PACE-IIT & MEDICAL

MUMBAI / DELHI-NCR / PUNE / HYDERABAD / AKOLA / GOA / JALGOAN / BOKARO / AMRAVATI / PATNA / BARAMATI

IIT – JEE: 2025 **MAJOR TEST - 5** **DATE: 03/08/24**

ANSWER KEY

Code – 01

PHYSICS		CHEMISTRY		MATHEMATICS	
1.	D	**31.**	D	**61.**	C
2.	A	**32.**	C	**62.**	A
3.	B	**33.**	B	**63.**	B
4.	B	**34.**	B	**64.**	B
5.	D	**35.**	A	**65.**	C
6.	C	**36.**	C	**66.**	A
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8.	C	**38.**	B	**68.**	C
9.	A	**39.**	A	**69.**	D
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PART (A) : PHYSICS

1. (D)

The net rate at which energy radiates from the object is

$$\frac{\Delta Q}{\Delta t} = e\sigma A\left(T^4 - T_0^4\right)$$

Since, $\Delta Q = -mc\Delta T$, we get

$$-\frac{\Delta T}{\Delta t} = \frac{e\sigma A\left(T^4 - T_0^4\right)}{mc}$$

Also, since $m = \frac{4}{3}\pi r^3\rho$ for a sphere, we get

$$A = 4\pi r^2 = 4\pi\left(\frac{3m}{4\pi\rho}\right)^{2/3}$$

Hence, $-\frac{\Delta T}{\Delta t} = \frac{e\sigma\left(T^4 - T_0^4\right)}{mc}\left[4\pi\left(\frac{3m}{4\pi\rho}\right)^{2/3}\right]$

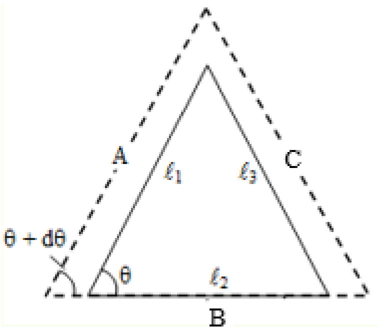
$$= K\left(\frac{1}{m}\right)^{1/3}$$

For the given two bodies

$$\frac{-(\Delta T/\Delta t)_1}{-(\Delta T/\Delta t)_2} = \left(\frac{m_2}{m_1}\right)^{1/3} = \left(\frac{1}{3}\right)^{1/3}$$

2. (A)

When the system is heated, the rods expand and the triangle does not remain equilateral. Let lengths of rods A, B and C be ℓ_1, ℓ_2 and ℓ_3 respectively then



$$\cos\theta = \frac{l_1^2 + l_2^2 - l_3^2}{2l_1l_2}$$

or $2l_1l_2\cos\theta = l_1^2 + l_2^2 - l_3^2$ ...(i)

Differentiating Equation (i), we get

$$2l_1\cos\theta dl_2 + 2l_2\cos\theta dl_1 - 2l_1l_2\sin\theta d\theta$$

$$= 2l_1dl_1 + 2l_2dl_2 - 2l_3dl_3 \quad ...(ii)$$

Let the temperature of the system be increased by ΔT, Then

$$\left.\begin{aligned} dl_1 &= l_1\alpha_1\Delta T \\ \text{and } dl_2 &= l_2\alpha_1\Delta T \\ dl_3 &= l_3\alpha_2\Delta T \end{aligned}\right\} \qquad ...(iii)$$

In case of equilateral triangle $\ell_1 = \ell_2 = \ell_3$ and $\theta = 60°$ (say)

From Eqs. (ii) and (iii), we get:

$$2l^2 \cos 60° \alpha_1 \Delta T + 2l^2 \cos 60° \alpha_1 \Delta T$$

$$-2l^2 \sin 60° d\theta$$

$$= 2l^2\alpha_1\Delta T + 2l^2\alpha_1\Delta T - 2l^2\alpha_2\Delta T$$

$$\frac{\alpha_1}{2}\Delta T + \frac{\alpha_1}{2}\Delta T - \frac{\sqrt{3}}{2}d\theta$$

$$= \alpha_1\Delta T + \alpha_1\Delta T - \alpha_2\Delta T$$

$$\alpha_1\Delta T - \frac{\sqrt{3}}{2}d\theta = 2\alpha_1\Delta T - \alpha_2\Delta T$$

$$(\alpha_2 - \alpha_1)\Delta T = \frac{\sqrt{3}}{2}d\theta$$

$$\Delta T = \frac{\sqrt{3}d\theta}{2(\alpha_2 - \alpha_1)}$$

3. (B)

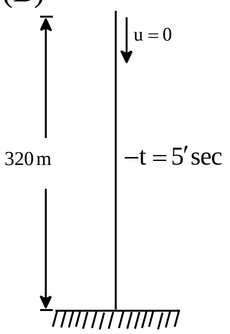
$$\frac{71-69}{4} = K\left[\frac{71+69}{2} - 30\right] \quad ...(i)$$

$$\frac{51-49}{t} = K\left[\frac{51+49}{2} - 30\right] \quad ...(ii)$$

Dividing (i) and (ii)

$$\frac{t}{4} = 2 \Rightarrow t = 8\,\text{min}$$

4. (B)



Let t be the time taken by the superman to reach the student for saving the students life just before reaching the ground. Hence, the time taken by the student to reach the ground $= (t+5)$s

For motion of student

$u = 0, h = 320\,m, g = 10\ m/s^2$

From equation, $h = ut + \frac{1}{2}gt^2$, i.e., $320 = 0 + \frac{1}{2}(10)(t+5)^2$

i.e., $(t+5)^2 = 64$; or $t+5=8$; i.e., $t = 3\text{sec}$

For motion of superman

Let initial velocity $= u = V, h = 320\text{m}, g = 10\text{m/s}^2$

From equation $h = ut + \frac{1}{2}gt^2$

i.e., $320 = V(3) + \frac{1}{2}(10)(3)^3$,

i.e., $320 = 3V + 45$

or $3V = 320 - 45$, or $V = \frac{275}{3}\text{m/s}$ **"B" Ans.**

5. (D)

Here, $\mu_1 = 1, \mu_2 = \frac{3}{2}, u = -15\text{cm}, r = +15\text{cm}$

According to refractive surface formula,

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_2}{r}$$

on putting values, $v = -45\text{cm}$

$$\because \frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_2}{r}$$

$$\frac{-\mu_2}{v^2}\frac{dv}{dt} + \frac{\mu_1}{u^2}\frac{du}{dt} = 0$$

$$\frac{dv}{dt} = \left(\frac{\mu_1}{\mu_2}\right)\left(\frac{v^2}{u^2}\right)\frac{du}{dt}$$

$$(v_{image} - v_{surface}) = \left(\frac{1}{3/2}\right) \times \left(\frac{45}{-15}\right)^2 \times (-2\text{cm/sec})$$

$$\left[\frac{du}{dt} = v_{object} - v_{surface} \text{ and } \frac{dv}{dt} = v_{image} - v_{surface}\right]$$

$v_{image} = -12 \text{ cm/sec}$

6. (C)

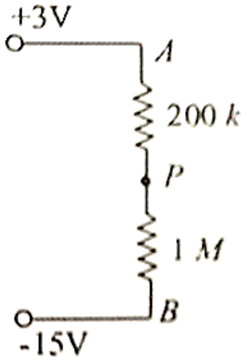
Potential difference across $1\text{M}\Omega$ resistor is

$$V_P - V_B = \frac{18V \times 1 \times 10^6\Omega}{(0.2+1)\times 10^6\Omega} = \frac{18V \times 1 \times 10^6\Omega}{1.2 \times 10^6\Omega} = 15V$$

$V_B = -15V$ [Given]

$\therefore V_P - V_B = 15V$ or $V_P = 15V + V_B$

$= 15V - 15V = 0V$



Potential difference across $200\,k\Omega$ resistor is

$$V_A - V_P = \frac{18V \times 0.2 \times 10^6 \Omega}{(0.2+1) \times 10^6 \Omega}$$

$$= \frac{18V \times 0.2 \times 10^6 \Omega}{1.2 \times 10^6 \Omega} = 3V$$

$V_A = +3V$ [Given]

$\therefore V_A - V_P = 3V$ or $V_P = V_A - 3V$

$= +3V - 3V = 0V$

7. (B)

Work done by spring on system is zero so, $\sum \vec{T}.\vec{a} = 0$

$-3T\left(3m/s^2\right) + Ta = 0$

$a = 9m/s^2$.

