-19} + 1.62 \times 10^{-19} = \frac{1}{2} \times 9 \times 10^{-31}\ v_f^2$

$0.98 \times 10^{-19} = 4.5 \times 10^{-31}\ \ v_f^2$

$\frac{0.98\times10^{12}}{4.5} = v_f^2$

$V_f = 0.466666 \times 10^6$

$= 4.6666 \times 10^5$ m/s $= \frac{14}{3}\times10^5 m/s$

26. The displacement current of 4.425 μA is developed in the space between the plates of parallel plate capacitor when volage is charging at a rate of 10^6 Vs^{-1}. The area of each plate of the capacitor is 40 cm^2. The distance between each plate of the capacitor is $x \times 10^{-3}$ m. The value of x is.
(Permittivity of free space. $E_0 = 8.85 \times 10^{-12}$ C^2 N^{-1} m^{-2}) _____

Ans. **8**

Sol. id = displacement current = $\frac{\varepsilon_0 d\phi E}{dt}$

$$id = \frac{\varepsilon_0 d}{dt}(EA)$$

Where $E = \frac{q}{A \in_0}$

$$id = \varepsilon_0 \frac{d}{dt}\left(\frac{qA}{A \in_0}\right) = \frac{dq}{dt} = \frac{d}{dt}(CV)$$

$$id = C\frac{dv}{dt}$$

$$id = \frac{\varepsilon_0 A}{d}\frac{dv}{dt}$$

$$4.425 \times 10^{-6} = \frac{8.85 \times 10^{-12} \times 40 \times 10^{-4} \times 10^6}{d}$$

$$d = 2 \times 10^{-6} \times 10^{-4} \times 10^6 \times 40$$

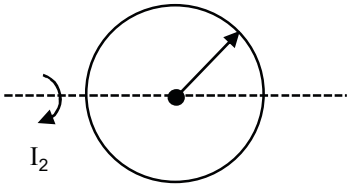
$$d = 80 \times 10^{-4} = 8 \times 10^{-3} \text{ m}$$

27. The moment of inertia of a uniform thin rod about a perpendicular axis passing through one end is I_1. The same rod is bent into a ring and its moment of inertia about a diameter is I_2. If $\frac{I_1}{I_2}$ is $\frac{x\pi^2}{3}$, then the value of x will be _____.

Ans **8**

Sol.

$$I_1 = \frac{m\ell^2}{3}$$



$$2\pi r = \ell$$

$$r = \frac{\ell}{2\pi}$$

$$I_2 = \frac{mr^2}{2} = \frac{m}{2}\left(\frac{\ell}{2\pi}\right)^2$$

$$\frac{I_1}{I_2} = \frac{8}{3}\pi^2$$

28. The half life of a radioactive in 5 years. After x year a given sample of the radioactive substance gets reduced to 6.25% of its initial value. The value of x is _____.

Ans **20**

Sol. Time taken in 50% if T_H

Time taken in 25% is $2T_H$

Time taken in 12.5% is $3T_H$

Time taken in 6.25% is $4T_H$

So $4T_H = 4 \times 5 = 20$ years

29. In a double slit experiment with monochromatic light. fringes are obtained on a screen placed at some distance from the plane of slits. If the screen is moved by 5×10^{-2}m towards the slits, the change in fringe width is 3×10^{-3}cm. If the distance between the slits is 1 mm, then the wavelength of the light will be

Ans **600**

Sol. $\beta = \frac{\lambda D}{d}$ Where d = 1mm

$$\beta = \frac{\lambda D'}{d}$$

As screen is shifted toward slit by 5×10^{-2}m

$\therefore D - D' = 5 \times 10^{-2}\text{m} = 5 \times 10^{-2} \times 1000 = 50\text{mm}$

Fringe width get change by 3×10^{-3}cm

$\therefore \beta - \beta' = 3 \times 10^{-3}\text{cm} = 3 \times 10^{-2}\text{mm}$

$$\beta - \beta = \frac{\lambda}{d}(D - D')$$

$$\lambda = \frac{[\beta - \beta']d}{[D - D]} = \frac{3 \times 10^{-2} \times 1}{50} = 0.6 \times 10^{-3} \text{ mm} = 6 \times 10^{-4} \text{ mm} = 600 \text{ mm}$$

30. An inductor of 0.5 mH, a capacitor 200 μF and a resistor of 2Ω are connected in series with 220 V ac source. If the current is in phase with the emf. the frequency of a source will be _____ $\times 10^2$ Hz

Ans **5**

$L = 0.5 \times 10^{-3}$H $C = 200 \times 10^{-6}$F $R = 2\Omega$

If current is in phase with energy so this is the condition of resonance.

$$f = f_R = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2 \times 3.14\sqrt{LC}}$$

$$f = \frac{1}{6.28\sqrt{0.5} \times 10^{-3} \times 200 \times 10^{-6}} = 503.55 \text{ Hz} = 5.03 \times 10^2 \text{ Hz} = 5$$

PART : CHEMISTRY

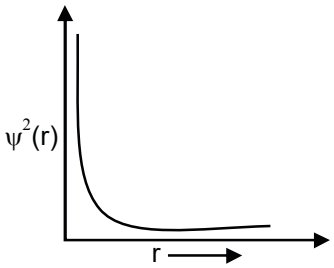
1. Using the rule significant figure, the correct answer for the expression $\frac{0.02858 \times 0.112}{0.5702}$ will be.

