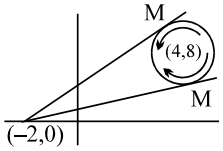
HINTS & SOLUTIONS

PAPER-1
PART : I MATHEMATICS

2. A and B are .....
Sol. use parametric

3. Point M moved.....
Sol.



Compute chord of contact of (–2, 0) and verify each alternative w.r.t. the and C.O.C.

4. A variable circle.....
Sol. centre is $x = t^2 - 3t + 1$ ....(1)

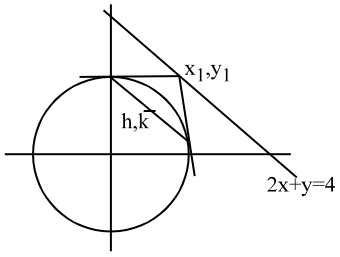
$y = t^2 + 2t$ ....(2)

eliminating t, we get

$x = t^2 + 2t - 5t + 1 = y - 5t + 1$

$t = \frac{y - x + 1}{5}$ Substituting the value of t in (2)

5. Tangents are .....
Sol.



(x_1, y_1) lies on $2x + y = 4$

$\Rightarrow 2x_1 + y_1 = 4$ ....(1)

chord of contact w.r.t. (x_1, y_1)

$xx_1 + yy_1 = 1$

also equation of chord whose mid point is (h, k)

$h^2 + k^2 = hx + ky$

$\therefore \frac{x_1}{h} = \frac{y_1}{k} = \frac{1}{h^2 + k^2}$

$\Rightarrow x_1 = \frac{h}{h^2 + k^2}$; $y_1 = \frac{k}{h^2 + k^2}$

substitute in (1)

$2 \cdot \frac{h}{h^2 + k^2} + \frac{k}{h^2 + k^2} = 4$

locus = $4(x^2 + y^2) = 2x + y$

6. The points .....
Sol. Let $x_1 = t - d$; $y_1 = 3(t - d)^2$

$x_2 = t$; $y_2 = 3t^2$

$x_3 = t + d$; $y_3 = 3(t + d)^2$

since y_1, y_2 and y_3 are in G.P.

however $9t^4 = 9(t - d)^2(t + d)^2$

$t^2 = (t - d)(t + d)$ or $-(t - d)(t + d)$

$t^2 = t^2 - d^2$ rejected as $a \neq 0$

$\therefore t^2 = d^2 - t^2$

$2t^2 = d^2 \Rightarrow d = \sqrt{2}t$ or $-\sqrt{2}t$

$r = \frac{t^2}{(t - d)^2} = \frac{t^2}{(t - \sqrt{2}\ t)^2}$

$= \frac{1}{(\sqrt{2} - 1)^2} = \frac{1}{3 - 2\sqrt{2}} = 3 + 2\sqrt{2}$

if $d = -\sqrt{2}t$ then $r = 3 - 2\sqrt{2}$]

7. If the roots of .....
Sol. roots are a/r , a, ar : where a >0 , r > 1]

Now $a/r + a + ar = -p$ ....(1)

$a.a/r + a.\ ar + ar.\ a/r = q$ ....(2)

$a/r.\ a.\ ar = 1$ ....(3)

$a^3 = 1 \Rightarrow a = 1 \Rightarrow$ [C]

from (1) putting a = 1 we get

$1/r + 1 + r = -p$ ....(4)

$\left(\sqrt{r} - \frac{1}{\sqrt{r}}\right)^2 + 3 = -p$

$p + 3 < 0 \Rightarrow$ (B)

from (2) putting a = 1 we get

$1/r + r + 1 = q$ ....(5)

from (4) and (5) we have $-p = q \Rightarrow p + q = 0$

8. Let n members.....
Sol. Let the number of members are n

Total number of points = $^nC_2$.

$\therefore {}^nC_2 - 17.5 = (n - 4)\ x$ (where x is the number of point scored by each player)

$n(n - 1) - 35 = 2(n - 4)\ x$

$2x = \frac{n(n-1)-35}{n-4}$

(where x takes the values 0.5 , 1 , 1.5 etc)

(must be an integer) = $\frac{n^2 - n - 35}{n - 4}$ (must be an integer)

$= \frac{n(n-4) + 3(n-4) - 23}{n - 4} = (n + 3) - \frac{23}{n - 4}$

$\Rightarrow \frac{23}{n - 4}$ must be an integer

$\Rightarrow$ n = 27 is the only possibility]

9. In how many .....

Sol. Stud means establishment or a farm in which horses are kept by an owner .

16 horses $\begin{cases} A\ B\ C\ A'\ B'\ C' \\ 10\ \text{others} \end{cases}$

Number of ways = $^{10}C_3$ × number of ways of choosing 3 out of A B C A′ B′ C′ so that A A′, B B′ or C C′ are not together

= $^{10}C_3\,[\,^6C_3 - {}^3C_1 \,.\, {}^4C_1\,] = {}^{10}C_3\ [\,20 - 12\,]$

= $^{10}C_3 \,.\, 8$

= $\dfrac{10\,.\,9\,.\,8}{1\,.\,2\,.\,3}\ .\ 8\ =\ 960$ (Ans.)

10. In a triangle .....

Sol. Using $c^2 = a^2 + b^2 - 2ab\cos C$

$\therefore\ c^2 + 2ab\cos C = 101\,c^2$

$\Rightarrow\ 100\,c^2 = 2ab\cos C$

$\Rightarrow\ ab\cos C = 50\,c^2$ ....(1)

also $\dfrac{\cot C}{\cot A + \cot B} = \dfrac{\cos C \cdot \sin A \cdot \sin B}{\sin C\ \ \sin(A+B)}$

= cos C $\dfrac{\sin A \cdot \sin B}{\sin^2 C}$

using sin A = ak etc

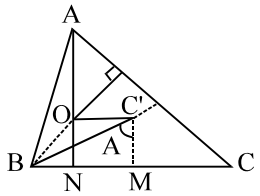
= cos C · $\dfrac{ab}{c^2}$ ....(2)

from (1) ab cos C = 50 c^2

$\dfrac{\cot C}{\cot A + \cot B}$ = 50

11. If the orthocentre .....

Sol.



R cos A = 2 R cosB cosC (C′ M = ON = distance of orthocentre from the side)

$\therefore\ \dfrac{\cos(B+C)}{\cos B\cos C}$ = – 2 (ON = 2R cosB cosC)

$\dfrac{\cos B\cos C - \sin B\sin C}{\cos B\cos C}$ = – 2

(C'B = R)

1 – tan B tanC = – 2

$\therefore$ tan B tan C = – 3

13. All the five .....

Sol. All the possible number are $^9C_5$ (none containing the digit 0) = 126

Total starting with 1 = $^8C_4$ = 70 | 1 | | | | |

(using 2, 3, 4, 5, 6, 7, 8, 9)

Total starting with 23 = $^6C_3$ = 20 | 2 | 3 | | | |

(4, 5, 6, 7, 8, 9)

Total starting with 245 = $^4C_2$ = 6 | 2 | 4 | 5 | | |

(6, 7, 8, 9)

97^{th} number = | 2 | 4 | 6 | 7 | 8 |

14. Given $(1 - 2x + 5x^2 - 10x^3)$ .....

Sol. $(1 - 2x + 5x^2 + 10x^3)$ $[\,C_0 + C_1x + C_2x^2 + ...]$

$= 1 + a_1x + a_2x^2 + ...$

$a_1 = n - 2$ and $a_2 = \dfrac{n(n-1)}{2} - 2n + 5$

put $a_1^2 = 2a_2$

$(n-2)^2 = n(n-1) - 4n + 10$

$n^2 - 4n + 4 = n^2 - 5n + 10$

n = 6 Ans]

15. If $(1 + x - 3x^2)^{2145}$ .....

Sol. Put x = – 1 ; $(-3)^{2145}$

$= a_0 - a_1 + a_2 - a_3 + ...$; $-(3)^{2145} = -(3^4)^{536} \cdot 3$

$\Rightarrow$ ends in 3

16. If $x^2 - 5x + 6 = 0$ .....

Sol. $x^2 - 5x + 6 = 0$ $\Rightarrow$ x = 3 or x = 2

$\log_2(x+y) = \log_2 5$ $\Rightarrow$ x + y = 5

since x = 3 , y =2 or x = 2 , y = 3

17. Find the number.....

Sol. from (2) and (3)

adding, x = $\dfrac{a+2}{2}$ subtracting y = $\dfrac{2-a}{2}$ substituting in (1)

a(a + 2) + (2 – a) = 2

$a^2 + 2a - a = 0 \ \Rightarrow\ a^2 + a = 0$

$\therefore$ a = 0 or a = –1 Ans.

