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Sri Chaitanya IIT Academy., India.

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR - HYD

Sec: Jr. Super60-I(Incoming) **Date:27-05-17**

Time: 07:30 AM to 10:30 AM **WTM-05** **Max.Marks:360**

Name of the Student: _____ **I.D.NO:** | | | | | | | | |

IMPORTANT INSTRUCTIONS:

1) Immediately fill in the particulars on this page of the Test Booklet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.
2) The test is of 3 hours duration.
3) The Test Booklet consists of 90 questions. The maximum marks are 360.
4) There are three parts in the question paper A, B, C consisting of **Mathematics, Chemistry** and **Physics** having 30 questions in each part of equal weightage. Each question is allotted 4 (four) marks for correct response.
5) Candidates will be awarded marks as stated above in instruction No. 4 for correct response of each question. (1/4) (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
6) There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 5 above.

SYLLABUS

MATHS:

Complete Sequence & Series (30%); Measurement of Angles, Trigonometric Ratios & Identities, T- Ratio of Compound angle, multiple, sub-multiple angles (Excluding graph, periodicity and extreme values) & some special angles (70%)

CHEMISTRY:

Gaseous State: Measurable properties of gases; Gas Laws - Ideal gas equation, Dalton's Law of Partial pressure: Graham's Law of diffusion, Kinetic theory of gases; Distribution of molecular velocities; Kinetic energy, Non ideality of gases; vander Waal's equation of state, Compressibility factor; liquification of gases & Critical state (70%)

Methods of expressing concentration of a solution - % by weight, Molarity, Molality, Normality, Mole fraction, ppm, % labelling of oleum, volume strength of hydrogen peroxide, stoichiometry-II: Titrations, Volumetric analysis: neutralisation titrations - simple titrations, double titrations and back titrations, Redox titrations: oxalic-acid vs KMnO4, Mohr's salt vs KMnO4 ; iodometry , iodimetry, Degree of hardness of water (30%)

PHYSICS:

Integration & its application, Complete vectors (Introduction to physical quantities like Position Vectors, displacement Vectors, Velocity Vector, acceleration Vector and mathematical relation between them), EXCLUDE ((Derivation of $v = u + at, s = ut + \frac{1}{2}at^2, v^2 - u^2 = 2as$) Problems on acceleration due to gravity, Lammi's Theorem, Projectile motion and relative motion, Graphs

Basic Mathematics: Algebra(logarithms, quadratic equations and expressions),Trigonometry, Co-ordinate geometry(Straight lines),Graphs: Straightline, Parabola, Rectangular hyperbola, Circle, sine, cosine, exponential + Include expression for areas of standard geometrical figures like - cone, ellipse etc. Limits, Continuity & differentiation. Application of differentiation - Maxima, Minima, Integration & its application (100%)

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MATHS

1. If $\sin\theta, \tan\theta, \cos\theta$ are in G.P then

$4\sin^2\theta - 3\sin^4\theta + \sin^6\theta + 2 =$

1) 3 2) 1

3) -3 4) -1

2. If $\sqrt{\frac{1+\sin A}{1-\sin A}} - \frac{\sin A}{\cos A} = \frac{1}{\cos A}$ then A lies in the quadrant

1) I, III 2) II, III

3) III, IV 4) IV, I

3. Let $f(\theta) = \frac{1}{1+(\cot\theta)^x}$ and $s = \sum_{\theta=1}^{89^0} f(\theta)$

then 2s-8=

1) 9 2) 18

3) 81 4) 0

4. If $\frac{\sin^4 x}{3} + \frac{\cos^4 x}{2} = \frac{1}{5}$ then $\tan^2 x =$

1) $\frac{2}{3}$ 2) $\frac{3}{2}$

3) $\frac{1}{3}$ 4) $\frac{1}{5}$

5. If $\left(4\cos^2 9^0 - 3\right)\left(4\cos^2 27^0 - 3\right) = \tan A$

then $2\sin A\cos A =$

1) $\cos 8A$ 2) $\cos 4A$

3) $\cos 3A$ 4) $\cos A$

6. $4\cos\frac{2\pi}{7}\cos\frac{\pi}{7} - 1 =$

1) $2\cos\frac{2\pi}{7}$ 2) $\cos\frac{2\pi}{7}$

3) $2\sin\frac{2\pi}{7}$ 4) $\sin\frac{2\pi}{7}$

7. If $A = \sin 45^0 + \cos 45^0, B = \sin 44^0 + \cos 44^0$

then

1) $A > B$ 2) $A < B$

3) $A = B$ 4) $A^2 = B$

8. In ΔABC, If $\sin A\cos B = \frac{1}{4}$ and

$3\tan A = \tan B$ then $\cot^2 A =$

1) 2 2) 3

3) 4 4) 5

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9. If $\cos 25^0 + \sin 25^0 = P$ then $\cos 50^0 =$

1) $\sqrt{2-p^2}$ 2) $-\sqrt{2-p^2}$

3) $p\sqrt{2-p^2}$ 4) $-p\sqrt{2-p^2}$

10. If $\frac{3-\tan^2\frac{\pi}{7}}{1-\tan^2\frac{\pi}{7}} = K\cos\frac{\pi}{7}$ then $k =$

1) 1 2) 2

3) 3 4) 4

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

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

1) 2 2) $2+4\cos x$

3) $2-4\cos x$ 4) $2+4\sin x$

12. $\sin^2 12^0 + \sin^2 21^0 + \sin^2 39^0 + \sin^2 48^0 - \sin^2 9^0 - \sin^2 18^0$

1) 1 2) -1

3) $\frac{3}{2}$ 4) 3

13. In ΔABC, $3\sin A + 4\cos B = 6$, and $3\cos A + 4\sin B = 1$ then $\angle C =$

1) 30^0 2) 120^0

3) 90^0 4) 60^0

14. Let $f:(-1,1) \to R$ be such that $f(\cos 4\theta) = \frac{2}{2-\sec^2\theta}$ for $\theta \in \left(0, \frac{\pi}{4}\right) \cup \left(\frac{\pi}{4}, \frac{\pi}{2}\right)$ then $f\left(\frac{1}{3}\right) =$

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

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

15. If

$\tan x + \tan 2x + \tan 3x = \tan x \tan 2x \tan 3x$
then, $|\sin 3x + \cos 3x| =$

1) -1 2) 0

3) 1 4) 2

16. The value of

$\tan\frac{\pi}{16}+\tan\frac{5\pi}{16}+\tan\frac{9\pi}{16}+\tan\frac{13\pi}{16} =$

1) -4 2) 4

3) 0 4) 8

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17. Let $a_1, a_2 \ldots\ldots a_{10}$ be in AP and $h_1, h_2 \ldots\ldots h_{10}$ be in H.P if $a_1 = h_1 = 2, a_{10} = h_{10} = 3$ then $a_{11}h_{14}$ is

1) 6 2) 5

3) 4 4) 12

18. Let $S_n = an^2 + bn$ be sum of n terms of a series of real numbers with T_n as its n^{th} term. If the ratio $\frac{T_{4n}}{T_n}$ is independent of n, then the value of $\frac{S_8}{S_9}$ is

