Question Booklet No.: Question Booklet Series: **A**

ENTRANCE TEST - 2025

School of Biological Sciences

Nanotechnology

[This Question Booklet has three sections pertaining to (A) Chemistry (B) Physics & (C) Biology. Section "A" Chemistry is compulsory for all; however, either Section "B"-Physics or Section "C" – Biology is to be attempted]

Total Questions: 60 [32 - Chemistry + 28 Physics or Biology) **Roll No.**

Time Allowed: 70 Minutes

Important Instructions for Candidates:

1. Candidates shall compulsorily use only **blue/ black ball point pen**. In no case gel/ink pen or pencil should be used.
2. Compulsorily write your **roll number** in the space provided at the top of this page of the question booklet.
3. Fill up the necessary information in the spaces provided on OMR Answer sheet including **Question Booklet Number** and **Question Booklet Series**.
4. OMR Answer sheet has an original copy and a candidate's copy glued beneath it at the top. While making entries in the original copy, candidate should ensure that the **two copies are aligned properly** so that the entries made in the original copy against each item are exactly copied in the candidate's copy.
5. All entries in the OMR Answer Sheet, including answers to questions, are to be recorded in the Original Copy only.
6. **Choose only one correct/most appropriate response** for each question among the options A, B, C and D and darken the circle of the appropriate response completely. Incompletely darkened circle is not correctly read by the OMR scanner and no complaint to this effect shall be entertained.
7. **Do not darken more the one circle of option for any question. A question with more than one darkened response shall be considered wrong.**
8. **There will be negative marking for wrong answers. Each wrong answer will lead to deduction of 0.25 marks per wrong answer from the score.**
9. Only those candidates who obtain positive score in Entrance Test shall be eligible for admission.
10. Do not make any stray mark on the OMR sheet as this may lead to errors while scanning.
11. OMR answer sheet must be handled carefully and it should not be folded or mutilated, as in such case it will not be properly evaluated by the machine.
12. No Electronic gadgets including calculators, mobiles, smart watches, blue tooth etc. shall be permitted inside the examination hall.
13. Rough work, if any, should be done on the blank sheets provided with the question booklet.
14. Ensure that the OMR Sheet is signed by the Examinee as well as by the invigilator.
15. At the end of the examination, fold the OMR Sheet along the crease on the top and tear off the top strip to separate the Original OMR Sheet from the Duplicate Copy.
16. Hand over the Original OMR answer sheet to the invigilator and retain the candidate's copy of OMR, Question Booklet and Admit card for your reference.
17. If any of the information in the response Sheet/Question Paper has been found missing or not mentioned as stated above, the candidate is solely responsible for that lapse.
18. Any deficiency on the OMR shall be the responsibility of the candidate himself/herself.

Section "A": Chemistry [Compulsory]

1. Which of the following conditions maximize the deviation of a real gas from ideal behavior?
   a. High pressure and low temperature
   b. Low pressure and high temperature
   c. Low pressure and low temperature
   d. High pressure and high temperature

2. Considering the Van der Waal's Equation, which of the following gases would you expect to have the highest 'a' value?
   a. Helium (He)
   b. Hydrogen (H_2)
   c. Neon (Ne)
   d. Ammonia (NH_3)

3. The plane with Miller indices (121) in a cubic crystal:
   a. is parallel to x and y axes but interests y axis at half unit length.
   b. intersects x and z axes at 1 unit length and y axis at 2 unit lengths
   c. intersects x and z axes at 1 unit length and y axis at half unit length
   d. is perpendicular to the y-axis and intersects the other two axes.

4. In a cubic crystal system with lattice constant a=4 Å, what is the spacing between the (200) planes?
   a. 2 Å
   b. 1 Å
   c. 4 Å
   d. 0.5 Å

5. Which of the following steps in the Born-Haber cycle is **endothermic**?
   a. Lattice formation
   b. Sublimation of metal
   c. Electron affinity
   d. Formation of ionic solid from gaseous ions

6. If the radius ratio of anionic solid is 0.52, what is the most likely coordination number?
   a. 3
   b. 4
   c. 6
   d. 8

7. Which of the following is paramagnetic according to Molecular Orbital theory?
   a. O_2
   b. N_2
   c. F_2
   d. Be_2

8. Which of the following compounds would be least expected to conduct electricity in the molten state, despite being formed from metal and non-metal?
   a. NaCl
   b. $CaCl_2$
   c. $AlCl_3$
   d. KBr

9. $[Cr(NH_3)_6]^{3+}$ shows a magnetic moment of ~3.87 B.M. The number of unpaired electrons is:
   a. 1
   b. 2
   c. 3
   d. 4

10. Werner predicted the structure of coordination complexes based on:
    a. modern orbital hybridization theory
    b. the color of compounds
    c. crystal field theory
    d. conductance and number of ions in solution

11. Which of the following hydroxides is least soluble in water?
    a. $Ba(OH)_2$
    b. $Mg(OH)_2$
    c. $Sr(OH)_2$
    d. $Ca(OH)_2$

12. Which noble gas forms stable compounds with fluorine and oxygen?
    a. Ne
    b. Ar
    c. Kr
    d. Xe

13. Which of the following carbocations is stabilized the most by hyperconjugation?
    a. $(CH_3)_3C^+$
    b. $CH_3CH_2^+$
    c. $CH_2{=}CHCH_2^+$
    d. $PhCH_2^+$

