



Indian Institute of Technology Madras
Zanzibar Campus

IIT Madras Zanzibar Campus Screening Test (IITMZST)

BS in Data Science & AI

2024 Screening Test - Question Paper

Chemistry

1. The atoms having only one unpaired electron in the ground-state electronic configuration are **(1 Mark)**
 - a) boron and carbon
 - b) nitrogen and carbon
 - c) boron and fluorine
 - d) nitrogen and fluorine

2. Rutherford targeted a thin gold foil with alpha particles. He observed that majority of the alpha particles **(1 Mark)**
 - a) passed through the gold foil
 - b) got deflected at wide angle by the gold foil
 - c) returned back from the gold foil
 - d) got absorbed in the gold foil

3. Given that unit of pressure is Pa, unit of volume is m^3 , and the unit of temperature is K. The unit of gas constant R is **(1 Mark)**
 - a) $\text{Pa m}^3\text{K}^{-1} \text{mol}^{-1}$
 - b) $\text{Pa}^{-1} \text{m}^{-3} \text{K mol}$
 - c) $\text{Pa m}^3 \text{K}^{-1}$
 - d) $\text{Pa}^{-1} \text{m}^{-3} \text{K}$

4. Given that, to keep a fixed amount of an ideal gas in a volume of 8 dm^3 at 400K the amount of pressure required is 20 atm. In order to compress the gas to keep in a volume of 2 dm^3 , at 400K, the pressure should be maintained at **(1 Mark)**
 - a) 5 atm
 - b) 14 atm
 - c) 26 atm
 - d) 80 atm

5. The correct order of ionic radii for the given cations is **(1 Mark)**
 - a) $\text{Li}^+ < \text{Na}^+ < \text{K}^+$
 - b) $\text{Li}^+ < \text{K}^+ < \text{Na}^+$
 - c) $\text{K}^+ < \text{Na}^+ < \text{Li}^+$
 - d) $\text{Na}^+ < \text{K}^+ < \text{Li}^+$

Physics

6. A person travelled for a certain distance along a straight line. For the first half of the distance, the person travelled with a uniform velocity v_1 and for the rest of the distance travelled a uniform velocity v_2 . Find the average velocity of the person.

(1 Mark)

- a) $\frac{v_1 v_2}{v_1 + v_2}$
b) $\frac{v_1 + v_2}{2}$
c) $\frac{2v_1 v_2}{v_1 + v_2}$
d) $\frac{v_1 + v_2}{4}$

7. A block of mass $m = 5\text{kg}$ is held by a cord on a frictionless inclined plane. Find the normal force exerted (in Newtons) by the plane on the block when $\theta = 60^\circ$.

(1 Mark)

- a) 5.5
b) 24.5
c) 34.5
d) 55.5

8. How many resistors of capacity $110\ \Omega$ are required to be connected in parallel so that they will carry a current of $16\ \text{A}$ when the supplied voltage is $440\ \text{V}$?

(1 Mark)

- a) 16
b) 8
c) 4
d) 1

9. A light object of mass m and a heavy object of mass M have equal momentum. Find the ratio of the kinetic energies of mass M to that of mass m .

(1 Mark)

- a) $m : M$
b) $M : m$
c) $m^2 : M^2$
d) $M^2 : m^2$

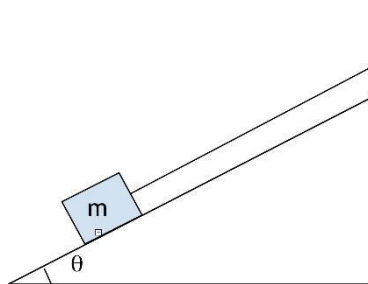


Figure 1: Block on an inclined plane

10. A 50g mass attached to a spring executes simple harmonic motion of amplitude 20cm. If the time period is 0.2s, find the total mechanical energy (in Joules) of the system. (1 Mark)

- a) π^2
- b) $\frac{\pi^2}{4}$
- c) $\frac{\pi^2}{8}$
- d) $\frac{\pi^2}{10}$

11. A pendulum swings in a vertical plane. At the lowest position of the swing, the kinetic energy (K.E.) is 8 Joules and the gravitational potential energy (G.P.E.) is 4 Joules. Which of the following statements is true when the swing is at the top position? (1 Mark)

- a) K.E. = 4 Joules and G.P.E. = 8 Joules
- b) K.E. = 0 Joules and G.P.E. = 12 Joules
- c) K.E. = 12 Joules and G.P.E. = 0 Joules
- d) K.E. = 8 Joules and G.P.E. = 4 Joules

