



भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान मोहाली
शिक्षा मंत्रालय, भारत सरकार द्वारा स्थापित
सैक्टर 81, नॉलेज सिटी, प० ओ० मनोली, एस० ए० एस० नगर, मोहाली,
पंजाब - 140306

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH MOHALI

Question paper-1 for the posts of Senior Technical Officer & Technical Officer

Date: 05.06.23

Instructions

1. Part A compulsory for all.
2. Part B compulsory for all.
3. Part C has 60 multiple choice questions (MCQs.) Candidates have to attempt any 20 out of these 60, as per their choice.
4. For MCQs, each correct answer will be awarded 2 marks, and for each wrong answer there will be negative 0.5 marks.

(Time-75 minutes)

Part-A (General Aptitude)

1. If $a+b+c = 6$ and $ab+bc+ca = 1$, then the value of $bc(b+c) + ca(c+a) + ab(a+b) + 3abc$ is

- (A) 33
- (B) 66
- (C) 55
- (D) 23

2. A work could be completed in 100 days by some workers. However, due to the absence of 10 workers, it was completed in 110 days. The original number of workers was

- (A) 100
- (B) 180
- (C) 115
- (D) 110

3. Energy : Joule :: ?

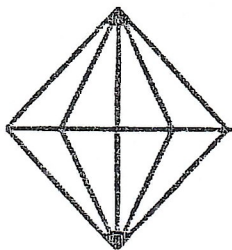
- (A) Axe : Grind
- (B) Ammeter : Current
- (C) Power : Ampere
- (D) Resistance : Ohm

4. Select the number that can be replace the question mark (?) in the following series.

8, 7, 12, 33, 128, ?

- (A) 235
- (B) 389
- (C) 635
- (D) 297

5. How many triangles are there in the given figure?



- (A) 13
- (B) 32
- (C) 21
- (D) 24

6. If PIPE is written as 169165, then what is the last digit of SWAN?

- (A) 5
- (B) 6
- (C) 4

(D) 3

7. Paisa : Rupee :: ? : Kilometer

(A) Metre

(B) Hectometer

(C) Quintal

(D) Decametre

8. Find the missing term

3	2	2
6	20	4
12	25	64
6	10	?

(A) 8

(B) 6

(C) 10

(D) 12

9. A bank pays interest to its depositors compounded yearly. If a deposit becomes Rs. 54,000/- at the end of 3rd year and Rs. 64,800/- at the end of 6th year, what is the principal invested in the deposit?

(A) 40,000

(B) 42,500

(C) 45,000

(D) 48,000

10. A two-digit number is such that if the digit 4 is placed to its right, its value would increase by 490. Find the original number?

- (A) 48
- (B) 54
- (C) 64
- (D) 56

11. 25 persons are in a room. 15 of them play hockey, 17 of them play football and 10 of them play both hockey and football. Then the number of persons playing neither hockey nor football is

- (A) 2
- (B) 17
- (C) 13
- (D) 3

12. Four persons PQR, and S are to be seated in a row. R should not be seated at the second position from the left end of the row. The number of distinct seating arrangements possible is:

- (A) 6
- (B) 9
- (C) 18
- (D) 24

13. Abhishek is elder to Savar. Savar is younger to Anshul. Which of the given conclusions is logically valid and is inferred from the above statements?

- (A) Abhishek is elder to Anshul
- (B) Anshul is elder to Abhishek
- (C) Abhishek and Anshul are of the same age
- (D) No conclusion follows

14. Tanya is older than Eric. Cliff is older than Tanya. Eric is older than Cliff If the first two statement are true, then the third statement is:

- (A) True
- (B) False
- (C) Uncertain

(D) Data insufficient

15. If the 5th date of a month is Tuesday, what date will be 3 day days after the 3rd Friday in the month?

(A) 19

(B) 18

(C) 17

(D) 22

Part- B (General Knowledge & General English)

16 . The River Markanda does not pass through which of the following districts of Haryana?

