PUNJAB PUBLIC SERVICE COMMISSION

Objective Type Test (January-2023) for Recruitment to the post of Scientific Assistant (Chemistry) in the Department of Home Affairs & Justice, Govt. of Punjab

READ INSTRUCTIONS BEFORE FILLING ANY DETAILS OR ATTEMPTING TO ANSWER THE QUESTIONS.

Total Questions: 120
Time Allowed: 2 Hours

Candidate's Name _____

Father's Name _____

Date of Birth ☐☐ ☐☐ ☐☐☐☐

DD MM YYYY

OMR Response Sheet No. _____

Roll No. _____

Candidate's Signature (Please sign in the box)

Question Booklet Set
A
Booklet Series

INSTRUCTIONS

1. The candidate shall NOT open this booklet till the time told to do so by the Invigilation Staff. However, in the meantime, the candidate can read these instructions carefully and subsequently fill the appropriate columns given above in CAPITAL letters. The candidate may also fill the relevant boxes out of 1 to 9 of the Optical Mark Reader (OMR) response sheet, supplied separately.
2. Use only blue or black ball point pen to fill the relevant columns on this page as well as in OMR sheet. Use of Ink pen or any other pen is not allowed.
3. The candidate shall be liable for any adverse effect if the information given above is wrong or illegible or incomplete.
4. Each candidate is required to attempt 120 questions in 120 minutes, except for orthopedically/visually impaired candidates, who would be given 40 extra minutes, for marking correct responses on the OMR sheet.
5. The question paper booklet has **23** pages.
6. The candidates, when allowed to open the question paper booklet, must first check the entire booklet to confirm that the booklet has complete number of pages, the pages printed correctly and there are no blank pages. In case there is any such error in the question paper booklet then the candidate should IMMEDIATELY bring this fact to the notice of the Invigilation Staff and obtain a new booklet of the same series as given earlier.
7. The serial number of the new Question booklet if issued for some reason should be entered in the relevant column of the OMR. The Invigilation Staff must make necessary corrections in their record regarding the change in the serial no. of Question booklet.
8. The paper consists of total 480 Marks. Each question shall carry 4 marks. There are four options for each question and the candidate has to mark the MOST APPROPRIATE answer on the OMR response sheet.
9. There is negative marking (1 mark for each question) for questions wrongly answered by the candidate.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidate MUST READ INSTRUCTIONS BEHIND THE OMR SHEET before answering the questions and check that two carbon copies attached to the OMR sheet are intact.

1. Which of the following quantum number determines the shape of an atomic orbital?

(a) n (b) l

(c) m_l (d) m_s

2. What is the hybridization in $[(MnO_4)]^-$?

(a) sp^3 (b) sd^3

(c) d^3s (d) dsp^2

3. Which of the following has minimum X-Y-X bond angle?

(a) H_2O (b) $POCl_3$

(c) NF_3 (d) AsH_3

4. Sum of the numerical values of ionization energy and electron affinity will be highest for an element with

(a) high electronegativity (b) large atomic radii
(c) low electronegativity (d) number of *d* electrons

5. Four gases are separately placed in four compartments of a gas container as shown in the following figure. All these four gases are allowed to mix with each other simultaneously. Select the third fastest gas which will get distributed uniformly.

F_2	**O_2**
Ne	**N_2**

(a) O_2 (b) F_2

(c) Ne (d) N_2

6. The value of Van't Hoff factor for an electrolyte solution with decreasing concentration of solution_____.

(a) increases (b) decreases
(c) depends on the nature of solute (d) remains constant

7. You are provided with solutions of 1 molar urea, 1 molar NaCl and 1 molar $CaCl_2$. Which of them will have the highest vapor pressure?

(a) All three will have same vapor pressure (b) NaCl solution
(c) $CaCl_2$ solution (d) Urea Solution

8. The total kinetic energy of one mole of CO_2 gas due to the translational and rotational motions is expected to be

(a) 3/2 RT (b) 5/2 kT
(c) 3 RT (d) 3/2 RT

9. Absolute entropy of a substance can be given as

(a) $\frac{C_p}{T}\,dT$ (b) $\frac{dq_{rev}}{T}$

(c) $\ln C_p T$ (d) $\int_o^T \frac{C_p}{T}\,dT$

10. Which of the following is an extensive property?

(a) Surface tension (b) Heat capacity
(c) Viscosity (d) Pressure

11. Which of the following is a correct form of Arrhenius equation?

(a) $log_e A = log_e k + \frac{E_a}{RT}$ (b) $log_{10} k = log_{10} A - \frac{E_a}{RT}$

(c) $log_e k = log_e A - \frac{E_a}{2.303\,RT}$ (d) $k = Ae^{E_a/RT}$

12. The relation between K_c (equilibrium constant) and K_p (equilibrium constant in terms of partial pressure) for a reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, can be given as

(a) $K_c = K_p$ (b) $K_c > K_p$

(c) $K_c = K_p\,(RT)^{\Delta ng}$ (d) $K_c < K_p$

13. Reaction of $SnCl_2$ with $HgCl_2$ gives a precipitate. In this reaction

(a) $SnCl_2$ acts as an oxidizing agent (b) redox reaction does not happen
(c) $SnCl_2$ acts as a reducing agent (d) chloro complex of Hg is formed

14. A cell is represented as $Pt/\ Cl_2\ (P_1)\ /\ Cl^-\ (a = 1)\ //\ Cl^-\ (a = 1)\ /\ Cl_2\ (P_2)\ /\ Pt$. If $P_2 > P_1$, then the E_{cell} of the cell will be

(a) $E_{cell} = -\frac{0.059}{2}\ log\frac{P_2}{P_1}$ (b) $E_{cell} = -0.059\ log\frac{P_2}{P_1}$

(c) $E_{cell} = +\frac{0.059}{2}\ log\frac{P_1}{P_2}$ (d) $E_{cell} = -\frac{0.059}{2}\ log\frac{P_1}{P_2}$

15. Autocatalysis is a process where

(a) reactants act as catalyst
(b) solvent acts as catalyst
(c) heat produced in the reaction acts as catalyst
(d) products act as catalyst

16. An enzyme contains an additional binding site for effector molecules, this enzyme is known as

(a) Conjugate enzyme
(b) Allosteric enzyme
(c) Holoenzyme
(d) Apoenzyme

17. Which among the following is not a type of phosphorus?

(a) Black phosphorus
(b) Yellow phosphorus
(c) White phosphorus
(d) Red phosphorus

18. The magnetic moment of a 2nd transition series element is calculated as

(a) $\sqrt{4s(s+1)+l(l+1)}$
(b) $\sqrt{4J(J+1))}$
(c) $\sqrt{4s(s+1)}$
(d) $\sqrt{2n(n+1)}$

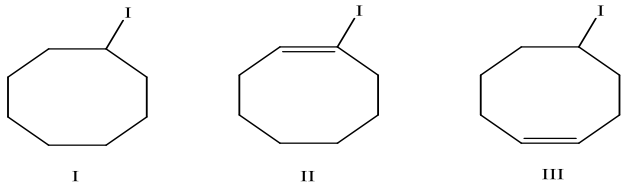
19. Thermite process for the extraction of metals is used when

(a) the thermal decomposition of carbonates do not yield oxides
(b) the melting points of oxides are very high
(c) the oxides can't be reduced by carbon
(d) the sulphides can't be converted into oxides by roasting

20. The diastereomer of (*R*)-4-bromo-*trans*-2-hexene is

(a) (S)-4-bromo-*cis*-2-hexene
(b) (R)-5-bromo-*cis*-2-hexene
(c) (S)-4-bromo-*trans*-2-hexene
(d) (R)-5-bromo-*trans*-2-hexene

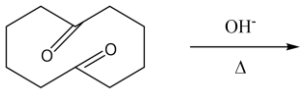
21. Arrange the following in order of hydrolysis.

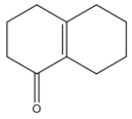


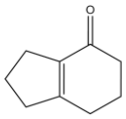
I II III

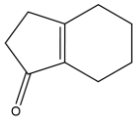
(a) I < II < III
(b) II < III < I
(c) II < I < III
(d) I < III < II

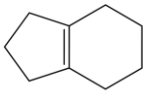
22. Major product in the following reaction will be



(a) 

(b) 

(c) 

(d) 

23. The most suitable reagent for the conversion of alcohol to aldehyde is

(a) Conc. HNO_3 (b) $K_2Cr_2O_7$

(c) CrO_3 (d) PCC

24. Sucrose is made up of

(a) α-D-glucose and β-D-fructose (b) β-D-glucose and α-D-fructose

(c) β-D-glucose and β-D-fructose (d) β-D-glucose and β-D-galactose

25. The site of protein synthesis is

(a) *m*-RNA (b) *t*-RNA

(c) Mitochondria (d) *r*-RNA

26. Accreditation of forensic science laboratories in India is the function of

(a) NICFS (b) FSI
(c) FPB (d) NABL

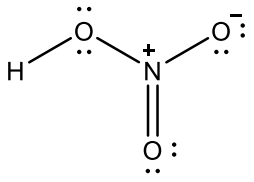
27. Authenticity of the documents is checked by

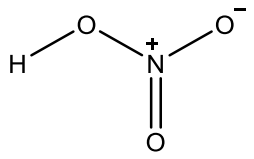
(a) NCRB (b) FPB
(c) GEQD (d) NICFC

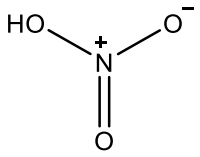
28. For the orbitals 4s, 3p, 3d, 5p, 4d, 4f, 5s, 4p, 6s what is the correct order of increasing energy?

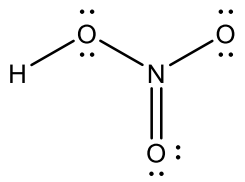
(a) 4s < 3p < 3d < 5p <4f < 5s < 4p < 6s < 4f
(b) 3p < 3d < 4s < 4p < 4d < 4f < 5s < 5p < 6s
(c) 3p < 4s < 3d < 4p < 4d < 5s < 4f < 5p < 6s
(d) 3p < 4s < 3d < 4p < 5s < 4d < 5p <6s < 4f

29. Correct Lewis structure of HNO_3 molecule is

(a) 

(b) 

(c) 

(d) 

30. Urea, $(NH_2C(O)NH_2)$, is sometimes used as a source of nitrogen in fertilizers. What is the geometry?
    (a) Trigonal Planar
    (b) Tetrahedral
    (c) Trigonal Pyramidal
    (d) Linear

31. In PCl_5 how many bonds have bond angle of 90^o?
    (a) 2
    (b) 3
    (c) 5
    (d) 1

32. Arrange the water, ethanol and hexane liquids in the increasing order of surface tension.
    (a) Hexane < ethanol < water
    (b) water < hexane < ethanol
    (c) Hexane < Water < ethanol
    (d) Ethanol < hexane < Water

33. Determine the molality of a solution prepared by dissolving 60g of Oxalic acid ($H_2C_2O_4$. $2H_2O$) in 500 gm water.

(a) 0.952
(b) 0.653
(c) 0.765
(d) 0.177

34. In a reversible chemical reaction at equilibrium, if the concentration of any one of the reactants is doubled, then the equilibrium constant will
(a) Also be Doubled
(b) Be Halved
(c) Zero
(d) Remains the same

35. When a neutral atom undergoes oxidation, the atom's oxidation state
(a) Decreases as it gains electrons
(b) Decreases as it loses electrons
(c) Increases as it gains electrons
(d) Increases as it loses electrons

36. Saturated solution of KNO_3 is used to make salt bridge because
(a) Velocity of K^+ is greater than that of NO_3^-
(b) Velocity of is NO_3^- greater than that of K^+
(c) Velocity of both NO_3^- and K^+ are nearly same
(d) KNO_3 is highly soluble in water

37. Nitric acid is manufactured by which process?
(a) Contact process
(b) Ostwald's process
(c) Solvation process
(d) Wacker process

38. Which of the electronic configuration belong to the alkaline earth metal?

(I) $1s^2\ 2s^2\ 2p^6\ 3s^2$

(II) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

(III) $1s^2\ 2s^2\ 2p^3$

(IV) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

Choose the correct option.

(a) IV and II
(b) I and III
(c) I and IV
(d) III and II

39. The energy required to remove most loosely bound electron from an isolated gaseous atom of the element in its ground state is called as
    (a) Electronegativity
    (b) Electron gain Enthalpy
    (c) Ionisation Enthalpy
    (d) Electron Affinity

40. Choose correct match of the contents in column I with those in column II and select the correct option.

Column I	Column II
(a) Ne	(i) High negative electron gain enthalpy
(b) F	(ii) Most electropositive element
(c) Ca	(iii) Strongest reducing agent
(d) Li	(iv) Highest ionization enthalpy

    (a) a–iv, b–i, c–ii, d–iii
    (b) a–iv, b–iii, c–ii, d–i
    (c) a–i, b–ii, c–iii, d–iv
    (d) a–ii, b–iv, c–i, d–iii

41. What is the coordination number of the Central metal ion in $[CoCl(NH_3)_5]Cl_2$?
    (a) 5
    (b) 6
    (c) 4
    (d) 3

42. Choose the complex that has been shown to be effective against cancer
    (a) mer-$[Co(NH_3)_3Cl_3]$
    (b) $Co(NH_3)_3Cl_3].2NH_3$
    (c) cis-$[PtCl_2(NH_3)_2]$
    (d) cis-$K_2[PtCl_2Br_2]$

43. Metallization occurs during roasting of
    (a) Gypsum
    (b) Cinnabar
    (c) Dolomite
    (d) iron pyrites

44. Identify method used in the following reaction

$$Ti_{(S)} + 2I_{2(g)} \xrightarrow{523K} TiI_{4(g)} \xrightarrow{1700K} Ti_{(S)} + 2I_{2(G)}$$

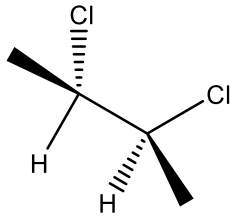
    (a) Flotation
    (b) Van Arkel
    (c) Poling
    (d) Refining

45. Refining aluminium using an electrolytic process is known as
    (a) Froth floatation process
    (b) Hall's process
    (c) Hoope's process
    (d) Baeyers process

46. Which of the following compounds will exhibit geometrical isomerism?
    (a) 2–Phenyl–1–butene
    (b) 1, 1–Diphenyl–1–propane
    (c) 1–Phenyl–2–butene
    (d) 3–Phenyl–1–butane

47. Trans 2-phenyl-1-bromocyclopentane on reaction with alcoholic KOH produces
    (a) 2-phenylcyclopentene
    (b) 1-phenylcyclopentene
    (c) 3-phenylcyclopentene
    (d) 4-phenylcyclopentene

48. The correct statement about the compound given below is:



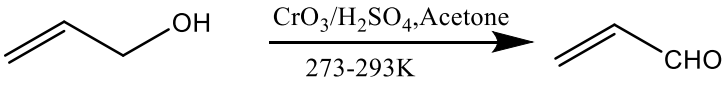
    (a) The compound is optically active
    (b) The compound possesses centre of symmetry
    (c) The compound possesses plane of symmetry
    (d) The compound possesses axis of symmetry

49. Which of the following is fast leaving group in S_N2 reaction?
    (a) Cl
    (b) Br
    (c) F
    (d) I

50. Which chemicals are used in Lucas's reagent?
    (a) Concentrated hydrochloric acid and anhydrous $ZnCl_2$
    (b) Concentrated Sulphuric acid and anhydrous $CaCl_2$
    (c) Concentrated Hydrochloric acid and anhydrous $CaCl_2$
    (d) Concentrated Nitric acid and anhydrous $AlCl_3$

51. In Victor Mayer's Test formation of blood red colour indicate
    (a) Secondary alcohol
    (b) Primary alcohol
    (c) Phenols
    (d) Tertiary alcohol

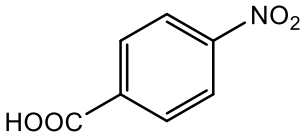
52. Consider the following reaction. Which reaction is it?

