BUSC Science Olympiad-2026

Science Mastermind (University)

Time: 60 *minutes*

Total Marks: 100

Subjects: Math, Physics, Chemistry, Biology, IQ

Name: _____

Class: _____

School: _____

Registration Number: _____

Phone: _____

Part 1: Mathematics

1. *Let A be a* 3×3 *matrix with eigenvalues* $1, 2,$ *and* 3*. What is the trace of* $A^2 + I$*?*

A) 7 B) 14

C) 17 D) 15

2. *The value of the integral* $\int_0^\infty \frac{\sin x}{x} dx$ *is:*

A) π B) $\pi/2$

C) 1 D) ∞

3. *What is the number of group homomorphisms from* Z_{10} *to* Z_{20}*?*

A) 10 B) 20

C) 5 D) 2

4. *Which of the following series converges absolutely?*

A) $\sum \frac{(-1)^n}{n}$ B) $\sum \frac{(-1)^n}{\sqrt{n}}$

C) $\sum \frac{\sin n}{n^2}$ D) $\sum \frac{1}{n \ln n}$

5. *In how many ways can* 5 *people be seated around a circular table if two particular people must not sit next to each other?*

A) 24 B) 12

C) 6 D) 120

6. *The solution to the differential equation* $\frac{dy}{dx} + y = e^{-x}$ *is:*

A) $y = (x + C)e^x$ B) $y = (x + C)e^{-x}$

C) $y = xe^{-x}$ D) $y = e^{-x} + C$

7. *What is the rank of a* 4×4 *matrix where every entry is* 1*?*

A) 4 B) 0

C) 1 D) 2

8. *The area of the region bounded by* $y^2 = x$ *and* $x = 4$ *is:*

A) $16/3$ B) $32/3$

C) $8/3$ D) 4

9. *If* $z = x + iy$*, what does* $|z - i| = |z + i|$ *represent in the complex plane?*

A) A circle B) The x-axis

C) The y-axis D) A parabola

10. *The number of ways to arrange the letters of the word "OLYMPIAD" such that vowels are always together is:*

A) 720 B) 4320

C) 1440 D) 5040

11. *Find the limit* $\lim_{x \to 0} \frac{e^x - 1 - x}{x^2}$.

A) 0 B) 1

C) ½ D) ∞

12. *The characteristic of the field* Z_7 *is:*

A) 0 B) 1

C) 7 D) 49

13. *How many zeros does the function* $f(z) = z^4 + 3z^2 + 1$ *have in the upper half-plane?*

A) 1 B) 2

C) 3 D) 4

14. *The eccentricity of the rectangular hyperbola* $x^2 - y^2 = a^2$ *is:*

A) 1 B) √2

C) 2 D) $1/\sqrt{2}$

15. *If* $P(A) = 0.4$ *and* $P(B) = 0.5$*, and* A, B *are independent, what is* $P(A \cup B)$*?*

A) 0.9 B) 0.2

C) 0.7 D) 0.1

16. *Which of the following is a non-denumerable set?*

A) Rational numbers

B) Algebraic numbers

C) Real numbers

D) Integers

17. *The derivative of* a^x *with respect to* x *is:*

A) $x\, a^{x-1}$ B) a^x

C) $a^x \ln a$ D) $a^x / \ln a$

18. *The volume of a sphere of radius* r *generated by revolving a semicircle around its diameter is:*

A) πr^2 B) $2\pi r^2$

C) $4/3\, \pi r^3$ D) $2/3\, \pi r^3$

19. *If the vectors* $(1, 2, 3)$*,* $(0, 1, 0)$*, and* $(k, 0, 1)$ *are linearly dependent, find* k*.*

A) $1/3$ B) 3

C) 0 D) 1

20. *The number of prime numbers between* 1 *and* 100 *is:*

A) 24 B) 25

C) 26 D) 23

Part 2: Physics

21. *In Special Relativity, if a particle moves at* $v = 0.6c$*, its relativistic mass is how many times its rest mass?*

A) 1.25 B) 1.66

C) 0.8 D) 2.0

22. *The de Broglie wavelength of an electron accelerated through a potential difference* V *is proportional to:*

