

University of Mumbai

National Centre for Nanosciences and Nanotechnology
M.Sc. Sem I Examination
Paper III: Essential Mathematics PSNN103

Sample Multiple Choice Questions

- Let V be a vector space with dimension 12. Let S be a subset of V which is linearly independent and has 11 vectors. Which of the following is FALSE?
 - There must exist a linearly independent subset S_1 of V such that $S \not\subseteq S_1$ and S_1 is not a basis for V .
 - Every nonempty subset S_1 of S is linearly independent.
 - There must exist a linearly dependent subset S_1 of V such that $S \not\subseteq S_1$.
 - Dimension of $\text{span}(S) < \text{dimension of } V$.
- Let A be a 5×5 matrix with all real elements and let $x \neq 0$. Then $x, Ax, A^2x, A^3x, A^4x, A^5x$ are
 - Linearly independent
 - Linearly dependent
 - Linearly independent if and only if A is symmetric.
 - linear dependent / independent: unable to decide due to insufficient information.
- The necessary condition for the McLaurin expansion to be true for function $f(x)$ is _____.
 - $f(x)$ should be continuous.
 - $f(x)$ should be differentiable.
 - $f(x)$ should exist at every point.
 - $f(x)$ should be continuous and differentiable
- The expansion of $e^{\sin(x)}$ is?
 - $1 + x + \frac{x^2}{2} + \frac{x^4}{8} + \dots$
 - $1 + x + \frac{x^2}{2} - \frac{x^4}{8} + \dots$
 - $1 + x - \frac{x^2}{2} + \frac{x^4}{8} + \dots$
 - $1 + x + \frac{x^3}{6} - \frac{x^5}{10} + \dots$
- The inverse of a symmetric matrix (if it exists) is?
 - symmetric matrix.
 - A skew symmetric matrix.
 - A diagonal matrix.
 - A triangular matrix
- Find the rank of the matrix $a \begin{bmatrix} 4 & 2 & -1 & 2 \\ 1 & -1 & 2 & 1 \\ 2 & 2 & -2 & 0 \end{bmatrix}$

- a. 0
- b. 1
- c. 2
- d. 3

7. If the function $f(x)$ is even, then which of the following is zero?

- a. a_0
- b. a_n
- c. b_n
- d. nothing is zero

8. Next Find the Eigen vector for value of $\lambda=-2$ for the given matrix $\begin{bmatrix} 3 & 5 \\ 3 & 1 \end{bmatrix}$

- a. $\begin{bmatrix} 0 \\ -1 \end{bmatrix}$
- b. $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$
- c. $\begin{bmatrix} i \\ -1 \end{bmatrix}$
- d. $\begin{bmatrix} 0 \\ -i \end{bmatrix}$

9. The perpendicular distance from the point $(3,-4)$ to the line $3x^2 - 4x + 10 = 0$

- a. 7
- b. 8
- c. 9
- d. 10

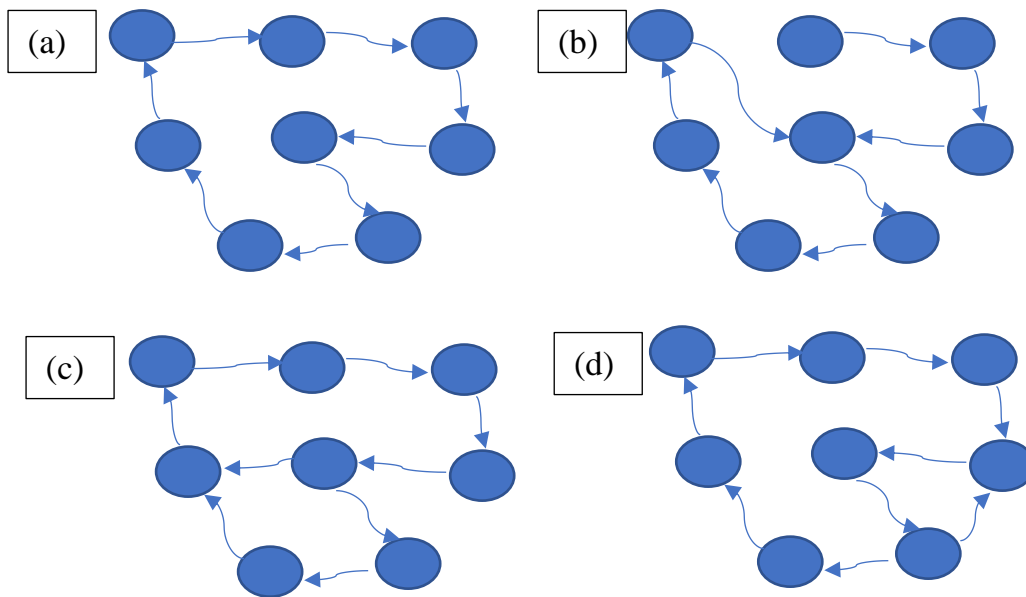
10. Here are two statements about the roots of the equation $x^2 - 8x + 12 = 0$.

