1-MSC-FS - Provisional Answer Key

1. The outer layer of the blastocyst, which later attaches to the uterus, is the:

   (A) Decidua (B) Trophoblast

   (C) Amnion (D) Inner cell mass

2. From which germ layer the skeletal muscles, heart, and skeleton are derived?

   (A) Ectoderm (B) Endoderm

   (C) Mesoderm (D) Coelom

3. Which of the following cannot pass through placental barriers in case of humans?

   (A) Blood cells (B) Glucose

   (C) Amino acids (D) Gases

4. Sertoli cells perform all of the following functions EXCEPT:

   (A) Provide nutrition to developing sperms (B) Phagocytose degenerating cells

   (C) Form blood-testis barrier (D) Secrete testosterone

5. Amniocentesis is primarily performed to detect:

   (A) Maternal infections (B) Chromosomal abnormalities in fetus

   (C) Multiple pregnancies (D) Placental abnormalities

6. Which of the following statement is INCORRECT with respect to RNA in eukaryotes?

   (A) Mutates at faster rate

   (B) Contains Ribose sugar which is more reactive

   (C) Suitable for the storage of genetic information

   (D) Contains Uracil

7. Which region(s) of the promoter sequence act as consensus sequence and bind(s) with the σ 70 (sigma 70) factor of RNA polymerase in *E.coli*?

   (A) (-10) and (B) (-35) only

   (C) (+1) only (D) (-10) and (-35) both

8. _____ subunit/complex of DNA pol-II acts as clamp loader on the lagging strand at each okazaki fragment.

   (A) α (Alpha) (B) β (Beta)

   (C) γ (Gamma) (D) λ(Lamda)

9. Industrial melanism in *Biston betularia* is an example of:

   (A) Directional selection (B) Stabilizing selection

   (C) Disruptive selection (D) Non-disruptive selection

10. The Hardy-Weinberg equilibrium is maintained when:

    (A) Mutations occur frequently

    (B) Population size is small

    (C) Mating is random and no evolutionary forces act

    (D) Natural selection is strong

11. Convergent evolution results in:

    (A) Homologous structures (B) Analogous structures

    (C) Vestigial structures (D) Atavistic structures

12. **Identify the pair which is matched correctly with reference to types of species that arise after speciation.**

(A) Allopatric Species -Species inhabiting same geographical areas

(B) Sibling Species- Species which are morphologically similar and can interbreed

(C) Parapatric Species-Species occupying separate areas, that share a common boundary

(D) Sympatric Species-Species inhabiting the different geographical area

13. **Lipid rafts in cell membranes are enriched in:**

(A) Phosphatidylserine and cholesterol **(B) Sphingolipids and cholesterol**

(C) Phosphatidylinositol and proteins **(D) Cardiolipin and proteins**

14. **Which carbohydrate linkage would be most resistant to enzymatic hydrolysis in the human digestive system?**

(A) α-1,4-glycosidic bonds in starch **(B) α-1,6-glycosidic bonds in glycogen**

(C) β-1,2-glycosidic bonds in sucrose **(D) β-1,4-glycosidic bonds in cellulose**

15. **The signal sequence on the protein targeted for ER is typically:**

(A) A hydrophobic sequence at the N-terminus

(B) Located at the C-terminus of proteins

(C) A nuclear localization signal

(D) Signal sequences distributed throughout the protein

16. ***Drosophila melanogaster* is particularly valuable for studying:**

(A) Plant development **(B) Adaptive Immune system function**

(C) Developmental genetics and behavior **(D) Photosynthesis mechanisms**

17. **Which of the following statement is CORRECT regarding the electron transport chain in cellular respiration:**

(A) Occurs in the mitochondrial matrix

(B) Creates a proton gradient across the inner mitochondrial membrane

(C) Directly produces ATP through substrate-level phosphorylation

(D) Requires oxygen as the final electron donor

18. **To isolate histidine auxotrophs, which of the following step(s)/method should be chosen:**

(A) Medium lacking histidine to select for mutants

(B) Antibiotic selection

(C) Medium without antibiotics

(D) Replica plating technique with and without histidine

19. **Plasmids are important in molecular biology because they:**

(A) Are essential for bacterial survival **(B) Always integrate into the chromosome**

(C) Can be used as cloning vectors **(D) Only replicate during cell division**

20. **Transduction differs from transformation, where**

(A) Transduction involves bacteriophages as vectors

(B) Transduction requires direct cell contact between two bacterial cells

(C) Transduction only transfers plasmid DNA

(D) Transduction occurs only in gram-positive bacteria

21. **GABA (gamma-aminobutyric acid) is primarily:**

(A) Excitatory neurotransmitter in the brain **(B) Neurotransmitter at neuromuscular junctions**

