1. (b, c)

$$V = \frac{kr^2}{2} \Rightarrow F = -\frac{dV}{dr} = -kr$$

$$\therefore \frac{mv^2}{r} = kr \Rightarrow v = \sqrt{\frac{k}{m}}R$$

Angular momentum $L = mvr = m\sqrt{\frac{k}{m}}R^2 = \sqrt{mk}R^2$

2. (a, c)

$$\vec{a} = t\hat{i} + jm/s^2$$

$$\Rightarrow \vec{v} = \frac{t^2}{2}\hat{i} + t\,jm/s$$

$$\Rightarrow \vec{r} = \frac{t^3}{6}\hat{i} + \frac{t^2}{2}jm$$

so, $\vec{\tau} = \vec{r} \times \vec{F} = \left(\frac{t^3}{2} - \frac{t^3}{6}\right)(-k) = \frac{t^3}{3}(-k)Nm$

3. (a, c)

$h = \frac{2\sigma\cos\theta}{r\rho g_{eff}}$ (ρ is density or water)

4. (b, d)

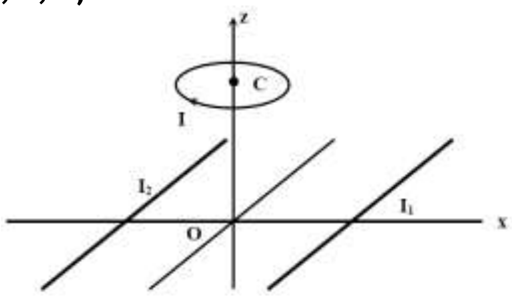
$$I = \frac{V}{R}\left(1 - e^{-\frac{Rt}{L}}\right) - \frac{V}{R}\left(1 - e^{-\frac{RT}{2L}}\right)$$

For I_{max}

$$\frac{dI}{dt} = 0$$

$\therefore t = \frac{2L}{R}\ln 2$ b and $I_{max} = \frac{V}{4R}$

5. (a, b, d)



(a) If $I_1 = I_2$, magnetic field due to infinite wires is equal to zero. So there must be a non-zero magnetic field at O due to the current carrying loop.

(b) If $I_1 > 0$ & $I_2 < 0$, magnetic field due to straight lines are along positive z-axis and due to loop it is along negative z-axis.

(c) If $I_1 < 0$ & $I_2 > 0$ magnetic field due to straight wires are along negative z-axis and due to the loop it is also along negative z-axis.

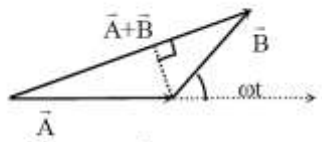
(d) $\underset{(\text{along z axis})}{\vec{B}_C} = \frac{\mu_0 I}{2R}(-k)$

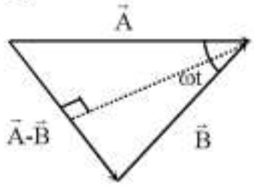
6. (b, c, d) Process II is an isothermal expansion

Process IV is an isothermal compression

In isobaric process, volume is directly proportional to temperature.

7. 2.00



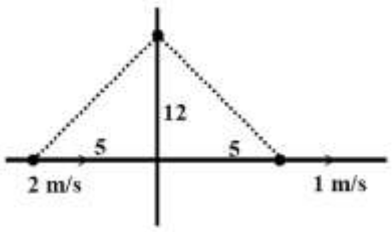


$$\therefore 2a\cos\frac{\omega t}{2} = \sqrt{3}(2a)\sin\frac{\omega t}{2}$$

$$\therefore \tan\frac{\omega t}{2} = \frac{1}{\sqrt{3}}$$

for the first time $\Rightarrow \frac{\pi t}{12} = \frac{\pi}{6} \Rightarrow t = 2\sec$

8. 5.00



$$\Delta f = f_0\left(\frac{330}{330-2\cos\theta} - \frac{330}{330+1\cos\theta}\right)$$

$$= f_0\left(\frac{330}{330-\frac{10}{13}} - \frac{330}{330+\frac{5}{13}}\right)$$

$$\approx f_0\left(1+\frac{10}{13\times 330} - 1 + \frac{5}{13\times 330}\right)$$

$$= \frac{15}{13\times 330}\times 1430 = 5Hz$$

9. 0.75

$$\frac{h}{\sin\theta} = \frac{1}{2}\frac{g\sin\theta}{1+\frac{I}{mR^2}}t^2$$

$$\therefore t = \frac{1}{\sin\theta}\sqrt{\frac{2h}{g}\left(1+\frac{I}{mR^2}\right)}$$

$$\therefore \frac{2-\sqrt{3}}{\sqrt{10}} = \frac{2}{\sqrt{3}}\sqrt{\frac{2h}{10}}\left(\sqrt{2}-\sqrt{\frac{3}{2}}\right)$$

$$\therefore h = 0.75m$$

10. 2.09

For collision:
using com $\rightarrow$ 1x2=1xu + 2xv
Using e $\rightarrow$ 2 = -u + v