18. If x is eliminated.....

Sol. adding sin(a + x) + sin(a – x) = 2(b + c)

2 sin a cos x = 2(b + c) $\Rightarrow$ cos x = $\dfrac{b+c}{\sin a}$ ....(1)

sub sin(a + x) – sin(a – x) = 2(b – c)

2 cos a sin x = 2(b – c) $\Rightarrow$ sin x = $\dfrac{b-c}{\cos a}$ ....(2)

squaring and adding both equation (1) and (2), we get

$\dfrac{(b+c)^2}{\sin^2 a} + \dfrac{(b-c)^2}{\cos^2 a} = 1$ Ans.

19. The term .....

$\left(9x - \dfrac{1}{3\sqrt{x}}\right)^{18}$, x > 0 .....

Sol. $T_{r+1} = {}^{18}C_r \cdot (9x)^{18-r} \cdot (-1)^r \cdot \dfrac{(x)^{-r/2}}{3^r}$

$T_{r+1} = {}^{18}C_r \cdot 9^{18-r} \,.\, \dfrac{(-1)^r}{3^r} \cdot x^{\left(18 - \frac{3r}{2}\right)}$

$\therefore\ 18 - \dfrac{3r}{2} = 0 \ \Rightarrow\ r = 12$

$^{18}C_{12} \cdot \dfrac{9^6}{3^{12}} = \alpha \cdot {}^{18}C_{12} \ \Rightarrow\ \alpha = 1$

20. The remainder.....

Sol. $\dfrac{1(2^{2000} - 1)}{1} = 2^{2000} - 1$

$(5-1)^{1000} - 1 = (1-5)^{1000} - 1$

$1 - {}^{1000}C_1 \cdot 5 + {}^{1000}C_2 \cdot 5^2 + ...+ {}^{1000}C_{1000} \cdot 5^{1000} - 1$

PART : II PHYSICS

21. A block of mass .....

Sol. Suppose n loops are formed in wire AC and m loops are formed in wire BC

$$n\left(\frac{\lambda}{2}\right)=1,\ m\left(\frac{\lambda}{2}\right)=2.5$$

$$\frac{n}{m}=\frac{1}{2.5}=\frac{2}{5}=\frac{4}{10}=\frac{6}{15}$$

So the loops in wires AC should be n = 2, 4, 6 .....

So the loops in wires BC should be m = 5, 10, 15 .....

Fundamental frequencies of wire AC as well as BC are :

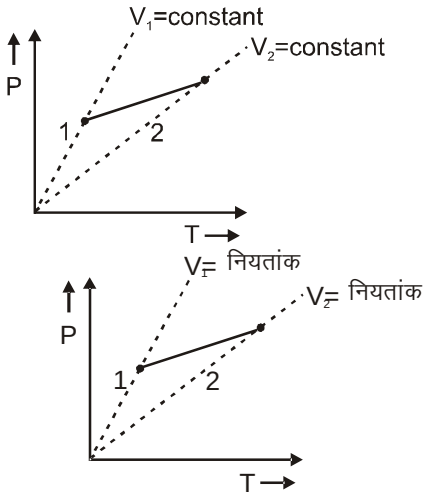
$f=\frac{n}{2\ell_1}\sqrt{\frac{I}{\mu}}$ or या $\frac{m}{2\ell_2}\sqrt{\frac{I}{\mu}}$

$f=\frac{2}{2\times1}\sqrt{\frac{10g}{0.01}},\ \frac{4}{2\times1}\sqrt{\frac{10g}{0.01}},\ \frac{6}{2\times1}\sqrt{\frac{10g}{0.01}}$

f = 100 Hz, 200 Hz, 300 Hz .....

22. Consider the P-T .....

Sol.



PV = nRT Here $V_2 > V_1$

23. A particle is executing .....

Sol. At time t_1, velocity of the particle is negative i.e. going towards $-X_m$. From the graph, at time t_1, its speed is decreasing. Therefore particle lies in between $-X_m$ and 0. At time t_2, velocity is positive and its magnitude is less than maximum i.e. it has yet not crossed O.

It lies in between $-X_m$ and 0.

Phase of particle at time t_1 is $(180 + \theta_1)$. Phase of particle at time t_2 is $(270 + \theta_2)$

Phase difference is $90 + (\theta_2 - \theta_1)$

$\theta_2 - \theta_1$ can be negative making $\Delta\phi < 90°$ but can not be more than 90°.

24. Heat is supplied to a .....

Sol. Slope of graph is less in the solid state i.e., temperature is rising slower, hence lower heat capacity.

The transition from solid to liquid state takes lesser time, hence latent heat is smaller.

25. Consider three fixed .....

Sol. $W_g + W_{fr} = \Delta K$

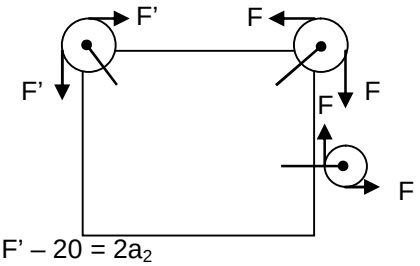
W_g & ΔK same for all cases so W_{fr} should also be same

$N_1 < N_2$ & $\ell_1 < \ell_2 \Rightarrow \mu_1 > \mu_2$ [N = Normal force, ℓ = length of the path]

$N_2 > N_3$ & $\ell_2 = \ell_3 \Rightarrow \mu_2 < \mu_3$

26. Initially system is at .....

Sol. $F' = 5a_3$



$F' - 20 = 2a_2$

$F - F' = 3a_1$

String constrained $a_1 - a_3 = a_2$

On solving $a_1 = \frac{110}{31} m/s^2$

$$a_2 = \frac{-10}{31} m/s^2$$

$$a_3 = \frac{120}{31} m/s^2$$

27. A sample of He gas .....

Sol. Number of moles = n (assume)

$C_V = \frac{3}{2}R$ and $C_P = \frac{5}{2}R$ (Monoatomic)

$T_A = 300$ K

$T_B / T_A = 2/1$

Hence $T_B = 600$ K

$Q_{BC} = W_{BC} = nRT_B \ln\left(\frac{V_C}{V_B}\right) = (n)(R)(600)\ln\left(\frac{4V_0}{2V_0}\right) = 600\, n\, R \ln 2$

$\therefore \quad Q_{DA} = W_{DA} = nRT_D \ln\left(\frac{V_A}{V_D}\right) = (n)(R)(300)\ln\left(\frac{V_0}{4V_0}\right) = 300\, n\, R\, \ell n\left(\frac{1}{4}\right)$

$Q_{DA} = -600\ nR \ln 2$

y $\left|\frac{\Delta Q}{\Delta Q}_{B\to C}\right| = 1$
$\left|\frac{\Delta Q}{\Delta Q}_{D\to A}\right|$

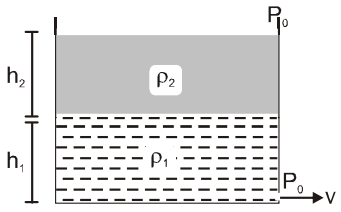
Pressure is constant from A to B.
Pressure decreases from B to C and again from C to D.
Pressure increases from D to A.

So $\frac{P_{max}}{P_{min}} = \frac{P_A}{P_D} = \left(\frac{P_A\ V_A}{P_D\ V_D}\right)\left(\frac{V_D}{V_A}\right)$

$= \left(\frac{nRT_A}{nRT_D}\right)\left(\frac{4}{1}\right) = 4$

28. A wide vessel with a.....

Sol.



$P_0 + h_1\rho_1 g + h_2\rho_2 g + 0 = P_0 + \frac{1}{2}\rho_1 v^2$

$v = \sqrt{2g\left(h_1 + \frac{h_2\rho_2}{\rho_1}\right)}$.

29. Three mass A, B and C of .....

Sol. For rod to remain balanced $M_c\ g \times \frac{L}{2} = T \times \frac{L}{2}$

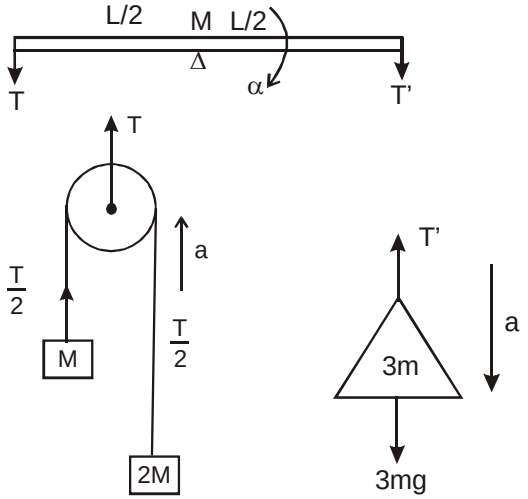
Also $\frac{T}{2} = \frac{4mg}{3} \quad \Rightarrow \quad M_c = \frac{8m}{3}$

But $3m > \frac{8mg}{3}$

So, right arm will move downward

Alternate

Sol. On fixing the Rod tension in right part is greater then tension in left part therefore right are will move downward.