- i. The roots are real and rational.
- ii. The roots are equal.

Which of the following is true?

- a. Neither statement is correct.
- b. Only statement (i.) is correct.
- c. Only statement (ii.) is correct.
- d. Both statements are correct.

1. What diagram can make a perfect statement of law.



2. Which is the correct representation of Newton's second law.

(a) $\frac{d^2y}{dx^2} = -kx^2$ (b) $\frac{d^2x}{dt^2} = m \frac{dV}{dt}$ (c) $\frac{d(mV)}{dt^2} = m \frac{dx^2}{dt^2}$ (d) $\frac{d(mV)}{dt^2} = m \frac{d^2y}{dx^2}$

3. Identify the correct statement:

- (a) Lagrange's equations can be used to prove Newton's laws
- (b) One cannot derive Newton's laws from Lagrange's equation alone.
- (c) Newtonian motion is similar to Lagrangian motion if we do not consider energy.
- (d) Lagrangian formulations are incomplete without Hamilton.

4. Hamilton of an equation of motion represents one of the following:

- (a) Energy of the system.
- (b) Lagrangian of the system.
- (c) System is in motion.
- (d) System is at rest.

5. Which gate is sufficient to make a latch

- (a) NOT gate (b) NOR Gate (c) AND Gate (d) OR Gate

6. Identify which truth table do not represent a basic Logic Gate.

(a)	A	B	O
	1	0	1
	1	1	1
	0	1	1
	0	0	0

(b)	A	O
	1	0
	0	1

(c)	A	B	O
	0	0	1
	0	1	0
	1	0	0
	1	1	0

(d)	A	B	O
	1	0	1
	1	1	0
	0	1	0
	0	0	1

7. Photoelectric effect is related to:

- (a) Removal of electrons from a metal foil
- (b) Balancing of electron in atoms of metal
- (c) Emission of radiation from a semiconductor
- (d) Reflection of electromagnetic radiation from a metal foil.

8. Wave like properties of matter can be best understood by:

- (a) Photoelectric effect
- (b) Thermionic emission
- (c) Double slit experiment.
- (d) De Broglie wavelength.

9. Which is the premier atomic model?

- (a) Rutherford's model
- (b) Vector atom model
- (c) Thomson's model
- (d) Bohr's model

10. Which of the following is a basic 1-bit memory element?

- (a) Latch
- (b) J-K Flip-flop
- (c) R-S flip-flop
- (d) D-flip flop.