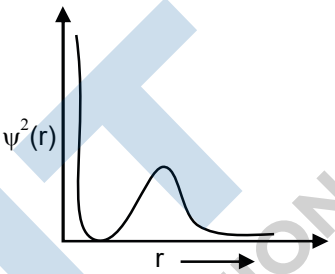
(A) 0.005613 (B) 0.00561 (C) 0.0056 (D) 0.006

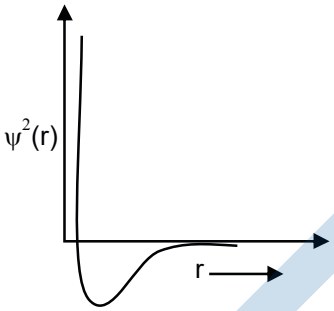
Ans **(B)**

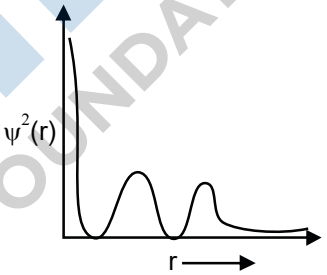
Sol. $\frac{0.0002858 \times 0.112}{0.5702} = \frac{0.0003200}{0.5702} = 0.000561$

2. Which of the following is the correct plot for the probability density ψ^2 (r) as a function of distance 'r' of the electron from the nucleus for 2s orbital?

(A) 

(B) 

(C) 

(D) 

Ans **(B)**

Sol. 2S orbital has one radial node (n – 1 – 1 = 2 – 0 – 1 = 1). ($\psi^2_{(r)} = 0$) at one point.

3. Consider the species CH_4, NH_4 and BH_4. Choose the correct option with respect to the there species.

(A) They are isoelectronic and only two have tetrahedral structure.

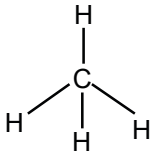
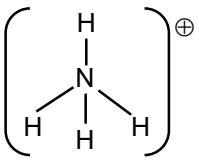
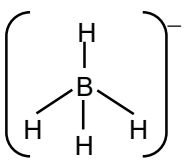
(B) They are isoelectronic and all have tetrahedral structure.

(C) Only two are isoelectronic and all have tetrahedral structure.

(D) Only two are isoelectronic and only two have tetrahedral structure.

Ans **(B)**

Sol.

Species	CH_4	NH_4^+	BH_4^-
No. of electron	10	10	10
Structure	 Tetrahedral	 Tetrahedral	 Tetrahedral

4. 4.0 moles of argon and 5.0 moles of PCl_5 are introduced into an evacuated flask of 100 liter capacity at 610 K. The system is allowed to equilibrate. At equilibrium the total pressure of mixture was found to be 6.0 atm. The K_p for the reaction is

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

(A) 2.25 (B) 6.24 (C) 12.13 (D) 15.24

Ans **(A)**

Sol. $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

5 moles	0	0
(5 – x)	x	x

Total moles at equilibrium = $(5 + x) + n_{Ar} = (5 + x) + 4 = (9 + x)$

$n_{total} = \frac{PV}{RT} = \frac{6\times100}{0.082\times610} = 11.995 = 12$ moles

9 + x = 12 moles

X = 3 moles

Pressure pf (PCl_5 + PCl_3 + Cl_2) = $\frac{8}{12} \times 6 = 4$ atm

$$K_p = \frac{P_{PCl3} \times P_{Cl_2}}{P_{PCl3}} = \frac{\left(\frac{3}{8}\times4\right)\left(\frac{3}{8}\times4\right)}{\left(\frac{2}{8}\times4\right)} = \left(\frac{3}{2}\right)\left(\frac{3}{2}\right) = \left(\frac{9}{4}\right) = 2.25$$

5. A 42.12% (w/v) solution of NaCl causes precipitation of a certain sol in 10 hours. The coagulating value of NaCl for the sol is

[Given: Molar mass : Na = 23.0 g mol^{-1} : Cl = 35.5 g mol^{-1}]

(A) 36 mmol L^{-1} (B) 36 mol L^{-1} (C) 1440 mol L^{-1} (D) 1440 mmol L^{-1}

Ans **(D)**

Sol. Coagulation value = $\frac{\text{milimoles of electrolyte}}{\text{Volume of solution in L}}$

Molarity of NaCl = $\frac{\%(w/v)\times10}{GMM} = [\frac{42.14\times10}{58.5}] = 72$ M

Coagulation of value for 10 hours = $\frac{\text{milimoles of electrolyte}}{\text{Volume of solution in L}} = 72000$

For 2 hours coagulation value = $\left(\frac{72000\times2}{10}\right) = 1440$ milimole

6. Given below are two statements One is labelled as **Assertion A** and the other is labelled as **Reason R.**
Assertion A : The first ionization enthalpy fir oxygen is lower than that of nitrogen
Reason R : The four electrons is 2_P orbitals of oxygen experience more electron-electron repulsion.
In the light of the above statement, choose the **correct** answer from the options given below.
(A) Both **A** and R are correct and **R** is the correct explanation od **A.**
(B) Both **A** and R are correct bur **R** is NOT the correct explanation of **A.**
(C) **A** is correct but **R** is not correct.
(D) **A** is not correct but **R** is correct.

Ans **(A)**

Sol. Resonance is (B) NTA answer is (A)

7. Match **List I** with **List II**

List I Ore	List II Composition

A. Siderite	I. $FeCO_3$
B. Malachite	II. $CuCO_3.Cu(OH)_2$
C. Sphalerite	III. ZnS
D. Calamine	IV.$ZnCO_3$

Choose the correct answer from the options given below:
(A) A-I, B-II, C-III, D-IV
(B) A-III, B-IV, C-II, D-I
(C) A-IV, B-III, C-I, D-II
(D) A-I, B-II, C-IV, D-III

Ans **(A)**

Sol. Siderite ⇒ $FeCO_3$

Malachite ⇒ $CuCO_3.Cu(OH)_2$

Carnalite ⇒ $KCl.MgCl_2.6H_2O$

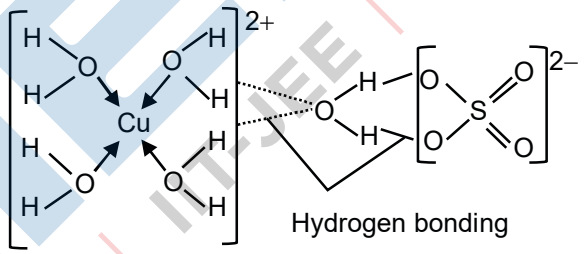
Calamine ⇒ $ZnCO_3$

8. Given the below are two statements.
- Statement I : In $CuSO_4.5H_2O$, Cu-O bonds are presents.
- Statement II : In $CuSO_4.5H_2O$, ligands coordinating with Cu(II) ion are O-and S-based ligands

In the light of the above statements, choose the **correct** answer from the options given below.
(A) Both statement I and Statement II are correct.
(B) Both Statement I and Statement II are correct.
(C) Statement I is correct but Statement II is incorrect.
(D) Statement I is incorrect but statement II is correct.