$\frac{L}{2}\alpha = a \quad \Rightarrow \quad L\alpha = 2a \quad \longrightarrow$ (1)

$3mg - T' = 3ma \quad \Rightarrow T'$

$= 3mg - 3ma \quad \longrightarrow$ (2)

$T'\ \frac{L}{2} - T\ \frac{L}{2} = \frac{ML^2}{12}\alpha$

$\Rightarrow \quad T' - T' = \frac{M}{6}L\alpha = \frac{M2a}{6} = \frac{Ma}{3}$

$\Rightarrow \quad T' - T = \frac{Ma}{3} \quad \longrightarrow$ (3)

$\frac{T}{2} = \frac{2(2m)(m)(g+a)}{2m+m}$

$\Rightarrow \quad T = \frac{8m(g+a)}{3} \quad \longrightarrow$ (4) From (2), (3), (4)

$3mg - 3ma - \frac{8m(g+a)}{3} = \frac{Ma}{3}$

$9mg - 9ma - 8mg - 8ma = ma$

$mg = (M + 17m)\ a \Rightarrow a = \frac{mg}{M+17m}$

Since a is the so right arm will move downward.

30. Three bodies each of .....

Sol. For A & B

$20 - T = 2a$

$T - 8 = 2a$

$a_B = 3\ m/s^2$.

For C

$a_C = 2\ m/s^2$

$a_{BC} = 1\ m/s^2$.

31. A vessel has .....

Sol. **(Moderate)** The pressure at A and B will be equal $P_A = P_B = \rho g\, 3h$

The force on the bottom ($\rho g\ 3h$). A_2 > weight of liquid.]

32. A partition divides a .....

Sol. In the equilibrium position the net force on the partion will be zero.
Hence pressure on both sides are same.
Hence, (A) is correct.
Initially, PV = nRT

$n_1 = \frac{P_1V_1}{RT_1} = \frac{PV}{RT}$ & $n_2 = \frac{(2\ P)(2\ V)}{RT} =$

$4\frac{PV}{RT} \quad \Rightarrow \quad n_2 = 4n_1$

Moles remains conserved.
Finally, pressure becomes equal in both parts.
Using, $P_1V_1 = n_1RT_1$

$P_2V_2 = n_2RT_2$

$P_1 = P_2$ & $T_1 = T_2$

$\therefore \quad \frac{V_1}{V_2} = \frac{n_1}{n_2} = \frac{1}{4}$

$\Rightarrow \quad V_2 = 4V_1$

Also $\quad V_1 + V_2 = 3V$

$\Rightarrow \quad V_1 + 4V_1 = 3V$

$\Rightarrow \quad V_1 = \frac{3}{5}V$

And $\quad V_2 = \frac{12}{5}\ V$

Hence (B) and (C) are correct.

In compartment (I) :

$P_1' V_1 = n_1RT_1$

$P_1' \left(\frac{3V}{5}\right) = \left(\frac{P\ V}{RT}\right)RT$

$P_1' = \frac{5Pv}{3v} = \frac{5}{3}P$

Hence (D) is also correct.

33. A wire of length L .....

Sol. $F = \frac{YA}{L}x$

So, $k = \frac{YA}{L}$ and $W = \frac{1}{2}\frac{YAx^2}{L}$

34. Eight identical droplets .....

Sol. Terminal velocity $v_T = \frac{2r^2(\rho - \sigma)g}{9\eta}$

35. One end of an ideal .....

Sol: Maximum work done by the spring = maximum loss in P.E. of the spring $= \frac{1}{2}kx^2$

The block will have maximum KE when the spring is in its undeformed state i.e., P.E =0 state

When spring does negative work the kinetic energy of the block will decrease.

While moving away from the wall the P E of the spring first decreases and then increases and therefore the K.E of the block first increases and then decreases.

36. A transverse sinusoidal .....

Sol. $\omega = v_{wave}k \quad = 10 \times \frac{2\pi}{50}\ s^{-1}$

$\omega = \frac{2\pi}{5}\ s^{-1}$

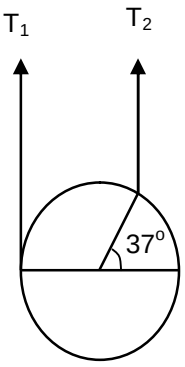
$v = \omega\sqrt{A^2 - x^2}$

$v = \frac{2\pi}{5}\sqrt{10^2 - \left(\frac{10}{\sqrt{2}}\right)^2} = \frac{2\pi}{5} \times \frac{10}{\sqrt{2}}$

$= 2\sqrt{2}\ \pi$ cm/s

37. An uniform sphere is .....

Sol. $T_1\ \ell = T_2 \times \left(\frac{4\ell}{5}\right)$



$5T_1 = 4T_2$

$K = \frac{f_1}{f_2} = \sqrt{\frac{T_1}{T_2}}.\frac{R_2}{R_1}$

$= \sqrt{\frac{4}{5}}.\frac{7}{10}$

$= \frac{7}{5\sqrt{5}}$

38. 5 gm steam at 100ºC .....

Sol. Heat released when 1g of steam at 100ºC is cooled to –20ºC ice is 730 cal. Now this heat is to be given to 1 + 6.3g = 7.3 g. This rises its temperature to 10ºC.

39. A graph between the .....

Sol. from graph

$V^2 = \left(-\frac{2700}{0.6}\right)S + 3600$

$2v\ \frac{dv}{ds} = \left(-\frac{2700}{0.6}\right)$, $v\ \frac{dv}{ds} = -2250$

40. A system of two .....

Sol. Spring force is an internal force and the only external force here is the gravity force.

$\Delta P = P_f - P_i$

$= (m_A + m_B)\ gt - 0$

$= 1.5 \times 10 \times 2$

$= 30$ kg m/s

PART : III CHEMISTRY

41. The following reactions .....

Sol. In a chemical reaction work done is given by $-\Delta n_g RT$

where $\Delta n_g = n_g(\text{product}) - n_g(\text{reactant})$
For one mole reactant consumed.

	I	II	III	IV
Δn_g	0.5	1	3	1

Hence answer is II and IV.

42. 150 mL of 0.0008 M ammonium.....

Sol. For $[Ca^{2+}]$, $M_1V_1 = M_2V_2$
$0.04 \times 50 = M_2 \times 200 \Rightarrow M_2 = 0.01$ M
Similarly, for $[SO_4^{2-}]$
$0.0008 \times 150 = M_2 \times 200$
$\Rightarrow$ $M_2 = 0.0006$ M
ionic product (Q) = $[Ca^{2+}] \times [SO_4^{2-}]$
$= 6 \times 10^{-6}$ So $Q < K_{sp}$

43. The densities of three .....

Sol. $d = \frac{PM}{ZRT}$ or $Z = \frac{PM}{dRT}$

$\Rightarrow Z_{O_2} = \frac{1\times 32}{0.8\times\frac{1}{12}\times 400} = 1.2$

(positive deviation, so less compressible than ideal gas).

$Z_{SO_2} = \frac{1\times 64}{\frac{32}{15}\times\frac{1}{12}\times 400} = 0.9$ (negative deviation)

$Z_{H_2} = \frac{1\times 2}{\frac{1}{25}\times\frac{1}{12}\times 400} = 1.5$(positive deviation from ideal gas).

1 atm is a low pressure, and at 400K, Z_{O_2} is greater than 1.

Hence Z_{O_2} will be equal to 1 at temperature lower than 400K. Hence Boyle's temperature of O_2 will be less than 400K.