12. A convex lens with focal length 0.2m is made of glass with refractive index $\mu_g = 1.50$. The lens is then immersed in a liquid with refractive index $\mu_l = 1.25$. The new focal length (in meters) of the lens in the liquid is _ _ _ (2 Marks)

13. The Figure shows a package sliding mechanism in a packing industry. The package slides on a friction-less track, P-Q-R-S-T which terminates in a straight horizontal section, S-T. If the package starts slipping from the point Q with zero initial velocity, the package will hit the ground from the point G at a distance of _ meters. The mass of the package is 3 kg and height of point Q from ground is $h=2\text{m}$. Point T and G are in the same vertical line. (2 Marks)

[Assume $g = 10\text{m/s}^2$]

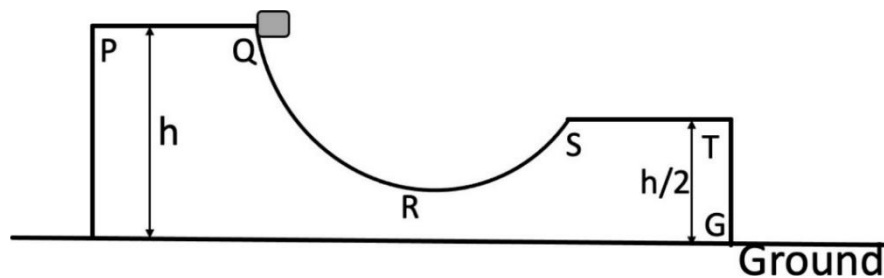


Figure 2: Package Sliding Mechanism

Mathematics

14. The expression $\sin\left(\frac{\pi}{4} + x\right) + \sin\left(\frac{\pi}{4} - x\right)$ reduces to **(1 Mark)**

- a) $\sqrt{2} \cos x$
- b) $\sqrt{2} \sin x$
- c) $-\sqrt{2} \cos x$
- d) $-\sqrt{2} \sin x$

15. If $\vec{x} = 2\hat{i} + \hat{j} + 3\hat{k}$, $\vec{y} = 3\hat{i} + \hat{j} + 2\hat{k}$ and $\vec{z} = \hat{i} + 2\hat{j} + \hat{k}$, then $\vec{x} \cdot (\vec{y} \times \vec{z})$ equals _____ **(1 Mark)**

16. If $y = \frac{1}{2} \sin^{-1}(x^2)$, then $\frac{dy}{dx}$ at $x = \frac{1}{\sqrt{2}}$ equals **(1 Mark)**

- a) $\pm\sqrt{\frac{2}{3}}$
- b) $\pm\sqrt{\frac{3}{2}}$
- c) $\pm\frac{2}{\sqrt{3}}$
- d) $\pm\frac{\sqrt{2}}{3}$

17. The distance to between two parallel lines $3y - 6x - 5 = 0$ and $3y - 6x - 13 = 0$ is **(1 Mark)**

- a) $\frac{3}{8\sqrt{5}}$
- b) $\frac{3}{4\sqrt{5}}$
- c) $\frac{8}{3\sqrt{5}}$
- d) $\frac{8}{5\sqrt{3}}$

18. The distance to the center of the circle $x^2 + y^2 - 4x - 8y = 41$ from the origin of the xy - plane is **(1 Mark)**

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

19. The pair of equations $5x + 7y - 10 = 0$ and $25x + 35y + 32 = 0$ have **(1 Mark)**

- a) a unique solution
- b) exactly two distinct solutions
- c) no solution
- d) infinitely many solutions

20. The value of the integral $\int_0^{\pi/4} \cos t \sin^3 t \, dt$ is **(1 Mark)**

- a) $1/16$
- b) 16
- c) $16/3$
- d) $3/16$

21. If the direction cosines of a line in space are $\frac{1}{2}, \frac{1}{2}, \alpha$, then α equals: (Note: This question has multiple correct options) **(1 Mark)**

- a) $\frac{1}{\sqrt{2}}$
- b) $-\frac{\sqrt{3}}{2}$
- c) $\frac{\sqrt{3}}{2}$
- d) $-\frac{1}{\sqrt{2}}$

22. Let A, B and C, be mutually exclusive events with complements A^c, B^c and C^c , respectively. If $P(A) = 0.2, P(B) = 0.1$ and $P(C) = 0.4$, then $P(A^c \cap B^c \cap C^c) = \underline{\quad}$

(1 Mark)