8. (C)

At highest point velocity is zero.
Only gravity is acting at this point particle will fall freely.

9. (A)

Retardation due to friction

$a = \mu g = (0.25)(10)$

$= 2.5\ ms^{-2}$

Collision is elastic, i.e. after collision first block comes to rest and the second block acquires the velocity of first block. Or we can understand it is this manner that second block is permanently at rest while only the first block moves. Distance travelled by it will be

$$s = \frac{v^2}{2a} = \frac{(5)^2}{(2)(2.5)} = 5m$$

$\therefore$ Final separation will be $(s-2) = 3m$

10. (A)

$$\frac{1}{f_a} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$=(1.5-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right) \quad ...(1)$$

And $\frac{1}{f_m}=\frac{\mu_g-\mu_m}{\mu_m}\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

$$\frac{1}{f_m}=\left(\frac{1.5}{1.6}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right) \quad ...(ii)$$

Thus,

$$\frac{f_m}{f_a}=\frac{(1.5-1)}{\left(\frac{1.5}{1.6}-1\right)}=-8$$

$$f_m=-8\times f_a$$

$$=-8\times\frac{-1}{5} \qquad \left(\because f_a=\frac{1}{p}=-\frac{1}{5}m\right)$$

$$=1.6\,m$$

$$\therefore P_m=\frac{\mu}{f_m}$$

$$=\frac{1.6}{1.6}=1D$$

11. (C)

$$V_T=\frac{2}{9}r^2\frac{(\rho_w-\rho_{air})}{\eta}g$$

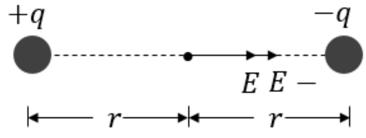
$\because \rho_{air}\approx 0$

$$\Rightarrow V_T=\frac{2}{9}\times\frac{(1.50\times10^{-6})^2\times10^3\times10}{2\times10^{-5}}$$

$$=2.5\times10^{-4}\,m/s$$

12. (C)

At O, $E\neq0, V=0$



13. (D)

$$\eta=\frac{\text{Shearing stress}}{\text{Shearing strain}}$$

Work done by the force

$$=\frac{1}{2}\times\text{shear stress}\times\text{shear strain}\times\text{volume}$$

$$=\frac{1}{2}\times\frac{F}{a^2}\times\frac{F}{a^2\eta}\times a^2t$$

$$= \frac{F^2 t}{2a^2 \eta} = \frac{\left(9\times10^4\right)^2\left(0.5\times10^{-2}\right)}{2(0.5)^2\times5.6\times10^9}$$

$$= 1.44\times10^{-2}\,J$$

14. (A)

$R = \rho\frac{1}{A}$ and mass $m = \text{volume}(V)\times\text{density}(d) = (Al)d$

Since, wires have same material so ρ and d is same for both they have same mass $\Rightarrow Al = \text{constant}$

$$\Rightarrow \ell \propto \frac{1}{A}$$

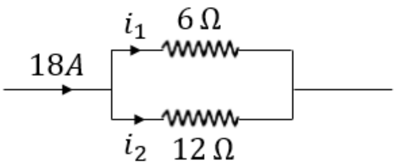
$$\Rightarrow \frac{R_1}{R_2} = \frac{\ell_1}{\ell_2}\times\frac{A_2}{A_1} = \left(\frac{A_2}{A_1}\right)^2 = \left(\frac{r_2}{r_1}\right)^4$$

$$\Rightarrow \frac{34}{R_2} = \left(\frac{r}{2r}\right)^4 \Rightarrow R_2 = 544\,\Omega$$

15. (C)

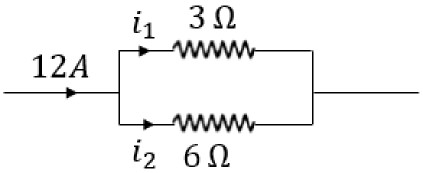
As 3Ω and 6Ω resistance are in parallel their equivalent resistance will be 2Ω.

Here 2Ω and 4Ω are in series, their equivalent resistance will be 6Ω. From current distributor law



$$i_1 = \frac{12\times18}{18} = 12A$$

$$i_2 = \frac{6\times18}{18} = 6A$$



Now, 12A current is entering in parallel combination of 3Ω and 6Ω again form distribution law

$$i_1 = \frac{6\times12}{9} = 8A$$

$$i_2 = \frac{3\times12}{9} = 4A$$

$\therefore$ Potential difference across 3Ω resistance

$= 8\times3 = 24\,V$

16. (D)

Angle of projection from B is 45°. As the body is able to cross the well of diameter 40 m.

Hence $R = \frac{v^2}{g}$ or $v = \sqrt{gR}$ or $v = \sqrt{10\times40} = 20\,ms^{-1}$

On the inclined plane, the retardation is

$g\sin\theta = g\sin 45° = \frac{10}{\sqrt{2}} ms^{-2}$

Using, $v^2 - u^2 = 2ax$

$(20)^2 - u^2 = 2\times\left(-\frac{10}{\sqrt{2}}\right)\times 20\sqrt{2}$

$\therefore\ u = 20\sqrt{2}\ ms^{-1}$, i.e., $V = 20\sqrt{2}\ ms^{-1}$

17. (B)

$\omega_{body} = 27\omega_{earth}$

$T^2 r^3 \Rightarrow \omega^2 \propto \frac{1}{r^3} \Rightarrow \omega \propto \frac{1}{r^{3/2}} \quad \therefore\ r \propto \frac{1}{\omega^{2/3}}$

$\Rightarrow \frac{r_{body}}{r_{earth}} = \left(\frac{\omega_{earth}}{\omega_{body}}\right)^{2/3} = \left(\frac{1}{27}\right)^{2/3} = \frac{1}{9}$

18. (D)

Work done = $\mu mgS = 0.4\times 40\times 10\times 20\ J = 3200\ J$

But in negative

As direction is opp.

19. (C)

Kinetic energy$_{(rotational)}$ $K_R = \frac{1}{2}I\omega^2$

Kinetic energy$_{(translational)}$ $K_T = \frac{1}{2}Mv^2\ (v = R\omega)$

M.I.$_{(initial)}$ $I_{ring} = MR^2; \omega_{initial} = \omega$

M.I.$_{(new)}$ $I'_{(system)} = MR^2 + 2mR^2$

$\omega'_{(system)} = \frac{M\omega}{M+2m}$

Solving we get loss in K.E.