$u = \frac{-2}{3}m/s \quad v = \frac{4}{3}m/s$

time taken for the block to came to the unstretched position of spring for the first time after the collision

$$= \pi\sqrt{\frac{m}{k}} = \pi \sec$$

distance between blocks = $\frac{2\pi}{3}$ m = 2.09 m (taking $\pi \approx 3.14$)

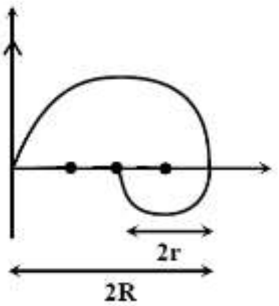
11. 1.50

After S_1 is closed, C_3 has charge 8 μC. when S_1 opened and S_2 closed, C_3 has charge 5 μC. so remaining 3 μC resides on C_1 and C_2

$$\frac{1}{C_{eq}} = \frac{1}{\epsilon_r} + \frac{1}{1} = \frac{5}{3}\left[\frac{1}{C} = \frac{V}{q}\right]$$

$$\Rightarrow \epsilon_r = \frac{3}{2} = 1.5$$

12. 2.00

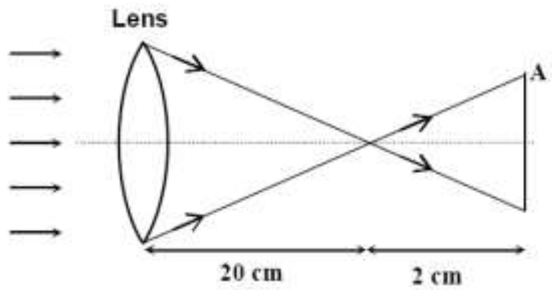


Avg. speed along x-axis

$$= \frac{\text{total distance travelled along x} - \text{axis}}{\text{total time taken}}$$

$$= \frac{2R + 2r}{\frac{\pi R}{V_0} + \frac{\pi r}{V_0}} = \frac{2V_0}{\pi} = 2m/s$$

13. 130.00



The area of A over which the light falls satisfy: Lens

$$\frac{A}{A_{lens}} = \left(\frac{2}{20}\right)^2 = \frac{1}{100}$$

so intensity at A = 100 x 1.3 =130 kW/m^2.

14. 4.00

In steady state, heat current in both material is same

$$\frac{K_1(300-200)A}{L} = \frac{K_2(200-100)4A}{L}$$

$$\Rightarrow \frac{K_1}{K_2} = 4$$

15. (i) (c)

$$E = \frac{F}{q}; F = qvB$$

E = BV; [E] = [B][L][T]$^{-1}$

(ii) (d)

$$\in_0 \mu_0 = \frac{1}{C^2}$$

$$\mu_0 = [\in_0]^{-1}[L]^{-2}[T]^2$$

16. (i) (b)

$$r + \Delta r = \frac{1-(a+\Delta a)}{1+(a+\Delta a)}$$

$$\Delta r = \frac{1-(a+\Delta a)}{1+(a+\Delta a)} - \frac{1-a}{1+a} = \frac{[1-(a+\Delta a)](1+a)-[1+(a+\Delta a)][1-a]}{(1+a+\Delta a)(1+a)}$$

$$|\Delta r| = \left|\frac{-2\Delta a}{(1+a)^2}\right|$$

alternate:

$$\Delta r = \frac{1-a}{1+a}\left[\frac{\Delta a}{1-a} + \frac{\Delta a}{1+a}\right]$$

$$\Delta r = \frac{2\Delta a}{(1+a)^2}$$

(ii) (c)

$$N_d = N_0\left(1-e^{-\lambda t}\right)$$

$$1000 = 3000\left(1-e^{-\lambda t}\right) \Rightarrow e^{\lambda} = \frac{3}{2}$$

$$\Delta N_d = N_0 e^{-\lambda t}\Delta\lambda$$

$$40 = 3000 \times \frac{2}{3} \times \Delta\lambda$$

$$\Delta\lambda = 0.02$$

alternate:

$$N = N_0 e^{-\lambda t}$$

$$N + \Delta N = N_0 e^{-(\lambda+\Delta\lambda)t}$$

$$\Delta N = N_0\left(e^{-(\lambda+\Delta\lambda)t} - e^{-\lambda t}\right)$$

$$\Delta N = N_0\left(e^{-\lambda t}e^{-\Delta\lambda t} - e^{-\lambda t}\right)$$

$$\Delta N = N_0 e^{-\lambda t}\left[e^{-\Delta\lambda t} - 1\right]$$

$$\Delta N \approx N[\Delta\lambda t]$$

$$\Delta\lambda = 0.02$$

17. (b, c)

(a) $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$ (N_2O can further decompose to N_2 and O_2 at temperature above 300°C)

(b) $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$

(c) $Ba(N_3)_2 \xrightarrow{\Delta} 3N_2 + Ba$

(d) Mg_3N_2 does not decompose at any temperature.