1) $\frac{9}{8}$ 2) $\frac{5}{4}$

3) $\frac{4}{5}$ 4) $\frac{8}{9}$

19. $1^2 - 2^2 + 3^2 - 4^2 + 5^2 - 6^2 + \ldots\ldots 19^2 - 20^2 =$

1) -150 2) 270

3) +240 4) -210

20. Let the sum of the series $\frac{2}{1^2+1^2+1^2} + \frac{4}{2^2+2^2+1^2} + \frac{6}{3^4+3^2+1} + \ldots\ldots +$ 19 terms is

1) $\frac{19}{20}$ 2) $\frac{38}{381}$

3) $\frac{380}{381}$ 4) $\frac{570}{571}$

21. 20^{th} term of the series 1+3+6+10------

1) 210 2) 200

3) 190 4) 250

22. The product of 9 G.M's inserted between the numbers $\frac{2}{9}$ and $\frac{9}{2}$ is

1) 9 2) 1

3) $\frac{9^9}{2^9}$ 4) $\frac{2^9}{9^9}$

23. The number of common terms between the sequences given by 1, 4, 7, 10..... 298 and 2, 4, 6, 8 ..... 300 is

1) 49 2) 50

3) 48 4) 100

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24. The value of $\frac{\cos^2 1^0 - \cos^2 2^0}{2\sin 3^0 \sin 1^0}$ is equal to

1) 1 2) $\frac{1}{3}$

3) $\frac{1}{2}$ 4) $\frac{1}{5}$

25. If $\tan\beta = 2\sin\alpha\sin\gamma\cos ec(\alpha+\gamma)$ then $\cot\alpha, \cot\beta, \cot\gamma$ are is

1) A.P 2) G.P

3) H.P 4) A.G.P

26. If $\theta \in \left(\frac{\pi}{4}, \frac{\pi}{2}\right)$ and $\sum_{n=1}^{\infty} \frac{1}{\tan^n\theta} = \sin\theta + \cos\theta$ then the value of $\tan\theta$ is

1) $\sqrt{3}$ 2) $\sqrt{2}+1$

3) $2+\sqrt{3}$ 4) $\sqrt{2}$

27. $\frac{\left(1+\tan 22^0\right)\left(1+\tan 23^0\right)}{\left(1-\cot 33^0\right)\left(1-\cot 12^0\right)} =$

1) $\tan 35^0$ 2) $\frac{1}{2}$

3) 1 4) 2

28. If $\tan\theta_1 = \lambda\cot\theta_2$ then $\frac{\cos(\theta_1-\theta_2)}{\cos(\theta_1+\theta_2)} =$

1) $\frac{1+\lambda}{1-\lambda}$ 2) $\frac{1-\lambda}{1+\lambda}$

3) $\frac{\lambda+1}{\lambda-1}$ 4) $\frac{\lambda-1}{\lambda+1}$

29. $\sin 20^0\left(4+\sec 20^0\right) =$

1) $\frac{1}{2}$ 2) $\sqrt{2}$

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

30. If

$4\cos 36^0 + \cot\left(7\frac{1}{2}^0\right) = \sqrt{n_1} + \sqrt{n_2} + \sqrt{n_3} + \sqrt{n_4} + \sqrt{n_5} + \sqrt{n_6}$

Then $\sum_{i=1}^{6} n_i^2$

1) 91 2) 20

3) 9 4) 0

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CHEMISTRY

31. 180 mL of a hydrocarbon effuses in 15 minute. Under similar conditions of P & T, 120mL of SO_2 takes 20 minute to effuse. If molecular mass of SO_2 is 64, then calculate molecular mass of hydrocarbon.

1) 16 2) 32

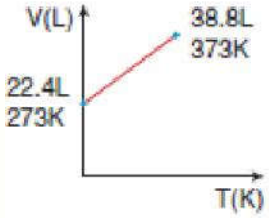
3) 64 4) 4

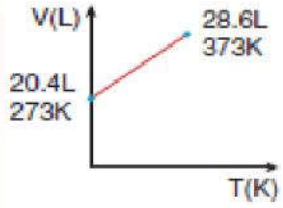
32. Calculate the temperature at which CO_2 has the same rms speed of that of O_2 at STP

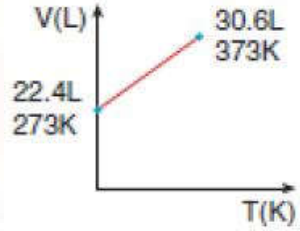
1) 375.38^0C 2) 102.38^0C

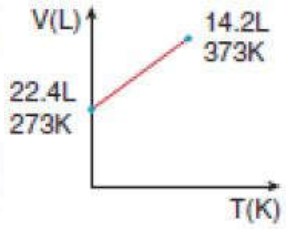
3) 202.38^0C 4) 475.38^0C

33. Which of the following V, T plots represents the behavior of 1 mol of an ideal gas at one atmosphere?

1) 

2) 

3) 

4) 

34. Equal weights of methane and oxygen are mixed in an empty container at 25^0C. The fraction of the total pressure exerted by oxygen is

1) $\frac{1}{3}$ 2) $\frac{1}{2}$

3) $\frac{2}{3}$ 4) $\frac{1}{3}\times\frac{273}{298}$

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35. At STP, a container has 1 mol of Ar, 2 mol of CO_2, 3 mol of O_2, and 4 mol of N_2. Without changing the total pressure if 1 mol of O_2 is removed, the partial pressure of O_2

1) is changed by about 26%

2) is halved

3) is unchanged

4) changed by 33%

36. A gas will approach ideal behavior at

1) low temperature and low pressure

2) low temperature and high pressure

3) high temperature and low pressure

4) high temperature and high pressure

37. A vessel of volume $0.02\,m^3$ contains a mixture of hydrogen and helium at 20^0C and 2 atm pressure. The mass of mixture is 5g. Find the ratio of mass of hydrogen to that of helium in the mixture (atomic weight of He = 4 u)

1) 1:2 2) 1:3

3) 2:3 4) 3:2

38. The compressibility factor for a real gas at high pressure is

1) 1 2) $1+Pb/RT$

3) $1-Pb/RT$ 4) $1+RT/Pb$

39. Pressure remaining the same, the volume of given mass of an ideal gas increases for every degree centigrade rise in temperature by definite fraction of its volume at

1) 0^0C

2) its critical temperature

3) absolute zero

4) its Boyle temperature

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40. The rms velocity of hydrogen is $\sqrt{7}$ times the rms velocity of nitrogen. If T is temperature of the gas, then