$= \frac{Mm}{(M+2m)}\omega^2 R^2$

20. (C)

Current passing through resistance R_1, $i_1 = \frac{v}{R_1} = \frac{10}{20} = 0.5\,A$ and, $i_2 = 1$

21. (2)

$r = \sqrt{b^2 + (ae)^2}$

$= \sqrt{b^2 + a^2\left(1 - \frac{b^2}{a^2}\right)} = a$

$\therefore \frac{-GMm}{r} + \frac{1}{2}mv^2 = \frac{-GMm}{2a}$

$v = \sqrt{\frac{GM}{a}}$

22. (3)

Given $T = 2\pi\sqrt{\frac{L}{g}}$

$\Rightarrow g = \frac{4\pi^2 L}{T^2}$

$\Rightarrow g = \frac{4\pi^2 L}{t^2}$

[as $T = \frac{t}{n}$]

So, percentage error in g

$= \frac{\Delta g}{g}\times 100 = \frac{\Delta L}{L}\times 100 + 2\frac{\Delta t}{t}\times 100$

$= \frac{0.1}{20.0}\times 100 + 2\times\frac{1}{80}\times 100$

$= 3\%$

23. (9)

The potential difference between A and B = 6 volts. The condenses $2\mu F$ and $5\mu F$ are in parallel. Their effective capacitance, $c = 2+5 = 7\ \mu F$

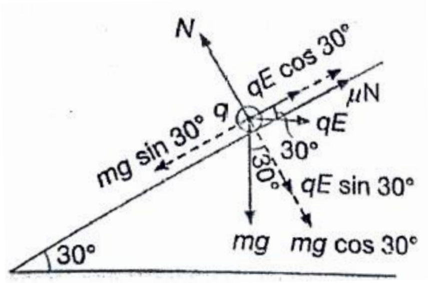
Now, $V_1 = V_2 = \frac{1}{3}:\frac{1}{7} = 7:3$

$V_2 = \frac{3}{10}\times 6 = \frac{9}{5}V$

$Q = CV_2^2 = \frac{5\times 9}{5} = 9\ \mu C$

24. (1320)

The different forces on the particles are shown in figure



From figure,

$N = mg\cos 30° + qE\cos 60°$

By definition, friction is

$f = \mu N = \mu mg\cos 30° + \mu qE\cos 60°$

If a is the acceleration of the particle down the incline, then

$mg\sin 30° - \mu N - qE\cos 30 = ma$

$\Rightarrow\ ma = mg\sin 30° - \mu Mg\cos 30° - \mu qE\cos 60° - qE\cos 30°$

Thus acceleration of the particle down the incline is

$a = g\sin 30° - \mu g\cos 30° - \frac{\mu qE}{m}\cos 60° - \frac{qE}{m}\cos 30°$

$\Rightarrow\ a = 10\left(\frac{1}{2}\right) - (0.2)(10)\left(\frac{\sqrt{3}}{2}\right) - \frac{(0.2)(0.01)(100)}{1}\left(\frac{1}{2}\right) - \frac{(0.01)(100)}{1}\left(\frac{\sqrt{3}}{2}\right)$

$\Rightarrow\ a = 5 - \sqrt{3} - 0.1 - \frac{\sqrt{3}}{2}$

$\Rightarrow\ a = 2.3\,ms^{-2}$

Now, distance travelled in time t is

$s = 0 + \frac{1}{2}at^2$

$\Rightarrow\ t = \sqrt{\frac{2\times 2}{a}}\ \left\{\because s = \frac{1}{\sin 30} = 2\right\}$

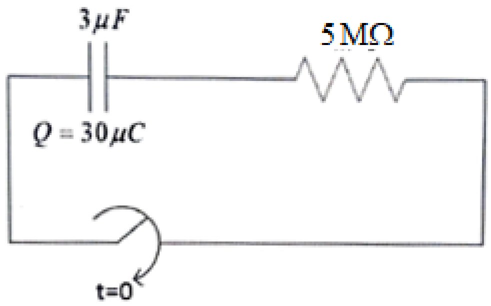
$\Rightarrow\ t = \sqrt{\frac{4}{2.305}}$

$\Rightarrow\ t = 1.32\,s$

$\Rightarrow\ t = 1320\times 10^{-3}\,s$

$\Rightarrow\ t = 1320\,ms$

25. (2)



At time t

$q = Qe^{-t/RC}\qquad I = \frac{dq}{dt} = \frac{Q}{RC}e^{-t/RC}$

$I = \frac{dq}{dt} = \frac{Q}{RC}e^{-t//RC}$

At $t = 0,\ I = \frac{Q}{RC}e^{-0/RC}$

$I = \frac{Q}{RC} = \frac{30}{5\times 10^6\times 3} = 2\times 10^{-6}A$

$\Rightarrow\ I = 2\,\mu A$

26. (2)

$y = \frac{\omega}{4} = \frac{\lambda D}{4d};\ \Delta x = \frac{yd}{D} = \frac{\lambda}{4};\ \phi = \frac{2\pi}{\lambda}\Delta x = \frac{\pi}{2}$

$\frac{\phi}{2} = \frac{\pi}{4}$

Now, $I_2 = I_1 \cos^2 \frac{\phi}{2}$

Or $\frac{I_1}{I_2} = \frac{1}{\cos^2 \frac{\phi}{2}} = 2$

27. (900)

Given: $T_i = 100k,\ V_f = 8V_i$

For and adiabatic process, $TV^{-1} = \text{constant}$

Or $T_i V_i^{\gamma-1} = T_f^{V} f^{\gamma-1}$

$\Rightarrow \frac{T_i}{T_f} = \left(\frac{V_f}{V_i}\right)^{\gamma-1} \Rightarrow \frac{T_i}{T_f} = \left(\frac{8V}{V_i}\right)^{\gamma-1}$ For monoatomic gas $\gamma = \frac{5}{3}$

$\therefore\ T_f = \frac{T_i}{\left(8^{5/3-1}\right)} = \frac{T_i}{4}$ Change in initial energy $\Delta u = nC_V\Delta T$

$= 1 \times \frac{3}{2}R\left(\frac{T_i}{4} - T_i\right) = \frac{3}{2} \times 8\left(\frac{-3}{4}\right) \times 100 = -900\ \text{J}$

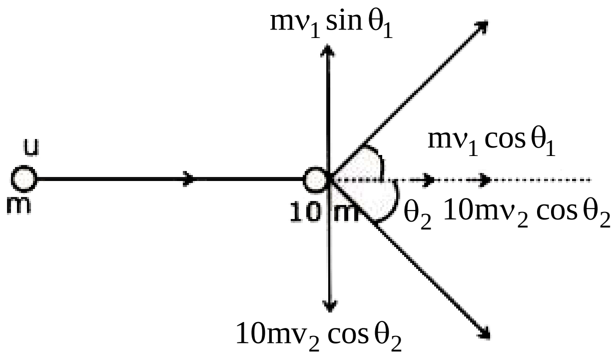
28. (25)

Current in 60Ω resistance $= 1A$

$\therefore\ Q = i^2Rt = (1)^2 \times 60 \times 7 \times 60\ \text{J}$

$\therefore\ Q = mS\Delta T \Rightarrow \Delta T = 25°C$

29. (10)



$\frac{1}{2}mv_1^2 = \frac{1}{2}\left(\frac{1}{2}mu^2\right) \Rightarrow v_1^2 = \frac{u^2}{2} \Rightarrow v_1 = \frac{u}{\sqrt{2}}$ ...(1)

Also collision is elastic:

$k_i = k_f = \frac{1}{2}mu^2 = \frac{1}{2}mv_1^2 + \frac{1}{2}(10m)v_2^2$

$\Rightarrow \frac{1}{2} \times \frac{1}{2}mu^2 = \frac{1}{2}(10m)v_2^2 \Rightarrow v_2^2 = \frac{u^2}{20}$

$\Rightarrow v_2 = \frac{u}{\sqrt{20}}$

By momentum conservation along y:

$m_1v_1 \sin\theta_1 = m_2v_2 \sin\theta_2$

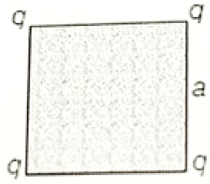
$\Rightarrow mv_1 \sin\theta_1 = 10mv_2 \sin\theta_2$

$\Rightarrow \frac{u}{\sqrt{2}}\sin\theta_1 = 10\times\frac{u}{\sqrt{20}}\sin\theta_2$

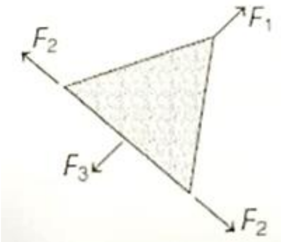
$\Rightarrow \sin\theta_1 = \sqrt{10}\sin\theta_2$

$\therefore n = 10$

30. (3)



Let us make free body diagram of any half portion.



