MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC Time: 3 Hours	JEE MAINS MODEL	Date:02-04-2020 Max. Marks: 300

MATHS

SYLLABUS: Properties of triangles (based on in radius), Addition of vectors Increasing & Decreasing functions, Maxima & minima

1. If in a triangle ABC, $\frac{1}{r^2}+\frac{1}{r_1^2}+\frac{1}{r_2^2}+\frac{1}{r_3^2}=$

1) $\frac{a+b+c}{\Delta}$ 2) $\frac{a^2+b^2+c^2}{\Delta^2}$ 3) $\frac{1}{2Rr}$ 4) R

2. If in a triangle ABC, $\left(\frac{1}{r}-\frac{1}{r_1}\right)\left(\frac{1}{r}-\frac{1}{r_2}\right)\left(\frac{1}{r}-\frac{1}{r_3}\right)=$

1) $\frac{abc}{\Delta^3}$ 2) 0 3) $4Rr^2$ 4) $\frac{1}{r}$

3. If in a triangle ABC, $(r_3+r_1)\sqrt{\frac{rr_2}{r_3+r_1}}=$

1) a 2) b 3) c 4) 0

4. If in a triangle ABC, $r\left(\cot\frac{B}{2}+\cot\frac{C}{2}\right)=$

1) a 2) b 3) c 4) 0

5. If in a triangle ABC, $r_1\cot\frac{A}{2}+r_2\cot\frac{B}{2}+r_3\cot\frac{C}{2}=$

1) s 2) 2s 3) 3s 4) 4s

6. If in a triangle ABC, $r\left(r_1\cot\frac{A}{2}+r_2\cot\frac{B}{2}+r_3\cot\frac{C}{2}\right)=$

1) 3s 2) 3Δ 3) $\frac{3}{\Delta}$ 4) $\frac{2}{\Delta}$

7. If in a triangle ABC, $\frac{r_1+r_2}{1+\cos C}=$

1) $\frac{2ab}{c\Delta}$ 2) $\frac{a+b}{c\Delta}$ 3) $\frac{abc}{2\Delta}$ 4) $\frac{abc}{\Delta^3}$

8. If in a triangle ABC, if $\lfloor A=90^0$ **then** $Cos^{-1}\left(\frac{R}{r_2+r_3}\right)=$

1) 90^0 2) 30^0 3) 60^0 4) 45^0

9. If in a triangle ABC, $\cos^2\frac{A}{2}+\cos^2\frac{B}{2}+\cos^2\frac{C}{2}=$

1) $\frac{1}{r}-\frac{1}{2R}$ 2) $1+\frac{r}{R}$ 3) $2+\frac{r}{2R}$ 4) $1-\frac{r}{2R}$

10. If in a triangle ABC, if $\left(1-\frac{r_1}{r_2}\right)\left(1-\frac{r_1}{r_3}\right)=2$ **then the triangle is**

1) isosceles 2) equilateral 3) right angled 4) none

11. The dimensions of the rectangle of perimeter 36 cm. Which will sweep out a volume as large as possible when revolved about one of its sides are

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

12. $f(x) = (\sin^{-1}x)^2 + (\cos^{-1}x)^2$ is stationary at

1) $x = \frac{1}{\sqrt{2}}$ 2) $x = \frac{\pi}{4}$ 3) x = 1 4) x = 0

13. The shortest distance of the line y - x - 1 = 0 from $x = y^2$ is

1) $\frac{3\sqrt{2}}{8}$ 2) $\frac{3\sqrt{2}}{4}$ 3) $\frac{3\sqrt{2}}{2}$ 4) None of these

14. If α, β are the roots of the quadratic equation $x^2-(a-2)x-(a+1)=0$ where a is variable, then the least value of $\alpha^2+\beta^2$ is

1) 3 2) 5 3) 7 4) None

15. If f(x) = alog|x| + bx^2 + x has its extreme values at x = - 1 and x = 2 then

1) a = 2, b = - 1 2) a = 2, b = - 1/2 3) a = - 2, b = 1/2 4) a = 2, b = 2

16. The minimum value of $2^{\left(x^2-3\right)^3+27}$ is

1) 2^{27} 2) 2 3) 1 4) 4

17. A particle is moving in a straight line such that its distance at any time 't' is given by $s=\frac{t^4}{4}-2t^3+4t^2+7$ then its acceleration is minimum at t =

1) 1 2) 2 3) 1/2 4) 3/2

18. If y = $\sum_{i=1}^{n} \left(x-x_i\right)^2$, x_i are constants, then y has minimum value at x =

1) n 2) $\Sigma \ x_i$ 3) $\frac{\Sigma \ x_i}{n}$ 4) $\frac{1}{n}$

19. A straight line through the point (3, 4) in the first quadrant meets the axes at A and B. Then the minimum area of OAB is (in sq units)

1) 12 2) 18 3) 24 4) 30

20. If x, y are strictly positive such that x + y = 1 then the minimum value of x log x + y log y is

1) log 2 2) -log2 3) 2 log2 4) 0

NUMERICAL VALUE QUESTIONS

21. If in a triangle ABC, $\frac{s-a}{\Delta}=\frac{1}{8}, \frac{s-b}{\Delta}=\frac{1}{12}, \frac{s-c}{\Delta}=\frac{1}{24}$ then b=

22. Let ABCD be a quadrilateral with area 18, with side AB parallel to the side CD and CD = 2AB . Let AD be perpendicular to AB and CD. If a circle is drawn inside the quadrilateral ABCD touching all the sides, then its radius is

23. If in a triangle ABC, if $A-B=120^0$ and R=8r then cos C =

24. If the function f given by $f(x)=x^3-3(a-2)x^2+3ax+7$ for some $a \in R$ is increasing in (0,1] and decreasing in [1,5), then a root of the equation $\frac{f(x)-14}{(x-1)^2}=0 (x \neq 1)$,is

