SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR JEE MAINS | **JEE MAINS MODEL UT-III** | **Date: 29-04-2020**

Time: 3 Hours | **Max. Marks: 300 M**

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.

Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

MATHEMATICS

1. A ray of light coming along the line $3x+4y-5=0$ gets reflected from the line $ax+by-1=0$ and goes along the line $5x-12y-10=0$, then

a) $a=\frac{64}{115},b=\frac{112}{15}$ b) $a=-\frac{64}{115},b=\frac{8}{115}$

c) $a=\frac{64}{115},b=\frac{-8}{115}$ d) $a=-\frac{64}{115},b=\frac{-8}{115}$

2. Find the equation of the sides of an isosceles right angled triangle whose hypotenuse is given by $3x+4y=4$ and the opposite vertex of the hypotenus is (2, 2)

a) $x+7y+12=0,7x+y-16=0$ b) $x-7y+6=0,7x+y-16=0$

c) $x-7y+12=0,7x+y-16=0$ d) $x-7y-12=0,8x+y+1=0$

3. A square of side a lies above the x-axis and has one vertex at the origin. The side passing through the origin makes an angle α (where, $0<\alpha<\pi/4$) with the positive direction of x-axis. The equation of its diagonal not passing through the origin is

a) $y(\cos\alpha-\sin\alpha)-x(\sin\alpha-\cos\alpha)=a$ b) $y(\cos\alpha+\sin\alpha)-x(\sin\alpha-\cos\alpha)=a$

c) $y(\cos\alpha+\sin\alpha)-x(\sin\alpha+\cos\alpha)=a$ d) $y(\cos\alpha+\sin\alpha)+x(\sin\alpha-\cos\alpha)=a$

4. The number of common tangents to the circles $x^2+y^2-4x-6y-12=0$ $x^2+y^2+6x+18y+26=0$ is

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

5. If two vertices of an equilateral triangle are $A(-a,0)$ and $B(a,0)$ where a > 0 and the third vertex C lies above x-axis, then the equation the circumcircle of ΔABC is

a) $3x^2+3y^2-2\sqrt{3}ay=3a^2$ b) $3x^2+3y^2-2ay=3a^2$

c) $x^2+y^2-2ay=a^2$ d) $x^2+y^2-\sqrt{3}ay=a^2$

6. The lines $2x-3y-5=0$ and $3x-4y=7$ are the diameters of a circle of area 154 sq.units, then the equation of the circle is

a) $x^2+y^2+2x-2y-62=0$ b) $x^2+y^2+2x-2y-47=0$

c) $x^2+y^2-2x+2y-47=0$ d) $x^2+y^2-2x+2y-62=0$

7. AB is chord of the circle $x+y=25$ of A and B intersect at C. If (2, 3) is the midpoint of AB then the area of the quadrilateral $OACB$ is

a) $50\sqrt{\frac{4}{3}}$ b) $50\sqrt{\frac{3}{13}}$ c) $50\sqrt{3}$ d) $\frac{50}{\sqrt{3}}$

8. Three circles of radii, a, b, c $(a<b<c)$ touch other externally, if they have x-axis as a common tangent, then

a) a,b,c are in A.P b) $\frac{1}{\sqrt{a}}=\frac{1}{\sqrt{b}}+\frac{1}{\sqrt{c}}$

c) $\sqrt{a},\sqrt{b},\sqrt{c}$ are in A.P d) $\frac{1}{\sqrt{b}}=\frac{1}{\sqrt{a}}+\frac{1}{\sqrt{c}}$

9. **If $\frac{2}{\sqrt{5}}$ is length of the common chord of the circles $x^2+y^2+2x+2y+1=0$ and $x^2+y^2+\alpha x+3y+2=0$, $\alpha\neq 0$, then $\alpha=$**

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

10. **Find the length of the line segment joining the vertex of the parabola $y^2=4ax$ and a point on the parabola, where the line segment makes angle θ to the x-axis**

a) $\frac{2a\cos\theta}{\sin^2\theta}$ b) $\frac{4a\cos\theta}{\sin^2\theta}$ c) $\frac{4a\cos\theta}{3\sin^2\theta}$ d) $\frac{5a\sin\theta}{3\cos^2\theta}$

11. **If the chord of contact of tangents from a point P to the parabola $y^2=12x$ touches the parabola $x^2=24y$, then the locus of P is**

a) straight line b) circle c) parabola d) hyperbola

12. **Let O be the vertex and Q be any point on the parabola $x^2=8y$ .If the point P divides the line segment OQ internally in the ratio 1 : 3 then the locus of P is**

a) $x^2=y$ b) $y^2=x$ c) $y^2=2x$ d) $x^2=2y$

13. **The length of the common tangent to the ellipse $\frac{x^2}{25}+\frac{y^2}{4}=1$ and circle $x^2+y^2=16$ intercepted by the coordinate axes is**

a) 5 b) $2\sqrt{7}$ c) $\frac{7}{\sqrt{3}}$ d) $\frac{14}{\sqrt{3}}$

14. **If θ and ϕ are eccentric angles of the ends of a pair of conjugate diameters of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ then $\theta-\phi$ is equal to**

a) $\pm\frac{\pi}{2}$ b) $\pm\pi$ c) 0 d) $\frac{\pi}{3}$

15. **The equation of the circle passing through foci of the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ and having centre at $(0,3)$ is**

a) $x^2+y^2-6y-7=0$ b) $x^2+y^2-6y+7=0$

c) $x^2+y^2-6y-5=0$ d) $x^2+y^2-6y+5=0$

16. **If two points P and Q on the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ whose centre C be such that CP perpendicular to CQ, a < b then $\frac{1}{CP^2}+\frac{1}{CQ^2}=$**

a) $-\frac{1}{a^2}+\frac{1}{b^2}$ b) $\frac{1}{a^2}+\frac{1}{b^2}$ c) $-\frac{1}{a^2}-\frac{1}{b^2}$ d) $\frac{1}{a^2}-\frac{1}{b^2}$

17. **The diameter of the hyperbola $9x^2-16y^2=14$ which is conjugate to y = 2x is**

a) $y=\frac{8}{9}x$ b) $y=\frac{9}{32}x$ c) $y=\frac{7}{8}x$ d) $y=\frac{12}{5}x$