For equilibrium,

Electrostatic force $F_1 = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{a^2}\left(\sqrt{2}+\frac{1}{2}\right)$ should be equal to,

Surface tension force $F_3 = 2(\gamma)\left(\sqrt{2}a\right)$

Equating F_1 and F_3, we get

$a^3 = k_1\left(\frac{q^2}{\gamma}\right)$

$\therefore a = k\left(\frac{q^2}{\gamma}\right)^{\frac{1}{3}}$

Here k_1 and k are constants. So, the answer is $N = 3$

PART (B) : CHEMISTRY

31. (D)

$$N_2O_4 \rightleftharpoons 2NO_2$$

Concentration at $t = 0$ 5 5

$\left[G^\circ_{N_2O_4}\right]_{298K} = 100\,kJmol^{-1}, \left[G^\circ_{NO_2}\right]_{298K} = 50\,kJmol^{-1}$

ΔG° for reaction $= 2 \times G^\circ_{NO_2} - G^\circ_{N_2O_4}$

$= 2 \times 50 - 100 = 0$

Now, $\Delta G = \Delta G^\circ + 2.303RT\log Q$

$\Delta G = 0 + 2.303 \times 8.314 \times 10^{-3} \times 298 \times \log \frac{5^2}{5}$

$\Delta G = +3.99\,kJ\,mol^{-1}$

Since $\Delta G = +ve$ and thus, the reaction will not proceed in the forward direction. It will take place in the backward direction. For the reverse reaction

$$2NO_2 \rightleftharpoons N_2O_4$$

	$2NO_2$	N_2O_4
Conc. at $t = 0$	5	5
Conc. at equilibrium	$(5 - 2x)$	$(5 + x)$

At equilibrium $\Delta G = 0$ and $\Delta G^\circ = 0$

$\therefore$ Form $\Delta G^\circ = -2.303RT\log K_c$

$K_c = 1$

Thus, $K_c = \frac{5 + x}{(5 - 2x)^2} = 1$

on solving we get $x = 1.25$

Therefore,

$[N_2O_4]_{at\,eq.} = 5 + 1.25 = 6.25\,mol\,litre^{-1}$

32. (C)

Given $w = 0.2g, W = 20g, \Delta T = 0.45°C$;

$\Delta T_f = \frac{1000 \times K_f \times w}{M \times W}$

or $0.45 = \frac{1000 \times 5.12 \times 0.2}{20 \times M}$

$\therefore$ M(observed) = 113.78

Now for

$$2CH_3COOH \rightleftharpoons (CH_3COOH)_2$$

	$2CH_3COOH$	$(CH_3COOH)_2$
Before association	1	0
After association	$1 - a$	$a/2$;

$\therefore \frac{M_{normal}}{M_{observed}} = 1 - a + \frac{a}{2}$;

or $\frac{60}{113.78} = 1 - a + \frac{a}{2}; a = 0.945$

33. (B)

$H_2S \rightleftharpoons 2H^+ + S^{2-}$

$K_{sp} = \left[H^{\oplus}\right]^2\left[S^{2-}\right]$

$10^{-22} = (1M)^2\left(S^{2-}\right) \quad \therefore \left[S^{2-}\right] = 10^{-22}M$

I. Q_{sp} (or IP) of $ZnS = \left[Zn^{2+}\right]\left[S^{2-}\right]$

$= 0.02 \times 10^{-22} = 2 \times 10^{-24}M$

$Q_{sp} < K_{sp}$ of $ZnS\left(2 \times 10^{-24} < 10^{-22}\right)$.

Does not precipitate.

II. Q_{sp} (or IP) of $CuS = \left[Cu^{2+}\right]\left[S^{2-}\right]$

$= 0.02 \times 10^{-22} = 2 \times 10^{-24}M$

Q_{sp} of $CuS > K_{sp}$ of $CuS\left(2 \times 10^{-24} > 8 \times 10^{-37}\right)$

So CuS will precipitate.

34. (B)

Na^+ is identical

$Cl^-, SO_4^{2-}, PO_4^{3-}$

$NaCl > Na_2SO_4 > Na_3PO_4$ polar nature

35. (A)

Electron affinity generally increases in a period from left to right because size decreases and nuclear charge increases. But the electron affinity of nitrogen is very low due to extra stability of half-filled 2p-orbital. Hence, the order of electron affinity is $B < C < O > N$

36. (C)

$$Kt = \frac{1}{n-1}\left[\frac{1}{A_t^{n-1}} - \frac{1}{A_0^{n-1}}\right]$$

$$Kt_{0.5} = \frac{1}{n-1}\left[\frac{2^{n-1}-1}{A_0^{n-1}}\right]$$

$$Kt_{0.875} = \frac{1}{n-1}\left[\frac{8^{n-1}-1}{A_0^{n-1}}\right]$$

$$\frac{t_{0.875}}{t_{0.5}} = \frac{8^{n-1}-1}{2^{n-1}-1}$$

37. (A)

$\Delta G = -nFE_{cell} = -2 \times 96500 \times 2 = -386\,kJ$

$\Delta S = nF\left(\frac{dE^\circ}{dT}\right) = 2 \times 96500 \times \left(-5 \times 10^{-4}\right) = -96.5\,J$

At 298 K

$T\Delta S = 298 \times (-96.5J) = -28.8\,kJ$ at constant T(= 298 K) and pressure
$\Delta G = \Delta H - T\Delta S \Rightarrow \Delta H = \Delta G + T\Delta S$
$= -386 - 28.8 = -412.8\,kJ$

38. (B)
For exothermic reaction yield $\uparrow$ on temperature $\downarrow$
i.e., $T_1 > T_2 > T_3$

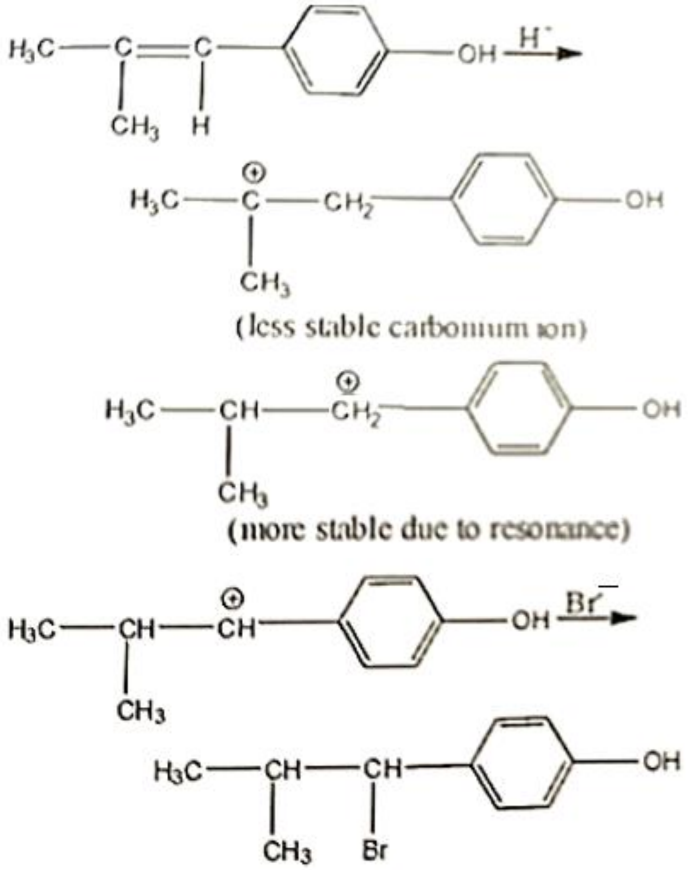
39. (A)
$CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g); \Delta H = -25\,kcal$
Given, $e_{C-H} = 20 + e_{C-Cl} = 20 + a\,(e_{C-Cl} = a)$
and $e_{H-H} = e_{HCl} = b$
Now, ΔH reaction $= -[e_{C-Cl} + e_{H-Cl}] + [e_{C-H} + e_{Cl-Cl}]$
$\therefore e_{Cl-Cl} = -25 - 20 + b = -45 + b$
or $-25 = -[a + b] + [20 + a + e_{Cl-Cl}]$
Now for, $H_2(g) + Cl_2(g) \rightarrow 2HCl(g);\ \Delta H_1 = ?$
$\therefore \Delta H_1 = -2[e_{H-Cl}] + [e_{H-H} + e_{Cl-Cl}]$
$= -2[b] + [b + (-45 + b)]$
$\Delta H_1 = -45\,kcal\,mol^{-1}$
$\therefore \Delta H$ formation for $HCl = -22.5\,kcal\,mol^{-1}$