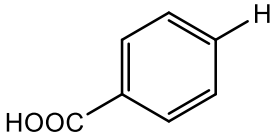


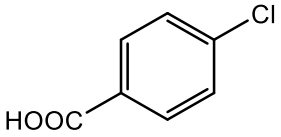
    (a) Sworn reduction
    (b) Jones oxidation
    (c) Corey's reaction
    (d) Pinacol reaction

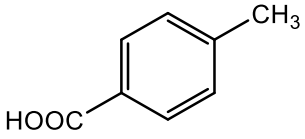
53. In a Cannizaro reaction which of the following aldehyde does not show reaction?
    (a) HCHO
    (b) C_6H_5CHO
    (c) CH_3CHO
    (d) $CHOC(CH_3)_3$

54. Which of the following is the strongest acid?

(a) 

(b) 

(c) 

(d) 

55. Liberman's nitroso reaction is used for detection of amines. Which colour is produced in test?
    (a) Indigo
    (b) Orange
    (c) Red
    (d) Greenish Blue

56. What is Hinsberg reagent?
    (a) Benzene sulphonyl chloride
    (b) Benzene Sulphonate
    (c) Aniline Chloride
    (d) Benzene sulphonic acid

57. Which of the following is an example of epimer?
    (a) Ribose and Glucose
    (b) Galactose and Glucose
    (c) Galactose and Mannose
    (d) All of the above

58. Change in specific optical rotation by interconversion of alpha and beta forms of D-Glucose to an equilibrium mixture is called as
    (a) Mutarotation
    (b) Functional group isomerism
    (c) Optical isomerism
    (d) None of the above

59. Which of the following is not a core histone protein in nucleosome?
    (a) H2A
    (b) H3
    (c) H2B
    (d) H1

60. The bond angle in C_α - C bond in protein is designated as___
    (a) Ψ (psi)
    (b) Θ (theta)
    (c) Φ (phi)
    (d) Γ (gamma)

61. Match List-I and List-II and find which of the given options is the correct match:

List-I	**List-II**
1) William Harschel	i) Forensic Ballistics
2) Osborn	ii) Forensic Anthropology
3) Krogman	iii) Questioned Document
4) Hatcher	iv) Fingerprint

(a) 1-iv, 2-iii, 3-ii, 4-i
(b) 1-iii, 2-iv, 3-ii, 4-i
(c) 1-iv, 2-ii, 3-iii, 4-i
(d) 1-i, 2-iii, 3-ii, 4-iv

62. How many divisions are there under BPR&D?
(a) 6
(b) 4
(c) 3
(d) 5

63. "Light and matter exhibit both wave-like and particle-like properties".

The above statement is related to

(a) Plank's equation
(b) Einstein's equation
(c) de Broglie relationship
(d) Bohr's relationship

64. The maximum possible number of 2*p* electrons having spin quantum number s = – ½ are

(a) 1
(b) 3
(c) 6
(d) 2

65. Electric susceptibility is inversely proportional to

(a) permeability
(b) polarization vector
(c) magnetic field intensity
(d) permittivity

66. According to Boyle's Law, pressure vs volume (P vs V) graph is

(a) straight line
(b) parabola
(c) hyperbola
(d) none of the above

67. Graham's law is
    (a) most accurate for effusion and approximate for diffusion of gas
    (b) most accurate for diffusion and approximate for effusion of gas
    (c) equally accurate for effusion and diffusion of gas
    (d) applicable only for diffusion of gas

68. Van der Waals Equation For n moles of the gas can be represented as
    (a) $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$
    (b) $\left(P + \frac{an}{V^2}\right)(V - nb) = nRT$
    (c) $\left(P + \frac{an^2}{V^2}\right)(V - n^2b) = nRT$
    (d) $\left(P + \frac{an}{V^2}\right)(V - b) = nRT$

69. The total number of atoms per unit cell in body-centered cubic structure is
    (a) 2
    (b) 4
    (c) 6
    (d) 8

70. Edge dislocation imperfection is a sub-type of which imperfection?
    (a) Line imperfection
    (b) Point imperfection
    (c) Surface imperfection
    (d) Volume imperfection

71. The negative deviations from Raoult's law are observed when the
    (a) adhesion is stronger than the cohesion
    (b) cohesion is stronger than the adhesion
    (c) adhesion and cohesion are equal
    (d) adhesion and cohesion both are completely absent

72. The energy that must be supplied to one mole of an ionic crystal in order to separate it into gaseous ions in a vacuum is called
    (a) Bond energy
    (b) Lattice energy
    (c) Ionic energy
    (d) Crystal energy

73. As per the Second Law of Thermodynamics, Spontaneous reactions generally have
    (a) $\Delta S_{univ} > 0$
    (b) $\Delta S_{univ} < 0$
    (c) $\Delta S_{univ} = 0$
    (d) $\Delta S_{univ} = 0$ or $\Delta S_{univ} < 0$

74. If a hypothetical chemical reaction; $A_2 + B_2 \rightarrow 2\ AB$

undergoes following steps

i) $A_2 \rightarrow A + A$ (fast)

ii) $A + B_2 \leftrightarrow AB + B$ (slow)

iii) $A + B \rightarrow AB$ (fast)

The overall order of the above reaction will be:

(a) 0
(b) 1
(c) 1.5
(d) 2

75. If Z is the frequency factor (frequency of collisions) and ρ is the steric factor (deals with orientation of molecules), then the pre-exponential factor in the Arrhenius Equation can be represented as;

(a) $A = \rho Z^2$

(b) $A = \rho Z^3$

(c) $A = \rho Z$

(d) $A = \rho^2 Z$

76. If,

E_a = the activation energy of the reaction in J/mol
R = the ideal gas constant = 8.3145 J/K·mol
T_1 and T_2 = absolute temperatures (in Kelvin)
k_1 and k_2 = the reaction rate constants at T_1 and T_2

Then the activation energy can be calculated using the equation:

(a) $\ln(k_2/k_1) = E_a/R \times (1/T_1 - 1/T_2)$

(b) $\ln(k_2/k_1) = E_a/R \times (1/T_2 - 1/T_1)$

(c) $\ln(k_1/k_2) = E_a/R \times (1/T_1 - 1/T_2)$

(d) $\ln(k_2/k_1) = E_a/R \times (T_2/T_1)$

77. 'In the process of respiration, deoxygenated blood interacts with oxygen-rich air in lungs. Due to higher partial pressure of oxygen inside the lungs, gas-exchange takes place.'

The above statement can be explained on the basis of

(a) Rault's law
(b) Henry's law
(c) Bragg's law
(d) Lussac's law

78. BF_3 is considered as an acid according to
    (a) Lewis concept
    (b) Bronsted Lowry concept
    (c) Arrhenius concept
    (d) Lewis concept as well as Bronsted Lowry concept

79. What will be the concentration of phenolate ion in 0.05 M solution of phenol? (given ionization constant of phenol is 1.0×10^{-10})
    (a) 3.6×10^{-4} M
    (b) 2.2×10^{-4} M
    (c) 3.6×10^{-6} M
    (d) 2.2×10^{-6} M

80. In the case of nitration of benzene using mixed conc. H_2SO_4 and HNO_3, if large amount of $KHSO_4$ is added to the mixture then the rate of nitration will be
    (a) slower
    (b) faster
    (c) exactly double
    (d) exactly half

81. Which of following is not a rechargeable cell?
    (a) Silver-oxide cell
    (b) Nickel–cadmium cell
    (c) Lithium-ion cell
    (d) Nickel–metal hydride cell

82. Freundlich adsorption isotherm is related with
    (a) homogeneous catalysis
    (b) heterogeneous catalysis
    (c) both homogeneous and heterogeneous catalysis
    (d) autocatalysis

83. In Modern periodic table, the sixth period is made up of
    (a) 18 elements
    (b) 32 elements
    (c) 14 elements
    (d) 29 element

84. Which process is used to extract silver from argentiferous lead?
    (a) Parke's process
    (b) Haber's process
    (c) Mond's process
    (d) None of the above

85. Which is a chiral molecule among the following?
    (a) Isobutyl alcohol
    (b) Isopropyl alcohol
    (c) 2-pentanol
    (d) 1-bromo 3-butene

86. Halite is a mineral formed by
    (a) Corrosion
    (b) Ionization
    (c) Evaporation
    (d) Dissolution

87. Down's process is used to extract
    (a) Fe
    (b) Al
    (c) Cr
    (d) Na

88. Generally, Arenes with carbon number 6 to 8, are

    (a) Water soluble
    (b) Non-carcinogenic
    (c) solid at room temperature
    (d) volatile liquids at room temperature

89. The first step in the nitration of benzene is to activate HNO_3 with sulfuric acid to produce

    (a) stronger electrophile called nitronium ion
    (b) weaker electrophile called nitronium ion
    (c) stronger nucleophile called nitronium ion
    (d) weaker nucleophile called nitronium ion

90. Boiling points of haloalkanes with same alkyl group are in the order

    (a) RCl>RBr>RI
    (b) RCl=RBr=RI
    (c) RCl=RBr<RI
    (d) RCl<RBr<RI

91. Acidity of phenol is generally attributed to

    (a) stabilization of the phenoxide ion by resonance localization
    (b) stabilization of the phenoxide ion by resonance delocalization.
    (c) stabilization of the phenoxide ion by resonance conjugation.
    (d) stabilization of the phenoxide ion by resonance hyperconjugation

92. Musk obtained from wild musk deer consist of chemical compound muscone which is
    (a) alcohol
    (b) acetic acid
    (c) ester
    (d) ketone

93. Formalin which is used in preserving biological specimens comprises of
    (a) formic acid
    (b) formaldehyde
    (c) chloroform
    (d) linolenic acid

94. Which of the following statement is true regarding Hinsberg's reagent?
    (a) Primary, secondary and tertiary amines react with Hinsberg's reagent to give different types of products
    (b) Primary amines react with Hinsberg's reagent, but secondary and tertiary amines do not react with Hinsberg's reagent
    (c) Primary and secondary amines react with Hinsberg's reagent but tertiary amines do not react with Hinsberg's reagent
    (d) Primary, secondary and tertiary amines do not react with Hinsberg's reagent

95. Schiff base is formed by
    (a) reaction of aniline with acetaldehyde
    (b) reaction of benzene with secondary amine
    (c) reaction of phenol with primary amine
    (d) Reaction of pyridine with acetone

96. In glycoproteins, proteins are linked with
    (a) glycerol
    (b) oligosaccharide
    (c) fatty acid
    (d) starch

97. Which of the following technique is used for sequencing of peptides?
    (a) Mass spectrometry
    (b) Spectrophotometry
    (c) NMR spectroscopy
    (d) Crystallography

98. Which CFSL is a centre of excellence in chemical sciences?
    (a) CFSL-Hyderabad
    (b) CFSL-Mumbai
    (c) CFSL-Chennai
    (d) CFSL-Chandigarh

99. In the Forensic Science, PCR stands for

(a) police and criminal record
(b) polymeric crime report
(c) polymerase chain reaction
(d) polymeric copy replication

100. The Central Detective Training School, Chandigarh functions under
(a) Bureau of Police Research & Development
(b) Department of Science and Technology
(c) Central Board of Higher Education
(d) Central Bureau of Investigation

101. Somesh distributed his savings among his wife, two sons and one daughter in such a way that wife gets double of what each son gets and each son gets double of what the daughter gets. If the amount received by each son is Rs. 48,000, what was the total amount distributed by Somesh?

(a) Rs. 92,000
(b) Rs. 1,80,000
(c) Rs. 2,12,000
(d) None of the above

102. A car travels a distance of 560 km in 9.5 hours partly at a speed of 40 kmph and partly at 160 kmph. What is the distance it travels at the speed of 160 kmph?

(a) 120 km
(b) 240 km
(c) 320 km
(d) None of the above

103. If a 'truck' is called 'train', 'train' is called 'tractor', 'tractor' is called 'ship', 'ship' is called ‘aeroplane', 'aeroplane' is called 'bulldozer' and bulldozer' is called 'scooter' then which of the following can fly?

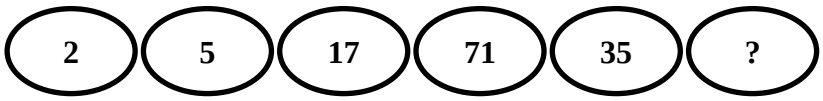
(a) Ship
(b) Aeroplane
(c) Bulldozer
(d) None of these

104. In a certain code MAJORITY is written as 'PKBNXSHQ'. How is SANCTION written in that code?
(a) TBODMNHS
(b) DOBTMNHS
(c) TBODSHNM
(d) None of these

105. A and B can do a piece of work in 6 days and A alone can do it in 9 days. In how many days can B alone do it?

(a) 18 days
(b) 14 days
(c) 12 days
(d) 15 days

106.Find the value of "?" in the following:



(a) 1805
(b) 1108
(c) 2159
(d) 4289

107.Use the relations defined below to solve the question that follows:

S * T means S is the sister of T.
S + T means S is the brother of T.
S - T means S is the son of T.
S / T means S is the daughter of T.
S = T means S is the father of T.
S x T means S is the mother of T.

Which of the following means A is the uncle of B?

(a) B + D x A
(b) A + C = B
(c) B + D / A
(d) A + D / B

108. Ms. Navya likes to let her students choose who their partners will be for study during the course; however, no pair of students may work together more than seven class periods in a row. Ankit and Benny have studied together seven class periods in a row. Catherine and Danny have worked together three class periods in a row. Catherine does not want to work with Ankit. Who should be assigned to work with Benny?

(a) Navya
(b) Ankit
(c) Danny
(d) Catherine

109.Three unbiased coins are tossed. What is the probability of getting atmost one head?

(a) 2/4
(b) 5/6
(c) 7/8
(d) 3/8

110.In a clock, how fast second hand rotates than minute hand (in degrees per second)?

(a) 1/10 degrees per second
(b) 6 degrees per second
(c) 59/10 degrees per second
(d) 36 degrees per second

111. Which conditions serve as a prerequisite for accessing Central grant under National Agricultural Market (e-NAM)?

1. E-auction platform for price discovery of agricultural produce.
2. Single point levy of market fee across the state.
3. A single unified trading license valid across the state.

Select the correct answer using the codes given below.

(a) 1 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

112.Given are the statements regarding sulphur cycle.

1. Most sulphur occurs as rocks or as dissolved in ocean
2. Hydrogen sulphide and dimethylsulphide are long-lived gases and comprise a major part of the atmosphere
3. A major fraction of sulphur is present in the proteins of living organisms
4. Bacteria drive the sulphur cycle

Identify the correct answer from the options given below

(a) 1 and 3 Only
(b) 2 and 3 Only
(c) 3 and 4 Only
(d) 1 and 4 Only

113. Amplified fragment length polymorphism (AFLP) represents a fingerprinting technique. Which of the following statement is correct about AFLP?

(a) AFLP is codominant marker
(b) AFLP is dominant marker
(c) Heterozygosity can be ascertained with AFLP markers
(d) AFLP is PCR based method, and does not involve restriction endonucleases.

114. Consider the following statements regarding *"Project Brainwave"*

1. Google launched Project Brainwave
2. High-performance FPGA is used for its operation
3. It is a deep learning platform for real-time AI inference in the cloud and on the edge

Which of the above statement(s) is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

115. Who among the following was/were the leaders arrested before the Jallianwala Bagh incident?

1. Dr. Satya pal
2. Dr. Saifuddin Kitchlew
3. Lala Lajpat Rai

(a) 3 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

116. Which according to the Constitution of India are fundamental for the governance of the country?

(a) Directive Principles of the State Policy
(b) Fundamental Rights and Duties
(c) Fundamental Duties
(d) Fundamental Rights

117. Who sang 'Hindustan Hamara' of Iqbal and 'Jan-gan-man' in the Central Assembly at midnight of 14/15 August, 1947?

(a) Rameshwari Nehru
(b) Meera Ben
(c) Sucheta Kriplani
(d) M.S. Subbulakshmi

118. According to Budget 2023-24, fiscal deficit is to be _____ of gross domestic product (GDP).

(a) 4.5%
(b) 5.9%
(c) 6.4%
(d) 7.2%

119. The Indian Space Research Organisation will send a spacecraft to orbit _____ planet to study what lies below its surface.