18. **A tangent to the hyperbola $\frac{x^2}{4}-\frac{y^2}{2}=1$ meets x-axis at P and y-axis at Q. Lines PR and QR are drawn such that OPRQ is a rectangle (where 'O' is the origin). Then R lies on**

a) $\frac{4}{x^2}+\frac{2}{y^2}=1$ b) $\frac{2}{x^2}-\frac{4}{y^2}=1$ c) $\frac{2}{x^2}+\frac{4}{y^2}=1$ d) $\frac{4}{x^2}-\frac{2}{y^2}=1$

19. The region represented by $|x-y|\le 2$ and $|x+y|\le 2$ is bounded by a

a) rhombus of area $8\sqrt{2}$ sq.units b) square of area 16 sq.units

c) square of side length $2\sqrt{2}$ units d) rhombus of side length 2 units

20. The area bounded by the angle bisectors of the lines represented by $x^2-y^2+2y=1$ and the line $x+y=3$ is

a) 2 b) 3 c) 4 d) 6

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers.

Marking scheme: +4 for correct answer, 0 in all other cases.

21. Given a family of lines $a(2x+y+4)+b(x-2y-3)=0$ the number of lines belonging to the family at distance $\sqrt{10}$ from (2, -3) is …….

22. The number of integral points (integral points mean both the coordinates should be integers) exactly in the interior of the triangle with vertices (0, 0), (21, 0), (0, 21) is …..

23. A line drawn through the point P(4, 7) cut the circle $x^2+y^2=9$ at the points A and B then PA.PB is equal to …..

24. If the normal at a point 'P' on the parabola $y^2=12x$ cuts the curve again at 'Q' and if 'R' is the midpoint of PQ then the product of the ordinates of 'P' and 'R' is …….

25. Let a and b respectively be the semi-transverse and semi-conjugate axes of hyperbola whose eccentricity satisfies the equation $9e^2-18e+5=0$. It s(5,0) is a focus and 5x= 9 is the corresponding direction of this hyperbola, then a^2-b^2 is equal to …….

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

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PHYSICS

26. Speed of light (c) acceleration due to gravity (g) and pressure (p) are taken as fundamental units, the dimensions of gravitational constant (G)

a) $c^0 g\, p^{-3}$ b) $c^2 g^3 p^{-2}$ c) $c^0 g^2 p^{-1}$ d) $c^2 g^2 p^{-2}$

27. Dimensions of ohm are same as (here h is planks constant e = electron charge)

a) h/e b) h^2/e c) h/e^2 d) h^2/e^2

28. Suppose refractive index μ is given as $\mu = A+\frac{B}{\lambda^2}$ where A and B are constantans and λ is wavelength, then dimension of B are same as that of

a) wavelength b) volume c) pressure d) area

29. If the value of r is 10.845 ohm and value of current is 3.23amp, the potential is 35.02935 its value of significant number would be

a) 3.5v b) 35.0v c) 35.029v d) 35.030v

30. A clock with an iron pendulum keeps correct time as 20^0C. How much it lose or gain if temperature changes to 40^0C

a) 10.368s b) 10.567s c) 10.638s d) 10.765s

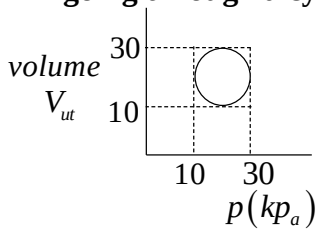
31. The temperature of 2 moles of a gas which was held at constant volume was changed from 100^0C to 120^0C . The change in internal energy was found to be 80J.The heat capacity of gas at constant volume will be equal to

a) 8J/K b) 4J/K c) 40J/K d) 2J/K

32. The efficiency of a cornot cycle is $\frac{1}{6}$. If in reducing the temperature of sink by 65^0K, the efficiency becomes $\frac{1}{3}$. The initial and final temperatures between which the cycle is working are

a) $117^0C, 52^0C$ b) $217^0C, 52^0C$ c) $317^0C, 52^0C$ d) $17^0C, 52^0C$

33. Heat energy observed by a system in going through a cyclic process, shown in figure is



a) $10^{-1}\pi J$ b) $10^4\pi J$ c) $10^2\pi J$ d) $10^{-3}\pi J$

34. A gas at a pressure p_0 is contained in a vessel. If the masses of all the molecules are halved and their velocities doubled, the resulting pressure 'p' would be equal to

a) $4p_0$ b) $2p_0$ c) p_0 d) $p_0/2$

35. The molecules of a given mass of a gas have r.m.s velocity 200m/s at 27^0C and $10^5\ N/m^2$ pressure when the temperature is doubled and pressure is halved, the r.m.s speed of the molecules of the same gas is

a) 200m/s b) 400m/s c) $200\sqrt{2}m/s$ d) $\frac{200}{\sqrt{2}}m/s$

36. The pressure inside a tyre is 4 times that of atmosphere. If the tyre bursts suddenly at temperature 300k, what will be the new temperature?

a) $300\left(4^{\frac{7}{2}}\right)$ b) $300(4)^{\frac{2}{7}}$ c) $300(2)^{\frac{7}{2}}$ d) $300(4)^{-\frac{2}{7}}$

37. The end of two rods of different materials with their thermal conductivities, radii of cross section and lengths in ratio 1 : 2 are maintained at the same temperature differences. If the rate of flow of heat in the large rod is 4cal/s, that in the shorter rod in cal/sec will be

a) 1 b) 2 c) 8 d) 16

38. The temperature of furnace is 2324^0C and the intensity is maximum in its radiation spectrum nearly at $12000A^0$. If the intensity in the spectrum of a star is maximum nearly at $4800A^0$, then calculate the surface temperature of the star

a) 6219.5^0C b) 6200.5^0C c) 6220.5^0C d) 6000^0C

39. A body initially at 80^0C cools to 64^0C in 5 minutes and to 52^0C in 10minutes. What will be the temperature after 15min and what is the temperature of surroundings?

a) -40^0C b) 41^0C c) 42^0C d) 43^0C

40. Two soap bubbles of radii r_1 and r_2 in vacuums coalesce under isothermal conditions. The resulting bubble has radius is such that

a) $R=\frac{(r_1+r_2)}{2}$ b) $R=\frac{r_1r_2}{r_1+r_2}$ c) $R=\sqrt{r_1^2+r_2^2}$ d) $R=r_1+r_2$

