RANKRIDGE IIT JEE/NEET JUNIOR COLLEGE (LONGTERM)

TELANGANA

STREAM: JR MPC
Time: 3:00 Hours

WEEKEND TEST-13

Date: 18-10-2025
Max Marks: 300

SYLLABUS

MATHEMATICS : limits

PHYSICS : Calorimetry and Centre of Mass

CHEMISTRY : **Track-1:** Chemical equilibrium:
1. Reversible and irreversible reactions
2. Equilibrium state
3. Characteristics and types of chemical equilibria
4. Law of mass action.

Track-2: Qualitative quantatitave analysis purification method classification of Organic compounds

MATHEMATICS

(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 in all other cases

1. $\lim\limits_{x\to 0}\dfrac{x\cot(4x)}{\sin^2 x.\cot^2 2x}=$

(A) 0 (B) 1
(C) 4 (D) 2

2. $\lim\limits_{x\to 0}\dfrac{1-\cos(2x^3)}{\tan^2 3x.\sin^2 4x}=$

(A) $\frac{1}{12}$ (B) $\frac{1}{32}$
(C) $\frac{1}{72}$ (D) $\frac{1}{42}$

3. $\lim\limits_{x\to 0}\dfrac{\sqrt{4+x}-\sqrt[3]{8+x}}{x}=$

(A) $\frac{-1}{6}$ (B) $\frac{1}{6}$
(C) $\frac{1}{12}$ (D) $\frac{-1}{12}$

4. $\lim\limits_{x\to 0}\dfrac{1-\cos 2x^0}{x^2}=$

(A) 0 (B) 1
(C) $\left(\frac{\pi}{180}\right)^2$ (D) $2\left(\frac{\pi}{180}\right)^2$

5. If $\lim\limits_{x\to 0}\dfrac{\log(3+x)-\log(3-x)}{x}=k$, the value of k is

(A) $-\frac{2}{3}$ (B) 0
(C) $-\frac{1}{3}$ (D) $\frac{2}{3}$

6. $\lim\limits_{x\to\infty}\left(\dfrac{x+a}{x+b}\right)^{x+b}=$

(A) 1 (B) e^{b-a}
(C) e^{a-b} (D) e^b

7. If $\lim\limits_{x\to 0}\dfrac{\log(3+x)-\log(3-x)}{x}=k$, the value of k is

(A) $-\frac{2}{3}$ (B) 0
(C) $-\frac{1}{3}$ (D) $\frac{2}{3}$

8. $\lim\limits_{x\to 1}\dfrac{x+x^2+x^3+.....+x^n-n}{x-1}=$

(A) $\frac{n(n+1)}{2}$ (B) $\frac{n+1}{2}$
(C) $\frac{2}{n}$ (D) n

9. $\lim_{x\to 0}\frac{6^x-3^x-2^x+1}{x^2}$

(A) $(\log_e^2)(\log_e^3)$ (B) $\log_e^5$

(C) $\log_e^6$ (D) 0

10. If $\alpha=\lim_{x\to 0}\frac{x.2^x-x}{1-\cos x}$ and $\beta=\lim_{x\to 0}\frac{x.2^x-x}{\sqrt{1+x^2}-\sqrt{1-x^2}}$ then

(A) $\alpha=\beta$ (B) $2\alpha=\beta$

(C) $\alpha=2\beta$ (D) $\alpha=3\beta$

11. $\lim_{x\to 0}\frac{\sin x-x+\frac{x^3}{6}}{x^5}=$

(A) $\frac{1}{120}$ (B) $\frac{-1}{120}$

(C) 0 (D) $\frac{1}{2}$

12. $\lim_{x\to 0}\frac{1-\cos x-\cos 2x+\cos x.\cos 2x}{x^4}=$

(A) 1 (B) 2

(C) 3 (D) 4

13. $\lim_{x\to 0}\left\{\operatorname{cosec}^3 x.\cot x-2\cot^3 x.\operatorname{cosec} x+\frac{\cot^4 x}{\sec x}\right\}=$

(A) 1/2 (B) 1

(C) 1/3 (D) -1/3

14. $\lim_{n\to\infty}\frac{n\left(1^3+2^3+3^3+....+n^3\right)^2}{\left(1^2+2^2+3^2+....+n^2\right)^3}=$