23. An academic department offers eight lower-level courses L_1, L_2, \dots, L_8 and ten higher level courses H_1, H_2, \dots, H_{10} . A valid curriculum consists of 4 lower level and 3 higher level courses. The number of different curricula possible are _ _ _ (1 Mark)

24. A multinational company receives e-mail requests for technical information related to sales and service. The daily numbers of e-mails for six days are 11, 9, 17, 19, 4, and 15. The absolute value of the difference between the mean and the median is _ _ _ (1 Mark)

25. The following are the numbers of minutes that a person had to wait for a bus to work on 5 working days: 1, 8, 5, 9, and 2. The variance of these numbers is _ _ _ (1 Mark)

26. Let $\vec{u} = \alpha\hat{i} - \hat{j} - 3\hat{k}$ and $\vec{v} = \hat{i} + 3\hat{j} - 5\hat{k}$ where α is a real number. If $(\vec{u} + \vec{v})$ is orthogonal to $(\vec{u} - \vec{v})$, then α^2 equals _ _ _ (1 Mark)

27. The radius of the circle which touches the x-axis at (5,0) and intersects the y-axis at (0,1) is _ _ _ (2 Marks)

28. The limit

$$\lim_{x \rightarrow 0} \frac{c|x| + de^{|x|} - d}{x}$$

exists if and only if

(2 Marks)

- a) $d = 0$
- b) $c + d = 0$
- c) $c - d = 0$
- d) $c = 0$

29. A fraction $\frac{a}{b}$ becomes $\frac{1}{2}$ when 1 is subtracted from its numerator and it becomes 1 when 5 is subtracted from its denominator. Then the sum $a + b$ equals _ _ _

(2 Marks)

30. Consider two lines $L_1 : 5x + 9y - 2 = 0$ and $L_2 : cx + y - 5 = 0$ where $c \neq 0$. Which of the following options is/are true? (Note: This question has multiple correct options)

(2 Marks)

- a) There exists a value of c such that L_1 is perpendicular to L_2 .
- b) There exists a unique value of c such that L_1 is parallel to L_2 .
- c) There exists a value of c such that L_1 and L_2 represent the same line.
- d) There exist infinitely many values of c such that L_1 is parallel to L_2

31. The value of the integral $\int_0^{\pi/2} \frac{\cos^4 x}{\sin^4 x + \cos^4 x} dx$ is

(2 Marks)

- a) $\frac{\pi}{4}$
- b) $\frac{\pi}{5}$
- c) $\frac{\pi}{2}$
- d) $\frac{\pi}{3}$

32. A train and a bus arrive at a station at a random time between 9 A.M and 10 A.M. The train stops for 15 minutes and the bus also stops for 15 minutes. The probability that the bus and the train will meet is

(2 Marks)

Verbal Aptitude

Q33-34: Read the passage below and answer the following questions.

Freedom of thought is considered to be the foundation for human dignity and agency, and a corner- stone for all human rights.

However, there has been very little exploration of what this means in practice. The UN Human Rights Committee has described this freedom as “profound and far reaching”, that it covers “thoughts on all matters”, and includes a right to mental privacy in that one cannot be compelled to reveal one’s thoughts. The UN Human Rights Committee has described as “profound and far reaching”, that it covers “thoughts on all matters, ”and includes a right to mental privacy in that one cannot be compelled to reveal one’s thoughts.

Any answer to the scope of freedom of thought is a delicate ‘balancing act’ because, like the freedom from torture, or the freedom of belief, it is an absolute right.

This means there can be no infringement of this right whatsoever.

What is - or isn’t - included in within freedom of thought’s protections can therefore have significant and potentially unforeseen ramifications.

33. What is the central concern in the passage?

(2 Marks)

- a) The foundation of human rights
- b) The mandate of UN committee on human rights
- c) The practice and scope of freedom of thought
- d) Safeguarding mental privacy

34. Why is it difficult to decide what falls under the purview of freedom of thought?

(2 Marks)

- a) The UN Committee lacks the expertise needed on the matter
- b) It cannot be defined unless mental privacy is explained.
- c) It is an absolute right that permits no infringement
- d) The subject is yet to be thoroughly explored

35. Which of the following means the same as infringement?

(1 Mark)

- a) Infraction
- b) Trespass
- c) Sin
- d) Bias

36-37: Based on logic that connects the word-pair to the left of double colon, find the word that can be paired with the word on the right.