(a) Mars
(b) Venus
(c) Jupiter
(d) Saturn

120. Who was the Chief Guest on India's 74th Republic Day celebrations?

(a) President Bashar al-Assad of Syria
(b) President Yoweri Museveni of Uganda
(c) President Abdel Fattah El Sisi of Egypt
(d) President Muhammadu Buhari of Nigeria

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SPACE FOR ROUGH WORK

PUNJAB PUBLIC SERVICE COMMISSION

Objective Type Test (January-2023) for Recruitment to the post of Scientific Assistant (Chemistry) in the Department of Home Affairs & Justice, Govt. of Punjab

READ INSTRUCTIONS BEFORE FILLING ANY DETAILS OR ATTEMPTING TO ANSWER THE QUESTIONS.

Total Questions: 120
Time Allowed: 2 Hours

Candidate's Name _____

Father's Name _____

Date of Birth ☐☐ ☐☐ ☐☐☐☐
DD MM YYYY

OMR Response Sheet No. _____

Roll No. _____

Candidate's Signature (Please sign in the box)

Question Booklet Set
B
Booklet Series

INSTRUCTIONS

1. The candidate shall NOT open this booklet till the time told to do so by the Invigilation Staff. However, in the meantime, the candidate can read these instructions carefully and subsequently fill the appropriate columns given above in CAPITAL letters. The candidate may also fill the relevant boxes out of 1 to 9 of the Optical Mark Reader (OMR) response sheet, supplied separately.

2. Use only blue or black ball point pen to fill the relevant columns on this page as well as in OMR sheet. Use of Ink pen or any other pen is not allowed.

3. The candidate shall be liable for any adverse effect if the information given above is wrong or illegible or incomplete.

4. Each candidate is required to attempt 120 questions in 120 minutes, except for orthopedically/visually impaired candidates, who would be given 40 extra minutes, for marking correct responses on the OMR sheet.

5. The question paper booklet has **23** pages.

6. The candidates, when allowed to open the question paper booklet, must first check the entire booklet to confirm that the booklet has complete number of pages, the pages printed correctly and there are no blank pages. In case there is any such error in the question paper booklet then the candidate should IMMEDIATELY bring this fact to the notice of the Invigilation Staff and obtain a new booklet of the same series as given earlier.

7. The serial number of the new Question booklet if issued for some reason should be entered in the relevant column of the OMR. The Invigilation Staff must make necessary corrections in their record regarding the change in the serial no. of Question booklet.

8. The paper consists of total 480 Marks. Each question shall carry 4 marks. There are four options for each question and the candidate has to mark the MOST APPROPRIATE answer on the OMR response sheet.

9. There is negative marking (1 mark for each question) for questions wrongly answered by the candidate.

10. Use of Electronic/Manual Calculator is prohibited.

11. The candidate MUST READ INSTRUCTIONS BEHIND THE OMR SHEET before answering the questions and check that two carbon copies attached to the OMR sheet are intact.

1. The value of Van't Hoff factor for an electrolyte solution with decreasing concentration of solution_____.

   (a) increases (b) decreases
   (c) depends on the nature of solute (d) remains constant

2. You are provided with solutions of 1 molar urea, 1 molar NaCl and 1 molar $CaCl_2$. Which of them will have the highest vapor pressure?

   (a) All three will have same vapor pressure (b) NaCl solution
   (c) $CaCl_2$ solution (d) Urea Solution

3. The total kinetic energy of one mole of CO_2 gas due to the translational and rotational motions is expected to be

   (a) 3/2 RT (b) 5/2 kT
   (c) 3 RT (d) 3/2 RT

4. Absolute entropy of a substance can be given as

   (a) $\frac{C_p}{T}\,dT$ (b) $\frac{dq_{rev}}{T}$

   (c) $\ln C_p T$ (d) $\int_o^T \frac{C_p}{T}\,dT$

5. Which of the following is an extensive property?

   (a) Surface tension (b) Heat capacity
   (c) Viscosity (d) Pressure

6. Which of the following is a correct form of Arrhenius equation?

   (a) $log_e A = log_e k + \frac{E_a}{RT}$ (b) $log_{10} k = log_{10} A - \frac{E_a}{RT}$

   (c) $log_e k = log_e A - \frac{E_a}{2.303\,RT}$ (d) $k = Ae^{E_a/RT}$

7. The relation between K_c (equilibrium constant) and K_p (equilibrium constant in terms of partial pressure) for a reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, can be given as

   (a) $K_c = K_p$ (b) $K_c > K_p$

   (c) $K_c = K_p\,(RT)^{\Delta ng}$ (d) $K_c < K_p$

8. Reaction of $SnCl_2$ with $HgCl_2$ gives a precipitate. In this reaction

   (a) $SnCl_2$ acts as an oxidizing agent (b) redox reaction does not happen
   (c) $SnCl_2$ acts as a reducing agent (d) chloro complex of Hg is formed

9. A cell is represented as $Pt/\ Cl_2\ (P_1)\ /\ Cl^-\ (a = 1)\ /\ /\ Cl^-\ (a = 1)\ /\ Cl_2\ (P_2)\ /\ Pt$. If $P_2 > P_1$, then the E_{cell} of the cell will be

(a) $E_{cell} = -\frac{0.059}{2}\ log\frac{P_2}{P_1}$ (b) $E_{cell} = -0.059\ log\frac{P_2}{P_1}$

(c) $E_{cell} = +\frac{0.059}{2}\ log\frac{P_1}{P_2}$ (d) $E_{cell} = -\frac{0.059}{2}\ log\frac{P_1}{P_2}$

10. Autocatalysis is a process where

(a) reactants act as catalyst
(b) solvent acts as catalyst
(c) heat produced in the reaction acts as catalyst
(d) products act as catalyst

11. An enzyme contains an additional binding site for effector molecules, this enzyme is known as

(a) Conjugate enzyme (b) Allosteric enzyme
(c) Holoenzyme (d) Apoenzyme

12. Which among the following is not a type of phosphorus?

(a) Black phosphorus (b) Yellow phosphorus
(c) White phosphorus (d) Red phosphorus

13. The magnetic moment of a 2nd transition series element is calculated as

(a) $\sqrt{4s(s+1) + l(l+1)}$ (b) $\sqrt{4J(J+1))}$

(c) $\sqrt{4s(s+1)}$ (d) $\sqrt{2n(n+1)}$

14. Thermite process for the extraction of metals is used when

(a) the thermal decomposition of carbonates do not yield oxides

(b) the melting points of oxides are very high

(c) the oxides can't be reduced by carbon

(d) the sulphides can't be converted into oxides by roasting

15. The diastereomer of (*R*)-4-bromo-*trans*-2-hexene is

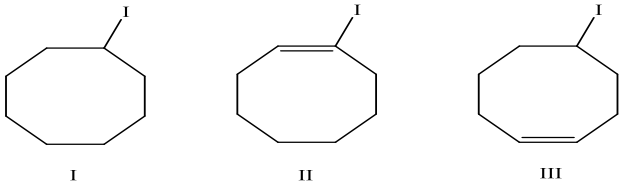
(a) (S)-4-bromo-*cis*-2-hexene

(b) (R)-5-bromo-*cis*-2-hexene

(c) (S)-4-bromo-*trans*-2-hexene

(d) (R)-5-bromo-*trans*-2-hexene

16. Arrange the following in order of hydrolysis.



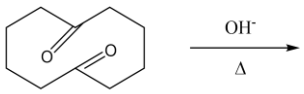
(a) I < II < III

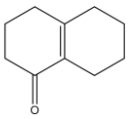
(b) II < III < I

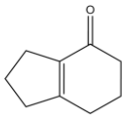
(c) II < I < III

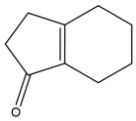
(d) I < III < II

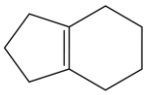
17. Major product in the following reaction will be



(a) 

(b) 

(c) 

(d) 

18. The most suitable reagent for the conversion of alcohol to aldehyde is

(a) Conc. HNO_3

(b) $K_2Cr_2O_7$

(c) CrO_3

(d) PCC

19. Sucrose is made up of

(a) α-D-glucose and β-D-fructose

(b) β-D-glucose and α-D-fructose

(c) β-D-glucose and β-D-fructose

(d) β-D-glucose and β-D-galactose

20. The site of protein synthesis is

(a) *m*-RNA

(b) *t*-RNA

(c) Mitochondria

(d) *r*-RNA

21. Accreditation of forensic science laboratories in India is the function of

(a) NICFS

(b) FSI

(c) FPB

(d) NABL

22. Authenticity of the documents is checked by

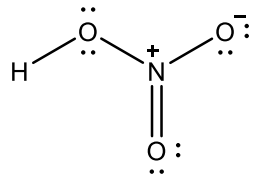
(a) NCRB (b) FPB
(c) GEQD (d) NICFC

23. For the orbitals 4s, 3p, 3d, 5p, 4d, 4f, 5s, 4p, 6s what is the correct order of increasing energy?

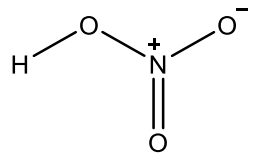
(a) 4s < 3p < 3d < 5p <4f < 5s < 4p < 6s < 4f
(b) 3p < 3d < 4s < 4p < 4d < 4f < 5s < 5p < 6s
(c) 3p < 4s < 3d < 4p < 4d < 5s < 4f < 5p < 6s
(d) 3p < 4s < 3d < 4p < 5s < 4d < 5p <6s < 4f

24. Correct Lewis structure of HNO_3 molecule is

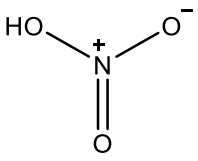
(a)



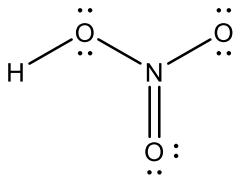
(b)



(c)



(d)



25. Urea, $(NH_2C(O)NH_2)$, is sometimes used as a source of nitrogen in fertilizers. What is the geometry?

(a) Trigonal Planar
(b) Tetrahedral
(c) Trigonal Pyramidal
(d) Linear

26. In PCl_5 how many bonds have bond angle of 90^o?

(a) 2
(b) 3
(c) 5
(d) 1

27. Arrange the water, ethanol and hexane liquids in the increasing order of surface tension.

(a) Hexane < ethanol < water
(b) water < hexane < ethanol
(c) Hexane < Water < ethanol
(d) Ethanol < hexane < Water

28. Determine the molality of a solution prepared by dissolving 60g of Oxalic acid ($H_2C_2O_4$. $2H_2O$) in 500 gm water.

(a) 0.952
(b) 0.653
(c) 0.765
(d) 0.177

29. In a reversible chemical reaction at equilibrium, if the concentration of any one of the reactants is doubled, then the equilibrium constant will

(a) Also be Doubled
(b) Be Halved
(c) Zero
(d) Remains the same

30. When a neutral atom undergoes oxidation, the atom's oxidation state

(a) Decreases as it gains electrons
(b) Decreases as it loses electrons
(c) Increases as it gains electrons
(d) Increases as it loses electrons

31. Saturated solution of KNO_3 is used to make salt bridge because

(a) Velocity of K^+ is greater than that of NO_3^-
(b) Velocity of is NO_3^- greater than that of K^+
(c) Velocity of both NO_3^- and K^+ are nearly same
(d) KNO_3 is highly soluble in water

32. Nitric acid is manufactured by which process?

(a) Contact process
(b) Ostwald's process
(c) Solvation process
(d) Wacker process

33. Which of the electronic configuration belong to the alkaline earth metal?

(I) $1s^2\ 2s^2\ 2p^6\ 3s^2$

(II) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

(III) $1s^2\ 2s^2\ 2p^3$

(IV) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

Choose the correct option.

(a) IV and II
(b) I and III
(c) I and IV
(d) III and II

34. The energy required to remove most loosely bound electron from an isolated gaseous atom of the element in its ground state is called as

(a) Electronegativity
(b) Electron gain Enthalpy
(c) Ionisation Enthalpy
(d) Electron Affinity

35. Choose correct match of the contents in column I with those in column II and select the correct option.

Column I	Column II
(a) Ne	(i) High negative electron gain enthalpy
(b) F	(ii) Most electropositive element
(c) Ca	(iii) Strongest reducing agent
(d) Li	(iv) Highest ionization enthalpy

(a) a–iv, b–i, c–ii, d–iii
(b) a–iv, b–iii, c–ii, d–i
(c) a–i, b–ii, c–iii, d–iv
(d) a–ii, b–iv, c–i, d–iii

36. What is the coordination number of the Central metal ion in $[CoCl(NH_3)_5]Cl_2$?

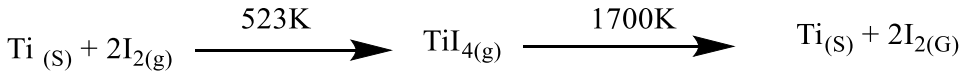
(a) 5
(b) 6
(c) 4
(d) 3

37. Choose the complex that has been shown to be effective against cancer

(a) mer-$[Co(NH_3)_3Cl_3]$
(b) $Co(NH_3)_3Cl_3].2NH_3$
(c) cis-$[PtCl_2(NH_3)_2]$
(d) cis-$K_2[PtCl_2Br_2]$

38. Metallization occurs during roasting of
    (a) Gypsum
    (b) Cinnabar
    (c) Dolomite
    (d) iron pyrites

39. Identify method used in the following reaction



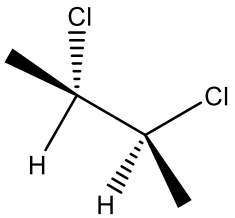
    (a) Flotation
    (b) Van Arkel
    (c) Poling
    (d) Refining

40. Refining aluminium using an electrolytic process is known as
    (a) Froth floatation process
    (b) Hall's process
    (c) Hoope's process
    (d) Baeyers process

41. Which of the following compounds will exhibit geometrical isomerism?
    (a) 2–Phenyl–1–butene
    (b) 1, 1–Diphenyl–1–propane
    (c) 1–Phenyl–2–butene
    (d) 3–Phenyl–1–butane

42. Trans 2-phenyl-1-bromocyclopentane on reaction with alcoholic KOH produces
    (a) 2-phenylcyclopentene
    (b) 1-phenylcyclopentene
    (c) 3-phenylcyclopentene
    (d) 4-phenylcyclopentene

43. The correct statement about the compound given below is:



    (a) The compound is optically active
    (b) The compound possesses centre of symmetry
    (c) The compound possesses plane of symmetry
    (d) The compound possesses axis of symmetry

44. Which of the following is fast leaving group in S_N2 reaction?

(a) Cl
(b) Br
(c) F
(d) I

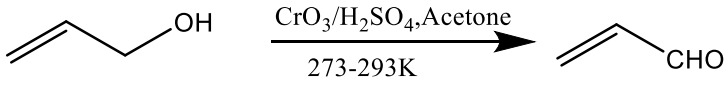
45. Which chemicals are used in Lucas's reagent?

(a) Concentrated hydrochloric acid and anhydrous $ZnCl_2$
(b) Concentrated Sulphuric acid and anhydrous $CaCl_2$
(c) Concentrated Hydrochloric acid and anhydrous $CaCl_2$
(d) Concentrated Nitric acid and anhydrous $AlCl_3$

46. In Victor Mayer's Test formation of blood red colour indicate

(a) Secondary alcohol
(b) Primary alcohol
(c) Phenols
(d) Tertiary alcohol

47. Consider the following reaction. Which reaction is it?

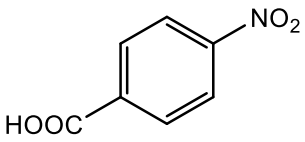


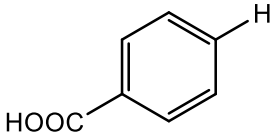
(a) Sworn reduction
(b) Jones oxidation
(c) Corey's reaction
(d) Pinacol reaction

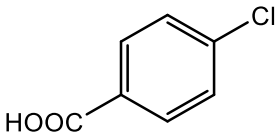
48. In a Cannizaro reaction which of the following aldehyde does not show reaction?