1) $T(H_2) = T(N_2)$

2) $T(H_2) > T(N_2)$

3) $T(H_2) < T(N_2)$

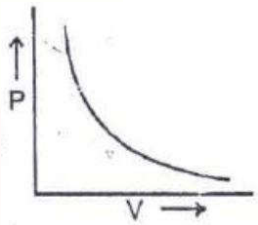
4) $T(H_2) = \sqrt{7}T(N_2)$

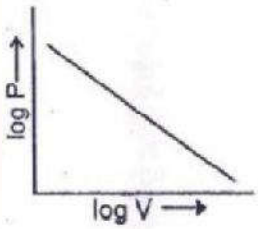
41. The values of van der Waals constant a for the gases $O_2, N_2, NH_3,$ and CH_4 are 1.360, 1.390, 4.170, and $2.253\,L^2\,\text{atm}\,mol^{-2}$, respectively. The gas that can most easily be liquefied is

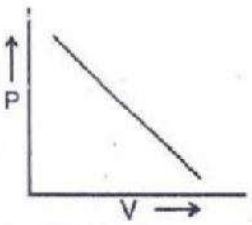
1) O_2 2) N_2

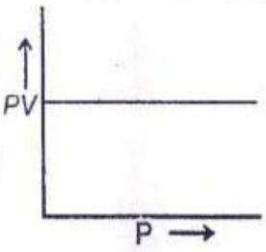
3) NH_3 4) CH_4

42. Which curve does not represent Boyle's law?

1) 

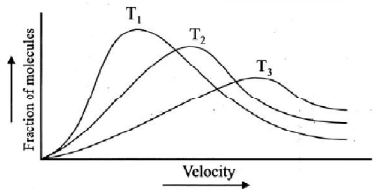
2) 

3) 

4) 

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43. In the graph shown in Fig. of Maxwell Boltzmann distribution of Molecular velocities



Which of the following is the correct order of temperature?

1) $T_1 < T_2 < T_3$

2) $T_3 < T_2 < T_1$

3) $T_2 < T_1 < T_3$

4) $T_1 = T_2 = T_3$

44. A vessel of irregular shape has a volume 'V'. It is first evacuated and coupled with a vessel of 4L capacity at $35^0 C$ and 10 atm pressure. If the final pressure in both the vessels is 3atm, calculate the volume V.

1) 9.3 L 2) 8 L

3) 6L 4) 8.3 L

45. A gas is enclosed in a vessel of volume 1000 mL at a pressure of 72.6 cm of Hg. it is being evacuated with the help of a piston pump, which expels 10% gas in each stroke. What will be the pressure after the second stroke?

1) 50cm 2) 56.6cm

3) 58.8cm 4) 66.6cm

46. A flask containing 250mg of air at $27^0 C$ is heated till 25% of air by mass is expelled from it. What is the final temperature of the flask

1) 127K 2) $127^0 C$

3) $254K$ 4) $254^0 C$

47. 100mL of 0.2N HCl solution is added to 100 mL of 0.2N $AgNO_3$ solution. The molarity of nitrate ions in the resulting mixture will be

1) 0.5 M 2) 0.05 M

3) 0.1M 4) 0.2M

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48. $KMnO_4$ reacts with KI in basic medium to from I_2 and MnO_2. When 250 mL of 0.1 M KI solution is mixed with 250 mL of 0.02M $KMnO_4$ in basic medium, what is the number of moles I_2 formed?

1) 0.0075 2) 0.005

3) 0.01 4) 0.015

49. If insulin contains 3.4% sulphur, what will be the minimum molecular mass of insulin?

1) 941.17 2) 640.175

3) 438.172 4) 245.170

50. Normality of a solution in which 1.20×10^{24} OH^- are present in 800 mL solution.

1)1.5N 2) 2.5N

3) 3.5N 4) 4.5N

51. Calculate the % of free SO_3 in oleum(a solution of SO_3 in H_2SO_4) that is labeled 109% H_2SO_4 by mass.

1) 98% 2) 109%

3) 40% 4) 80%

52. The normality of 30 volumes H_2O_2 solution is

1) 3.57 2) 7.53

3) 5.36 4) 5.73

53. Mass percentage (w/w) of ethylene glycol $\left(HOCH_2-CH_2OH\right)$ in a aqueous solution is 20, then mole fraction of solute is

1) 0.5 2) 0.067

3) 0.1 4) 0.4

54. 20mL of x M HCl is added to 10mL of 0.1M $NaHCO_3$ solution and a further 5mL of 0.2M Na_2CO_3 solution is required to neutralize the remaining acid, using methyl orange indicator. The value of x is

1) 0.167M 2) 0.133M

3) 0.15M 4) 0.2M

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55. Density of 2.05M solution of acetic acid in water is 1.02g/mL. The molality of same solution is

1) $1.14 mol\,kg^{-1}$

2) $3.28 mol\,kg^{-1}$

3) $2.28 mol\,kg^{-1}$

4) $0.44 mol\,kg^{-1}$

56. The density of neon will be highest at

1) STP 2) $0^0 C, 2\,atm$

3) $273^0 C, 1\,atm$ 4) $273^0 C, 2\,atm$

57. 0.5 mole of each of H_2, SO_2 and CH_4 are kept in a container. A hole was made in the container. After 3 hours, the order of partial pressures in the container will be

1) $P_{SO_2} > P_{CH_4} > P_{H_2}$

2) $P_{H_2} > P_{SO_2} > P_{CH_4}$

3) $P_{CH_4} > P_{SO_2} > P_{H_2}$

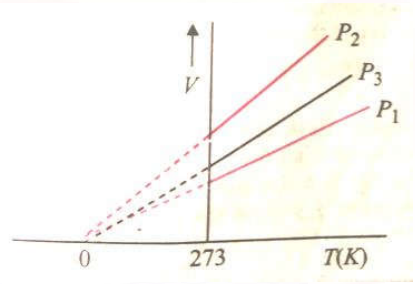
4) $P_{H_2} > P_{CH_4} > P_{SO_2}$

58. The temperature at which RMS velocity of SO_2 molecules is half that of He molecules at 300 K is

1) 150K 2) 600K

3) 900K 4) 1200K

59. The volume temperature graphs of a given mass of an ideal gas at constant pressure are shown below. What is the correct order of pressure?



1) $P_1 > P_3 > P_2$ 2) $P_1 > P_2 > P_3$

3) $P_2 > P_3 > P_1$ 4) $P_2 > P_1 > P_3$

60. For H_2 gas, the compressibility factor, $Z = PV / n$ RT is

1) equal to 1

2) equal to 0

3) always greater than 1

4) initially less than 1 and then becomes greater than 1 at high pressures

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PHYSICS

61. If $y = 3e^x - 5x^3 + 3$, then slope of the function at $x = 0$ is

1) 1 2)2

3) 3 4)0

62. If a particle moves from point P (2, 3, 5) to point Q (3, 4, 5). Its displacement vector be

1) $\hat{i} + \hat{j} + 10\hat{k}$ 2) $\hat{i} + \hat{j} + 5\hat{k}$

3) $\hat{i} + \hat{j}$ 4) $2\hat{i} + 4\hat{j} + 6\hat{k}$

63. If $A = 3\hat{i} + 4\hat{j}$ and $B = 7\hat{i} + 24\hat{j}$, the vector having the same magnitude as B and parallel to A is