(A) $\frac{16}{27}$ (B) $\frac{27}{16}$

(C) $\frac{9}{16}$ (D) $\frac{16}{9}$

15. $\lim_{n\to\infty}\left(\frac{1}{3.7}+\frac{1}{7.11}+....n\text{ terms}\right)=$

(A) 1/12 (B) 1/4

(C) 1/3 (D) 0

16. $\lim_{x\to 0}\left[\tan\left(x+\frac{\pi}{4}\right)\right]^{\frac{1}{x}}=$

(A) e^2 (B) e

(C) $e^{3/2}$ (D) e^{-1}

17. $\operatorname{Lim}_{x\to 0}\frac{x\tan 2x-2x\tan x}{(1-\cos 2x)^2}=$

(A) 2 (B) -2

(C) $\frac{1}{2}$ (D) $\frac{-1}{2}$

18. $\lim_{x\to\infty}\sqrt{\frac{x-\sin x}{x+\cos^2 x}}=$

(A) 1 (B) 2

(C) 3 (D) 4

19. $\lim_{x\to 0}\left(\frac{2^x+3^x+8^x+27^x}{4}\right)^{\frac{1}{\sin x}}=$

(A) $\frac{3}{2}$ (B) $\sqrt{6}$

(C) 6 (D) 4

20. $\lim_{x\to\infty}\left(1+\frac{\lambda}{x}+\frac{\mu}{x^2}\right)^{2x}=e^4$ then $\lambda=(\mu\in R)$

(A) 1 (B) 2

(C) 3 (D) 4

(NUMERICAL VALUE TYPE)

Section-II contains 5 Numerical Value Type questions.

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

21. **The integer n for which** $\lim_{x\to 0}\frac{(\cos x-1)(\cos x-e^x)}{x^n}$ **is a finite non-zero number is**

22. $\lim_{x\to 0}\frac{x^2}{1-\sqrt{1-x^2}}=$ 2.

23. $\lim_{x\to 0}\frac{1}{x}\cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)=$ ____.

24. $\lim_{x\to 5^-}\frac{|x-5|}{x-5}=$ 1.

25. If $\lim_{x\to 0}\left\{\frac{1}{x^8}\left(1-\cos\frac{x^2}{2}-\cos\frac{x^2}{4}+\cos\frac{x^2}{2}\cos\frac{x^2}{4}\right)\right\}=2^{-k}$ then the value of k is 8.

PHYSICS

(SINGLE CORRECT ANSWER TYPE)

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26. The ratio of densities of two substances is 2:3 and that of specific heats is 1 : 2. The ratio of thermal capacities per unit volume is
(A) 1:2 (B) 2:1
(C) 1:3 (D) 3:1

27. Two spheres with radii in the ratio 1:2 have specific heats in the ratio x:y and densities in the ratio z:x. The ratio of their thermal capacities is
(A) z:2y (B) zy:8
(C) z:8y (D) xy:2z

28. A copper block of mass 500 gm and specific heat 0.1 cal/gm°C heated from 30°C to 290°C, the thermal capacity of the block is
(A) 50cal/° C (B) 50gm
(C) 5cal/° C (D) 5gm

29. Two liquids A and B are at 30°C and 20°C respectively. When they are mixed in equal masses the temperature of the mixture is found to be 26°C. The ratio of specific heats is
(A) 4:3 (B) 3:4
(C) 2:3 (D) 3:2

30. Mg of ice at 0°C is mixed with Mg of water at 10°c. The final temperature is
(A) 8°C (B) 6°C
(C) 4°C (D) 0°C

31. A beaker contains 200g of water. The heat capacity of the beaker is equal to that of 20g water. The initial temperature of water in the beaker is 20°C. If 440g of hot water at 92°C is poured in it, the final temperature (neglecting radiation loss) will be nearly
(A) 58°C (B) 68°C
(C) 73°C (D) 78°C

32. Two liquids A and B are at temperatures of 75°C and 150°C respectively. Their masses are in the ratio of 2: 3 and specific heats are in the ratio 3: 4. The resultant temperature of the mixture, when the above liquids, are mixed (Neglect the water equivalent of container) is
(A) 125°C (B) 100°C
(C) 50°C (D) 150°C