Ans **(C)**

Sol. $CuSO_4.5H_2O \Rightarrow [Cu(H_2O)_4]SO_4.H_2O$



9. Amongst baking soda, caustic soda and washing soda, carbonate anion is present in
(A) washing soda only.
(B) Washing soda and baking soda only.
(C) Washing soda and baking soda only.
(D) Baking soda caustic soda and washing soda.

Ans **(A)**

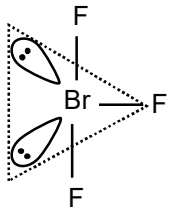
Sol.

Compound	Fromula
(1) Baking soda	$NaHCO_3$
(2) Washing soda	$Na_2CO_3.10H_2O$
(3) Caustic soda	NaOH

10. Number of lone pair(s) of electron on central atom and the shape of BrF_3 molecular respectively. are
(A) 0, triangular planer
(B) 1, Pyramidal
(C) 2 bent T-shape
(D) 1. Bent T-shape

Ans **(C)**

Sol.



Bent T-shape with two unpaired electron.

11. Aqueous solution of which of the following boron compounds will be strongly basic is nature?

(A) $NaBH_4$ (B) $LiBH_4$ (C) B_2H_6 (D) $Na_2B_4O_7$

Ans **(D)**

Sol. $Na_2B_4O_7$ on reaction with water gives NaOH and H_3BO_3

12. Sulphur dioxide is one of the compounds of polluted air. SO_2 is also a major contributor to acid rain. The correct and complete reaction to represent acid rain caused SO_2 is

(A) $2SO_2 + O_2 \rightarrow 2\ SO_3$

(B) $SO_2 + O_3 \rightarrow SO_3 + O_2$

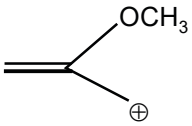
(C) $SO_2 + H_2O_2 \rightarrow H_2SO_4$

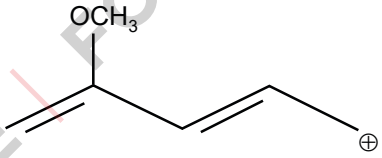
(D) $2SO_2 + O_2 + 2H_2O \rightarrow 2H_2SO_4$

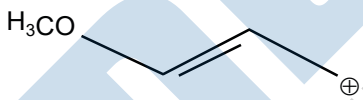
Ans **(D)**

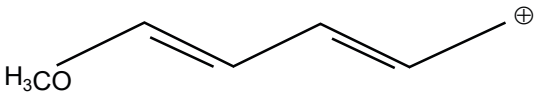
Sol. It is fact

13. Which of the following carbocations is most stable?

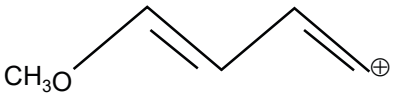
(A) 

(B) 

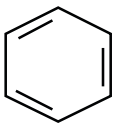
(C) 

(D) 

Ans **(D)**

Sol. Due to extend conjugation most stable carbocation is 

.

14.  $+ CH_3CH_2CH_2Cl \xrightarrow{\text{Anhydrous, } AlCl_3}$ 'A'

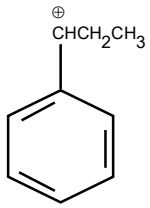
Major Product

The stable carbocation formed in the above reaction is

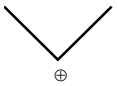
(A) $CH_3CH_2\overset{\oplus}{C}H_2$

(B) $CH_3\overset{\oplus}{C}H_2$

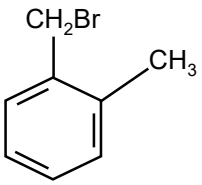
(C) $CH_3 - \overset{\oplus}{C}H - CH_3$

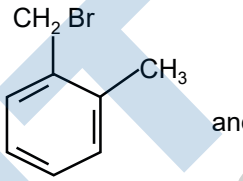
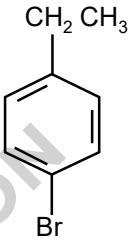
(D) 

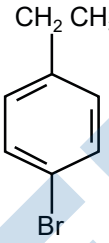
Ans **(C)**

Sol. $CH_3-CH_2-CH_2-Cl \xrightarrow{AlCl_3} CH_3-CH_2-CH_2^+ \xrightarrow{\text{Rearrangement}}$ 

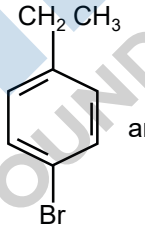
15. Two isomers (A) and (B) with Molar mass 184 g/mol and elemental composition C, 52.2%; H, 4.9% and Br 42.9% gave benzoic acid and p-bromobenzoic acid, respectively on oxidation with $KMnO_4$. Isomer 'A' is optically active and give a pale yellow precipitate when warmed with alcoholic $AgNO_3$. Isomer 'A' and 'B' are. respectively

(A) $H_3C-CHBr-C_6H_5$ and 

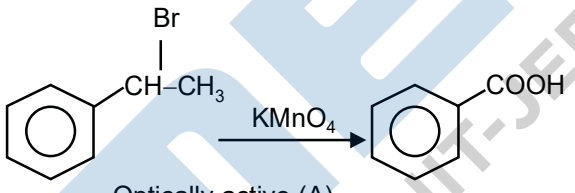
(B)  and 

$H_3C-CHBr-C_6H_5$ and 

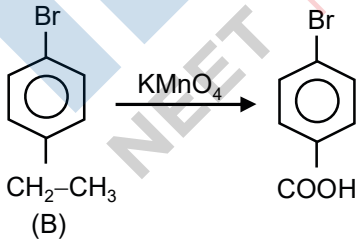
(C)

(D)  and $H_3C-CHBr-C_6H_5$

Ans **(C)**

Sol. 