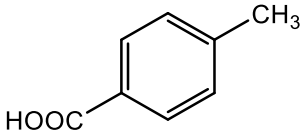
(a) HCHO
(b) C_6H_5CHO
(c) CH_3CHO
(d) $CHOC(CH_3)_3$

49. Which of the following is the strongest acid?

(a) 

(b) 

(c) 

(d) 

50. Liberman's nitroso reaction is used for detection of amines. Which colour is produced in test?
    (a) Indigo
    (b) Orange
    (c) Red
    (d) Greenish Blue

51. What is Hinsberg reagent?
    (a) Benzene sulphonyl chloride
    (b) Benzene Sulphonate
    (c) Aniline Chloride
    (d) Benzene sulphonic acid

52. Which of the following is an example of epimer?
    (a) Ribose and Glucose
    (b) Galactose and Glucose
    (c) Galactose and Mannose
    (d) All of the above

53. Change in specific optical rotation by interconversion of alpha and beta forms of D-Glucose to an equilibrium mixture is called as
    (a) Mutarotation
    (b) Functional group isomerism
    (c) Optical isomerism
    (d) None of the above

54. Which of the following is not a core histone protein in nucleosome?
    (a) H2A
    (b) H3
    (c) H2B
    (d) H1

55. The bond angle in C_α - C bond in protein is designated as___

    (a) Ψ (psi)
    (b) Θ (theta)
    (c) Φ (phi)
    (d) Γ (gamma)

56. Match List-I and List-II and find which of the given options is the correct match:

List-I	**List-II**
1) William Harschel	i) Forensic Ballistics
2) Osborn	ii) Forensic Anthropology
3) Krogman	iii) Questioned Document
4) Hatcher	iv) Fingerprint

    (a) 1-iv, 2-iii, 3-ii, 4-i
    (b) 1-iii, 2-iv, 3-ii, 4-i
    (c) 1-iv, 2-ii, 3-iii, 4-i
    (d) 1-i, 2-iii, 3-ii, 4-iv

57. How many divisions are there under BPR&D?
    (a) 6
    (b) 4
    (c) 3
    (d) 5

58. “Light and matter exhibit both wave-like and particle-like properties”.

    The above statement is related to

    (a) Plank’s equation
    (b) Einstein’s equation
    (c) de Broglie relationship
    (d) Bohr’s relationship

59. The maximum possible number of 2*p* electrons having spin quantum number s = – ½ are

(a) 1
(b) 3
(c) 6
(d) 2

60. Electric optical rotation by susceptibility is inversely proportional to
(a) permeability
(b) polarization vector
(c) magnetic field intensity
(d) permittivity

61. According to Boyle's Law, pressure vs volume (P vs V) graph is
(a) straight line
(b) parabola
(c) hyperbola
(d) none of the above

62. Graham's law is
(a) most accurate for effusion and approximate for diffusion of gas
(b) most accurate for diffusion and approximate for effusion of gas
(c) equally accurate for effusion and diffusion of gas
(d) applicable only for diffusion of gas

63. Van der Waals Equation For n moles of the gas can be represented as
(a) $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$
(b) $\left(P + \frac{an}{V^2}\right)(V - nb) = nRT$
(c) $\left(P + \frac{an^2}{V^2}\right)(V - n^2b) = nRT$
(d) $\left(P + \frac{an}{V^2}\right)(V - b) = nRT$

64. The total number of atoms per unit cell in body-centered cubic structure is
(a) 2
(b) 4
(c) 6
(d) 8

65. Edge dislocation imperfection is a sub-type of which imperfection?
(a) Line imperfection
(b) Point imperfection
(c) Surface imperfection
(d) Volume imperfection

66. The negative deviations from Raoult's law are observed when the

(a) adhesion is stronger than the cohesion
(b) cohesion is stronger than the adhesion
(c) adhesion and cohesion are equal
(d) adhesion and cohesion both are completely absent

67. The energy that must be supplied to one mole of an ionic crystal in order to separate it into gaseous ions in a vacuum is called

(a) Bond energy
(b) Lattice energy
(c) Ionic energy
(d) Crystal energy

68. As per the Second Law of Thermodynamics, Spontaneous reactions generally have

(a) $\Delta S_{univ} > 0$
(b) $\Delta S_{univ} < 0$
(c) $\Delta S_{univ} = 0$
(d) $\Delta S_{univ} = 0$ or $\Delta S_{univ} < 0$

69. If a hypothetical chemical reaction; $A_2 + B_2 \rightarrow 2\ AB$

undergoes following steps

i) $A_2 \rightarrow A + A$ (fast)

ii) $A + B_2 \leftrightarrow AB + B$ (slow)

iii) $A + B \rightarrow AB$ (fast)

The overall order of the above reaction will be:

(a) 0

(b) 1

(c) 1.5

(d) 2

70. If Z is the frequency factor (frequency of collisions) and ρ is the steric factor (deals with orientation of molecules), then the pre-exponential factor in the Arrhenius Equation can be represented as;

(a) $A = \rho Z^2$

(b) $A = \rho Z^3$

(c) $A = \rho Z$

(d) $A = \rho^2 Z$

71. If,

E_a = the activation energy of the reaction in J/mol
R = the ideal gas constant = 8.3145 J/K·mol
T_1 and T_2 = absolute temperatures (in Kelvin)
k_1 and k_2 = the reaction rate constants at T_1 and T_2

Then the activation energy can be calculated using the equation:

(a) $\ln(k_2/k_1) = E_a/R \times (1/T_1 - 1/T_2)$

(b) $\ln(k_2/k_1) = E_a/R \times (1/T_2 - 1/T_1)$

(c) $\ln(k_1/k_2) = E_a/R \times (1/T_1 - 1/T_2)$

(d) $\ln(k_2/k_1) = E_a/R \times (T_2/T_1)$

72. 'In the process of respiration, deoxygenated blood interacts with oxygen-rich air in lungs. Due to higher partial pressure of oxygen inside the lungs, gas-exchange takes place.'

The above statement can be explained on the basis of

(a) Rault's law
(b) Henry's law
(c) Bragg's law
(d) Lussac's law

73. BF_3 is considered as an acid according to

(a) Lewis concept
(b) Bronsted Lowry concept
(c) Arrhenius concept
(d) Lewis concept as well as Bronsted Lowry concept

74. What will be the concentration of phenolate ion in 0.05 M solution of phenol? (given ionization constant of phenol is 1.0×10^{-10})

(a) 3.6×10^{-4} M

(b) 2.2×10^{-4} M

(c) 3.6×10^{-6} M

(d) 2.2×10^{-6} M

75. In the case of nitration of benzene using mixed conc. H_2SO_4 and HNO_3, if large amount of $KHSO_4$ is added to the mixture then the rate of nitration will be

(a) slower
(b) faster
(c) exactly double
(d) exactly half

76. Which of following is not a rechargeable cell?
    (a) Silver-oxide cell
    (b) Nickel–cadmium cell
    (c) Lithium-ion cell
    (d) Nickel–metal hydride cell

77. Freundlich adsorption isotherm is related with
    (a) homogeneous catalysis
    (b) heterogeneous catalysis
    (c) both homogeneous and heterogeneous catalysis
    (d) autocatalysis

78. In Modern periodic table, the sixth period is made up of
    (a) 18 elements
    (b) 32 elements
    (c) 14 elements
    (d) 29 element

79. Which process is used to extract silver from argentiferous lead?
    (a) Parke's process
    (b) Haber's process
    (c) Mond's process
    (d) None of the above

80. Which is a chiral molecule among the following?
    (a) Isobutyl alcohol
    (b) Isopropyl alcohol
    (c) 2-pentanol
    (d) 1-bromo 3-butene

81. Halite is a mineral formed by
    (a) Corrosion
    (b) Ionization
    (c) Evaporation
    (d) Dissolution

82. Down's process is used to extract
    (a) Fe
    (b) Al
    (c) Cr
    (d) Na

83. Generally, Arenes with carbon number 6 to 8, are
    (a) Water soluble
    (b) Non-carcinogenic
    (c) solid at room temperature
    (d) volatile liquids at room temperature

84. The first step in the nitration of benzene is to activate HNO_3 with sulfuric acid to produce
    (a) stronger electrophile called nitronium ion
    (b) weaker electrophile called nitronium ion
    (c) stronger nucleophile called nitronium ion
    (d) weaker nucleophile called nitronium ion

85. Boiling points of haloalkanes with same alkyl group are in the order
    (a) RCl>RBr>RI
    (b) RCl=RBr=RI
    (c) RCl=RBr<RI
    (d) RCl<RBr<RI

86. Acidity of phenol is generally attributed to
    (a) stabilization of the phenoxide ion by resonance localization
    (b) stabilization of the phenoxide ion by resonance delocalization.
    (c) stabilization of the phenoxide ion by resonance conjugation.
    (d) stabilization of the phenoxide ion by resonance hyperconjugation

87. Musk obtained from wild musk deer consist of chemical compound muscone which is
    (a) alcohol
    (b) acetic acid
    (c) ester
    (d) ketone

88. Formalin which is used in preserving biological specimens comprises of
    (a) formic acid
    (b) formaldehyde
    (c) chloroform
    (d) linolenic acid

89. Which of the following statement is true regarding Hinsberg's reagent?
    (a) Primary, secondary and tertiary amines react with Hinsberg's reagent to give different types of products
    (b) Primary amines react with Hinsberg's reagent, but secondary and tertiary amines do not react with Hinsberg's reagent
    (c) Primary and secondary amines react with Hinsberg's reagent but tertiary amines do not react with Hinsberg's reagent
    (d) Primary, secondary and tertiary amines do not react with Hinsberg's reagent

90. Schiff base is formed by
    (a) reaction of aniline with acetaldehyde
    (b) reaction of benzene with secondary amine
    (c) reaction of phenol with primary amine
    (d) Reaction of pyridine with acetone

91. In glycoproteins, proteins are linked with

(a) glycerol
(b) oligosaccharide
(c) fatty acid
(d) starch

92. Which of the following technique is used for sequencing of peptides?

(a) Mass spectrometry
(b) Spectrophotometry
(c) NMR spectroscopy
(d) Crystallography

93. Which CFSL is a centre of excellence in chemical sciences?

(a) CFSL-Hyderabad
(b) CFSL-Mumbai
(c) CFSL-Chennai
(d) CFSL-Chandigarh

94. In the Forensic Science, PCR stands for

(a) police and criminal record
(b) polymeric crime report
(c) polymerase chain reaction
(d) polymeric copy replication

95. The Central Detective Training School, Chandigarh functions under

(a) Bureau of Police Research & Development
(b) Department of Science and Technology
(c) Central Board of Higher Education
(d) Central Bureau of Investigation

96. Somesh distributed his savings among his wife, two sons and one daughter in such a way that wife gets double of what each son gets and each son gets double of what the daughter gets. If the amount received by each son is Rs. 48,000, what was the total amount distributed by Somesh?

(a) Rs. 92,000
(b) Rs. 1,80,000
(c) Rs. 2,12,000
(d) None of the above

97. A car travels a distance of 560 km in 9.5 hours partly at a speed of 40 kmph and partly at 160 kmph. What is the distance it travels at the speed of 160 kmph?
    (a) 120 km
    (b) 240 km
    (c) 320 km
    (d) None of the above

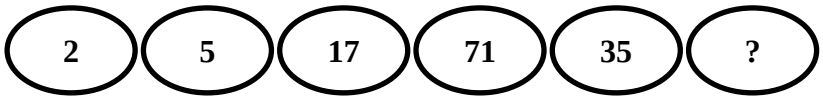
98. If a 'truck' is called 'train', 'train' is called 'tractor', 'tractor' is called 'ship', 'ship' is called ‘aeroplane', 'aeroplane' is called 'bulldozer' and bulldozer' is called 'scooter' then which of the following can fly?

    (a) Ship
    (b) Aeroplane
    (c) Bulldozer
    (d) None of these

99. In a certain code MAJORITY is written as 'PKBNXSHQ'. How is SANCTION written in that code?
    (a) TBODMNHS
    (b) DOBTMNHS
    (c) TBODSHNM
    (d) None of these

100. A and B can do a piece of work in 6 days and A alone can do it in 9 days. In how many days can B alone do it?
    (a) 18 days
    (b) 14 days
    (c) 12 days
    (d) 15 days

101. Find the value of “?” in the following:



    (a) 1805
    (b) 1108
    (c) 2159
    (d) 4289

102. Use the relations defined below to solve the question that follows:

S * T means S is the sister of T.
S + T means S is the brother of T.
S - T means S is the son of T.
S / T means S is the daughter of T.
S = T means S is the father of T.
S x T means S is the mother of T.

Which of the following means A is the uncle of B?

(a) B + D x A

(b) A + C = B

(c) B + D / A

(d) A + D / B

103. Ms. Navya likes to let her students choose who their partners will be for study during the course; however, no pair of students may work together more than seven class periods in a row. Ankit and Benny have studied together seven class periods in a row. Catherine and Danny have worked together three class periods in a row. Catherine does not want to work with Ankit. Who should be assigned to work with Benny?

(a) Navya

(b) Ankit

(c) Danny

(d) Catherine

104. Three unbiased coins are tossed. What is the probability of getting atmost one head?

(a) 2/4

(b) 5/6

(c) 7/8

(d) 3/8

105. In a clock, how fast second hand rotates than minute hand (in degrees per second)?

(a) 1/10 degrees per second
(b) 6 degrees per second
(c) 59/10 degrees per second
(d) 36 degrees per second

106. Which conditions serve as a prerequisite for accessing Central grant under National Agricultural Market (e-NAM)?

1. E-auction platform for price discovery of agricultural produce.
2. Single point levy of market fee across the state.
3. A single unified trading license valid across the state.

Select the correct answer using the codes given below.

(a) 1 only
(b) 3 only
(c) 1 and 3 only
(d) 1,2 and 3

107. Given are the statements regarding sulphur cycle.

1. Most sulphur occurs as rocks or as dissolved in ocean
2. Hydrogen sulphide and dimethylsulphide are long-lived gases and comprise a major part of the atmosphere
3. A major fraction of sulphur is present in the proteins of living organisms
4. Bacteria drive the sulphur cycle

Identify the correct answer from the options given below

(a) 1 and 3 Only
(b) 2 and 3 Only
(c) 3 and 4 Only
(d) 1 and 4 Only

108. Amplified fragment length polymorphism (AFLP) represents a fingerprinting technique. Which of the following statement is correct about AFLP?

(a) AFLP is codominant marker
(b) AFLP is dominant marker
(c) Heterozygosity can be ascertained with AFLP markers
(d) AFLP is PCR based method, and does not involve restriction endonucleases

109. Consider the following statements regarding *"Project Brainwave"*

1. Google launched Project Brainwave
2. High-performance FPGA is used for its operation
3. It is a deep learning platform for real-time AI inference in the cloud and on the edge

Which of the above statement(s) is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

110. Who among the following was/were the leaders arrested before the Jallianwala Bagh incident?

1. Dr. Satya pal
2. Dr. Saifuddin Kitchlew
3. Lala Lajpat Rai

(a) 3 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

111. Which according to the Constitution of India are fundamental for the governance of the country?

(a) Directive Principles of the State Policy
(b) Fundamental Rights and Duties
(c) Fundamental Duties
(d) Fundamental Rights

112. Who sang 'Hindustan Hamara' of Iqbal and 'Jan-gan-man' in the Central Assembly at midnight of 14/15 August, 1947?

(a) Rameshwari Nehru
(b) Meera Ben
(c) Sucheta Kriplani
(d) M.S. Subbulakshmi

113. According to Budget 2023-24, fiscal deficit is to be _____ of gross domestic product (GDP).

(a) 4.5%
(b) 5.9%
(c) 6.4%
(d) 7.2%

114. The Indian Space Research Organisation will send a spacecraft to orbit _____ planet to study what lies below its surface.

(a) Mars
(b) Venus
(c) Jupiter
(d) Saturn

115. Who was the Chief Guest on India's 74^{th} Republic Day celebrations?

(a) President Bashar al-Assad of Syria
(b) President Yoweri Museveni of Uganda
(c) President Abdel Fattah El Sisi of Egypt
(d) President Muhammadu Buhari of Nigeria

116. Which of the following quantum number determines the shape of an atomic orbital?

(a) n (b) l

(c) m_l (d) m_s

117. What is the hybridization in $[(MnO_4)]^-$?

(a) sp^3 (b) sd^3

(c) d^3s (d) dsp^2

118. Which of the following has minimum X-Y-X bond angle?

(a) H_2O (b) $POCl_3$

(c) NF_3 (d) AsH_3

119. Sum of the numerical values of ionization energy and electron affinity will be highest for an element with

(a) high electronegativity (b) large atomic radii

(c) low electronegativity (d) number of *d* electrons

120. Four gases are separately placed in four compartments of a gas container as shown in the following figure. All these four gases are allowed to mix with each other simultaneously. Select the third fastest gas which will get distributed uniformly.