33. Three liquids with masses m_1, m_2, m_3 are thoroughly mixed. If their specific heats are S_1, S_2, S_3 and their temperatures $\theta_1, \theta_2, \theta_3$ respectively, the temperature of the mixture is
(A) $\frac{S_1\theta_1 + S_2\theta_2 + S_3\theta_3}{m_1S_1 + m_2S_2 + m_3S_3}$
(B) $\frac{m_1S_1\theta_1 + m_2S_2\theta_2 + m_3S_3\theta_3}{m_1S_1 + m_2S_2 + m_3S_3}$
(C) $\frac{m_1S_1\theta_1 + m_2S_2\theta_2 + m_3S_3\theta_3}{m_1\theta_1 + m_2\theta_2 + m_3\theta_3}$
(D) $\frac{m_1\theta_1 + m_2\theta_2 + m_3\theta_3}{S_1\theta_1 + S_2\theta_2 + S_3\theta_3}$

34. Two liquids are at 40°C and 30°C. When they are mixed in equal masses, the temperature of the mixture is 36°C. Ratio of their specific heats is
(A) 3:2 (B) 2:3
(C) 4:3 (D) 3:4

35. Two liquids at temperatures 60°C and 20°C respectively have masses in the ratio 3:4 their specific heats in the ratio 4:5. If the two liquids are mixed, the resultant temperature is
(A) 70°C (B) 50°C
(C) 40°C (D) 35°C

36. Three different substances have the specific heats in the ratio 1:2:3 and the temperature increases in the ratio 3:2:1 when the same heat is supplied to the three substances. The ratio of their masses is
(A) 1:1:1 (B) 1:2:3
(C) 3:2:1 (D) 4:3:4

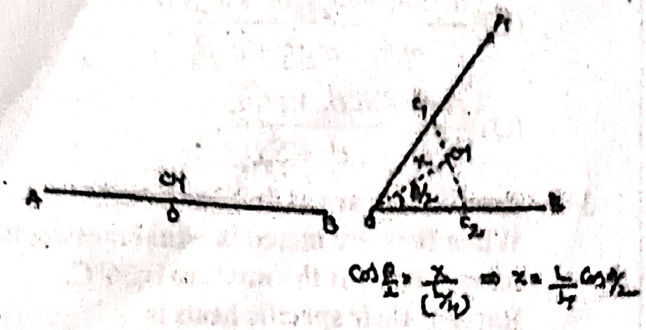
37. 30 gram of copper is heated to increase its temperature by 20°C if the same quantity of heat is given to 20 gram of water the rise in its temperature.
$(S_w = 4200 J/kg-K \& S_{cu} = 420 J/kg-K)$
(A) 5°C (B) 6°C
(C) 3°C (D) 8°C

38. A rigid body consists of a 3kg mass located at $\vec{r_1} = (2\hat{i} + 5j)m$ and a 2kg mass located at $\vec{r_2} = (4\hat{i} + 2j)m$. The position of centre of mass is
(A) $\left(\frac{14}{5}j + \frac{19}{5}\hat{i}\right)m$ (B) $\left(\frac{14}{5}\hat{i} + \frac{19}{5}j\right)m$
(C) $\left(\frac{19}{5}\hat{i} + \frac{14}{5}j\right)m$ (D) 0

39. A boat of mass 50kg is at rest. A dog of mass 5kg moves in the boat with a velocity of 20m/s. What is the velocity of boat?
(A) 4m/s (B) 2m/s

(C) 8m/s (D) 1 m/s

40. A thin uniform rod of length "L" is bent at its mid point as shown in the figure. The distance of the centre of mass from the point "O" is



(A) $\frac{L}{2}\sin\frac{\theta}{2}$ (B) $\frac{L}{2}\cos\frac{\theta}{2}$

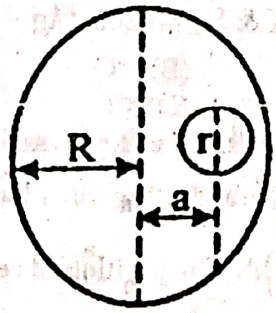
(C) $\frac{L}{4}\sin\frac{\theta}{2}$ (D) $\frac{L}{4}\cos\frac{\theta}{2}$

41. A uniform metre rod is bent into L shape with the bent arms at 90° to each other. The distance of the center of mass from the bent point is