18. (b, c)

(a) Electronic configuration of central metal atom in both cases is [Ar] $3d^{10}4s^24p^6$ (8 electrons in outermost shell and 18 valence electrons respectively).

(b) Low spin complex because CO is a strong field ligand.

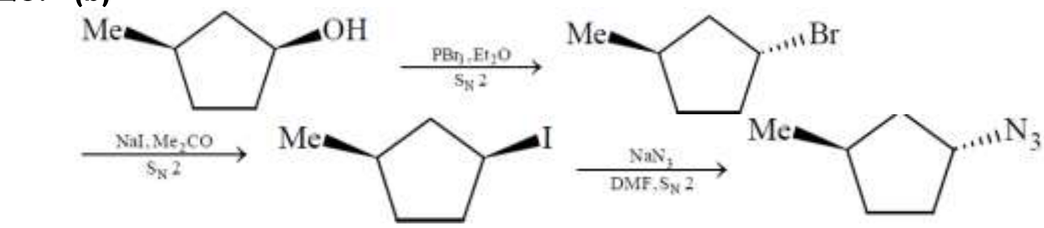
(c) Metal-carbon bond strengthens when the oxidation state of metal is lowered.

(d) The carbonyl C - O bond becomes stronger when the oxidation state is increased.

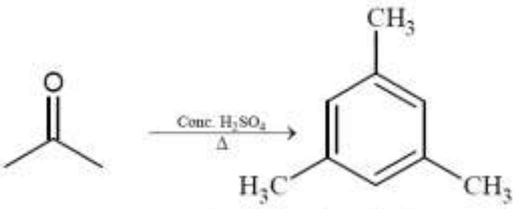
19. (a, b, c)

Bi_2O_5 is more basic than N_2O_5.
NF_3 is more covalent than BiF_3.
PH_3 boils at lower temperature than NH_3.
N - N single bond is weaker than P - P single bond.

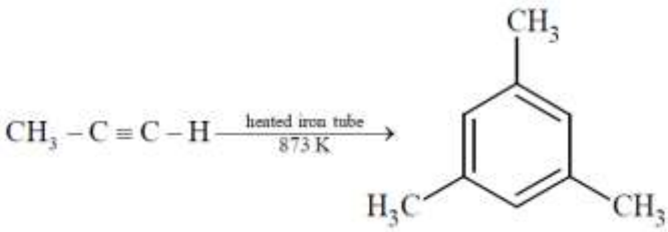
20. (b)

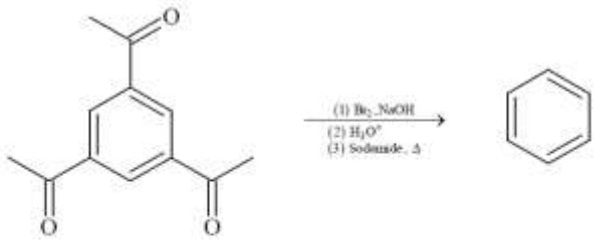


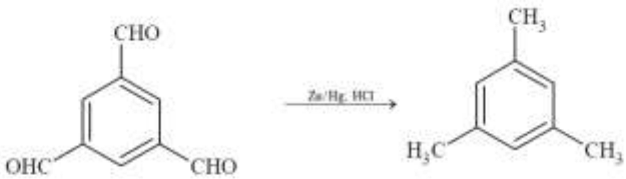
21. (a, b, d)



(1, 3, 5 – trimethylbenzene)







22. (b, c)

$\Delta H_{AC} + \Delta H_{CB} + \Delta H_{BA} = 0$
$\Delta H_{BA} = 0$ (Temperature is constant)
$\Delta H_{AC} = \Delta H_{BC}$ ...(1)
We know that $q_p = \Delta H$ (In path BC, P = constant)
Hence $q_{BC} = \Delta H_{BC}$
From Eq. (1)
$q_{BC} = \Delta H_{AC}$
(b) $q_{BC} = -P_2(V_1-V_2) = P_2(V_2-V_1)$
(c) $\Delta H_{CA} = nC_p(T_1-T_2) = -nC_P(T_2-T_1)$
$\Delta U_{CA} = nC_v(T_1-T_2) = -nC_v(T_2-T_1)$
As, $C_P > C_v$
So, $\Delta H_{CA} < \Delta U_{CA}$