Optically active (A)

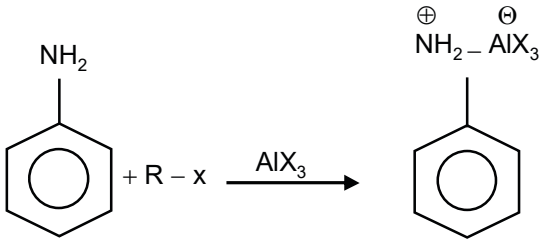


(B)

16. In Friedel-Crafts alkylation of aniline, one gets
(A) alkylated product with ortho and para substitution
(B) secondary amine after acidic treatment.
(C) an amide product
(D) positively charged nitrogen at benzene ring.

Ans **(D)**

Sol.



2°amine

17. Given below are two statement one is labelled as **Assertion A** and the other is labelled as **Reason R.**
Assertion A: Dacron is an example of polyester polymer.
Reason R: Dacron is made up to ethylene glycol and terephthalic acid monomers.
In the light of the above statements, choose the most appropriate answer from the option 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 but **R** is not correct.
(D) **A** is correct but **R** is correct.

Ans **(A)**

Sol. It is fact.

18. The structure of protein that is unaffected by heating is
(A) Secondary structure (B) tertiary structure
(C) primary structure (D) quaternary structure

Ans **(C)**

Sol. During denaturation of protein 2 and 3 structure destroyed but 1° structure remain intact.

19. The mixture of chloroxylenol and terpineol is an example of
(A) antiseptic (B) pesticide
(C) disinfectant (D) narcotic analgesic

Ans **(A)**

Sol. Commonly used antiseptic Dettol is mixture of chloroxylenol and terpineol.

20. A white precipitate was formed when $BaCl_2$ was added to water extract of an inorganic salt. Further, a gas 'X' with characteristic odour was released when the formed white precipitate was dissolved in dilute HCl. The anion present in the inorganic salt is
(A) I^- (B) SO_3^{2-} (C) S^{2-} (D) NO_2^-

Ans **(B)**

Sol. $SO_3^{2-} + Ba^{2+} \longrightarrow BaSO_3\downarrow$ (White ppt) $\xrightarrow{\text{dil HCl}} SO_2(g)\uparrow$ (Burning sulphur like smell) $S^{2-} + Ba^{2+} \longrightarrow$ No ppt

21. A box contain 0.90 g of the liquid water in equilibrium with water vapour at 27°C. The equilibrium vapour pressure of water at 27°C is 32.0 Torr. When the volume of the box is increased. Some of the liquid water evaporates to maintain the equilibrium pressure. If all the liquid water evaporates, then the volume of the box must be _____ liter. [nearest integer]
(Given: R = 0.082 L atm K^{-1} mol^{-1})
(Ignore the volume of the liquid water and assume water vapours behave as an ideal gas.)

Ans **29**

Sol. PV = nRT

$$\frac{32}{760} \times V = \frac{0.9}{18} \times 0.082 \times 300$$

V = 29.12 Liter ≈ 29

22. 2.2 g of nitrous oxide (N_2O) gas is cooled at a constant pressure of 1 atm from 310 K to 270 K causing the compression of the gas from 217.1 mL to 167.75 mL. The change in internal energy of the process. ΔU is '–x' J. The value of 'x' is _____.
[nearest integer]
(Given atomic mass of N = 14 g mol^{-1} and of O = 16 g mol^{-1}.
Molar heat capacity of N_2O is 100 JK^{-1} mol^{-1})

Ans **195**

Sol. Mass of nitrous oxide (N_2O) = 2.2 gram
Pressure constant = (1 atm)
T_1 = 310 K V_1 = 217.1 ml
T_2 = 270 K V_2 = 167.75 ml

Molar heat capacity of N2O = $100 \frac{J}{K \times mole}$

$q = nC_m\Delta T$

No. of mole = $\frac{2.2}{44} = 0.05$

$q = -0.05 \times 100 \times 40$

$= -200 \frac{J}{K \times mole}$

$W = -P\Delta V$

$= 1 \times [167.75 - 217.1] \times 10^{-3}$

$= 49.35 \times 10^{-3}$ atm × liter

$= 49.35 \times 10^{-3} \times 101.352$ J

= 5J

$\Delta U = q + w$

$= -200 + 5$

$= -195$ J

23. Elevation in boiling point for 1.5 molal solution of glucose in water is 4 K. The depression in freezing point for 4.5 molal solution of glucose in water is 4K. The ratio of molal elevation constant to molal depression constant (K_b/K_f) is _____.

Ans **3**

Sol. $\Delta T_b = K_b \times m_1$

$\Delta T_f = K_f \times m_2$

$\Rightarrow \frac{\Delta Tb}{\Delta Tf} = \frac{Kb \times 1.5}{Kf \times 4.5} = \frac{4k}{4k}$

$\frac{Kb}{Kf} = 3$

24. The cell potential for the given cell at 298 K

$Pt | H_2$ (g,1 bar) | H^+ (aq) || Cu^{2+} (aq) | Cu (s)

Is 0.31V. The pH of the acidic solution is found to be 3, whereas concentration of Cu^{2+} is 10^{-x} M. The value of x is _____.