1) $5\hat{i} + 20\hat{j}$ 2) $15\hat{i} + 10\hat{j}$

3) $20\hat{i} + 15\hat{j}$ 4) $15\hat{i} + 20\hat{j}$

64. Position vector of a particle varies with time t as $\vec{r} = t\hat{i} + \frac{t^2}{2}\hat{j} + t\hat{k}$ magnitude of component of its acceleration along its velocity at t=1s is

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

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

65. The tangent to the curve $y = 3x^2 - 5$ at the point (2,7) makes all angle θ with +ve x-axis, then

1) $\tan\theta = 7$ 2) $\tan\theta = 10$

3) $\tan\theta = 11$ 4) $\tan\theta = 12$

66. How many minimum number of coplanar vectors having different magnitudes can be added to give zero resultant

1) 2 2) 3

3) 4 4) 5

67. The expression $\left(\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j}\right)$ is a

1) Unit vector

2) Null vector

3) Vector of magnitude $\sqrt{2}$

4) None of these

68. Suppose that $\vec{a} = 2\hat{i} + \hat{j}, \vec{b} = \hat{i} - 4\hat{j} + \hat{k}, \vec{c} = \hat{j} + \hat{k}$ then $\vec{a} \times (\vec{b} \times \vec{c})$ *equals to*

1) $-3\hat{i} - \hat{j} + \hat{k}$

2) $\hat{i} - 2\hat{j} + 3\hat{k}$

3) $3\hat{i} + \hat{j} - \hat{k}$

4) $-\hat{i} - 2\hat{j} + \hat{k}$

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69. If $\vec{a},\vec{b}$ are any two vectors then which of the following relation is correct

1) $|\vec{a}-\vec{b}|\le|\vec{a}|-|\vec{b}|$ 2) $|\vec{a}-\vec{b}|>|\vec{a}|-|\vec{b}|$

3) $|\vec{a}-\vec{b}|=|\vec{a}|-|\vec{b}|$ 4) $|\vec{a}-\vec{b}|\ge|\vec{a}|-|\vec{b}|$

70. A vector is represented by $3\hat{i}+\hat{j}+2\hat{k}$. Its length in XY plane is

1) 2 2) $\sqrt{14}$

3) $\sqrt{10}$ 4) $\sqrt{5}$

71. Resultant of two forces 1 N and P N is equal to 1 N and perpendicular to it. Magnitude of P and its direction w.r.t 1 N is

1) $\sqrt{2}\,N,45^0$ 2) $\sqrt{2}\,N,135^0$

3) $1N135^0$ 4) $\frac{1}{\sqrt{2}}N,135^0$

72. Resultant of $\vec{P}$ and $\vec{Q}$ is $\vec{R}$, If the magnitude of $\vec{Q}$ is doubled, the new resultant is perpendicular to $\vec{P}$, then magnitude of $\vec{R}$ is

1) P 2) Q

3) $\frac{P}{2}$ 4) $\sqrt{P^2+4Q^2}$

73. Difference of two units vector is a unit vector, magnitude their resultant is

1) 1 2) $\sqrt{2}$

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

74. Magnitude of resultant of two vectors $(P+Q)$ *and* $(P-Q)$ *is* $\sqrt{3P^2+Q^2}$ angle between them is

1) 90^0 2) 30^0

3) 45^0 4) 60^0

75. If two vectors $5\hat{i}+10\hat{j}$ represent adjacent sides of a parallelogram, then the ratio of the length of their diagonals is

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

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

76. Two forces P+Q and P-Q makes an angle 2α with each other , their resultant makes an angle θ with the bisector of the angle between them , then

1) $P\tan\alpha=Q\tan\theta$

2) $P\tan\theta=Q\tan\alpha$

3) $\frac{P}{Q}=\tan\theta\tan\alpha$

4) $\frac{P}{Q}=\cot\theta\cot\alpha$

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77. Two forces 2p, p act on a particle if the first is doubled and second one is increased by 12 N , the direction of the resultant is unaltered .value of p is

1) 2 2) 10

3)12 4)20

78. If $y = a\sin x^2$,where a=constant $\frac{dy}{dx} =$

1) $2ax\sin x^2$ 2) $2ax\cos x^2$

3) $2ax\sin x$ 4) $2ax\cos x$

79. If $\left|\vec{A}_1\right| = 2,\ \left|\vec{A}_2\right| = 3\ and \left|\vec{A}_1 + \vec{A}_2\right| = 2$ then $\left|\left(\vec{A}_1 + 2\vec{A}_2\right).\left(3\vec{A}_1 - 4\vec{A}_2\right)\right|$

1) 60 2) 61

3) 62 4) 64

80. If a unit vector is represented by $0.5\hat{i} + 0.8\hat{j} + c\hat{k}$, then the value of '$c$' is

1) 1 2) $\sqrt{0.11}$

3) $\sqrt{0.01}$ 4) $\sqrt{0.39}$

81. Maximum value of the function y(x)= sinx+cosx

1) 1 2) $\sqrt{2}$

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

82. Maximum and minimum magnitudes of the resultant of two vectors of magnitudes P and Q are in the ratio $3:1$. Which of the following relations is true

1) $P = 2Q$ 2) $P = Q$

3) $PQ = 1$ 4) None of these

83. If vectors P, Q and R have magnitude 5, 12 and 13 units and $\vec{P} + \vec{Q} = \vec{R}$, the angle between Q and R is

1) $\cos^{-1}\frac{5}{12}$ 2) $\cos^{-1}\frac{5}{13}$

3) $\cos^{-1}\frac{12}{13}$ 4) $\cos^{-1}\frac{7}{13}$

84. If two vectors $2\hat{i} + 3\hat{j} - \hat{k}$ and $-4\hat{i} - 6\hat{j} - \lambda\hat{k}$ are parallel to each other then value of λ be

1) 0 2) 2

3) 3 4) 4

85. The angle between the vectors $\vec{A}$ and $\vec{B}$ is θ. The value of the triple product $\vec{A}.(\vec{B}\times\vec{A})$ is

1) A^2B 2) Zero

3) $A^2B\sin\theta$ 4) $A^2B\cos\theta$

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86. What is the angle between $(\vec{P}+\vec{Q})$ and $(\vec{P}\times\vec{Q})$

1) 0 2) $\frac{\pi}{2}$

3) $\frac{\pi}{4}$ 4) π

87. There are two force vectors, one of 5 *N* and other of 12 *N* at what angle the two vectors be added to get resultant vector of 17 *N*, 7 *N* and 13 *N* respectively

1) 0°, 180° AND 90°

2) 0°, 90° AND 180°

3) 0°, 90° and 90°

4) 180°, 0° and 90°

88. A particle has displacement of 12 *m* towards east and 5 *m* towards north then 6 *m* vertically upward. The sum of these displacements is

1) 12

2) 10.04 *m*

3) 14.31 *m*

4) None of these

89. If the resultant of the two forces has a magnitude smaller than the magnitude of larger force, the two forces must be

1) Different both in magnitude and direction

2) Mutually perpendicular to one another

3) Possess extremely small magnitude

4) Point in opposite directions

90. Let the angle between two nonzero vectors $\vec{A}$ and $\vec{B}$ be 120° and resultant be $\vec{C}$

1) $\vec{C}$ must be equal to $|\vec{A}-\vec{B}|$

2) $\vec{C}$ must be less than $|\vec{A}-\vec{B}|$

3) $\vec{C}$ must be greater than $|\vec{A}-\vec{B}|$

4) $\vec{C}$ may be equal to $|\vec{A}-\vec{B}|$

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Sri Chaitanya IIT Academy., India.