40. (B)
$$\frac{\text{Ew of acid}}{\text{Ew of salt of Mg}} = \frac{\text{weight of acid}}{\text{Weight of salt}}$$
$Mg + 2HX\,(\text{monobasic acid}) \rightarrow MgX_2 + H_2$
Let Ew of acid $=$ Ew of H $+$ Ew of acid radical
$\therefore$ Ew of salt of Mg $=$ Ew of Mg $+$ Ew of acid radical
$$\therefore \frac{\text{Ew of acid}}{\text{Ew of Mg salt}} = \frac{\text{Weight of acid}}{\text{Weight of Mg salt}}$$
$$\Rightarrow \frac{\text{Ew of H} + \text{Ew of acid radical}(E)}{\text{Ew of Mg} + \text{Ew of acid radical}(E)} = \frac{1.0}{1.301}$$
$$\Rightarrow \frac{1+E}{12+E} = \frac{1.0}{1.301}$$
$\therefore E = 35.54$
$\therefore$ Ew of acid $=$ Ew of H $+$ Ew of acid radical
$= 1 + 35.54 = 36.54$

41. (A)
Stability constant $(K_s) \propto$ strength of ligand
Strength of ligand N donor > Cl donor.

42. (A)

The addition of HBr to an alkene is an example of electrophilic addition reactions. It takes place by following mechanism.



43. (A)

$O_2 = 8 + 8 = 16$

$= \sigma 1s^2, \overset{*}{\sigma} 1s^2, \sigma 2s^2, \sigma 2p_z^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\overset{1}{_x} 2p_x^1 =\overset{1}{_\pi} 2p_y^1\right)$

∵ It has 2 unpaired electrons.

∴ It is paramagnetic.

$CN^- = 6 + 7 + 1 = 14$

∴ No unpaired electron and no paramagnetic.

$CO = 6 + 8 = 14$

∴ No unpaired electron and no paramagnetic.

$NO^+ = 7 + 8 - 1 = 14$

∴ No unpaired electron and not paramagnetic.

44. (D)

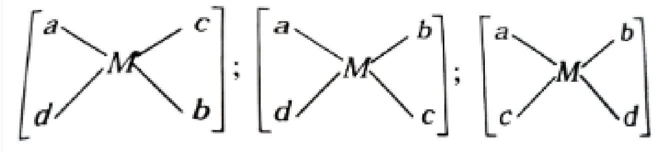
$KCOO - CH_2 - CH_2 - COOK + 2H_2O \longrightarrow \underset{\text{anode}}{CH_2} = CH_2 + 2CO_2 + H_2 + \underset{\text{cathode}}{2KOH}$

Total equivalents of $C_2H_4 + CO_2 + H_2 = 0.2 + 0.2 + 0.2 = 0.6$

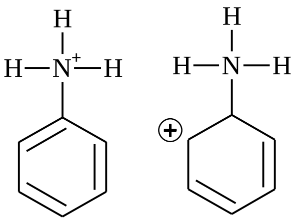
Total moles of gases $= \frac{0.2}{2} + \frac{0.2}{1} + \frac{0.2}{2} = 0.4$

$V = \frac{nRT}{P} = \frac{0.4 \times 0.0821 \times 273}{1} = 8.96\,L$

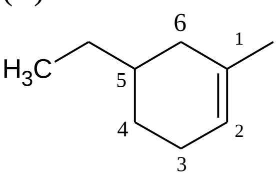
45. (B)
The electrolyte (X) must be weak electrolyte as such type of variation is always for weak electrolyte. So X is CH_3COOH.

46. (C)
[M (abc(D)] complex is square planar so will have three geometrical isomers.


47. (D)
Meq. of H_2SO_4 needed for 20 Meq. of $NaOH = 20$
Thus, volume of H_2SO_4 needed $= V_{mL}$
or $V \times 0.25 \times 2 = 20$
$\therefore V = 40\,mL$
Also, temperature increases during neutralization and then decreases after neutralization on further addition of acid.

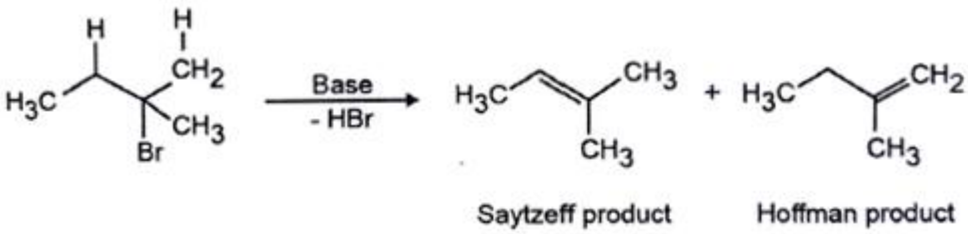
48. (D)


Expansion of octet is not possible for second period elements NN O etc in option A, B if positive charge delocalized expansion of octet of an atom is required which is not possible where in option C explanation of octet of oxygen is required which also not possible.

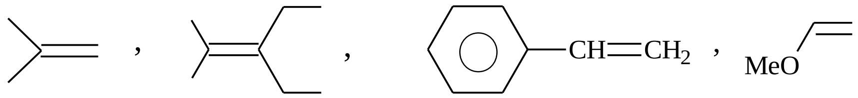
49. (B)

5-Ethyl-1-methylcyclohexene
The parent hydrocarbon is a 6-member ring with one carbon-carbon double bond. Hence, it is called cyclohex-1-ene.
One ethyl group at sixth carbon atom one methyl groups at third carbon atoms are present.
Hence, the IUPAC name of the compound is 5-ethyl 3-methyl cyclohex-1-ene.

50. (D)
$E = hv$ and $\Delta E = \dfrac{hc}{\lambda}$
$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} = \frac{4000}{2000} = 2$$

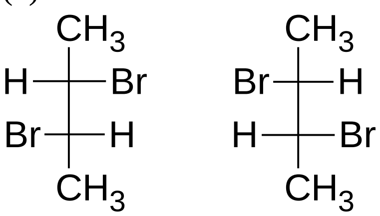
51. (2)
In elimination reaction, two products are formed. One is the Saytzeff product and the other is Hoffman product.