14. According to Hückel's Rule, a compound is aromatic if it has:
    a. Planar structure and 6n π-electrons
    b. Planar, cyclic structure with (4n+2) π-electrons
    c. Non-planar structure and (4n+2) π-electrons
    d. Non-cyclic structure with 4n π-electrons

15. Which of the following is the correct energy order for butane conformations?
    a. Anti < Gauche < Fully eclipsed
    b. Fully eclipsed < Gauche < Anti
    c. Gauche < Anti < Fully eclipsed
    d. Fully eclipsed < Anti < Gauche

16. Which of the following statements is false?
    a. Enantiomers are always chiral
    b. Meso compounds are optically inactive
    c. Diastereomers are always optically active
    d. A racemic mixture is optically inactive

17. The SN_1 reaction of a chiral alkyl halide gives a:
    a. Racemic mixture
    b. Product with inverted configuration only
    c. Product with retention of configuration only
    d. Mesocompound

18. Which of the following is a reagent for Wolff–Kishner reduction?
    a. Zn/HCl
    b. $NaBH_4$
    c. NH_2NH_2 and KOH in glycol
    d. $LiAlH_4$

19. In the Baeyer–Villiger oxidation, ketones are converted into:
    a. Esters
    b. Alcohols
    c. Acids
    d. Aldehydes

20. Which reaction involves the rearrangement of aryl esters into hydroxy aryl ketones using $AlCl_3$ or heat?
    a. Fries rearrangement
    b. Claisen rearrangement
    c. Reimer–Tiemann reaction
    d. Mannich reaction

21. The Gibbs-Helmholtz equation is used to calculate variation of:
    a. enthalpy with temperature
    b. Gibbs free energy with temperature
    c. entropy with pressure
    d. internal energy with volume

22. In a water-ice system, the solid–liquid phase boundary in a P–T diagram has a negative slope because:
    a. Water is denser than ice
    b. Enthalpy of fusion is zero
    c. Vapor pressure of ice is higher
    d. None of these

44. Which of the following is correct regarding RNA?
A) Can have catalytic activity
B) Can act as an adapter molecule
C) Can act as genetic material
D) All of the Above

45. Which of the following is *NOT* a type-2 restriction endonuclease?
A) XmaI
B) XhoI
C) EcoRI
D) None of the above

46. Which of the following reactions in molecular cloning is ATP dependent?
A) Restriction digestion
B) Phosphatase reaction
C) DNA ligation
C) All of the above

47. Pick the odd one out?
A) Plasmid
B) YAC
C) Cosmid
D) Phagemid

48. Annealing temperature in a PCR reaction is dependent upon:
A) Length of the primer
B) Base composition of the primer
C) Salt concentration of the buffer
D) All of the above

49. Which of the following acts as a reducing agent in SDS-PAGE?
A) SDS
B) B-Mercaptoethanol
C) Ammonium Persulphate
D) TEMED

50. Which of the following statements regarding Isoelectric focusing (IEF) is correct?
A) IEF is based on separation of molecules on the basis of their molecular weight
B) IEF is based on separation of molecules on the basis of their size
C) IEF is based on separation of molecules on the basis of their hydrodynamic shape
D) None of the above

51. Which of the following matrices is/are used in Western blotting?
A) Nylon
B) Polyvinylidene Difluoride
C) Nitrocellulose
D) All of the Above

52. Which of the following ELISA types is used to determine the concentration of small molecules in a biological sample?
A) Direct
B) Indirect
C) Competitive
D) Sandwich

53. In glycolysis, during oxidation, electrons are removed by:
A) NAD^+
B) FAD^+
C) $NADP^+$
D) None of the above

Section "B": Physics

33. A particle of mass m is moved from a distance r to 2r from a mass M. If U_1 and U_2 are the gravitational potential energies at distances r and 2r respectively, what is the ratio U_1: U_2
(A) 1:2
(B) -1:-2
(C) -2:-1
(D) 2:-1

34. The time dilation effect in Special Relativity implies that
(A) Moving clocks tick faster
(B) Moving clocks tick slower
(C) Time is absolute
(D) Time stops at high speeds

35. In a central force field, the potential energy U(r) of a particle depends only on
(A) The relative velocity of the particles
(B) The direction of motion of the particle
(C) The distance from the center of force
(D) The angular velocity of the particle

36. The total energy of a particle executing simple harmonic motion is
(A) Constant at all positions
(B) Zero at the mean position
(C) Maximum at the mean position
(D) Minimum at the extreme position

37. Faraday's law of electromagnetic induction states that
(A) A changing magnetic field induces an electric field
(B) A changing electric field induces a magnetic field
(C) Magnetic monopoles exist
(D) Electric fields are conservative

38. The polarization of an electromagnetic wave refers to
(A) The orientation of the magnetic field vector
(B) The frequency of the wave
(C) The speed of the wave
(D) The orientation of the electric field vector

39. The displacement current is included in Maxwell's equation to account for
(A) Static charges
(B) Changing magnetic fields
(C) Changing electric fields
(D) Steady currents

40. Lenz's law is a consequence of
(A) Newton's Third Law
(B) Conservation of charge
(C) Conservation of momentum
(D) Conservation of energy