(Given $E^{\Theta}_{Cu2+/Cu}$ = 0.34 V and $\frac{2.303RT}{F}$ =0.06)

Ans **7**

Sol. **Anode :** $H_2(g) \longrightarrow 2H^+ + 2e^-$

Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu(s)$

Overall : $H2(g) + Cu^{2+}(aq) \longrightarrow 2H^+(aq) + Cu(s)$

$$E_{cell} = E°_{cell} - \frac{0.059}{2} \log \frac{[H^+]^2}{[Cu^{2+}]}$$

$$0.31 = 0.34 - \frac{0.06}{2} \log \left(\frac{[H^+]^2}{[Cu^{2+}]} \right)$$

$0.31 = 0.34 + 0.03 [-\log [H^+]^2 + \log [Cu^{2+}]$
$0.31 = 0.34 + 0.03 [\ 2pH + \log [Cu^{2+}]$
$-0.03 = 0.03 [\ 2pH + \log [Cu^{2+}]$
$-1 = 6 + \log [Cu^{2+}]$
$-7 = \log [Cu^{2+}]$
$\text{Log } [Cu^{2+}] = \log 10^{-7}$
$[Cu^{2+}] = 10^{-7}$
$X = 7$

25. The equation
$K = (6.5 \times 10^{12} s^{-1}) e^{-26000K/T}$
is followed for the decomposition of compound A. The activation energy for the reaction is _____ KJ mol^{-1}. [nearest integer]
(Given: R = 8.314 JK^{-1} mol^{-1})

Ans **216**

Sol. $K = Ae^{-\left(\frac{Ea}{R}\right)/T}$

$K = 6.5 \times 10^{-12} e^{-26000K/T}$

$\left(\frac{Ea}{R}\right) = 26000 = 26 \times 10^3$

$Ea = 26 \times 10^3 \times 8.314 = 216.164 \times 10^3\ J = 216.164\ KJ$

26. Spin only magnetic moment of $[MnBr_6]^{4-}$ is _____ B.M (round off to the closest integer)

Ans **6**

Sol. $[MnBr_6]^{4-}$
$_{25}Mn^{2+} = 3d^5 4s° \Rightarrow t_{2g}^{1,1,1}, eg^{1,1}$
number of unpaired electrons = 5
μ (spin only) $= \sqrt{n(n+2)}BM = \sqrt{5(5+2)}BM = \sqrt{35}BM = 5.916BM \approx 6BM$

27. For the reaction given below :
$CoCl_3 . x\ NH_3 + Ag\ NO_3(aq) \rightarrow$
If two equivalents of AgCl precipitate out, then the value of x will be _____.

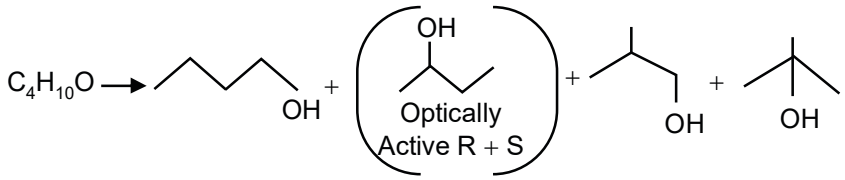
Ans **5**

Sol. $CoCl_3.xNH_3 + AgNO_3(\text{excess}) \longrightarrow AgCl$
1 mole **2 moles**
It means 2 Cl are outsaid the Co- ordinations sphere & Co-Ordination number of Co is 6
So possible complex is $[Co(NH_3)_5Cl]Cl_2$
So x = 5

28. The number of chiral alcohol(s) with molecular formula $C_4H_{10}O$ is _____'

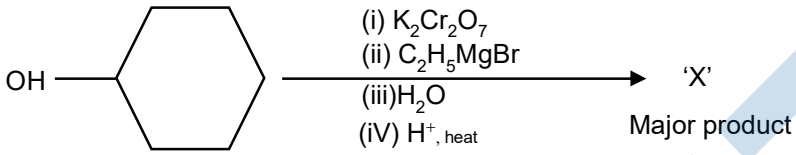
Ans **(2)**

Sol.



Only 2- Butanol is chiral with R or S configuration..

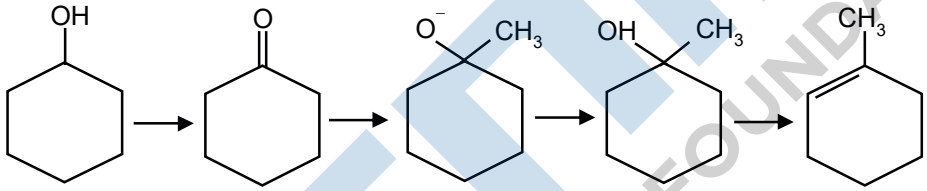
29. In the given reaction.



the number of Sp2 hybridised carbon(s) in compound 'X' is _____.

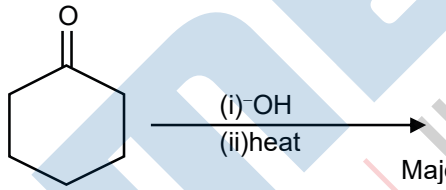
Ans **(8)**

Sol.



No. of sp^2 carbon are 2 in final product.

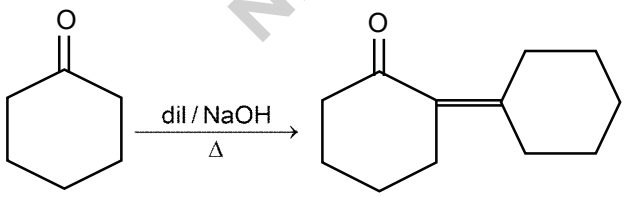
30. In the given reaction.



The number of electrons present in the product 'P' is _____.

Ans **(4)**

Sol.