(A) $\frac{L}{4\sqrt{2}}m$ (B) $\frac{L}{2\sqrt{2}}m$

(C) $\frac{L}{\sqrt{2}}m$ (D) $\frac{L}{8\sqrt{2}}m$

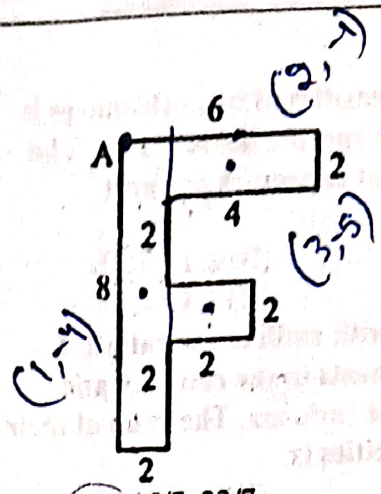
42. A circular hole of radius ^ 6 r' is made in a disk of radius 'R' and of uniform thickness at a distance 'a' from the centre of the disk. The distance of the new centre of mass from the original centre of mass is



(A) $\frac{aR^2}{R^2-r^2}$ (B) $\frac{ar^2}{R^2-r^2}$

(C) $\frac{a(R^2-r^2)}{r^2}$ (D) $\frac{a(R^2-r^2)}{R^2}$

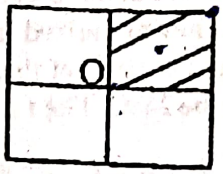
43. The centre of mass of the letter F which is cut from a uniform metal sheet from point A is



(A) 15/7, 33/7 (B) 15/7, 23/7

(C) 22/7, 33/7 (D) 33/7, 22/7

44. Figure shows a square plate of uniform thickness and side length $\sqrt{2}m$. One fourth of the plate is removed as indicated. The distance of centre of mass of the remaining portion from the centre of the original square plate is



(A) 1/3m (B) 1/2 m

(C) 1/6 m (D) 1/8m

45. Three particles each of mass 2kg are at the corners of an equilateral triangle of side $\sqrt{3}m$. If one of the particles is removed, the shift in the centre of mass is

(A) 0.2m (B) 0.5m

(C) 0.4m (D) 0.3m

NUMERICAL VALUE TYPE)

Section-II contains 5 Numerical Value Type questions.

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46. A metal block absorbs 4500 cal of heat when heated from 30°C to 80°C. Its thermal capacity is _____ cal/°C.

47. Power of a man who can chew 0.3 kg ice in one minute is (in cal/s) _____

48. The amount of steam at 100°C that should be passed into 600 g of water at 10°C to make the final temperature as 40°C will be _____ g.

49. Three identical particles each of mass 0.1kg are arranged at three corners of a square of side $\sqrt{2}m$. The distance of the

center of mass from the fourth corner is $\frac{x}{3}$ meter where x = 3.

50. A uniform wire is bent into the form of a rect-angle of length L and width W. The coordi-nates of its centre of mass from a corner are $\left[\frac{L}{x}, \frac{W}{2}\right]$ where x = 2.

CHEMISTRY

(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 in all other cases

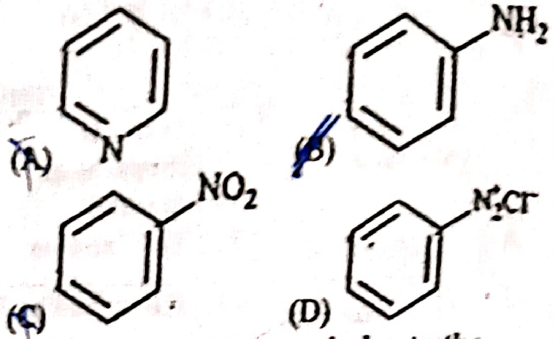
51. On complete combustion, 0.5 g of an organic compound gave 0.3 g of carbon dioxide and 0.2 g of water. Determine the percentage composition of carbon and hydrogen in the compound.
(A) 16.36%, 4.44% (B) 6.29%, 4.44%
(C) 16.36%, 2.22% (D) 8.83%, 2.22%

52. In Dumas' method for estimation of nitrogen, 0.5 g of an organic compound gave 100 mL of nitrogen collected at 300 K temperature and 715 mm pressure. Calculate the percentage composition of nitrogen in the compound.
(Aqueous tension at 300 K = 15 mm)
(A) 17.44% (B) 20%
(C) 32.84% (D) 40%