(A) Ambala

(B) Panchakula

(C) Sirmaur

(D) Kurukshetra

17 . The author of world famous Harry Potter series is

(A) Arundhati Roy

(B) J K Rowling

(C) Taslima Nasrin

(D) Salman Rushdie

18 . Which Indian state has the least literacy rate?

(A) Bihar

(B) Rajasthan

(C) Arunachal Pradesh

(D) Orissa

19 . Where is 'Operation Sadbhawana' being organized by the Indian Army recently?

(A) Jammu Kashmir

(B) Kasol

(C) Ladakh

(D) Pathankot

20 Under whose captainship did India win all three major ICC trophies in white-ball cricket till 2021?

(A) Kapil Dev

(B) Virat Kohli

(C) Sourav Ganguly

(D) Mahendra Sing Dhoni

21 Who won a gold medal for India in the Jawelin throw event at Tokyo Olympics 2020?

(A) Sumit Antil

(B) Shivpal Singh

(C) Ajeet Singh Yadav

(D) Neeraj Chopra

22 . The cat and the dog have a _____ enemy in the rat.

(A) Same

(B) Common

(C) Mutual

(D) Similar

23. Choose the word opposite in the meaning to the **Genial**

- (A) Stupid
- (B) Stingy
- (C) Boorish
- (D) Unkind

24. I _____ you to keep quiet.

- (A) beg of
- (B) beg from
- (C) beg
- (D) beg for

25. He stood _____ as a rock and faced the challenge.

- (A) quite
- (B) strong
- (C) solid
- (D) firm

26. He is known for his unscrupulous ways. He always sheds _____ tears to deceive people.

- (A) Fox's
- (B) Crocodile's
- (C) Crocodile
- (D) Fox

27. You should _____ when to say _____.

- (A) no / no

- (B) no / know
- (C) know / know
- (D) know / no

28 . I contemplated _____ Singapore for my vacation but decided against it.

- (A) to visit
- (B) having to visit
- (C) visiting
- (D) for a visit

29 . . Which country will host the G20 Summit in 2024?

- (A) USA
- (B) Brazil
- (C) India
- (D) South Africa

30 . . What is the rank of India in the economy forum index?

- (A) 130
- (B) 137
- (C) 139
- (D) 140

Part-C

31. Which of the following is used in electron microscope?

- (A) Light waves
- (B) Electron beams and magnetic field
- (C) Magnetic field
- (D) Electron Beam

32. The evolutionary history of an organism is called
- (A) Taxonomy
 - (B) Phylogeny
 - (C) Dendrogram
 - (D) Cladogram
33. All the organisms of different species, living in a habitat are called
- (A) Community
 - (B) Family
 - (C) Ecosystem
 - (D) Population
34. Urine passes from the kidney to the bladder through
- (A) Uterus
 - (B) Urethra
 - (C) Ureter
 - (D) Convoluted tubule
35. Which class of immunoglobulins will increase in case of a chronic infection?
- (A) IgA
 - (B) IgG
 - (C) IgM
 - (D) IgE
36. Chromosome structure can be observed best during _____
- (A) Anaphase
 - (B) Metaphase

(C) Prophase

(D) None of the above

37. Short strands of _____ primer are used in DNA replication.

(A) DNA

(B) RNA

(C) Histone

(D) Protein

38. The mRNA codon of valine is

(A) GUC

(B) UGG

(C) CCA

(D) TTG

39. How many autosomes does a human primary spermatocyte have?

(A) 34

(B) 44

(C) 54

(D) 23

40. Which condition can be explained by Lamarckism?

(A) Giraffes got their long neck

(B) Humans lost their tail

(C) Humans became bipedal

(D) All of the above

4 1. Match the two columns that represents plant organs (I) and parts within these organs (II).

	Column I		Column II
A	Carpel	(i)	Petals, corolla
B	Perianth	(ii)	Vegetative cell, generative cell
C	Microsporocyte	(iii)	Stigma, style, ovary
D	Megasporocyte	(iv)	Antipodal cells, polar nuclei, synergid cells

(A) A- (i); B- (iii); C-(ii); D-(iv)

(B) A- (iii); B-(iv); C-(i); D-(ii)

(C) A- (i); B-(iii); C-(iv); D-(ii)

(D) A- (iii); B-(i); C-(ii); D- (iv)

4 2. Which technique is used to detect AIDS?