25. Let $f(x)=5-|x-2|$ and $g(x)=|x+1|$, $x \in R$. If attains maximum value at α and $g(x)$ attains minimum value at β , $\lim_{x \to \alpha\beta} \frac{(x-1)\left(x^2-5x+6\right)}{\left(x^2-6x+8\right)}$ is equal to :

PHYSICS

SYLLABUS: oscillations, heat & thermodynamics

26. **A particle starts its SHM from mean position at t= 0. If its time period is T and amplitude A. The distance travelled by the particle in the time from**

t = 0 to $t=\frac{5T}{4}$ **is**

1) A 2) 2A 3) 4 A 4) 5A

27. **The minimum phase difference between two SHM's** $y_1=\sin\frac{\pi}{6}\sin\omega t+\sin\frac{\pi}{3}\cos\omega t$ **;**

$y_2=\cos\frac{\pi}{6}\sin\omega t+\cos\frac{\pi}{3}\cos\omega t$ **is**

1) $\frac{\pi}{3}$ 2) $\frac{\pi}{6}$ 3) $\frac{\pi}{12}$ 4) 0

28. **A particle of mass m executes SHM with amplitude A and frequency n. The average kinetic energy during its motion from mean to extreme positions is**

1) $\pi^2mn^2A^2$ 2) $2\pi^2mn^2A^2$ 3) $\frac{\pi^2mn^2A^2}{2}$ 4) zero

29. **If a simple harmonic motion is represented by** $\frac{d^2x}{dt^2}+\alpha x=0$**, its time period is**

1) $2\pi\alpha$ 2) $2\pi\sqrt{\alpha}$ 3) $\frac{2\pi}{\alpha}$ 4) $\frac{2\pi}{\sqrt{\alpha}}$

30. **Average kinetic energy in one time period of a simple harmonic oscillator whose amplitude is A angular velocity** ω **and mass M is**

1) $\frac{1}{4}M\omega^2A^2$ 2) $\frac{1}{2}M\omega^2A^2$ 3) $M\omega^2A^2$ 4) 0

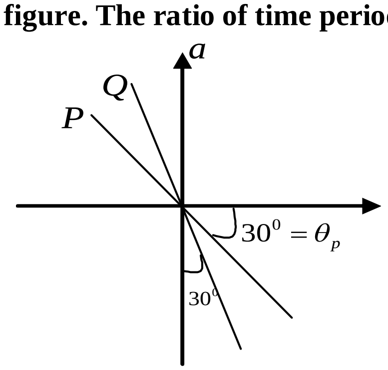
31. **Two masses M and m are suspended together by a massless spring of force constant k. When the masses are in equilibrium, M is removed without disturbing the system. Then the amplitude of oscillation is**

1) Mg/k 2) mg/k 3) (M+m)g/k 4)(M–m)g/k

32. **A particle is executing SHM with a frequency of** $\frac{1}{8}Hz$**. If starts from the mean position at time t=0, the ratio of distances covered by it in 1st and 2nd second is**

1) 1 2) $1/\left(\sqrt{2}-1\right)$ 3) $1/\left(\sqrt{3}-1\right)$ 4) $\sqrt{2}-1$

33. **The acceleration - displacement graph of two particles P and Q executing SHM are represented as shown in the figure. The ratio of time period of P,Q respectively is**



1) $\sqrt{3}:1$ 2) $1:\sqrt{3}$ 3) $3:1$ 4) $1:3$

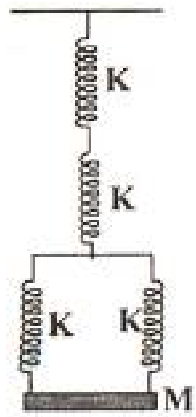
34. **Two simple pendulums of length 100m and 121m start swinging together. They will swing together again after**

1) the longer pendulum makes 10 oscillations
2) the shorter pendulum makes 10 oscillations
3) the longer pendulum makes 11 oscillations
4) the shorter pendulum makes 20 oscillations

35. The change in the length of a simple pendulum of length 1m, when its period of oscillation changes from 2s to 1.5s is

1) increased by $\frac{7}{8}m$ 2) decreased by $\frac{7}{8}m$ 3) increased by $\frac{7}{16}m$ 4) decreased by $\frac{7}{16}m$

36. The frequency of oscillation of the system shown in the figure will be

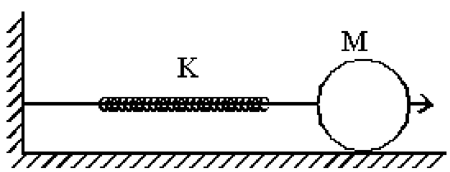


1) $\frac{1}{2\pi}\sqrt{\frac{k}{M}}$ 2) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$ 3) $\frac{1}{2\pi}\sqrt{\frac{k}{5M}}$ 4) $\frac{1}{2\pi}\sqrt{\frac{2k}{5M}}$

37. Two simple pendulums are drawn to same side from their mean positions and are released simultaneously. Their time periods are 2s and 3s. The phase difference between the pendulums when the longer pendulum completes one oscillation is

1) π/3rad 2) π/2rad 3) 2π/3rad 4) π rad

38. A disc of mass M is attached to a horizontal massless spring of force constant K so that it can roll without slipping along a horizontal surface. If the disc is pushed a little towards right and then released, its centre of mass executes SHM with a period of



1) $2\pi\sqrt{\frac{M}{K}}$ 2) $2\pi\sqrt{\frac{3M}{K}}$ 3) $2\pi\sqrt{\frac{M}{2K}}$ 4) $2\pi\sqrt{\frac{3M}{2K}}$

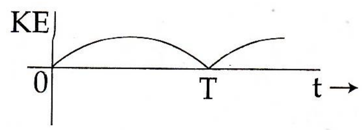
39. The mass and the diameter of a planet are three times the respective values for the Earth. The period of oscillation of a simple pendulum on the Earth is 2 s. The period of oscillation of the same pendulum on the planet would be