F_2	**O_2**
Ne	**N_2**

(a) O_2 (b) F_2

(c) Ne (d) N_2

*****

SPACE FOR ROUGH WORK

PUNJAB PUBLIC SERVICE COMMISSION

Objective Type Test (January-2023) for Recruitment to the post of Scientific Assistant (Chemistry) in the Department of Home Affairs & Justice, Govt. of Punjab

READ INSTRUCTIONS BEFORE FILLING ANY DETAILS OR ATTEMPTING TO ANSWER THE QUESTIONS.

Total Questions: 120
Time Allowed: 2 Hours

Candidate's Name _____

Father's Name _____

Date of Birth ☐☐ ☐☐ ☐☐☐☐

DD MM YYYY

OMR Response Sheet No. _____

Roll No. _____

Candidate's Signature (Please sign in the box)

Question Booklet Set
C
Booklet Series

INSTRUCTIONS

1. The candidate shall NOT open this booklet till the time told to do so by the Invigilation Staff. However, in the meantime, the candidate can read these instructions carefully and subsequently fill the appropriate columns given above in CAPITAL letters. The candidate may also fill the relevant boxes out of 1 to 9 of the Optical Mark Reader (OMR) response sheet, supplied separately.
2. Use only blue or black ball point pen to fill the relevant columns on this page as well as in OMR sheet. Use of Ink pen or any other pen is not allowed.
3. The candidate shall be liable for any adverse effect if the information given above is wrong or illegible or incomplete.
4. Each candidate is required to attempt 120 questions in 120 minutes, except for orthopedically/visually impaired candidates, who would be given 40 extra minutes, for marking correct responses on the OMR sheet.
5. The question paper booklet has **23** pages.
6. The candidates, when allowed to open the question paper booklet, must first check the entire booklet to confirm that the booklet has complete number of pages, the pages printed correctly and there are no blank pages. In case there is any such error in the question paper booklet then the candidate should IMMEDIATELY bring this fact to the notice of the Invigilation Staff and obtain a new booklet of the same series as given earlier.
7. The serial number of the new Question booklet if issued for some reason should be entered in the relevant column of the OMR. The Invigilation Staff must make necessary corrections in their record regarding the change in the serial no. of Question booklet.
8. The paper consists of total 480 Marks. Each question shall carry 4 marks. There are four options for each question and the candidate has to mark the MOST APPROPRIATE answer on the OMR response sheet.
9. There is negative marking (1 mark for each question) for questions wrongly answered by the candidate.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidate MUST READ INSTRUCTIONS BEHIND THE OMR SHEET before answering the questions and check that two carbon copies attached to the OMR sheet are intact.

1. Which of the following is a correct form of Arrhenius equation?

(a) $log_e A = log_e k + \frac{E_a}{RT}$ (b) $log_{10} k = log_{10} A - \frac{E_a}{RT}$

(c) $log_e k = log_e A - \frac{E_a}{2.303\ RT}$ (d) $k = Ae^{E_a/RT}$

2. The relation between K_c (equilibrium constant) and K_p (equilibrium constant in terms of partial pressure) for a reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, can be given as

(a) $K_c = K_p$ (b) $K_c > K_p$

(c) $K_c = K_p\,(RT)^{\Delta ng}$ (d) $K_c < K_p$

3. Reaction of $SnCl_2$ with $HgCl_2$ gives a precipitate. In this reaction

(a) $SnCl_2$ acts as an oxidizing agent (b) redox reaction does not happen
(c) $SnCl_2$ acts as a reducing agent (d) chloro complex of Hg is formed

4. A cell is represented as $Pt/\ Cl_2\ (P_1)\ /\ Cl^-\ (a = 1)\ //\ Cl^-\ (a = 1)\ /\ Cl_2\ (P_2)\ /\ Pt$. If $P_2 > P_1$, then the E_{cell} of the cell will be

(a) $E_{cell} = -\frac{0.059}{2} log \frac{P_2}{P_1}$ (b) $E_{cell} = -0.059\ log \frac{P_2}{P_1}$

(c) $E_{cell} = +\frac{0.059}{2} log \frac{P_1}{P_2}$ (d) $E_{cell} = -\frac{0.059}{2} log \frac{P_1}{P_2}$

5. Autocatalysis is a process where

(a) reactants act as catalyst
(b) solvent acts as catalyst
(c) heat produced in the reaction acts as catalyst
(d) products act as catalyst

6. An enzyme contains an additional binding site for effector molecules, this enzyme is known as

(a) Conjugate enzyme (b) Allosteric enzyme
(c) Holoenzyme (d) Apoenzyme

7. Which among the following is not a type of phosphorus?

(a) Black phosphorus (b) Yellow phosphorus
(c) White phosphorus (d) Red phosphorus

8. The magnetic moment of a 2nd transition series element is calculated as

(a) $\sqrt{4s(s+1) + l(l+1)}$ (b) $\sqrt{4J(J+1))}$

(c) $\sqrt{4s(s+1)}$ (d) $\sqrt{2n(n+1)}$

9. Thermite process for the extraction of metals is used when

(a) the thermal decomposition of carbonates do not yield oxides

(b) the melting points of oxides are very high

(c) the oxides can't be reduced by carbon

(d) the sulphides can't be converted into oxides by roasting

10. The diastereomer of (*R*)-4-bromo-*trans*-2-hexene is

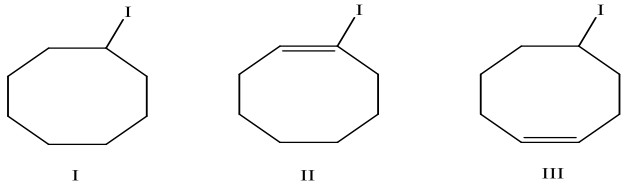
(a) (S)-4-bromo-*cis*-2-hexene

(b) (R)-5-bromo-*cis*-2-hexene

(c) (S)-4-bromo-*trans*-2-hexene

(d) (R)-5-bromo-*trans*-2-hexene

11. Arrange the following in order of hydrolysis.



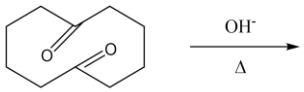
(a) I < II < III

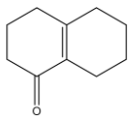
(b) II < III < I

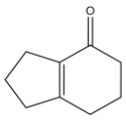
(c) II < I < III

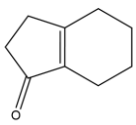
(d) I < III < II

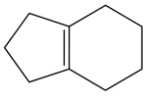
12. Major product in the following reaction will be



(a) 

(b) 

(c) 

(d) 

13. The most suitable reagent for the conversion of alcohol to aldehyde is
    (a) Conc. HNO_3 (b) $K_2Cr_2O_7$
    (c) CrO_3 (d) PCC

14. Sucrose is made up of
    (a) α-D-glucose and β-D-fructose (b) β-D-glucose and α-D-fructose
    (c) β-D-glucose and β-D-fructose (d) β-D-glucose and β-D-galactose

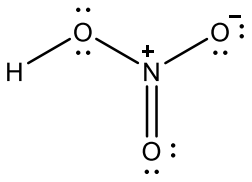
15. The site of protein synthesis is
    (a) *m*-RNA (b) *t*-RNA
    (c) Mitochondria (d) *r*-RNA

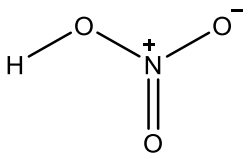
16. Accreditation of forensic science laboratories in India is the function of
    (a) NICFS (b) FSI
    (c) FPB (d) NABL

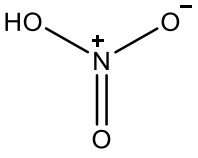
17. Authenticity of the documents is checked by
    (a) NCRB (b) FPB
    (c) GEQD (d) NICFC

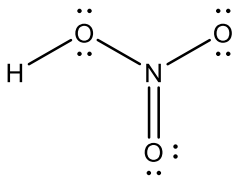
18. For the orbitals 4s, 3p, 3d, 5p, 4d, 4f, 5s, 4p, 6s what is the correct order of increasing energy?
    (a) 4s < 3p < 3d < 5p <4f < 5s < 4p < 6s < 4f
    (b) 3p < 3d < 4s < 4p < 4d < 4f < 5s < 5p < 6s
    (c) 3p < 4s < 3d < 4p < 4d < 5s < 4f < 5p < 6s
    (d) 3p < 4s < 3d < 4p < 5s < 4d < 5p <6s < 4f

19. Correct Lewis structure of HNO_3 molecule is

(a) 

(b) 

(c) 

(d) 

20. Urea, ($NH_2C(O)NH_2$), is sometimes used as a source of nitrogen in fertilizers. What is the geometry?
    (a) Trigonal Planar
    (b) Tetrahedral
    (c) Trigonal Pyramidal
    (d) Linear

21. In PCl_5 how many bonds have bond angle of 90^o?
    (a) 2
    (b) 3
    (c) 5
    (d) 1

22. Arrange the water, ethanol and hexane liquids in the increasing order of surface tension.
    (a) Hexane < ethanol < water
    (b) water < hexane < ethanol
    (c) Hexane < Water < ethanol
    (d) Ethanol < hexane < Water

23. Determine the molality of a solution prepared by dissolving 60g of Oxalic acid ($H_2C_2O_4.\ 2H_2O$) in 500 gm water.

    (a) 0.952
    (b) 0.653
    (c) 0.765
    (d) 0.177

24. In a reversible chemical reaction at equilibrium, if the concentration of any one of the reactants is doubled, then the equilibrium constant will
    (a) Also be Doubled
    (b) Be Halved
    (c) Zero
    (d) Remains the same

25. When a neutral atom undergoes oxidation, the atom's oxidation state
    (a) Decreases as it gains electrons
    (b) Decreases as it loses electrons
    (c) Increases as it gains electrons
    (d) Increases as it loses electrons

26. Saturated solution of KNO_3 is used to make salt bridge because
    (a) Velocity of K^+ is greater than that of NO_3^-
    (b) Velocity of is NO_3^- greater than that of K^+
    (c) Velocity of both NO_3^- and K^+ are nearly same
    (d) KNO_3 is highly soluble in water

27. Nitric acid is manufactured by which process?
    (a) Contact process
    (b) Ostwald's process
    (c) Solvation process
    (d) Wacker process

28. Which of the electronic configuration belong to the alkaline earth metal?

    (I) $1s^2\ 2s^2\ 2p^6\ 3s^2$

    (II) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

    (III) $1s^2\ 2s^2\ 2p^3$

    (IV) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

    Choose the correct option.

    (a) IV and II
    (b) I and III
    (c) I and IV
    (d) III and II

29. The energy required to remove most loosely bound electron from an isolated gaseous atom of the element in its ground state is called as
    (a) Electronegativity
    (b) Electron gain Enthalpy
    (c) Ionisation Enthalpy
    (d) Electron Affinity

30. Choose correct match of the contents in column I with those in column II and select the correct option.

Column I	Column II
(a) Ne	(i) High negative electron gain enthalpy
(b) F	(ii) Most electropositive element
(c) Ca	(iii) Strongest reducing agent
(d) Li	(iv) Highest ionization enthalpy

    (a) a–iv, b–i, c–ii, d–iii
    (b) a–iv, b–iii, c–ii, d–i
    (c) a–i, b–ii, c–iii, d–iv
    (d) a–ii, b–iv, c–i, d–iii

31. What is the coordination number of the Central metal ion in $[CoCl(NH_3)_5]Cl_2$?
    (a) 5
    (b) 6
    (c) 4
    (d) 3

32. Choose the complex that has been shown to be effective against cancer
    (a) mer-$[Co(NH_3)_3Cl_3]$
    (b) $Co(NH_3)_3Cl_3].2NH_3$
    (c) cis-$[PtCl_2(NH_3)_2]$
    (d) cis-$K_2[PtCl_2Br_2]$

33. Metallization occurs during roasting of
    (a) Gypsum
    (b) Cinnabar
    (c) Dolomite
    (d) iron pyrites

34. Identify method used in the following reaction

$$Ti_{(S)} + 2I_{2(g)} \xrightarrow{523K} TiI_{4(g)} \xrightarrow{1700K} Ti_{(S)} + 2I_{2(G)}$$

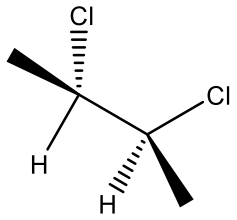
    (a) Flotation
    (b) Van Arkel
    (c) Poling
    (d) Refining

35. Refining aluminium using an electrolytic process is known as
    (a) Froth floatation process
    (b) Hall's process
    (c) Hoope's process
    (d) Baeyers process

36. Which of the following compounds will exhibit geometrical isomerism?
    (a) 2–Phenyl–1–butene
    (b) 1, 1–Diphenyl–1–propane
    (c) 1–Phenyl–2–butene
    (d) 3–Phenyl–1–butane

37. Trans 2-phenyl-1-bromocyclopentane on reaction with alcoholic KOH produces
    (a) 2-phenylcyclopentene
    (b) 1-phenylcyclopentene
    (c) 3-phenylcyclopentene
    (d) 4-phenylcyclopentene

38. The correct statement about the compound given below is:



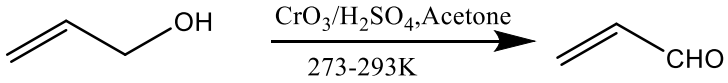
(a) The compound is optically active
(b) The compound possesses centre of symmetry
(c) The compound possesses plane of symmetry
(d) The compound possesses axis of symmetry

39. Which of the following is fast leaving group in S_N2 reaction?
(a) Cl
(b) Br
(c) F
(d) I

40. Which chemicals are used in Lucas's reagent?
(a) Concentrated hydrochloric acid and anhydrous $ZnCl_2$
(b) Concentrated Sulphuric acid and anhydrous $CaCl_2$
(c) Concentrated Hydrochloric acid and anhydrous $CaCl_2$
(d) Concentrated Nitric acid and anhydrous $AlCl_3$

41. In Victor Mayer's Test formation of blood red colour indicate
(a) Secondary alcohol
(b) Primary alcohol
(c) Phenols
(d) Tertiary alcohol

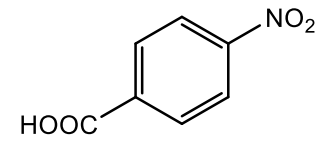
42. Consider the following reaction. Which reaction is it?

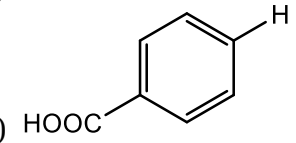


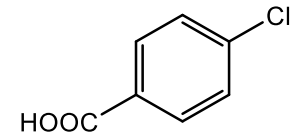
(a) Sworn reduction
(b) Jones oxidation
(c) Corey's reaction
(d) Pinacol reaction

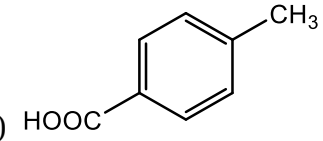
43. In a Cannizaro reaction which of the following aldehyde does not show reaction?
(a) HCHO
(b) C_6H_5CHO
(c) CH_3CHO
(d) $CHOC(CH_3)_3$

44. Which of the following is the strongest acid?

(a) 

(b) 

(c) 

(d) 

45. Liberman's nitroso reaction is used for detection of amines. Which colour is produced in test?

(a) Indigo

(b) Orange

(c) Red

(d) Greenish Blue

46. What is Hinsberg reagent?

(a) Benzene sulphonyl chloride

(b) Benzene Sulphonate

(c) Aniline Chloride

(d) Benzene sulphonic acid

47. Which of the following is an example of epimer?

(a) Ribose and Glucose

(b) Galactose and Glucose

(c) Galactose and Mannose

(d) All of the above

48. Change in specific optical rotation by interconversion of alpha and beta forms of D-Glucose to an equilibrium mixture is called as
    (a) Mutarotation
    (b) Functional group isomerism
    (c) Optical isomerism
    (d) None of the above

49. Which of the following is not a core histone protein in nucleosome?
    (a) H2A
    (b) H3
    (c) H2B
    (d) H1

50. The bond angle in C_α - C bond in protein is designated as___

    (a) Ψ (psi)
    (b) Θ (theta)
    (c) Φ (phi)
    (d) Γ (gamma)

51. Match List-I and List-II and find which of the given options is the correct match:

List-I	**List-II**
1) William Harschel	i) Forensic Ballistics
2) Osborn	ii) Forensic Anthropology
3) Krogman	iii) Questioned Document
4) Hatcher	iv) Fingerprint

    (a) 1-iv, 2-iii, 3-ii, 4-i
    (b) 1-iii, 2-iv, 3-ii, 4-i
    (c) 1-iv, 2-ii, 3-iii, 4-i
    (d) 1-i, 2-iii, 3-ii, 4-iv

52. How many divisions are there under BPR&D?
    (a) 6
    (b) 4
    (c) 3
    (d) 5

53. "Light and matter exhibit both wave-like and particle-like properties".

