JEE MAIN

COURSE
NUCLEUS

TEST CODE				
1	1	3	1	6

MOCK TEST-12

Class: **XII** ***Time:*** **3 Hours.** ***Max. Marks:*** **360**

IMPORTANT INSTRUCTIONS

1. The question paper consists of **'90'** objective type questions. There are **'30'** questions each in **Physics** , **Chemistry** and **Mathematics** respectively. **Please fill the OMR answer Sheet accordingly and carefully.**

2. Each question has four choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

3. You will be **awarded 4 marks** for each question, if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble are darkened. In all other cases, **minus one (–1) mark** will be awarded.

4. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 3 above.

5. Use **Black or Blue Ball Point Pen** only for filling particulars.

6. Use of **Calculator, Log Table, Slide Rule and Mobile** is not allowed.

7. Rough work is to be done on the space provided at the bottom and in end of the booklet for this purpose in the Test Booklet only.

8. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator. However, the candidates are allowed to take away this Test Booklet with them.

9. Do not fold or make any stray marks on the Answer Sheet.

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USEFUL DATA

Atomic weights: Al = 27, Mg = 24, Cu = 63.5, Mn = 55, Cl = 35.5, O = 16, H = 1, P = 31, Ag = 108, N = 14, Li = 7, I = 127, Cr = 52, K=39, S = 32, Na = 23, C = 12, Br = 80, Fe = 56, Ca = 40, Zn = 65.5, Ti = 48, Ba = 137, U = 238, Co= 59, B =11, F = 19, He = 4, Ne = 20, Ar = 40 , Mo = 96

[Take : $\ell n\ 2 = 0.693$, $\ell n\ 1.1 = 0.095$, $\ell n\ 3 = 1.09$, $e = 1.6 \times 10^{-19}$, $m_e = 9.1 \times 10^{-31}$ kg]

Take: $\in_0 = 8.85 \times 10^{-12}\ C^2/Nm^2$, $g = 10\ m/s^2$, $S_{water} = 1$ cal/gm °C, $L_{ice} = 80$ cal/gm. , $g = 10\ m/s^2$ unless otherwise stated

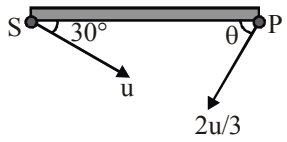
PHYSICS

Q.1 If f_1, f_2 and f_3 are the fundamental frequencies of three segments into which a string is divided, then the original fundamental frequency f_0 of the whole string is

(1) $f_0 = f_1 + f_2 + f_3$ (2) $\frac{1}{f_0} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$

(3) $\frac{1}{\sqrt{f_0}} = \frac{1}{\sqrt{f_1}} + \frac{1}{\sqrt{f_2}} + \frac{1}{\sqrt{f_3}}$ (4) None of these

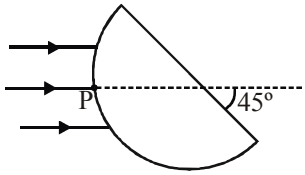
Q.2 Sachin (S) hits a ball along the ground with a speed u in a direction which makes an angle 30° with the line joining him and the fielder Prem (P). Prem runs to intercept the ball with a speed $\frac{2u}{3}$. At what angle θ should he run to intercept the ball ?



(1) $\sin^{-1}\left[\frac{\sqrt{3}}{2}\right]$ (2) $\sin^{-1}\left[\frac{2}{3}\right]$ (3) $\sin^{-1}\left[\frac{3}{4}\right]$ (4) $\sin^{-1}\left[\frac{4}{5}\right]$

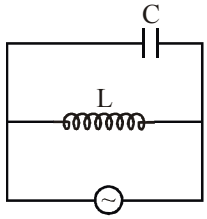
SPACE FOR ROUGH WORK

Q.3 A parallel narrow beam of light is incident on the surface of a transparent hemisphere of radius R and refractive index $\mu = 1.5$ as shown. The distance of the image formed by refraction only (at the spherical surface only) from P is



(1) $\frac{R}{2}$ (2) 3 R (3) $\frac{R}{3}$ (4) 2 R

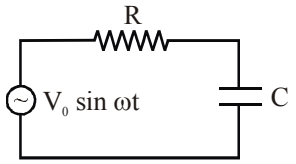
Q.4 In the AC network shown in figure, the rms current flowing through the inductor and capacitor are 0.6 A and 0.8 A respectively. Then the current coming out of the source is



(1) 1.0 A (2) 1.4 A (3) 0.2 A (4) None of above

Q.5 Rain drops are spherical in shape because of
(1) surface tension (2) capilliarity (3) downward motion (4) acceleration due to gravity

Q.6 An AC voltage source $V = V_0 \sin \omega t$ is connected across resistance R and capacitance C as shown in figure. It is given that $R = \frac{1}{\omega C}$. The peak current is I_0. If the angular frequency of the voltage source is changed to $\omega/\sqrt{3}$ then the new peak current in the circuit is



(1) $\frac{I_0}{2}$ (2) $\frac{I_0}{\sqrt{2}}$ (3) $\frac{I_0}{\sqrt{3}}$ (4) $\frac{I_0}{3}$

SPACE FOR ROUGH WORK

Q.7 A particle is executing SHM on a straight line starting from mean position. It passes through the mean position at successive intervals t and 2t with a speed v. Find the amplitude of the motion.

(1) 2vt (2) vt (3) $\frac{vt}{\pi}$ (4) $\frac{vt}{2\pi}$

Q.8 A long rod has one end at 0°C and other end at a high temperature. The coefficient of thermal conductivity varies with distance x from the low temperature end as, $k = k_0(1 + ax)$, where $k_0 = 10^2$ SI unit and $a = 1\ m^{-1}$. At what distance from the first end the temperature will be 100°C ? The area of cross-section is $1cm^2$ and rate of heat conduction is 1 W.

(1) 2.7 m (2) 1.7 m (3) 3 m (4) 1.5 m

Q.9 If the distance of an object from the first focus of an equiconvex lens is x then the distance of its real image from second focus is 4x. Find the focal length of the lens :

(1) 8x (2) 4 x (3) $4\sqrt{2}$ x (4) 2x

Q.10 When placed in air at 30°C, the temperature of a body decreases from 60°C to 50°C in ten minutes. After next ten minutes its temperature will be :

(1) Less than 40°C (2) 40°C (3) More than 40°C (4) Not definite

Q.11 An ideal gas $\left(\frac{C_p}{C_v} = \gamma\right)$ has initial volume V_0 and is kept in a vessel. It undergoes a change and follows the following relation $P = kV^2$ (where P is pressure, and V is volume). Find the change in internal energy of the gas if its final pressure is P_0 :

(1) $\frac{k}{\gamma - 1}\left[\left(\frac{P_0}{k}\right)^{3/2} - V_0^3\right]$ (2) $\frac{2k}{\gamma - 1}\left[\left(\frac{P_0}{k}\right)^{3/2} - V_0^3\right]$

(3) $\frac{k}{2(\gamma - 1)}\left[\left(\frac{P_0}{k}\right)^{3/2} - V_0^3\right]$ (4) None of these

SPACE FOR ROUGH WORK

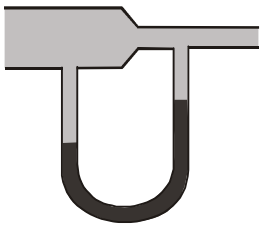
Q.12 Work done by a system under isothermal change from a volume V_1 to V_2 for a gas which obeys Vander Waal's equation $(V-\beta n)\left(P+\frac{\alpha n^2}{V^2}\right)=nRT$, is :

(1) $nRT\log_e\left(\frac{V_2-n\beta}{V_1-n\beta}\right)+\alpha n^2\left(\frac{V_1-V_2}{V_1V_2}\right)$ (2) $nRT\log_{10}\left(\frac{V_2-\alpha\beta}{V_1-\alpha\beta}\right)+\alpha n^2\left(\frac{V_1-V_2}{V_1V_2}\right)$

(3) $nRT\log_e\left(\frac{V_2-n\alpha}{V_1-n\alpha}\right)+\beta n^2\left(\frac{V_1-V_2}{V_1V_2}\right)$ (4) $nRT\log_e\left(\frac{V_1-n\beta}{V_2-n\beta}\right)+\alpha n^2\left(\frac{V_1V_2}{V_1-V_2}\right)$

Q.13 3.2 kg of ice at – 10°C just melts when with a mass m of steam, at 100°C is passed through it. Then :
(1) m = 400 g (2) m = 800 g (3) m = 425 g (4) m = 900 g

Q.14 In the experimental arrangement shown in figure, the areas of cross-section of the wide and narrow portions of the tube are 5 cm^2 and 2 cm^2 respectively. The rate of flow of water through the tube is 500 $cm^3\ s^{-1}$. The difference of mercury levels in the U-tube is :



(1) 0.97 cm (2) 1.93 cm (3) 0.67 cm (4) 4.67 cm

Q.15 For a gas sample with N_0 number of molecules, function N(V) is given by : $N(V)=\frac{dN}{dV}=\left(\frac{3N_0}{V_0^3}\right)V^2$ for $0 < V < V_0$ and $N(V) = 0$ for $V > V_0$. Where dN is number of molecules in speed range V to V + dV. The rms speed of the molecules is :