53. In Carius method of estimation of halogen, 2.5 g of an organic compound gave 1.2 g of AgBr. Find out the percentage of bromine in the compound.
(A) 14.58 (B) 28.29
(C) 34.84 (D) 20.42

54. In sulphur estimation, 0.157 g of an organic compound gave 0.4813 g of barium sulphate. What is the percentage of sulphur in the compound?
(A) 42.10 (C) 12.11
(B) 19.15 (D) 34.18

55. Which of the following compounds will be suitable for Kjeldahl's method for nitrogen estimation?



56. The fragrance of flowers is due to the presence of some steam volatile organic compounds called essential oils. These are generally insoluble in water at room temperature but are miscible with water vapour in vapour phase. A suitable method for the extraction of these oils from the flowers is
(A) distillation (B) crystallisation
(C) steam distillation
(D) distillation under reduced pressure

57. Match the following List-I with List-II.

	List-I (Mixture)		List-II (Purification Process)
A.	Chloroform and Aniline	I.	Steam distillation
B.	Benzoic acid and Naphthalene	II.	Sublimation
C.	Water and Aniline	III.	Distillation
D.	Naphthalene and Sodium chloride	IV.	Crystallisation

(A) A – IV, B – III, C – I, D – II
(B) A – III, B – I, C – IV, D – II
(C) A – III, B – IV, C – II, D – I
(D) A – III, B – IV, C – I, D – II

58. Match the following List-I with List-II.

	List-I		List-II
A.	Coloured impurity	p.	Steam distillation
B.	Mixture of o-nitrophenol and p-nitrophenol	q.	Fractional distillation
C.	Crude naphtha	r.	Charcoal treatment
D.	Mixture of glycerol and sugar	s.	Distillation under reduced pressure

(A) (A)-(r), (B)-(s), (C)-(p), (D)-(q)
(B) (A)-(p), (B)-(s), (C)-(r), (D)-(q)

(C) (A)-(r), (B)-(p), (C)-(q), (D)-(s)
(D) (A)-(r), (B)-(p), (C)-(s), (D)-(q)

59. Match the following Item-I with Item-II.

	Item-I (Mixture		Item - II (Separation method)
A.	H_2O : Sugar	P.	Sublimation
B.	H_2O : Aniline	Q.	Recrystallization
C.	H_2O : Toluene	R.	Steam distillation
		S.	Differential extraction

(A) (A)→(S); (B) → (R); (C) → (P)
(B) (A)→(Q); (B) → (R); (C) → (S)
(C) (A)→(R); (B) → (P); (C) → (S)
(D) (A)→(Q); (B)→(R); (C) → (P)

60. Match the following Column I with Column II.

	Column I (Elements)		Column II (Colour of precipitate formed in Lassaigne's test)
A.	Nitrogen	p.	Yellow
B.	Sulphur	q.	Prussian blue
C.	Chlorine	r.	Violet
D.	Phosphorus	s.	White

(A) A→ (q), B→ (r), C → (p), D → (s)
(B) A→(r), B → (q), C → (p), D → (s)
(C) A→ (q), B→ (r), C → (s), D → (p)
(D) A → (r), B → (q), C → (s), D → (p)

61. Match the following Column-I with Column-II.

	Column-I		Column-II
A.	Separation of sublimable compounds from non-sublimable	p.	Steam distillation
B.	Method based on the difference in the solubilities of the compound and the impurities in a suitable solvent	q.	Sublimation
C.	Separation of liquids having sufficient difference in their boiling points.	r.	Distillation
D.	Separation of substances which are steam volatile and are immiscible with water.	s.	Crystallization

(A) A - (q) B - (s) C - (r) D - (p)
(B) A - (q) B - (r) C - (p) D - (s)
(C) A - (s) B - (q) C - (r) D - (p)
(D) A - (q) B - (s) C - (p) D - (r)

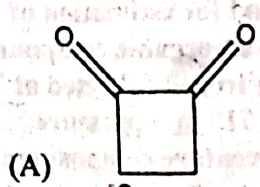
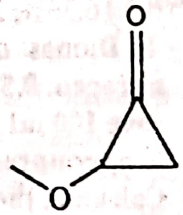
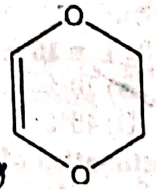
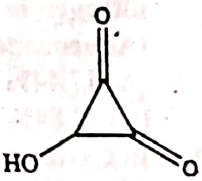
62. Match the following Column I with Column II.

