UPSEE 2016
Paper 1 Code AA Solutions
Physics

Ans.1: (D) $2R$

By energy conservation between points A and B

$$Mg(2R)+\frac{1}{2}m(0)^2=mgH+\frac{1}{2}m(0)^2 \Rightarrow H=2R$$

Ans.2: (D) 40 sec

$$4t+2t=4(60)\Rightarrow t=40$$

Ans.3: (A) Towards the left

Point of contact of wheel has velocity towards left.

Ans.4: (C) *b* and *m* alone

$$F=-\frac{dU}{dx}=-2bx\Rightarrow \omega=\sqrt{\frac{2b}{m}}$$

Ans.5: (D) light is absorbed in quanta of energy $E=h\upsilon$

Ans.6: (B) 954 kg/m^3

$$V\rho g=\frac{V}{6}(724)g+\frac{5V}{6}(1000)g \quad \Rightarrow \rho=954\,Kg/m^3$$

Ans.7: (C) 144 cm

$n(18)=l$ where length of string is *l*

$(n+1)(16)=l$

Gives n=8 and *l*=144cm

Ans.8:(A) $4.8\times10^{-4}C$

$$Q=\frac{\phi}{R}=\frac{(20\times10^{-4})(2.4)}{10}=4.8\times10^{-4}C$$

Ans.9: (B) $\frac{3q}{2\sqrt{2}\pi\varepsilon_0 a}$

$$V=\frac{kq}{a\sin45^0}+\frac{k(-q)}{a\sin45^0}+\frac{k(3q)}{a\cos45^0}=\frac{1}{4\pi\varepsilon_0}\frac{3q}{\frac{a}{\sqrt{2}}}=\frac{3q}{2\sqrt{2}\pi\varepsilon_0 a}$$

Ans.10:(D) ∞

Resistance = $\frac{dV}{dI}=\frac{1}{\left(\frac{dI}{dV}\right)}=\frac{1}{Slope}=\frac{1}{0}=\infty$

Ans.11: (C) It moves back and forth (oscillating) towards the wolf

Sound wave is longitudinal wave .

Ans.12:(B)Silver

Ans.13: (D) 4V

$$A_1V_1=A_2V_2\Rightarrow \pi(2R)^2V=\pi R^2V_B \Rightarrow 4V=V_B$$

Ans.14: (B)6 minutes

$$-\frac{d\theta}{dt}=k\left[\theta_{av}-\theta_0\right]$$

$$-\frac{(59-61)}{4}=k\left[\frac{61+59}{2}-30\right]$$

$$\frac{1}{2}=k30\Rightarrow k=\frac{1}{60}$$

$$-\frac{(49-51)}{t}=k\left[\frac{51+49}{2}-30\right]$$

$$\frac{2}{t}=k(20)\Rightarrow t=6$$

Ans.15:(C)18000C

$$i=\frac{7.5}{9}\quad\therefore Q=it=\frac{7.5}{9}(6)(60)(60)=18000C$$

Ans.16: (B) $\frac{B\omega l^2}{2}$

Ans.17: (A) $3\Phi_E$

$$\Phi_E=\frac{q}{\varepsilon_0}\qquad\therefore \Phi=\frac{q+(-3q)+5q}{\varepsilon_0}=\frac{3q}{\varepsilon_0}=3\Phi_E$$

Ans.18:(B)27A

$IV=P_1+P_2+P_3$

$I(120)=1800+1300+100$ ∴ $I=26.67A$

Ans.19: (A)2A

$$B=\frac{\mu_0}{2\pi(0.1)}\left[10+8+I-20\right]=0\qquad\therefore I=2$$

Ans.20:(C)80V

$$\left|\varepsilon\right|=L\left|\frac{di}{dt}\right|=(40\times10^{-6})\left(\frac{6-0}{3\times10^{-6}}\right)=80V$$

Ans.21: (D) $12.1eV$

$$\Delta E=E_3-E_1=-1.5-(-13.6)=12.1eV$$

Ans.22: (D) There is no change

$\vec{F}=q\vec{v}\times\vec{B}=0$ So velocity is constant

Ans.23: (B) -10^{-5}

Ans.24: (A) 1

$$K.E=\frac{1}{2}mv^2=\frac{1}{2}m\left(\sqrt{\frac{GM}{r}}\right)^2=\frac{1}{2}m\frac{GM}{r}\quad,$$

$$U=-m\frac{GM}{r}\quad\therefore E=K.E+U=m\frac{GM}{2r}-m\frac{GM}{r}=-m\frac{GM}{2r}$$

Alternative:

we know that $E=-K\Rightarrow|E|=K$

Ans.25:(B) $16m/s^2 \quad ,4m/s$

$$a_c = 32\cos 60^0 = 16m/s^2$$

$$a_c = \frac{v^2}{R} \Rightarrow 16 = \frac{v^2}{1} \quad \Rightarrow v = 4m/s$$

Ans.26:(D) $10\frac{m}{s^2}$ **upwards the incline**

$$a = \frac{75 - 5g\sin 30^0}{5} = (75-25)/5 = 10m/s^2$$

Ans.27:(A) 60J

$$W = KE_f - KE_i = \frac{1}{2}(3)(64+16) - \frac{1}{2}(3)(36+4) = \frac{1}{2}(3)(80-40) = 60J$$

Ans.28: (C) 335J

$W = Q_A - Q_R$

$25 = 360 - Q_R \quad \therefore Q_R = 335J$

Ans.29: (A) $\frac{3\sigma}{2\varepsilon_0}$

$$E = \frac{\sigma}{2\varepsilon_0} + \frac{-2\sigma}{2\varepsilon_0} + \frac{4\sigma}{2\varepsilon_0} = \frac{3\sigma}{2\varepsilon_0}$$

Ans .30: (C) Three in parallel

$U = \frac{1}{2}CV^2$ For U maximum, C must be maximum

Ans.31:(D) $\frac{20}{3}\Omega$

By Wheatstone bridge $R_{eq} = \frac{(4+6)(8+12)}{(4+6)+(8+12)} = \frac{20}{3}\Omega$