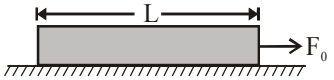
(1) $\sqrt{\frac{3}{5}}V_0$ (2) $\sqrt{\frac{2}{5}}V_0$ (3) $\sqrt{2}\,V_0$ (4) $\sqrt{3}\,V_0$

SPACE FOR ROUGH WORK

Q.16 When a copper sphere is heated, percentage change :

(1) Is maximum in radius
(2) Is maximum in volume
(3) Is minimum in density
(4) Is equal in radius, volume and density

Q.17 A constant force F_0 is applied on a uniform elastic string placed over a smooth horizontal surface as shown in figure. Young's modulus of string is Y and area of cross-section is S. The strain produced in the direction of force is :

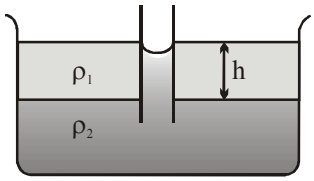


(1) $\frac{F_0 Y}{S}$ (2) $\frac{F_0}{SY}$ (3) $\frac{F_0}{2SY}$ (4) $\frac{F_0 Y}{2S}$

Q.18 The compressibility of water is 4×10^{-5} per unit atmospheric pressure. The decrease in volume of 100 cm^3 of water under a pressure of 100 atmosphere will be :

(1) 0.4 cm^3 (2) 0.025 cm^3 (3) 4×10^{-5} cm^3 (4) 0.04 cm^3

Q.19 A container contains two immiscible liquids of density ρ_1 and ρ_2 ($\rho_2 > \rho_1$). A capillary of radius r is inserted in the liquids so that its bottom reaches upto denser liquid. Denser liquid rises in capacillary and attains a height h which is also equal to column length of lighter liquid. Assuming zero contact angle, find surface tension of heavier liquid :



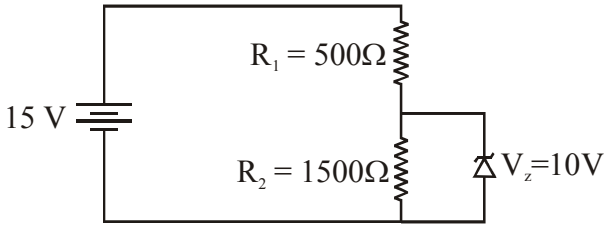
(1) $\frac{r\rho_2 gh}{2}$ (2) $\frac{r}{2}(\rho_2 - \rho_1)gh$ (3) $2\pi r\rho_2 gh$ (4) $2\pi r(\rho_2 - \rho_1)gh$

Q.20 When cooking oil is heated in a frying pan, the oil moves around in the pan more easily when it is hot. The main reason for this is that with rise in temperature, there is a decrease in :

(1) Surface tension
(2) Viscosity
(3) Angle of contact
(4) Density

SPACE FOR ROUGH WORK

Q.21 In the circuit (Fig.), the current through Zener diode is :



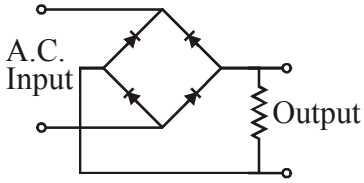
(1) 10 mA (2) 6.67 mA (3) 5 mA (4) 3.33 mA

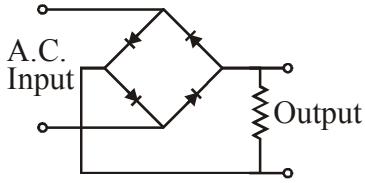
Q.22 The truth table shown below is for which of the following gates ?

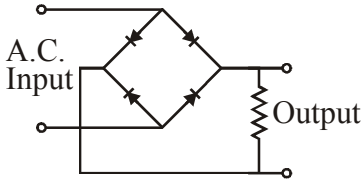
A	B	X
1	1	0
1	0	0
0	1	0
0	0	1

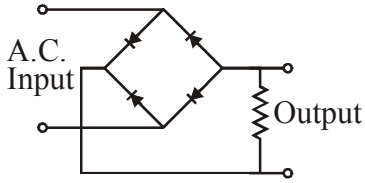
(1) AND (2) NAND (3) XOR (4) NOR

Q.23 Which of the following circuits provides full-wave rectification of an a.c. input?

(1) 

(2) 

(3) 

(4) 

Q.24 In a Fraunhofer's diffraction by a slit, if slit width is a, wave length λ, focal length of lens is f, linear width of central maxima is :–

(1) $\frac{f\lambda}{a}$ (2) $\frac{fa}{\lambda}$ (3) $\frac{2f\lambda}{a}$ (4) $\frac{f\lambda}{2a}$

SPACE FOR ROUGH WORK

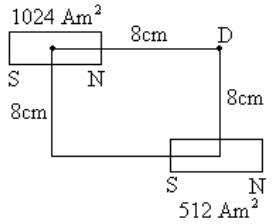
Q.25 Direction of the second maximum in the Fraunhofer diffraction pattern at a single slit is given by (a is the width of the slit) :–

(1) $a \sin\theta = \frac{\lambda}{2}$ (2) $a \cos\theta = \frac{3\lambda}{2}$ (3) $a \sin\theta = \lambda$ (4) $a \sin\theta = \frac{3\lambda}{2}$

Q.26 The magnetic susceptibility for diamagnetic materials is

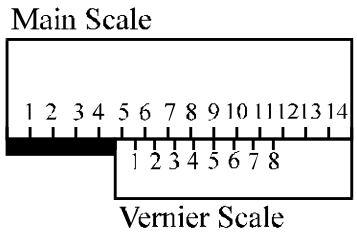
(1) small and negative (2) small and positive (3) Large and positive (4) large and negative

Q.27 Find the magnetic induction at D due to the two short magnets as shown in the figure



(1) 1536×10^{-7} T (2) 0.3 T (3) 0.5 T (4) 0.2 T

Q.28 Consider the vernier calipers as shown, the instrument has no zero error. What is the length of the rod shown, if 1 msd = 1mm? Use 7 msd = 8 vsd.



(1) 4.625 mm (2) 4.56 mm (3) 4.325 mm (4) none

Q.29 Find $\frac{3.06}{1.2}$ +1.15 and express the answer in correct significant digits

(1) 3.70 (2) 3.7 (3) 3.75 (4) 3.8

Q.30 An LC circuit contains inductance L = 1μH and capacitance C = 0.01μF. The wavelength of electromagnetic wave generated is nearly

(1) 0.5 m (2) 5 m (3) 190 m (4) 30 m

SPACE FOR ROUGH WORK

Q.31 A sample of hard water has its hardness due to $MgSO_4$ only. When this water is passed through anion exchange resin, SO_4^{2-} ions are replaced by OH^-. 25 ml of hard water sample so treated require 20 ml of 10^{-3} M H_2SO_4. What is hardness of water expressed in term of ppm of $CaCO_3$?
(1) 80 ppm (2) 2 ppm (3) 20 ppm (4) 120 ppm

Q.32 Which of the following is not a common component of both DNA and RNA?
(1) Ribose (2) Phosphate (3) Cytosine (4) Thymine

Q.33 Dehydration of hydrates of halides of calcium, barium and strontium i.e., $CaCl_2.6H_2O$, $BaCl_2.2H_2O$, $SrCl_2.6H_2O$, can be achieved by heating. Which of the following statement is incorrect about these halides?
(1) act as dehydrating agent
(2) can absorb moisture from air
(3) Tendency to form hydrate decreases from calcium to barium
(4) None of the above

Q.34 1 M aqueous solution of $AgNO_3$, $Cu(NO_3)_2$ and $Au(NO_3)_3$ are electrolyzed, the same amount of electricity passes through each solution. If 0.1 mol of solid Cu is formed then how many moles of Ag and Au are formed ?
(1) 0.1 mol Ag, 0.1 mol Au (2) 0.05 mol Ag, 0.075 mol Au
(3) 0.5 mol Ag, 0.15 mol Au (4) 0.2 mol Ag, 0.067 mol Au

Q.35 Identify sugar which doesn't give silver mirror test with Tollen's reagent ($AgNO_3 + NH_4OH$) ?
(1) Fructose (2) Maltose (3) Lactose (4) Sucrose

Q.36 Which of the following reactions are disproportionation reactions?

(a) $Cu^+ \xrightarrow[\text{medium}]{\text{aqueous}} Cu^{2+}(aq) + Cu$

(b) $3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + MnO_2 + 2H_2O$

(c) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$

(d) $2MnO_4^- + 3Mn^{2+} + 2H_2O \longrightarrow 5MnO_2 + 4H^+$

(1) a, b (2) a, b, c (3) b, c, d (4) a, d

SPACE FOR ROUGH WORK

Q.37 Identify the **correct** statement :

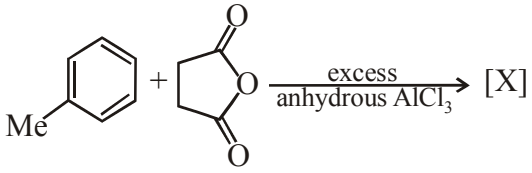
(1) On increasing temperature rate of reaction will always increase.