41. The Zeroth Law of Thermodynamics introduces the concept of
(A) Temperature
(B) Entropy
(C) Internal energy
(D) Heat capacity

42. Wien's displacement law relates the wavelength of maximum emission of a blackbody to its
(A) Entropy
(B) Energy
(C) Temperature
(D) Pressure

43. The Rayleigh-Jeans law fails to explain blackbody radiation at
(A) Low frequencies
(B) High frequencies
(C) All frequencies
(D) none of the above

44. For a cyclic reversible process, the total change in entropy of the system is
(A) Zero
(B) Maximum
(C) Minimum
(D) Equal to the heat exchanged

45. Lissajous figures are used to study
(A) Superposition of waves
(B) Interference of light
(C) Diffraction patterns
(D) Polarization of light

46. The group velocity of a wave packet represents the velocity of
(A) The phase of the wave
(B) The envelope of the wave
(C) The individual wave components
(D) The energy of the wave

47. The resolving power of a diffraction grating depends on
(A) The number of slits
(B) The amplitude of the incident wave
(C) The width of the slits
(D) The distance between slits

48. The viscosity of a liquid is a measure of its
(A) Compressibility
(B) Density
(C) Resistance to flow
(D) Surface tension

49. In the Compton effect, the shift in wavelength depends on
(A) The intensity of incident radiation
(B) The angle of scattering
(C) The energy of incident photons
(D) Neutrons by protons

50. The eigen values of the Hamiltonian operator correspond to
(A) The mass of the nucleus
(B) Possible values of momentum
(C) Allowed values of energy
(D) Allowed values of time

51. The tunnel effect is a consequence of
(A) Wave nature of particles
(B) Particle nature of waves
(C) Classical mechanics
(D) Thermodynamics

52. Pair production involves the creation of
(A) Two electrons
(B) Two protons
(C) A proton and a neutron
(D) An electron and a positron

53. The spin-orbit coupling results in
(A) Splitting of energy levels
(B) Merging of energy levels
(C) No change in energy levels
(D) Shifting of energy levels

54. Which set contains only hadrons
(A) Electron, muon, neutrino
(B) Photon, kaon, electron
(C) Muon, tau, neutrino
(D) Proton, pion, neutron

55. The meson theory of nuclear forces explains the interaction between nucleons via the exchange of
(A) Photons
(B) Electrons
(C) Pions
(D) Gluons

56. The binding energy of a nucleus is the energy required to
    (A) Separate its nucleons
    (B) Combine its nucleons
    (C) Ionize its electrons
    (D) Excite its electrons

57. The Einstein model of specific heat assumes
    (A) Atoms vibrate collectively
    (B) Atoms vibrate independently
    (C) Electrons are free
    (D) Phonons are quantized

58. The Kronig-Penney model explains
    (A) Superconductivity
    (B) Specific heat anomaly
    (C) Quantum Hall effect
    (D) Origin of band gaps in solids

59. The concept of Brillouin zones is important in understanding
    (A) Electronic band structure
    (B) Thermal conductivity
    (C) Magnetic ordering
    (D) Optical properties

60. Electrical conductivity of intrinsic semiconductors with increasing temperature
    (A) Decreases
    (B) Remains constant
    (C) Increases
    (D) fluctuates

Section "B": Biology

33. Lecithin is a naturally existing emulsifying agent found in egg yolks, soya beans etc. It is a ..... in nature.
A) Polysaccharide
B) Protein
C) Lipid
C) Nucleic acid

34. Proteins do not usually have this as a major function:
A) Catalysis
B) Energy storage
C) Transport
D) Structural function

35. Which one of the following is *NOT* correctly matched?
A) Adenine and Guanine : Purines
B) Cytosine and Thymidine : Heterocyclic compounds
C) DNA building block : Nucleoside
D) DNA : Deoxyribose sugar

36. Which of the following is a sugar substitute used in chewing gums and candies?
A) Ribitol
B) Xylitol
C) Inositol
D) Mannitol

37. Which of the following statements is *NOT TRUE* about chromosomes?
A) Chromosomes are present within the nucleus
B) Chromosomes contain centromere but not a telomere
B) Chromosomes are made up of DNA in the form of chromatin and protein
C) All of the above

38. Cellular structures which aid in digestion of cellular as well as extracellular components:
A) Lysosomes
B) Peroxisomes
C) Liposomes
D) Glyoxysomes

39. Which of the following is *NOT* a common component of prokaryotic cell membranes?
A) Cholesterol
B) Lipids
C) Proteins
D) Carbohydrates

40. Which of the following membrane properties is temperature dependent?
A) Fluidity
B) Internal composition
C) Transport
D) Size

41. Which of the following is an alcoholic amino-acid pair group?
A) S, R
B) M, S
C) S, T
D) P, S

42. Which of the following is not correct?
A) LacA gene codes for β- galactoside transacetylase
B) LacY gene codes for β- galactoside permease
C) LacZ gene codes for β- galactosidase
D) None of the Above

43. A DNA sequence that binds regulatory proteins and is located at the front of the promoter or may overlap with it, is called:
A) Operator site
B) Suppressor site
C) Regulatory site
D) None of the above

23. The entropy of a substance at absolute zero is not zero if:
    a. It undergoes a phase change at 0 K
    b. It is perfectly crystalline
    c. It has residual (configurational) disorder
    d. Its heat capacity is zero