(C) Hormone in the endocrine system **(D) Inhibitory neurotransmitter in the brain**

22. The Michaelis constant (Km) represents:

(A) Maximum velocity of an enzyme

(B) Substrate concentration at half-maximal velocity

(C) Enzyme concentration at the beginning of the reaction

(D) Product concentration at equilibrium

23. Which of the following statement is TRUE for an allosteric enzyme ?

(A) Has only one binding site (B) Cannot be inhibited

(C) Shows sigmoidal kinetics (D) Has linear kinetics

24. Feedback inhibition in metabolic pathways typically involves:

(A) The first enzyme being inhibited by the substrate

(B) Only positive regulation

(C) Random enzyme inhibition

(D) The final product inhibiting the first committed enzyme

25. The first acceptor of carbon dioxide in C_4 photosynthesis, is

(A) ribulose 1, 5-bisphosphate (B) phosphoenol pyruvate

(C) oxaloacetic acid (D) 3-phosphoglycerate

26. The entropy of a reversible process:

(A) Decreases (B) Increases

(C) Remains constant (D) Becomes zero

27. The solution to the one-dimensional time-independent Schrödinger equation in a finite potential well is:

(A) Exponential only (B) Sinusoidal only

(C) Sinusoidal inside, exponential outside (D) Constant everywhere

28. The resonance condition in a driven harmonic oscillator occurs when:

(A) Driving frequency is zero

(B) Driving frequency equals damping frequency

(C) Driving frequency equals natural frequency

(D) Driving frequency equals twice the natural frequency

29. Which law governs the electromagnetic induction phenomenon?

(A) Ampere's Law (B) Faraday's Law

(C) Gauss's Law (D) Lenz's Law

30. Which of the following is NOT a scalar quantity?

(A) Temperature (B) Work

(C) Electric potential (D) Impulse

31. Which of the following statements about the wave function is true?

(A) It represents the momentum of a particle

(B) Its square gives the probability density

(C) It always has a real value

(D) It represents the force on a particle

32. The Compton effect demonstrates:

(A) Wave nature of electrons (B) Particle nature of light

(C) Photoelectric effect (D) Quantization of energy

33. In a damped harmonic oscillator, the amplitude:

(A) Increases with time
(B) Remains constant
(C) Decreases exponentially with time
(D) Is independent of damping

34. The condition for constructive interference is:

(A) Path difference = odd multiple of λ/2
(B) Path difference = integral multiple of λ
(C) Phase difference = π
(D) Amplitude difference = maximum

35. The moment of inertia of a uniform solid sphere about its diameter is:

(A) (2/5)MR²
(B) (1/2)MR²
(C) (2/3)MR²
(D) MR²

36. What is the wavelength of an electron moving with velocity v according to de Broglie's hypothesis?

(A) λ = h/v
(B) λ = h/mv
(C) λ = mv/h
(D) λ = hv

37. Which thermodynamic process occurs at constant pressure?

(A) Isothermal
(B) Adiabatic
(C) Isochoric
(D) Isobaric

38. In simple harmonic motion, the total energy is proportional to:

(A) Amplitude
(B) Amplitude²
(C) Frequency
(D) Time

39. Which one of the following has the highest refractive index?

(A) Air
(B) Water
(C) Glass
(D) Diamond

40. Which law of thermodynamics defines entropy?

(A) Zeroth Law
(B) First Law
(C) Second Law
(D) Third Law

41. Which principle states that two identical fermions cannot occupy the same quantum state?

(A) Heisenberg principle
(B) Bohr's postulate
(C) Pauli exclusion principle
(D) Rutherford model

42. Which concept best explains the behavior of electrons in an energy band of a solid?

(A) Thermal expansion
(B) Classical mechanics
(C) Quantum mechanics
(D) Magnetic flux

43. Which astronomical object is known for having an escape velocity greater than the speed of light?

(A) White dwarf
(B) Neutron star
(C) Black hole
(D) Red giant

44. What is the primary reason a satellite stays in orbit around the Earth?

(A) Earth's magnetism
(B) Gravitational force
(C) Solar radiation pressure
(D) Tidal forces

45. Which optical phenomenon causes the sky to appear blue during the day?

(A) Reflection
(B) Diffraction
(C) Rayleigh scattering
(D) Total internal reflection