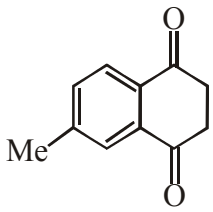
(2) Molecularity is defined for every zero order reaction.

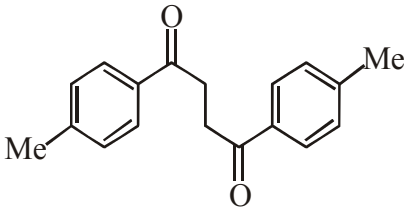
(3) Overall order of reaction cannot be changed even by changing reaction condition.

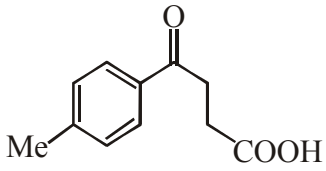
(4) In case of $\frac{1}{2}$ order reaction, completion time will be finite.

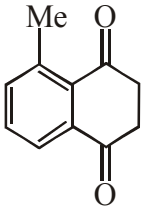
Q.38 Find the major product X formed in the given reaction.



(1) 

(2) 

(3) 

(4) 

Q.39 Polarity in a molecule and hence the dipole moment depends primarily on electronegativity of the constituent atoms and shape of a molecule. Which of the following has the highest dipole moment?

(1) CO_2 (2) HI (3) H_2O (4) SO_2

Q.40 Identify the **correct** statement :

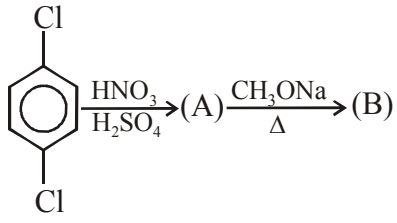
(1) Adsorption is entropy driven process.

(2) In lyophilic sols viscosity of sol is same as that of medium.

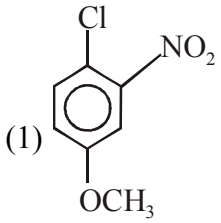
(3) In lyophilic sols surface tension is usually less than that of medium.

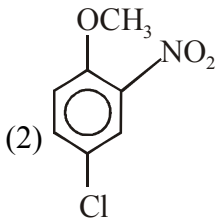
(4) Tyndall effect is more distinct in lyophilic sols.

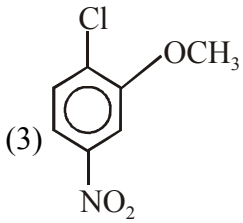
SPACE FOR ROUGH WORK

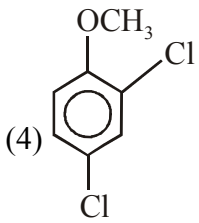
Q.41 

What is the final product(B) ?

(1) 

(2) 

(3) 

(4) 

Q.42 Which of the following reactions is an example of autoreduction ?

(1) $Fe_3O_4 + 4CO \xrightarrow{\Delta} 3Fe + 4CO_2$

(2) $Cu_2O + C \xrightarrow{\Delta} 2Cu + CO$

(3) $Cu^{2+}(aq) + Fe(s) \xrightarrow{\Delta} Cu(s) + Fe^{2+}(aq)$

(4) $Cu_2O + \frac{1}{2}Cu_2S \xrightarrow{\Delta} 3Cu + \frac{1}{2}SO_2$

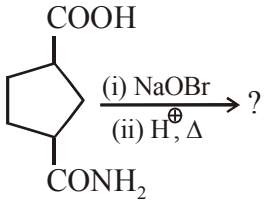
Q.43 During isothermal expansion of an ideal gas which of the following happen :

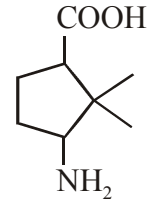
(i) Temperature does not change
(ii) Process is spontaneous
(iii) Energy of system does not change
(iv) Entropy increases.

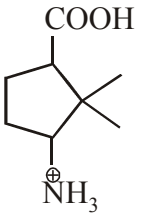
(1) (i) and (iii) only
(2) (i), (ii), (iii) and (iv)
(3) (i), (ii) and (iv) only
(4) (ii) only

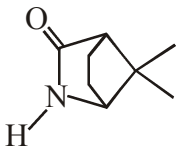
SPACE FOR ROUGH WORK

Q.44 What is the final product of the following reaction ?



(1) 

(2) 

(3) 

(4) 

Q.45 Elements of group-15 form compounds in +5 oxidation state. However, bismuth forms only one well characterised compound in +5 oxidation state. The compound is

(1) Bi_2O_5 (2) BiF_5 (3) $BiCl_5$ (4) Bi_2S_5

Q.46 The following pairs of solution are mixed in equal volume. Which combination **does not** produce a buffer solution ?

(1) 0.5 M HCOOH and 0.4 M NaOH.
(2) 0.1 M NH_3 and 0.1 M HCl.
(3) 0.2 M HCOONa and 0.1 M HNO_3.
(4) 0.2 M HCOOH and 0.4 M HCOONa.

Q.47 Which of the following conversion can be carried out by hydrazine in alkaline medium with ethylene glycol?

(1) Cyclohexanone to cyclohexanol
(2) 2-Butanol to butane
(3) Ethanal to Ethyl alcohol
(4) Acetophenone to ethyl benzene

SPACE FOR ROUGH WORK

Q.48 The formation of the oxide ion, $O^{2-}(g)$, from oxygen atom requires first an exothermic and then an endothermic step as shown below:

$$O(g) + e^- \longrightarrow O^-(g); \quad \Delta H = -141 \text{ kJ mol}^{-1}$$

$$O^-(g) + e^- \longrightarrow O^{2-}(g); \quad \Delta H = +780 \text{ kJ mol}^{-1}$$

Thus process of formation of O^{2-} in gas phase is unfavourable even though O^{2-} is isoelectronic with Neon. It is due to the fact that,

(1) oxygen is more electronegative.

(2) addition of electron in oxygen results in larger size of the ion.

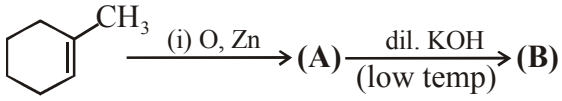
(3) electron repulsion outweighs the stability gained by achieving noble gas configuration.

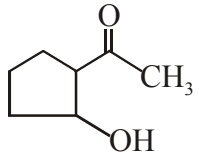
(4) Lattice energy of oxide formation compensate energy gained during anion formation.

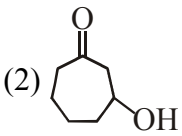
Q.49 Which of the following transition will produce light of visible spectrum of He^+?

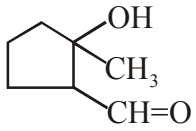
(1) $2 \rightarrow 1$ (2) $3 \rightarrow 2$ (3) $4 \rightarrow 2$ (4) $8 \rightarrow 4$

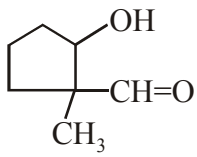
Q.50 Find the major product of the given reaction.



(1) 

(2) 

(3) 

(4) 

Q.51 The colour of the coordination compounds depends on the crystal field splitting. What will be the correct order of absorbed wavelength of light in the visible region, for the complexes, $[Co(NH_3)_6]^{3+}$, $[Co(CN)_6]^{3-}$, $[Co(H_2O)_6]^{3+}$

(1) $[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+}$

(2) $[Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+} > [Co(CN)_6]^{3-}$

(3) $[Co(H_2O)_6]^{3+} > [Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-}$

(4) $[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+} > [Co(H2O)_6]^{3+}$

Q.52 What is K_{sp} of Hg_2Cl_2 at 298 K ?

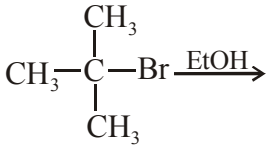
$Hg_2^{2+} + 2e^- \rightarrow 2Hg(l)$, $E° = 0.8V$

$Hg_2Cl_2(s) + 2e^- \rightarrow 2Hg(l) + 2Cl^-(aq)$, $E° = 0.21V$

(1) 10^{-20} (2) 3.3×10^{-11} (3) 5.1×10^{-9} (4) 5.7×10^{-6}

SPACE FOR ROUGH WORK

Q.53 Predict reaction mechanism and major product of the following reaction.



(1) S_N1,  (2) S_N2, EtO  (3) S_N2,  (4) S_N2, HO 

Q.54 Which of the following reactions increases production of dihydrogen from synthesis gas?