24. If the temperature of the hot reservoir is 500 K and the cold reservoir is 300 K, what is the efficiency of the Carnot engine?
    a. 0.4
    b. 0.6
    c. 0.25
    d. 0.5

25. Which of the following is true about molar conductivity of strong electrolytes as per Debye-Hückel-Onsager equation?
    a. It increases linearly with concentration
    b. It remains constant with dilution
    c. It decreases linearly with square root of concentration
    d. It increases with square root of concentration

26. For $BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$, if solubility is s, then K_{sp} is expressed as:
    a. s
    b. s^2
    c. $2s^2$
    d. s^3

27. Calculate the electrode potential of a Zn electrode in 0.01 M Zn^{2+} at 25°C. (Standard electrode potential of $Zn^{2+}/Zn = -0.76$ V)
    a. –0.82 V
    b. –0.70 V
    c. –0.76 V
    d. –0.68 V

28. In a saturated calomel electrode (SCE), the reference reaction involves:
    a. Ag^+/Ag
    b. $Hg_2Cl_2(s) + 2e^- \rightleftharpoons 2Hg(l) + 2Cl^-$
    c. $Cl_2 + 2e^- \rightleftharpoons 2Cl^-$
    d. $H^+ + e^- \rightleftharpoons \frac{1}{2} H_2(g)$

29. The half-life of a first-order reaction is independent of:
    a. Rate constant
    b. Initial concentration
    c. Temperature
    d. Activation energy

30. Paper chromatography separates components based on their:
    a. Size and shape
    b. Solubility and adsorption
    c. Molecular weight
    d. Boiling point

31. The instrument used to measure surface tension is:
    a. Viscometer
    b. Capillary tube
    c. Stalagmometer
    d. Manometer

32. Which of the following compounds can be purified by sublimation?
    a. NaCl
    b. Benzoic acid
    c. Camphor
    d. Glucose

Important Note: This section is followed by:
- ✓ Section "B" – Physics, and
- ✓ Section "C" – Biology.

You are required to attempt all 28 (33 to 60) questions either from Physics or from Biology

54. The rate-limiting step of fatty acid oxidation in the mitochondria is catalyzed by:
A) Carnitine : Palmitoyl Transferase I (CPT I)
B) Acyl CoA dehydrogenase
C) Enoyl CoA hydratase
B) β-keto thiolase

55. Aspartate aminotransferase uses which of the following substrates to generate aspartate and α-ketoglutarate?
A) Glutamate and Malonate
B) Glycine and Oxaloacetate
C) Glutamate and Oxaloacetate
D) Glutamate and Pyruvate

56. Phenylketonuria (PKU), an inherited error of metabolism, is caused by deficiency of which of the following enzyme?
A) Phenylalanine reductase
B) Phenylalanine transferase
C) Phenylalanine carboxylase
D) Phenylalanine hydoxylase

57. A child presented to a clinic with runny nose and symptoms of asthma. Which of the following blood cells can be expected to be elevated in Complete Blood Count?
A) Basophils
B) Neutrophils
C) Eosinophils
D) Monocytes

58. Which of the following is a thymus independent type I antigen?
A) Bacterial nucleic acids
B) Bacterial polysaccharide
C) Viral Nucleic acids
D) Bacterial proteins

59. Which of the following contributes to lymphocyte maturation in humans?
A) Bone marrow
B) Lymph nodes
C) Tonsils
D) Spleen

60. Monoclonal antibodies (mab) have a wide range of clinical applications like card-based tests for pregnancy, viruses etc. Which of the following best describes them?
A) They are dissimilar and originate from multiple cells
B) They are dissimilar and originate from single cell
C) They are identical and originate from multiple cells
D) They are identical and originate from single cell

Sr. No. 100

ENTRANCE TEST-2024

SCHOOL OF BIOLOGICAL SCIENCES

NANOTECHNOLOGY

Total Questions : 60 **Question Booklet Series** **D**

Time Allowed : 70 Minutes **Roll No. :** | | | | | | |

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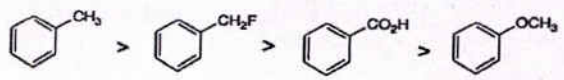
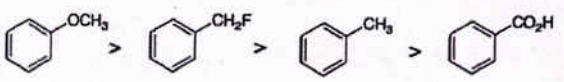
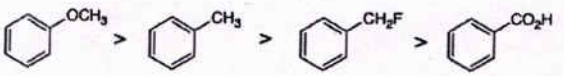
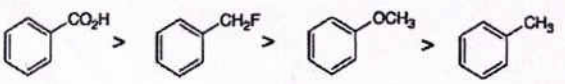
SEAL

CHEMISTRY

1. Bomb calorimeter is used to determine _____.
   (A) molar heat capacity
   (B) heat of combustion
   (C) rate kinetics
   (D) affinity

2. SN1 reaction of an optically active substrate results in :
   (A) Racemization
   (B) Retention of configuration
   (C) Inversion of configuration
   (D) Optical Resolution

3. Which is the correct order of reactivity (most reactive to least reactive) toward electrophilic aromatic substitution ?
   (A) 
   (B) 
   (C) 
   (D) 

4. How many pairs of degenerate π molecular orbitals are found in benzene ?
   (A) Three
   (B) Two
   (C) Four
   (D) Six