41. Two liquid of densities d_1 and d_2 are flowing in identical capillaries under same pressure differences. If t_1 and t_2 are the time taken for the flow of equal quantities of liquid, then the ratio of coefficients of viscosities of liquids must be

a) $\frac{d_1d_2}{t_1t_2}$ b) $\frac{d_1t_1}{d_2t_2}$ c) $\frac{d_1t_2}{d_2t_1}$ d) $\sqrt{\frac{d_1t_1}{d_2t_2}}$

42. If 'A' denotes the area of free surface of liquid and 'h' the depth of an orifice of area of cross section a below the liquid surface, then the velocity v of flow through the orifice is given by

a) $v=\sqrt{2gh}$ b) $v=\sqrt{2gh}\sqrt{\frac{A^2}{A^2-a^2}}$

c) $v=2gh\sqrt{\frac{A}{A-a}}$ d) $v=\sqrt{2gh}\sqrt{\frac{A^2-a^2}{A^2}}$

43. A body of mass 2kg is floating in water with half of the volume submerged. What would be the force required to wholly submerge it into water?

a) 2N b) 8N c) 19.6N d) 4.9N

44. An open vessel containing water in gives a constant acceleration a in the horizontal direction. Then the free surface of water gets sloped with the horizontal at an angle θ, given by

a) $\theta=\tan^{-1}\left(\frac{a}{g}\right)$ b) $\theta=\tan^{-1}\left(\frac{g}{a}\right)$ c) $\mathrm{n}\theta=si\,\mathrm{n}^{-1}\left(\frac{a}{g}\right)$ d) $\theta=\cos^{-1}\left(\frac{g}{a}\right)$

45. The reading of spring balance when a block is suspended format it in air is 60N. This reading is changed to 40N. When the block is submerged in water. The specific gravity of the block must be therefore

a) 3 b) 2 c) 6 d) 3/2

SECTION- II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers.

Marking scheme: +4 for correct answer, 0 in all other cases.

46. Triple point of neon is 24.57k, the temperature on the Fahrenheit θ cali is …… ^{0}F

47. A copper block of mass 2.6kg is heated in furnace is a temperature of 500^{0}C then placed on a large ice block. What is the maximum amount of ice that can melt [S_{copper} = 0.39J/g/k, heat of fusion of water = 335J/g ……kg

48. An air bubble of volume 1.0cm^3 rises from bottom of a lake 40m deep at a temperature of 12^{0}C. Volume of it when it reaches the surface of lake of temperature 35^{0}C.....cm^3

49. Mercury has an angle of contact equal to 140^0 with sodalime glass. A narrow tube of radius 1.00mm made of this glass is dipped in a through containing mercury. By what amount does the mercury dip down in the tube relative to the liquid surface outside? - ..……mm
[S.T of $Hg=0.465$, **density d =** $13.0\times10^3 kg/m^3$, $\cos140=-0.7660$ **]**

50. A physical quantity p is related to four observables a, b, c, d are follows $p=\frac{a^3b^2}{\sqrt{c}.d}$. The percentage error in a, b, c, d are 1%, 3%, 4% and 2% . The percentage error in quantity p …….%

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CHEMISTRY

51. Number of angular nodes for 4d orbitals is

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

52. The pair of ions having same electronic configuration is

a) Cr^{+3}, Fe^{+3} b) Fe^{+3}, Mn^{+2} c) Fe^{+3}, Co^{+3} d) Sc^{+3}, Cr^{+3}

53. The number of orbitals associated with third shell will be
a) 2 b) 4 c) 9 d) 3

54. A substance absorbs electromagnetic radiations of wavelength 12.3nm and then emits another electromagnetic radiation of wavelength 24.6nm. If ratio of number of photons absorbed to number of photons emitted is 2 :1 then ratio of energy absorbed to energy emitted will be
a) 2 : 1 b) 1 : 1 c) 4 : 1 d) 1 : 4

55. The relative strength of inter-ionic intermolecular forces in the deceasing order is
a) ion – dipole > dipole-dipole > ion-ion b) dipole – dipole > ion – dipole > ion – ion
c) ion – ion > ion-dipole > dipole > dipole d) ion-dipole > ion – ion > dipole – dipole

56. The pressure of a 1 : 4 mixture of dyhydrogen and dioxygen enclosed in a vessel is one atmosphere. What would be the partial pressure of dioxygen.
a) $0.8\times10^{5} atm$ b) $0.008 Nm^{-2}$ c) $8\times10^{4} Nm^{-2}$ d) 0.25atm

57. How does the surface tension of a liquid vary with increase in temperature?
a) Remain same b) Decrease c) Increase d) No relation

58. Which of the following is not an example of redox reaction
a) $Cuo + H_2 \rightarrow Cu + H_2O$ b) $2K + F_2 \rightarrow 2KF$
c) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ d) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$

59. In which of the following compounds, an element exhibits two different oxidation states
a) NH_2OH b) NH_4NO_3 c) N_2H_4 d) N_3H

60. If 500ml of a 5M solution is diluted to 1500ml , what will be the molarity of the solution obtained
a) 1.5M b) 1.6M c) 0.017M d) 1.59M

61. The equilibrium constants Kp_1 and Kp_2 for the reactions $x \rightleftharpoons 2y$ and $Z \rightleftharpoons P + Q$, respectively are in the ratio 1 : 9. If the degree of dissociation of 'X' and 'Z' be equal then the ratio of total pressure at these equilibria is
a) 1 : 36 b) 1 : 1 c) 1 : 3 d) 1 : 9

62. Ka_1, Ka_2 and Ka_3 are in the respective ionization constants for the following reactions
$H_2S \rightleftharpoons H^+ + HS^-$, $HS^- \rightleftharpoons H^+ + S^{-2}$, $H_2S \rightleftharpoons 2H^+ + S^{-2}$
The correct relationship between Ka_1, Ka_2, Ka_3 is
a) $Ka_3 = Ka_1 \times Ka_2$ b) $Ka_3 = Ka_1 + Ka_2$ c) $Ka_3 = Ka_1 - Ka_2$ d) $Ka_3 = Ka_1 / Ka_2$