(1) $CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270K} CO(g) + 3H_2(g)$

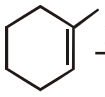
(2) $C(s) + H_2O(g) \xrightarrow{1270K} CO(g) + H_2(g)$

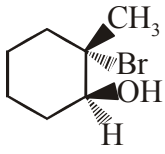
(3) $CO(g) + H_2O(g) \xrightarrow[Catalyst]{673K} CO_2(g) + H_2(g)$

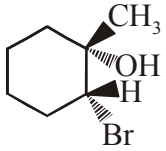
(4) $C_2H_6 + 2H_2O \xrightarrow[Ni]{1270K} 2CO + 5H_2$

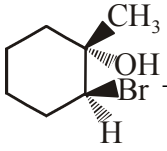
Q.55 If in NaCl crystal all ions present along one axis passing through centre of two opposite faces are removed then formula of the crystal will be :

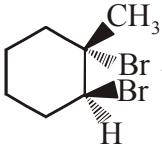
(1) NaCl (2) Na_4Cl_3 (3) Na_3Cl_4 (4) $NaCl_3$

Q.56  $\xrightarrow{Br_2/H_2O}$ Major product(s) is :

(1)  + enantiomer

(2)  + enantiomer

(3)  + enantiomer

(4)  + enantiomer

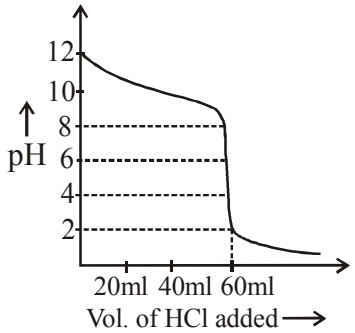
SPACE FOR ROUGH WORK

Q.57 Passing H_2S gas into aqueous solution of mixture of Hg^{2+}, Ni^{2+}, Cu^{2+} and Mn^{2+} ions, the precipitates formed are :

(1) HgS and NiS (2) NiS and MnS

(3) CuS and HgS (4) CuS and MnS

Q.58 1g of a weak monoacidic base is titrated against 1M HCl(aq.) to give data as shown. What is identity of the base?



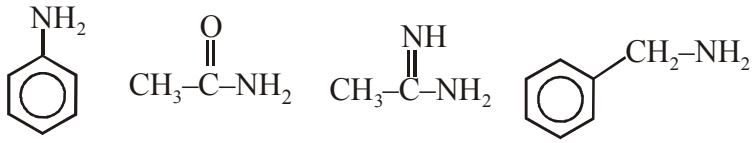
(1) NH_3 [pka (NH_4^+) = 9]

(2) $C_6H_5NH_2$ [pka $(C_6H_5NH_3^+)$ = 4.6]

(3) NH_2OH [pka (NH_3OH^+) = 6]

(4) $(CH_3)_3N$ [pka $(CH_3)_3\overset{\oplus}{N}H$) = 9.8]

Q.59 Find out the correct order of basic strength among the given compounds.



(I) **(II)** **(III)** **(IV)**

(1) III > IV > I > II (2) IV > III > I > II

(3) IV > III > II > I (4) IV > I > II > III

Q.60 Precipitate 'P' dissolves in hot dil. HNO_3 and coloured solution is obtained, when $K_4[Fe(CN)_6]$ was added to this coloured solution, brown coloured precipitate is obtained; then cation present in the precipitate 'P' is :

(1) Fe^{3+} (2) Zn^{2+} (3) Cd^{2+} (4) Cu^{2+}

SPACE FOR ROUGH WORK

Q.61 $\int_0^{\frac{\pi}{2}} \sin^{20} x \cos^{20} x \, dx = \frac{1}{\lambda}\int_0^{\frac{\pi}{2}} \sin^{20} x \, dx$, then λ is equal to

(1) 2^{20} (2) 2^{10} (3) 2^{-20} (4) 2^{19}

Q.62 If A is a 3×3 matrix such that $A^T = 5A + 2I$ where A^T is the transpose of A and I is the 3×3 identity matrix, then there exist a column matrix $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \neq \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$. Then AX is equal to

(1) $AX = X$ (2) $AX = \frac{-X}{2}$ (3) $AX = -2X$ (4) $AX = 0$

Q.63 $\lim_{n\to\infty} \sum_{r=1}^{2n} \frac{r}{\sqrt{n^2 + r^2}}$ equals

(1) $\sqrt{5}$ (2) $\sqrt{2} - 1$ (3) $\sqrt{5} - 1$ (4) $1 + \sqrt{2}$

Q.64 If $f(x)$ is polynomial function satisfying $f(x) \cdot f\left(\frac{1}{x}\right) + 3\, f(x) + 3\, f\left(\frac{1}{x}\right) = 0$ and $f(3) = 24$, then the value of $f(-2) + f(2)$ is

(1) 2 (2) -6 (3) 0 (4) None of these

Q.65 A vertical pole subtends an angle $\tan^{-1}\left(\frac{1}{3}\right)$ at a point P on the ground. The angle substended by upper half of the pole at the point P is

(1) $\frac{2}{9}$ (2) $\frac{3}{19}$ (3) $\frac{4}{13}$ (4) None of these

SPACE FOR ROUGH WORK

Q.66 The locus of the mid- point of the chords of the ellipse $49x^2 + 16y^2 = 784$, the tangents at the ends of which intersect on the circle $x^2 + y^2 = 100$ is

(1) $(49x^2 + 16y^2)^2 = \left(\frac{784}{10}\right)^2 (x^2 - y^2)$ (2) $49x^2 + 16y^2 = \frac{784}{10}$

(3) $(49x^2 + 16y^2)^2 = \left(\frac{784}{10}\right)^2 (x^2 + y^2)$ (4) None of these

Q.67 The sum $\sum_{r=0}^{30} {}^{30}C_r \cdot \sin(rx) \cdot \cos(30 - r)x$ is equal to

(1) $2^{30} \cdot \cos 30x$ (2) $2^{29} \cdot \cos 30x$ (3) $2^{29} \cdot \sin 29x$ (4) $2^{29} \cdot \sin 30x$

Q.68 The maximum value of $y = 4\cos 2x + 3\sin x + 5$ is equal to

(1) 10 (2) $\frac{297}{32}$ (3) 0 (4) None of these

Q.69 If a, b, c $\in$ R are distinct number in A.P., a, α, b are in G.P., b, β, c are also in G.P., then α^2 , b^2 , β^2 will be in

(1) A.P. (2) G.P. (3) H.P. (4) None of these

Q.70 If the plane passing through the points (a, 1, 1), (1, 2, 1) and (2, 3, 4) is parallel to the line $\vec{r} = \lambda(\hat{i} - \hat{j} + 2\hat{k})$ ($\lambda \in R$), then a is equal to

(1) $-\frac{1}{2}$ (2) -1 (3) $\frac{3}{2}$ (4) 0

Q.71 The area of $S \cap S'$ is where $S = \left\{(x, y); \frac{y(3x-1)}{x(3x-2)} < 0\right\}$ and

$S' = \{(x, y) \in A \times B, -1 \le A \le 1 \text{ and } -1 \le B \le 1\}$

(1) 1 (2) 2 (3) 3 (4) 4

SPACE FOR ROUGH WORK

Q.72 Let chord of contact is drawn from every point lying on circle $x^2 + y^2 = 36$ to the ellipse $\frac{x^2}{4} + \frac{y^2}{9} = 1$ such that all the lines touches an standard ellipse whose eccentricity is

(1) $\frac{\sqrt{65}}{9}$ (2) $\frac{\sqrt{5}}{3}$ (3) $\frac{4}{5}$ (4) None of these

Q.73 Let tangents PA and PB are drawn from variable point P on the parabola $y^2 = 4x$ to the circle $x^2 + y^2 + 6x - 4y - 3 = 0$, then the director circle of locus of circumcentre of ΔPAB is

(1) $x + 2 = 0$ (2) $x^2 + y^2 + 6x - 4y - 19 = 0$

(3) $x = -\frac{1}{2}$ (4) None of these

Q.74 If $z = \frac{1}{2}\left(\sqrt{3} - i\right)$, then the least positive integer 'n' for which $(z^{29} + i^{29})^{94} = z^n$ is

(1) 6 (2) 12 (3) 8 (4) 10

Q.75 If $x = \alpha$, $y = \beta$ is a solution of equation $12 \sin x + 5 \cos x = 2y^2 - 8y + 21$, then the value of $(2\beta + 1)\tan\alpha$ is equal to

(1) $\frac{25}{12}$ (2) 12 (3) 13 (4) None of these

Q.76 Three cylinders each of height 16 cm and radius of base 4 cm are placed on a plane so that each cylinder touches the other two. What is the volume of the region enclosed between the three cylinders?