36. Man: Clansmen :: Midfielder:

(1 Mark)

- a) Team
- b) Nation
- c) Captain
- d) Goalkeeper

37. Closure: Conflict :: Recovery:

(1 Mark)

- a) Gain
- b) Injury
- c) Deprivation
- d) Poverty

Q 38-40: Fill in the blanks with the most suitable word that completes the sentence.

38. _____ is the true measure of a person

(1 Mark)

- a) Weight
- b) Height
- c) Compassion
- d) Complexion

39. There is nothing in the world so _____ contagious as laughter and good humor.

(1 Mark)

- a) Revoltingly
- b) Sparsely
- c) Irresistibly
- d) Acrimoniously

40. By the time Sam _____ eighteen, he had already travelled all _ _ _ the world

(1 Mark)

- a) Turned, around
- b) Became, across
- c) Was, through
- d) Turned, along

Analytical Ability

41. X and Y do a piece of work in 30 days. Y and Z can do the same work in 20 days while Z and X can do the same work in 15 days. In how many days can they together do the work?

(1 Mark)

- a) $3/40$ days
- b) 34 days
- c) $40/3$ days
- d) 43 days

42. A boat takes 8 hours and 48 minutes to cover a certain distance upstream and 4 hours to cover the same distance downstream. Find the ratio between the speed of the boat and the speed of the water current.

(1 Mark)

- a) 2:1
- b) 3:2
- c) 8:3
- d) 3:8

43. How much time in years will it take for an amount of rupees 450 to yield rupees 81 as interest at 4.5% per annum of simple interest.

(1 Mark)

- a) 3.5
- b) 4
- c) 4.5
- d) 5

44. A, B, C, D, and E are sitting on a bench. A is sitting next to B, C is sitting next to D, D is not sitting with E who is on the left end of the bench. C is on the second position from the right of B and E. A and C are sitting together. In which position A is sitting.

(1 Mark)

- a) Between B and D
- b) Between B and C
- c) Between E and D
- d) Between C and E

45. Find the missing number:

(1 Mark)

25	6	28
49	9	77
37	6	??

- a) 40
- b) 38
- c) 39
- d) 35

Common Data for Q 46-47

Study the following table and answer the questions based on it.

Year	Item of Expenditure (in millions)				
	Salary	Fuel and Transport	Bonus	Interest on Loans	Taxes
1998	288	98	3.0	23.4	83
1999	342	112	2.52	32.5	108
2000	324	101	3.84	41.6	74
2001	336	133	3.68	36.4	88
2002	420	142	3.96	49.4	98

Figure 3: Expenditure Table

46. The total amount of bonus paid by the company during the given period is approximately what percent of the total amount of salary paid during this period? **(1 Mark)**

- (a) 0.1%
- (b) 0.5%
- (c) 1%
- (d) 1.25%

47. The ratio between the total expenditure on Taxes for all the years and the total expenditure on Fuel and Transport for all the years respectively is approximately equal to?

(1 Mark)

- a) 4:7
- b) 10:13
- c) 15:18
- d) 5:8

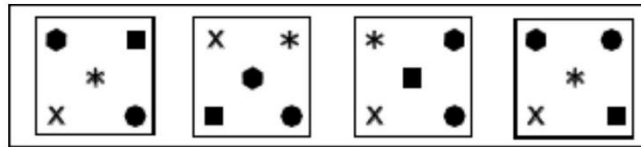
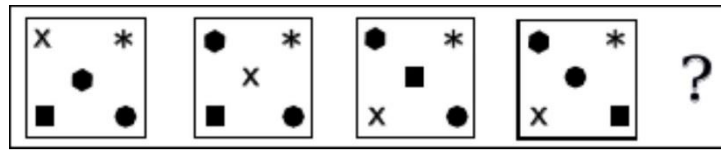
48. GHJ, LMO, RSU, YZB, ???

(1 Mark)

- a) GHJ
- b) CDF
- c) KLN
- d) RSV

49. In the figure below, find the correct sequence:

(1 Mark)



(A)

(B)

(C)

(D)

Figure 4: Sequence

- a) A
- b) B
- c) C
- d) D

50. Introducing a boy, a girl says “He is the son of the daughter of the father of my uncle”. How is the boy related to the girl? (Choose the best answer from the given options)

(1 Mark)

- a) Brother
- b) Nephew
- c) Uncle
- d) Son in law

Note: The 2024 year questions represents only the type of questions that will be asked during the screening test. It is not indicative of the exam pattern or number of questions that will be asked during the screening test.

For queries related to questions

Email id: admissions@iitmz.ac.in

IITMZ Admission Committee

IIT Madras