63. Acidity of BF_3 can be explained on the basis of which of the following concepts
a) Arrhenius concept b) Bronsted lowery concept
c) Lewis concept d) Bronsted lowery as well as Lewis concept

64. In an exothermic reaction, heat is evolved and system loses heat to the surroundings for such system
a) q_p will be negative b) ΔH will be negative
c) q_p will be positive d) Both a and b

65. If the combustion of 1 gram of graphite produces 20.7kJ of heat, what will be molar enthalpy change
a) $+2.48\times10^{2} KJ.mol^{-1}$ b) $+2.48\times10^{2} J.mol^{-1}$
c) $-1.7\times10^{2} KJ.mol^{-1}$ d) $-2.48\times10^{2} KJ.mol^{-1}$

66. For the reaction at 298K $2A + B \rightarrow C$ $\Delta H = 400 KJ.mole^{-1}$ and $\Delta S = 0.2 KJ.K^{-1}.mole^{-1}$. At what temperature will the reaction becomes spontaneous considering ΔH and ΔS to be constant over the temperature range?
a) above 2000K b) 1300K c) 1500K d) 1000K

67. Hybridization of 'AS' in ASF_5 is
a) sp^3 b) sp^3d^2 c) sp^3d d) sp^3d^3

68. Bond order increasing order of $N_2^+, N_2, O_2, O_2^{-2}$

a) $O_2^{-2} < N_2^+ < O_2 < N_2$ b) $O_2^{-2} < O_2 < N_2^+ < N_2$

c) $N_2 > N_2^+ > O_2 > O_2^{-2}$ d) $O_2 < O_2^{-2} < N_2^+ < N_2$

69. Orthonitrophenol is more volatile than paranitro phenol due to presence of

a) Intermolecular H – bonding b) Intra molecular H-bond

c) Covalent bonds d) Ionic bonds

70. More dative bonds present in the following compounds is

a) B_2H_6 b) $B_3N_3H_6$ c) NH_4^+ d) Al_2Cl_6

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers.
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71. 18gram glucose is added to 178.2gram water. The vapour pressure (or) partial pressure of water in torr for this aqueous solution is ……
[Total pressure is considered as 760torr]

72. For the reactions $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$ **. If** $Kp = Kc(RT)^X$ **. What is the value of 'X'……**

73. An acid solution containing 2×10^{-3} **moles of** A^{+n} **ions uses up** 1.2×10^{-3} **moles of** MnO_4^- **for the oxidation of** A^{+n} **to** AO_3^- **then the value of 'n' is ……..**

74. Number of lone pairs of central atom in ClF_3 **molecule is ……**

75. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10dm^3 to a volume of 100dm^3 at 27^0C **……**

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SR MPC JEE MAIN | **JEE MAINS MODEL UT-III** | **Date: 29-04-2020**

Time: 3 Hours | **Max. Marks: 300 M**

KEY SHEET

MATHEMATICS

1) **C**	2) **C**	3) **B**	4) **C**	5) **A**	6) **C**	7) **B**	8) **B**	9) **A**	10) **B**
11) **D**	12) **D**	13) **D**	14) **A**	15) **A**	16) **D**	17) **B**	18) **D**	19) **C**	20) **A**
21) **1**	22) **190**	23) **56**	24) **-36**	25) **-7**					

PHYSICS

26) **C**	27) **C**	28) **D**	29) **B**	30) **A**	31) **B**	32) **A**	33) **C**	34) **B**	35) **C**
36) **D**	37) **A**	38) **A**	39) **D**	40) **C**	41) **B**	42) **D**	43) **C**	44) **A**	45) **A**
46) **-415.44**	47) **1.5**	48) **5.26**	49) **5.34**	50) **13.00**					

CHEMISTRY

51) **C**	52) **B**	53) **C**	54) **C**	55) **C**	56) **C**	57) **B**	58) **D**	59) **B**	60) **B**
61) **A**	62) **A**	63) **C**	64) **D**	65) **D**	66) **A**	67) **C**	68) **B**	69) **B**	70) **B**
71) **752.4**	72) **1**	73) **2**	74) **2**	75) **38.3**					

HINTS & SOLUTIONS

MATHEMATICS

1. Equation of bisectors of the given lines are

$$\left(\frac{3x+4y-5}{\sqrt{3^2+4^2}}\right)=\pm\left(\frac{5x-12y-10}{\sqrt{5^2+(-12)^2}}\right)$$

$$(39x+52y-65)=\pm(25x-60y-50)$$

$$14x+112y-15=0,\ 64x-8y-115=0$$

$$\frac{14}{15}x+\frac{112y}{15}-1=0,\ \frac{64}{115}x-\frac{8}{115}y-1=0$$

$$a=\frac{64}{115},\ b=\frac{-8}{115}$$

2. Let ABC be an isosceles right angled triangle at A with AB = AC. $\angle ABC=\angle ACB=45^0$.
Now, we have determine the angle between AC and BC

The slope of line BC i.e. $3x+4y=4$ is $m_2=-\frac{3}{4}$

The slope of the line AC is $m_1=m$

$$\tan\theta=\frac{|m_1-m_2|}{1+m_1m_2}\Rightarrow\tan 45^0=\left|\frac{m-\left(-\frac{3}{4}\right)}{1+m\left(-\frac{3}{4}\right)}\right|$$

$$1=\left|\frac{m+\frac{3}{4}}{1-\frac{3m}{4}}\right|\Rightarrow\pm1=\frac{4m+3}{4-3m}$$

$$\Rightarrow m=\frac{1}{7},-7$$

Hence equation of the line AB and line AC

$$y-2=\frac{1}{2}(x-2)\text{ and }y-2=-7(x-2)$$

$$7y-14=x-2 \qquad y-2=-7x+14$$

$$x-7y+12=0 \qquad 7x+y-16=0$$

3. Slope of the diagonal $=\tan\left(\frac{3\pi}{4}+\alpha\right)$

$$=\frac{-1+\tan\alpha}{1+\tan\alpha}$$

$$=\frac{\sin\alpha-\cos\alpha}{\sin\alpha+\cos\alpha}$$

The equation is $\frac{y-a\sin\alpha}{x-a\cos\alpha}=\frac{\sin\alpha-\cos\alpha}{\sin\alpha+\cos\alpha}$

$$\Rightarrow y(\sin\alpha+\cos\alpha)-x(\sin\alpha-\cos\alpha)=a$$

4. Given $x^2+y^2-4x-6y-12=0$

$$x^2+y^2+6x+18y+26=0$$

$$C_1(2,3),\ \ r_1=5,\ C_2(-3,-9),\ r_2=8$$

$C_1C_2 = \sqrt{(2+3)^2+(3+9)^2} = \sqrt{5^2+12^2} = 13$

$r_1 + r_2 = 5+8 = 13$

$C_1C_2 = r_1 + r_2$

Thus, both circles touch each other externally,

Hence, there are three common tangents.