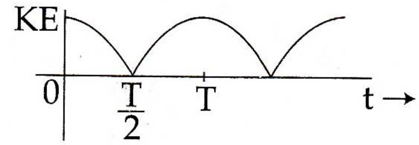
1) $\frac{2}{\sqrt{3}}s$ 2) $\frac{3}{2}s$ 3) $\frac{\sqrt{3}}{2}s$ 4) $2\sqrt{3}s$

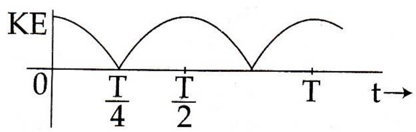
40. A spring whose unstretched lenght is l has a force constat k. The spring is cut into two pieces of unstretched lengths l_1 and l_2 where, $l_1 = nl_2$ and n is an integer. The ratio k_1/k_2 of the corresponding force constants, k_1 and k_2 will be :

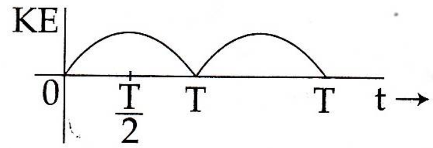
1) n^2 2) $\frac{1}{n}$ 3) $\frac{1}{n^2}$ 4) n

41. A particle is executing simple harmonic motion with a time period T. A time t = 0, it is at its position of equilibrium. The kinetic energy - time graph of the particle will look like:

1) 

2) 

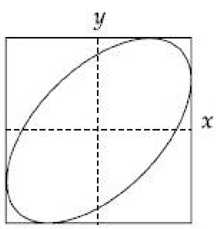
3) 

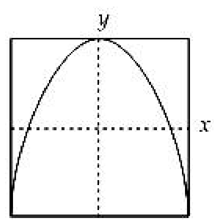
4) 

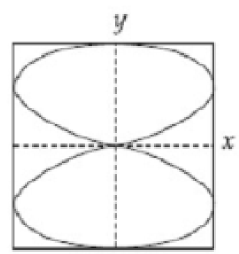
42. A particle performs simple harmonic motion with amplitude A. Its speed is trebled at the instant that it is at a distance $\frac{2A}{3}$ from equilibrium position. The new amplitude of the motion is :

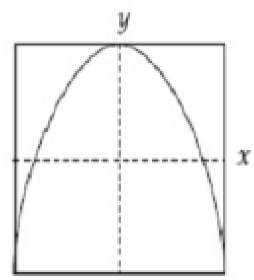
1) $\frac{A}{3}\sqrt{41}$ 2) 3A 3) $A\sqrt{3}$ 4) $\frac{7A}{3}$

43. x and y displacements of a particle are given as $x(t) = a\sin\omega t$ and $y(t) = a\sin 2\omega t$. Its trajectory will look like :

1) 

2) 

3) 

4) 

44. An aluminium sphere of 20 cm diameter is heated from 0^0C to 100⁰C. Its volume changes by (given that coefficient of linear expansion for aluminium $\alpha_{Al} = 23\times10^{-6}/^0C$)

1) 28.9 cc 2) 2.89 cc 3) 9.28 cc 4) 49.8 cc

45. The freezing point on a thermometer is marked as 20^o and the boiling point as 150^o. A temperature of 60^oC on this thermometer will be read as

1) 40^o 2) 65^o 3) 98^o 4) 110^o

NUMERICAL VALUE QUESTIONS

46. A damped harmonic oscillator has a frequency of 5 oscillations per second. The amplitude drops to half its value for every 10 oscillations. The time it will take to drop to $\frac{1}{1000}$ of the original amplitude is close to :

47. The displacement of a damped harmonic oscillator is given by $x(t) = e^{-0.1t}\cos(10\pi t + \varphi)$. Here t is in seconds. The time taken for its amplitude of vibration to drop to half of its initial value is close to:

48. In an engine the piston undergoes vertical simple harmonic motion with amplitude 7 cm. A washer rests on top of the piston and moves with it. The motor speed is slowly increased. The frequency of the piston at which the washer no longer stays in contact with the piston, is close to:

49. A spring balance has a scale that reads 0 to 20 kg. The length of the scale is 10cm. A body suspended from this balance, when displaced and released, oscillates with period of $\frac{\pi}{10}s$. The mass of the body is

50. **Two pendulums with lengths 1.44 m and 1 m start oscillating simultaneously. After how many oscillations of longer pendulum will they be in the same phase?**

CHEMISTRY

SYLLABUS: States of Matter, Thermodynamics

51. **The enthalpy of fusion of water is** $6.01\,\text{Kj mole}^{-1}$**. The entropy change of 1 mole of ice at its melting point will be**

1) 22 KJ mole^{-1} 2) 109 KJ mole^{-1} 3) 44 KJ mole^{-1} 4) 11 KJ mole^{-1}

52. **For a reaction** $\Delta H = +29\text{ KJ mole}^{-1}$ $\Delta S = -35\text{ JK}^{-1}\text{ mole}^{-1}$ **at what temperature the reaction will be spontaneous**

1) 828.7^0C 2) $828.7\,K$

3) Spontaneous at all temperature 4) Not possible

53. **What is** ΔG^0 **for this reaction** $\frac{1}{2}N_{2(g)} + \frac{3}{2}H_{2(g)} \rightleftharpoons NH_{3(g)}\ Kp = 4.42\times10^4\ at\ 25^0C$

1) $-26.5\text{ KJ mole}^{-1}$ 2) $-11.5\text{ KJ mole}^{-1}$ 3) -2.2 KJ mole^{-1} 4) $-0.97\text{ KJ mole}^{-1}$

54. **The standard free energy change of a reaction is** $\Delta G^0 = -115\,KJ$ **at 298 K. Calculate the equilibrium constant in log Kp**