(1) $98\left(4\sqrt{3} - \pi\right)$ cm^3 (2) $96\left(2\sqrt{3} - \pi\right)$ cm^3 (3) $96\left(\sqrt{3} - \pi\right)$ cm^3 (4) $128\left(2\sqrt{3} - \pi\right)$ cm^3

Q.77 The differential equation of the curve $\frac{x}{a-1} + \frac{y}{a+1} = 1$ is given by

(1) $(y' - 1)(y + xy') = 2y'$ (2) $(y' + 1)(y + xy') = y'$

(3) $(y' + 1)(y - xy') = 2y'$ (4) None of these

Q.78 The number of points on the line $3x + 4y = 5$ which are at a distance of $\sec^2\theta + 2\,\text{cosec}^2\theta$, $\theta \in R$ from the point (1, 3) is

(1) 0 (2) 1 (3) 2 (4) Infinite

SPACE FOR ROUGH WORK

Q.79 If $f(x)=\begin{cases} b\,\text{sgn}\,(\cos^{-1}x-\cos^{-1}x^2); & x>0 \\ \dfrac{\sin^{-1}x-x}{x^3}; & x<0 \\ a; & x=0 \end{cases}$ is continuous at $x=0$, then $a+b$ is equal to

(1) 0 (2) $\frac{1}{3}$ (3) $-\frac{1}{3}$ (4) None of these

Q.80 From first 100 natural numbers, 3 numbers are selected. If these three numbers are in A.P. , then find the probability that these numbers are even

(1) $\frac{1}{66}$ (2) $\frac{29}{66}$ (3) $\frac{29}{49}$ (4) $\frac{12}{49}$

Q.81 The number of positive integral solution of the equation $2x+2y+2z+w=30$. If $1\le x, y, z\le 6$ and $1\le w\le 12$, are

(1) 140 (2) 200 (3) 144 (4) None of these

Q.82 The sum of all integral values of $a\in[1, 10]$ for which $f(x)=x^3-3x^2+ax+2\cos x$ is strictly increasing.

(1) 10 (2) 15 (3) 40 (4) 45

Q.83 $\int\frac{3\cos x}{2\cos x+5\sin x}dx$ is equal to

(1) $\frac{15}{29}x+\frac{6}{29}\,l\text{n}\,|2\cos x+5\sin x|+C$ (2) $\frac{6}{29}x-\frac{15}{29}\,l\text{n}\,|2\cos x+5\sin x|+C$

(3) $\frac{6}{29}x+\frac{15}{29}\,l\text{n}\,|2\cos x+5\sin x|+C$ (4) None of these

[**Note :** where C is integration constant]

Q.84 Let a, b and c be the roots of the equation $x^3-9x^2+15x+2=0$. The volume of a parallelopiped with non parallel sides $a\hat{i}+b\hat{j}+c\hat{k}$, $b\hat{i}+c\hat{j}+a\hat{k}$ and $c\hat{i}+b\hat{j}+a\hat{k}$ is

(1) 324 (2) 225 (3) 144 (4) None of these

SPACE FOR ROUGH WORK

Q.85 Let $S_n = \cot^{-1}\left(6x + \frac{2}{x}\right) + \cot^{-1}\left(10x + \frac{2}{x}\right) + \cot^{-1}\left(15x + \frac{2}{x}\right) + ...+ n$ terms where $x > 0$.

If $\lim_{n\to\infty} S_n = 1$, then x equals

(1) cot 1 (2) $\frac{2}{3}\cot 1$ (3) $\frac{3}{2}\tan 1$ (4) None of these

Q.86 The number of roots of the equation $x^2 \cdot e^{2-|x|} = 1$ is

(1) 0 (2) 2 (3) 4 (4) 6

Q.87 A dice is thrown three times if geting a composite face is considered as a success then mean and variance of the probability distribution of number of success are

(1) 1, $\frac{2}{3}$ (2) $\frac{1}{2}$, $\frac{5}{12}$ (3) 2, $\frac{3}{2}$ (4) None of these

Q.88 The standard deviation of 5 scores 1, 2, 3, 4, 5 is

(1) $\frac{2}{5}$ (2) $\frac{3}{5}$ (3) $\sqrt{2}$ (4) $\sqrt{3}$

Q.89 There are two sets $A = \{a : a \in N \text{ and } -3 \le a \le 5\}$ and $B = \{b : b \in Z \text{ and } 0 \le b \le 3\}$. The number of elements common in $A \times B$ and $B \times A$ are

(1) 4 (2) 9 (3) 16 (4) 12

Q.90 If the range of $y = \frac{(x-\alpha)(x^3 - 3x + 1)}{x - \alpha}$ is all real numbers, then number of integers in the range of α is

(1) 2 (2) 3 (3) 5 (4) Infinite

SPACE FOR ROUGH WORK

COURSE
NUCLEUS

JEE-MAIN MOCK TEST-12
XII

TEST CODE
1 1 3 1 6

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans	2	3	2	3	1	2	3	2	4	3	1	1	3	2	1
Q.No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans	2	3	1	2	2	4	4	4	3	4	1	2	1	4	3
	PC	OC	IOC	PC	OC	IOC	PC	OC	IOC	PC	OC	IOC	PC	OC	IOC
Q.No.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans	1	1	4	4	4	1	4	3	3	3	2	4	2	3	2
	PC	OC	IOC	PC	OC	IOC	PC	OC	IOC	PC	OC	IOC	PC	OC	IOC
Q.No.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans	2	4	4	4	1	3	1	1	3	1	3	3	1	1	4
Q.No.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans	1	2	3	2	2	3	4	2	1	4	2	1	1	4	2
Q.No.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans	4	3	3	1	4	1	2	3	1	2	3	1	3	2	3

HINTS & SOLUTIONS

PHYSICS

Q.1 $f \propto \frac{1}{l}$

$\therefore l = \frac{k}{f}$

Now $l = l_1 + l_2 + l_3$

$\therefore \frac{k}{f_0} = \frac{k}{f_1} + \frac{k}{f_2} + \frac{k}{f_3}$

$\therefore \frac{1}{f_0} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$

Q.2 Relative velocity of P with respect to S should be along PS or absolute velocity cimponents perpendicular to PS should be same.

$\therefore \quad \frac{2u}{3}\sin\theta = u \sin 30°$

$\therefore \quad \theta = \sin^{-1}\left(\frac{3}{4}\right)$

Applyin $\frac{\mu_2}{v} - \frac{\mu_1}{} = \frac{\mu_2 - \mu_1}{R}$ we get,

$\frac{1.5}{v} - \frac{1}{\infty} = \frac{1.5 - 1.0}{+R}$

$\therefore \quad v = +3R$

Q.4 As I_L & I_C are 180° out of phase
So, $I_{net} = |I_L - I_C|$
$= 0.2$ A

Q.5 Spheres have minimum surface area as surface tension tends to minimize area of decrease surface energy to gain greater stability.

Q.6 $R = \frac{1}{\omega C} = X_C$

$\therefore \quad Z = \sqrt{R^2 + X_C^2} = \sqrt{2}\,R$

(as $X_C = R$)

$I_0 = \frac{V_0}{Z} = \frac{V_0}{\sqrt{2}R}$ ...(i)

When ω becomes $\frac{1}{\sqrt{3}}$ time, X_C will become $\sqrt{3}$ times or $\sqrt{3}$ R.

$$Z' = \sqrt{(R^2) + (\sqrt{3}R)^2} = 2R$$

$$I'_0 = \frac{V_0}{Z'} = \frac{V_0}{2R} = \frac{I_0}{\sqrt{2}}$$

Q.7 Initial phase $\phi = 0$

Thus the point from where time is considered, is origin.

$T = (t_{OA} + t_{AO}) + (t_{OB} + t_{BO})$

$$= t + t = 2t = \frac{2\pi}{\omega}$$

B O A

$\omega = \pi/t$

$x = a \sin \omega t = a \sin \pi = 0$

$v = a\omega \cos \omega t = -a\omega = -a\pi/t$

$$\text{Amplitude} = |a| = \frac{vt}{\pi}$$

Q.8 $$H = \frac{T.D}{R}$$

$$R = \frac{T.D}{H} = \frac{100 - 0}{1} = 100 \text{ kW}^{-1}$$

$$\text{Now, } R = \int_0^x dR = \int_0^x \frac{dx}{k_0(1+ax)A}$$

$$\text{or } 100 = \int_0^x \frac{dx}{10^2(1+x)(10^{-4})}$$

Solving this equation we get,

$x = 1.7$ m

Q.9 $u = -(x + f)$ and $v = +(4x + f)$

From $$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{(4x+f)} + \frac{1}{(x+f)} = \frac{1}{f}$$

On solving, $f = 2x$

Q.10 $$\ln\left(\frac{60-30}{50-30}\right) = b\,(10 \text{ min}) = \ln\left(\frac{50-30}{\theta-30}\right)$$

$$\Rightarrow \theta - 30 = \frac{2}{3} \times 20 \Rightarrow q = \frac{130}{3}°C > 40°C$$

Q.11 $$\Delta U = nC_v\Delta T = \frac{nR\Delta T}{\gamma - 1} = \frac{P_f V_f - P_i V_i}{\gamma - 1}$$

$$= \frac{1}{\gamma - 1}\left[P_0\sqrt{\frac{P_0}{k}} - kV_0^2 V_0\right]$$

$$= \frac{k}{\gamma - 1}\left[\left(\frac{P_0}{k}\right)^{3/2} - V_0^3\right]$$

Q.12 $$W = \int_{V_1}^{V_2} PdV = nRT \int_{V_1}^{V_2} \frac{dV}{V - \beta n} - \alpha n^2 \int_{V_1}^{V_2} \frac{dV}{V^2}$$

$$= nRT \ln\left(\frac{V_2 - \beta n}{V_1 - \beta n}\right) + \alpha n^2\left(\frac{V_1 - V_2}{V_1 V_2}\right)$$