A.P, TELANGANA, KARNATAKA, TAMILNADU, MAHARASHTRA, DELHI, RANCHI

A right Choice for the Real Aspirant

ICON CENTRAL OFFICE, MADHAPUR - HYD

Sec: Jr. Super60-I **Date: 27-05-17**

Time: 07:30AM to10:30AM **WTM-05** **Max. Marks: 360**

KEY SHEET

MATHS

1	2	2	4	3	3	4	2	5	1	6	1
7	1	8	2	9	3	10	4	11	4	12	1
13	1	14	1	15	3	16	2	17	4	18	3
19	4	20	3	21	1	22	2	23	2	24	3
25	1	26	1	27	3	28	1	29	3	30	1

CHEMISTRY

31	1	32	2	33	3	34	1	35	1	36	3
37	1	38	2	39	1	40	3	41	3	42	3
43	1	44	1	45	3	46	2	47	3	48	1
49	1	50	2	51	3	52	3	53	2	54	3
55	3	56	2	57	1	58	4	59	1	60	3

PHYSICS

61	4	62	3	63	4	64	1	65	2	66	2
67	1	68	2	69	4	70	3	71	2	72	2
73	2	74	1	75	1	76	2	77	3	78	1
79	4	80	2	81	2	82	1	83	3	84	2
85	2	86	2	87	1	88	3	89	4	90	3

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SOLUTIONS

MATHS

1. Sol: $4\tan^2\theta = \sin\theta\cos\theta \Rightarrow \sin\theta = \cos^3\theta$

   Given expression can be written is

   $\sin^6\theta - 3\sin^2\theta + 3\sin^2\theta - 1 + 3 + \sin^2\theta$

   $\left(\sin^2\theta - 1\right)^3 + 3 + \sin^2\theta = -\cos^6\theta + 3 + \sin^2\theta$

2. Sol: conceptual

3. Sol: $f(\theta) = \dfrac{(\sin\theta)^x}{(\sin\theta)^x + (\cos\theta)^x}$

   But $f(\theta) + f\left(\dfrac{\pi}{2} - \theta\right) = 1$

   $s = \sum_{\theta=1}^{89^0} f(\theta) = f(1) + f(2)_____ + f\left(89^0\right)$

   $= \left(1 + 1 + ----44 times\right) + \dfrac{1}{2} = \dfrac{89}{2}$

4. sol: $2\sin^4 x + 3\left(1 - \sin^2 x\right)^2 = \dfrac{6}{5}$

   $5\sin^4 x - 6\sin^2 x + 3 = \dfrac{6}{5}$

   $25\sin^4 x - 30\sin^2 x + 9 = 0$

5. Sol: use $\cos 3x = 4\cos^3 x - 3\cos x$

6. Sol: $4\cos\dfrac{2\pi}{7}\cos\dfrac{\pi}{7} - 1 = \dfrac{4\sin\dfrac{\pi}{7}\cos\dfrac{\pi}{7}\cos\dfrac{2\pi}{7}}{\sin\dfrac{\pi}{7}} - 1$

   $= \dfrac{\sin\dfrac{4\pi}{7}}{\sin\dfrac{\pi}{7}} - 1 = \dfrac{\sin\dfrac{3\pi}{7}}{\sin\dfrac{\pi}{7}} - 1$

   $= 3 - 4\sin^2\dfrac{\pi}{7} - 1$

   $= 2\cos\dfrac{2\pi}{7}$

7. SOL: $A = \sqrt{2}$

   $B = \sqrt{2}\sin\left(45^0 + 44^0\right) = \sqrt{2}\sin 89^0 \quad \therefore A > B$

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8. Sol: $\cos A \sin B = \frac{3}{4}$

$\therefore \sin(A+B) = 1$

$C = 90^0, B = 90^0 - A$

9. Sol: $\sin 50^0 = P^2 - 1$

$\cos 50^0 = \sqrt{1-\sin^2 50^0} = p\sqrt{2-p^2}$

10. Sol: Let $\theta = \frac{\pi}{7}$

$3\theta = \pi - 4\theta$

$\sin 3\theta = \sin 4\theta$

$3 - 4\sin^2\theta = 4\cos\theta(2\cos^2\theta - 1)$

$\Rightarrow 8\cos^2\theta - 4\cos\theta = 4\cos^2\theta - 1$

$\Rightarrow 4\cos\theta = \frac{4\cos^2\theta - 1}{2\cos^2\theta - 1} = \frac{3-\tan^2\theta}{1-\tan^2\theta}$

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

$2\left(1 + \cos\left(\frac{\pi}{2} - x\right)\right) + \sqrt{4\sin^2 x}$

$2 + 2\sin x + 2\sin x$

12. Sol: Use $\sin^2\theta + \sin^2(60-\theta) + \sin^2(60+\theta) = \frac{3}{2}$

13. Sol: conceptual

14. Sol: $\cos 4\theta = \frac{1}{3}$

$\cos 2\theta = \pm\sqrt{\frac{2}{3}} \left(\because \theta \in \left(0, \frac{\pi}{4}\right)\right) \cup \left(\frac{\pi}{4}, \frac{\pi}{2}\right)$

$f\left(\frac{1}{3}\right) = \frac{2}{2-\sec^2\theta} = 1 + \frac{1}{\cos 2\theta}$

15. Sol: $x = \frac{n\pi}{6}, n \in z$

$\therefore x = \frac{\pi}{3}, \frac{2\pi}{3} - - -$

16. Sol: Let $\tan\frac{\pi}{16} = \theta \Rightarrow \frac{\pi}{2} = 8\theta$

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$\tan 13\theta = \tan\left(\frac{\pi}{2}+5\theta\right) = -\cot 5\theta$

$\tan 9\theta = \tan\left(\frac{\pi}{2}+\theta\right) = -\cot\theta$

$\therefore$ Given each term

$\tan\theta + \tan 5\theta - \cot\theta - \cot 5\theta$

$= -(\cot\theta - \tan\theta) - (\cot 5\theta - \tan 5\theta)$

$= -2\cot 2\theta - 2\cot 10\theta$

$= -2\cot 2\theta - 2\cot(90+2\theta)$

$= -2(\cot 2\theta - \tan 2\theta)$

$= 4\cot 4\theta$

18. Using Tn = Sn - Sn-1 = 2an + b - a

will be independent of n if b - a = 0

Sn = an(n+1)

19. (1+2)(1-2) + (3+4)(3-4).....+ (19+20)(19-20)