23. (1) Paramagnetic: H NO_2 monomer O_2^- (superoxide), S_2 (Vapour), [Mn_3O_4 is mixed oxide of Mn^{+2} and Mn^{+3}],
(NH4)2 [$FeCl_4$], $(NH_4)_2[NiCl_4]$, K_2MnO_4 Diamagnetic: K_2CrO_4

24. (2992)

$$Ca(OH)_2 + (NH_4)_2SO_4 \longrightarrow 2NH_3 + \underset{\text{(Gypsum)}}{CaSO_4.2H_2O}$$

moles $\quad 12 \quad \frac{1584}{132} = 12 \quad 24 \quad 12$

Weight of gypsum formed = 12 x 172 = 2064 g

$$NiCl_2.6H_2O + 6NH_3 \longrightarrow [Ni(NH_3)_6]Cl_2$$

moles $\quad \frac{952}{238} = 4 \quad 24 \quad \frac{24}{6} = 4$

Mass of $[Ni(NH_3)_6]$ $C1_2$ formed = 4 x 232 = 928 g

Total weight = 2064 + 928 = 2992 g.

25. (3)

X^- = Octahedral void

M^+ = FCC point

M^+	X^-
(i) 4	4-3 = 1
(ii) 4-6x $\frac{1}{2}$	1 + 6 x $\frac{1}{2}$
(iii) 1-1	3 + 1=4
(iv) 0 + 1	4-1=3

Hence $\frac{\text{anion}}{\text{cation}} = \frac{3}{1} = 3$

26. (10)

Case I:

$$E_{cell} = E^0_{cell} - \frac{RT}{2F}\ln\frac{1}{1}$$

= 2.1-0 = 2.7V

Case II:

$$E_{cell} = E^0_{cell} - \frac{RT}{2F}\ln\frac{x}{1}$$

$$2.67 = 2.7 - \frac{R \times 300}{2F}\ln x$$

$$-0.03 = \frac{R \times 300}{2F}\ln x$$

$$\ln x = \frac{0.03 \times 2 \times F}{300 \times R} = 2.3$$

x= 10

27. (2.22)

As in fig 2, the system attains equilibrium, so,

$P_A = P_B$ and $T_A = T_B$

$$\frac{P_A V_A}{R n_A T_A} = \frac{P_B V_B}{n_B T_B R}$$

$$\frac{V_A}{V_B} = \frac{n_A}{n_B}$$

$$n_A = \frac{5}{400R}$$

$$n_B = \frac{3}{300R}$$

Due to sliding of piston vol. of A will be increased by x and that of B will be decreased by x.

V_A=1+x

V_B = 3-x

$$\frac{1+x}{3-x}=\frac{\frac{5}{400R}}{\frac{3}{300R}}$$

$$4(1+x)=5(3-x)$$

$$4x+5x=11\Rightarrow x=\frac{11}{9}$$

Hence volume of container A will be

$$V_A=1+\frac{11}{9}=\frac{20}{9}=2.22$$

28. (19)

$$x_A=\frac{1}{2},x_B=\frac{1}{2}$$

$$P_T=P_A^0\frac{1}{2}+P_B^0\times\frac{1}{2}$$

(Given P_A^0 = 20)

90 = 45x2 = $P_A^0+P_B^0$ … (1)

$P_B°$ =90-20=70

22.5 = $P_A^0x_A+P_B^0(1-x_A)$

= $20x_A+70(1-x_A)$

22.5 = $20x_A$ + 70 - $70x_A$

= 70 - $50x_A$

$$x_A=\frac{47.5}{50}=\frac{19}{20}$$

$$x_B=\frac{1}{20}$$

$$\frac{x_A}{x_B}=\frac{\frac{19}{20}}{\frac{1}{20}}=19$$

29. (4.47)

$$\underset{}{AB}\rightleftharpoons \underset{S}{A^+}+\underset{(S-X)}{B^-}$$

$$2\times10^{-10}=S(S-x) \qquad \text{… (1)}$$

$$\underset{(S-x)}{B^-}+\underset{10^{-3}}{H^+}\rightleftharpoons \underset{x}{XB}$$

$$\frac{1}{10^{-8}}=\frac{x}{(S-x)\times10^{-3}}$$

$$\frac{x}{S-x}=10^5 \qquad \text{…(2)}$$

Multiply equation (1) and (2).