Ans.32: (C) $a < b, b > c$

Ans.33: (B) $2f$

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{-R}\right)$$

$$\frac{1}{f_1} = (\mu - 1)\left(\frac{1}{R} - \frac{1}{\infty}\right) \Rightarrow f_1 = 2f$$

Ans.34: (B) 26V

$$V = (2+4)4 + 2 = 26\,volt$$

Ans.35: (C) $2\sqrt{2}$

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mKE}} = \frac{h}{\sqrt{2mqV}}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{m_2 q_2}}{\sqrt{m_1 q_1}} = \frac{\sqrt{4m_p 2e}}{\sqrt{m_p e}} = 2\sqrt{2}$$

Ans.36:(A) $\frac{6g}{5L}\sin\theta$

$$I = 4m\left(\frac{L}{2}\right)^2 + m\left(\frac{L}{2}\right)^2 = \frac{5}{4}mL^2$$

$$\tau = 4mg\frac{L}{2}\sin\theta - mg\frac{L}{2}\sin\theta = mg\frac{3L}{2}\sin\theta$$

$$\tau = I\alpha \Rightarrow \alpha = \frac{\tau}{I} = \frac{6g}{5L}\sin\theta$$

Ans.37: (C) $4\hat{i} - 5\hat{j}$

Horizontal component remains constant, whereas vertical component changes its sign.

Ans.38: (C) 5 %

$$T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow \frac{\Delta T}{T} = \frac{\Delta l}{2l} + \frac{\Delta g}{2g} \Rightarrow \frac{\Delta T}{T}\% = \left(\frac{3}{2} + \frac{7}{2}\right)\% = 5\%$$

Ans.39: (D) 100W

Work per cycle $= \frac{1}{2}\times(30-10)(8-2) = 60J \quad \therefore P = \frac{60\times100}{60} = 100W$

Ans.40: (A)Path –I

Ans.41: (A) 3Hz

$\upsilon_1 = 30300/100 = 303Hz \quad ,\upsilon_2 = 30300/101 = 300Hz \Rightarrow \upsilon_1 - \upsilon_2 = 3Hz$

Ans.42: (C) $0.75I_0$

$I = I_0\cos^2 30^0 = 0.75I_0$

Ans.43: (B) laser light is highly coherent

Ans.44:(B) 19%

$$KE_2 = \frac{p_2^2}{2m} = \frac{(0.9p)^2}{2m} = \frac{0.81p^2}{2m}$$

Ans.45: (A) Magnification of microscope is inversely proportional to the least distance of distinct vision.

Magnification $M = 1 + \frac{D}{f}$

Ans.46: (C) $64\pi SR^2$

$$W = S\left[8\pi S(3R)^2 - 8\pi S(R)^2\right] = 64\pi S(R)^2$$

Ans.47: (C)Less than 300 km/hr

$$< v > = \frac{d+d}{t_1+t_2} = \frac{200+200}{\frac{200}{400}+\frac{200}{200}} = \frac{800}{3} = 267km/hr$$

Ans.48: (C) remains constant

$dS = \frac{dQ}{T} = 0 \quad \therefore$S=constant

Ans.49:(C) $A = 0, B = 1, C = 1$

Output $C = A + AB$

Ans.50: (C) chromatic aberration

<u>Chemistry</u>

Ans.51: (C) He^+

Ionization Potential = $E_\infty - E_1$

$54.4 = 0 - E_1$ or $E_1 = -54.4$ eV

But $E_1 = -13.6 \times \frac{Z^2}{(1)^2} eV$ or $-54.4eV = -13.6 \times Z^2$ or Z=2 ,So He^+ ion

Ans.52:(C) $n = 3,\ l = 2,\ m = 1,\ s = +\frac{1}{2}$

Energy $\alpha\ (n + l)$

For Options: (A) $(n+l) = 3 + 0 = 3$

(B) $(n+l) = 3 + 1 = 4$

(C) $(n+l) = 3 + 2 = 5$

(D) $(n+l) = 4 + 0 = 4$

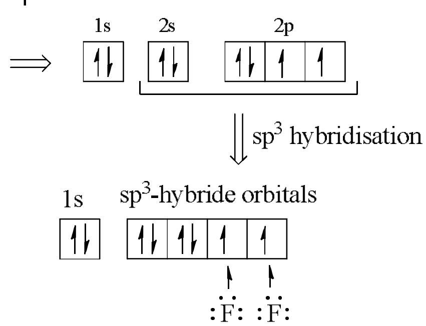
So $n = 3,\ l = 2,\ m = 1,\ s = +\frac{1}{2}$ Set of quantum number has highest energy.

Ans.53: (C) sp^3

OF_2 :-

${}_6O \Rightarrow 1s^2 2s^2 2p^4$

or ${}_6O$



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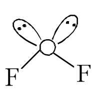


sp^3, Two lone pairs of electron V-shape

Ans.54:. (D) SO_3^{2-}, ClO_3^- and BO_3^{3-}

$NO_3^- \Rightarrow sp^2 \Rightarrow$ Trigonal planar

$AsO_3^{3-} \Rightarrow sp^3 \Rightarrow$ Pyramidal (onelone pair)

$CO_3^{-2} \Rightarrow sp^2 \Rightarrow$ Trigonal planar

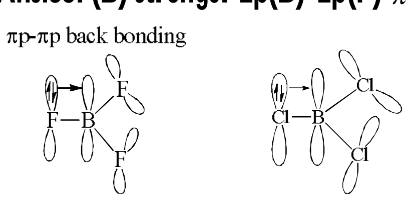
$ClO_3^- \Rightarrow sp^2 \Rightarrow$ Pyramidal(one lone pair)

$SO_3^{-2} \Rightarrow sp^3 \Rightarrow$ Pyramidal(one lone pair)

$BO_3^{3-} \Rightarrow sp^3 \Rightarrow$ Pyramidal(one lone pair)

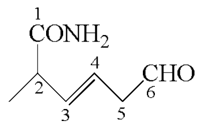
So SO_3^{2-}, ClO_3^- & BO_3^{3-} all are non-planar

Ans.55: (B) stronger 2p(B)–2p(F) $\pi-$ bonding



Size of Cl is more than the size of F so in case of BF_3 strong 2p(B)–2p(F) π-bonding occurs so lewis acidity of BF_3 is less than BCl_3 .