= - (3 + 7 + ... + 39) = -10/2(3 + 39) = -210

20. $T_n = \frac{2}{n^4+n^2+1} = \frac{2n}{\left(n^2-n+1\right)\left(n^4+n^2+1\right)} = \frac{1}{n^2-n+1} - \frac{1}{n^2+n+1}$

By telescoping,

$S_n = \sum T_n = 1 - \frac{1}{n^2+n+1} = \frac{n(n+1)}{n(n+1)+1} \Rightarrow S_{19} = \frac{19\times 20}{381}$

21. n^{th} term of the given series $\frac{n(n+1)}{2}$

22. Property of GM

23. 1, 4, 7.....298 T n= 3n - 2, n = 1 to 100

2, 4, 6.....300 Tm = 2m, m = 1 to 150

For 3n - 2 = 2m n must be even

n = 2, 4, 6, ... 100

24. $\frac{\sin^2 2^0 - \sin^2 1^0}{2\sin 3^0 \sin 1^0} = \frac{\sin 3^0 \sin 1^0}{2\sin 3^0 \sin 1^0} = \frac{1}{2}$

25. $\tan\beta = \frac{2\sin\alpha\sin\gamma}{\sin(\alpha+\gamma)} \Rightarrow 2\cot\beta = \frac{\sin(\alpha+\gamma)}{\sin\alpha\sin\gamma} = \cot\alpha + \cot\gamma$

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26. $\theta \in \left(\frac{\pi}{4}, \frac{\pi}{2}\right) \Rightarrow \tan\theta > 1 \Rightarrow 0 < \frac{1}{\tan\theta} < 1$

$$\therefore \sum_{n=1}^{\infty} \frac{1}{\tan^n \theta} = \frac{\left(\frac{1}{\tan\theta}\right)}{1-\frac{1}{\tan\theta}} = \frac{1}{\tan\theta - 1} = \frac{\cos\theta}{\sin\theta - \cos\theta}$$

$$\therefore \sum_{n=1}^{\infty} \frac{1}{\tan^n \theta} = \sin\theta + \cos\theta \Rightarrow \frac{\cos\theta}{\sin\theta - \cos\theta} = \sin\theta + \cos\theta$$

$$\cos\theta = \sin^2\theta - \cos^2\theta$$

$$2\cos^2\theta + \cos\theta - 1 = 0$$

$$\cos\theta = \frac{1}{2} \ . \Rightarrow \tan\theta = \sqrt{3}$$

27. $A + B = 45^0 \Rightarrow (1+\tan A)(1+\tan B) = 2$ and $(1-\cot A)(1-\cot B) = 2$

28. $\tan\theta_1 \tan\theta_2 = \lambda$

$$\frac{\sin\theta_1 \sin\theta_2}{\cos\theta_1 \cos\theta_2} = \frac{\lambda}{1}$$

$$\Rightarrow \frac{\cos\theta_1 \cos\theta_2 + \sin\theta_1 \sin\theta_2}{\cos\theta_1 \cos\theta_2 - \sin\theta_1 \sin\theta_2} = \frac{1+\lambda}{1-\lambda}$$

$$\frac{\cos(\theta_1 - \theta_2)}{\cos(\theta_1 + \theta_2)} = \frac{1+\lambda}{1-\lambda}$$

29. $$\frac{\sin 20^0}{\cos 20^0}\left(4\cos 20^0 + 1\right) = \frac{2\sin 40^0 + \sin 20^0}{\cos 20^0}$$

$$= \frac{2\sin\left(60 - 20^0\right) + \sin 20^0}{\cos 20^0}$$

$$= \sqrt{3}$$

30. $\cot 7\frac{1}{2}^0 = \sqrt{2} + \sqrt{3} + \sqrt{4} + \sqrt{6}$

$$4\cos 36^0 = \sqrt{3} + 1$$

$$\therefore 4\cos 36^0 + \cot 7\frac{1}{2}^0 = \sqrt{6} + \sqrt{5} + \sqrt{4} + \sqrt{3} + \sqrt{2} + \sqrt{1}$$

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CHEMISTRY

31. According to Graham's law

$$\frac{r_{HC}}{r_{SO_2}} = \frac{V_{HC}t_{HC}}{V_{SO_2}/t_{SO_2}} = \sqrt{\frac{M_{SO_2}}{M_{HC}}}$$

$$\frac{180/15}{120/20} = \sqrt{\frac{64}{M_{HC}}} \Rightarrow M_{HC} = 16$$

32. $$(u_{rms})_{O_2} = \sqrt{\left[\frac{3RT}{M}\right]} = \sqrt{\left[\frac{3R\times 273}{32}\right]}(at\ STP)$$

For $CO_2, (u_{rms})_{CO_2} = \sqrt{\left[\frac{3RT}{44}\right]}$

But, $(u_{rms})_{O_2} = (u_{rms})_{CO_2}$

$$\therefore \frac{3R\times 273}{32} = \frac{3RT}{44}$$

$$\Rightarrow T = 375.38K = 102.38^0 C$$

33. ideal gas will obey all gas laws. So, as per charles' law,

(C) Ideal gas will obey all gas laws. So, as per Charles' law,

$$V_2 = \left(\frac{T_2}{T_1}\right)\times V_1 = \left(\frac{373}{273}\right)\times 22.4 = 30.6\ \text{L}$$

34.

(A) $$\frac{n_{\text{methane}}}{n_{O_2}} = \frac{w_{CH_4}}{w_{O_2}} \times \frac{M_{O_2}}{M_{CH_4}} = \frac{32}{16} = 2$$

According to Dalton's law of partial pressure $p_{CH_4} = x_{CH_4} \times p_{\text{total}}$

As $x_{CH_4} = \frac{2}{3}$ and $x_{O_2} = \frac{1}{3}$, so $p_{O_2} = x_{O_2} \times P_{\text{total}} = \frac{1}{3}$ part

35. (A)

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$$p_i = p_f \Rightarrow \frac{10RT}{V_i} = \frac{9RT}{V_f}$$

$$V_f = \frac{9V_i}{10}$$

$$p_{O_2 i} = \frac{3RT}{V_i} \quad \text{and} \quad p_{O_2 f} = \frac{2RT}{V_f}$$

$$\frac{p_{O_2 i} - p_{O_2 f}}{p_{O_2 i}} = \frac{3 - \frac{20}{9}}{3} = 26\%$$

36. Real gases approach ideal gas behavior at high temperature and low pressure.

37.

$$\text{(A) } n = \frac{2 \times 20}{293 \times 0.0821} = 1.67 = \frac{5}{3}$$

$$\Rightarrow \frac{x}{2} + \frac{5-x}{4} = \frac{5}{3} \Rightarrow 15 + 3x = 20$$

$$\text{So, } x = \frac{5}{3}$$

$$\text{Required ratio } \frac{x}{5-x} = \frac{\frac{5}{3}}{5 - \frac{5}{3}} = \frac{1}{2}$$

38. For real gases, $\left(P + \frac{a}{V^2}\right)(V - b) = RT$

At high pressure, $P >> a/V^2$

Thus neglecting a/V^2 gives

$P(V-b) = RT$ or $PV = RT + Pb$

Or $\frac{PV}{RT} = Z = \frac{RT + Pb}{RT}$

$\therefore Z = 1 + \frac{Pb}{RT}$

39.