S.x = $2x10^{-5}$

From Eq. (1)

S^2=Sx = $2x10^{-10}$

S^2-$2x10^{-5}$=$2x10^{-10}$

S^2=$2x10^{-5}$+$2x10^{-10}$ ≅ $2x10^{-5}$

S = 4.47x 10^{-3}

y = 4.47

30. (0.05)

2 = $2xK_{b(x)}m$

1 = $2K_{b(y)}m$

$$\frac{K_{b(x)}}{K_{b(y)}} = 2$$

$$\Delta T_{b(x)} = \left(1-\frac{\alpha_1}{2}\right)K_{b(x)}m \qquad \underset{1-\alpha}{2S} \rightleftharpoons \underset{\frac{\alpha}{2}}{S_2}$$

$$\Delta T_{b(y)} = \left(1-\frac{\alpha^2}{2}\right)K_{b(y)}m \qquad i = 1-\alpha+\frac{\alpha}{2}$$

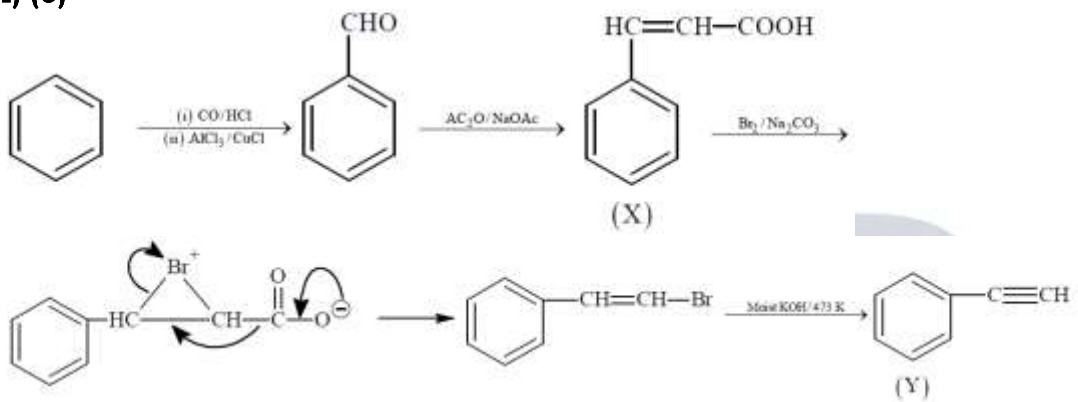
$$3 = \frac{\Delta T_{b(x)}}{\Delta T_{b(y)}} = \frac{\left(1-\frac{\alpha_1}{2}\right)K_{b(x)}}{\left(1-\frac{0.7}{2}\right)K_{b(y)}} \quad i = 1-\frac{\alpha}{2}$$

$$3 = \frac{\left(1-\frac{\alpha_1}{2}\right)\times 2}{\left(1-\frac{0.7}{2}\right)}$$

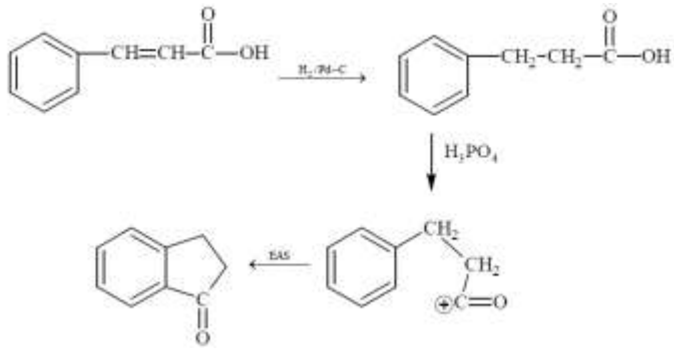
$$\left(1-\frac{\alpha_1}{2}\right) = \frac{3\times 0.65}{2} = 1.5\times 0.65$$

$$\alpha_1 = 0.05$$

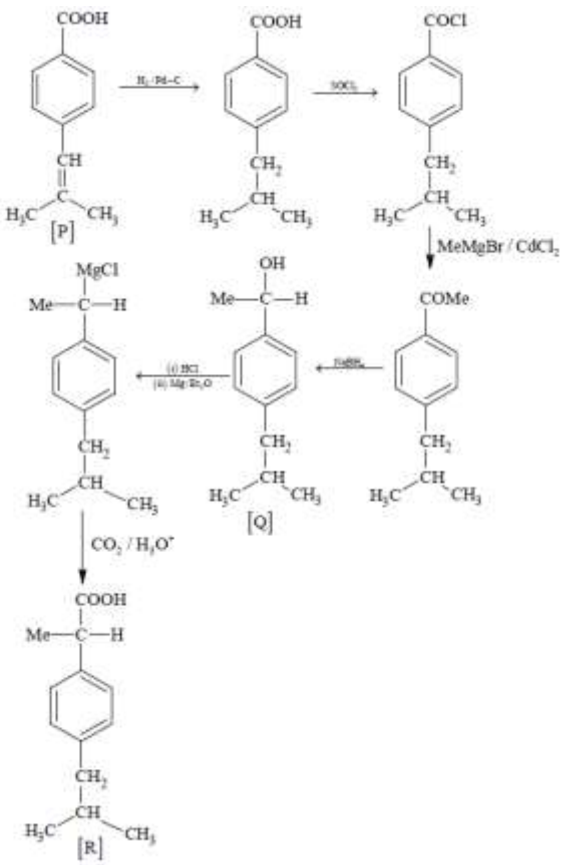
31. (i) (c)