5. The stereoisomers which can be interconverted by rotation of single bond are called :
   (A) Conformational isomers
   (B) Configurational isomers
   (C) Geometrical isomers
   (D) Chain isomers

6. In Newman projection formula, front carbon atom is shown by a _____.
   (A) Circle
   (B) Ellipse
   (C) Dot
   (D) Line

7. Heterolysis of which of the following bonds is likely to form a carbanion ?
   (A) C-CI
   (B) C-Mg
   (C) C-O
   (D) C-N

8. Cannizzaro reaction involves migration of which of the following species ?
   (A) Proton
   (B) Hydride ion
   (C) Carbene
   (D) Carbanion

9. In Clemmensen Reduction carbonyl compound is treated with _____.

(A) Zinc amalgam + HCl

(B) Sodium amalgam + HCl

(C) Zinc amalgam + nitric acid

(D) Sodium amalgam + HNO_3

10. Which of the following compounds has three equatorial positions occupied by nonbonding electron density ?

(A) $AlCl_3$

(B) XeF_2

(C) Dicholordiamino platinum

(D) Alkyl magnesium bromide

11. Solubility of Potassium chloride shall be minimum in :

(A) Water

(B) Methanol

(C) Acetic acid

(D) Dimethyl ketone

12. Which of the following statements is *FALSE* about the Born-Haber cycle ?

(A) The cycle is an application of Hess Law

(B) It can be used to determine the lattice energy of an ionic solid

(C) The cycle helps in determining the amount of activation energy involved in a reaction

(D) It can be used to calculate the electron affinity of an atom

13. If the water molecule is linear :

(A) it would have a very high boiling point

(B) it would be highly reactive

(C) its dipole moment would be zero

(D) it would be highly ionic

14. Maxwell distribution of molecular velocities says that the fraction of total gas molecules that has acquired the most probable velocity will _____ with the increase in temperature.

(A) increase

(B) decrease

(C) remains constant

(D) can't say if we do not know the pressure

15. The unit of "a" in Van der Waals equation for one mole would be :

(A) Nm^2

(B) Nm^3

(C) Nm^4

(D) Nm^5

16. Which of the following has the highest value for a gas at a given temperature ?

(A) RMS velocity

(B) Average velocity

(C) Most probable velocity

(D) (A) and (C) have the same value and higher than (B)

17. For a cubic crystal with dimensions "a", the Miller indices of the planes for which interplanar spacing is "a" would be :

(A) 100

(B) 110

(C) 200

(D) 300

18. Which of the following coordination compounds cannot produce a white precipitate on reaction with silver nitrate ?

(A) $[Co(NH_3)_3Cl_3]$

(B) $[Co(NH_3)_4Cl_2]Cl$

(C) $[Co(NH_3)_5Cl]Cl_2$

(D) $[Co(NH_3)_6]Cl_3$

19. The effective nuclear charge experienced by a valence p- electron in a boron atom calculated using Slater rules is :

(A) 3.5

(B) 4.5

(C) 4.8

(D) 2.6

20. In the case of the complex $[Ti(H_2O)_6]^{2+}$, the geometry, the number of d-electrons and the magnetic character respectively is :

(A) octahedral, 2, paramagnetic

(B) octahedral, 6, paramagnetic

(C) octahedral, 2, diamagnetic

(D) tetrahedral, 2, paramagnetic

21. The complex with maximum CFSE is :

(A) $[CoCl_4]^{2-}$

(B) $[Co(H_2O)_6]^{3+}$

(C) $[CoF_3(H_2O)_3]$

(D) $[CoF_6]^{3+}$

22. Which of the following thermodynamic laws introduces the concept of entropy ?

(A) Zeroth law of Thermodynamics

(B) First law of Thermodynamics

(C) Second law of Thermodynamics

(D) Third law of Thermodynamics

23. During the isothermal expansion of an ideal gas, which of the following thermodynamic quantities are zero ?

(A) DH

(B) DU

(C) w

(D) All of these

24. The number of the components present in the system KCl-NaBr-H_2O are :

(A) 3

(B) 4

(C) 2

(D) 1

25. C_v is given by :

(A) $(\partial E/\partial T)_V$

(B) $(\partial E/\partial V)_T$

(C) $(\partial E/\partial P)_V$

(D) $(\partial V/\partial T)_P$

26. For the first-order reaction, after two half lives, the concentration of reactant is reduced to _____.

(A) 25%

(B) 75%

(C) 100/e %

(D) $100/e^2$ %

27. Molar conductance at infinite dilution for a compound AB is 145.0 Scm^2mol^{-1} and for CB is 110.1 Scm^2mol^{-1}. Limiting molar conductance for A^+ is 73.5 Scm^2mol^{-1}. What is limiting molar conductance for C^+ ion ?

(A) 326.6 Scm^2mol^{-1}

(B) 38.6 Scm^2mol^{-1}

(C) 181.6 Scm^2mol^{-1}

(D) 90.8 Scm^2mol^{-1}

28. Which of the electrodes is mostly used as indicating electrode of pH ?

(A) Calomel electrode

(B) Quinhydrone electrode

(C) Glass electrode

(D) Silver electrode

29. For a reaction, $A(g) + 2B(g) \rightarrow C(g) + D(g)$, $dx/dt = k\,[A][B]$. The initial concentrations of A and B are respectively 0.1 M and 0.2 M. Now if the concentration of both A and B are reduced to 0.05 M, then the rate of reaction relative to the initial value would be :

(A) 1/6

(B) 1/8

(C) 1/12

(D) 1/200

30. Find the concentration of HCl, if 10 ml of 0.5 M $Ca(OH)_2$ is required to titrate 50 ml of HCl.

(A) 1/10 M

(B) 1/5 M

(C) 5 M

(D) 10 M

31. When sodium nitroprusside is added to Lassagne's extract, a violet colour is formed. It indicates the presence of _____.