(A) $(V_2 - V_1) = V_0 a(t_2 - t_1) \Rightarrow \Delta V = aV_0$
For every 1°C increase in temperature, the volume of a given mass of an ideal gas increases by a definite fraction 1/273.15 of V_0.

40.

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(C) The rms velocity is given by

$$u_{rms} = \left(\frac{3RT}{M}\right)^{1/2}$$

Given that $\frac{(u_{rms})_{H_2}}{(u_{rms})_{N_2}} = \sqrt{7}$

So, $\frac{(u_{rms})_{H_2}}{(u_{rms})_{N_2}} = \sqrt{7} \Rightarrow \frac{(3RT_{H_2}/2)^{1/2}}{(3RT_{N_2}/28)^{1/2}} = \sqrt{7} \Rightarrow 4T_{H_2} = T_{N_2}$

41. (C) The more the value of a, more is its compressibility as a represents attractive forces.

42. (C) Graphs (A), (B), and (D) represent Boyle's law, that is, $pV = K$ (constant). Graph (C) does not represent Boyle's law since $pV \neq$ Constant.

43. (A) As the peak of the curve decreases, temperature increases.

44. $p_1v_1 = p_2v_2$

$4L \times 10\,atm = (4+v)3atm$

$v = 9.3L$

45. If mass of gas expelled out

$$\frac{p_1}{n_1} = \frac{p_2}{n_2}$$

$$\frac{72.6}{n} = \frac{p_2}{0.9n} \Rightarrow p_2 = 65.34$$

$$\frac{65.34}{0.99} = \frac{p_2}{0.809} \Rightarrow p_2 = 58.8\,cm$$

46. Mass of air after heating $= 250 - \frac{250}{4} = 187.5\,mg$

$n_1T_1 = n_2T_2$

$250 \times 300 = 187.5 \times T_2$

$$T_2 = \frac{250 \times 300}{187.5} = 400\,K$$

$T_2 = 400 - 273 = 127^0\,C$

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47. NO_3^- in the mixture $e = \frac{100 \times 0.2}{100 + 100} = 0.1$

48. $MnO_4^- + I^- \rightarrow MnO_2 + I_2$

No: of milli eq.of

$MnO_4^- = 0.02 \times 3 \times 250 = 15$

No: of milli eq. of

$I_2 = 0.1 \times 1 \times 250 = 25$

Here Mno_4^- is limiting reagent.

$\therefore$ No of milli eq. of I_2 formed = 15

$\therefore$ No of milli eq. of I_2

Formed $= \frac{15}{1000} = 0.015$

$\therefore$ No of milli moles. Of I_2 formed =

$\frac{0.015}{2} = 0.0075$

49. For minimum mol. Mass, insulin must contain atleast one sulphur atom in its one molecule. Because when 3.4g sulphur is present then mol. Mass of insulin = 100. 32g sulphur is present then molecular mass of insulin $= \frac{100 \times 32}{3.4} = 941.176$

50. Because OH^- has unit negative charge so $E_{OH^-} = M_{OH^-}$ and also $N_{OH^-} = M_{OH^-}$

No. of g.eq. of OH^- = No. of g. moles $= \frac{1.20 \times 10^{24}}{6.023 \times 10^{23}} = 2$

$\therefore$ Normality (N) $= \frac{2 \times 1000}{800} = 2.5N$

51. 100g of 109% H_2SO_4 on dilution gives 109g H_2SO_4 solution, and the SO_3 present in 100g oleum will combine with 9g water, thus according to equation $H_2O + SO_3 \rightarrow H_2SO_4$ moles of free SO_3 = moles of $H_2O = \frac{9}{18} = 0.5$ Mass of $SO_3 = 0.5 \times 80 = 40g$ $\left(\because m_{SO_2} = 80\right)$ Thus, 40g free SO_3 is present in 100g of 109% oleum.

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52. $30 = N \times 5.6$ or $= \frac{30}{5.6} = 5.36$

53. Concept of mole fraction

54. m.eqt of HCl = m.eqt of $\left(NaHCO_3 + Na_2CO_3\right)$ $20x = \left(10 \times 0.1\right) + \left(5 \times 0.2 \times 2\right)$

$\therefore x = 0.15M$

55. $\because$ mass of solvent = mass of solution – mass of solute

$= \left[1000 \times 1.02\right] - \left[2.05 \times 60\right] = 897g$

$\therefore$ Molality $= \frac{Moles\,of\,CH_3COOH}{mass\,of\,solvent(in\,kg)}$

$= \frac{2.05 \times 1000}{897} = 2.285$

56. $d = \frac{PM}{RT}$. Density will be highest when $\frac{P}{T}$ is highest, i.e., higher pressure and lower temperature.

57. The rate of diffusion is incersely proportional to the square root of the density at constant pressure. H_2 with lower molar mass will diffuse out maximum and SO_2 with maximum molar mass will diffuse out minimum. Hence, after 3 hours, $^{p}H_2$ will be maximum and p_{so_2} will be minimum.

58. $\frac{u\left(SO_2\right)}{u\left(He\right)} = \sqrt{\frac{T\left(SO_2\right)}{M\left(SO_2\right)} \times \frac{M\left(He\right)}{T\left(He\right)}}$,

$\frac{1}{2} = \sqrt{\frac{T\left(SO_2\right)}{64} \times \frac{4}{300}}, T\left(SO_2\right) = 1200\,K$

59. At constant $T\left(273K\right)$, as PV = constant, lower the volume, higher is the pressure. Hence, $P_1 > P_3 > P_2$

60. For $H_2, Z > 1$ as it shows positive deviations only

PHYSICS

61. conceptual

62. Displacement vector $\vec{r} = \Delta x\hat{i} + \Delta y\hat{j} + \Delta z\hat{k}$

$= (3-2)\hat{i} + (4-3)\hat{j} + (5-5)\hat{k} = \hat{i} + \hat{j}$

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63. $|B| = \sqrt{7^2 + (24)^2} = \sqrt{625} = 25$

Unit vector in the direction of A will be $\hat{A} = \frac{3\hat{i} + 4\hat{j}}{5}$

So required vector $= 25\left(\frac{3\hat{i} + 4\hat{j}}{5}\right) = 15\hat{i} + 20\hat{j}$

64.

$$\vec{v} = \frac{d\vec{r}}{dt} = \hat{i} + t\hat{j} + \hat{k}$$

$$\vec{a} = \hat{j}$$

$$\text{compont of } \vec{a} \text{ along } \vec{v}$$

$$= \vec{a}.\hat{v}$$

$$= \hat{j}.\frac{\hat{i} + t\hat{j} + 1\hat{k}}{\sqrt{1 + t^2 + 1}}$$

$$= \frac{t}{\sqrt{2 + t^2}}$$

65. $\left[\frac{dy}{dx}\right] = 6x = 6 \times 2 = 12$

$\text{at } x=2$

$\therefore \tan\theta = \frac{dy}{dx} = 12$

66. $\vec{F}_3 = \vec{F}_1 + \vec{F}_2$ There should be minimum three coplaner vectors having different magnitude which should be added to give zero resultant