    The above statement is related to

    (a) Plank's equation
    (b) Einstein's equation
    (c) de Broglie relationship
    (d) Bohr's relationship

54. The maximum possible number of 2*p* electrons having spin quantum number s = – ½ are

(a) 1
(b) 3
(c) 6
(d) 2

55. Electric susceptibility is inversely proportional to
(a) permeability
(b) polarization vector
(c) magnetic field intensity
(d) permittivity

56. According to Boyle's Law, pressure vs volume (P vs V) graph is
(a) straight line
(b) parabola
(c) hyperbola
(d) none of the above

57. Graham's law is
(a) most accurate for effusion and approximate for diffusion of gas
(b) most accurate for diffusion and approximate for effusion of gas
(c) equally accurate for effusion and diffusion of gas
(d) applicable only for diffusion of gas

58. Van der Waals Equation For n moles of the gas can be represented as
(a) $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$
(b) $\left(P + \frac{an}{V^2}\right)(V - nb) = nRT$
(c) $\left(P + \frac{an^2}{V^2}\right)(V - n^2b) = nRT$
(d) $\left(P + \frac{an}{V^2}\right)(V - b) = nRT$

59. The total number of atoms per unit cell in body-centered cubic structure is
(a) 2
(b) 4
(c) 6
(d) 8

60. Edge dislocation imperfection is a sub-type of which imperfection?
(a) Line imperfection
(b) Point imperfection
(c) Surface imperfection
(d) Volume imperfection

61. The negative deviations from Raoult's law are observed when the
    (a) adhesion is stronger than the cohesion
    (b) cohesion is stronger than the adhesion
    (c) adhesion and cohesion are equal
    (d) adhesion and cohesion both are completely absent

62. The energy that must be supplied to one mole of an ionic crystal in order to separate it into gaseous ions in a vacuum is called
    (a) Bond energy
    (b) Lattice energy
    (c) Ionic energy
    (d) Crystal energy

63. As per the Second Law of Thermodynamics, Spontaneous reactions generally have
    (a) $\Delta S_{univ} > 0$
    (b) $\Delta S_{univ} < 0$
    (c) $\Delta S_{univ} = 0$
    (d) $\Delta S_{univ} = 0$ or $\Delta S_{univ} < 0$

64. If a hypothetical chemical reaction; $A_2 + B_2 \rightarrow 2\ AB$

    undergoes following steps

    i) $A_2 \rightarrow A + A$ (fast)

    ii) $A + B_2 \leftrightarrow AB + B$ (slow)

    iii) $A + B \rightarrow AB$ (fast)

    The overall order of the above reaction will be:

    (a) 0
    (b) 1
    (c) 1.5
    (d) 2

65. If Z is the frequency factor (frequency of collisions) and ρ is the steric factor (deals with orientation of molecules), then the pre-exponential factor in the Arrhenius Equation can be represented as;
    (a) $A = \rho Z^2$
    (b) $A = \rho Z^3$
    (c) $A = \rho Z$
    (d) $A = \rho^2 Z$

66. If,

E_a = the activation energy of the reaction in J/mol
R = the ideal gas constant = 8.3145 J/K·mol
T_1 and T_2 = absolute temperatures (in Kelvin)
k_1 and k_2 = the reaction rate constants at T_1 and T_2

Then the activation energy can be calculated using the equation:

(a) $\ln(k_2/k_1) = E_a/R \times (1/T_1 - 1/T_2)$

(b) $\ln(k_2/k_1) = E_a/R \times (1/T_2 - 1/T_1)$

(c) $\ln(k_1/k_2) = E_a/R \times (1/T_1 - 1/T_2)$

(d) $\ln(k_2/k_1) = E_a/R \times (T_2/T_1)$

67. 'In the process of respiration, deoxygenated blood interacts with oxygen-rich air in lungs. Due to higher partial pressure of oxygen inside the lungs, gas-exchange takes place.'

The above statement can be explained on the basis of

(a) Rault's law
(b) Henry's law
(c) Bragg's law
(d) Lussac's law

68. BF_3 is considered as an acid according to
(a) Lewis concept
(b) Bronsted Lowry concept
(c) Arrhenius concept
(d) Lewis concept as well as Bronsted Lowry concept

69. What will be the concentration of phenolate ion in 0.05 M solution of phenol? (given ionization constant of phenol is 1.0×10^{-10})
(a) 3.6×10^{-4} M

(b) 2.2×10^{-4} M

(c) 3.6×10^{-6} M

(d) 2.2×10^{-6} M

70. In the case of nitration of benzene using mixed conc. H_2SO_4 and HNO_3, if large amount of $KHSO_4$ is added to the mixture then the rate of nitration will be
(a) slower
(b) faster
(c) exactly double
(d) exactly half

71. Which of following is not a rechargeable cell?
    (a) Silver-oxide cell
    (b) Nickel–cadmium cell
    (c) Lithium-ion cell
    (d) Nickel–metal hydride cell

72. Freundlich adsorption isotherm is related with
    (a) homogeneous catalysis
    (b) heterogeneous catalysis
    (c) both homogeneous and heterogeneous catalysis
    (d) autocatalysis

73. In Modern periodic table, the sixth period is made up of
    (a) 18 elements
    (b) 32 elements
    (c) 14 elements
    (d) 29 element

74. Which process is used to extract silver from argentiferous lead?
    (a) Parke's process
    (b) Haber's process
    (c) Mond's process
    (d) None of the above

75. Which is a chiral molecule among the following?
    (a) Isobutyl alcohol
    (b) Isopropyl alcohol
    (c) 2-pentanol
    (d) 1-bromo 3-butene

76. Halite is a mineral formed by
    (a) Corrosion
    (b) Ionization
    (c) Evaporation
    (d) Dissolution

77. Down's process is used to extract
    (a) Fe
    (b) Al
    (c) Cr
    (d) Na

78. Generally, Arenes with carbon number 6 to 8, are
    (a) Water soluble
    (b) Non-carcinogenic
    (c) solid at room temperature
    (d) volatile liquids at room temperature

79. The first step in the nitration of benzene is to activate HNO_3 with sulfuric acid to produce
    (a) stronger electrophile called nitronium ion
    (b) weaker electrophile called nitronium ion
    (c) stronger nucleophile called nitronium ion
    (d) weaker nucleophile called nitronium ion

80. Boiling points of haloalkanes with same alkyl group are in the order
    (a) RCl>RBr>RI
    (b) RCl=RBr=RI
    (c) RCl=RBr<RI
    (d) RCl<RBr<RI

81. Acidity of phenol is generally attributed to
    (a) stabilization of the phenoxide ion by resonance localization
    (b) stabilization of the phenoxide ion by resonance delocalization.
    (c) stabilization of the phenoxide ion by resonance conjugation.
    (d) stabilization of the phenoxide ion by resonance hyperconjugation

82. Musk obtained from wild musk deer consist of chemical compound muscone which is
    (a) alcohol
    (b) acetic acid
    (c) ester
    (d) ketone

83. Formalin which is used in preserving biological specimens comprises of
    (a) formic acid
    (b) formaldehyde
    (c) chloroform
    (d) linolenic acid

84. Which of the following statement is true regarding Hinsberg's reagent?
    (a) Primary, secondary and tertiary amines react with Hinsberg's reagent to give different types of products
    (b) Primary amines react with Hinsberg's reagent, but secondary and tertiary amines do not react with Hinsberg's reagent
    (c) Primary and secondary amines react with Hinsberg's reagent but tertiary amines do not react with Hinsberg's reagent
    (d) Primary, secondary and tertiary amines do not react with Hinsberg's reagent

85. Schiff base is formed by
    (a) reaction of aniline with acetaldehyde
    (b) reaction of benzene with secondary amine
    (c) reaction of phenol with primary amine
    (d) Reaction of pyridine with acetone

86. In glycoproteins, proteins are linked with
    (a) glycerol
    (b) oligosaccharide
    (c) fatty acid
    (d) starch

87. Which of the following technique is used for sequencing of peptides?
    (a) Mass spectrometry
    (b) Spectrophotometry
    (c) NMR spectroscopy
    (d) Crystallography

88. Which CFSL is a centre of excellence in chemical sciences?
    (a) CFSL-Hyderabad
    (b) CFSL-Mumbai
    (c) CFSL-Chennai
    (d) CFSL-Chandigarh

89. In the Forensic Science, PCR stands for

    (a) police and criminal record
    (b) polymeric crime report
    (c) polymerase chain reaction
    (d) polymeric copy replication

90. The Central Detective Training School, Chandigarh functions under
    (a) Bureau of Police Research & Development
    (b) Department of Science and Technology
    (c) Central Board of Higher Education
    (d) Central Bureau of Investigation

91. Somesh distributed his savings among his wife, two sons and one daughter in such a way that wife gets double of what each son gets and each son gets double of what the daughter gets. If the amount received by each son is Rs. 48,000, what was the total amount distributed by Somesh?

    (a) Rs. 92,000
    (b) Rs. 1,80,000
    (c) Rs. 2,12,000
    (d) None of the above

92. A car travels a distance of 560 km in 9.5 hours partly at a speed of 40 kmph and partly at 160 kmph. What is the distance it travels at the speed of 160 kmph?

(a) 120 km
(b) 240 km
(c) 320 km
(d) None of the above

93. If a 'truck' is called 'train', 'train' is called 'tractor', 'tractor' is called 'ship', 'ship' is called 'aeroplane', 'aeroplane' is called 'bulldozer' and bulldozer' is called 'scooter' then which of the following can fly?

(a) Ship
(b) Aeroplane
(c) Bulldozer
(d) None of these

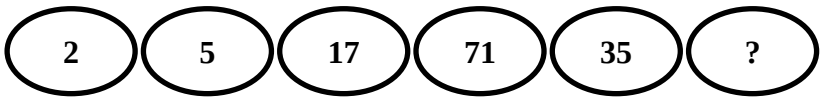
94. In a certain code MAJORITY is written as 'PKBNXSHQ'. How is SANCTION written in that code?

(a) TBODMNHS
(b) DOBTMNHS
(c) TBODSHNM
(d) None of these

95. A and B can do a piece of work in 6 days and A alone can do it in 9 days. In how many days can B alone do it?

(a) 18 days
(b) 14 days
(c) 12 days
(d) 15 days

96. Find the value of "?" in the following:



(a) 1805
(b) 1108
(c) 2159
(d) 4289

97. Use the relations defined below to solve the question that follows:

S * T means S is the sister of T.
S + T means S is the brother of T.
S - T means S is the son of T.
S / T means S is the daughter of T.
S = T means S is the father of T.
S x T means S is the mother of T.

Which of the following means A is the uncle of B?

(a) B + D x A

(b) A + C = B

(c) B + D / A

(d) A + D / B

98. Ms. Navya likes to let her students choose who their partners will be for study during the course; however, no pair of students may work together more than seven class periods in a row. Ankit and Benny have studied together seven class periods in a row. Catherine and Danny have worked together three class periods in a row. Catherine does not want to work with Ankit. Who should be assigned to work with Benny?

(a) Navya

(b) Ankit

(c) Danny

(d) Catherine

99. Three unbiased coins are tossed. What is the probability of getting atmost one head?

(a) 2/4

(b) 5/6

(c) 7/8

(d) 3/8

100. In a clock, how fast second hand rotates than minute hand (in degrees per second)?

(a) 1/10 degrees per second

(b) 6 degrees per second

(c) 59/10 degrees per second

(d) 36 degrees per second

101. Which conditions serve as a prerequisite for accessing Central grant under National Agricultural Market (e-NAM)?

1. E-auction platform for price discovery of agricultural produce.
2. Single point levy of market fee across the state.
3. A single unified trading license valid across the state.

Select the correct answer using the codes given below.

(a) 1 only

(b) 3 only

(c) 1 and 3 only

(d) 1,2 and 3

102. Given are the statements regarding sulphur cycle.

1. Most sulphur occurs as rocks or as dissolved in ocean
2. Hydrogen sulphide and dimethylsulphide are long-lived gases and comprise a major part of the atmosphere
3. A major fraction of sulphur is present in the proteins of living organisms
4. Bacteria drive the sulphur cycle

Identify the correct answer from the options given below

(a) 1 and 3 Only
(b) 2 and 3 Only
(c) 3 and 4 Only
(d) 1 and 4 Only

103. Amplified fragment length polymorphism (AFLP) represents a fingerprinting technique. Which of the following statement is correct about AFLP?

(a) AFLP is codominant marker
(b) AFLP is dominant marker
(c) Heterozygosity can be ascertained with AFLP markers
(d) AFLP is PCR based method, and does not involve restriction endonucleases

104. Consider the following statements regarding *"Project Brainwave"*

1. Google launched Project Brainwave
2. High-performance FPGA is used for its operation
3. It is a deep learning platform for real-time AI inference in the cloud and on the edge

Which of the above statement(s) is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

105. Who among the following was/were the leaders arrested before the Jallianwala Bagh incident?

1. Dr. Satya pal
2. Dr. Saifuddin Kitchlew
3. Lala Lajpat Rai

(a) 3 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

106. Which according to the Constitution of India are fundamental for the governance of the country?

(a) Directive Principles of the State Policy
(b) Fundamental Rights and Duties
(c) Fundamental Duties
(d) Fundamental Rights

107. Who sang 'Hindustan Hamara' of Iqbal and 'Jan-gan-man' in the Central Assembly at midnight of 14/15 August, 1947?

(a) Rameshwari Nehru
(b) Meera Ben
(c) Sucheta Kriplani
(d) M.S. Subbulakshmi

108. According to Budget 2023-24, fiscal deficit is to be _____ of gross domestic product (GDP).

(a) 4.5%
(b) 5.9%
(c) 6.4%
(d) 7.2%

109. The Indian Space Research Organisation will send a spacecraft to orbit _____ planet to study what lies below its surface.

(a) Mars
(b) Venus
(c) Jupiter
(d) Saturn

110. Who was the Chief Guest on India's 74th Republic Day celebrations?

(a) President Bashar al-Assad of Syria
(b) President Yoweri Museveni of Uganda
(c) President Abdel Fattah El Sisi of Egypt
(d) President Muhammadu Buhari of Nigeria

111. Which of the following quantum number determines the shape of an atomic orbital?

(a) n (b) l

(c) m_l (d) m_s

112. What is the hybridization in $[(MnO_4)]^-$?

(a) sp^3 (b) sd^3

(c) d^3s (d) dsp^2

113. Which of the following has minimum X-Y-X bond angle?

(a) H_2O (b) $POCl_3$

(c) NF_3 (d) AsH_3

114. Sum of the numerical values of ionization energy and electron affinity will be highest for an element with

(a) high electronegativity (b) large atomic radii

(c) low electronegativity (d) number of *d* electrons

115. Four gases are separately placed in four compartments of a gas container as shown in the following figure. All these four gases are allowed to mix with each other simultaneously. Select the third fastest gas which will get distributed uniformly.

F_2	**O_2**
Ne	**N_2**

(a) O_2 (b) F_2

(c) Ne (d) N_2

116. The value of Van't Hoff factor for an electrolyte solution with decreasing concentration of solution_____.

(a) increases (b) decreases
(c) depends on the nature of solute (d) remains constant

117. You are provided with solutions of 1 molar urea, 1 molar NaCl and 1 molar $CaCl_2$. Which of them will have the highest vapor pressure?