1) 20.16 2) 2.303 3) 2.016 4) 13.83

55. **Which of the following is correct expression that relates change of entropy with the change of pressure for an ideal gas at constant temperature among the following.**

1) $\Delta S = nRT\ln\frac{p_2}{p_1}$ 2) $\Delta S = T(p_2 - p_1)$ 3) $\Delta S = nR\ln\frac{p_1}{p_2}$ 4) $\Delta S = 2.303\,nR\ln\frac{p_1}{p_2}$

56. **Standard entropies of** X_2, Y_2 **and** XY_3 **are 60, 40 50** $JK^{-1}\ mole^{-1}$ **respectively. For the reaction**

$\frac{1}{2}X_2 + \frac{3}{2}Y_2 \longrightarrow XY_3$ $\Delta H = -30\ KJ$ **to be at equilibrium, the temperature will be**

1) 1000 K 2) 1250 K 3) 500 K 4) 750 K

57. $4.48\,L$ **of an ideal gas at requires 12 calories to rise its temperature by** 15^0C **at constant volume the** Cp **of the gas is**

1) 3 cal 2) 4 cal 3) 7 cal 4) 6 cal

58. **What is the value of internal energy change** (ΔU) **at** 27^0C **of a gaseous reaction** $2A_{2(g)} + 5B_{2(g)} \longrightarrow 2A_2B_{5(g)}$ **(Heat change at constant pressure is** $-50700\ J$ **)**

1) $-50700\ J$ 2) $-63171\ J$ 3) $-38229\ J$ 4) $+38229\ J$

59. **For the process** $H_2O_{(l)} \longrightarrow H_2O_{(g)}$ **at** $t = 100^0C$ **and 1 atm pressure the correct choice is**

1) $\Delta S_{system} > 0,\quad \Delta S_{surroundings} > 0$ 2) $\Delta S_{system} > 0,\quad \Delta S_{surroundings} < 0$

3) $\Delta S_{system} < 0,\quad \Delta S_{surroundings} > 0$ 4) $\Delta S_{system} < 0,\quad \Delta S_{surroundings} < 0$

60. **What is the sign of** ΔG^0 **and the values of K for an electro chemical cell for which** $E^0_{Cell} = 0.80\,Volt$

1) $\Delta G = -ve \quad K > 1$ 2) $\Delta G^0 = +ve \quad K > 1$

3) $\Delta G = +ve \quad K < 1$ 4) $\Delta G = -ve \quad K < 1$

61. **The difference between the heats of reaction at constant pressure and a constant volume for the reaction** $2C_6H_{6(l)} + 15\,O_{2(g)} \rightarrow 12\,CO_{2(g)} + 6H_2O_{(l)}\ at\ 25^0C$ **in KJ is**

1) -7.43 2) $+3.72$ 3) -3.72 4) $+7.43$

62. **Two moles of an ideal gas expanded isothermally and reversibly from 1L to 10L at 300 K. What is the enthalpy change?**

1) 4.98 KJ 2) 11.47 KJ 3) – 11.47 KJ 4) 0 KJ

63. **The species which by definition has zero standard molar enthalpy of formation at 298 K**

1) $Br_{2(g)}$ 2) $Cl_{2(g)}$ 3) $H_2O_{(g)}$ 4) $CH_{4(g)}$

64. Which of the following thermodynamic relation is correct

1) $dG = VdP - SdT$ 2) $dU = PdV + TdS$ 3) $dH = -VdP + TdS$ 4) $dG = VdP + SdT$

65. Although the dissolution of a NH_4Cl in water is an endothermic reaction, it is spontaneous because

1) $\Delta H = +Ve, \quad \Delta S = -Ve$ 2) $\Delta H = +Ve, \quad \Delta S = 0$

3) $\Delta H = +Ve, \quad T\Delta S < \Delta H$ 4) $\Delta H = +Ve, \quad \Delta S = +Ve$ and $\Delta H < T\Delta S$

66. The amount of heat liberated when one mole of NH_4OH react with one mole of HC*l* is

1) 13.7 K cal 2) more than 13.7 K cal 3) Less than 13.7 K cal 4) Can't be predicted

67. For the reaction $Ag_2O_{(g)} \rightarrow 2Ag_{(g)} + \frac{1}{2}O_{2(g)}$ which one the following is true

1) $\Delta H = \Delta U$ 2) $\Delta H < \Delta U$ 3) $\Delta H > \Delta U$ 4) $\Delta H = \frac{1}{2}\Delta U$

68. The dissociation energy of CH_4 is 400 K cal/mole and that of ethane is 670 K cal mole^{-1}. The C – C bond energy is

1) 270 K cal 2) 70 K cal 3) 200 K cal 4) 240 K cal

69. The heat of combustion of methane is –880 KJ mole^{-1}.If 3.2 gr of methane is burnt the heat evolved is

1) 88 KJ 2) 264 KJ 3) 176 KJ 4) 440 KJ

70. The enthalpy change of a reaction does not depends on

1) Initial and final state of the reaction 2) State of the reactions and products

3) Nature of the reactants 4) Different intermediate states

(Numerical Value Answer Type)

71. The emf of the cell reaction $Zn_{(s)} + Cu^{+2}_{(aq)} \rightarrow Zn^{+2}_{(aq)} + Cu_{(s)}$ is 1.1 V calculate free energy change. Enthalpy for the reaction is – 216.7 KJ mole^{-1} by using free energy & enthalpy calculate entropy change for this reaction.

72. Oxygen gas weighing 64 gr is expanded from 1 atm to 0.25 atm at 30^0 C calculate entropy change

73. The enthalpies of combustion at 25^0 C of H_2, cyclo hexane and cyclo hexene $\left(C_6H_{10}\right)$ are – 241, – 3920 and –3800 KJ/mole respectively. The heat of hydrogenation of cyclo hexene is

74. Enthalpy of formation of methane at constant pressure and 300 K is –75.83 KJ. What will be the heat of formation at constant volume?