46. Which device is used to measure atmospheric pressure?

(A) Thermometer (B) Barometer

(C) Hydrometer (D) Altimeter

47. Which of the following is not a unit of energy?

(A) Joule (B) Calorie

(C) Watt (D) Electronvolt

48. Which type of lens is used to correct myopia (short-sightedness)?

(A) Convex lens (B) Concave lens

(C) Cylindrical lens (D) Bifocal lens

49. Which characteristic of a wave determines its loudness?

(A) Wavelength (B) Amplitude

(C) Frequency (D) Speed

50. Which principle is used in hydraulic brakes?

(A) Pascal's Principle (B) Archimedes' Principle

(C) Bernoulli's Principle (D) Newton's Law

51. If the ionization potential of Na is 5.48 eV. Potassium is expected to have a value of

(A) 5.48 eV (B) 4.34 eV

(C) 5.68 eV (D) 8.4 eV

52. A bottle of dry ammonia and a bottle of dry hydrogen chloride connected through a long tube are opened simultaneously at both ends, the white ammounium chloride ring first formed will be

(A) At the centre of the tube (B) Near the hydrogen chloride bottle

(C) Near the ammonia bottle (D) Throughout the length of the tube

53. Which of the following crystal types has generally low melting point?

(A) Ionic crystals (B) Molecular crystals

(C) Covalent crystals (D) Metallic crystals

54. Which of the following statements is not correct?

(A) Special stability of half-filled and fully-filled atomic configurations amongst s- and p-block elements is reflected in ionization potential trends along a period.

(B) Special stability of half-filled and fully-filled atomic configurations amongst s- and p-block elements is reflected in electron affinity trends along a period.

(C) Aufbau order is not obeyed in cases where energy difference between ns and (n – 1)d subshell is large.

(D) Special stability of half-filled subshell is attributed to higher exchange energy of stabilization.

55. Which of the following spectral series of hydrogen atom lies in the far infrared region of electromagnetic radiation?

(A) Lyman (B) Balmer

(C) Paschen (D) Pfund

56. Which of the following is expected to have largest bond dissociation enthalpy?

(A) HF (B) HCl

(C) HBr (D) HI

57. Mixing of 0.1 mol of NaOH and 0.1 mol of acetic acid in one litre of water results into

(A) An acidic solution
(B) An alkaline solution
(C) A neutral solution
(D) A solution with no free OH^- ions

58. Which of the following indicators is best suited in the titration of a weak acid versus a strong base reaction?

(A) Phenolphthalein
(B) Methyl orange
(C) Methyl red
(D) Litmus

59. In the electrolysis of alkaline water, a total of 1 mol of gases is evolved. The amount of water decomposed would be

(A) 1 mol
(B) 2 mol
(C) (1/3) mol
(D) (2/3) mol

60. Which of the following ion is expected to have least value of molar conductivity at infinite dilution in an aqueous solution?

(A) Na^+
(B) K^+
(C) Rb^+
(D) Cs^+

61. Which of the following statements is not correct?

(A) KCl is a substitute for NaCl for patients of high blood pressure.
(B) KOH is a stronger alkali than NaOH.
(C) KOH is used in the manufacture of soft soap.
(D) NaOH is a non-deliquescent white crystalline solid.

62. The compound with no dipole moment is

(A) methyl chloride
(B) carbon tetrachloride
(C) methylene chloride
(D) chloroform

63. In XeF_6, the number of pairs of electrons around Xe is

(A) 4
(B) 6
(C) 7
(D) 8

64. The basic character of the transition metal monoxides follows the order

(A) CrO > VO > FeO > TiO
(B) TiO > FeO > VO > CrO
(C) TiO > VO > CrO > FeO
(D) VO > CrO > TiO > FeO

65. Which of the following pairs is expected to exhibit same colour in solution?

(A) $VOCl_2$, $MnCl_2$
(B) $CuCl_2$, $VOCl_2$
(C) $VOCl_2$, $FeCl_2$
(D) $MnCl_2$, $FeCl_2$

66. In CH_3CH_2OH, the bond that undergoes heterolytic cleavage most readily is

(A) C—C
(B) C—H
(C) C—O
(D) O—H

67. The number of optical isomers in an aldose containing *"n"* asymmetric carbon atoms is

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

68. 1–Chlorobutane on reaction with alcoholic potash gives

(A) 1-butene
(B) 1-butanol
(C) 2-butene
(D) 2-butanol

69. In the presence of peroxide, hydrogen chloride and hydrogen iodide do not give anti-Mardovnikov addition to alkenes because

(A) Both are highly ionic

(B) One is oxidising and the other is reducing

(C) One of the steps is endothermic in both the cases

(D) All the steps are exothermic in both the cases

70. Which of the following compounds does not have the general formula as alkynes?

(A) Dienes (B) Cycloalkenes

(C) Bycyclics (D) Cycloalkanes

71. The shape of XeO_2F_2 molecule is

(A) Trigonal bipyramidal (B) Square planar

(C) Tetrahedral (D) See-saw

72. Methylene blue, from its aqueous solution, is adsorbed on activated charcoal at 25 °C. For this process, the correct statement is

(A) The adsorption requires activation at 25 °C

(B) The adsorption is accompanied by a decrease in enthalpy

(C) The adsorption increases with increase of temperature

(D) The adsorption is irreversible.