44. You are given a solution of .....

Sol. (A) $[OH^-] = \frac{50\times 0.1}{500} = 10^{-2}$ M

pH = 12

(B) $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

10		5	
5		0	5

Buffer solution

(C) $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

5		5	
0	0		5

$pH = 7 + \frac{1}{2}pK_a + \frac{1}{2}\log C$

$= 7 + \frac{1}{2}\times 4.74 + \frac{1}{2}\log\frac{5}{100} = 8.72$

(D) $CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

$[OH^-] = \frac{2.5}{75} = \frac{1}{30}$M

45. Which of the following .....

Sol. $H_2O(\ell) \rightleftharpoons H_2O(g)$;

$K_p = p_{H_2O}$ = VP For endothermic process T↑ K_P↑

46. Select the correct .....

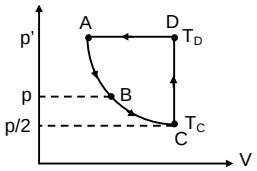
Sol. (A) This is because the gas will having larger value of 'a' will have a larger force of attraction and hence lesser distance between its molecule.
(D) This is because the gas with smaller value of 'b' will occupy lesser volume and hence will be more compressible.

47. Which of the following .....

Sol. These are the fact.

48. 1 mol of an ideal gas [$\gamma = 1.5$] .....

Sol.



$\Delta S_{CD} = 4\ \ell n16 = n\ C_v\ \ell n\frac{T_D}{T_C}$

$= n\frac{R}{\gamma-1}\ \ell n\frac{T_D}{T_C}$ ($\gamma = 1.5$)

or $\frac{T_D}{T_C} = 16 = \frac{P'}{P/2}$ $\therefore$ P' (or P_A) = 8P

for AB $\frac{T_B}{T_A} = \left(\frac{p_A}{p_B}\right)^{\frac{1-\gamma}{\gamma}}$

$\frac{T_B}{300} = (8)^{-1/3} = \frac{1}{2}$

$T_B = 150$ K = T_C

$\frac{P_C}{T_C} = \frac{P_D}{T_D}$ or $\frac{P/2}{150} = \frac{8P}{T_D}$ or $T_D = 2400$ K (B option)

ΔS_{DA} (isobaric) = n $C_P\ \ell n\frac{T_A}{T_D}$ = n $(C_v + R)\ \ell n\frac{T_A}{T_D}$

$= 1\ (2R+R)\ \ell n\frac{300}{2400} = -3\ R\ \ell n8$ (A option)

W_{AB}(adiabatic) = n C_V $(T_2 - T_1)$
$= 1\times 2R \times -150 = -600$ cal (C option)

W_{BC} (isothermal) = $-nRT\ \ell n\frac{P_B}{P_C} = -1\times 2\times 150\ \ell n\frac{P}{P/2}$

$= -300\ \ell n2$ cal (D option)

49. Which amongs the .....

Sol. (C) O_2 is paramagnetic.
(D) Only $(BeH_2)_n$ have 3C-2e bonding.

50. In which of the following .....

Sol. Correct orders of (C) & (D) are :
Increasing magnitude of first $-\Delta H_{eg}$: O < Se < S
Increasing electronegativity : C < Cl < O < F

51. Select correct about .....

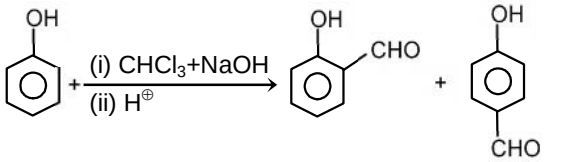
Sol. $P_4 + NaOH\ (aq.) \longrightarrow NaH_2PO_2 + PH_3$
Sod. hypophosphite

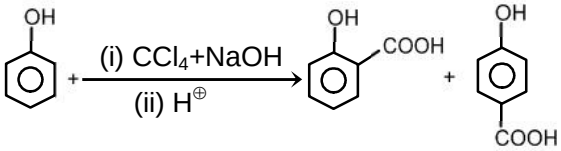
52. For the given compounds .....

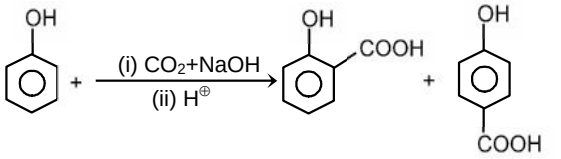
Sol. Carboxylic acid and ester are functional isomer and isomeric ester are metamers of each other.

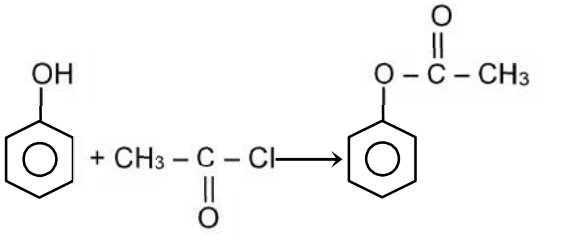
53. Among the following .....

Sol.







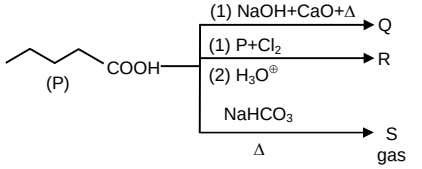


54. Boric acid on heating at .....

Sol. $H_3BO_3 \xrightarrow{100^oC} HBO_2 \xrightarrow{160^oC}$

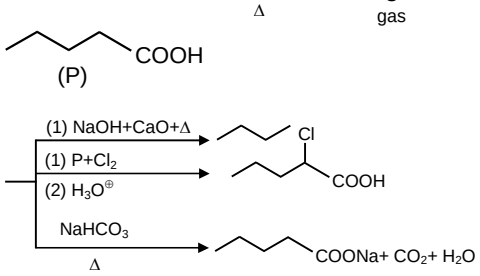
$H_2B_4O_7 \xrightarrow{Red\ hot} B_2O_3$

55.



.....

Sol.



56. Identify the number of .....

Sol. Only S_2, S_3, S_5, S_7, S_8 and S_9 are correct.

57. 0.2 mole of NH_4Cl is .....

Sol. $NH_4Cl(s) \rightarrow NH_3(g) + HCl_{(g)}$

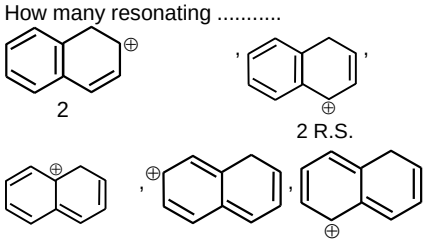
$K_P = 0.36\ atm^2$, $P_{NH_3}(eq) = 0.6$ atm.

But $P_{NH_3} = 0.5$ atm.

Hence all $NH_4Cl(s)$ has dissociated and equilibrium is not achieved.

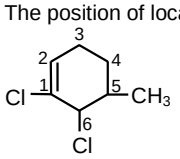
58. How many resonating .....

Sol.



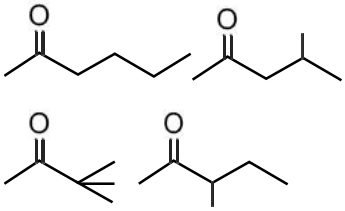
59. The position of locant .....

Sol. The position of locant methyl .....



60. How many structural .....

Sol.



PAPER-2
PART : I MATHEMATICS

1. The number .....

Sol $|x| \le 10 \Rightarrow -10 \le x \le 10$

$|y| \le 10 \Rightarrow -10 \le y \le 10$ $\quad |x - y| \le 10 \Rightarrow -10 \le x - y \le 10$ total number of points

$= (20 + 1)^2 - 2[1 + 2 + ...+ 10] = 331$

2. For the binomial .....

Sol. $T_{r+1} = {}^{10}C_r(x \sin p)^{10-r}(x^{-1}\cos p)^r$

$= {}^{10}C_r\, x^{10-2r}(\sin p)^{10-r}(\cos p)^r$

For the term independent of x,

$10 - 2r = 0 \quad \Rightarrow r = 5$

$\therefore T_6 = {}^{10}C_5 (\sin p)^5 (\cos p)^5$

$= {}^{10}C_5 \cdot \dfrac{(\sin 2p)^5}{2^5}$ $\therefore$ greatest value of $T_6 = {}^{10}C_5 \cdot \dfrac{1}{2^5}$

Now T_6 will be least if $\sin 2p = -1$

$\Rightarrow 2p = 2n\pi - \dfrac{\pi}{2}$

$\Rightarrow p = n\pi - \dfrac{\pi}{4} \Rightarrow p = (4n - 1)\dfrac{\pi}{4}, n \in I$

$\therefore$ sum of coefficients is $= (\sin p + \cos p)^{10}$

$= (1 + \sin 2p)^5$

Least 0 greatest 2^5

3. Let the pair of .....

Sol3 . We have the parabola $(y - 1)^2 = -4(x + 1)$

$\Rightarrow$ directrix: $x + 1 = 1 \Rightarrow x = 0$

4. If α and β are.....

Sol. For (A) when $\alpha < x < \beta$ then $ax^2 + bx + c < 0$ so that log function will undefined.