A) V B) V^2

C) $1/\sqrt{V}$ D) √V

23. *The work done in an adiabatic process is equal to the change in:*

A) Entropy B) Enthalpy

C) Internal Energy D) Temperature

24. *In a Young's Double Slit Experiment, if the entire apparatus is immersed in water, the fringe width:*

A) Increases B) Decreases

C) Remains same D) Disappears

25. *Which Maxwell equation implies that magnetic monopoles do not exist?*

A) Gauss's Law for Electricity

B) Gauss's Law for Magnetism

C) Faraday's Law

D) Ampere-Maxwell Law

26. *The escape velocity of a body from Earth depends on its mass* m *as:*

A) m^1 B) m^0

C) m^{-1} D) m^2

27. *What is the Boolean expression for an* XOR *gate with inputs* A *and* B*?*

A) $A + B$ B) AB

C) $\bar{A}B + A\bar{B}$ D) $\overline{A + B}$

28. *The moment of inertia of a solid sphere of mass* M *and radius* R *about its diameter is:*

A) $1/2\ MR^2$ B) $2/3\ MR^2$

C) $2/5\ MR^2$ D) $7/5\ MR^2$

29. *At what temperature do the Celsius and Fahrenheit scales show the same reading?*

A) $0°$ B) $-40°$

C) $100°$ D) $40°$

30. *A heat engine works between* $300\ K$ *and* $600\ K$*. Its maximum possible efficiency is:*

A) 100% B) 75%

C) 50% D) 25%

31. *The Compton shift* $\Delta\ \lambda$ *is maximum when the scattering angle is:*

A) $0°$ B) $90°$

C) $180°$ D) $45°$

32. *The phenomenon of 'Superconductivity' was discovered by:*

A) Heike Kamerlingh Onnes B) Bardeen

C) Cooper D) Schrieffer

33. *A p-type semiconductor is formed by doping Silicon with:*

A) Phosphorus B) Arsenic

C) Boron D) Antimony

34. *The energy of a photon of wavelength* λ *is:*

A) $h\lambda/c$ B) hc/λ

C) λ/hc D) $h/c\lambda$

35. *Which particle is the mediator of the strong nuclear force in the Standard Model?*

A) Photon B) W Boson

C) Gluon D) Graviton

36. *The terminal velocity of a small sphere falling through a viscous liquid is proportional to:*

A) r B) r^2

C) $1/r$ D) r^3

37. *In an* LCR *circuit, at resonance, the impedance is:*

A) Maximum B) Minimum (Equal to R)

C) Zero D) Infinite

38. *The phase difference between voltage and current in a purely capacitive circuit is:*

A) 0 B) $\pi/2$

C) π D) $\pi/4$

39. *The binding energy per nucleon is maximum for which nucleus?*

A) H^2 B) Fe^{56}

C) U^{235} D) He^4

40. *Brewster's angle* θ_p *for a medium of refractive index* n *is given by:*

A) $sin\ \theta_p\ =\ n$ B) $cos\ \theta_p\ =\ n$

C) $tan\ \theta_p\ =\ n$ D) $cot\ \theta_p\ =\ n$

Part 3: Chemistry

41. *Which molecule has a square planar geometry?*

A) CH_4 B) SF_6

C) XeF_4 D) BF_3

42. *The conjugate base of* $H_2PO_4^-$ *is:*

A) H_3PO_4 B) HPO_4^{2-}

C) PO_4^{3-} D) OH^-

43. *Which rule states that no two electrons in an atom can have the same four quantum numbers?*

A) Hund's Rule

B) Aufbau Principle

C) Pauli Exclusion Principle

D) Heisenberg Uncertainty Principle

44. *The IUPAC name of* CH_3COCH_3 *is:*

A) Ethanal B) Propanone

C) Propanal D) Butanone

45. *Which thermodynamic property is always positive for a spontaneous process in an isolated system?*