5. In an equilateral triangle circumcentre lies on the centroid of a triangle

$\therefore$ centre of circle = centroid of triangle

$$= \left(0, \frac{a}{\sqrt{3}}\right), r = \frac{2a}{\sqrt{3}}$$

$$\therefore \ (x-0)^2 + \left(y - \frac{a}{\sqrt{3}}\right)^2 = \left(\frac{2a}{\sqrt{3}}\right)^2$$

$3x^2 + 3y^2 + a^2 - 2a\sqrt{3}y = 4a^2$

$3x^2 + 3y^2 - 2a\sqrt{3}y = 3a^2$

6. The centre of the required circle lies at the intersection of $2x-3y-5=0 \, and \, 3x-4y-7=0$

centre (1, -1)

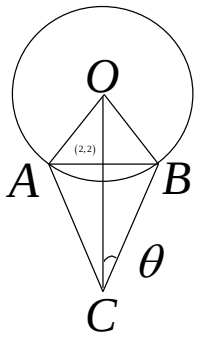
By hypothesis we have $\pi r^2 = 154$

$r = 7$

Hence, the equation of the required circle is $(x-1)^2 + (y+1)^2 = 7^2$

$x^2 + y^2 - 2x + 2y - 47 = 0$

7.



Area of quadrilateral OACB

Area = OB.BC

$= 5^2 \cot\theta$

$= 50\sqrt{\frac{3}{13}}$

9. $S - S' = 0, C = (-1,-1)$

$(2-\alpha)x - y - 1 = 0$

$$d = \frac{|\alpha - 2|}{\sqrt{(\alpha-2)^2+1}}$$

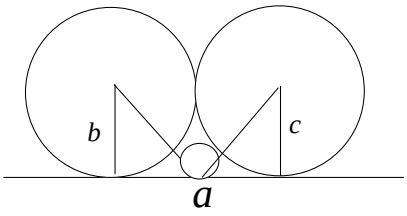
Length of the chord = $2\sqrt{r^2 - d^2}$

$$\frac{2}{\sqrt{5}} = 2\sqrt{1 - \frac{(\alpha-2)^2}{(\alpha-2)^2+1}}$$

$$\frac{1}{\sqrt{5}} = \frac{1}{\sqrt{(\alpha-2)^2+1}}$$

$(\alpha-2)^2+1=5 \Rightarrow \alpha-2=\pm 2,\ \alpha=4,\ \alpha\neq 0$

8.



$\sqrt{(a+b)^2-(a-b)^2}+\sqrt{(a+c)^2-(a-c)^2}$

$=\sqrt{(a+c)^2-(b-c)^2}$

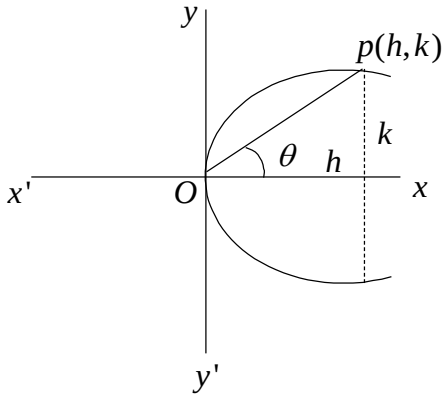
$\sqrt{ab}+\sqrt{ac}=\sqrt{bc}$

$\frac{1}{\sqrt{c}}+\frac{1}{\sqrt{b}}=\frac{1}{\sqrt{a}}$

10. Let any point (h, k) will satisfy

$y^2=4ax$ i.e. $k^2=4ah$ …….i)

Let a line OP makes an angle θ from the x-axis



In ΔOPA, $\sin\theta=\frac{PA}{OP}=\frac{k}{l}\Rightarrow k=l\sin\theta$

And, $\cos\theta=\frac{OA}{OP}=\frac{h}{l}\Rightarrow h=l\cos\theta$

From eq (i), $l^2\sin^2\theta=4a\times l\cos\theta$

$l=\frac{4a\cos\theta}{\sin^2\theta}$

11. Let there be a point $P(x_1,y_1)$

So, the chord of contact is $yy_1=6(x+x_1)$

$\Rightarrow x=\frac{yy_1}{6}-x_1$ …….i)

On comparing eq. (i) by $x=my+c$

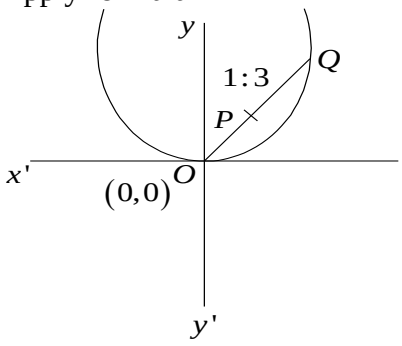
We get $m=\frac{y_1}{6},\ c=-x_1$

Now $x=my+c$ touches $x^2=24y$, if $c=\frac{6}{m}$

$-x_1=\frac{6}{y_1/6}\Rightarrow -x_1y_1=36$

12. Any point on the parabola $x^2 = 8y$ is $(4t, 2t)$ point P divides the line segment joining of $O(0,0)$ and $Q(4t, 2t^2)$ in the ratio 1 : 3