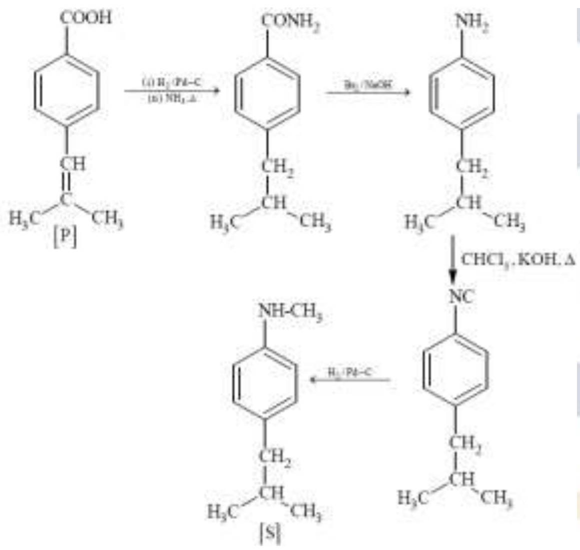
(ii) (a)



32. (i) (a)



(ii) (b)



33. (a, b, d)

(a)Arg(-1-i)=- $\frac{3\pi}{4}$

(b) Arg(-1+it)= $\begin{cases} \pi - \tan^{-1}(t) \ if \ t \geq 0 \\ \tan^{-1}(t) - \pi \ if \ t < 0 \end{cases}$

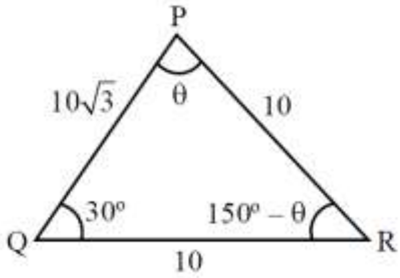
Not continuous at t = 0

(c) $Arg\left(\frac{z_1}{z_2}\right) - \arg(z_1) + \arg(z_2) = 0$

(d) $Arg\left(\frac{z - z_1}{z_2 - z_1}\right) + Arg\left(\frac{z_2 - z_3}{z - z_3}\right) = \pi$

$\Rightarrow$ z, z_1, z_2, z_3 form a cyclic quadrilateral Hence locus of z is circle

34. (b, c, d)



(a) $\dfrac{10}{\sin\theta}=\dfrac{10\sqrt{3}}{\sin(150-\theta)}$

$\Rightarrow \dfrac{\cos\theta}{2}+\dfrac{\sqrt{3}}{2}\sin\theta=\sqrt{3}\sin\theta$

$\Rightarrow \dfrac{1}{\sqrt{3}}=\tan\theta \Rightarrow \theta=30^0$

(b) $\Delta=\dfrac{1}{2}10.10\sqrt{3}\sin 30^0=25\sqrt{3}, \angle QRP=120^0$

(c) $r=\dfrac{\Delta}{s}=\dfrac{25\sqrt{3}}{10+5\sqrt{3}}=\dfrac{25\sqrt{3}\left(10-5\sqrt{3}\right)}{25}=10\sqrt{3}-15$

(d) Area $=\pi R^2=\dfrac{\pi}{4}\left(\dfrac{10}{1/2}\right)^2=100\pi$

35. (c, d)

(a) Direction ratios of line of intersection are given by

$\left(2\hat{i}+j-k\right)\times\left(\hat{i}+2j+k\right)=3\hat{i}-3j+3k \Rightarrow dr=(1,-1,1)$

(b) $\vec{a}.\vec{b}=\left(\hat{i}-j+k\right).\left(3\hat{i}-3j+3k\right)=3+3+3=9\neq 0$

(c) Angle between $P_1, P_2=\cos^{-1}\left|\dfrac{2+2-1}{\sqrt{6}.\sqrt{6}}\right|=\cos^{-1}\left(\dfrac{1}{2}\right)=60^0$

(d) P_3 : x - y + z = 0

Distance of (2, 1, 1) from the plane $=\dfrac{2}{\sqrt{3}}$

36. (a, b, d)

L.M.V.T. in [-4, 0]

$\dfrac{f(0)-f(-4)}{4}=f'(x_0)$

$\left|f'(x_0)\right|\leq\dfrac{|f(0)|+|f(-4)|}{4}\leq 1$

If f(x) periodic then $\lim_{x\to\infty} f(x)\neq 1$

Similarly, $\left|f'(x_1)\right|\leq 1$ for some $x_1 \in (0, 4)$

$g(x) = (f(x))^2 + (f'(x))^2$

$g(x_0) \leq 5$, $g(x_1) \leq 5$

g(0) = 85 it has a local maximum having value ≥ 85

Say α

$g'(\alpha) = 0$, $g''(\alpha)<0$

$2f(\alpha)f'(\alpha) + 2f'(\alpha)f''(\alpha) = 0$

$f'(\alpha)(f(\alpha) + f''(\alpha)) = 0$

as $f'(a) \neq 0$

37. (b, c)