75. Calculate the amount of work done (J) by 2moles of an ideal gas at 298 K in a reversible isothermal expansion from 10 lit to 20 lit

SR MPC | JEE MAINS MODEL | Date:02-04-2020
Time: 3 Hours | | Max. Marks: 300

KEY SHEET

MATHS

1) **2**	2) **1**	3) **2**	4) **1**	5) **3**	6) **2**	7) **3**	8) **3**	9) **4**	10) **3**
11) **3**	12) **1**	13) **1**	14) **2**	15) **2**	16) **3**	17) **2**	18) **3**	19) **3**	20) **2**
21) **16**	22) **2**	23) **0.87**	24) **7**	25) **0.5**					

PHYSICS

26) **4**	27) **2**	28) **1**	29) **4**	30) **1**	31) **1**	32) **2**	33) **1**	34) **1**	35) **4**
36) **4**	37) **4**	38) **4**	39) **4**	40) **3**	41) **3**	42) **4**	43) **2**	44) **1**	45) **3**
46) **20**	47) **7**	48) **1.9**	49) **4.9**	50) **5**					

CHEMISTRY

51) **1**	52) **4**	53) **1**	54) **1**	55) **3**	56) **4**	57) **4**	58) **3**	59) **2**	60) **1**
61) **1**	62) **4**	63) **2**	64) **1**	65) **4**	66) **3**	67) **3**	68) **2**	69) **3**	70) **4**
71) **-0.014**	72) **23.05**	73) **-121**	74) **-73.34**	75) **-3434.9**					

HINTS & SOLUTIONS

MATHS-A

1. $\frac{(s-a)^2}{\Delta^2}+\frac{(s-b)^2}{\Delta^2}+\frac{(s-c)^2}{\Delta^2}+\frac{s^2}{\Delta^2}=\frac{1}{\Delta^2}\left[\{3S^2-2S(a+b+c)+a^2+b^2+c^2\}+s^2\right]$

$=\frac{1}{\Delta^2}\left[\left(a^2+b^2+c^2\right)\right]=\frac{a^2+b^2+c^2}{\Delta^2}$

2. $\left(\frac{r_1-r}{rr_1}\right)\left(\frac{r_2-r}{rr_2}\right)\left(\frac{r_3-r}{rr_3}\right)=\frac{4Rr^2}{r^2\Delta^2}$

$=\frac{abc/\Delta}{\Delta^2}=\frac{abc}{\Delta^3}$

3. $\left(4RCos^2\frac{B}{2}\right)\frac{\sqrt{\frac{\Delta}{s}\cdot\frac{\Delta}{s-b}}}{\frac{\Delta}{s-c}-\frac{\Delta}{s-a}}=4R\frac{\sqrt{s(s-b)}}{ac}\cdot\frac{\sqrt{(s-c)(s-a)}}{s(s-b)}=\frac{4R\Delta}{ac}$

4. Use $\cot\frac{B}{2},\cot\frac{C}{2}$ formule in terms of Δ *and* s

5. $r_1.\cot(A/2)+r_2\cot(B/2)+r_3\cot(C/2)=$

S+S+S=3S

6. G.E is $r(s+s+s)=3rs=3\Delta$

7. $\frac{r_1+r_2}{1+\cos c}=\left[\frac{\Delta}{s-a}+\frac{\Delta}{s-b}\right]\times\frac{1}{2\cos^2(C/2)}=\frac{\Delta abc}{2\Delta^2}=\frac{abc}{2\Delta}$

8. $4RCos\frac{A}{2}Sin\frac{B+C}{2}=4RCos^2\frac{A}{2}=4R\left(\frac{1}{2}\right)=2R$

$=\frac{R}{r_2+r_3}=\frac{1}{2}\Rightarrow\cos^{-1}\frac{R}{r_2+r_3}=\cos^{-1}1/2=60^0$

9. $\frac{1-\cos 2A}{2}+\frac{1-\cos 2B}{2}+\frac{1-\cos 2C}{2}$

$\frac{3}{2}-\frac{1}{2}[\cos 2A+\cos 2B+\cos 2C]$ (apply transformations method)

10. $\left(1-\frac{r_1}{r_2}\right)\left(1-\frac{r_1}{r_3}\right)=2\Rightarrow\left(1-\frac{s-b}{s-a}\right)\left(1-\frac{s-c}{s-a}\right)=2$

$\Rightarrow(b-a)(c-a)=2(s-a)^2\Rightarrow b^2+c^2=a^2\Rightarrow\underline{|A}=90$

11. Let volume $v=\pi x^2y\to(1)$

$P=2(x+y)\ 36=2(x+y)\to(2)$

12. $f(x)=(\sin^{-1}x)^2+(\cos^{-1}x)^2$

$f^1(x)=0$ ($\because$ f has stationary)

$\Rightarrow\sin^{-1}x=\cos^{-1}\Rightarrow x=\frac{1}{\sqrt{2}}$

13. $y=x+1\ x=y^2$ Let d= $\frac{|x-y+1|}{\sqrt{2}}=\frac{|y^2-y+1|}{\sqrt{2}}$

$d^1=0\Rightarrow$ d has maxima or minima

$\Rightarrow d'=\frac{2y-1}{\sqrt{2}}=0\Rightarrow y=\frac{1}{2},x=\frac{1}{4}$

14. $x^2-(a-2)x-(a+1)=0$

$\alpha+\beta=-\frac{b}{a}\qquad\alpha.\beta=c/a$

Let $S=\alpha^2+\beta^2=(\alpha+\beta)^2-2\alpha.\beta$

15. $f(x)=a\log|x|+bx^2+x$

$f^1(x)=\frac{a}{x}+2bx+1\Rightarrow f^1(x)=0$

Solve $f^1(-1)=0,f^1(2)=0$

16. $f(x)=2^{(x^2-3)^3+27}\Rightarrow\log f(x)=\left((x^2-3)^3+27\right)\log 2$

$\Rightarrow f^1(x)=0$

17. $S=\frac{t^4}{4}-2t^3+4t^2+7$

$S^1=t^3-6t^2+8t\Rightarrow S^{11}=a=3t^2-12t+8\sigma_X^2$

$\Rightarrow S^{111}(t)=0\Rightarrow$ S has max. or min.