PART : MATHEMETICS

1. Let α be a root of the equation $1 + x^2 + x^4 = 0$. Then the value of $\alpha^{1011} + \alpha^{2022} - \alpha^{3033}$ is equal to:

(A) 1 (B) α (C) $1 + \alpha$ (D) $1 + 2\alpha$

Ans. (A)

Sol. $x^4 + x^2 + 1 = 0$

α is a root $\therefore \alpha^4 + \alpha^2 + 1 = 0$

$\Rightarrow \alpha^2 = \omega$ or ω^2

Now $\alpha^{1011} + \alpha^{2022} - \alpha^{3033}$

$= \alpha.(\alpha^2)^{505} + (\alpha^2)^{1011} - \alpha.(\alpha^2)^{1516}$

$= \alpha.\omega^{505} + \omega^{1011} - \alpha.\omega^{1516}$

$= \alpha\omega + 1 - \alpha\omega$

$= 1$

2. Let arg(z) represent the principal argument of the complex number z. Then

$|z| = 3$ and $\arg(z-1) - \arg(z+1) = \frac{\pi}{4}$ intersect

(A) exactly at one point. (B) exactly at two points.

(C) nowhere (D) at infinitely many points.

Ans. (C)

3. Let $A = \begin{pmatrix} 2 & -1 \\ 0 & 2 \end{pmatrix}$. If $B = I - {}^5C_1(\text{adj}A) + {}^5C_2(\text{adj}A)^2 - \ldots - {}^5C_5(\text{adj}A)$, then the sum of all elements of the matrix B is

(A) –5 (B) –6 (C) –7 (D) –8

Ans. (C)

Sol. $B = (I - (\text{adj}\,A)^5 = \left(\begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} - \begin{bmatrix} 2 & 1 \\ 0 & 2 \end{bmatrix}\right)^5 = \begin{bmatrix} -1 & -1 \\ 0 & -1 \end{bmatrix} = C^5$

$C^2 = \begin{bmatrix} -1 & -1 \\ 0 & -1 \end{bmatrix}\begin{bmatrix} -1 & -1 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$

$C^4 = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 4 \\ 0 & 1 \end{bmatrix}$

$B = C^4C = \begin{bmatrix} 1 & 4 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} -1 & -1 \\ 0 & -1 \end{bmatrix} = \begin{bmatrix} -1 & -5 \\ 0 & -1 \end{bmatrix}$

Sum if elements = (– 1) + (– 5) + (– 1) = – 7

4. The sum of the infinite series $1+\frac{5}{6}+\frac{12}{6^2}+\frac{22}{6^3}+\frac{35}{6^4}+\frac{51}{6^5}+\frac{70}{6^6}+.....$ is equal to:

(A) $\frac{425}{216}$

(B) $\frac{429}{216}$

(C) $\frac{288}{125}$

(D) $\frac{280}{125}$

Ans. (C)

Sol. $\text{Let } S=1+\frac{5}{6}+\frac{12}{6^2}+\frac{22}{6^3}+.....(1)$

$$\frac{S}{6}=\frac{1}{6}+\frac{5}{6^2}+\frac{12}{6^3}+.....(2)$$

Equation (1) – (2)

$$\frac{5S}{6}=1+\frac{4}{6}+\frac{7}{6^2}+\frac{10}{6^3}+.....(3)$$

$$\frac{5S}{36}=\frac{1}{6}+\frac{4}{6^2}+\frac{7}{6^3}+.....(4)$$

Equation (3) – (4)

$$\frac{25S}{36}=1+\frac{3}{6}+\frac{3}{6^2}+\frac{3}{6^3}+.....$$

$$=1+\frac{\frac{3}{6}}{1-\frac{1}{6}}=1+\frac{3}{5}$$

$$\frac{25S}{36}=\frac{8}{5}\Rightarrow S=\frac{288}{125}$$

5. The value of $\lim\limits_{x\to1}\frac{\left(x^2-1\right)\sin^2(\pi x)}{x^4-2x^3+2x-1}$ is equal to:

(A) $\frac{\pi^2}{6}$

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

(C) $\frac{\pi^2}{2}$

(D) π^2

Ans. (D)

Sol. Given $\lim\limits_{x\to1}\frac{\left(x^2-1\right)\sin^2\pi x}{x^4-2x^3+2x-1}$

$$=\lim_{x\to1}\frac{(x-1)(x+1)\sin^2\pi x}{(x-1)^3(x+1)}$$

Put x = 1 + h

$$=\lim_{h\to0}\frac{\sin^2\pi(1+h)}{(1+h-1)^2}$$

$$\lim_{h\to0}\pi^2\frac{\sin^2\pi h}{\pi^2h^2}=\pi^2$$

6. Let $f: R \to R$ be a function defined by $f(x) = (x-3)^{n_1}(x-5)^{n_2}$, $n_1, n_2 \in N$. Then, which of the following is NOT true?

(A) For $n_1 = 3$, $n_2 = 4$, there exists $\alpha \in (3,5)$ where f attains local maxima.

(B) For $n_1 = 4$, $n_2 = 3$, there exists $\alpha \in (3,5)$ where f attains local maxima.

(C) For $n_1 = 3$, $n_2 = 5$, there exists $\alpha \in (3,5)$ where f attains local maxima.

(D) For $n_1 = 4$, $n_2 = 6$, there exists $\alpha \in (3,5)$ where f attains local maxima.

Ans. (C)

7. Let f be a real valued continuous function on [0,1] and

$$f(x)=x+\int_0^1(x-1)f(t)dt.$$

Then, which of the following points (x, y) lies on the curve y = f(x)?