Sample question paper in MCQ format

- 1 Removing the exposed photoresists process is known as _____
a. developing b. lift-off c. stripping d. cut-off
- 2 One of the standard substrate cleaning procedure is _____
a. RCA cleaning b. CRA cleaning c. wafer cleaning d. water cleaning
- 3 In optical lithography patterns are transferred on the template using _____
a. pattern generator b. stencil c. optical mask d. photon generator
- 4 Mask aligner is the equipment used for _____
a. depositing films b. spinning photoresist c. pattern transfer d. developing photoresist
- 5 Use of X-rays in lithography is commonly known as _____
a. UV lithography b. extreme UV lithography c. normal lithography d. IR lithography
- 6 The mask having dark features and transparent background is _____
a. dark field mask b. bright mask c. gray mask d. black and white mask
- 7 Gray mask is specially designed to pattern the _____
a. 1D objects b. 0D objects c. 2D objects d. 3D objects
- 8 To deposit insulating layer of SiO₂ on the template following deposition technique is recommended _____
a. Thermal evaporation b. e-beam evaporation c. chemical vapor deposition d. chemical bath deposition
- 9 Thickness of a human hair is _____
a. 100 nm b. 200 nm c. 100 micron d. 200 micron
- 10 In the case of SWCNT-FETs the SWCNTs used works as _____
a. scarifying material b. active material c. insulating material d. contact material

Sample MCQs (Essential Biology)

1. Water is a _____ solvent
 - a. Polar
 - b. Non-polar
 - c. Amphipathic
 - d. Non-polar uncharged
2. The H-O-H bond angle of water molecule is
 - a. 104.0
 - b. 104.5
 - c. 105.0
 - d. 105.5
3. Lysosomes are known as suicide bags because of the presence of:
 - a. Food vacuole
 - b. Hydrolytic activity
 - c. Parasitic activity
 - d. Catalytic activity
4. The most abundant immunoglobulin in the serum is:
 - a. IgG
 - b. IgA
 - c. IgE
 - d. IgM
5. The tracking dye used in SDS PAGE will be
 - a. Anionic
 - b. Cationic
 - c. Non-Ionic
 - d. Amphipathic
6. Thylakoid membrane of chloroplast is rich in
 - a. Galactolipids
 - b. Phospholipids
 - c. Cardiolipin
 - d. Sphingolipids
7. Which of the following is an essential amino acid?
 - a. Proline
 - b. Histidine
 - c. Leucine
 - d. Methionine
8. The shortest phase of cell cycle is:
 - a. Metaphase
 - b. Prophase
 - c. Telophase
 - d. Anaphase
9. Which of the following is LEAST likely to occur for the removal of cancerous cells in our body?
 - a. Complement fixation

- b. Autophagy
- c. Phagocytosis
- d. T-cell based cytotoxicity

10. Node of Ranvier is found on:

- a. Axon
- b. Dendrites
- c. Near nucleus
- d. Axon terminal

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M.Sc. Sem I Examination

Paper II: Essential Chemistry

1. At 25 °C, Concentration of pure Water is.....

1. 1.0 M
2. 18.0 M
3. 55.5 M
4. 0.0 M

2. Among the following, the process that exothermic is:

1. Fusion
2. Sublimation
3. Evaporation
4. Condensation

3. The hybridization of BH₃ Molecule is:

1. sp
2. sp²
3. sp³
4. sp³d

4. Which of the following species the bond order is 3 ?

1. CN
2. BN
3. NO
4. CN⁻

5. A catalyst increases the rate of a reaction by:

1. Decreasing the activation energy
2. Increasing the activation energy
3. Making the reaction endothermic
4. Making the reaction exothermic

6. In which of the following bonds does H carry δ^{-ve} charge?

1. F-H
2. O-H
3. B-H
4. N-H

7. Based on the first law of thermodynamics, which one of the following is correct?

1. For an isothermal process, $q = +w$
2. For an isochoric process, $\Delta U = -q$
3. For an adiabatic process, $\Delta U = -w$
4. For a cyclic process, $q = -w$

8. Carbon-14 dating method was developed by

1. Leona Woods
2. Ernest Lawrence
3. Willard Libby
4. James R. Arnold

9. Which of the following characteristics is not possessed by an ideal solution:

1. Obeys Raoult's law.
2. Volume change on mixing is not equal to zero.
3. There should be no chemical reaction between solute and solvent.
4. Only very dilute solutions behave as ideal solutions.

10. When a solute is dissolved in water it shows:

1. Decrease in freezing point of water.
2. Decrease in boiling point of water.
3. Increase in vapour pressure of water.
4. All of the above.