18. $y=\sum_{i=1}^{n}(x-x_i)^2=\sum x^2-2x\sum x_i+\sum x_i^2$

$$\frac{dy}{dx}=0 \Rightarrow n(2x)-2\sum x_i+0=0 \Rightarrow x=\frac{\sum x_i}{n}$$

19. $\frac{x}{a}+\frac{y}{b}=1 \Rightarrow \frac{3}{a}+\frac{4}{b}=1$

$\frac{4}{b}=1-\frac{3}{a} \Rightarrow \frac{1}{b}=\frac{(a-3)}{a}\times\frac{1}{4}$

$b=\frac{4a}{a-3}$

$A=\frac{1}{2}|ab| \Rightarrow A^1=0 \Rightarrow A$ has max. or min.

20. Let $f(x)=x\log x+y\log y$

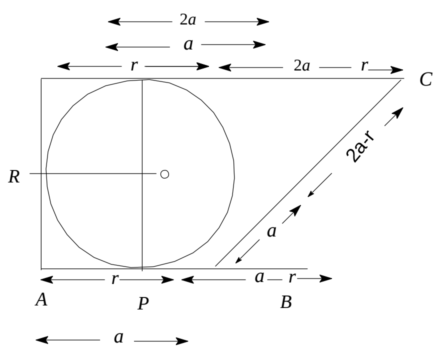
$x+y=1 \Rightarrow y=1-x$

$f(x)=x\log x+(1-x)\log(1-x)$

$f^1(x)=0 \Rightarrow$ f has maxima (or) minima

21. $\frac{1}{r_1}=\frac{1}{8},\frac{1}{r_2}=\frac{1}{12},\frac{1}{r_3}=\frac{1}{24}$

22.



Given $AB \square CD, CD=2AB$. Let $AB=a$, then $CD=2a$.

let radius of the circle be r.

let the circle touches AB=r, BP=a-r, DR=DS=r and $CS=2a-r$

In ΔBEC,

$BC^2=BE^2+EC^2 \Rightarrow (a-r+2a-r)^2=(2r)^2=9a^2+4r^2-12ar$

$4r^2+a^2 \Rightarrow a=\frac{3}{2}r.......(i)$

Also, area (quad ABCD) = 18

$\Rightarrow$ area (quad ABCD) + area $(\Delta BCE)=18$

$=a\times 2r+\frac{1}{2}\times a\times 2r=18=ar=6$

$=\frac{3r^2}{2}=6=r^2=4=r=2$

23. $R=8r=8\left(4r\sin A/_2 \sin B/_2 \sin C/_2\right) \therefore 2\sin A/_2 \sin B/_2 \sin C/_2=\frac{1}{16}$

$\Rightarrow\left(\cos\frac{A-B}{2}-\cos\frac{A+B}{2}\right)\sin\frac{C}{2}=\frac{1}{16}$

$\Rightarrow \sin\frac{C}{2}\left(\frac{1}{2}-\sin\frac{C}{2}\right)=\frac{1}{16}=\sin^2\frac{C}{2}=\frac{1}{4} \Rightarrow \cos c=1-2\sin^2\frac{C}{2}=1-\frac{1}{8}=\frac{7}{8}$

24. $f^1(x)=3(x^2-2(a-2)x+a)$

$f^1(1)=0$
$\Rightarrow a=5$
$$\therefore \frac{f(x)-14}{(x-1)^2}=\frac{x^3-9x^2+15x-7}{(x-1)^2}=x-7=0\Rightarrow x=7$$

25. Maxima of f(x) occured at x = 2 i.e. $\alpha=2$
Minima of g(x) occured at x = -1 i.e. $\beta=-1$
$$\therefore \lim_{x\to 2}\frac{(x-1)(x-2)(x-3)}{(x-2)(x-4)}=\frac{1}{2}$$

PHYSICS

26. y = A sin ωt
$T\to 4A$
$T+T/4\to 4A+A=5A$

27. $y_1=\sin\frac{\pi}{6}\sin\omega t+\cos\frac{\pi}{6}\cos\omega t$
$y_1=\cos\left(\omega t-\frac{\pi}{6}\right)$
$y_2=\sin\frac{\pi}{3}\sin\omega t+\cos\frac{\pi}{3}\cos\omega t$
$=\cos\left(\omega t-\frac{\pi}{3}\right)$

28. $KE_{avg}=\dfrac{\frac{1}{2}m\omega^2A^2}{2}=\frac{1}{4}m4\pi^2n^2A^2$

29. $\frac{d^2x}{dt^2}=-\alpha x$
$a=-\omega^2x$

30. $KE_{avg}=\frac{1}{2}KE_{\max}$

31. $A=\dfrac{Weight\ of\ removed\ mass}{Spring\ cons\tan t}$

32. $n=\frac{1}{8}Hz$
in one second $S=A\sin\left[\frac{2\pi}{T}\times 1\right]=\frac{A}{\sqrt{2}}$
in two seconds $S_1=A\sin\left[90^0\right]=A$
$S_2=S_1-S$
$$\frac{S_1}{S_2}=\frac{A/\sqrt{2}}{\left[A-A/\sqrt{2}\right]}=\frac{1}{\sqrt{2}-1}$$

33.