(A) Northern blot and ELISA

(B) Immunoblot and ELISA

(C) Western blot and ELISA

(D) Southern blot and ELISA

4 3. _____ is an instrument that helps to achieve specific temperature and pressure for scientific/medical and industrial applications.

- (A) Sterilizers
- (B) Autoclave
- (C) Electrosurgical unit
- (D) None of the above

4 4. Ethanol can be produced using _____

- (A) *Saccharomyces cerevisiae*
- (B) *Escherichia coli*
- (C) *Pseudomonas syringae*
- (D) None of the above

4 5. Which of the following is an immunosuppressant that prevents transplanted organs from being rejected in recipients.

- (A) Thrombin
- (B) Cyclosporine
- (C) Aspirin
- (D) None of the above

4 6. PCR technique was invented by

- (A) Kary Mullis
- (B) Boyer
- (C) Sanger
- (D) Cohn

4 7. Koshland's theory of enzyme action is known as

(A) Lock and key theory

(B) Reduced fit theory

(C) Induced fit theory

(D) Enzyme coenzyme theory

48. Which is the most abundant biomolecule on earth?

(A) Mineral salts

(B) Proteins

(C) Lipids

(D) Carbohydrates

49. Cystic fibrosis follows which of the following inheritance pattern

(A) Sex-linked recessive

(B) Autosomal dominant

(C) Autosomal recessive

(D) Sex-linked dominant

50. Which of the following is a cell surface receptor?

(A) Enzyme-linked receptors

(B) G protein-linked receptors

(C) Ion-channel linked receptors

(D) All of the above

51. Which of the following statements is true for an ideal-dilute solution?

(A) The solute and solvent both obey Raoult's law.

- (B) The solute obeys Raoult's law and the solvent obeys Henry's law.
(C) The solute obeys Henry's law and the solvent obeys Raoult's law.
(D) The solute and solvent both obey Henry's law.

5.2. The ionic strength of the a electrolyte M_2X_3 where X is divalent ion, is _____ times molality of salt

- (A) 10
(B) 3
(C) 15
(D) 9

5.3. The end group analysis of which of these monomer based polymer could be carried out

- (A) Acrylic Acid
(B) Ethylene
(C) Terephthalic acid
(D) Methyl Methacrylate

5.4. Which mode in the chain termination step is accompanied by a transfer of hydrogen molecule?

- (A) Combination
(B) Disproportionation
(C) Propagation
(D) all of the mentioned

5.5. What is the molarity of a 25% ammonium hydroxide? Given the density of the solution is 0.907 g/cm^3

- (A) 14.7
(B) 13.3
(C) 14.1
(D) 13.8

6. The stoichiometry of a metal-ligand complex can be established using
- (A) Newton-Raphson Method
 - (B) Job's plot method of continuous variation
 - (C) Method of standard Addition
 - (D) None of the above
57. What is the pH of a 0.001 M formic acid solution? $K_a = 1.8 \times 10^{-4}$.
- (A) 3.74
 - (B) 10.3
 - (C) 3.37
 - (D) 10.6
58. According to the Beer-Lambert Law, on which of the following does absorbance *not* depend?
- (A) Extinction coefficient of the sample
 - (B) Solution concentration
 - (C) Distance that the light has travelled through the sample
 - (D) Colour of the solution
59. Properties of a primary standard for use in acid-base titrations include
- (A) Reactive with oxygen and low molar mass
 - (B) Low molar mass and low solubility.
 - (C) High purity and low solubility.
 - (D) Stability and high purity.
60. Accuracy is defined as:
- (A) A measure of how often an experimental value can be repeated.
 - (B) The closeness of a measured value to the real value.
 - (C) The number of significant figures used in a measurement.
 - (D) None of these
61. Which statement is incorrect about a weak electrolyte?