(B) $\Delta < 0$, $a > 0$ so $ax^2 + bx + c > 0$, $x \in R$ so that logarithmic function defined all values of x

(C) In this condition quadratic polynomial touches x axis at x = b/2a. Except this point $ax^2 + bx + c > 0$, so that logarithmic function defined at $R - \left\{\frac{-b}{2a}\right\}$

(D) If $\Delta = 0$, $a < 0$ so that quadratic polynomial $ax^2 + bx + c \le 0$ so the function is defined nowhere.

5. The sequence .....

Sol. $S_3 = \frac{S_1 + S_2}{2}$, $S_2 < S_3 < S_1$ & $S_4 = \frac{S_2 + S_3}{2}$

$\Rightarrow S_2 < S_4 < S_3 < S_1$

$S_5 = \frac{S_4 + S_3}{2} \Rightarrow S_4 < S_5 < S_3 < S_1$

Continuing in this manner, we will get

$S_2 < S_4 < S_6 < S_8 < \ldots < S_7 < S_5 < S_3 < S_1$

$\Rightarrow \{S_{2n}\}$ is increasing

6. If $S_1 < S_2$, then.....

Sol. $S_{2n+1} - S_{2n} = \frac{1}{2}(S_{2n} + S_{2n-1}) - S_{2n}$

$= -\frac{1}{2}(S_{2n} - S_{2n-1})$

$= \left(\frac{-1}{2}\right)^2 (S_{2n-1} - S_{2n-2})$ and so on

$S_{2n+1} - S_{2n} = \left(\frac{1}{2}\right)^{2n-1} (S_1 - S_2)$

7. Their sum is .....

Sol. (a + b + c) is divisible by 3 if

Case (i)

All three integers are from same group

No. of ways of selection = 3. ${}^nC_3$

Case (ii)

One integer from each group

No. of ways of selection = ${}^nC_1 \cdot {}^nC_1 \cdot {}^nC_1 = n^3$

$\therefore$ Total ways = $3\,{}^nC_3 + n^3$

$= \frac{n}{2}(3n^2 - 3n + 2)$

8. $(a^2 - b^2)$ is .....

Sol. $(a^2 - b^2)$ is divisible by 3 if either (a – b) or (a + b) is divisible by 3 which is possible if

Case (i)

Both are chosen from same group = $3 \cdot {}^nC_2$

Case (ii)

One is chosen from Group G_2 and other from $G_3 = {}^nC_1 \cdot {}^nC_1$

$\therefore$ Total ways = $3\,{}^nC_2 + n^2 = \frac{3n(n-1)}{2} + n^2$

9. The point from .....

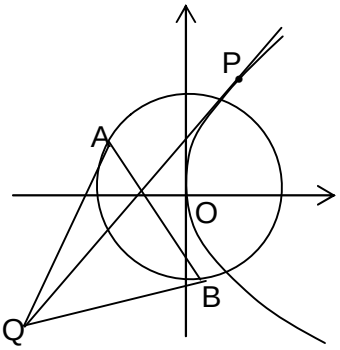
10. The locus of .....

Sol,9 Required point will lies on director circle of given circle & the directrix of the parabola so,

$x_1^2 + y_1^2 = 8$ & $x_1 + 2 = 0$

$y_1 = \pm 2$

Equation of circumcenter of ΔAQB is



$x^2 + y^2 - 4 + \lambda(x\alpha + y\beta - 8) = 0$

It passes through (0, 0)

$\lambda = -1/2$

10. Let circumcentre be (h, k) = $\left(\frac{\alpha}{4}, \frac{\beta}{4}\right)$

$\beta t = \alpha + 2t^2$

$\alpha - 2\beta + 8 = 0$

$h - 2k + 2 = 0$ is locus

11. Let 'a' and .....

Sol. a + b = m; ab = 2

$(a + b) + \frac{1}{a} + \frac{1}{b} = p$

$(a + b) + \frac{a+b}{ab} = p$

$\therefore\ p = m + \frac{m}{2} = \frac{3m}{2}$ ....(1)

also $\left(a + \frac{1}{b}\right)\left(b + \frac{1}{a}\right) = q$

$\Rightarrow\ ab + \frac{1}{ab} + 2 = q$

$\Rightarrow\ 2 + \frac{1}{2} + 2 = q \quad \Rightarrow \quad q = \frac{9}{2}$ ....(2)

now from (1) and (2)

p = 2q

$\frac{3m}{2} = 9 \quad \Rightarrow \quad m = 6$ Ans.

12. If ln (4 × 12 × .....

Sol. ln(4) + ln(12) + ln(36) + ln(108) + ... up to n terms

ln(4) + (ln 4 + ln 3) + (ln 4 + ln 9) + (ln 4 + ln 27) + ...

n ln(4) + ln(3)(1 + 2 + 3 + ... + (n – 1))

$n \ln(4) + \ln(3)\left[\frac{n(n-1)}{2}\right] \Rightarrow 2n \ln(2) + \left[\frac{n(n-1)}{2}\right]\ln(3)$

13. In the expansion.....

Sol. Given expression = $1 + (1 + x) + (1 + x)^2 + \ldots + (1 + x)^{19}$

$= \frac{(1+x)^{20} - 1}{(1+x) - 1} = \frac{(1+x)^{20} - 1}{x}$

(It is a G.P. with first term = 1 + x, common ratio = 1 + x)

Now coefficient of x^p in $\frac{(1+x)^{20}-1}{x}$ = coefficient of x^{p+1} in $\{(1+x)^{20}-1\}$

$T_{r+1} = {}^{20}C_r\, x^{20-r}$

$\because$ n = 20 even

$\Rightarrow$ $T_{(n/2)+1}$ is the term with greatest coefficient

$\therefore T_{(20/2)+1} = T_{11} = {}^{20}C_r\, x^{20-10}$

$\therefore$ $p + 1 = 10 \Rightarrow p = 9$ Ans.

14. Let the number .....

Sol. exterior angle = $\frac{2\pi}{n}$

$\therefore$ interior angle = $\pi - \frac{2\pi}{n} = 180° - \frac{360°}{n}$

where n is the number of sides

now $\frac{360°}{n}$ must be an integer < 180° hence $n \neq 1, 2$ (think !). We have to find the number of divisors of 360 other than 1 and 2.

now $360 = 2^3 \cdot 3^2 \cdot 5^1$ number of divisors = $4 \cdot 3 \cdot 2 = 24$

$\therefore$ required number of divisors = 24 – 2 = 22

15. In a sequence .....

Sol. centre: $C_n = 1 + (n-1)3$

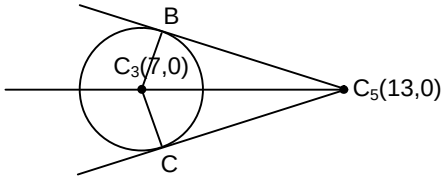
$C_n = 3n - 2$ $\quad C_5(13, 0)$

radius $R_n = ar^{n-1}$

$=2^{n-1}$

$R_3 = 2^2 = 4$

Line AB



(y – 0) = m(x – 13)

mx – y – 13m = 0

$\Rightarrow \left|\frac{-6m}{\sqrt{m^2+1}}\right| = 4 \Rightarrow 36m^2 = 16m^2 + 16$

$\Rightarrow m = \pm\frac{2}{\sqrt{5}}$

$m_1 = \frac{2}{\sqrt{5}}$, $m_2 = -\frac{2}{\sqrt{5}}$

hence $10|m_1m_2| = 10 \times \frac{4}{5} = 8$

16. If the normal .....

Sol. Equation of normal

ax sec t – by cosec t = $a^2 - b^2$

is farthest from centre (0, 0)

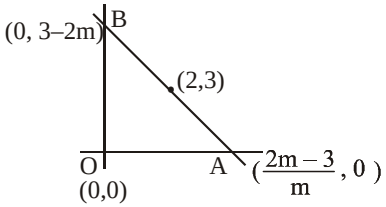
$\tan^2 t = \frac{b}{a} = \frac{2}{3}$

$\Rightarrow$ tant = $\sqrt{\frac{2}{3}}$, sect = $\sqrt{\frac{5}{3}}$, cosec t = $\sqrt{\frac{5}{2}}$

$\therefore \sqrt{\frac{5}{3}}\, x - 2\sqrt{\frac{5}{2}}\, y = 5 \Rightarrow \frac{x}{\sqrt{\frac{5}{3}}} - \frac{y}{\sqrt{\frac{5}{2}}} = 1$

17. The number .....

Sol.



equation of any line through (2, 3) is y -3 = m(x – 2)

y = mx – 2m + 3

with the help of the fig. area of $\Delta OAB = \pm 12$

ie. $\frac{1}{2}\left(\frac{2m-3}{m}\right)(3-2m) = \pm 12$

taking + sign me get $(2m+3)^2 = 0$

this gives one value of m = –3/2

taking negative sign we get

$4m^2 - 36m + 9 = 0$ $\quad (D > 0)$

quadratic in m gives 2 values of m

$\Rightarrow$ 3 st. lines are possible.