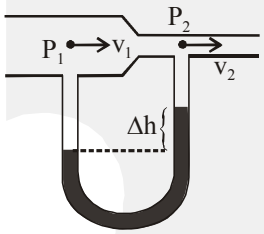
Q.13 $m_{ice}\, S_{ice}\, (10) + m_{ice}\, L_{ice} = ML_v + MS_{water}$ (100)

$\Rightarrow 3200\,(0.5)\,(10) + 3200\,(80)$

$= m[540 + 100]$

$\Rightarrow m = 425$ gm

Q.14



$$P_1 - P_2 = \rho_{Hg}\, g\Delta h = \frac{1}{2}\rho_{water}\,(V_2^2 - V_1^2) \ldots\ldots(1)$$

Also, $A_1U_1 = A_2U_2 = 500$ cm^3/s

$\Rightarrow U_1 = 1$ m/s and $U_2 = 2.5$ m/s

Putting in (1) and solving,

$\Delta h \approx 1.93$ cm

Q.15 $$v_{rms} = \left[\frac{\int V^2 dN}{\int dN}\right]^{1/2} = \left[\frac{\int_0^{v_0} V^4 dV}{\int_0^{v_0} V^2 dV}\right]^{1/2}$$

$$= \sqrt{\frac{3}{5}}\, V_0$$

Q.16 $$\frac{\rho_\theta}{\rho_0} \approx 1 - \gamma\Delta\theta$$

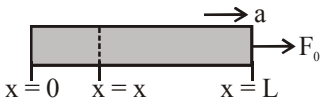
$\Rightarrow$ % change in density $= (\gamma\Delta\theta) \times 100$

$$\frac{V_\theta}{V_0} = 1 + \gamma\Delta\theta \Rightarrow \%\text{change in volume} = (\gamma\Delta\theta) \times 100$$

$$\therefore V \propto r^3 \Rightarrow \frac{r_\theta}{r_0} = (1+\gamma\Delta\theta)^{1/3} \approx 1 + \frac{\gamma\Delta\theta}{3}$$

$$\therefore \%\text{ change in radius} = \left(\frac{\gamma\Delta\theta}{3}\right) \times 100$$

Q.17



$$a = \frac{F_0}{M} = \frac{T_x L}{Mx} \Rightarrow T_x = \frac{F_0 x}{L}$$

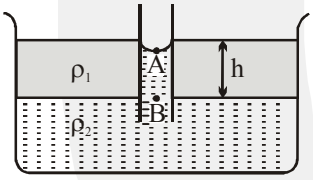
$$\Rightarrow \sigma_x = \frac{T_x}{S} = \frac{F_0 x}{LS}$$

$$\therefore \delta l = \frac{1}{Y}\int_0^L \sigma_x dx = \frac{F_0}{LSY}\frac{L^2}{2}$$

$$\therefore \in = \frac{\delta l}{L} = \frac{F_0}{2SY}$$

Q.18 $C = -\dfrac{\delta V / V}{\delta P} \Rightarrow |\delta V| = VC\delta P = 0.4\ \text{cm}^3$

Q.19



$$P_{atm} - P_A = \frac{2S}{r} \quad ....(1)$$

$$P_A = P_B - \rho_2 gh$$
$$= P_{atm} + \rho_1 gh - \rho_2 gh \quad ....(2)$$

from (1) and (2)

$$S = \frac{rgh}{2}(\rho_2 - \rho_1)$$

Q.20 Viscosity in liquids decreases with rise in temperature.

Q.21 $I_{R_2} = \dfrac{V_z}{1500} = \dfrac{1}{150}\text{A} \downarrow$

$$I_{R_1} = \frac{15 - V_z}{R_1} = \frac{1}{100}\text{A} \downarrow$$

$$\Rightarrow I_z = I_{R_1} - I_{R_2}$$

$$= \frac{1}{300}\text{A} = 3.33\ \text{mA}$$

Q.22 In NOR gate, output is high (1) only when both inputs are low (0).

Q.23 Option (4) represents standard circuit for a bridge type full wave rectifier.

Q.24 $\text{Linear width} = 2f\theta = \dfrac{2f\lambda}{a}$

Q.25 for secondary maximas,

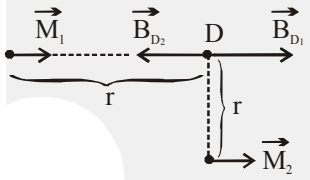
$$a\sin\theta = \frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}, ...$$

$\therefore$ For second maxima

$$\sin\theta = \frac{3\lambda}{2a}$$

Q.26 Standard results

Q.27



$$\left|\vec{B}_D\right| = B_{D_1} - B_{D_2}$$

$$= \frac{2\mu_0}{4\pi}\frac{M_1}{r^3} - \frac{\mu_0 M_2}{4\pi r^3} = 0.3\ \text{T}$$

Q.28 Length = M.S.R. + V.S.R. × L.C.
M.S.R. = 4 mm V.S.R. = 5

$$\text{L.C.} = 1\ \text{M.S.D.} - 1\ \text{V.S.D.} = \frac{1}{8}\ \text{mm}$$

$$\therefore \text{length} = \frac{37}{8}\ \text{mm} = 4.625\ \text{mm}$$

Q.29 $\dfrac{3.06}{1.2} = 2.55 = 2.6$ ($\therefore$ it should have two significant digits)
Now 1.15 + 2.6 = 3.75 should be rounded off to 1 decimal place.
$\therefore$ Final answer = 3.8

Q.30 $f = \frac{\omega}{2\pi} = \frac{1}{2\pi\sqrt{LC}} = \frac{10^7}{2\pi}$ Hz

$\therefore \lambda = \frac{c}{f} = \frac{3\times10^8\times2\pi}{10^7} \approx 190$ m

CHEMISTRY

Q.31 $H_2SO_4 + 2OH^- \rightarrow SO_4^{2-} + 2H_2O$

$\therefore$ In 25 ml treated water,

$n_{OH^-} = 20 \times 10^{-3} \times 2$ mmol

$\therefore \quad n_{MgSO_4} = \frac{n_{OH^-}}{2} = 20 \times 10^{-3}$ mmol

$\therefore \quad$ In 1L $n_{MgSO_4} = \frac{20\times10^{-3}}{25} \times 1000$ mmol

$= \frac{4}{5}$ mmol

$\therefore \quad$ In 1L hard water, equivalent n_{CaCO_3}

$= \frac{4}{5}$ mmol

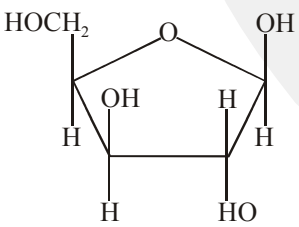
$\therefore \; m_{CaCO_3} = \frac{4}{5}\times100\text{mg} = 80$ mg

i.e. Hardness of water = 80 mg/L

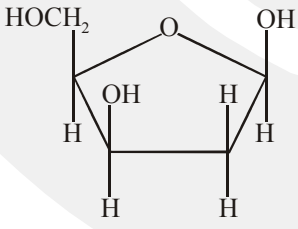
= 80 ppm Ans.

Q.32 DNA : 2-Deoxyribosenucleic acid

RNA : Ribonucleic acid



β-D-Ribose in(RNA)



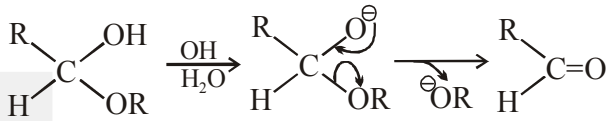
β-D-2-Deoxyribose in(RNA)

Q.34 Here, eq. of Ag = eq. of Cu = eq. of Au

$\Rightarrow 1 \times n_{Ag} = 2 \times 0.1$ mol $= 3 \times n_{Au}$

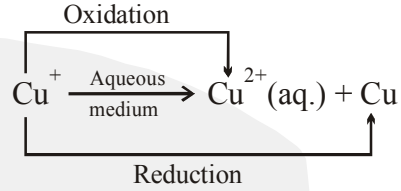
$\therefore n_{Ag} = 0.2$ mol and $n_{Au} = 0.067$ mol

Q.35 Since sucrose doesn't have Hemiacetal linkage present. So it is not reduced fructose. Maltose and Lactose, all have hemiacetal link. So, they are reduced.