(a) All three will have same vapor pressure (b) NaCl solution
(c) $CaCl_2$ solution (d) Urea Solution

118. The total kinetic energy of one mole of CO_2 gas due to the translational and rotational motions is expected to be

(a) 3/2 RT
(b) 5/2 kT
(c) 3 RT
(d) 3/2 RT

119. Absolute entropy of a substance can be given as

(a) $\frac{C_p}{T}\,dT$
(b) $\frac{dq_{rev}}{T}$
(c) $\ln C_p T$
(d) $\int_o^T \frac{C_p}{T}\,dT$

120. Which of the following is an extensive property?

(a) Surface tension
(b) Heat capacity
(c) Viscosity
(d) Pressure

*****

SPACE FOR ROUGH WORK

PUNJAB PUBLIC SERVICE COMMISSION

Objective Type Test (January-2023) for Recruitment to the post of Scientific Assistant (Chemistry) in the Department of Home Affairs & Justice, Govt. of Punjab

READ INSTRUCTIONS BEFORE FILLING ANY DETAILS OR ATTEMPTING TO ANSWER THE QUESTIONS.

Total Questions: 120
Time Allowed: 2 Hours

Candidate's Name _____

Father's Name _____

Date of Birth ☐☐ ☐☐ ☐☐☐☐
DD MM YYYY

OMR Response Sheet No. _____

Roll No. _____

Candidate's Signature (Please sign in the box)

Question Booklet Set
D
Booklet Series

INSTRUCTIONS

1. The candidate shall NOT open this booklet till the time told to do so by the Invigilation Staff. However, in the meantime, the candidate can read these instructions carefully and subsequently fill the appropriate columns given above in CAPITAL letters. The candidate may also fill the relevant boxes out of 1 to 9 of the Optical Mark Reader (OMR) response sheet, supplied separately.
2. Use only blue or black ball point pen to fill the relevant columns on this page as well as in OMR sheet. Use of Ink pen or any other pen is not allowed.
3. The candidate shall be liable for any adverse effect if the information given above is wrong or illegible or incomplete.
4. Each candidate is required to attempt 120 questions in 120 minutes, except for orthopedically/visually impaired candidates, who would be given 40 extra minutes, for marking correct responses on the OMR sheet.
5. The question paper booklet has **23** pages.
6. The candidates, when allowed to open the question paper booklet, must first check the entire booklet to confirm that the booklet has complete number of pages, the pages printed correctly and there are no blank pages. In case there is any such error in the question paper booklet then the candidate should IMMEDIATELY bring this fact to the notice of the Invigilation Staff and obtain a new booklet of the same series as given earlier.
7. The serial number of the new Question booklet if issued for some reason should be entered in the relevant column of the OMR. The Invigilation Staff must make necessary corrections in their record regarding the change in the serial no. of Question booklet.
8. The paper consists of total 480 Marks. Each question shall carry 4 marks. There are four options for each question and the candidate has to mark the MOST APPROPRIATE answer on the OMR response sheet.
9. There is negative marking (1 mark for each question) for questions wrongly answered by the candidate.
10. Use of Electronic/Manual Calculator is prohibited.
11. The candidate MUST READ INSTRUCTIONS BEHIND THE OMR SHEET before answering the questions and check that two carbon copies attached to the OMR sheet are intact.

1. An enzyme contains an additional binding site for effector molecules, this enzyme is known as

(a) Conjugate enzyme
(b) Allosteric enzyme
(c) Holoenzyme
(d) Apoenzyme

2. Which among the following is not a type of phosphorus?

(a) Black phosphorus
(b) Yellow phosphorus
(c) White phosphorus
(d) Red phosphorus

3. The magnetic moment of a 2nd transition series element is calculated as

(a) $\sqrt{4s(s+1)+l(l+1)}$
(b) $\sqrt{4J(J+1))}$
(c) $\sqrt{4s(s+1)}$
(d) $\sqrt{2n(n+1)}$

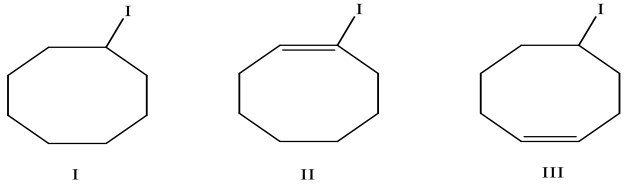
4. Thermite process for the extraction of metals is used when

(a) the thermal decomposition of carbonates do not yield oxides
(b) the melting points of oxides are very high
(c) the oxides can't be reduced by carbon
(d) the sulphides can't be converted into oxides by roasting

5. The diastereomer of (*R*)-4-bromo-*trans*-2-hexene is

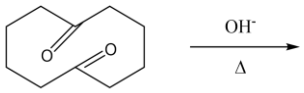
(a) (S)-4-bromo-*cis*-2-hexene
(b) (R)-5-bromo-*cis*-2-hexene
(c) (S)-4-bromo-*trans*-2-hexene
(d) (R)-5-bromo-*trans*-2-hexene

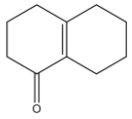
6. Arrange the following in order of hydrolysis.

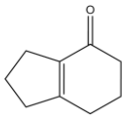


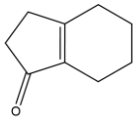
(a) I < II < III
(b) II < III < I
(c) II < I < III
(d) I < III < II

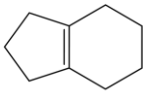
7. Major product in the following reaction will be



(a) 

(b) 

(c) 

(d) 

8. The most suitable reagent for the conversion of alcohol to aldehyde is

(a) Conc. HNO_3 (b) $K_2Cr_2O_7$

(c) CrO_3 (d) PCC

9. Sucrose is made up of

(a) α-D-glucose and β-D-fructose (b) β-D-glucose and α-D-fructose

(c) β-D-glucose and β-D-fructose (d) β-D-glucose and β-D-galactose

10. The site of protein synthesis is

(a) *m*-RNA (b) *t*-RNA

(c) Mitochondria (d) *r*-RNA

11. Accreditation of forensic science laboratories in India is the function of

(a) NICFS (b) FSI
(c) FPB (d) NABL

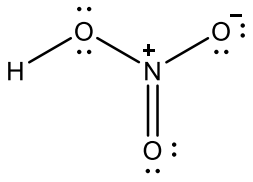
12. Authenticity of the documents is checked by

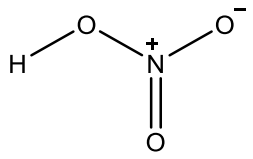
(a) NCRB (b) FPB
(c) GEQD (d) NICFC

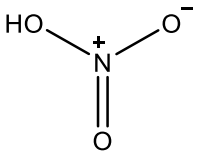
13. For the orbitals 4s, 3p, 3d, 5p, 4d, 4f, 5s, 4p, 6s what is the correct order of increasing energy?

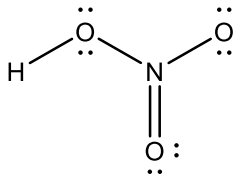
(a) 4s < 3p < 3d < 5p <4f < 5s < 4p < 6s < 4f
(b) 3p < 3d < 4s < 4p < 4d < 4f < 5s < 5p < 6s
(c) 3p < 4s < 3d < 4p < 4d < 5s < 4f < 5p < 6s
(d) 3p < 4s < 3d < 4p < 5s < 4d < 5p <6s < 4f

14. Correct Lewis structure of HNO_3 molecule is

(a) 

(b) 

(c) 

(d) 

15. Urea, $(NH_2C(O)NH_2)$, is sometimes used as a source of nitrogen in fertilizers. What is the geometry?
    (a) Trigonal Planar
    (b) Tetrahedral
    (c) Trigonal Pyramidal
    (d) Linear

16. In PCl_5 how many bonds have bond angle of 90^o?
    (a) 2
    (b) 3
    (c) 5
    (d) 1

17. Arrange the water, ethanol and hexane liquids in the increasing order of surface tension.
    (a) Hexane < ethanol < water
    (b) water < hexane < ethanol
    (c) Hexane < Water < ethanol
    (d) Ethanol < hexane < Water

18. Determine the molality of a solution prepared by dissolving 60g of Oxalic acid ($H_2C_2O_4$. $2H_2O$) in 500 gm water.

    (a) 0.952
    (b) 0.653
    (c) 0.765
    (d) 0.177

19. In a reversible chemical reaction at equilibrium, if the concentration of any one of the reactants is doubled, then the equilibrium constant will
    (a) Also be Doubled
    (b) Be Halved
    (c) Zero
    (d) Remains the same

20. When a neutral atom undergoes oxidation, the atom's oxidation state
    (a) Decreases as it gains electrons
    (b) Decreases as it loses electrons
    (c) Increases as it gains electrons
    (d) Increases as it loses electrons

21. Saturated solution of KNO_3 is used to make salt bridge because
    (a) Velocity of K^+ is greater than that of NO_3^-
    (b) Velocity of is NO_3^- greater than that of K^+
    (c) Velocity of both NO_3^- and K^+ are nearly same
    (d) KNO_3 is highly soluble in water

22. Nitric acid is manufactured by which process?
    (a) Contact process
    (b) Ostwald's process
    (c) Solvation process
    (d) Wacker process

23. Which of the electronic configuration belong to the alkaline earth metal?

    (I) $1s^2\ 2s^2\ 2p^6\ 3s^2$

    (II) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^1$

    (III) $1s^2\ 2s^2\ 2p^3$

    (IV) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

    Choose the correct option.

    (a) IV and II
    (b) I and III
    (c) I and IV
    (d) III and II

24. The energy required to remove most loosely bound electron from an isolated gaseous atom of the element in its ground state is called as
    (a) Electronegativity
    (b) Electron gain Enthalpy
    (c) Ionisation Enthalpy
    (d) Electron Affinity

25. Choose correct match of the contents in column I with those in column II and select the correct option.

Column I	Column II
(a) Ne	(i) High negative electron gain enthalpy
(b) F	(ii) Most electropositive element
(c) Ca	(iii) Strongest reducing agent
(d) Li	(iv) Highest ionization enthalpy

    (a) a–iv, b–i, c–ii, d–iii
    (b) a–iv, b–iii, c–ii, d–i
    (c) a–i, b–ii, c–iii, d–iv
    (d) a–ii, b–iv, c–i, d–iii

26. What is the coordination number of the Central metal ion in $[CoCl(NH_3)_5]Cl_2$?
    (a) 5
    (b) 6
    (c) 4
    (d) 3

27. Choose the complex that has been shown to be effective against cancer
    (a) mer-$[Co(NH_3)_3Cl_3]$
    (b) $Co(NH_3)_3Cl_3].2NH_3$
    (c) cis-$[PtCl_2(NH_3)_2]$
    (d) cis-$K_2[PtCl_2Br_2]$

28. Metallization occurs during roasting of
    (a) Gypsum
    (b) Cinnabar
    (c) Dolomite
    (d) iron pyrites

29. Identify method used in the following reaction

$$Ti_{(S)} + 2I_{2(g)} \xrightarrow{523K} TiI_{4(g)} \xrightarrow{1700K} Ti_{(S)} + 2I_{2(G)}$$

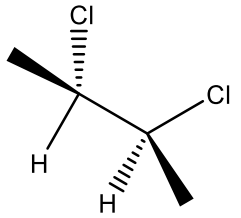
    (a) Flotation
    (b) Van Arkel
    (c) Poling
    (d) Refining

30. Refining aluminium using an electrolytic process is known as
    (a) Froth floatation process
    (b) Hall's process
    (c) Hoope's process
    (d) Baeyers process

31. Which of the following compounds will exhibit geometrical isomerism?
    (a) 2–Phenyl–1–butene
    (b) 1, 1–Diphenyl–1–propane
    (c) 1–Phenyl–2–butene
    (d) 3–Phenyl–1–butane

32. Trans 2-phenyl-1-bromocyclopentane on reaction with alcoholic KOH produces
    (a) 2-phenylcyclopentene
    (b) 1-phenylcyclopentene
    (c) 3-phenylcyclopentene
    (d) 4-phenylcyclopentene

33. The correct statement about the compound given below is:



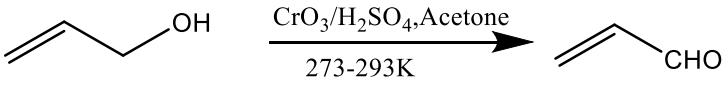
    (a) The compound is optically active
    (b) The compound possesses centre of symmetry
    (c) The compound possesses plane of symmetry
    (d) The compound possesses axis of symmetry

34. Which of the following is fast leaving group in S_N2 reaction?
    (a) Cl
    (b) Br
    (c) F
    (d) I

35. Which chemicals are used in Lucas's reagent?
    (a) Concentrated hydrochloric acid and anhydrous $ZnCl_2$
    (b) Concentrated Sulphuric acid and anhydrous $CaCl_2$
    (c) Concentrated Hydrochloric acid and anhydrous $CaCl_2$
    (d) Concentrated Nitric acid and anhydrous $AlCl_3$

36. In Victor Mayer's Test formation of blood red colour indicate
    (a) Secondary alcohol
    (b) Primary alcohol
    (c) Phenols
    (d) Tertiary alcohol

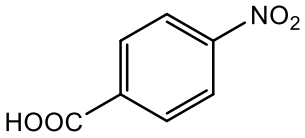
37. Consider the following reaction. Which reaction is it?

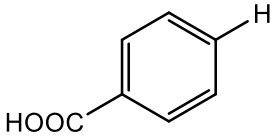


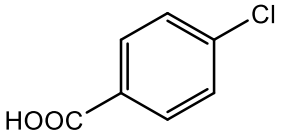
    (a) Sworn reduction
    (b) Jones oxidation
    (c) Corey's reaction
    (d) Pinacol reaction

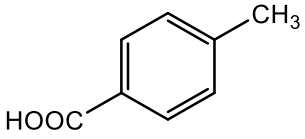
38. In a Cannizaro reaction which of the following aldehyde does not show reaction?
    (a) HCHO
    (b) C_6H_5CHO
    (c) CH_3CHO
    (d) $CHOC(CH_3)_3$

39. Which of the following is the strongest acid?

(a) 

(b) 

(c) 

(d) 

40. Liberman's nitroso reaction is used for detection of amines. Which colour is produced in test?
    (a) Indigo
    (b) Orange
    (c) Red
    (d) Greenish Blue

41. What is Hinsberg reagent?
    (a) Benzene sulphonyl chloride
    (b) Benzene Sulphonate
    (c) Aniline Chloride
    (d) Benzene sulphonic acid

42. Which of the following is an example of epimer?
    (a) Ribose and Glucose
    (b) Galactose and Glucose
    (c) Galactose and Mannose
    (d) All of the above

43. Change in specific optical rotation by interconversion of alpha and beta forms of D-Glucose to an equilibrium mixture is called as
    (a) Mutarotation
    (b) Functional group isomerism
    (c) Optical isomerism
    (d) None of the above

44. Which of the following is not a core histone protein in nucleosome?
    (a) H2A
    (b) H3
    (c) H2B
    (d) H1

45. The bond angle in C_{α} - C bond in protein is designated as___
    (a) Ψ (psi)
    (b) Θ (theta)
    (c) Φ (phi)
    (d) Γ (gamma)

46. Match List-I and List-II and find which of the given options is the correct match:

List-I	**List-II**
1) William Harschel	i) Forensic Ballistics
2) Osborn	ii) Forensic Anthropology
3) Krogman	iii) Questioned Document
4) Hatcher	iv) Fingerprint

(a) 1-iv, 2-iii, 3-ii, 4-i
(b) 1-iii, 2-iv, 3-ii, 4-i
(c) 1-iv, 2-ii, 3-iii, 4-i
(d) 1-i, 2-iii, 3-ii, 4-iv

47. How many divisions are there under BPR&D?
(a) 6
(b) 4
(c) 3
(d) 5

48. "Light and matter exhibit both wave-like and particle-like properties".