18. Given A(0, 0) .....

Sol. Let the coordinates of C be (1, c)

$m_2 = \frac{c-y}{1-x}$; $m_2 = \frac{c-m_1x}{1-x}$

$m_2 - m_2x = c - m_1x$

$(m_1 - m_2)x = c - m_2$

$c = (m_1 - m_2)x + m_2$ ....(1)

now area of $\Delta ABC = \frac{1}{2}\begin{vmatrix} 0 & 0 & 1 \\ x & m_1x & 1 \\ 1 & c & 1 \end{vmatrix}$

$= \frac{1}{2}[cx - m_1x] = \frac{1}{2}\left|[(m_1 - m_2)x + m_2)x - m_1x]\right|$

$= \frac{1}{2}\left|[(m_1 - m_2)x^2 + m_2x - m_1x]\right|$

$= \frac{1}{2}(m_1 - m_2)(x - x^2)$ $\quad (x > x^2$ in (0, 1)

Hence :, $f(x) = \frac{1}{2}(x - x^2)$;

$f(x)]_{max} = \frac{1}{8}$ when $x = \frac{1}{2}$

19. A five digits .....

Sol. Since a five digits no. is formed using the digits {0,1,2,3,4 and 5} divisible by 3 i.e. only possible

Case-1 Using digits 0,1,2,4,5 no. of ways = 4.4.3.2.1 = 96

Case-2 Using digits 1,2,3,4,5 no. of ways 5.4.3.2.1 = 120

Total numbers formed = 120 + 96 = 216 = 6^3

20. Find the largest.....

Sol. $f(x) = a - 1 + 2x - x^2$

$= a - (x-1)^2$

$f_{max} = a$ ..... (1)

$g(x) = (x-a)^2 + 10 - 2a - a^2$

$g_{min} = 10 - 2a - a^2$ ..... (2)

$f_{max} < g_{min}$

$\Rightarrow a < 10 - 2a - a^2$

$\Rightarrow a^2 + 3a - 10 < 0$

$\Rightarrow (a+5)(a-2) < 0$

$\Rightarrow a \in (-5, 2)$

a = 1

21. The sum of .....

Sol. $\frac{a}{r}+a+ar=56$

$\left(\frac{a}{r}-1\right)+(ar-21)=2(a-7)$

$\Rightarrow \frac{a}{r}+ar-22=2a-14$

$\Rightarrow \frac{a}{r}+ar=2a+8$

$\Rightarrow a+\frac{a}{r}+ar=3a+8=56$

$\Rightarrow 3a = 48$

$\Rightarrow a = 16$

Also $16\left(\frac{1}{r}+1+r\right)=56$

$\frac{1+r+r^2}{r}=\frac{7}{2}$

$\Rightarrow 2 + 2r + 2r^2 = 7r$

$\Rightarrow 2r^2 - 5r + 2 = 0 \Rightarrow 2r^2 - 4r - r + 2 = 0$

$2r(r - 2) - 1(r - 2) = 0$

$\Rightarrow r=\frac{1}{2},2$

$\therefore$ Numbers are $\frac{16}{2},16,16\times 2$

22. Let $A=\{t\in N\,|\,12$ .....

Sol. A = {1, 5,7,11,13,17,19, 23…….}

Hence $A\cap B$ = {1, 5,7,11,13,17,19,23}

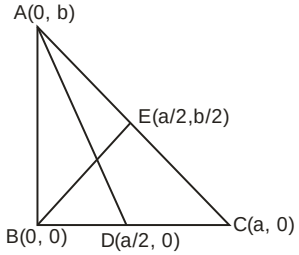
$\therefore\ n(A\cap B)=8$

23. The medians .....

Sol. The coordinates of D and E are (a/2, 0) and (a/2, b/2) respectively.

Now, m_1 = Slope of AD = $\frac{b-0}{0-a/2}=-\frac{2b}{a}$

m_2 = Slope of BE = $\frac{b/2-0}{a/2-0}=\frac{b}{a}$



Since AD and BE are perpendicular, therefore

$m_1m_2 = -1$

24. If $x\in\left(\pi,\ \frac{3\pi}{2}\right)$ .....

Sol. $4\cos^2\left(\frac{\pi}{4}-\frac{x}{2}\right)+\sqrt{4\sin^4 x+4\sin^2 x\cos^2 x}=4$

$\cos^2\left(\frac{\pi}{4}-\frac{x}{2}\right)+|2\sin x|$

$=4\cos^2\left(\frac{\pi}{4}-\frac{x}{2}\right)-2\sin x$

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

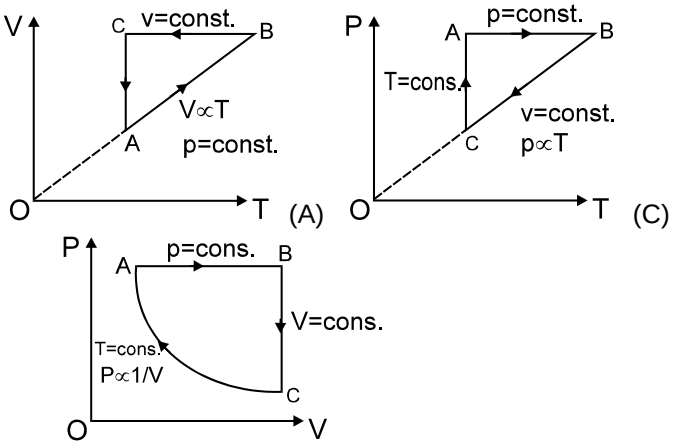
PART : II PHYSICS

27. A semi circular disc .....

Sol. Displacement of centre of mass is zero. So take centre of mass as origin then find displacement of all points.

28. An ideal gas .....

Sol.



29. Projection velocity of .....

Sol. f_{max} = 0.2 × 60 × 10 = 120 N

relative motion about to start when acceleration = 2 m/s² and

120t = 180 × 2

t = 3 sec.

For velocity of block at t = 3 sec.

$a=\frac{120t}{180}=\frac{2t}{3}$

$v=\frac{t^2}{3}\Big|_0^3$ = 3 m/s.

So, velocity of ball = $3\hat{i}+10\hat{j}+5\hat{k}$

30. The time of flight .....

Sol. Time of flight = $\frac{2\times10}{10}$ = 2 sec

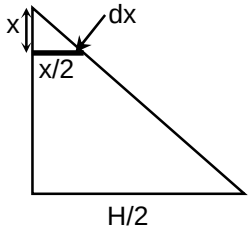
32. In previous question .....

Sol. (31 to 32)

$$\frac{x}{a}=\frac{H}{H/2}$$

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

$$m=\rho g\frac{H}{4}\times H\times H$$



Due to acceleration in x

Avg. Pressure = $\frac{0+\rho g\frac{x}{2}}{2}=\frac{\rho gx}{4}$

$$F_{net}=\int_0^H\left(\rho gx-\frac{\rho gx}{4}\right)dx\frac{x}{2}$$

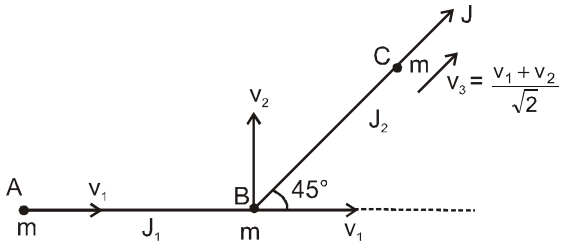
$$F_{net}=\int_0^H\rho g\frac{x}{4}dx\frac{x}{2}$$

$$F_{net}=\rho g\ \frac{H^3}{12}$$

So, $F_{net}=\frac{mg}{3}$

34. Speed of C just .....

Sol. $\frac{J_2}{\sqrt{2}}=2mv_1$ $\frac{J_2}{\sqrt{2}}=mv_2$ $\Rightarrow$ $v_2=2\ v_1$



$$J-J_2=\frac{m}{\sqrt{2}}\ (v_1+v_2)$$

$$J-2\sqrt{2}\,mv_1=\frac{3mv_1}{\sqrt{2}} \qquad \Rightarrow J=\frac{7mv_1}{\sqrt{2}}$$

$$\Rightarrow v_1=\frac{\sqrt{2}J}{7m} \qquad v_2=\frac{2\sqrt{2}J}{7m}$$

$$v_A=v_1=\frac{\sqrt{2}J}{7m} \qquad v_B=\frac{\sqrt{10}J}{7m}$$

$$v_c=\frac{v_1+v_2}{\sqrt{2}}=\frac{3J}{7m}$$

35. A coordinate axis system .....

Sol. The external force on two body system acts along y-axis. The initial momentum of the two body system is zero. Hence the C.M. of two body system always moves along y-axis