(A) Sulphur

(B) Halogens

(C) Nitrogen

(D) Hydrogen

32. What is the SI unit of viscosity ?

(A) Candela

(B) Poiseuille

(C) Newton/m

(D) No units

PHYSICS

33. Which of the following statement is *CORRECT* ?

(A) The interference pattern in Michelson interferometer is based on the principle of division of wave-front

(B) The interference pattern in Young's two slit experiment is based on the principle of division of amplitude

(C) A Michelson interferometer is basically a multiple-wave interferometer

(D) Two-wave interference is characterized by a sinusoidal variation of light intensity with phase difference between the interfering waves

34. Poiseuille's formula for the volume 'V' of a liquid of density 'ρ' flowing in time 't' through a capillary tube of length 'L' and radius 'r' under a pressure difference 'P' between the ends of the tube is :

(A) $V = (\pi Prt)/(8L\eta)$

(B) $V = (\pi Prt^4)/(8L\eta)$

(C) $V = (\pi P^4rt)/(8L\eta)$

(D) $V = (\pi Pr^4t)/(8L\eta)$

35. In a typical common emitter amplifier having a certain voltage gain, if the emitter bypass capacitor is removed then :

(A) The circuit will become unstable

(B) The voltage gain will decrease

(C) The voltage gain will increase

(D) The input impedance will decrease

36. If v_g represents the group velocity of waves in a certain medium, while its phase velocity is represented by v_p, then which of the following is correct ?

(A) for a normal dispersive medium, $v_p < v_g$

(B) for a non-dispersive medium, $v_p > v_g$

(C) for an anomalously dispersive medium, $v_p < v_g$

(D) for a normal dispersive medium, $\frac{dv_p}{d\lambda} < 0$, where λ represents the wavelength

37. In a photoelectric effect experiment, ultraviolet light of wavelength 320×10^{-9} m falls on the photocathode with work function of 2.1 eV. The stopping potential should be approximately equal to :

(A) 1.6 Volts

(B) 1.8 milli Volts

(C) 1.6 milli Volts

(D) 1.8 Volts

38. The number of normal Zeeman splitting components of $^1P \rightarrow {}^1D$ transition is :

(A) 4

(B) 2

(C) 3

(D) 6

39. The approximate transmission probability T for a particle, of mass m and energy E, to tunnel through the barrier, of height U and width L, is proportional to (where h is the Planck's constant) :

(A) $\exp\left(-4\pi\frac{\sqrt{(U-E)}}{2mh}\right)$

(B) $\exp\left(-4\pi\frac{\sqrt{2m(U-E)}}{h^2}\right)$

(C) $\exp\left(-4\pi\frac{\sqrt{2m(U-E)}}{h}\right)$

(D) $\exp\left(-4\pi\frac{\sqrt{(U-E)}}{2mh^2}\right)$

40. Given two vectors $\vec{A}$ and $\vec{B}$,

$\vec{A} = (2\hat{i} - 5\hat{j} + 2\hat{k})$

$\vec{B} = (4\hat{i} - 10\hat{j} + c\hat{k})$

What should be the value of 'c' so that $\vec{A}$ and $\vec{B}$ would become parallel to each other ?

(A) 1

(B) 2

(C) 3

(D) 4

41. If a particle is moving in a central force field, then which of the conservation laws is responsible for its motion to be restricted in a plane ?

(A) conservation of angular momentum

(B) conservation of energy

(C) conservation of linear momentum

(D) conservation of mass

42. Which of the following statements regarding the Galilean transformation is true ?

(A) It describes the transformation between inertial reference frames moving at constant velocities relative to each other

(B) It describes the transformation between inertial reference and non-inertial frames moving at constant velocities relative to each other

(C) It predicts the constancy of the speed of light in all inertial reference frames

(D) It applies to both linear and rotational motion

43. Which of the following statement is wrong regarding an electrostatic field E that exists in a given region R ?

(A) Curl of E is zero

(B) E can always be expressed as the gradient of a scalar field

(C) The potential difference between any two arbitrary points in the region R is zero

(D) The work done in a closed path lying entirely in R is zero

44. Which of the following statement is *NOT CORRECT* about Maxwell's Equations ?

(A) Maxwell's equations are not invariant in form under Lorentz transformations

(B) Maxwell's equations in free space are invariant under Lorentz transformation

(C) Maxwell's equations show that electromagnetic waves travel with the same speed in every inertial frame

(D) Maxwell's equations form the foundation of classical electromagnetism, classical optics and electric circuits

45. For isotropic dielectric media, the relative electric permittivity is a :

(A) Vector quantity

(B) Second-order Tensor quantity

(C) Scalar quantity

(D) None of the above because relative permittivity cannot be defined for an isotropic medium