$f'(x)=e^{f(x)-g(x)}.g'(x)$ given $f(1)=g(2)=1$

$\int -f'(x).e^{-f(x)}dx=\int -e^{-g(x)}.g'(x)dx$

$\int d\left(e^{-f(x)}\right)=\int d\left(e^{-g(x)}\right)+C$

$e^{-f(x)}=e^{-g(x)}+C$

Put $x=1\Rightarrow C=\frac{1}{e}-\frac{1}{e^{g(1)}}$

$x=2\Rightarrow e^{f(2)}=\frac{e^{1+g(1)}}{2e^{g(1)}-e}$

$\Rightarrow g(1)>1-\log_e 2$ & $f(2)>1-\log_e 2$

38. (b, c)

$f(x)=1-2x+e^{x}\int_0^x e^{-t}f(t)dt$

$\Rightarrow f'(x)=-2+e^{x}\int_0^x e^{-t}f(t)dt+f(x)$

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

$\Rightarrow f'(x)-2f(x)=2x-3$

$f(x)e^{-2x}=\frac{2xe^{-2x}}{-2}-\frac{2e^{-2x}}{4}-\frac{3e^{-2x}}{-2}+C$

put x = 0, f(0) = 1 $\Rightarrow$ C = 0

$f(x)e^{-2x}=-xe^{-2x}+e^{-2x}$

$\Rightarrow$ f(x)=1-x

which passes through (2, -1)

area $=\frac{\pi}{4}-\frac{1}{2}=\frac{\pi-2}{4}$

39. (8) $(\log_2 9)^{2\log_{\log_2 9} 2}\times\left(\sqrt{7}\right)^{\log_7 4}=2^2\times 4^{1/2}=8$

40. (625) Divisible by 4 $\Rightarrow$ last 2 digits divisible by 4 $\Rightarrow$ ends in 12, 24, 32, 44 or 52

$\therefore$ 5^3x5 = 625

41. (3748)

n(X $\cup$ Y) = n(X) + n(Y) - n(X $\cap$ Y)

1,6, 11,....2018 term

T_n=1+(n-1)5 = 5n-4

U_K = 9 + (K-1)7 = 7K + 2

for common terms

5n-4 = 7K + 2

$\Rightarrow n=\frac{7K+6}{5}\le 2018, K\le 1440$

K = 2,7, ...r

2 + (r-1)5 $\le$ 1440

$\therefore$ r_{max} = 288

$\therefore$ number of common term = 288 = n(X $\cap$ Y)

n(X $\cup$ Y) = 2018 + 2018 - 288 = 3748.

42. (2)

$$\sin^{-1}\left(\frac{x^2}{1-x}-\frac{x\left(\frac{x}{2}\right)}{1-\frac{x}{2}}\right)=\frac{\pi}{2}-\cos^{-1}\left(\frac{-x/2}{1+\frac{x}{2}}-\frac{(-x)}{1+x}\right)$$

$$\Rightarrow \sin^{-1}\left(x^2\left(\frac{1}{1-x}-\frac{1}{2-x}\right)\right)=\frac{\pi}{2}-\cos^{-1}\left(x\left(\frac{1}{1+x}-\frac{1}{2+x}\right)\right)$$

$$\sin^{-1}\left[\frac{x^2}{(1-x)(2-x)}\right]=\frac{\pi}{2}-\cos^{-1}\left[\frac{x}{(1+x)(2+x)}\right]=\sin^{-1}\left[\frac{x}{(1+x)(2+x)}\right]$$

$$\Rightarrow x\left[\frac{x}{(1-x)(2-x)}-\frac{1}{(1+x)(2+x)}\right]=0$$

$x = 0$ or $x^3 + 3x^2 + 2x = x^2 - 3x + 2$

$\Rightarrow x^3 + 2x^2 + 5x-2 = 0$

increasing function $\forall$ x

$f(0) = -2$, $f(1/2)>0$

$\Rightarrow$ one root between $\left(0,\frac{1}{2}\right)$

$\Rightarrow$ total number of solutions = 2

43. (1)

$$\ln(L)=\lim_{n\to\infty}\frac{1}{n}\sum_{r=1}^{n}\ln\left(\frac{n+r}{n}\right)$$

$$=\int_0^1 \ln(1+x)\,dx$$

$$=\left|x\ln(1+x)\right|_0^1-\left|x-\ln(1+x)\right|_0^1$$

$$=\ln 2-(1-\ln 2)$$

$$=\ln(4/e)$$

$$\Rightarrow L=4/e\Rightarrow[L]=1$$

44. (3)

$$\vec{c}.\vec{a}=x\Rightarrow 2\cos\alpha=x$$

$$\vec{c}.\vec{b}=y\Rightarrow 2\cos\alpha=y$$

$$\because |\vec{c}|=2$$

$\therefore$ $x^2 + y^2 + 1 = 4 \Rightarrow 8\cos^2\alpha = 3$

($\because \vec{a},\vec{b},\vec{a}\times\vec{b}$ all are $\perp$ to each other & are unit vectors)