(A) (2, 4)

(B) (1, 2)

(C) (4, 17)

(D) (6, 8)

Ans. (D)

8. If $\int_0^2\left(\sqrt{2x}-\sqrt{2x-x^2}\right)dx=\int_0^1\left(1-\sqrt{1-y^2}-\frac{y^2}{2}\right)dy+\int_1^2\left(2-\frac{y^2}{2}\right)dy+I$

Then I equals

(A) $\int_0^1 \left(1+\sqrt{1-y^2}\right)dy$

(B) $\int_0^1 \left(\frac{y^2}{2}-\sqrt{1-y^2}+1\right)dy$

(C) $\int_0^1 \left(1-\sqrt{1-y^2}\right)dy$

(D) $\int_0^1 \left(\frac{y^2}{2}\sqrt{1-y^2}+1\right)dy$

Ans. (C)

9. If y = y(x) is the solution of the differential equation $\left(1+e^{2x}\right)\frac{dy}{dx}+2\left(1+y^2\right)e^x=0$ and y (0) = 0, then $6\left(y'(0)+\left(y\left(\log_e\sqrt{3}\right)\right)^2\right)$ is equal to

(A) 2

(B) – 2

(C) – 4

(D) – 1

Ans. (C)

10 Let p : $y^2 = 4ax$, a > 0 be a parabola with focus S. Let the tangents to the parabola P make an angle of $\frac{\pi}{4}$ with the line y = 3x + 5 touch the parabola P at A and B. Then the value of a for which A, B and S are collinear is

(A) 8 only

(B) 2 only

(C) $\frac{1}{4}$ only

(D) any a > 0

Ans. (D)

11. Let a triangle ABC be inscribed in the circle $x^2-\sqrt{2}(x+y)+y^2=0$ such that $\angle BAC=\frac{\pi}{2}$. If the length of side AB is $\sqrt{2}$, then the area of the ΔABC is equal to :

(A) $\left(\sqrt{2}+\sqrt{6}\right)/3$

(B) $\left(\sqrt{6}+\sqrt{3}\right)/2$

(C) $\left(3+\sqrt{3}\right)/4$

(D) $\therefore OG = \sqrt{4+4} = 2\sqrt{2}$

Ans. (BONUS)

12. Let $\Rightarrow \frac{x-2}{3} = \frac{y+1}{-2} = \frac{z+3}{-1}$ lie on the plane px – qy + z = 5, for some p, q $\in$ R. The shortest distance of the plane from the origin is:

(A) $\sqrt{\frac{3}{109}}$

(B) $\sqrt{\frac{5}{142}}$

(C) $\frac{5}{\sqrt{71}}$

(D) $\frac{1}{\sqrt{142}}$

Ans. (B)

13. The distance of the origin from the centroid of the triangle whose two sides have the equations x – 2y + 1 = 0 and 2x – y –1 = 0 and whose orthocenter is $\vec{r} = -\hat{k} + \lambda\left(\hat{i}+\hat{j}+\hat{k}\right), \lambda \in R.$ is:

(A) $\sqrt{2}$

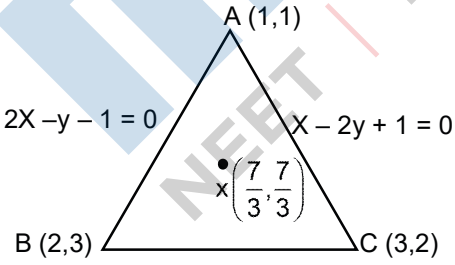
(B) 2

(C) $2\sqrt{2}$

(D) 4

Ans. (C)

Sol.



attitude through B is 2x + y + λ = 0

$\Rightarrow \frac{14}{3} + \frac{7}{3} + \lambda = 0$

λ = –7

$\therefore$ altitude is 2x + y – 7 = 0

Equation of AB is 2x – y – 1 = 0

$\therefore$ B(2, 3), similarly C(3, 2)

$\therefore$ centroid G(2, 2)

$\therefore OG = \sqrt{4+4} = 2\sqrt{2}$

14. Let Q be the mirror image of the point P(1, 2, 1) with respect to the plane x + 2y + 2z =16. Let T be a plane passing through the point Q and contains the line $\vec{r} = -\hat{k} + \lambda(\hat{i} + \hat{j} + \hat{k}), \lambda \in R$. Then, which of following points lies on T?

(A) (2, 1, 0)

(B) (1, 2, 1)

(C) (1, 2, 2)

(D) (1, 3, 2)

Ans. (B)

15. Let A, B, C be three points whose position vectors respectively are

$\vec{a} = \hat{i} + 4\hat{j} + 3\hat{k}$

$\vec{b} = 2\hat{i} + \alpha\hat{j} + 4\hat{k}, \alpha \in R$

$\vec{c} = 3\hat{i} + 2\hat{j} + 5\hat{k}$

If is the smallest positive integer for which are noncollinear, then the length of the median, in Δ ABC, through A is :

(A) $\frac{\sqrt{82}}{2}$

(B) $\frac{\sqrt{62}}{2}$

(C) $\frac{\sqrt{69}}{2}$

(D) $\frac{\sqrt{66}}{2}$

Ans. (A)

16. The probability that a relation R from {x, y} to {x, y} is both symmetric and transitive, is equal to

(A) $\frac{5}{16}$

(B) $\frac{9}{16}$

(C) $\frac{11}{16}$

(D) $\frac{13}{16}$

Ans. (A)

17. The number of values of $\alpha \in N$ such that the variance of $3, 7, 12, \alpha, 43 - \alpha$ is a natural number is :

(A) 0

(B) 2

(C) 5

(D) infinite

Ans. (A)

18. From the base of a pole of height 20 meter, the angle of elevation of the top of a tower is 60°. The pole subtends an angle 30° at the top of the tower. Then the height of the tower is :

(A) $15\sqrt{3}$

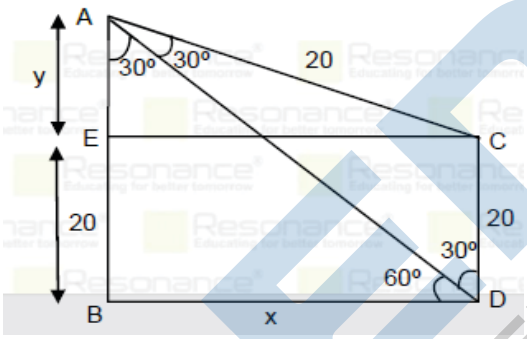
(B) $20\sqrt{3}$

(C) $20 + 10\sqrt{3}$

(D) 30

Ans. (D)

Sol.