Ans.56: (A) 2-methyl-6-oxohex-3-enamide



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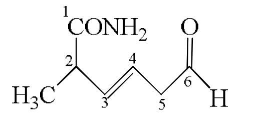
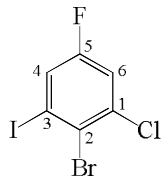


2-methyl-6-oxohex-3-enamide

priority ⇒ Amide > Aldehyde

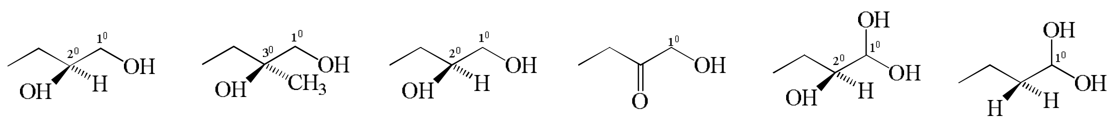
Ans.57: (B) 2-Bromo-1-chloro-5-fluoro-3-iodo benzene



* Numbbering according to lowest set of locant rule

2-Bromo-1-chloro-5-flaoro-5-Flauoro-3-iodo-banzene

Ans.58: (D)(i), (iii), (v)



(I) (II) (III) (IV) (V) (VI)

So at least one 2^0- alcohol present in I, III & V

Ans.59: (C) intermediate 2

According to Hammonds Postulates the transition state resemble to that species which is energetically near to it.

Ans.60: (B) Cl > F > Br > I

On moving up to down in the group. Electron affinity decrease due to decrease in size but chlorine has high electron affinity fluorine due to presence of vacant d-orbitals.

Ans.61: (B) Coordination isomerism

Answer is (B) because of coordination isomerism is a form of structural isomerism in which the composition of the complex ion varies. In a coordination isomer the total ratio of ligand to metal remains the same, but the ligands attached to specific metal ion change.

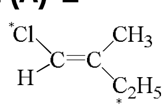
Ans.62: (A) zero

Species which is excess in reaction mixture follow zero order kinetics, so order of reaction with respect to O_2 is zero

Ans.63: (D) Reduction

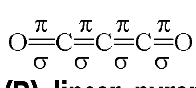
Friedel-Craft reaction is a aromatic electrophilic substitution. So reduction is not a fried-craft reaction.

Ans.64: (A) E



Higher priority group (*) are different side ,So prefix is (E)

Ans.65: (A) 4σ and 4π bonds

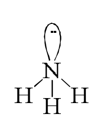


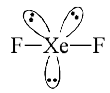
4σ & 4π

Ans.66: (B) linear, pyramidal

XeF_2 = sp^3d hybridization, 3l.p. & 2 l.p.

NH_3 = sp^3 hybrid 1l.p. + 3b.p.



So 

Ans.67: (C) 2,1 and 1

$BrF_4^- \Rightarrow sp^3d^2 \Rightarrow$ 2 l.p.+ 4b.p.

$XeF_6 \Rightarrow sp^3d^3 \Rightarrow$ 1 l.p. + 6 b.p.

$SbCl_6^{3-} \Rightarrow sp^3d^3 \Rightarrow$ 1 l.p. + 6 b.p

Ans.68: (A) isotropic

Crystalline solids are anisotropic not isotropic

Ans.69: (A) vapour pressure of solute is zero

Non volatile solute is always have zero vapour pressure

Ans.70: (B) associated colloids

Micelles are associated colloids which are formed above the CMC (critical micelles concentration)

Ans.71: (A) Milk fat is dispersed in water

Emulsions are colloids in which both dispersed phase & dispersion medium are liquids. So milk is emulsion in which liquid is dispersed in water.

Ans.72: (D) –1412 kJ mol^{-1}

$2C + 2H_2 \rightarrow C_2H_5,\ \Delta H_f = 52$ (1)

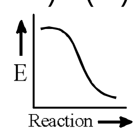
$C + O_2 \rightarrow CO_2,\ \Delta H_f = -394$ (2)

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O,\ \Delta H_f = 286$ (3)

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O,\ \ \Delta H_C = ?$ (4)

But equ. 2× (equ-2) – 2 × (equ-3) – (equ-1) = equ-4

2 (–394) + 2(–286) – (52) = – 1412 KJmol^{-1}

Ans.73: (C) 

If the difference between energy of reactant & transition state is zero then activation energy is zero.

Ans.74: (C) $t_{1/2} \propto a^0$

$$t_{1/2}\ \alpha\ \frac{1}{n-1}$$

For first order reaction n = 1

So $t_{1/2}\ \alpha\ \frac{1}{a^0}$

Or $t_{1/2}\ \alpha\ a^0$ constant

Ans.75: (D) 2.0 ML^{-1}

Active mass is concentration in mole litre^{-1} or concentration in molarity

So Molarity = $\frac{8.5}{17} \times \frac{1000}{250} = 2.0 ML^{-1}$

Ans.76: (C) $K_1^2 = K_2$

$$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g),\ K_1 = \frac{[SO_3]}{[SO_2][O_2]^{1/2}}$$

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g),\ K_2 = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$$

$$K_1^2 = \frac{[SO_3]^2}{[SO_2]^2[O_2]} = K_2$$

So $K_1^2 = K_2$

Ans.77: (B) threo stereoisomers

When same groups are present in opposite side called threo stereoisomer .

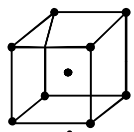
Ans.78: (C) Schottky

During the Schottky defects same number of cations & anions are missing from their lattice site so density is decreased.