- (A) At infinite dilution, a weak electrolyte is taken to be fully ionized.
(B) Acetic acid is an example of a weak electrolyte
(C) A weak electrolyte is partially dissociated in aqueous solution
(D) The molar conductivity of a weak electrolyte remains approximately constant as the concentration increases.

62. Unit of zero-order reaction rate constant is

- (A) s^{-1}
(B) $\text{mol}^{-1}\text{dm}^3\text{s}^{-1}$
(C) $\text{mol dm}^{-3}\text{s}^{-1}$
(D) $\text{mol}^{-2}\text{dm}^{-6}\text{s}^{-1}$

63. A unimolecular reaction is characterized by

- (A) Zero order reaction at higher concentration of the reactant
(B) Second order reaction at lower concentration of the reactant
(C) First order reaction at lower concentration of the reactant
(D) None of the above

64. Which among the following is a TD (to deliver) analytical glassware

- (A) Erlenmeyer Flask
(B) Iodine flask
(C) Burette
(D) Volumetric flasks

65. The pipette with upper and the lower marking of the volume that it can deliver is

- (A) Mohr's Pipette
(B) Seriological pipette
(C) Volumetric pipette
(D) None of the above

66. What are important factors when considering if a reaction will occur?

- A) Collision frequency
(B) Activation energy
(C) Orientation
(D) All of the above
67. Quantum yield in photochemistry of emission is best defined as
(A) Rate of fluorescence emission
(B) Number of photons emitted
(C) Number of photons emitted divided by number of photons absorbed
(D) Fraction of excited molecules produced upon direct excitation
68. Which of the following statements is not correct?
(A) Aldehydes and ketones undergo nucleophilic addition
(B) Aldehydes and ketones undergo electrophilic substitution
(C) Lower members of aldehydes and ketones are soluble in water due to hydrogen bonding
(D) Aldehydes and ketones contain polar carbonyl group
69. Which of the following will not be soluble in NaHCO_3 ?
(A) 2,4,6-trinitrophenol
(B) Benzoic acid
(C) Phenol
(D) Benzenesulphonic acid
70. Chlorobenzene forms DDT in the presence of conc. H_2SO_4 when it reacts with
(A) CH_3CHO
(B) Cl_2CHCHO
(C) ClCH_2CHO
(D) Cl_3CCHO

71. An ion with charge q , mass m , and speed v enters a magnetic field B and is deflected into a path with a radius of curvature R . If a second ion has speed $2v$, while m , q , and B are unchanged, what will be the radius of the second ion's path?

- (A) $4R$
- (B) $2R$
- (C) $R/2$
- (D) $R/4$

72. The Electric field intensity E due to an infinite uniformly charged plane sheet at a point distant r from the sheet is related as

- (A) Independent of r
- (B) $E \propto r$
- (C) $E \propto r^{-1}$
- (D) $E \propto r^{-2}$

73. Number of nucleon/ m^3 in a nucleus is

- (A) 10^{40}
- (B) 10^{44}
- (C) 10^{50}
- (D) 10^{49}

74. The graph between binding energy per nucleon and mass number A , small peaks indicates that the corresponding element

- (A) Radioactive
- (B) Comparable more stable
- (C) Less stable
- (D) None of these

75. What is wavelength of the electron beam of energy 415 MeV

- (A) 2fm

- (B) 3 fm
- (C) 4 fm
- (D) 5 fm

76. If particles are moving with same velocity then maximum de-Broglie wavelength is for

- (A) Proton
- (B) α -particle
- (C) β -particle
- (D) Neutron

77. A phase shift oscillator consists of a number of

- (A) LC circuits
- (B) RC circuits
- (C) LR circuits
- (D) LCR circuits

78. Which of the following is a closed packing structure?

- (A) Face Centered Cubic
- (B) Body Centered Cubic
- (C) Diamond Structure
- (D) NaCl Structure

79. Which of the following has the highest packing fraction?

- (A) Hexagonal Close Packing
- (B) Zinc Blende Structure
- (C) Cesium Chloride Structure
- (D) Body Centered Cubic Structure

80. A function $\Phi(x, y)$ satisfying Laplace equation is called

- (A) Analytic
- (B) Holomorphic
- (C) Harmonic,
- (D) Non-harmonic

§ 1. What are the centre and radius of the circle $Z-0.5 = 0.3 \cdot \text{Exp}(2i\theta)$?