52. (4)

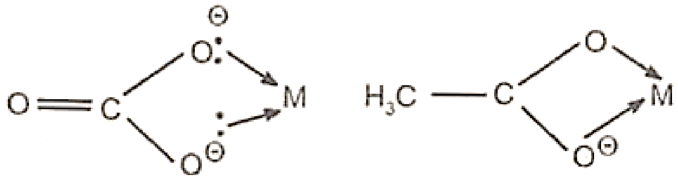


53. (2)



(±) Racemic

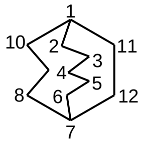
54. (2)



55. (5)
Due to stability of carbocation.

56. (3)
$[Co(NH_3)_6]Cl_2$
$Co^{2+}: [Ar]3d^7 4s^0 4p^0$
For this complex $\Delta_0 <$ P.E., so pairing of electron does not take place.
sp^3d^2 hybridisation
Total 3 unpaired electrons are present.
$[Co(NH_3)_6]Cl_3$
$Co^{3+}: [Ar]3d^6 4s^0 4p^0$
d^2sp^3 hybridisation
NH_3 acts as SFL because $\Delta_0 >$ P.E.
So, here all electrons become paired.

57. (532)



Bicyclo [5.3.2] dodecane
x = 5, y = 3, z = 2

58. (79)

	N_2	+	O_2	$\rightleftharpoons$	2NO
Initial mole	a		$(100-a)$		0
Mole at eq.	$(a-x)$		$(100-a-x)$		2x

Given, $\frac{2x}{100}=\frac{1.8}{100}$ $\quad\therefore x=0.9$

$$k_p=k_c=\frac{[NO]^2}{[N_2][O_2]}$$

$$=\frac{(2x)^2}{(a-x)(100-a-x)}=2.1\times10^{-3}$$

$\therefore a=79\%$

59. (8)
No. of chiral carbon $(n)=3$

No. of optical isomers $=2^n=2^3=8$

60. (0)
$Ru(44):[Kr]4d^7 5s^1$

$Ru^{+2}=[Kr]4d^6$

$Ru^{2+}=4d^6=t_{2g}{}^{2,2,2}eg^{0,0}$

As $\Delta_0>P$

$\therefore$ Pairing of e^-s will take place.

No. of unpaired $e^-s=0$
$\therefore$ Magnetic moment $=0$ B.M

PART (C) : MATHEMATICS

61. (C)

$f(x)=\frac{x}{1+x^2}$

$\therefore\ f\left(\frac{1}{x}\right)=\frac{\frac{1}{x}}{1+\frac{1}{x^2}}=\frac{x}{1+x^2}=f(x)$

$\therefore\ f(x)$ is many-one function. Now let $y=f(x)=\frac{x}{1+x^2}$

$\Rightarrow\ y+x^2y=x$

$\Rightarrow\ yx^2-x+y=0$

As $x\in R$

$\therefore(-1)^2-4(y)(y)\ge 0$

$\Rightarrow\ 1-4y^2\ge 0$

$\Rightarrow\ y\in\left[-\frac{1}{2},\frac{1}{2}\right]$

$\therefore$ Range = Codomain

$=\left[-\frac{1}{2},\frac{1}{2}\right]$

So, $f(x)$ is surjective.

62. (A)

$f(x+y)=f(x)+f(y)$

Function should be $f(x)=mx$

$f(1)=7$

$\therefore\ m=7, f(x)=7x$

$\sum_{r=1}^{n} f(r)=7\sum_{1}^{n} r=\frac{7n(n+1)}{2}$

63. (B)

$2ae=16, e=\sqrt{2}\Rightarrow a=4\sqrt{2}$ and $b=4\sqrt{2}$

$\therefore$ Equation is $\frac{x^2}{\left(4\sqrt{2}\right)^2}-\frac{y^2}{\left(4\sqrt{2}\right)^2}=1\ \Rightarrow\ x^2-y^2=32$.

64. (B)

Clearly, for the given point, t = 1

Hence tangent: $y=x+a$

Slope = 1

65. (C)

We know that: $\frac{b^2}{a^2} = 1 - e^2$

Eccentricity of the ellipse will be same if ratio of $\frac{b}{a}$ is same, according to the given condition,

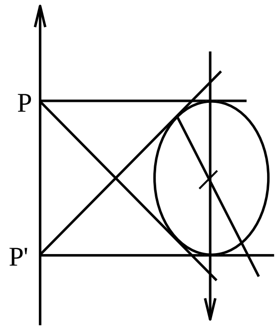
$\Rightarrow \frac{b}{a} = \frac{5}{13}$

$\Rightarrow \frac{a}{b} = \frac{13}{5}$.

66. (A)

contact is $T = 0$

Equation of polar

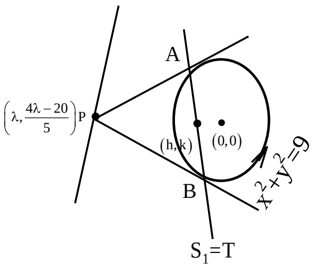


Equation of chord of contact

Here, equation of chord of contact w.r.t. P is

$$x\lambda + y \cdot \left(\frac{4\lambda - 20}{5}\right) = 9$$

$$5\lambda x + (4y - 20)y = 45 \qquad ...(i)$$



And equation of chord bisected at the point $Q(h, k)$ is

$$xh + yk - 9 = h^2 + k^2 - 9$$

$$\Rightarrow xh + ky = h^2 + k^2 \qquad ...(ii)$$

From Eqs. (i) and (ii), we get

$$\frac{5\lambda}{h} = \frac{4\lambda - 20}{k} = \frac{45}{h^2 + k^2}$$

$\therefore \lambda = \frac{20h}{4h - 5k}$ and $\lambda = \frac{9h}{h^2 + k^2}$

$$\Rightarrow \frac{20h}{4h - 5k} = \frac{9h}{h^2 + k^2}$$

or $20\left(h^2+k^2\right)=9\left(4h-5k\right)$

or $20\left(x^2+y^2\right)=36x-45y$

67. (B)

$\left(1+x-2x^2\right)^6=1+a_1x+a_2x^2+.....$

Putting $x=1$, we get

$0=1+a_1+a_2+a_3+....+a_{12}$ ...(1)

Putting, $x=-1$, we get

$64=1-a_1+a_2+a_3+....+a_{12}$ ...(2)

(1) + (2) gives

$64=2[1+a_2+a_4+....+a_{12}]$

$\Rightarrow 1+a_2+a_4+.......+a_{12}=32$

$\Rightarrow 1+a_2+a_4+....+a_{12}=32$

$\Rightarrow a_2+a_4+.....+a_{12}=31$

68. (C)

$f(x)=\dfrac{2\left(2^x+2^{-x}\right)+\left(3^x+3^{-x}\right)}{2}\geq 3$

As we know, A.M $\geq$ G.M

69. (D)

$f(x)=\cot^{-1}\left\{\dfrac{3x-x^3}{1-3x^2}\right\}$ and $g(x)=\cos^{-1}\left\{\dfrac{1-x^2}{1+x^2}\right\}$

Put $x=\tan\theta$ in both equations

$f(\theta)=\cot^{-1}\left\{\dfrac{3\tan\theta-\tan^3\theta}{1-3\tan^2\theta}\right\}=\cot^{-1}\{\tan 3\theta\}$

$f(\theta)=\cot^{-1}\cot\left(\dfrac{\pi}{2}-3\theta\right)=\dfrac{\pi}{2}-3\theta\Rightarrow f'(\theta)=-3$ ...(i)

and $g(\theta)=\cos^{-1}\left\{\dfrac{1-\tan^2\theta}{1+\tan^2\theta}\right\}=\cos^{-1}(\cos 2\theta)=2\theta$