Ans.79: (A) $\frac{1}{8}$

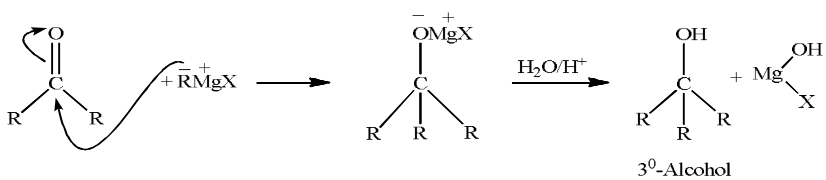
$N = N_0 / 2^n \therefore N = N_0 / 2^3 = N_0 / 8$

Ans.80: (B) 2



$= \frac{1}{8} \times 8 + 1 \times 1 = 2$

Ans.81: (C) 3^0 alcohol



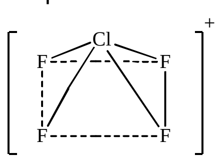
Ans.82: (B) $CaOCl_2$

Bleaching powder is $CaOCl_2$

Ans.83: (B) square pyramidal

$ClF_4^+ \Rightarrow sp^3d$ /hybridization

4 b.p. of e^- & 1 lone pair of e^- & shape is square pyramidal



Ans.84: (D) $3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$

If gaseous moles of reactant is equal to the gaseous moles of product then reaction is not affected by the changing in pressure

So (A) $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g),\ \Delta n = 3 - 2 = 9$

(B) $H_2(g) + I_2(s) \rightleftharpoons 2HI(g),\ \ \Delta n = 2 - 1 = 1$

(C) $C_{(s)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + H_2(g),\ \Delta n = 2 - 1 = 1$

(D) $3Fe_{(s)} + 4H_2O_{(g)} \rightleftharpoons Fe_3O_{4(s)} + 4H_{2(g)}\ \Delta n = 4 - 4 = 0$

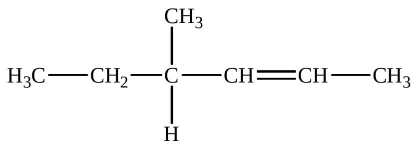
Ans.85: (A) Increasing the temperature

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_{3(g)} + 92.3KJ$

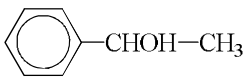
Reaction is exothermic so on increasing the temperature equilibrium shifted in backward direction

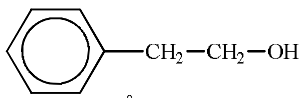
Ans.86: (B) $CH_3CH_2-\underset{}{CH}(CH_3)-C{=}CH-CH_3$

Compound

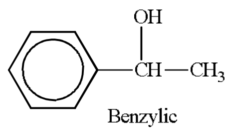


gives geometrical isomerism & it is also give enantiomerism.

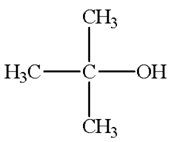
Ans.87: (B) 

(a) 

1^0-alcohol

(b) 

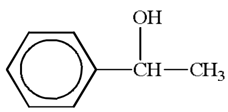
Benzylic

(c) 

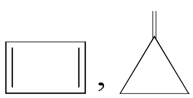
3^0-alcohol

(d) $H_2C{=}CH-CH_2-OH$

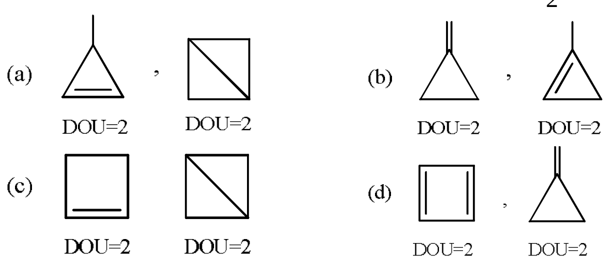
Allylic

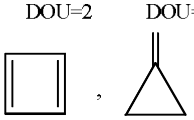
So compound  give fastest reaction with conc. HCl

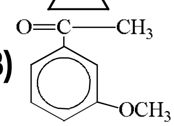
Ans.88: (A) Polythene

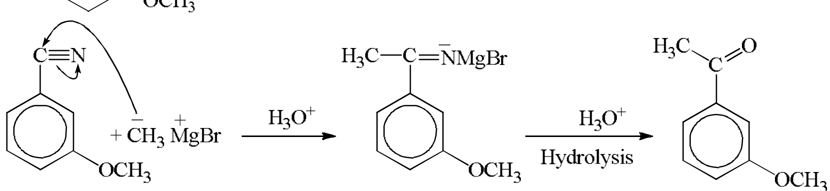
Ans.89: (D) 

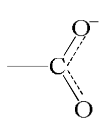
C_4H_6 Degree of unsaturation (DOU) = $\frac{10-6}{2} = 2$



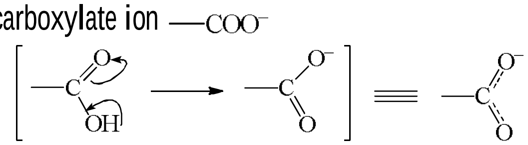
So  is not the pair of C_4H_6

Ans.90:(B) 



Ans.91: (D) 

Resonance in carboxylate ion $—COO^-$



Resonating structures

Resonance hybride

Ans.92: (B) kg. ms^{-2}

$$E = mc^2 \Rightarrow kg(ms^{-1})^2 = Kgm^2s^{-2}$$

So kg.ms^{-2} is not the unit of energy .