A) $\Delta\ G$ B) $\Delta\ H$

C) $\Delta\ S$ D) $\Delta\ E$

46. *What is the hybridization of Carbon in Ethene (C_2H_4)?*

A) sp B) sp^2

C) sp^3 D) dsp^2

47. *Which of the following is a 'Hard Acid' according to HSAB theory?*

A) Ag^+ B) Hg^{2+}

C) Li^+ D) Cu^+

48. *The number of signals in the $H-NMR$ spectrum of CH_3CH_2OH (pure) is:*

A) 1 B) 2

C) 3 D) 4

49. *Which reagent is used in the Hinsberg test to distinguish between primary, secondary, and tertiary amines?*

A) Benzene sulfonyl chloride

B) Nitrous acid

C) Bromine water

D) Tollen's reagent

50. *The main constituent of Natural Gas is:*

A) Ethane B) Methane

C) Propane D) Butane

51. *In the extraction of Aluminum (Hall-Heroult process), cryolite is added to:*

A) Oxidize aluminum

B) Lower the melting point of alumina

C) Increase the density of the electrolyte

D) Prevent corrosion

52. *Which of the following is a Greenhouse gas?*

A) N_2 B) O_2

C) CH_4 D) Ar

53. *The order of a reaction whose rate constant unit is $L \cdot mol^{-1} \cdot s^{-1}$ is:*

A) Zero B) First

C) Second D) Third

54. *Which amino acid is achiral?*

A) Alanine B) Glycine

C) Valine D) Leucine

55. *The oxidation state of Cr in $K_2Cr_2O_7$ is:*

A) $+3$ B) $+5$ C) $+6$ D) $+7$

56. *The monomer of Natural Rubber is:*

A) Neoprene B) Isoprene

C) Styrene D) Vinyl Chloride

57. *Which law relates the solubility of a gas in a liquid to its partial pressure?*

A) Raoult's Law B) Henry's Law

C) Dalton's Law D) Gay-Lussac's Law

58. *A buffer solution can be prepared by mixing:*

A) HCl and $NaCl$

B) $NaOH$ and KOH

C) CH_3COOH and CH_3COONa

D) NH_4OH and $NaOH$

59. *Which transition metal ion is responsible for the blue color of Vitriol?*

A) Fe^{2+} B) Cu^{2+}

C) Ni^{2+} D) Co^{2+}

60. *What is the product of the reaction between Phenol and Bromine water?*

A) 2-Bromophenol B) 4-Bromophenol

C) 2,4,6-Tribromophenol D) Bromobenzene

Part 4: Biology

61. *Which organelle is known as the 'Powerhouse of the cell'?*

A) Nucleus B) Ribosome

C) Mitochondria D) Golgi body

62. *The 'Central Dogma' of molecular biology is:*

A) $DNA \rightarrow RNA \rightarrow Protein$

B) $RNA \rightarrow DNA \rightarrow Protein$

C) $Protein \rightarrow RNA \rightarrow DNA$

D) $DNA \rightarrow Protein \rightarrow RNA$

63. *Which vitamin is essential for blood clotting?*

A) Vitamin A B) Vitamin C

C) Vitamin K D) Vitamin E

64. *The basic functional unit of the human kidney?*

A) Neuron B) Nephron

C) Both of them D) None

65. *Which hormone is responsible for the 'fight or flight' response?*

A) Insulin B) Adrenaline

C) Thyroxine D) Estrogen

66. *Double fertilization is a characteristic feature of:*

A) Gymnosperms B) Angiosperms

C) Pteridophytes D) Bryophytes

67. *In a DNA molecule, Adenine pairs with Thymine via how many hydrogen bonds?*

A) 1 B) 2

C) 3 D) 4

68. *Which of the following is a start codon?*

A) UAA B) UAG

C) AUG D) UGA

69. *The theory of 'Natural Selection' was proposed by:*

A) Lamarck B) Darwin

C) Mendel D) Hugo de Vries

70. *Which blood group is known as the 'Universal Donor'?*

A) AB positive B) O negative

C) A positive D) B negative

71. *The exchange of genetic material between non-sister chromatids of homologous chromosomes is called:*