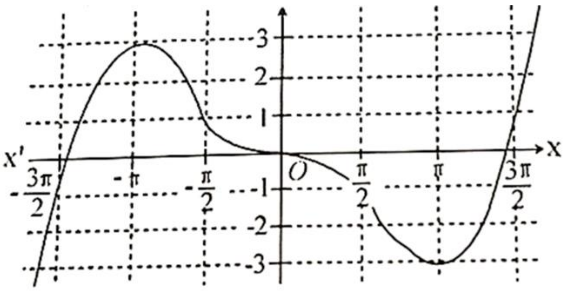
$\Rightarrow g'(\theta)=2$ ...(ii)

Now $\lim\limits_{x\to a}\left(\dfrac{f(x)-f(a)}{g(x)-g(a)}\right)=f'(a)\cdot\dfrac{1}{g'(a)}=-3\times\dfrac{1}{2}=-\dfrac{3}{2}$

70. (B)

$f'(x)=-x\sin x=0$ when $x=0$ or π

$\left.\begin{array}{l} f'(0^-)=(-)(-)(-)<0 \\ f'(0^+)=(-)(+)(+)<0 \end{array}\right\}$ no sign change



This also implies that f is decreasing at $x = 0$

$\Rightarrow (b)$ is correct

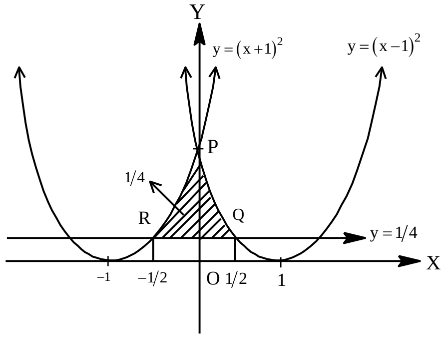
$f''(x) = -(x\cos x + \sin x)$

$f''(\pi) = -(-\pi) > 0$ minima at $x = \pi$

$f''(-\pi) = -(\pi) < 0$ maxima at $x = -\pi$

71. (A)

The curves $y = (x-1)^2, y = (x+1)^2$ and $y = \frac{1}{4}$ are shown as



Where points of intersection are

$(x-1)^2 = \frac{1}{4} \Rightarrow x = \frac{1}{2}$ and $(x+1)^2 = \frac{1}{4} \Rightarrow x = -\frac{1}{2}$

i.e. $Q\left(\frac{1}{2}, \frac{1}{4}\right)$ and $R\left(-\frac{1}{2}, \frac{1}{4}\right)$

$\therefore$ Required area $= 2\int_0^{1/2}\left[(x-1)^2 - \frac{1}{4}\right]dx$

$= 2\left[\frac{(x-1)^3}{3} - \frac{1}{4}x\right]_0^{1/2}$

$= 2\left[-\frac{1}{8.3} - \frac{1}{8} - \left(-\frac{1}{3} - 0\right)\right] = \frac{8}{24} = \frac{1}{3}$ sq unit

72. (B)

$\frac{dy}{dx} = (x-1)y + (x-1) \Rightarrow \frac{dy}{dx} = (x-1)(y+1) \Rightarrow \frac{dy}{y+1} = (x-1)dx$

Integrating both sides, we get

$\ln(y+1)=\frac{x^2}{2}-x+c$

$x=0, y=0$

$\Rightarrow c=0$

$\therefore \ln(y+1)=\frac{x^2}{2}-x$

Putting $x=1, \ln(y+1)=\frac{1}{2}-1=-\frac{1}{2}$

$y+1=e^{-\frac{1}{2}}$

$y=e^{-\frac{1}{2}}-1$

$\therefore y(1)=e^{-\frac{1}{2}}-1$

73. (C)

Let tangent to $y^2=4x$ be $y=mx+\frac{1}{m}$

Since this is also tangent to $x^2=-32y$

$x^2=-32\left(mx+\frac{1}{m}\right)$

$\Rightarrow x^2+32mx+\frac{32}{m}=0$

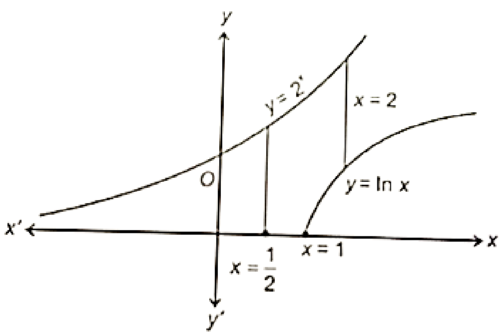
Now, $D=0$

$(32m)^2-4\left(\frac{32}{m}\right)=0$

$\Rightarrow m^3\frac{4}{32}\Rightarrow m=\frac{1}{2}$

74. (B)

$R=\left\{(x,y):\max\{0,\log_e x\}\le y\le 2^x, \frac{1}{2}\le x\le 2\right\}$



$\int_{\frac{1}{2}}^{2} 2^x dx-\int_{1}^{2}\ln x dx$

$$\Rightarrow\left[\frac{2^x}{\ln 2}\right]_{1/2}^{2}-\left[x\ln x-x\right]_1^2$$

$$\Rightarrow\frac{\left(2^2\right)-2^{1/2}}{\log_e 2}-\left(2\ln 2-1\right)$$

$$\Rightarrow\frac{\left(2^2-\sqrt{2}\right)}{\log_e 2}-2\ln 2+1$$

$$\therefore a=2^2-\sqrt{2},\ \beta=-2,\ \lambda=1$$

$$\therefore\left(\alpha+\beta-2\lambda\right)^2$$

$$=\left(2^2-\sqrt{2}-2-2\right)^2$$

$$=\left(\sqrt{2}\right)^2=2$$

75. (B)

$$f(x)\begin{cases} x.\dfrac{a^{-2|x|}-5}{3+a^{1/|x|}}; & |x|\neq 0; a>1 \\ 0; & x=0\end{cases}$$

$$f'\left(0^+\right)=0; f'\left(0^-\right)=0$$

diff. & cont. at x = 0

76. (A)

Here $P(a\cos\alpha, b\sin\alpha), Q(a\cos\beta, b\sin\beta), S(ae, 0)$ are collinear, then

$$\begin{vmatrix} a\cos\alpha & b\sin\alpha & 1 \\ a\cos\beta & b\sin\beta & 1 \\ ae & 0 & 1\end{vmatrix}=0$$

$$\begin{vmatrix} \cos\alpha & \sin\alpha & 1 \\ \cos\beta & \sin\beta & 1 \\ e & 0 & 1\end{vmatrix}=0$$

$$\Rightarrow e\left(\sin\alpha-\sin\beta\right)+\sin\left(\beta-\alpha\right)=0$$

$$\Rightarrow\ 2e\sin\frac{\alpha-\beta}{2}\cos\frac{\alpha+\beta}{2}=2\sin\frac{\alpha-\beta}{2}\cos\frac{\alpha-\beta}{2}$$

$$\Rightarrow e=\frac{\cos\left(\dfrac{\alpha-\beta}{2}\right)}{\cos\left(\dfrac{\alpha+\beta}{2}\right)}$$

$$=\frac{2\sin\left(\dfrac{\alpha+\beta}{2}\right)\cos\left(\dfrac{\alpha-\beta}{2}\right)}{2\sin\left(\dfrac{\alpha+\beta}{2}\right)\cos\left(\dfrac{\alpha+\beta}{2}\right)}$$

$= \dfrac{\sin\alpha + \sin\beta}{\sin(\alpha+\beta)}$

77. (A)

The domain of the given function is $(3-2\pi, 3-\pi)\cup(3,4]$.

The integers in the domain are $\{-3,-2,-1,4\}$

78. (C)

As we know, the sum of probability density function is one.