Ans.93: (A) 134.1 gm mol^{-1}

$P_{total} = 99.652 KPa$

$P_{water} = 85.140 KPa$

$P_{liquid} = (99.652 - 85.140) KPa = 14.512 kPa$

And $\frac{m_A}{m_B} = \frac{1.27g}{1g}$

We have $\frac{m_A}{m_B} = \frac{P_A M_A}{P_B M_B}$

or $M_A = \left(\frac{m_A}{m_B}\right)\left(\frac{P_B M_B}{P_A}\right)$ $\therefore M_A = (1.27)\left(\frac{85.140\,KPa \times 18g\,mol^{-1}}{14.512\,kPa}\right)$ $\cong$ 134.1 g mol^{-1}

Ans.94: (A) Cell will swell

Osmotic pressure

Ans.95: (C) 6.92

Solution is very dilute so concentration of H$^+$ ions in HCl solution

= H$^+$ ions in water + H$^+$ is ion in HCl

= $1\times10^{-7} + 2\times10^{-8} = 12\times10^{-8}$

So pH = $-\log(12\times10^{-8}) = -\log(2^2 \times 3 \times 10^{-8})$

$= -2\log 2 - \log 3 + 8\log 10 = -2(0.301) - 0.477 + 8 = 6.92$

Ans.96: (C) $A_3B_{12}C$

A	B	C
At corner	At Centre of Each face	At corner
$6\times\frac{1}{8}$	$6\times\frac{1}{2}$	$2\times\frac{1}{8}$
$\frac{3}{4}$	3	$\frac{1}{4}$
3	12	1

So molecular formula = $A_3B_{12}C$,

Ans.97: (C) X_2Y_4Z

Z	Y	X
Corner	in $\frac{1}{2}$ Td Voids	in $\frac{1}{2}$ Oh voids
$8\times\frac{1}{8}$	$8\times\frac{1}{2}\times1$	$4\times\frac{1}{2}\times1$
1	4	2

So formula is X_2Y_4Z

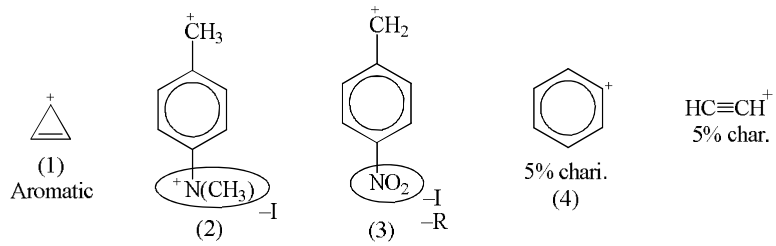
Ans.98: (D) B > A > C

According to question the position of elements in electrochemical series is

C
A
B

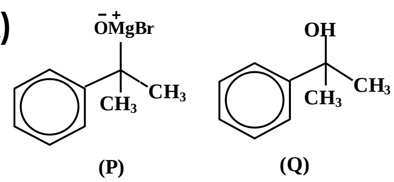
Oxidizing power of elements increases in electrochemical series on moving up to down so decreasing order of oxidizing power is B > A > C

Ans.99: (D) 1 > 2 > 3 > 4 > 5



So decreasing order of stability 1 > 2 > 3 > 4 > 5

Ans.100: (A)



Maths

Ans.101: (D) 90^0

Let the angle between P and Q be α .Then as resultant of P and Q is P. $\Rightarrow P^2 = P^2 + Q^2 + 2PQ\cos\alpha$

$0 = Q + 2P\cos\alpha$

Let θ be the angle which the new resultant makes with Q

Then $\tan\theta = 2P\sin\alpha / (Q + 2P\cos\alpha) = 1/0 = \infty$

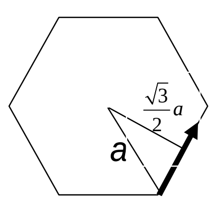
$\Rightarrow \theta = 90^0$

Ans.102. (B) $\frac{3L}{4}$

$$x_{cm} = \frac{\int_0^L x\,dm}{\int_0^L dm} = \frac{\int_0^L x\lambda dx}{\int_0^L \lambda dx} = \frac{\int_0^L x\alpha x^2 dx}{\int_0^L \alpha x^2 dx} = \frac{3L}{4}$$

Ans.103. (B) $\frac{\sqrt{3}}{2}aF$

$$\tau = \left(\frac{\sqrt{3}}{2}a\right)F - \left(\frac{\sqrt{3}}{2}a\right)F + \left(\frac{\sqrt{3}}{2}a\right)F = \left(\frac{\sqrt{3}}{2}a\right)F$$



Ans.104: (A) a

$$a_x = \frac{d^2x}{dt^2} = \frac{d}{dt}\left(a(1+\cos t)\right) = -a\sin t$$

$$a_y = \frac{d^2y}{dt^2} = \frac{d}{dt}\left(a\sin t\right) = a\cos t$$

$$\text{acceleration} = \sqrt{a_x^2 + a_y^2} = a$$

Ans.105: (B) –2

$$v=\frac{dx}{dt}=\frac{1}{2}t^{-\frac{1}{2}}$$

$$a=\frac{dv}{dt}=\frac{1}{2}\left(-\frac{1}{2}\right)t^{-\frac{3}{2}}=-2\frac{1}{2^3}t^{-\frac{3}{2}}=-2v^3$$

Ans.106: (A) $\frac{gh}{d}$

$$u=\sqrt{2gh}$$

$$\Rightarrow 0=u^2-2ad$$

$$2gh=2ad\Rightarrow a=\frac{gh}{d}$$

Ans.107. (C) $(4,-8)$

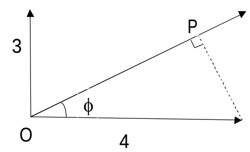
Here $a=4, m=\tan 45^0=1$

So required normal point $\left(am^2,-2am\right)=\left(4,-8\right)$

Ans.108: (A) 3.2

$\tan\phi=3/4\Rightarrow\cos\phi=4/5$

Projection $=4\cos\phi=3.2$



Ans.109: (D) None of the options

$\vec{R}$ must be perpendicular to $\vec{A}$ as well as perpendicular to $\left(\vec{B}\times\vec{C}\right)$

Let $\vec{A}=\hat{i},\vec{B}=\hat{i}+\hat{j},\vec{C}=\hat{k}$

$$\vec{R}=\vec{A}\times\left(\vec{B}\times\vec{C}\right)=\hat{i}\times\left[\left(\hat{i}+\hat{j}\right)\times\hat{k}\right]=\hat{i}\times\left[\left(-\hat{j}+\hat{i}\right)\right]=-\hat{k}$$