Apply formula



$$h = \frac{1\times 4t + 3\times 0}{4} \Rightarrow h = t$$

$$k = \frac{1\times 2t^2 + 3\times 0}{4} \Rightarrow k = \frac{t^2}{2}$$

$$\Rightarrow k = \frac{1}{2}h^2$$

$$2k = h^2$$

$$2y = x^2$$

13. The tangent to $\frac{x^2}{25} + \frac{y^2}{4} = 1$ is $\frac{x}{5}\cos\theta + \frac{y}{2}\sin\theta = 1$. If it is also tangent to the circle, then

$$16 = \frac{1}{\frac{\cos^2\theta}{25} + \frac{\sin^2\theta}{4}} = \frac{100}{4 + 21\sin^2\theta}$$

$$\Rightarrow \sin^2\theta = \frac{3}{28},\ \cos^2\theta = \frac{25}{28}$$

If the tangents meets the axes at A and B then $A = \left(\frac{5}{\cos\theta}, 0\right),\ B = \left(0, \frac{2}{\sin\theta}\right)$

$$AB^2 = \frac{25}{\cos^2\theta} + \frac{4}{\sin^2\theta} = 28 + \frac{4}{3}.28 = \frac{196}{3}$$

$$AB = \frac{14}{\sqrt{3}}$$

14. Let $y = m_1 x$ and $y = m_2 x$ be a pair of conjugate diameters of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

Let $P(a\cos\theta, b\sin\theta), Q(a\cos\phi, b\sin\phi)$ be ends of these two diameters. Then

$$m_1 m_2 = -\frac{b^2}{a^2}$$

$$\frac{b\sin\theta - 0}{a\cos\theta - 0} \times \frac{b\sin\phi - 0}{a\cos\phi - 0} = -\frac{b^2}{a^2}$$

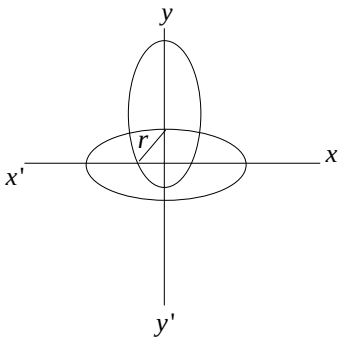
$$\sin\theta.\sin\phi = -\cos\theta.\cos\phi$$

$$\cos(\theta - \phi) = 0$$

$$\theta - \phi = \pm\frac{\pi}{2}$$

15. Given $\frac{x^2}{16} + \frac{y^2}{9} = 1$, here $a = 4, b = 3, c = \frac{\sqrt{7}}{4}$

$\therefore$ *foci is* $(\pm ae,0)=\left(\pm 4\frac{\sqrt{7}}{4},0\right)=\left(\pm\sqrt{7},0\right)$



Radius of the circle $r=\sqrt{(ae)^2+b^2}=\sqrt{7+9}=4$

Now, $(x-0)^2+(y-3)^2=16$

$x^2+y^2-6y-7=0$

16. Let $CP=r_1$ and $CQ=r_2$

CP is inclined to transverse axis at an angle θ

So that P is $(r_1\cos\theta, r_1\sin\theta)$, P lies on hyperbola

$\Rightarrow r_1^2\left(\frac{\sin^2\theta}{a^2}-\frac{\cos^2\theta}{b^2}\right)=1$

Replacing θ by $90+\theta$, we get $r_1^2\left(\frac{\sin^2\theta}{a^2}-\frac{\cos^2\theta}{b^2}\right)$

$\Rightarrow \frac{1}{r_1^2}+\frac{1}{r_2^2}=\frac{\cos^2\theta}{a^2}-\frac{\sin^2\theta}{b^2}+\frac{\sin^2\theta}{a^2}-\frac{\cos^2\theta}{b^2}$

$=\frac{1}{a^2}-\frac{1}{b^2}$

17. Let $y=m_1x, y=m_2x$ be two conjugate diameters of a hyperbola

Then $m_1m_2=\frac{b^2}{a^2}$

Here, the hyperbola is $\frac{x^2}{16}-\frac{y^2}{9}=1$ and diameters is y = 2x

$m_1=2, a^2=16, b^2=9, m_2=?$

$2m_2=\frac{9}{16}\Rightarrow m_2=\frac{9}{32}$

The required diameter is $y=\frac{9}{32}x$

18. Given $\frac{x^2}{4}-\frac{y^2}{2}=1$

The equation of tangent is

$\frac{x}{a}\sec\theta-\frac{y}{b}\tan\theta=1$

$\frac{x}{2}\sec\theta-\frac{y}{\sqrt{2}}\tan\theta=1$

So the coordinates of P and Q are

$P(2\cos\theta,0), Q\left(0,-\sqrt{2}\cot\theta\right)$

Let coordinates of R are (h, k)

$h = 2\cos\theta, k = -\sqrt{2}\cot\theta$

$\frac{k}{h} = -\frac{\sqrt{2}}{2\sin\theta} \Rightarrow \sin\theta = \frac{-\sqrt{2}h}{2k}$

$\sin^2\theta = \frac{2h^2}{4k^2} \Rightarrow 1-\cos^2\theta = \frac{2h^2}{4k^2}$

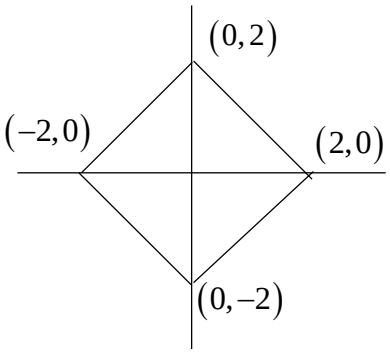
$1-\frac{h^2}{4} = \frac{2h^2}{4k^2}$

$\frac{2h^2}{4k^2} + \frac{h^2}{4} = 1$

$\frac{h^2}{4}\left(\frac{2}{k^2}+1\right) = 1$

$\frac{4}{h^2} - \frac{2}{k^2} = 1$

19. $|x-y| \le 2$ and $|x+y| \le 2$



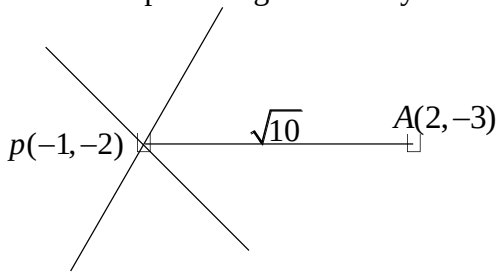
Square whose side is $2\sqrt{2}$

20 $P.I = \left(-\frac{g}{a}, -\frac{f}{b}\right) = (0,1) = (x_1, y_1)$

Angular bisectors are $xy - x = 0$

Area = $\frac{(lx_1 + my_1 + n)^2\sqrt{h^2-ab}}{|am^2 - 2hlm + bl^2|} = 1$

21. concurrent point of given family of lines is P(1, -2)