73. Concentrated nitric acid, upon long standing, turns yellow-brown due to the formation of

(A) NO (B) NO_2

(C) N_2O (D) N_2O_4

74. Conversion of boron trifluoride to tetrafluoroborate accompanies

(A) Increase in symmetry and bond elongation

(B) Increase in symmetry and bond contraction

(C) Decrease in symmetry and bond contraction

(D) Decrease in symmetry and bond elongation

75. A crystal has the lattice parameters a^1 b^1 c and a = b = g = 90°. The crystal system is

(A) Tetragonal (B) Monoclinic

(C) Cubic (D) Orthorhombic

76. A particle moves in a circle of radius 5 m with a constant speed of 10 m/s. What is the magnitude of its acceleration?

(A) 0 (B) 5 m/s^2

(C) 10 m/s^2 (D) 20 m/s^2

77. The dimensional formula for Planck's constant is:

(A) $[M^2L^2T^{-1}]$ (B) $[MLT^{-2}]$

(C) $[ML^2T^{-2}]$ (D) $[ML^2T^{-1}]$

78. A convex lens of focal length 20 cm has power:

(A) 0.2D (B) 5D

(C) 2D (D) 20D

79. Ohm's Law is valid when:

(A) Temperature is constant (B) Voltage is high

(C) Resistance varies (D) Circuit is open

80. Which electromagnetic wave has highest energy?

(A) Ultraviolet (B) X-rays

(C) Gamma rays (D) Infrared

81. Which quantum number determines the shape of an orbital?

(A) Principal (B) Azimuthal

(C) Magnetic (D) Spin

82. In an electrochemical cell, electrons flow from:

(A) Cathode to anode (B) Anode to cathode

(C) Salt bridge (D) Electrolyte to wire

83. The number of atoms in 0.5 mole of Na is:

(A) 3.011×10^{23} (B) 6.022×10^{23}

(C) 12.044×10^{23} (D) 1.505×10^{23}

84. The IUPAC name of $CH_3–CH=CH_2$ is:

(A) Propene (B) 1-Propene

(C) Ethyl methane (D) Alkyl methane

85. The bond formed by the sharing of electrons between two atoms is called:

(A) Ionic bond (B) Covalent bond

(C) Metallic bond (D) Hydrogen bond

86. The genetic material in a bacteriophage is:

(A) DNA (B) RNA

(C) Both DNA and RNA (D) Protein

87. The site of glycolysis in the cell is:

(A) Cytoplasm (B) Nucleus

(C) Mitochondria (D) Chloroplast

88. The function of chlorophyll in photosynthesis is to:

(A) Absorb light energy (B) Catalyse glucose formation

(C) Transport electrons (D) Split water molecules

89. The main function of the lymphatic system is:

(A) Transport of oxygen (B) Transport of glucose

(C) Defense against pathogens (D) Removal of waste products

90. Which of the following is a nitrogenous waste excreted by humans?

(A) Urea (B) Ammonia

(C) Uric acid (D) All of the above

91. The primary source of energy in the biosphere is:

(A) Nitrogen (B) Sunlight

(C) Glucose (D) Carbon dioxide

92. Which phase of mitosis shows alignment of chromosomes at equator?

(A) Prophase (B) Metaphase

(C) Anaphase (D) Telophase

93. Haemophilia is a:

(A) Chromosomal disorder (B) Sex-linked recessive disorder

(C) Dominant disorder (D) Mitochondrial disorder

94. Which antibody is abundant in colostrum?

(A) IgG (B) IgE

(C) IgA (D) IgM

95. Which organelle is called the 'powerhouse' of the cell?

(A) Ribosome (B) Golgi body

(C) Lysosome (D) Mitochondria

96. The Henry classification system is primarily based on which fingerprint pattern feature?

(A) Bifurcations (B) Delta formations

(C) Presence of whorls (D) Ridge endings

97. What is the significance of the "core" in fingerprint pattern analysis?

(A) It anchors delta identification

(B) It marks the starting point of ridge bifurcation

(C) It represents the approximate center of the pattern

(D) It indicates pressure origin

98. The comparison microscope is crucial in bullet comparison because it:

(A) Determines the chemical composition of lead

(B) Detects trace blood on metal

(C) Aligns bullets side-by-side in the same view

(D) Measures velocity of fired rounds

99. In firearm evidence, the term "lands" refers to:

(A) Surface grooves that collect gunpowder (B) Metal regions between grooves in rifled barrels

(C) Signature abrasion caused by triggers (D) Bullet-facing chamber seals

100. Which serological test is most sensitive for locating trace bloodstains at a crime scene?

(A) Precipitin test (B) Kastle-Meyer test

(C) Takayama crystal test (D) Luminol test