In ΔABD

$\tan 60° = \frac{20+y}{x}$.....(1)

In ΔAEC

$\tan 60° = \frac{y}{20} = \frac{1}{2} \Rightarrow y = 10$ .....(2)

Height of tower = 20 + y = 30m

19. Negation of the Boolean statement $(p \vee q) \Rightarrow ((\sim r) \vee p)$ is equivalent to

(A) $p \vee (\sim q) \wedge r$

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

(C) $(\sim p) \wedge q \wedge r$

(D) $p \vee q \wedge (\sim r)$

Ans. (C)

Sol. Given $(p \vee q) \Rightarrow (\sim r) \vee p$

$\therefore$ Negation is $(p \vee q) \wedge \sim (\sim r \vee p)$

$= (p \vee q) \wedge (r \vee \sim p)$

$= (q \wedge \sim p) \wedge r$

20. Let $n \geq 5$ be an integer. If $9^n - 8n - 1 = 64\alpha$ and $6n - 5n - 1 = 25\beta$ equal to.

(A) $1 + {}^nC_2 (8 - 5) + {}^nC_3 (8^2 - 5^2) + \ldots + {}^nC_n (8^{n-1} - 5^{n-1})$

(B) $1 + {}^nC_3 (8 - 5) + {}^nC_4 (8^2 - 5^2) + \ldots + {}^nC_n (8^{n-2} - 5^{n-2})$

(C) ${}^nC_3 (8 - 5) + {}^nC_4 (8^2 - 5^2) + \ldots + {}^nC_n (8^{n-2} - 5^{n-2})$

(D) ${}^nC_4 (8 - 5) + {}^nC_5 (8^2 - 5^2) + \ldots + {}^nC_n (8^{n-3} - 5^{n-3})$

Ans. (C)

21. Let $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{c}$ be a vector such thet $\vec{a} + (\vec{b} \times \vec{c}) = \vec{0}$ and $\vec{b} \cdot \vec{c} = 5$. Then, the value of $3(\vec{c} \cdot \vec{a})$ is equal to__.

Ans. 10

22. Let y = y(x), x > 1, be the solution of the differential equation

$(x-1)\frac{dy}{dx} + 2xy = \frac{1}{x-1}$, with $y(2) = \frac{1+e^4}{2e^4}$. If $y(3) \frac{e^\alpha + 1}{\beta e^\alpha}$. than the value of

$\alpha + \beta$ is equal to __.

Ans. 14

23. Let 3, 6, 9, 12…. upto 78 terms and 5, 9, 13, 17…. upto 59 terms be two series Then, the sum of the terms common to both the series is equal to__.

Ans. 2223

Sol. 3,6,9 ……upto 78^{th} term

$t_{78} = 3 + (78 - 1)\, 3 = 234$

5,9,13,17.....upto 59^{th} term

$T_{59} = 5 + (59-1)\, 4 = 237$

Now series of common term is

9,21,33.....

$t_n = 9 + (n-1)\, 12 \leq 234$

$12n \leq 237$

$n \leq 19.75 \Rightarrow n = 19$

$\therefore S_{19} = \frac{19}{2}[18 + (19-1)12] = 19 \times 117 = 2223$

24. The number of solution of the equation $\sin x = \cos^2 x$ in the interval (0, 10) is__.

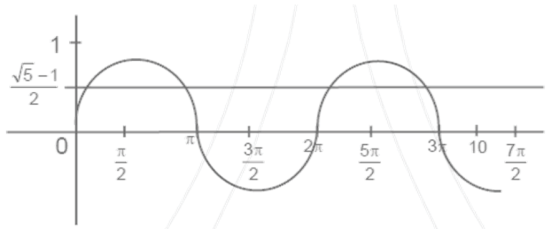
Ans. 4

Sol. Given equation $\sin x = \cos^2 x$

$\Rightarrow \sin^2 x + \sin x - 1 = 0$

$\Rightarrow \sin x = \frac{-1\pm\sqrt{5}}{2}$

$\Rightarrow \sin x = \frac{\sqrt{5}-1}{2}$



$\therefore$ Number of solution = 4

25. For real number a, b (a > b > 0), let

Area $\left\{(x,y) : x^2 + y^2 \leq a^2 \text{ and } \frac{x^2}{a^2} + \frac{y^2}{b^2} \geq 1\right\} = 30\pi$

and

Area $\{(x, y) : x^2 + y^2 \geq b^2 \text{ and } \frac{x^2}{a^2} + \frac{y^2}{b^2} \leq 1\} = 18\pi$

: Then the value of $(a - b)^2$ is equal to__.

Ans. 12

26. Let f and g be twice differentiable even functions on (–2, 2) such that

$f\left(\frac{1}{4}\right) = 0$, $f\left(\frac{1}{2}\right) = 0$, $f(1) = 1$ and $g\left(\frac{3}{4}\right) = 0$. $g(1) = 2$

Than, the minimum number of solutions of $f(x)\, g''(x) + f'(x)\, g'(x) = 0$ in (–2, 2) is equal to__.

Ans. 4

27. Let the coefficients of x^{-1} and x^{-3} in the expansion of $\left(2x^{\frac{1}{5}} - \frac{1}{x^{\frac{1}{5}}}\right)^{15}$, x > 0, be m and n respectively. If r is a positive integer such that $mn^2 = {}^{15}C_r \cdot 2^r$, then the value of r is equal to__.

Ans. 5

28. The total number of four digit number such that each of first three digits is divisible by the last digit, is equal to_____.

Ans. 1086

29. Let $M = \begin{bmatrix} 0 & -\alpha \\ \alpha & 0 \end{bmatrix}$, where α is a non-zero real number an $N = \sum_{k=1}^{49} M^{2k}$. If $(I - M^2) N = -2I$, then the positive integral valve of α is__.

Ans. 1

30. Let f(x) and g(x) be two real polynomials of degree 2 and 1 respective. If $f(g(x)) = 8x^2 - 2x$, and $g(f(x)) = 4x^2 + 6x + 1$. then the value of f(2) + g(2) is_____.

Ans. 1