A) Linkage B) Crossing over

C) Mutation D) Transformation

72. *Which enzyme is used to join DNA fragments?*

A) DNA Polymerase B) DNA Ligase

C) Helicase D) Restriction Endonuclease

73. *The primary site of gas exchange in humans is:*

A) Trachea B) Bronchi

C) Alveoli D) Larynx

74. *Which disease is caused by a deficiency of Vitamin C?*

A) Rickets B) Scurvy

C) Beri-beri D) Night blindness

75. *The major component of the plant cell wall is:*

A) Chitin B) Cellulose

C) Peptidoglycan D) Glycogen

76. *PCR (Polymerase Chain Reaction) is used for:*

A) Protein synthesis B) DNA amplification

C) Lipid analysis D) Carbohydrate testing

77. *Which part of the brain controls body temperature and hunger?*

A) CerebellumB) Medulla oblongata

C) Hypothalamus D) Thalamus

78. *The symbiotic association between fungi and algae is called:*

A) Mycorrhiza B) Lichen

C) Parasitism D) Commensalism

79. *How many ATP molecules are produced from one molecule of glucose during aerobic respiration (total)?*

A) 2 B) $36 - 38$

C) 4 D) 10

80. *Which plant hormone is responsible for fruit ripening?*

A) Auxin B) Gibberellin

C) Ethylene D) Cytokinin

Part 5: IQ & Logical Reasoning

81. *If* $1 = 5, 2 = 25, 3 = 125, 4 = 625$, *then* $5 =$?

A) 3125 B) 5

C) 1 D) 25

82. *Which number should come next in the series:* $2, 6, 12, 20, 30, \ldots$*?*

A) 40 B) 42

C) 44 D) 46

83. *A doctor gives you* 3 *pills and tells you to take one every half hour. How long will the pills last?*

A) 1 hour B) 1.5 hours

C) 2 hours D) 30 minutes

84. *If "LIGHT" is coded as "MJHIT", then "DARK" is coded as:*

A) EBSL B) CBSL

C) ECMS D) EBRL

85. *Which word does NOT belong with the others?*

A) Inch B) Mile

C) Acre D) Yard

86. *Pointing to a man, a woman said, "His mother is the only daughter of my mother." How is the woman related to the man?*

A) Sister B) Mother

C) Daughter D) Grandmother

87. *In a row of* 25 *people, if* A *is* 10^{th} *from the left, what is A's position from the right?*

A) 15^{th} B) 16^{th}

C) 14^{th} D) 17^{th}

88. *If today is Monday, what day will it be after* 61 *days?*

A) WednesdayB) Saturday

C) Tuesday D) Thursday

89. *A clock shows* 4:30. *If the minute hand points East, in which direction does the hour hand point?*

A) North-East B) South-East

C) North-WestD) South-West

90. *Find the odd one out:* $27, 64, 125, 144, 216$.

A) 64 B) 144

C) 216 D) 125

91. *If North becomes South-East, what does West become?*

A) North-East B) North-West

C) South-East D) South-West

92. *How many squares are there in a* 4×4 *chessboard?*

A) 16 B) 30

C) 32 D) 25

93. *If* $A + B = 10$ *and* $A - B = 4$, *then* $A \times B = ?$

A) 21 B) 24

C) 40 D) 14

94. *Complete the pattern: ATT, BSS, CRR, ...*

A) DQQ B) DPP

C) DKK D) DMM

95. *The day before yesterday was Saturday. What day will it be the day after tomorrow?*

A) Tuesday B) Wednesday

C) Thursday D) Friday

96. *If* $3, 5, 8, 13, 21, \ldots$ *what is the next number?*

A) 34 B) 29

C) 31 D) 35

97. *Which is the heaviest? A pound of feathers or a pound of lead?*

A) Feathers B) Lead

C) Both are equal D) Lead, due to density

98. *If you rearrange the letters "BARIHSAL", you get the name of a:*

A) Country B) City

C) Planet D) Element

99. *A father is twice as old as his son.* 20 *years ago, he was* 4 *times as old. How old is the father now?*

A) 40 B) 60

C) 30 D) 80

100. *Find the missing number:* $1, 4, 9, 16, 25, ?$

A) 30 B) 36 C) 49 D) 35