36. Two moles of an ideal .....

Sol. $T_A=T_C$ $\quad\therefore\ \Delta U=0$

$$Q_{net}=W_{net}=\frac{P_0}{2}\times V_0=\frac{nRT_0}{2}$$

$$=\frac{2\times8.3\times300}{2}=2490\ J$$

37. An uniform hollow .....

Sol. $I_c=\frac{2}{3}mR^2$

$$I_{cm}=\frac{5}{12}mR^2$$

Whom w is maximum

$$mg\frac{R}{2}=\frac{1}{2}\left(\frac{5}{12}mR^2\right)\omega^2$$

$$\mu^2\frac{R}{2}=\frac{6g}{5}$$

$$N_{max}=mg+m.\ \frac{6g}{5}$$

$$N_{max}=\frac{11mg}{5}$$

38. A capillary tube with .....

Sol. Upward force by capillary tube on top surface of liquid is

$$f_{up}=4\sigma a\cos\theta$$

If liquid is raised to a height *h* then we use

$4\sigma a\cos\theta=ha^2\rho g$ or $h=\frac{4\sigma\cos\theta}{a\rho g}$ **Ans.**

39. The specific heat of .....

Sol. $\frac{5R}{2}$ = 1.25 cal/gm–k

Let molar mass be M

$$\left(\frac{5}{2}\right)\left(\frac{8.4\ J}{mole\text{-}k}\right)=\frac{(1.25)(4.2J)}{\left(\frac{1}{M}mole\right)k}$$

$$M=\frac{5}{1.25}=4.$$

40. The work done in .....

Sol. $(10\times11-10\times6)\times10^{-4}\times2T=\Delta w$

$$50\times10^{-4}\times2T=3\times10^{-4}$$

$$\Rightarrow \qquad T=\frac{3}{100}=3\times10^{-2}\ N/m.$$

41. A sphere of mass m .....

Sol. The only force acting on the body is the viscous force

Here, $m\frac{vdv}{dx} = -6\pi\eta rv = -rv$

$\Rightarrow \int_{v}^{0} mdv = \int_{0}^{x} -rdx \Rightarrow x = \frac{mv}{r}$

42. A masonry column .....

Sol. Since stress at any cross section is same

$\Rightarrow$ Stress at top = stress at general cross sectional

$\Rightarrow \frac{F}{A_1} = \frac{W+F}{A}$

Here W = weight of column above the general cross section

$\Rightarrow \frac{F}{A_1} = \int \frac{\rho A g dz + F}{A}$

$\Rightarrow \frac{FA}{A_1} - F = \rho g \int A\,dz$

Differentiating w.r.t. z on both sides

$$\frac{F}{A_1}\cdot\frac{dA}{dz} = \rho g A$$

$\Rightarrow \int_{A_1}^{A_2} \frac{1}{A}\cdot dA = \frac{\rho g A_1}{F}\int_{0}^{h} dz$

$\Rightarrow \ell n\ \frac{A_2}{A_1} = \frac{\rho g A_1 h}{F} = \frac{2F}{F} = 2$

$\Rightarrow \frac{A_2}{A_1} = e^2 = 7.38$

$\Rightarrow$ Closest integer = 7

43. 4 moles of H_2 at 500 K .....

Sol. $TV^{\gamma-1} = C$

$\gamma - 1 = n$

$n = \frac{6}{13}$

$\gamma = \frac{4\times\frac{7}{2}R + 2\times\frac{5}{2}R}{4\times\frac{5}{2}R + 2\times\frac{3}{2}R} = \frac{19}{13}$

44. Some water at 0ºC is .....

Sol. Let f $\rightarrow$ fraction which freezes, m = mass of water

$f = \frac{7}{8}$

mass of water freezes = mf

heat lost by freezing water = mfL_F

Heat gained by vapour = $m(1-f)\,.\,L_V$

using principle of calorimetry

$mf\,L_F = m\,(1-f)\,L_V$

$\frac{7}{8}L_F = \frac{7}{8}L_V$

$L_V = 7\,L_F$

45. An observer moves .....

Sol. $O \rightarrow \frac{v}{5}$ $\overset{\text{v,f}}{\underset{\text{rest}}{\overset{\leftarrow \text{sound}}{\text{s}}}}$

$f' = f\left(\frac{v + v/5}{v - 0}\right)$

$f' = \frac{6}{5}f$

% charges $\frac{\frac{6}{5}f - f}{f}\times 100 = \frac{1}{5}\times 100 = 20\%$

46. 4^{th} harmonic of an .....

Sol. Clearly it is open organ pipe

$\frac{4v}{2\ell} = \frac{5v}{2\ell} - 33$

$\frac{v}{2\ell} = 33$

$2\ell = 10$

$\ell = 5\text{m}.$

47. A uniform smooth and solid .....

Sol. $\frac{1}{2}mv^2 = \frac{1}{2}kx^2$

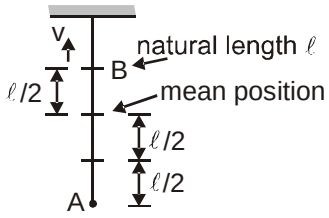
$x = \sqrt{\frac{m}{k}}.v = \sqrt{\frac{2}{200}}\times 0.7 = \frac{1}{10}\times 0.7\text{m} = 7\text{ cm}$

48. A small body of mass m .....

Sol. By conservation of energy at A and B

$\frac{1}{2}mv^2 = \frac{1}{2}K\left(\frac{3\ell}{2}\right)^2 - mg\,\frac{3\ell}{2} = \frac{3}{4}mg$

$\Rightarrow v = \sqrt{\frac{3g\ell}{2}}$



$\therefore$ The period of oscillation is

$= \frac{2v}{g} + \frac{2}{3}T = \sqrt{\frac{6\ell}{g}} + \frac{4®}{3}\sqrt{\frac{\ell}{2g}}$

PART : III CHEMISTRY

50. Given for H_2CO_3 $K_{a_1} = 4 \times 10^{-7}$.....

Sol. $[H^+]$ for H_2CO_3 = $\sqrt{K_1C_0} = \sqrt{4\times10^{-7}\times0.1} = 2\times10^{-4}$ M

$[H^+]$ for $NaHCO_3$ = $\sqrt{K_1K_2} = \sqrt{4\times10^{-7}\times4\times10^{-11}} = 4\times10^{-9}$ M

52. The product formed by .....

Sol. Since the compound on oxidative ozonolysis gives 1 mol of CO_2 and butanoic acid, it must be terminal alkyne

$$CH_3–CH_2–CH_2–C\equiv CH \xrightarrow[(2)\ H_2O]{(1)\ O_3+Zn}$$

$$CH_3–CH_2–CH_2–\overset{\overset{O}{\|}}{C}–CH=O$$

53. Select correct option .....

Sol. For irreversible isothermal expansion process,

$\Delta S_{sys} = nR \ln \frac{V_2}{V_1}$ = + ve

Since heat is absorbed by the system, so

q_{surr} = – ve

$\therefore$ ΔS_{surr} = – ve

54. The change in entropy .....

Sol. $\Delta S_{sys} = nR \ln \frac{V_2}{V_1} = 2 \times 8.3 \ln 3$

$= 2 \times 8.3 \times 2.3 \times 0.48 = 18.33$ J/K

$\Delta S_{surr} = -\frac{q_{sys}}{T} = \frac{\text{Work done}}{T} =$

$\frac{1}{300}\times[-10^5(30-10)\times10^{-3}]$

$= \frac{-2\times10^3}{300} = \frac{-20}{3}$ = – 6.66 J/K.

ΔS_{total} = 18.33 – 6.66 = 11.67 JK^{-1}

55. Equal volume of 1M NaOH.....

Sol. $M = \frac{1V + \frac{10V}{40\times0.1} + \frac{1200V}{1040}}{3V} = \frac{121}{78}$.