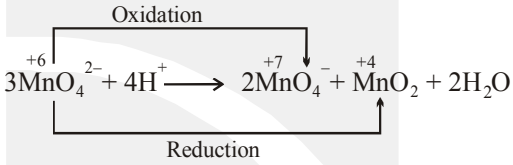


(Hemiacetal) (Aldehyde)

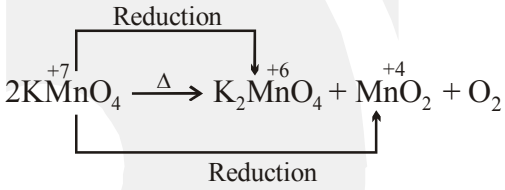
Q.36(a)



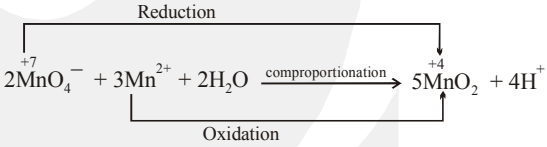
(b)



(c)

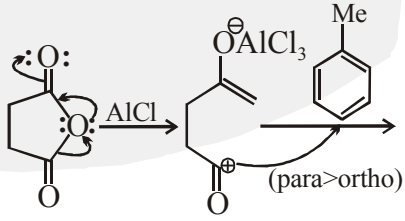


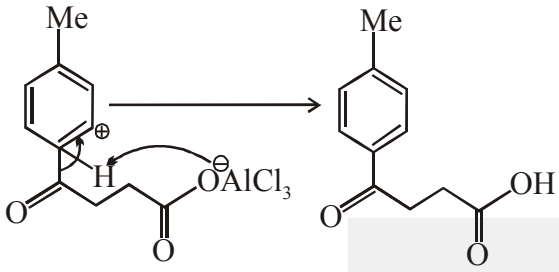
(d)



Q.37 $T_{completion} = \frac{2\sqrt{Co}}{K}$

Q.38



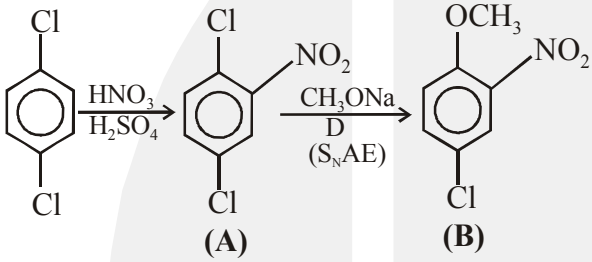


Q.39 H_2O 

Dipole moment of lone pair and bond pair are in same direction. So dipole moment is maximum.

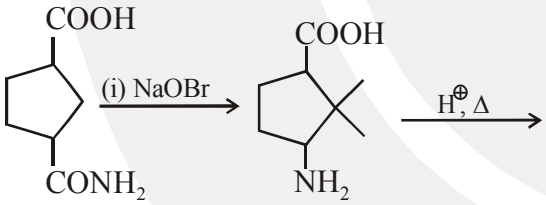
Q.40 Theory based

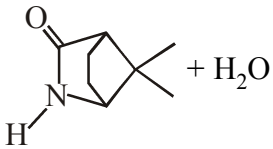
Q.41



Q.43 Theory based

Q.44

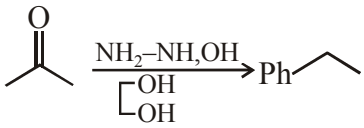




Q.45 Bismuth forms only one well characterised compound in +5 oxidation state is BiF_5 because the electronegativity of F is high and it is of small size.

Stability : $Bi^{3+} > Bi^{5+}$ (Inert pair effect)

Q.46 Theory based

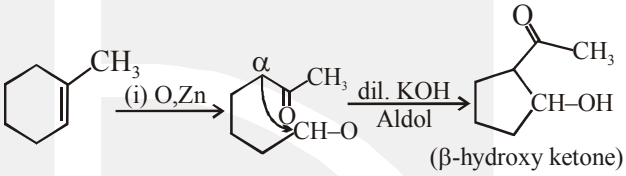
Q.47 

(Wolff kishner reduction)

Wolff kishner reduction is used to carbonyl compounds to alkanes.

Q.49 Theory based

Q.50



(β-hydroxy ketone)

Reactivity(Aldehyde > Ketone)

Q.51 $\Delta = \dfrac{hC}{\lambda_{absorbed}}$

i.e. means $\Delta \uparrow \lambda_{absorbed} \downarrow$

$\Delta \alpha$ strength of ligand

Δ : C > N > O

So $\Delta : [Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+}$

$\lambda_{absorbed} : [Co(CN)_6]^{3-} < [Co(NH_3)_6]^{3+} < [Co(H_2O)_6]^{3+}$

Q.52 $\because E^o_{cell} = -\dfrac{0.059}{n}\log K_{sp}$

$\Rightarrow (0.8 - 0.21)\ V = -\dfrac{0.059}{2}\log K_{sp}$

$\Rightarrow \log K_{sp} = -20$

$\therefore K_{sp} = 10^{-20}$ Ans.

Q.53 Polar protic solvent (EtOH) along with tertiary halide  Br will favour S_N1, reaction.

Q.54 $\underset{\text{(Coal)}}{C} + \underset{\text{(steam)}}{H_2O} \xrightarrow[\text{Catalyst}]{\approx 1200\,K} \underset{\text{Water gas / Syn gas}}{CO(g) + H_2(g)\uparrow}$

$CO(g) + H_2O(g) \xrightarrow[\text{Catalyst}]{673\,K} CO_2(g) + H_2\uparrow$

Q.55 Formula of unit cell = $Na_3Cl_3 = NaCl$ Ans.

Q.56 Anti-addition of $\overset{\ominus}{O}H$ (nucleophile) and $\overset{\oplus}{Br}$ (electrophilic) takes place as per Markovnikov's rule in Halohydrin formation reaction.

Q.57 $M^{2+} + H_2S \xrightarrow[H^+/H_2O]{} MS\downarrow$

$[M = Hg^{2+}, Cu^{2+}]$

$M^{2+} + H_2S \xrightarrow{OH^-} MS\downarrow$

$[M = Ni^{2+} / Mn^{2+}]$

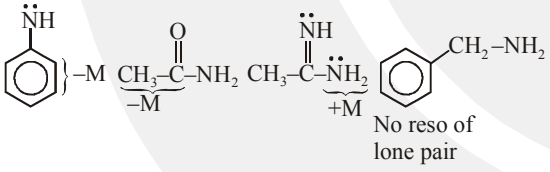
Q.58 After addition of 60 mL, 1 M HCl the base is neutralised.

$\therefore n_{base} = n_{HCl} = MV$

$= 1 \times \frac{60}{1000}\text{mol} = \frac{1\,g}{M_{base}}$

$\therefore M_{base} = \frac{50}{3}\,g/mol \approx 17$

$\therefore$ Base is NH_3

Q.59 

(–M) of $CH_3-\overset{\overset{O}{\|}}{C}-$ is greater than (–M) of –Ph that's why amide is weaker base than aniline.

Q.60 $CuS\downarrow \xrightarrow{\text{dil.}HNO_3} Cu^{2+}(aq.)$

Black

$\xrightarrow{K_4[Fe(CN)_6]} Cu_2[Fe(CN)_6]\downarrow$

Chocolate brown ppt.

Q.61 $\frac{1}{2^{20}}\int_0^{\frac{\pi}{2}} \sin^{20}(2x)\,dx = \frac{1}{2^{20}}\left(\frac{1}{2}\right)\int_0^{\pi} \sin^{20} x\,dx$

$= \frac{1}{2^{20}}\int_0^{\frac{\pi}{2}} \sin^{20} x\,dx$.

Q.62 $A^T = 5A + 2I$

$A = 5A^T + 2I$

$A = 5(5A + 2I) + 2I$

$2A + I = 0;\ 2AX + X = 0$

$\Rightarrow AX = \frac{-X}{2}$.

Q.63 $\int_0^2 \frac{x}{\sqrt{1+x^2}}\,dx \Rightarrow \left[\frac{1}{2}\times 2\sqrt{1+x^2}\right]_{10}^{2} = \sqrt{5} - 1$

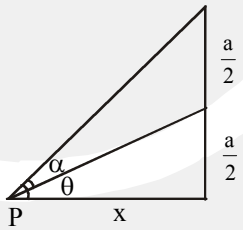
Q.64 $f(x) = -3 + x^3 \Rightarrow f(2) + f(-2) = -6$

Q.65 $\tan(\theta - \alpha) = \frac{a}{2x} = \frac{1}{6}$

$\tan\theta = \frac{a}{x} = \frac{1}{3}$

$\tan\alpha = \frac{\tan(\theta) - \tan(\theta-\alpha)}{1 + \tan\theta\cdot\tan(\theta-\alpha)}$

$= \frac{\frac{1}{3} - \frac{1}{6}}{1 + \frac{1}{18}} \Rightarrow \frac{6-3}{19} = \frac{3}{19}$



Q.66 $T = S_1$; $49hx + 16ky = 49h^2 + 16k^2$

equation of this line

$49x \cdot 10\cos\theta + 16y \cdot 10\sin\theta = 784$

Compare and eliminate $\sin\theta$ and $\cos\theta$

Result is $(49h^2 + 16k^2)^2 = \left(\frac{784}{10}\right)^2 (h^2 + k^2)$

Q.67 $S = {}^{30}C_0 \cdot \sin(0x) \cdot \cos 30x + {}^{30}C_1 \cdot \sin 1x \cdot \cos 29x + \ldots\ldots + {}^{30}C_{30} \cdot \sin 30x \cdot \cos 0x$