46. The quantum mechanical operator for the Kinetic energy of a particle moving in one dimension is given by :

(A) $\frac{\hbar}{2m}\frac{d^2}{dx^2}$

(B) $-\frac{i\hbar}{2m}\frac{d}{dx}$

(C) $\frac{i\hbar}{2m}\frac{d}{dx}$

(D) $-\frac{\hbar^2}{2m}\frac{d^2}{dx^2}$

47. The ground state wavefunction for the hydrogen atom is proportional to :

(A) $\exp\left(\frac{-r}{a_0}\right)$

(B) $\exp\left(\frac{-r^2}{a_0}\right)$

(C) $\exp\left(\frac{r^2}{a_0}\right)$

(D) $\exp\left(\frac{r}{a_0}\right)$

48. A system has N non-degenerate eigen states populated by N non-interacting and distinguishable spin-zero particles in thermodynamic equilibrium. The entropy of the system is :

(A) $2\ k_B\ T\ \ln N$

(B) $3\ k_B\ T\ \ln N$

(C) $2N\ k_B\ \ln 3$

(D) $2N\ k_B\ \ln 2$

49. A Carnot cycle operates on a working substance between two reservoirs at temperatures T1 and T2 with T1 > T2. During each cycle, an amount of heat Q1 is extracted from the reservoir at T1 and an amount Q2 is delivered in the reservoir at T2. Which of the following statements/equations is NOT correct ?

(A) Entropy of the hotter reservoir decreases

(B) Entropy of the universe increases

(C) Work done in one cycle is equal to Q1 – Q2

(D) $\frac{Q1}{T1} = \frac{Q2}{T2}$

50. Two gases separated by an impermeable but movable partition are allowed to freely exchange energy. At equilibrium, the two sides will have the same :

(A) Volume and energy

(B) Volume and temperature

(C) Pressure and volume

(D) Pressure and temperature

51. Which of the following statement is correct ?

(A) Stefan-Boltzmann law states that the total rate of emission of radiant energy by a body per unit area is related to energy density as fifth power of its temperature

(B) Rayleigh-Jeans formula for the distribution of energy treats blackbody radiation as photons which arise due to multiple reflections at the walls of the enclosure

(C) According to Planck, blackbody radiation chamber is filled up not only with radiation but also with quantum resonators which exchange energy with the radiation

(D) According to Rayleigh-Jeans formula the energy density of Blackbody spectrum within the wavelength range λ and $\lambda + d\lambda$ is directly proportional to the fourth power of the wavelength

52. A primitive unit cell of a lattice has the following primitive vectors :

$$\vec{a}_1 = \frac{a}{2}(\hat{i} + \hat{j} + \hat{k})$$

$$\vec{a}_2 = \frac{a}{2}(-\hat{i} + \hat{j} + \hat{k})$$

$$\vec{a}_3 = \frac{a}{2}(\hat{i} - \hat{j} + \hat{k})$$

The reciprocal lattice corresponding to the above direct lattice is :

(A) Face centred cubic

(B) Body centred cubic

(C) Simple cubic

(D) Hexagonal

53. Particles that participate in the Strong Interactions are called :

(A) Neutrinos

(B) Leptons

(C) Hadrons

(D) Photons

54. An RC network produces a phase-shift of 60°. The number of such RC networks, that can be cascaded together and connected to a Common Emitter amplifier so that the final circuit behaves as an oscillator, are :

(A) 6

(B) 12

(C) 18

(D) 3

❋❋❋❋

55. Which of the following statements is related to the observation that a heavy nucleus contains more neutrons than protons ?

(A) The nuclear force holding neutrons together in the nucleus is stronger compared to the force between protons

(B) The range of the nuclear force between protons is shorter than that between neutrons, resulting in fewer protons being bound together by this force

(C) Due to their instability, the number of protons within a nucleus decreases over time

(D) It costs more energy to add a proton to a (heavy) nucleus than a neutron because of the Coulomb repulsion between protons

56. At low temperatures, the behaviour of the lattice contribution to the specific heat of a 3D solid will depend as a function of temperature T :

(A) C_v is proportional to T

(B) C_v is proportional to T^3

(C) C_v is proportional to T^2

(D) C_v is inversely proportional to T

57. For a free particle the following process is forbidden because :

$$p^+ \rightarrow n + e^+ + \nu_e$$

where n , e^+, ν_e is a neutron, a positron and a neutrino respectively.

(A) It violates the conservation of angular momentum

(B) It violates the conservation of energy

(C) A proton cannot decay into a neutron even inside the nucleus

(D) It violates the conservation of linear momentum

58. The bound state of an electron and a positron is called positronium. If the ground state energy of the hydrogen atom is –13.6 eV, the ground state energy of positronium will be :

(A) –8.6 eV

(B) –13.6 eV

(C) –10.4 eV

(D) –6.8 eV

59. The magnetic field at a distance d from an infinite straight wire carrying a steady current I is proportional to :

(A) I/d

(B) I^2/d

(C) I d

(D) None of the above

60. The interference pattern on a screen is created by illuminating the slits of a double slit interference setup with a collimated white light source. Which of the following statements about a red filter covering one slit is true ?