Hence $\vec{R}$ is neither parallel nor perpendicular to $\vec{B}$

Ans. 110.(C) $e^y=2e^x+\frac{x^3}{3}+c$

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

$$\int e^y dy=\int\left(2e^x+x^2\right)dx$$

$$\Rightarrow e^y=2e^x+\frac{x^3}{3}+c$$

Ans.111:(A) $y^3+cy=x$

$$2y^3dy=ydx-xdy$$

$$2ydy=\frac{ydx-xdy}{y^2}=d\left(\frac{x}{y}\right)$$

$$\Rightarrow y^2+c=\frac{x}{y}$$

Ans.112: (A) $\frac{1}{3}$

$$\lim_{n\to\infty}\frac{1}{n^3}(1^2+2^2+3^2+......+n^2)=\lim_{n\to\infty}\frac{1}{n^3}\frac{n(n+1)(2n+1)}{6}$$

$$=\lim_{n\to\infty}\frac{\left(1+\frac{1}{n}\right)\left(2+\frac{1}{n}\right)}{6}=\frac{2}{6}=\frac{1}{3}$$

Ans.113: (C) 0

$$f(0)=\lim_{x\to 0} f(x)$$

$$\Rightarrow a=\lim_{x\to 0} x\sin\frac{1}{x}$$

$$\Rightarrow a=0\times(-1 \text{ to } +1)=0$$

Ans.114: (C) $x^{\sin x}\left(\cos x\log x+\frac{\sin x}{x}\right)$

$$\log y=\log\left(x^{\sin x}\right)=\sin x\log x$$

$$\frac{1}{y}\frac{dy}{dx}=\left(\cos x\log x+\frac{\sin x}{x}\right)$$

$$\Rightarrow \frac{dy}{dx}=x^{\sin x}\left(\cos x\log x+\frac{\sin x}{x}\right)$$

Ans.115: (D) $x-y=2$ **and** $x-y=\frac{86}{27}$

Only in (D)option slopes of both lines(tangents) are 1 that is equal to slope of y=x line

Alternative method:

$$\frac{dy}{dx}=3x^2-4x+1 \quad ...(1)$$

$$y=x\Rightarrow\frac{dy}{dx}=1 \quad ...(2)$$

From (1) and (2) $1=3x^2-4x+1\Rightarrow x=0,4/3$

$x=0$ gives $y=-2$ and $x=4/3$ gives $y=-50/27$

Thus the tangents to the curve at the points $(0,-2)$ and $(4/3,-50/27)$ are parallel to line $y=x$. The equations of these tangents are $y-(-2)=1(x-0)$ and $y-(-50/27)=1(x-4/3)$

i.e. $x-y=2$ and $x-y=\frac{86}{27}$

Ans.116: (A) 1

$$\lim_{x\to 0}\frac{\cosh x-\cos x}{x\sin x}=\lim_{x\to 0}\left\{\frac{\cosh x-\cos x}{x^2}\left(\frac{x}{\sin x}\right)\right\} \qquad \left[\frac{0}{0}\text{form}\right]$$

$$=\lim_{x\to 0}\left\{\frac{\cosh x-\cos x}{x^2}.1\right\} \qquad \left[\frac{0}{0}\text{form}\right]$$

$$=\lim_{x\to 0}\left\{\frac{\sinh x+\sin x}{2x}\right\} \qquad \left[\frac{0}{0}\text{form}\right]$$

$$=\lim_{x\to 0}\left\{\frac{\cosh x+\cos x}{2}\right\}=\frac{1+1}{2}=1$$

Alternative:

$$\lim_{x\to 0}\frac{\cosh x-\cos x}{x\sin x}=\lim_{x\to 0}\left\{\frac{\frac{e^x+e^{-x}}{2}-\left(1-\frac{x^2}{2}+...\right)}{x\left(x-\frac{x^3}{3}+..\right)}\right\}$$

$$=\lim_{x\to 0}\left\{\frac{\frac{\left(1+\frac{x^2}{2}+...\right)+\left(1-\frac{x^2}{2}+...\right)}{2}-\left(1-\frac{x^2}{2}+...\right)}{x\left(x-\frac{x^3}{3}+..\right)}\right\}=\lim_{x\to 0}\left\{\frac{1}{\left(1-\frac{x^2}{3}+..\right)}\right\}=1$$

Ans.117: (B) $e^{\left(\frac{1}{e}\right)}$

$$f(x)=(1/x)^x$$

$$f'(x)=(1/x)^x(-\log x-1)$$

$$f'(x)=0\Rightarrow(-\log x-1)=0\Rightarrow x=1/e$$

Maxima of function is $=\left(\frac{1}{1/e}\right)^{1/e}=e^{1/e}$

Here $f''(x)=(1/x)^x(\log x+1)^2+(1/x)^x\left(-\frac{1}{x}\right)$

At $x=1/e$, $f''(1/e)<0$

$x=1/e$ पर $f''(1/e)<0$

Ans.118: (D) $\frac{\pi}{4}-\frac{1}{2}\log 2$

Let $x=\sin\theta\Rightarrow dx=\cos\theta d\theta\Rightarrow x=0,\theta=0\, and\, x=\frac{1}{\sqrt{2}},\theta=\frac{\pi}{4}$

$$I=\int_0^{\frac{\pi}{4}}\theta\sec^2\theta d\theta=[\theta\tan\theta]_0^{\frac{\pi}{4}}-\int_0^{\frac{\pi}{4}}1.\tan\theta d\theta$$

$$=\left[\frac{\pi}{4}\tan\frac{\pi}{4}-0.\tan 0\right]-[\log\sec\theta]_0^{\frac{\pi}{4}}$$

$$=\left[\frac{\pi}{4}\right]-\left[\log\sec\frac{\pi}{4}-\log\sec 0\right]=\frac{\pi}{4}-\left(\log\sqrt{2}-\log 1\right)=\frac{\pi}{4}-\frac{1}{2}\log 2$$