$$a=\omega^2\theta$$

$$\frac{a}{\theta}=\frac{4\pi^2}{T^2}=\tan\theta$$

$$T^2\,\alpha\,\frac{1}{\tan\theta}$$

$$\frac{T_1^2}{T_2^2}=\frac{\tan\theta_2}{\tan\theta_1}$$

$$=\frac{\tan 60}{\tan 30}$$

$$\frac{T_1^2}{T_2^2}=\frac{3}{1}$$

$$\frac{T_1}{T_2}=\sqrt{3}:1$$

34. $t_{sp}=t_{lp}$

$$(n+1)T_{sp}=n\left(t_{lp}\right)$$

$$(n+1)\sqrt{l_{SP}}=n\sqrt{l_{LP}}$$

35. $T_1^2-T_2^2=\frac{4\pi^2}{g}\left(l_1-l_2\right)$

$$1.75=4\left(l_1-l_2\right)$$

36. $n=\frac{1}{2\pi}\sqrt{\frac{k_{eff}}{m}}\;=\frac{1}{k_{eff}}=\frac{1}{2k}+\frac{1}{k}+\frac{1}{k}$

37. $\omega_1t_1\sim\omega_2t_2=\frac{2\pi}{T_1}t\sim\frac{2\pi}{T_2}t$

$$2\pi\left(3/2\sim 3/3\right)=\pi$$

38. $\mathrm{T}=2\pi\sqrt{\frac{M\left(1+\frac{k^2}{R^2}\right)}{k}}$

39. $T=2\pi\sqrt{\frac{l}{g}}$

$$\frac{T_1}{T_2}=\sqrt{\frac{g_2}{g_1}}$$

$$T_2=2\sqrt{\frac{g_1}{g_2}}$$

$$g_2=\frac{3GM}{(3R)^2}=\frac{g}{3}$$

$$T_2=2\sqrt{3}s$$

40. $k_1=\frac{C}{\ell_1}$

$k_2 = \frac{C}{\ell_2}$

$\frac{k_1}{k_2} = \frac{C\ell_2}{\ell_1 C}\ell_2 = \frac{\ell_2}{n\ell_2} = \frac{1}{n}$

41. At t = 0 KE is maximum

A $t = T/4$ KE is zero

KE oscillates with time period $\frac{T}{2}$

42. $V_{max} = A\omega$

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

at $x = 2A/3$

$v = \omega\sqrt{A^2 - \frac{4A^2}{9}}$

$v = \frac{\omega A\sqrt{5}}{3}$

For new amplitude

at $x = 2A/3$

$v' = 3\times v$

$v' = \omega A\sqrt{5}$

as ω is same

$\omega A\sqrt{5} = \omega\sqrt{A'^2 - \frac{4A^2}{9}} \Rightarrow 5A^2 = A'^2 - \frac{4A^2}{9}$

$A'^2 = \frac{49A^2}{9} \Rightarrow A' = \frac{7A}{3}$

43. $x = a\sin wt$, $y = a\sin 2wt$

$y = 2a\sin wt\cos wt$, $y = 2x\sqrt{1 - \frac{x^2}{a^2}}$

$y = \frac{2}{a}x\sqrt{(a-x)(a+x)}$

44. Cubical expansion $\Delta V = \gamma V\Delta T = 3\alpha V\Delta T$

$= 3\times 23\times 10^{-6}\times\left(\frac{4}{3}\pi(10)^3\right)\times 100$

$\left(r = \frac{d}{2} = 10\ cm\right)$

=28.9 cc

45. 100div=130div

1div=130/100

60div=60x130/100div on new scale

$\therefore$ reading on new scale=78^0+20=98^0

46. $A = \frac{A_0}{2}$ after 10 oscillations

$\because$ After 2 seconds

$$\frac{A_0}{2} = A_0 e^{-\gamma(2)}$$

$$2 = e^{2\gamma}$$

$$l\text{n}\,2 = 2\gamma$$

$$\gamma = \frac{\ln 2}{2}$$

$$\because A = A_0 e^{-\gamma t}$$

$$l\text{n}\frac{A_0}{A} = \gamma t$$

$$l\text{n}1000 = \frac{\ln 2}{2}t$$

$$2\left(\frac{3l\text{n}10}{l\text{n}2}\right) = t$$

$$t = 19.931\,\text{sec}$$

$$t \approx 20\,\text{sec}$$

47. $A = A_0 e^{-0.1t} = \frac{A_0}{2}$

$$ln\,2 = 0.1t$$

$$t = 10\,ln2 = 6.93 \approx 7\text{ sec}$$

48. $\omega^2 A = g$ **,** $T = \frac{2\pi}{\omega}$ $\quad \omega = 2\pi t$

$$\omega^2(0.07) = 10m/s^2,$$

$$4\pi^2 f^2(0.07) = 10m/s^2$$

$$f = \frac{5}{\sqrt{7}}Hz = 1.9Hz$$

49. $T = 2\pi\sqrt{m/k}$

50. $t_{sp} = t_{lp}$

$$(n+1)\sqrt{l_{sp}} = n\sqrt{l_{lp}}$$

$$(n+1)\sqrt{1} = n\sqrt{1.44}$$

CHEMISTRY

51. $\Delta S_{fusion} = \frac{\Delta H_{fusion}}{T_{mp}} = \frac{6.01\times1000}{273} = 22\ KJ\ mole^{-1}$

52. $\Delta G = \Delta H - T\Delta S$

$\Delta H = +Ve \quad \Delta S = -Ve$ then $\Delta G = +Ve$ at all temperature

53. $\Delta G^\circ = -2.303\,RT\log Kp$

$$= -2.303\times8.314\times298\log\left(4.42\times10^4\right)$$

$$= -26.5\ KJ\ mole^{-1}$$

54. $\log Kp = \frac{-\Delta G^\circ}{2.303\,RT} = \frac{-(-115\times1000)}{2.303\times8.314\times298} = 20.16$