45. (0.5)

$$\sqrt{3}a\cos x+2b\sin x=c$$

$$\sqrt{3}a\cos\left(\frac{\pi}{3}-x\right)+2b\sin\left(\frac{\pi}{3}-x\right)=c$$

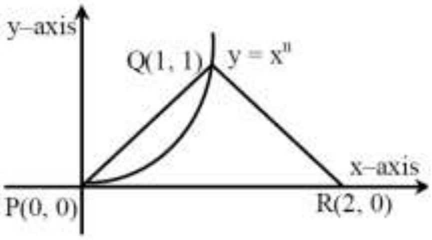
$$\Rightarrow \sqrt{3}a\left(\cos x.\frac{1}{2}+\frac{\sin x\sqrt{3}}{2}\right)+2b\left(\frac{\sqrt{3}}{2}\cos x-\frac{1}{2}\sin x\right)=c$$

$$\Rightarrow\left(\frac{\sqrt{3}}{2}a+\sqrt{3}b\right)\cos x+\left(\frac{3}{2}a-b\right)\sin x=c$$

$$\left(\sqrt{3}b-\frac{\sqrt{3}}{2}a\right)\cos x+\left(\frac{3}{2}a-3b\right)\sin x=0$$

$$\Rightarrow\frac{b}{a}=\frac{1}{2}$$

46. (4)



Area (Δ PQR) = 1 sq. unit

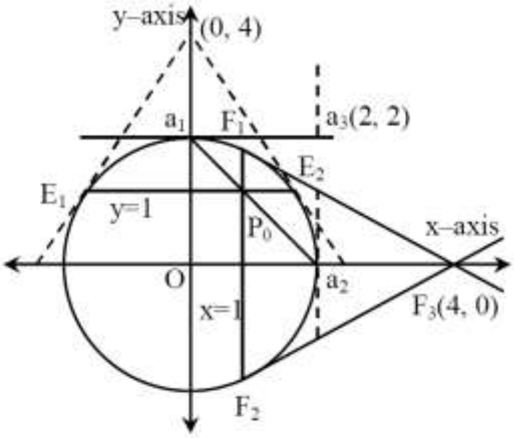
$$\Delta = \frac{1}{2} - \int_0^1 x^n dx = \frac{3}{10}$$

$$\Rightarrow \frac{1}{n+1} = \frac{1}{5}$$

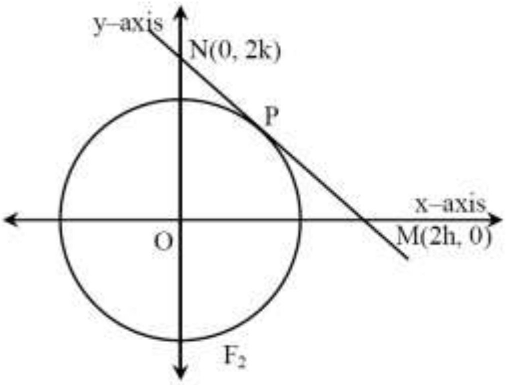
$\Rightarrow$ n =4.

47. (i) (a)

Clearly, they lie on x + y = 4



(ii) (d)



$\frac{x}{2h} + \frac{y}{2k} = 1$ and $\frac{xx_1}{4} + \frac{yy_1}{4} = 1$ are same

$$\Rightarrow x_1 = \frac{2}{h}, y_1 = \frac{2}{k}$$

$$\Rightarrow \frac{4}{h^2} + \frac{4}{k^2} = 4 \Rightarrow x^2 + y^2 = x^2 y^2$$

48. (i) (a)

$$P = \frac{D_4}{5!} = \frac{9}{120} = \frac{3}{40}$$

(ii)(c)

S_1	S_3	S_5	S_2	S_4
S_2	S_4	S_1	S_3	S_5
S_3	S_5	S_1	S_4	S_2
S_3	S_5	S_2	S_4	S_1
S_4	S_1	S_3	S_5	S_2
S_4	S_2	S_5	S_1	S_3
S_5	S_2	S_4	S_1	S_3

Same number of ways in reverse order

$$P(E)=\frac{n(E)}{n(S)}=\frac{7\times 2}{5!}=\frac{7}{60}$$