	Column I (Element detected)		Column II (Reagent used/ Product formed)
A.	Nitrogen	I.	$Na_2[Fe(CN)_5NO]$
B.	Sulphur	II.	$AgNO_3$
C.	Phosphorous	III.	$Fe_4[Fe(CN)_6]_3$
D.	Halogen	IV.	$(NH_4)_2MoO_4$

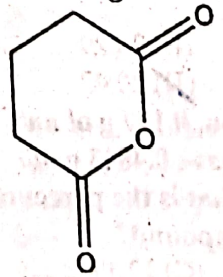
Choose the correct answer from the options given below

	A	B	C	D
(A)	II	IV	I	III
(B)	IV	II	I	III
(C)	II	I	IV	III
(D)	III	I	IV	II

63. Which of the following is heterocyclic compound?

(A) 
(B) 
(C) 
(D) 

64. Number of hetero atoms present in the following heterocyclic compound is



(A) 3
(B) 2
(C) 1
(D) zero

65. During testing of nitrogen in organic compound by Lassaigne's test, which of the following compounds are formed

(i) NaCN
(ii) $Fe_4[Fe(CN)_6]_3$

(iii) $Na_4[Fe(CN)_6]$

(iv) $Fe_3[Fe(CN)_6]_4$

(A) only (i) (B) both I and iii

(C) only i, ii, iii (D) only ii

66. **Select the response that correctly identifies the number of carbon atoms of each type of hybridization in the compound given below:**

$H_2C=C=CH-CH=O$

	sp^3	sp^2	sp
(1)	2	2	0
(2)	1	3	0
(3)	0	3	1
(4)	1	2	1

67. **A liquid compound (x) can be purified by steam distillation only if it is**

(A) Not steam volatile, immiscible with water

(B) Steam volatile, immiscible with water

(C) Not steam volatile, miscible with water

(D) Steam volatile, miscible with water

68. **Compound that will give positive Lassaigne's test for both nitrogen and halogen is**

(A) $NH_2OH.HCl$ (B) NH_4Cl

(C) $N_2H_4.HCl$ (D) $CH_3NH_2.HCl$

69. **According to law of mass action, for** $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ **(R_f = Rate of forward and R = Rate of backward reaction). Which of the following is true at equilibrium?**

(A) $R_b = K_b[CaCO_3]^2$

(B) $R_f = K_f[CaO_3]^2$

(C) $R_f = K_f[CO_2]$

(D) $\frac{R_f}{R_b} = [CO_2]^1$

70. **A gas bulb is filled with NO_2 gas and immersed in an ice bath at 0°C which becomes colourless after sometime. This colourless gas will be**

(A) NO_2 (B) N_2O

(C) N_2O_4 (D) N_2O_3

(NUMERICAL VALUE TYPE)

Section-II contains 5 Numerical Value Type questions.

Marking scheme: +4 for correct answer, 0 if not attempt and -1 in all other cases

71. **During detection of Sulphur is lassing's test a violet compound with formula $Na_x[Fe(CN)_5NOS]$ is formed. What is x?**

4

72. **How many of the following compounds may give vlood red colouration while performing Lassaigne's test for nitrogen**

2

(A) $(NH_2)_2C=S$

(B) $p-NH_2-C_6H_4-SO_3$

(C) $C_6H_5SO_2H$

(D) $(NH_2)_2C=O$

73. **The active mass of 64gm of HI in a two litre flask would be $x\times10^{-2}$, where x is?.**

25

74. **The equilibrium constant for the reaction, $2x+y \rightleftharpoons x_2y$ is $10L^2\ mol^{-2}$. The rate constant for the back ward reaction $2.8s^{-1}$. What is the rate constant of the forward reaction?**

75. **8.5 grams of ammonia are dissolved to form 4L aqueous solution. ~~Calculate the active mass.~~**

The active mass of

125 $\times$ 10 $= x\cdot10^{-3}$

x

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BEST OF LUCK