$S = {}^{30}C_{30} \cdot \sin(30x) \cdot \cos(0x) + {}^{30}C_{29} \cdot \sin 29x \cdot \cos 1x + \ldots\ldots +..$

$$2S = \sum_{r=0}^{30} {}^{30}C_r \left(\sin(rx)\cdot\cos(30-r)x + \cos(rx)\cdot\sin(30-r)x\right)$$

$$2S = \sum_{r=0}^{30} {}^{30}C_r \cdot \sin(30x)$$

$$S = 2^{29}\cdot \sin(30x)$$

Q.68 $4(1-2\sin^2 x) + 3\sin x + 5$

$\Rightarrow -8t^2 + 3t + 9$

$$\text{maximum} \Rightarrow -8\times\frac{9}{256} + 3\times\frac{3}{16} + 9$$

$$= \frac{9}{32} + 9 = \frac{9\times 33}{32} = \frac{297}{32}$$

Q.69 $2b = a + c$, $\beta^2 = bc$ and $\alpha^2 = ab$

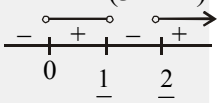
$$2b = \frac{\alpha^2}{b} + \frac{\beta^2}{b} \Rightarrow \alpha^2 + \beta^2 = 2b^2$$

Q.70 $$\begin{vmatrix} a-1 & -1 & 0 \\ 1 & 1 & 3 \\ 1 & 1 & 2 \end{vmatrix} = 0 \Rightarrow \begin{vmatrix} a & -1 & 0 \\ 0 & 1 & 3 \\ 0 & 1 & 2 \end{vmatrix} = 0$$

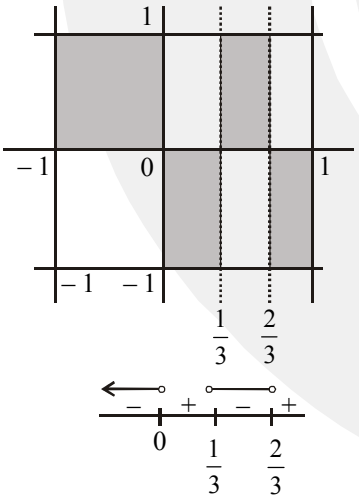
$\Rightarrow a(3-2) = 0 \Rightarrow a = 0$

Q.71

Case (I) : $y < 0,\ \dfrac{3x-1}{x(3x-2)} > 0$



Case (II) : $y > 0,\ \dfrac{3x-1}{x(3x-2)} < 0$



Area = $1 + 1 = 2$

Q.72 Equation of C.O.C : $\dfrac{6\cos\theta\cdot x}{4} + \dfrac{6\sin\theta\cdot y}{9} = 1$

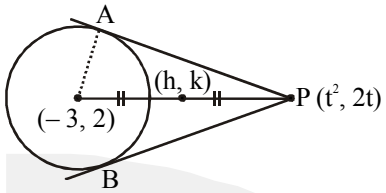
$$x\cdot\frac{\cos\theta}{\left(\frac{4}{6}\right)} + \frac{y\cdot\sin\theta}{\left(\frac{9}{6}\right)} = 1$$

$$e^2 = 1 - \left(\frac{4/6}{9/6}\right)^2 \Rightarrow e^2 = 1 - \frac{16}{81} = \frac{65}{81}$$

Q.73 $t^2 - 3 = 2h$ and $2t + 2 = 2k$

$(k-1)^2 = (2h+3)$, $t = k - 1$

$$(y-1)^2 = 2\left(x + \frac{3}{2}\right)$$



$$x + \frac{3}{2} = -\frac{2}{4} \Rightarrow x + 2 = 0$$

Q.74 $$Z = i\left(\frac{-1-i\sqrt{3}}{2}\right) = iw^2$$

$z^{29} = (iw^2)^{29} = iw$ and $i^{29} = i$

$(iw + i)^{94} = z^n \Rightarrow (-iw^2)^{94} = (iw^2)^n$

$-w^2 = i^n w^{2n} \Rightarrow n = 10$

Q.75 L.H.S. ≤ 13 and R.H.S $= 2(y-2)^2 + 13$

$\Rightarrow$ R.H.S. ≥ 13

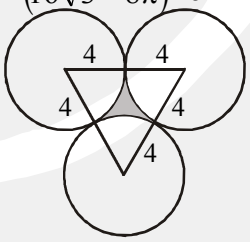
$\beta = 2$ and $\sin(\alpha + \theta) = 1$

$$\Rightarrow \alpha = \frac{\pi}{2} - \theta = \frac{\pi}{2} - \tan^{-1}\left(\frac{5}{12}\right)$$

$$\alpha = \tan^{-1}\frac{12}{5} \Rightarrow \tan\alpha = \frac{12}{5}$$

Q.76 $$\text{Area of base} = \frac{\sqrt{3}}{4}\times 8^2 - \frac{\pi}{2}(4)^2$$

$$\text{Volume} = \left(16\sqrt{3} - 8\pi\right)16 = 128\left(2\sqrt{3} - \pi\right)\text{cm}^3$$



Q.77 $$\frac{1}{a-1} + \frac{y'}{a+1} = 1 \Rightarrow a = \frac{y'-1}{y'+1}$$

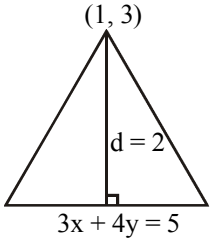
$$\Rightarrow a + 1 = \frac{2y'}{y'+1} \text{ and } a - 1 = -\frac{2}{y'+1}$$

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

$\Rightarrow (y'+1)(y - xy') = 2y'$

Q.78 $\sec^2\theta + 2\,\text{cosec}^2\theta \geq 3 + 2\sqrt{2}$

$d = \dfrac{3+12-5}{5} = 2$, then 2 points



Q.79 $x \to 0^+$, b sgn (– ve) = – b

x = 0, a

$\Rightarrow a = -b \Rightarrow a + b = 0$

Q.80 $\dfrac{^{25}C_2 + {}^{25}C_2}{^{50}C_2 + {}^{50}C_2} = \dfrac{12}{49}$

Q.81 $w = 2t$

$x + y + z + t = 15 \Rightarrow {}^{14}C_3$

$0 \leq x \leq 5$

$X + Y + Z + T = 9$

$x = 6 - X$

$\Rightarrow {}^{12}C_3 - {}^4C_1 \times {}^6C_3$

$y = 6 - Y$

$\Rightarrow \dfrac{12\times11\times10}{6} = 220 - 80 = 140$

$z = 6 - Z$

$t = 6 - T$

Q.82 $f'(x) = 3x^2 - 6x + a - 2\sin x \geq 0$

$= 3x^2 - 6x + a - 2 \geq 0$

$= 36 - 3 \times 4\,(a - 2) \geq 0$

$= 3 - a + 2 \geq 0$

$= a \leq 5$

Q.83 $N^r \,.\, A\,(D^r) + B\left(\dfrac{d}{dx}D^r\right)$, $A = \dfrac{6}{29}$, $B = \dfrac{15}{29}$

Q.84 Volume $= \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$

$\Rightarrow |\,3abc - a^3 - b^3 - c^3\,|$

$= (a + b + c)\,(a^2 + b^2 + c^2 - \Sigma ab)$

$\Rightarrow (\Sigma a)\left((\Sigma a)^2 - 3\Sigma ab\right)$

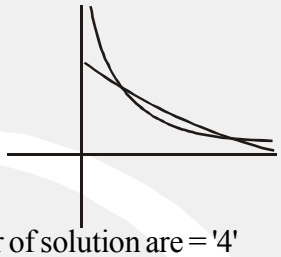
$\Rightarrow 9\,(81 - 3 \times 15) = 9 \times 36 = 324$

Q.85 $S_n = \displaystyle\sum_{n=3}^{n} \tan^{-1}\left(\frac{\frac{x}{2}}{1 + \frac{n}{2}\frac{(n+1)}{2}\cdot x^2}\right)$

$= \displaystyle\sum_{n=3}^{n} \tan^{-1}\left(\frac{(n+1)\frac{x}{2} - \frac{nx}{2}}{1 + (n+1)\frac{x}{2}\cdot n\frac{x}{2}}\right)$

$S_\infty = \dfrac{\pi}{2} - \tan^{-1}\left(\dfrac{3x}{2}\right) = 1 \Rightarrow \dfrac{3x}{2} = \cot 1,\ x = \dfrac{2}{3}\cot 1$

Q.86 Put $|x| = t$, $t \cdot e^{2-t} = 1$, $t \geq 0$, $e^{2-t} = \dfrac{1}{t}$, $t \neq 0$



number of solution are = '4'

Q.87 $n = 3$, $p = \dfrac{2}{6} = \dfrac{1}{3}$, $q = \dfrac{2}{3}$

variance = npq $= 3 \times \dfrac{1}{3} \times \dfrac{2}{3} = \dfrac{2}{3}$

mean = np $= 3 \times \dfrac{1}{3} = 1$

Q.88 $\bar{x} = \dfrac{1+2+3+4+5}{5} = 3$

$\sum (x - \bar{x})^2 = 4 + 1 + 0 + 1 + 4 = 10$

S.D. $= \sigma = \sqrt{\dfrac{\sum (x-\bar{x})^2}{N}} = \sqrt{\dfrac{10}{5}} = \sqrt{2}$

Q.89 $A \equiv \{1, 2, 3, 4, 5\}$, $B \equiv \{0, 1, 2, 3\}$

Common in A & B are 3 elements

Then common in A × B and B × A are $3 \times 3 = 9$

Q.90 $\alpha \in [-2, 2]$