56. 120 g of 1 M aqueous NaOH .....

Sol. $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

1M M

100mL x mL

mm 100 – 2x 0

$\frac{100-2x}{100+x} = 0.1 \quad \Rightarrow x = \frac{90}{2.1} = 42.85$ mL

59. A person takes 6.1 g of an.....

Sol. $HCO_3^- \longrightarrow CO_2$

Mole of HCO_3^- = $\frac{6.1}{61}\times\frac{20}{100}$ = 0.02 mol of CO_2

PV = nRT

$1 \times V = 0.2 \times \frac{1}{12} \times 298$

or V_{CO_2} = 0.49 L

60. For a gaseous reaction .....

Sol. $A + 3B \rightleftharpoons 2C$

$\Delta G° = \Delta H° - T\Delta S°$

$= –90 – 400 \times (–0.200)$

$= –90 + 80 = – 10$ KJ.

$\therefore$ For $\frac{1}{2}A + \frac{3}{2}B \rightleftharpoons C$

$\Delta G° = – 5$ KJ

61. Consider the following .....

Sol.

	$PCl_5 \rightleftharpoons$	PCl_3 +	Cl_2	
t = 0	P	0	0	(at 27°C)
t = 0	$\frac{480P}{300}$	0	0	(at 207°C)
t = eq.	$\frac{480\ P}{300}$ –P'	P'	P'	(at 207°C)

$\therefore$ Total pressure at eq. at 207°C

$= \frac{480\ P}{300}$ –P' + 2P' = 2P (given)

$\therefore$ $\frac{8P}{5}$ + P' = 2P

$\therefore$ P' = $\frac{2P}{5}$

$\therefore$ % dissociation of PCl_5 at 207°C = $\frac{P'}{\left(\frac{480\ P}{300}\right)}\times100$

$= \frac{2\ \ P/5}{8\ \ P/5} \times 100 = 25\%$

62. By how many of the .....

Sol. (a, b, d, e, h)

63. Consider the following .....

Sol. $Z = 1 + \left(b - \frac{a}{RT}\right)\frac{1}{V_m}$ (at low P)

At inversion temperature

$T = \frac{2a}{Rb}$.

$$Z = 1 + \left(b - \frac{a}{\frac{R \times 2a}{Rb}} \right) \frac{1}{V_m}$$

$$= 1 + \left(b - \frac{b}{2} \right) \frac{1}{V_m} \qquad = 1 + \frac{b}{2} \times \frac{1}{V_m}$$

$$\text{slope} = \frac{b}{2} = \frac{1.02 - 1.01}{0.011 - 0.001} = \frac{0.01}{0.01} = 1$$

$b = 2\ cm^3$

$V_C = 3b = 6\ cm^3$

64. 0.1 litre solution is made .....

Sol. Total millimoles of H^+ ion = 40 + 40 + 20 = 100

millimoles of OH^- = $\frac{4}{40} \times 1000 = 100$

so solution is neutral (pH = 7).

65. The maximum number .....

Sol. $2p \rightarrow 2e^-$

$3s \rightarrow 2e^-$

$3p \rightarrow 2e^-$

$3d \rightarrow 1\ e^-$

$(n + \ell - m) = 3$ for 7 electrons

66. How many of the following .....

Sol. a, b,c,d,f,g,h are correct.

Hg_2I_2 – Mercurous iodide

67. How many of the following .....

Sol. In the given reaction 1,3,5 are correct.

In (2) $\longrightarrow$ SO_3 is electrophile,

In (4) $\longrightarrow$ $CH_3^{\oplus}$ is electrophile

68. Out of Be, Mg, Ca, Sr, Li, ...

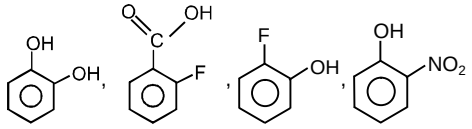
Be, Mg, Ca, Sr, Li, Na .....

Sol. $LiNO_3$ does not liberate NO_2 gas on heating.

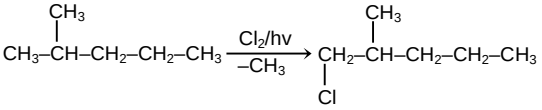
69. How many of the following .....

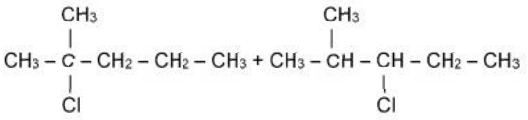
Sol. Formic acid terminal alkyne and aldehyde gives positive tollen's test

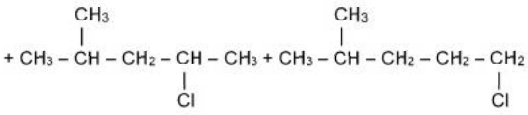
70. Intramolecular H-Bonding.....

Sol. 

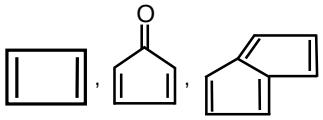
71. How many total monochloro .....

Sol. 





72. How many compounds will .....

Sol. 

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MAJOR TEST (MT)
(JEE ADVANCED PATTERN)
TARGET : JEE (MAIN+ADVANCED) 2019

DATE : 18-02-2018
COURSE : VIPUL (01JB, 07JB)

ANSWER KEY

CODE-0

PAPER-1

PART : I MATHEMATICS

1.	(AB)	**2.**	(AB)	**3.**	(BC)	**4.**	(A)	**5.**	(C)	**6.**	(AD)	**7.**	(ABCD)
8.	(BC)	**9.**	(C)	**10.**	(BC)	**11.**	(AD)	**12.**	(ACD)	**13.**	(B)	**14.**	(A)
15.	(B)	**16.**	(2)	**17.**	(2)	**18.**	(4)	**19.**	(1)	**20.**	(0)		

PART : II PHYSICS

21.	(AD)	**22.**	(BCD)	**23.**	(BC)	**24.**	(AC)	**25.**	(BD)	**26.**	(BC)	**27.**	(ABC)
28.	(C)	**29.**	(B)	**30.**	(BC)	**31.**	(AB)	**32.**	(ABCD)	**33.**	(BC)	**34.**	(AD)
35.	(AD)	**36.**	(2)	**37.**	(7)	**38.**	(5)	**39.**	(9)	**40.**	(3)		

PART : III CHEMISTRY

41.	(CD)	**42.**	(AC)	**43.**	(AD)	**44.**	(BC)	**45.**	(ABD)	**46.**	(AD)	**47.**	(ACD)
48.	(ABCD)	**49.**	(AB)	**50.**	(AB)	**51.**	(ABC)	**52.**	(BC)	**53.**	(BC)	**54.**	(ACD)
55.	(ABC)	**56.**	(6)	**57.**	(0)	**58.**	(7)	**59.**	(5)	**60.**	(4)		

PAPER-2

PART : I MATHEMATICS

1.	(AB)	**2.**	(ABC)	**3.**	(BCD)	**4.**	(ABCD)	**5.**	(A)	**6.**	(B)	**7.**	(A)
8.	(C)	**9.**	(D)	**10.**	(D)	**11.**	(6)	**12.**	(2)	**13.**	(9)	**14.**	(2)
15.	(8)	**16.**	(4)	**17.**	(3)	**18.**	(8)	**19.**	(6)	**20.**	(1)	**21.**	(2)
22.	(8)	**23.**	(2)	**24.**	(2)								

PART : II PHYSICS

25.	(AD)	**26.**	(AD)	**27.**	(ABD)	**28.**	(AC)	**29.**	(C)	**30.**	(A)	**31.**	(B)
32.	(D)	**33.**	(A)	**34.**	(C)	**35.**	(3)	**36.**	(2)	**37.**	(5)	**38.**	(4)
39.	(4)	**40.**	(3)	**41.**	(1)	**42.**	(7)	**43.**	(6)	**44.**	(7)	**45.**	(4)
46.	(5)	**47.**	(7)	**48.**	(8)								

PART : III CHEMISTRY

49.	(BCD)	**50.**	(AD)	**51.**	(ACD)	**52.**	(B)	**3.**	(D)	**54.**	(B)	**55.**	(A)
56.	(D)	**57.**	(D)	**58.**	(C)	**59.**	(5)	**60.**	(5)	**61.**	(5)	**62.**	(5)
63.	(6)	**64.**	(7)	**65.**	(7)	**66.**	(7)	**67.**	(3)	**68.**	(5)	**69.**	(5)
70.	(4)	**71.**	(5)	**72.**	(3)								