Ans.119: (D) $\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{1}{\sqrt{3}}\tan\frac{x}{2}\right)+c$

$$\int\frac{1}{2+\cos x}dx=\int\frac{dx}{1+2\cos^2\frac{x}{2}}=\int\frac{dx}{3\cos^2\frac{x}{2}+\sin^2\frac{x}{2}}=\int\frac{\sec^2\frac{x}{2}}{3+\tan^2\frac{x}{2}}dx$$

$$Let\ \tan\frac{x}{2}=t\Rightarrow\frac{1}{2}\sec^2\frac{x}{2}dx=dt$$

$$I=2\int\frac{dt}{3+t^2}=\frac{2}{\sqrt{3}}\tan^{-1}\frac{t}{\sqrt{3}}+c=\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{1}{\sqrt{3}}\tan\frac{x}{2}\right)+c$$

Ans.120.(A) $\frac{\sqrt{7}}{4}$

$$\frac{x^2}{16}+\frac{y^2}{9}=1$$

$$e=\sqrt{1-\frac{9}{16}}=\frac{\sqrt{7}}{4}$$

Ans.121. (C) $x^2-y^2=32$

Distance between foci $=2ae$

and $16=2a\sqrt{2}\Rightarrow a=4\sqrt{2}$

$$b^2=a^2(e^2-1)=32(2-1), b=4\sqrt{2}$$

Required equation $\frac{x^2}{32}-\frac{y^2}{32}=1$

Ans.122: (C) $2x-3y+13=0$

Equation of chord $T=S'$

$$T=-2x+3y-81$$

$$S'=4+9-81=-68$$

Equation of chord $-2x+3y-81=-68$

$$2x-3y+13=0$$

Alternative

$$xx_1+yy_1=x_1^2+y_1^2$$

$$-2x+3y=(-2)^2+(3)^2=13$$

Ans.123: (D) $2m^2=l\,n$

Eliminating x between the given equations

$$y^2=8\left(-\frac{n+my}{l}\right)\Rightarrow ly^2+8my+8n=0$$

Given straight line touches the parabola if roots of the equation are same

$(8m)^2 = 4.l.8n \Rightarrow 2m^2 = l\,n$

Ans.124: (C) $x + 3y = 0$

The centre C of the circle is given by $\left[-\frac{1}{2}(-6), -\frac{1}{2}(2)\right]$ or $(3,-1)$

Required diameter is the line joining the origin (0,0)and the centre C(3,-1) and hence the requires equation is

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

$$3y = -x \Rightarrow x + 3y = 0$$

Ans.125: (B) $|z+5|^2$

$$(z+5)(\overline{z}+5) = (z+5)\overline{(z+5)} = |z+5|^2$$

Ans.126: (D) $(z\,\overline{z})$ **is nonnegative real**

Ans.127: (B) −3

$$\because 1 + \omega + \omega^2 = 0$$

$$\therefore \left(1+\omega-\omega^2\right)^2 + \left(1-\omega+\omega^2\right)^2 + 1 = \left(-\omega^2-\omega^2\right)^2 + (-\omega-\omega)^2 + 1$$

$$= 4\omega^4 + 4\omega^2 + 1 = 4\left(\omega+\omega^2\right) + 1 = 4(-1) + 1 = -4 + 1 = -3$$

Ans.128: (A) 0

$$\left(1+i\sqrt{3}\right)^{12} = 2^{12}\left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right)^{12} = 2^{12}\left(\cos 4\pi + i\sin 4\pi\right) = 2^{12} + i.0$$

Ans.129: (D) $f(\theta) \ge 4$

$$f(\theta) = 2\left[(\cos\theta - \sec\theta)^2 + 2\cos\theta\sec\theta\right] = \left[2(\cos\theta-\sec\theta)^2 + 4\right] \ge 4$$

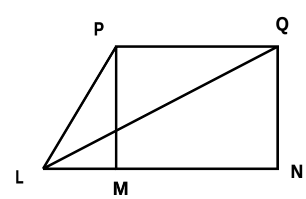
Ans.130:(C) $x = \frac{n\pi}{2} + \frac{\pi}{8}$

$$\frac{\cos x}{\sin x} - \frac{\sin x}{\cos x} = 2 \Rightarrow \cos^2 x - \sin^2 x = 2\sin x\cos x$$

$$\Rightarrow \cos 2x = \sin 2x$$

$$\Rightarrow \tan 2x = 1 \Rightarrow 2x = n\pi + \frac{\pi}{4}$$

Ans.131: (A) $\frac{100}{\sqrt{3}} m/s$



$$PQ = MN = LN - LM = 1\cot 30^0 - 1\cot 60^0 = \sqrt{3} - \frac{1}{\sqrt{3}} = \frac{2}{\sqrt{3}} km$$

$$Speed = \frac{2000}{\sqrt{3}}\frac{1}{20} = \frac{100}{\sqrt{3}} m/s$$

Ans.132: (D) $\frac{1}{4}\sin\theta\sin 4\theta$

$$\sin^2\theta\cos\theta\left(\cos^2\theta - \sin^2\theta\right) = \sin^2\theta\cos\theta\cos 2\theta$$

$$=\frac{1}{2}\sin\theta\sin 2\theta\cos 2\theta=\frac{1}{4}\sin\theta\sin 4\theta$$

Ans.133: (A) Isosceles triangle

$$2\sin C\cos A=\sin B\Rightarrow 2\cos A=\frac{\sin B}{\sin C}$$

$$2\frac{b^2+c^2-a^2}{2bc}=\frac{b}{c}\Rightarrow b^2+c^2-a^2=b^2\Rightarrow c^2=a^2$$

Ans.134:(C) $\frac{1}{\sqrt{5}}$

$$\tan\left[\frac{1}{2}\cos^{-1}\left(\frac{2}{3}\right)\right]=\tan\frac{\theta}{2}=\frac{1-\cos\theta}{\sin\theta}$$

$$=\frac{1-\cos\theta}{\sqrt{1-\cos^2\theta}}=\sqrt{\frac{1-\cos\theta}{1+\cos\theta}}=\sqrt{\frac{1-\frac{2}{3}}{1+\frac{2}{3}}}=\sqrt{\frac{1}{5}}$$