$PA = \sqrt{10}$. Therefore, the number of lines which are at a distance of $\sqrt{10}$ from A is 1

22. Required integral points, satisfy the condition

$0 < x + y < 21$, where $x, y \in N$

If x = 1, then $y = 1,2,3,....19$

If x = 2, then $y = 1,2,3,....18$

If $x = 19$ then y = 1

Required integral points = 19+18+……+1=190

23. $PA.PB = |s_{11}|$

$|s_{11}| = |16 + 49 - 9| = 56$

24. a = 3, $P = \left(at^2, 2at\right)$

$Q = \left[a\left(-t - \frac{2}{t}\right)^2, 2a\left(-t - \frac{2}{t}\right)\right]$

R = midpoint of PQ

Product of ordinates of P and R

$= -4a^2 = -4(9) = -36$

25. $9e^2 - 18e + 5 = 0 \Rightarrow e = \frac{5}{3}$

$1 + \frac{b^2}{a^2} = e^2 = \frac{25}{9}$

Also distance between foci and directrix is

$\left(ae - \frac{a}{e}\right) = 5 - \frac{9}{5}$

$a\left(\frac{5}{3} - \frac{3}{5}\right) = \frac{16}{5} \Rightarrow a = 3$

$1 + \frac{b^2}{9} = e^2 \pm \frac{25}{9}$

$\Rightarrow b^2 = 16$

$a^2 - b^2 = 9 - 16 = -7$

PHYSICS

26. $G = e^x g^y p^z$

$\therefore M^z\ L^{x+y-z} T^{-x-2y-2z}$

27. $\frac{h}{e^2} = \frac{M L^2 T^{-1}}{\left[AT\right]^2} = ML^2T^{-3}A^{-2}$

28. use principle of hemogenity.

$\mu = \frac{C}{V}$ = no unit and dimension less

$\mu = A,\ \lambda = \beta$

$\mu = \frac{\beta}{\lambda^2}$, B = m^2

29. use significant figure rules.

30. $\Delta T = \frac{1}{2} \propto \left(t_2 - t_1\right) \times 86,400$

31. $dU = \mu c_v dT$

Heat capacity = $nc_v = 4J / K$

32. $\frac{1}{6} = \frac{T_1 - T_2}{T_1}$

$\frac{1}{3} = \frac{T_1 - T_2 + 65}{T_1}$

33. $W = area\ of\ loop = \pi r^2$

34. $p_0 = \frac{1}{3}\frac{mn}{v}\left(v_1^2 + v_2^2 + v_3^2 ..... v_n^2\right)$

$$p = \frac{1}{3}\frac{m}{2}\frac{n}{v}\left((2v_1)^2 + (2v_2)^2 + (2v_3)^2 + ...(2v_n)^2\right)$$

$$= \frac{4p_0}{2} = 2p_0$$

35. $V_{rms} \propto \sqrt{T}$

36. $T^{\gamma}P^{1-\gamma} = k,\ \frac{T_1}{T_2} = \left(\frac{p_1}{p_2}\right)^{\frac{1-\gamma}{\gamma}}$

37. $Q = \frac{KATt}{2}, \frac{Q}{t} = \frac{KA(T_1 - T_2)}{L}$

38. $\lambda mT = cons\tan t$

39. $\frac{\Delta T}{t} = k\left[\frac{T_1 + T_2}{2} - T_0\right]$

40. When bubbles coalesce in vacuum there is no change in temperature. So surface energy does not change. Surface area remaining unchanged. $4\pi r_1^2 + 4\pi r_2^2 = 4\pi r^2$

41. Poiseuille principle

$$\eta = \frac{\pi p r^4}{8lv}$$

v = rate of flow of volume of liquid

$$v = \frac{v}{t}$$

$$\eta \propto \frac{1}{v} \propto \frac{t}{v}$$

$$\eta \propto \frac{t}{\frac{m}{d}} \propto \frac{dt}{m}$$

$$\eta \propto dt$$

$$\frac{\eta_1}{\eta_2} = \frac{d_1 t_1}{d_2 t_2}$$

42. Bernoulis law

$$\frac{p}{\rho} + gh + \frac{v_1^2}{2} = \frac{p}{\rho} + 0 + \frac{v_2^2}{2}$$

v_1 = velocity of all surface of liquid

v_2 = velocity of efflux

$$AV_1 = aV_2\ ;\ V_1 = \frac{aV_2}{A_1}$$

$$gh + \frac{1}{2}\frac{aV_2}{A} = \frac{V_2^2}{2}$$

$$V = \sqrt{2gh}\sqrt{\frac{A^2 - a^2}{A^2}}$$

43. upthrust = $\frac{v}{2}1000 \times g$ *newton*

$$\mu g = \frac{v}{2} \times 1000 \times g$$

$$v = \frac{4}{10000} m^3$$

The force required to wholly submerge the body into water = $\frac{v}{2}\times d\times g$

44. $h = h_2 - h_1$

$\tan\theta = \frac{h}{x} = \frac{a}{g}$

$\therefore \tan\theta = \frac{a}{g}$

45. S.G = $\frac{weight\ in\ water}{loss\ of\ wt\ of\ liquid} = \frac{60}{60-20} = 3$

46. $\frac{K-273.15}{5} = \frac{F-32}{9}$

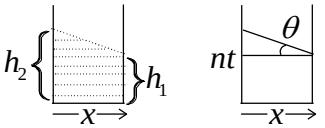
$F = (K_1 - 273.15)\times\frac{9}{5} + 32$ = -415.44^{0}F

47. $Q_1 = mst,\ Q_1 = Q_2$

$Q_2 = mL, m^1 = \frac{mst}{L} = 1.5kg$

48. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}, V_2 = \frac{P_1V_1T_2}{T_1P_2}$

49.