67. $\vec{P} = \frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} \therefore |\vec{P}| = \sqrt{\left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2} = 1$

$\therefore$ It is a unit vector

68. $\vec{b} \times \vec{c} = \left(\hat{i} - 4\hat{j} + \hat{k}\right) \times \left(\hat{j} + \hat{k}\right)$

$\vec{b} \times \vec{c} = -3\hat{i} - \hat{j} + \hat{k}$

$\vec{a} \times \left(\vec{b} \times \vec{c}\right) = \left(2\hat{i} + \hat{j}\right) \times \left(-3\hat{i} - \hat{j} + \hat{k}\right)$

$\hat{i} - 2\hat{j} + \hat{k}$

69. CONCEPTUAL

70. $\vec{R} = 3\hat{i} + \hat{j} + 2\hat{k}$

$\therefore$ Length in XY plane $= \sqrt{R_x^2 + R_y^2} = \sqrt{3^2 + 1^2} = \sqrt{10}$

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71. CONCEPTUAL

72. $R^2 = P^2 + Q^2 2PQ\cos\theta \qquad P = 2Q\cos(180-\theta)$

$\Rightarrow R^2 = Q^2 \qquad = -2Q\cos\theta$

73.

$\vec{a}-\vec{b}=\vec{c} \quad a=b=c=1$

$|\vec{a}-\vec{b}| = \sqrt{1+1-2\cos\theta} = 1$

$\Rightarrow 2\cos\theta = 1$

$\cos\theta = \frac{1}{2}$

$|\vec{a}+\vec{b}| = \sqrt{1+1+2\cos\theta} = \sqrt{3}$

74.

$R = (\vec{P}+\vec{Q})+(\vec{P}-\vec{Q})$

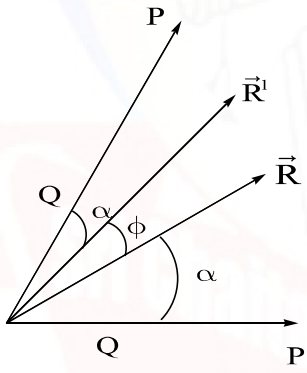
$= 2\vec{P} - \Rightarrow 2P = \sqrt{3P^2+Q^2} \therefore Q = P$

$\cos\theta = \frac{(\vec{P}+\vec{Q}).(\vec{P}-\vec{Q})}{|\vec{P}+\vec{Q}||\vec{P}-\vec{Q}|} = \frac{P^2-Q^2}{|11|}$

$\Rightarrow \theta = 90^0$

75. $d_1 = |\vec{a}+\vec{b}|$

$d_2 = |\vec{a}-\vec{b}|$

76. 

$2\alpha+\phi=\theta$

$\frac{\phi}{2} = \frac{\theta}{2} - \alpha$

$\tan\frac{\phi}{2} = \tan(\frac{\phi}{2}-\alpha), \text{————————1}$

$\tan\alpha = \frac{Q\sin\theta}{P+Q\cos\theta} \text{————————2}$

solving 1 and 2 we get the answer

77.

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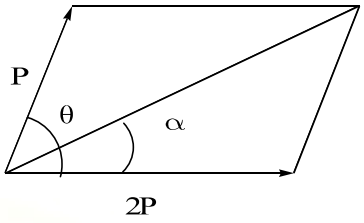
$$\tan\alpha=\frac{P\sin\theta}{P\cos\theta+2p}=\frac{P+12}{(P+12)\cos\theta+4P}$$

$$\Rightarrow\frac{P}{P\cos\theta+2P}=\frac{P+12}{(P+12)\cos\theta+4P}$$

$$\Rightarrow P\cos\theta+12\cos\theta+4P=P\cos\theta+2P+12\cos\theta+24$$

$$2P=24$$

$$\Rightarrow P=12$$



78. conceptual

79.

$$3^2=2^2+3^2+2(2)(3)\cos\theta$$

$$\Rightarrow\cos\theta=-\frac{1}{3}$$

$$(\vec{A}_1+2\vec{A}_2).(3\vec{A}_1-\vec{A}_2)=3A_1^2=4A_1A_2\cos\theta+6A_1A_2\cos\theta-8A_2^2$$

$$=3\times4+2\times2\times3\cos\theta-8\times9$$

$$=60-4$$

$$=-64$$

80. Magnitude of unit vector = 1 $\Rightarrow \sqrt{(0.5)^2+(0.8)^2+c^2}=1$

By solving we get $c=\sqrt{0.11}$

81.

$$\frac{dy}{dx}=0\Rightarrow\cos x-\sin x=0$$

$$\Rightarrow\tan x=1$$

$$\Rightarrow x=\frac{\pi}{4}$$

$$\frac{d^2y}{dx^2}<0 \text{ at } x=\frac{\pi}{4}$$

$$\therefore y_{max}=\frac{1}{\sqrt{2}}+\frac{1}{\sqrt{2}}=\sqrt{2}$$

82. According to problem $P+Q=3$ and $P-Q=1$

By solving we get $P=2$ and $Q=1$ $\therefore \frac{P}{Q}=2 \Rightarrow P=2Q$

83. $|\vec{P}|=5$, $|\vec{Q}|=12$ and $|\vec{R}|=13$

$$\cos\theta=\frac{Q}{R}=\frac{12}{13}$$

$$\therefore \theta=\cos^{-1}\left(\frac{12}{13}\right)$$

84. Let $\vec{A}=2\hat{i}+3\hat{j}-\hat{k}$ and $\vec{B}=-4\hat{i}-6\hat{j}+\lambda\hat{k}$

$\vec{A}$ and $\vec{B}$ are parallel to each other

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$\frac{a_1}{b_1}=\frac{a_2}{b_2}=\frac{a_3}{b_3}$ i.e. $\frac{2}{-4}=\frac{3}{-6}=\frac{-1}{\lambda} \Rightarrow \lambda=2$.

85. Let $\vec{A}.(\vec{B}\times\vec{A})=\vec{A}.\vec{C}$

Here $\vec{C}=\vec{B}\times\vec{A}$ Which is perpendicular to both vector $\vec{A}$ and $\vec{B}$ $\therefore$ $\vec{A}.\vec{C}=0$

86. Vector $(\vec{P}+\vec{Q})$ lies in a plane and vector $(\vec{P}\times\vec{Q})$ is perpendicular to this plane i.e. the angle between given vectors is $\frac{\pi}{2}$

87. For 17 *N* both the vector should be parallel *i.e.* angle between them should be zero.

For 7 *N* both the vectors should be antiparallel *i.e.* angle between them should be 180°

For 13 *N* both the vectors should be perpendicular to each other *i.e.* angle between them should be 90°

88. $R=\sqrt{12^2+5^2+6^2}=\sqrt{144+25+36}=\sqrt{205}=14.31\ m$

89. conceptual

90. conceptual