- (A) 0 and 0.3
- (B) 0.5 and 0.3
- (C) 0.5 and 0.15
- (D) 0 and 0.15

§ 2. Identify the correct statement for the following vectors $\mathbf{a} = 3\mathbf{i} + 2\mathbf{j}$ and $\mathbf{b} = \mathbf{i} + 2\mathbf{j}$:

- (A) Vectors \mathbf{a} and \mathbf{b} are linearly independent
- (B) Vectors \mathbf{a} and \mathbf{b} are linearly dependent
- (C) Vectors \mathbf{a} and \mathbf{b} are orthogonal
- (D) Vectors \mathbf{a} and \mathbf{b} are normalized

§ 3. In superconducting state

- (A) Entropy increases and thermal conductivity decreases
- (B) Entropy and thermal conductivity increases
- (C) Entropy and thermal conductivity increases
- (D) Entropy decreases and thermal conductivity increases

§ 4. For isotropic harmonic oscillator, energy for second excited state is

- (A) $3/2 \hbar\omega$
- (B) $5/2 \hbar\omega$
- (C) $7/2 \hbar\omega$
- (D) $9/2 \hbar\omega$

§ 5. The relation between Fermi energy and density of electrons:

- (A) $E_F \propto \rho$
- (B) $E_F \propto \rho^{3/2}$
- (C) $E_F \propto \rho^{2/3}$
- (D) $E_F \propto \rho^{1/2}$

§ 6. If v_p and v_g be the phase velocity and group velocity of the lattice wave, then in the long wavelength side

- (A) $v_g > v_p$
- (B) $v_g = v_p$
- (C) $v_g < v_p$
- (D) $v_g = v_p = \infty$

§ 7. Cooper pairs are formed

- (A) At very low temperatures as the thermal energy is not sufficient to disrupt the binding
- (B) At high temperatures as the thermal energy is sufficient to form the cooper pair
- (C) Both a and b
- (D) None of These

§ 8. The phenomenon which explain transverse nature of light?

- (A) Interference
- (B) Diffraction
- (C) Polarization
- (D) Dispersion

9. Diffraction fringes are obtained if width of slit is equal to _____ of the source.

- (A) Frequency
- (B) Amplitude
- (C) Wavelength
- (D) Time Period

10. In which of the following, interference is produced by division of wave front?

- (A) Fabry-Perot Interferometer
- (B) Michelson's Interferometer
- (C) Newton's ring Experiment
- (D) Fresnel's Biprism



भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान मोहाली

शिक्षा मंत्रालय, भारत सरकार द्वारा स्थापित
सैक्टर 81, नॉलेज सिटी, एं ओं मनोली, एं एं एं नगर, मोहाली, पंजाब -
140306

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH MOHALI

Paper- 2 for the post of **Senior Technical Officer**

Date: 05.06.23

Instructions

Out of following 9 descriptive questions the candidate has to attempt any 5 questions.

Total Marks 50

Time ~~75~~ minutes

1. Draw schematic representation of Kreb's cycle. (10)
2. How did Nirenberg and Matthaei determine the first codon of genetic code? (10)
3. Differentiate between bioremediation and bioleaching. (10)
4. What is potentiometry? Explain the construction, working and sources of error for pH Meter. (10)
5. Discuss the construction of double beam spectrometer. What is the difference between Standard Addition and standard calibration method of analysis using UV-Visible spectrometer? Discuss this advantage and disadvantage. (10)
6. Discuss the microsemi-elemental analysis of organic compounds and functional group analysis for phenols, aldehydes, carboxylic acids and amines qualitatively. (10)
7. Discuss the electromagnetic spectrum and application of its each radiation range. (10)
8. Discuss briefly about the four fundamental forces of the nature. (10)
9. Derive Maxwell's equations and discuss its physical interpretation. (10)