$T = \frac{hrdg}{2\cos\theta}$

$h = \frac{2.T.\cos\theta}{rdg}$

50. $\therefore \frac{\Delta p}{p}\left[3\frac{\Delta a}{a} + 2\frac{\Delta b}{b} + \frac{1}{2}\frac{\Delta c}{c} + \frac{\Delta d}{d}\right]\times 100$

CHEMISTRY

51. Number of angular nodes for 4d orbital is '2'
'd' orbital l = 2

52. $Fe^{+3}(Z=26) = [Ar]3d^5,\ Mn^{+2}(Z=25) = [Ar]3d^5$

53. Number of orbitals in 3rd shell (n = 3) = n^2
$n^2 = (3)^2 = 9$

54. $\frac{E_{absorbed} = n_{ab}\times\frac{1240}{12.3}}{E_{absorbed} = n_{em}\times\frac{1240}{24.6}} = \frac{2}{1}\times\frac{24.6}{12.3} = 4:1$

55. Conceptual $(ion-ion > ion-dipole > dipole-dipole)$

56. Number of moles of H_2 and O_2 be 1 and 4 mole fraction of $O_2 = \frac{4}{5}$

$Po_2 = M.F\ of\ O_2\times total\ pressure$

$Po_2 = \frac{4}{5}\times 1 = 0.8atm = 0.8\times10^5 Nm^{-2} = 8\times10^4 Nm^{-2}$

57. Surface tension $\propto \frac{1}{temperature}$

58. $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + 2HCl$ is a displacement reaction not a redox reaction

59. NH_4^+, NO_3^-

In NH_4^+, 'N' o.s = -3

In NO_3^-, 'N' o.s = +5

60. $M_1V_1 = M_2V_2 \Rightarrow 5\times 500 = M_2 \times 1500$

$M_2 = \frac{5\times 500}{1500} = 1.66M$

61. $X \rightleftharpoons 2Y$

1 0

$(1-x)$ $2x$

$Kp_1 = \frac{(2x)^2}{(1-x)}\left[\frac{P_1}{1+x}\right]^1$

$Z \rightleftharpoons P+Q$

1 0 0

(1-x) x x

$Kp_2 = \frac{x^2}{(1-x)}\left[\frac{p_2}{1+x}\right]^1$

$Kp_2 = \frac{x^2}{(1-x)}\left[\frac{p_2}{1+x}\right]^1$

$\frac{4\times p_1}{p_2} = \frac{1}{9} \Rightarrow \frac{p_1}{p_2} = \frac{1}{36}$

62. For the reaction

$H_2S \rightleftharpoons H^+ + HS^-$

$Ka_1 = \frac{[H^+][HS^-]}{[H_2S]}$

For the reaction $HS^- \rightleftharpoons H^+ + S^{-2}$

$Ka_2 = \frac{[H^+][S^{-2}]}{[HS^-]}$

When the above two reactions are added their equilibrium constants are multiplied thus

$Ka_3 = \frac{[H^+][S^{-2}]}{[H_2S]}$

Hence $Ka_3 = Ka_1 \times Ka_2$

13. According to lewis concept

14. For exothermic reaction $q_p = -ve$, $\Delta H = -ve$

15. Molar enthalpy change for graphite (ΔH) = enthalpy change for 1g x molar mass of carbon

$= -20.7\times 12 = -2.48\times 10^2 KJ.mol^{-1}$

Since the sign of $\Delta H = -ve$ *because it is exothermic*

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

Assuming the reaction at equilibrium $\Delta G = 0$

$T = \dfrac{\Delta H}{\Delta S} = \dfrac{400kJ\ mol^{-1}}{0.2\,KJ.K^{-1}.mol^{-1}}$

$T = 2000K$

For the reaction to be spontaneous ΔG must be negative hence for the given reaction to be spontaneous 'T' should be greater than 2000K

17. $\text{H.S} = \dfrac{1}{2}\times\left(v.e + M.S.a\right) \Rightarrow \dfrac{1}{2}\times\left(5+5\right) = \dfrac{1}{2}\times 10 = 5$

So, sp^3d hybridization

18. $O_2^{-2} \Rightarrow B.O = \dfrac{10-8}{2} = \dfrac{2}{2} = 1$

$O_2 \Rightarrow B.O = \dfrac{10-6}{2} = \dfrac{4}{2} = 2$

$N_2^{+} \Rightarrow B.O = \dfrac{9-4}{2} = \dfrac{5}{2} = 2.5$

$N_2 \Rightarrow B.O = \dfrac{10-4}{2} = \dfrac{6}{2} = 3$

19. Intramolecular H-bonds present in ortho nitrophenol.
So that it is more volatile

20. $a) B_2H_6 \rightarrow No\ dative\ bonds$

$b) B_2N_3H_6 \rightarrow 3\ dative\ bonds$

c) $NH_4^{+} \rightarrow 1\ dative bond$

d) $\underset{(\text{dimer of } AlCl_3)}{Al_2Cl_6} \rightarrow 2\ dative bond$

21. $P_{solvent} = P_{total}.X_{solvent}, \quad nH_2O = \dfrac{178.2}{18} = 9.9$

$XH_2O\ (or)\ X_{solvent} = \dfrac{9.9}{10}, \quad n_{glucose} = \dfrac{18}{180} = 0.1$

$X_{solvent} = 0.99$

$P_{solvent} = 760\times 0.99 = 752.4\ torr$

22. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

$\Delta n = 2-1 = 1, \quad \Delta n = x$

$Kp = KC\left(RT\right)^{\Delta n} \Rightarrow Kp = Kc\left(RT\right)^{1}$

$\Delta n = x = 1$

23. $\left(5-n\right)MnO_4^{-} + 5A^{n-1} \rightarrow \left(5-n\right)Mn^{+2} + 5AO_3^{-}$

$\dfrac{\left(5-n\right)}{5} = \dfrac{1.2\times 10^{-3}}{2\times 10^{-3}} \Rightarrow \left(5-n\right) = 1.2\times 5$

$\Rightarrow \left(5-n\right) = 3 \Rightarrow n = 2$

24. $ClF_3 \quad H.S = \dfrac{1}{2}\times\left(7+3\right) = 5$

$T.P = 5$

$B.P = 3$

$l.P = 2$

$l.P = 2$

25. For an ideal gas for isothermal reversible process

$\Delta S = 2.303nR\log\left(\dfrac{V_2}{V_1}\right)$

$$= 2.303 \times 2 \times 8.314 \times \log\left(\frac{100}{10}\right) = 38.3 J.mol^{-1}.k^{-1}$$

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