$\therefore P(X=x_1)+P(X=x_2)+....+P(X=x_{10})=1$

$\Rightarrow 1k+2k+3k+....+10k=1$

$\Rightarrow \dfrac{10(10+1)}{2}k=1$

$\Rightarrow k=\dfrac{1}{55}$

79. (D)

Put $\sin x+\cos x=t \Rightarrow (\cos x-\sin x)dx=dt$

$\Rightarrow -(\sin x-\cos x)dx=dt$

$\therefore \int \dfrac{\sin x-\cos x}{\sin x+\cos x}dx=-\int \dfrac{dt}{t}=\log t+c=\log\left(\dfrac{1}{t}\right)+c$

Hence, $\int \dfrac{\sin x-\cos x}{\sin x+\cos x}dx=\log_e\left(\dfrac{1}{\sin x+\cos x}\right)+c$

80. (A)

Given, $=\tan^{-1}\sqrt{\dfrac{1-\sin x}{1+\sin x}}$

$=\tan^{-1}\sqrt{\dfrac{1-\cos\left(\dfrac{\pi}{2}-x\right)}{1+\cos\left(\dfrac{\pi}{2}-x\right)}}$

$=\tan^{-1}\left|\tan\left(\dfrac{\pi}{4}-\dfrac{x}{2}\right)\right|$

$=\dfrac{\pi}{4}-\dfrac{x}{2} \quad \left|\because x=\dfrac{\pi}{6}\right|$

$\Rightarrow \dfrac{dy}{dx}=-\dfrac{1}{2}$

81. (42)

$\dfrac{x^2}{a^2}-\dfrac{y^2}{1}=1 \qquad \dfrac{x^2}{4}+\dfrac{y^2}{3}=1$

$e_H = \sqrt{1+\frac{1}{a^2}}$ $\qquad$ $e_E = \sqrt{1-\frac{3}{4}} = \frac{1}{2}$

$\ell.R. = \frac{2}{a}$ $\qquad$ $\ell R = \frac{2\times 3}{2} = 3$

$\frac{2}{a} = 3$

$a = \frac{2}{3}$

$e_H = \sqrt{1+\frac{9}{4}} = \frac{\sqrt{13}}{2}$

$12\left(e_H^2 + e_E^2\right) = 12\left(\frac{13}{4}+\frac{1}{4}\right)$

$= \frac{12\times 14}{4} = 42$

82. (4)

$M(P,Q)$ is mid-point of PQ

$M(P\,Q')$ is mid-point of PQ'

In a $\Delta PQQ'$ since $M(P,Q)$ & $M(P,Q')$ are mid-point of PQ & PQ' hence line joining $M(P,Q), M(P,Q')$ is parallel to QQ' and half of it.

$\Rightarrow$ max distance $= \frac{1}{2}QQ' = \frac{1}{2}(8) = 4$

83. (1)

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

$f(x) + f\left(\frac{1}{1-x}\right) = \frac{2}{x} - \frac{2}{1-x}$

Put $x = \frac{1}{1-t}$ $\qquad$ $1-x = 1-\frac{1}{1-t} = -\frac{1}{1-t}$

$\therefore\ f\left(\frac{1}{1-t}\right) + f\left(\frac{t-1}{t}\right) = 2(1-t) - \frac{2(1-t)}{-t}$

$\therefore\ f\left(\frac{1}{1-x}\right) + f\left(\frac{x-1}{x}\right) = 2(1-x) + 2\left(\frac{1-x}{x}\right)$

Put $\frac{x-1}{x} = t$

$x - 1 = xt$

$x = \frac{1}{1-t}$

$1-x = 1-\frac{1}{1-t} = \frac{-t}{1-t}$

$\frac{1}{1-x} = \frac{t-1}{t}$

$\therefore\ f\left(\frac{t-1}{t}\right)+f(t)=\frac{2t}{t-1}+\left(\frac{2t}{t-1}\right)\left(\frac{1-t}{1}\right)$

$\therefore\ f\left(\frac{x-1}{x}\right)+f(x)=\frac{2x}{x-1}-2x$

$\therefore\ 2f(x)=\frac{2}{x}-\frac{2}{1-x}-2(1-x)-\frac{2(1-x)}{x}+\frac{2x}{x-1}-2x$

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

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

84. (4)

We have, $\frac{dx}{dt}=x+1$

$\Rightarrow\ \frac{1}{x+1}dx=dt \Rightarrow\ \log(x+1)=t+C$

Putting $t=0, x=0$, we get

$\log 1=C \Rightarrow C=0$

$\therefore\ t=\log_e(x+1)$

Putting $x=99$, we get

$t=\log_e 100=2\log_e 10$

$[2\ln 10]=4$

85. (5)

According to question $(a^2-2a-15)e^{ax}+(b^2-2b-15)e^{bx}=0$

$\Rightarrow\ (a^2-2a-15)=0$ and $b^2-2b-15=0$

$\Rightarrow\ (a-5)(a+3)=0$ and $(b-5)(b+3)=0$

$\Rightarrow\ a=5$ or -3 and $b=5$ or -3

$\therefore\ a\neq b$ hence $a=5$ and $b=-3$ or $a=-3$ and $b=-5$

$\Rightarrow ab=-15$

86. (79)

$f(x)=4|2x+3|+9\left[x+\frac{1}{2}\right]-12[x+20]$

$x\in(-20, 20)$

$f(x)$ is not diff. at $x=I\in\{-19,-18,.....0,....19\}=39$

At $x=I+\frac{1}{2}$, $f(x)$ non diff. at 39 points (except $x=-\frac{3}{2}$)

Check at $x=\frac{-3}{2}$ Discontinuous at $x=\frac{-3}{2}$ $\therefore$ N.R(1)

No. of point of non-differentiability
= 39 + 39 + 1 = 79

87. (8)

$\ln f(x) = \ln(x-1) + \ln(x-2) + ... + \ln(x-n)$

$\Rightarrow f'(x) = f(x)\left[\frac{1}{x-1} + \frac{1}{x-2} + ... + \frac{1}{x-n}\right]$

$\Rightarrow f'(x) = (x-2)(x-3)(x-n) + (x-1)(x-3)....(x-n) + ... + (x-1)(x-2)....(x-(n-1))$

$\Rightarrow f'(n) = (n-1)(n-2)(n-3).3.2.1$ (all other factors except the last vanished when $x = n$)

$\Rightarrow 5040 = (n-1)!$

$N = 8$

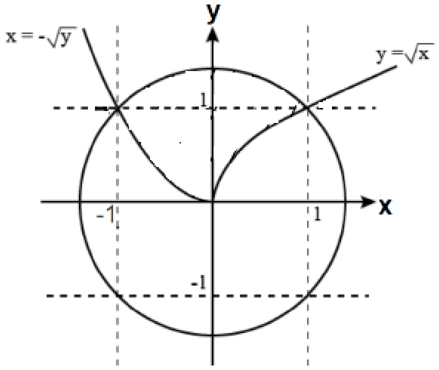
88. (9)

$\therefore$ Number of ways of putting all the 4 balls into boxes of different colour.

$= 4!\left[1 - \frac{1}{1!} + \frac{1}{2!} - \frac{1}{3!} + \frac{1}{4!}\right] = 4!\left(\frac{1}{2} - \frac{1}{6} + \frac{1}{24}\right) = 24\left(\frac{12-4+1}{24}\right) = 9$

89. (8)

Required area = area of one quadrant of the circle $= \frac{\pi}{2}$



90. (3)

Let $f(x) = x^5 - 6x^2 - 4x + 5 = 0$

Then the number of change of sign in $f(x)$ is 2 therefore $f(x)$ can have at most two positive real roots.

Now, $f(-x) = -x^5 - 6x^4 + 4x + 5 = 0$

Then the number of change of sign is 1.

Hence $f(x)$ can have at most one negative real root. So that total possible of real roots is 3.