(A) No interference pattern is observed after the slit is covered with the red filter

(B) Interference pattern remains unchanged with and without the red filter

(C) A red interference pattern is observed

(D) The central maximum is red with coloured higher order maxima

OR

BIOLOGY

(Biochemistry & Biotechnology)

33. Which of the following covalent bond types are found in the structure of ATP ?

(A) N-glycosidic, thioester, phosphodiester bond

(B) N-glycosidic, phosphoanhydride, phosphomonoester bond

(C) Ester, ether, N-glycosidic bond

(D) Thioester, ether, N-glycosidic bond

34. The first committed step in glycolysis is mediated by :

(A) Hexokinase

(B) Phosphofructokinase-1

(C) Aldolase

(D) Enolase

35. Cori cycle takes place in :

(A) Kidney and liver

(B) Heart and muscle

(C) Muscle and liver

(D) Liver and heart

36. Which of the following is the prosthetic group of acyl carrier protein ?

(A) 4'-phosphopantetheine

(B) 3'-phosphopantetheine

(C) 2'-phosphopantetheine

(D) 1'-phosphopantetheine

37. Which of the following statements does NOT apply to IgG ?

(A) Appears early in the primary immune response

(B) Neutralizes bacterial toxins

(C) Can fix complement

(D) Crosses the human placenta

38. Which of the following is involved in type I hypersensitivity ?

(A) IgE

(B) IgG

(C) IgA

(D) IgM

39. Which of these cell types is an important antigen presenting cell?

(A) Helper T cells

(B) Natural Killer cells

(C) Dendritic cells

(D) Epithelial cells

40. Lacrimal secretions contain :

(A) IgG

(B) IgM

(C) IgA

(D) IgE

41. Which of the following are the aromatic amino acids ?

(A) Serine and Threonine

(B) Phenylalanine and Tyrosine

(C) Alanine and Proline

(D) Lysine and Histidine

42. The reducing disaccharide cellobiose is linked by :

(A) α 1-6 glycosidic linkage

(B) β 1-4 glycosidic linkage

(C) α 1-4 glycosidic linkage

(D) β 1-6 glycosidic linkage

43. CH_3-$(CH_2)_{14}$-COOH is the condensed structural formula of :

(A) Palmitic acid

(B) Stearic acid

(C) Caproic acid

(D) Lauric acid

44. The degree of inhibition α by a competitive inhibitor is obtained from :

(A) Measurement of Vmax

(B) Measurement of the y-intercept on a Lineweaver-Burk Plot

(C) Measurement of K_M

(D) Is unrelated to the binding affinity of the inhibitor to the enzyme

45. Fluid mosaic model of the cell membrane was given by :

(A) Gorter and Grendel

(B) Henderson and Unwin

(C) Davson and Danielli

(D) Singer and Nicolson

46. The ribosome in eukaryotic cell is made up of :

(A) 50S and 30S subunits

(B) 60S and 40S subunits

(C) 50S and 40S subunits

(D) 60S and 30S subunits

47. Which of the following is absent in Gram +ve bacteria ?

(A) Peptidoglycan

(B) Flagella

(C) Lipopolysaccharide

(D) Cell wall

48. During which phase the chromosomes condense and move together, aligning in the center of the dividing cell ?

(A) Metaphase

(B) Prophase

(C) Telophase

(D) Anaphase

49. Topoisomerases help in :

(A) Elongation of DNA strand

(B) Relaxing supercoiled DNA

(C) Decatenating of interlocked DNA

(D) Both (B) and (C) are correct

50. Which of the following is the stop codon ?

(A) AUG

(B) GUG

(C) UAA

(D) None of the above

51. Edwards syndrome is :

(A) Trisomy 21

(B) Trisomy 13

(C) Trisomy 18

(D) XXY

52. Which of the following events will cause the E. coli's lac operon to operate ?

(A) Glucose absence, Lactose presence

(B) Glucose absence, Lactose absence

(C) Glucose presence, Lactose presence

(D) Glucose presence, Lactose absence

53. Which of the following hormones, first produced by recombinant DNA technology was approved by FDA in 1982 ?

(A) Melatonin

(B) Insulin

(C) Estrogen

(D) Glucagon

54. Which of the following statements about phagemids is *INCORRECT* ?

(A) They are filamentous-phage-derived vectors containing the replication origin of a plasmid

(B) They usually encode no or only one kind of coat proteins

(C) Structural and functional proteins necessary to accomplish the life cycle of phagemid are provided by the helper phage

(D) Are devoid of restriction enzymes recognition sites

55. Which of the following type of restriction endonuclease targets methylated DNA ?

(A) Type I

(B) Type II

(C) Type III

(D) Type IV

56. The temperature at which the denaturation of DNA occurs in PCR :

(A) 60°C

(B) 70°C

(C) 94°C

(D) 90°C

57. In agarose gel electrophoresis, the rate of migration of a DNA molecule through the gel is determined by :

(A) Size and conformation of DNA molecule

(B) Type of agarose and its concentration

(C) Presence of ethidium bromide

(D) All of the above

58. Southern blotting is a technique for detection and quantification of :

(A) DNA

(B) RNA

(C) Proteins

(D) All of the above

59. What is the role of goat anti-rabbit IgG horseradish peroxidase conjugate in an ELISA experiment ?

(A) Primary Antibody

(B) Secondary Antibody

(C) Substrate

(D) None of the above

60. The use of green fluorescent protein in flow cytofluorimetry permits measurement of :

(A) Cell size

(B) Cell granularity

(C) DNA content

(D) Intracellular gene expression