Ans.135: (D) $\phi=\frac{xy}{zr}$

$$\tan^{-1}\frac{yz}{xr}+\tan^{-1}\frac{xz}{yr}=\tan^{-1}\left[\frac{\frac{yz}{xr}+\frac{xz}{yr}}{1-\frac{z^2}{r^2}}\right]=\tan^{-1}\left[\frac{\frac{z}{xyr}\left(x^2+y^2\right)}{1-\frac{z^2}{r^2}}\right]$$

$$=\tan^{-1}\left[\frac{\frac{zr^2}{xyr}\left(x^2+y^2\right)}{x^2+y^2+z^2-z^2}\right]=\tan^{-1}\left[\frac{zr}{xy}\right]=\cot^{-1}\left[\frac{xy}{zr}\right]=\frac{\pi}{2}-\tan^{-1}\left[\frac{xy}{zr}\right]$$

Ans.136: (B) $\frac{2}{7}$

Total numbers ${}^7P_5=2520$

Total ways of odd digits at both ends= ${}^4P_2=12$

Total ways of writing digits at remaining 3 places= ${}^5P_3=60$

Total favourable conditions= $12\times 60=720$

Required probability= $\frac{720}{2520}=\frac{2}{7}$

Ans.137: (D) $\left(\frac{9}{10}\right)^5$

Probability of cycle having no puncture is $\left(\frac{90}{100}\right)$

By binomial distribution $p=\left(\frac{9}{10}\right), q=\frac{1}{10}$

Required probability $= {}^5C_5 q^0 p^5 = \left(\frac{9}{10}\right)^5$

Ans.138: (C) 3/5

$P(E_1 \cup E_2) = P(E_1) + P(E_2) - P(E_1 \cap E_2)$

Since $P(E_1)$ and $P(E_2)$ are independent

$P(E_1 \cup E_2) = P(E_1) + P(E_2) - P(E_1)P(E_2)$

$= \frac{1}{3} + \frac{2}{5} - \frac{1}{3}.\frac{2}{5} = \frac{9}{15} = \frac{3}{5}$

Ans.139: (A) $\frac{1}{35}$

Exhaustive events=$\lfloor 7$

Alternative manner

MWMWMWM

Total ways=$\lfloor 4 \times \lfloor 3$

Required probability=$\frac{\lfloor 4 \times \lfloor 3}{\lfloor 7} = \frac{1}{35}$

Ans.140. (C) H.P.

$\log_2 6 = \log_2(3) + \log_2 2 = \log_2 3 + 1$

$\log_2 12 = \log_2(3) + \log_2 4 = \log_2 3 + 2$

Hence $\log_2 3, \log_2 6, \log_2 12$ are in A.P.

or $\frac{1}{\log_2 3}, \frac{1}{\log_2 6}, \frac{1}{\log_2 12}$ are in H.P.

Hence $\log_3 2, \log_6 2, \log_{12} 2$ are in H.P.

Ans.141.(C) $2(s-r)$

$r + t = 2s \Rightarrow t = 2s - r$

$t - r = 2(s - r)$

Ans.142: (B) 1

Ans.143: (D) $p > 3$

$p = (\log_\pi 3) + (\log_\pi 4) + 1 = \{(\log_\pi 12) + 1\} > (2+1)$

$\log_\pi 12 > \log_\pi \pi^2 \Rightarrow \log_\pi 12 > 2 \quad \because \log_\pi \pi^2 = 2$

Ans.144 (A) 252

Total terms=11

Midterm=$T_6 = {}^{10}C_5 \left(\frac{3x^2}{5}\right)^5 \left(\frac{5}{3x^2}\right)^5 = \frac{\lfloor 10}{\lfloor 5 \lfloor 5} = \frac{10.9.8.7.6}{5.4.3.2.1} = 252$

Ans.145: (C) 2

From first eq. $a+b=-1, ab=1$

From second equation $\frac{a}{b}+\frac{b}{a}=-p, \frac{a}{b}.\frac{b}{a}=q=1$

$$-p=\frac{a^2+b^2}{ab}=\frac{(a+b)^2-2ab}{1}=(-1)^2-2(1)=-1 \Rightarrow p=1$$

$p+q=2$

Ans.146: (A) 0

$$\Delta=\frac{1}{abc}\begin{vmatrix}1 & abc & a^4\\1 & bca & b^4\\1 & cab & c^4\end{vmatrix}=\begin{vmatrix}1 & 1 & a^4\\1 & 1 & b^4\\1 & 1 & c^4\end{vmatrix}=0 \because C_1=C_2$$

Ans.147: (D)None of the options

$$\begin{bmatrix}9x-1\\6\end{bmatrix}+\begin{bmatrix}-2x\\3\end{bmatrix}=\begin{bmatrix}8\\9\end{bmatrix}$$

$$\begin{bmatrix}7x-1\\9\end{bmatrix}=\begin{bmatrix}8\\9\end{bmatrix}\Rightarrow 7x-1=8 \Rightarrow x=\frac{9}{7}$$

Ans.148: (D) $\begin{bmatrix}1 & 1\\1 & 1\end{bmatrix}$ **is not unit matrix.**

Ans.149: (B) One-one Into function

For any $x_1, x_2 \in N$

$x_1 \neq x_2 \Rightarrow 2x_1+3 \neq 2x_2+3$

$f(x_1) \neq f(x_2)$

So function is one one function

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

$f^{-1}(x)=\frac{x-3}{2} \notin N$ (Domain) when x=1,2,3,..

So function is one one into function.

Ans.150: (B) $[-2,\infty)$

Let $f(x)=y \Rightarrow x^2-6x+7-y=0$

$\because x$ is real so $B^2-4AC \geq 0$

$\Rightarrow 36-4(7-y) \geq 0 \Rightarrow 2+y \geq 0$

$\Rightarrow y \geq -2 \therefore$ Range $=[-2,\infty)$