55. From first law

$\Delta U = q - w$

$O = q - w\left(for\ isothermal\ \ process \right)$

$q = w = PdV$

$dS = nR.\frac{T.dV}{T}\left(P = \frac{nRT}{V} \right)$

$dS = nR\frac{dV}{V}$

On integration $\Delta S = nR\ln\frac{V_2}{V_1}$

$P_1V_1 = P_2V_2$

$\frac{V_2}{V_1} = \frac{P_1}{P_2}$

$\Delta S = nR\ln\left(\frac{P_1}{P_2} \right)$

56. $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3$

$\Delta S^{\circ}_{\text{Reaction}} = \Delta S^{\circ}_{XY_3} - \frac{1}{2}\Delta S^{\circ}_{X_2} - \frac{3}{2}\Delta S^{\circ}_{Y_2}$

$= 50 - \frac{1}{2}\times 60 - \frac{3}{2}\times 40 = -40JK^{-1}mole^{-1}$

$\Delta G = \Delta H - T\Delta S = 0$ at equilibrium

$T = \frac{\Delta H}{\Delta S} = \frac{-30\times 1000}{40} = 750\ K$

57. $C_V = \frac{\Delta U}{n\Delta T}$ $\quad n = \frac{4.48}{2.24} = 0.2$

$C_V = \frac{12}{0.2\times 15} = 4\ cal$

$C_P = C_V + R = 4 + 2 = 6\ cal$

58. $\Delta H = \Delta U + \Delta n_g RT$

$-50700 = \Delta U + (-5)8.314\times 300$

$\Delta U = -38229\ J$

59. At equilibrium $H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$ 1 atm, 100^0 C

$\Delta S_{Total} = 0$

$\Delta S_{System} + \Delta S_{Surrounding} = 0$

$\Delta S_{System} > 0\ and\ \Delta S_{System} < 0$

60. $\Delta G^{\circ} = -nFE^{\circ}_{cell}$ $\quad \Delta G^{\circ} = -2.303\ RT\ \log K$

61. $\Delta H = \Delta U + \Delta nRT$ $\quad \Delta n = 12 - 15 = -3$

$\Delta H - \Delta U = \Delta nRT$

$= -3\times 8.314\times 298$

$= -7432\ J = -7.43\ KJ$

62. Isothermal process $\Delta T = 0$

$\Delta H = nCp.\Delta T$

$\Delta H = 0$

63. Standard enthalpy of formation zero for $Cl_{2(g)}$ but not $Br_{2(g)}$.

$Cl_{2(g)}$ is natural exist but $Br_{2(l)}$ is exist naturally.

64. $G = H - TS$
$dG = dH - TdS - SdT$
$H = U + PV$
$dH = dV + PdV + VdP$
$dU = TdS - PdV$
$\therefore dG = TdS - PdV + PdV + VdP - TdS - SdT$
$dG = VdP - SdT$

65. The reaction to be spontaneous $\Delta G = -Ve$
$\Delta G = \Delta H - T\Delta S$
If ΔH & ΔS are +Ve
$\Delta H < T\Delta S$ in order to be reaction spontaneous

66. NH_4OH is weak base hence heat of neutralization less than 13.6 K cal.

67. $\Delta H = \Delta U + \Delta n\ RT$
$\Delta n = \frac{1}{2} - 0 = \frac{1}{2}$
Thus $\Delta H > \Delta U$

68. The dissociation energy of CH_4 is 400 K cal
The C – H bond energy $= \frac{400}{4} = 100\ K\ cal$
In ethane 6C – H bonds and one C – C bond present
Hence C – C bond energy $= 670 - 6 \times 100$
$= 70\ K\ cal$

69. $CH_4\left(1\ mole\right) 16gr \rightarrow$ Heat of combustion 880KJ
$3.2\ gr \rightarrow \quad x$
$x = \frac{3.2 \times 880}{16} = 176\ KJ$

70. The enthalpy change does not depends upon no of intermediate states (Hess law)

71. $-\Delta G^\circ = nFE^\circ$
$= 2 \times 96500 \times 1.1 = 212.3\ KJ$
$\Delta G^\circ = \Delta H - T\Delta S$
$\Delta S = \frac{\Delta H - \Delta G}{T} = \frac{-216.7 - \left(-2123\right)}{298}$
$= -0.01476\ KJ\ K^{-1} mole^{-1}$

72. $n = \frac{w}{M.wt} = \frac{64}{32} = 2$
$\Delta S = 2.303\ nR \log \frac{P_1}{P_2}$
$= 2.303 \times 2 \times 8.314 \times \log \frac{1}{0.25}$
$= 2.303 \times 2 \times 8.314 \times \log 4$
$= 23.053\ JK^{-1}$

73. $H_2 + \frac{1}{2}O_2 \rightarrow H_2O_{(l)} \Delta H = -24\ KJ$
$C_6H_{10} + \frac{17}{2}O_2 \rightarrow 6CO_2 + 5H_2O \qquad \Delta H = -3800\ KJ$
$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O \qquad \Delta H = -3920\ KJ$
$C_6H_{10} + H_2 \rightarrow C_6H_{12}$

$\Delta H = -241 - 3800 - (-3920) = -121\ KJ$

74. $C_{(S)} + 2H_{2(g)} \rightarrow CH_{4(g)}$ $\Delta H = -75.83\ KJ$

$\Delta n = (1-2) = -1$

$\Delta H = \Delta U + \Delta nRT$

$\Delta U = \Delta H - \Delta nRT$

$= -75.83 - (-1) \times 8.314 \times 300$

$= -75.83 + 2.49 = -73.34\ KJ$

75. $w = -2.303\ nRT\ \log \frac{V_2}{V_1}$

$= -2.303 \times 2 \times 8.314 \times 298 \times \log \frac{20}{10}$

$= -3434.9\ Jouls$