The above statement is related to

(a) Plank's equation
(b) Einstein's equation
(c) de Broglie relationship
(d) Bohr's relationship

49. The maximum possible number of 2*p* electrons having spin quantum number s = – ½ are

(a) 1
(b) 3
(c) 6
(d) 2

50. Electric susceptibility is inversely proportional to
(a) permeability
(b) polarization vector
(c) magnetic field intensity
(d) permittivity

51. According to Boyle's Law, pressure vs volume (P vs V) graph is
(a) straight line
(b) parabola
(c) hyperbola
(d) none of the above

52. Graham's law is
    (a) most accurate for effusion and approximate for diffusion of gas
    (b) most accurate for diffusion and approximate for effusion of gas
    (c) equally accurate for effusion and diffusion of gas
    (d) applicable only for diffusion of gas

53. Van der Waals Equation For n moles of the gas can be represented as
    (a) $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$
    (b) $\left(P + \frac{an}{V^2}\right)(V - nb) = nRT$
    (c) $\left(P + \frac{an^2}{V^2}\right)(V - n^2b) = nRT$
    (d) $\left(P + \frac{an}{V^2}\right)(V - b) = nRT$

54. The total number of atoms per unit cell in body-centered cubic structure is
    (a) 2
    (b) 4
    (c) 6
    (d) 8

55. Edge dislocation imperfection is a sub-type of which imperfection?
    (a) Line imperfection
    (b) Point imperfection
    (c) Surface imperfection
    (d) Volume imperfection

56. The negative deviations from Raoult's law are observed when the
    (a) adhesion is stronger than the cohesion
    (b) cohesion is stronger than the adhesion
    (c) adhesion and cohesion are equal
    (d) adhesion and cohesion both are completely absent

57. The energy that must be supplied to one mole of an ionic crystal in order to separate it into gaseous ions in a vacuum is called
    (a) Bond energy
    (b) Lattice energy
    (c) Ionic energy
    (d) Crystal energy

58. As per the Second Law of Thermodynamics, Spontaneous reactions generally have
    (a) $\Delta S_{univ} > 0$
    (b) $\Delta S_{univ} < 0$
    (c) $\Delta S_{univ} = 0$
    (d) $\Delta S_{univ} = 0$ or $\Delta S_{univ} < 0$

59. If a hypothetical chemical reaction; $A_2 + B_2 \rightarrow 2\ AB$

undergoes following steps

i) $A_2 \rightarrow A + A$ (fast)

ii) $A + B_2 \leftrightarrow AB + B$ (slow)

iii) $A + B \rightarrow AB$ (fast)

The overall order of the above reaction will be:

(a) 0
(b) 1
(c) 1.5
(d) 2

60. If Z is the frequency factor (frequency of collisions) and ρ is the steric factor (deals with orientation of molecules), then the pre-exponential factor in the Arrhenius Equation can be represented as;

(a) $A = \rho Z^2$

(b) $A = \rho Z^3$

(c) $A = \rho Z$

(d) $A = \rho^2 Z$

61. If,

E_a = the activation energy of the reaction in J/mol
R = the ideal gas constant = 8.3145 J/K·mol
T_1 and T_2 = absolute temperatures (in Kelvin)
k_1 and k_2 = the reaction rate constants at T_1 and T_2

Then the activation energy can be calculated using the equation:

(a) $\ln(k_2/k_1) = E_a/R \times (1/T_1 - 1/T_2)$

(b) $\ln(k_2/k_1) = E_a/R \times (1/T_2 - 1/T_1)$

(c) $\ln(k_1/k_2) = E_a/R \times (1/T_1 - 1/T_2)$

(d) $\ln(k_2/k_1) = E_a/R \times (T_2/T_1)$

62. 'In the process of respiration, deoxygenated blood interacts with oxygen-rich air in lungs. Due to higher partial pressure of oxygen inside the lungs, gas-exchange takes place.'

The above statement can be explained on the basis of

(a) Rault's law
(b) Henry's law
(c) Bragg's law
(d) Lussac's law

63. BF_3 is considered as an acid according to
    (a) Lewis concept
    (b) Bronsted Lowry concept
    (c) Arrhenius concept
    (d) Lewis concept as well as Bronsted Lowry concept

64. What will be the concentration of phenolate ion in 0.05 M solution of phenol? (given ionization constant of phenol is 1.0×10^{-10})
    (a) 3.6×10^{-4} M
    (b) 2.2×10^{-4} M
    (c) 3.6×10^{-6} M
    (d) 2.2×10^{-6} M

65. In the case of nitration of benzene using mixed conc. H_2SO_4 and HNO_3, if large amount of $KHSO_4$ is added to the mixture then the rate of nitration will be
    (a) slower
    (b) faster
    (c) exactly double
    (d) exactly half

66. Which of following is not a rechargeable cell?
    (a) Silver-oxide cell
    (b) Nickel–cadmium cell
    (c) Lithium-ion cell
    (d) Nickel–metal hydride cell

67. Freundlich adsorption isotherm is related with
    (a) homogeneous catalysis
    (b) heterogeneous catalysis
    (c) both homogeneous and heterogeneous catalysis
    (d) autocatalysis

68. In Modern periodic table, the sixth period is made up of
    (a) 18 elements
    (b) 32 elements
    (c) 14 elements
    (d) 29 element

69. Which process is used to extract silver from argentiferous lead?
    (a) Parke's process
    (b) Haber's process
    (c) Mond's process
    (d) None of the above

70. Which is a chiral molecule among the following?

(a) Isobutyl alcohol
(b) Isopropyl alcohol
(c) 2-pentanol
(d) 1-bromo 3-butene

71. Halite is a mineral formed by

(a) Corrosion
(b) Ionization
(c) Evaporation
(d) Dissolution

72. Down's process is used to extract

(a) Fe
(b) Al
(c) Cr
(d) Na

73. Generally, Arenes with carbon number 6 to 8, are
(a) Water soluble
(b) Non-carcinogenic
(c) solid at room temperature
(d) volatile liquids at room temperature

74. The first step in the nitration of benzene is to activate HNO_3 with sulfuric acid to produce
(a) stronger electrophile called nitronium ion
(b) weaker electrophile called nitronium ion
(c) stronger nucleophile called nitronium ion
(d) weaker nucleophile called nitronium ion

75. Boiling points of haloalkanes with same alkyl group are in the order
(a) RCl>RBr>RI
(b) RCl=RBr=RI
(c) RCl=RBr<RI
(d) RCl<RBr<RI

76. Acidity of phenol is generally attributed to
(a) stabilization of the phenoxide ion by resonance localization
(b) stabilization of the phenoxide ion by resonance delocalization.
(c) stabilization of the phenoxide ion by resonance conjugation.
(d) stabilization of the phenoxide ion by resonance hyperconjugation

77. Musk obtained from wild musk deer consist of chemical compound muscone which is
    (a) alcohol
    (b) acetic acid
    (c) ester
    (d) ketone

78. Formalin which is used in preserving biological specimens comprises of
    (a) formic acid
    (b) formaldehyde
    (c) chloroform
    (d) linolenic acid

79. Which of the following statement is true regarding Hinsberg's reagent?
    (a) Primary, secondary and tertiary amines react with Hinsberg's reagent to give different types of products
    (b) Primary amines react with Hinsberg's reagent, but secondary and tertiary amines do not react with Hinsberg's reagent
    (c) Primary and secondary amines react with Hinsberg's reagent but tertiary amines do not react with Hinsberg's reagent
    (d) Primary, secondary and tertiary amines do not react with Hinsberg's reagent

80. Schiff base is formed by
    (a) reaction of aniline with acetaldehyde
    (b) reaction of benzene with secondary amine
    (c) reaction of phenol with primary amine
    (d) Reaction of pyridine with acetone

81. In glycoproteins, proteins are linked with
    (a) glycerol
    (b) oligosaccharide
    (c) fatty acid
    (d) starch

82. Which of the following technique is used for sequencing of peptides?
    (a) Mass spectrometry
    (b) Spectrophotometry
    (c) NMR spectroscopy
    (d) Crystallography

83. Which CFSL is a centre of excellence in chemical sciences?
    (a) CFSL-Hyderabad
    (b) CFSL-Mumbai
    (c) CFSL-Chennai
    (d) CFSL-Chandigarh

84. In the Forensic Science, PCR stands for

(a) police and criminal record
(b) polymeric crime report
(c) polymerase chain reaction
(d) polymeric copy replication

85. The Central Detective Training School, Chandigarh functions under
(a) Bureau of Police Research & Development
(b) Department of Science and Technology
(c) Central Board of Higher Education
(d) Central Bureau of Investigation

86. Somesh distributed his savings among his wife, two sons and one daughter in such a way that wife gets double of what each son gets and each son gets double of what the daughter gets. If the amount received by each son is Rs. 48,000, what was the total amount distributed by Somesh?

(a) Rs. 92,000
(b) Rs. 1,80,000
(c) Rs. 2,12,000
(d) None of the above

87. A car travels a distance of 560 km in 9.5 hours partly at a speed of 40 kmph and partly at 160 kmph. What is the distance it travels at the speed of 160 kmph?

(a) 120 km
(b) 240 km
(c) 320 km
(d) None of the above

88. If a 'truck' is called 'train', 'train' is called 'tractor', 'tractor' is called 'ship', 'ship' is called ‘aeroplane', 'aeroplane' is called 'bulldozer' and bulldozer' is called 'scooter' then which of the following can fly?

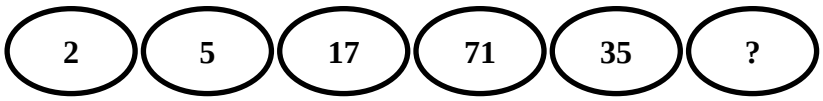
(a) Ship
(b) Aeroplane
(c) Bulldozer
(d) None of these

89. In a certain code MAJORITY is written as 'PKBNXSHQ'. How is SANCTION written in that code?
(a) TBODMNHS
(b) DOBTMNHS
(c) TBODSHNM
(d) None of these

90. A and B can do a piece of work in 6 days and A alone can do it in 9 days. In how many days can B alone do it?

(a) 18 days
(b) 14 days
(c) 12 days
(d) 15 days

91. Find the value of "?" in the following:



(a) 1805
(b) 1108
(c) 2159
(d) 4289

92. Use the relations defined below to solve the question that follows:

S * T means S is the sister of T.
S + T means S is the brother of T.
S - T means S is the son of T.
S / T means S is the daughter of T.
S = T means S is the father of T.
S x T means S is the mother of T.

Which of the following means A is the uncle of B?

(a) B + D x A
(b) A + C = B
(c) B + D / A
(d) A + D / B

93. Ms. Navya likes to let her students choose who their partners will be for study during the course; however, no pair of students may work together more than seven class periods in a row. Ankit and Benny have studied together seven class periods in a row. Catherine and Danny have worked together three class periods in a row. Catherine does not want to work with Ankit. Who should be assigned to work with Benny?

(a) Navya
(b) Ankit
(c) Danny
(d) Catherine

94. Three unbiased coins are tossed. What is the probability of getting atmost one head?
    (a) 2/4
    (b) 5/6
    (c) 7/8
    (d) 3/8

95. In a clock, how fast second hand rotates than minute hand (in degrees per second)?
    (a) 1/10 degrees per second
    (b) 6 degrees per second
    (c) 59/10 degrees per second
    (d) 36 degrees per second

96. Which conditions serve as a prerequisite for accessing Central grant under National Agricultural Market (e-NAM)?
    1. E-auction platform for price discovery of agricultural produce.
    2. Single point levy of market fee across the state.
    3. A single unified trading license valid across the state.

    Select the correct answer using the codes given below.
    (a) 1 only
    (b) 3 only
    (c) 1 and 3 only
    (d) 1,2 and 3

97. Given are the statements regarding sulphur cycle.
    1. Most sulphur occurs as rocks or as dissolved in ocean
    2. Hydrogen sulphide and dimethylsulphide are long-lived gases and comprise a major part of the atmosphere
    3. A major fraction of sulphur is present in the proteins of living organisms
    4. Bacteria drive the sulphur cycle

    Identify the correct answer from the options given below
    (a) 1 and 3 Only
    (b) 2 and 3 Only
    (c) 3 and 4 Only
    (d) 1 and 4 Only

98. Amplified fragment length polymorphism (AFLP) represents a fingerprinting technique. Which of the following statement is correct about AFLP?
    (a) AFLP is codominant marker
    (b) AFLP is dominant marker
    (c) Heterozygosity can be ascertained with AFLP markers
    (d) AFLP is PCR based method, and does not involve restriction endonucleases.

99. Consider the following statements regarding *"Project Brainwave"*

1. Google launched Project Brainwave
2. High-performance FPGA is used for its operation
3. It is a deep learning platform for real-time AI inference in the cloud and on the edge

Which of the above statement(s) is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

100. Who among the following was/were the leaders arrested before the Jallianwala Bagh incident?

1. Dr. Satya pal
2. Dr. Saifuddin Kitchlew
3. Lala Lajpat Rai

(a) 3 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

101. Which according to the Constitution of India are fundamental for the governance of the country?

(a) Directive Principles of the State Policy
(b) Fundamental Rights and Duties
(c) Fundamental Duties
(d) Fundamental Rights

102. Who sang 'Hindustan Hamara' of Iqbal and 'Jan-gan-man' in the Central Assembly at midnight of 14/15 August, 1947?

(a) Rameshwari Nehru
(b) Meera Ben
(c) Sucheta Kriplani
(d) M.S. Subbulakshmi

103. According to Budget 2023-24, fiscal deficit is to be _____ of gross domestic product (GDP).

(a) 4.5%
(b) 5.9%
(c) 6.4%
(d) 7.2%

104. The Indian Space Research Organisation will send a spacecraft to orbit _____ planet to study what lies below its surface.

(a) Mars
(b) Venus
(c) Jupiter
(d) Saturn

105. Who was the Chief Guest on India's 74th Republic Day celebrations?

(a) President Bashar al-Assad of Syria
(b) President Yoweri Museveni of Uganda
(c) President Abdel Fattah El Sisi of Egypt
(d) President Muhammadu Buhari of Nigeria

106. Which of the following quantum number determines the shape of an atomic orbital?

(a) n (b) l

(c) m_l (d) m_s

107. What is the hybridization in $[(MnO_4)]^-$?

(a) sp^3 (b) sd^3

(c) d^3s (d) dsp^2

108. Which of the following has minimum X-Y-X bond angle?

(a) H_2O (b) $POCl_3$

(c) NF_3 (d) AsH_3

109. Sum of the numerical values of ionization energy and electron affinity will be highest for an element with

(a) high electronegativity (b) large atomic radii
(c) low electronegativity (d) number of *d* electrons

110. Four gases are separately placed in four compartments of a gas container as shown in the following figure. All these four gases are allowed to mix with each other simultaneously. Select the third fastest gas which will get distributed uniformly.

F_2	**O_2**
Ne	**N_2**

(a) O_2 (b) F_2

(c) Ne (d) N_2

111. The value of Van't Hoff factor for an electrolyte solution with decreasing concentration of solution_____.

(a) increases (b) decreases
(c) depends on the nature of solute (d) remains constant

112. You are provided with solutions of 1 molar urea, 1 molar NaCl and 1 molar $CaCl_2$. Which of them will have the highest vapor pressure?

(a) All three will have same vapor pressure (b) NaCl solution
(c) $CaCl_2$ solution (d) Urea Solution

113. The total kinetic energy of one mole of CO_2 gas due to the translational and rotational motions is expected to be

(a) 3/2 RT (b) 5/2 kT
(c) 3 RT (d) 3/2 RT

114. Absolute entropy of a substance can be given as

(a) $\frac{C_p}{T}\,dT$ (b) $\frac{dq_{rev}}{T}$

(c) $\ln C_p T$ (d) $\int_o^T \frac{C_p}{T}\,dT$

115. Which of the following is an extensive property?

(a) Surface tension (b) Heat capacity
(c) Viscosity (d) Pressure

116. Which of the following is a correct form of Arrhenius equation?

(a) $log_e A = log_e k + \frac{E_a}{RT}$ (b) $log_{10} k = log_{10} A - \frac{E_a}{RT}$

(c) $log_e k = log_e A - \frac{E_a}{2.303\,RT}$ (d) $k = Ae^{E_a/RT}$

117. The relation between K_c (equilibrium constant) and K_p (equilibrium constant in terms of partial pressure) for a reaction $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$, can be given as

(a) $K_c = K_p$ (b) $K_c > K_p$

(c) $K_c = K_p\,(RT)^{\Delta ng}$ (d) $K_c < K_p$

118. Reaction of $SnCl_2$ with $HgCl_2$ gives a precipitate. In this reaction

(a) $SnCl_2$ acts as an oxidizing agent (b) redox reaction does not happen
(c) $SnCl_2$ acts as a reducing agent (d) chloro complex of Hg is formed

119. A cell is represented as $Pt/\ Cl_2\ (P_1)\ /\ Cl^-\ (a = 1)\ /\ /\ Cl^-\ (a = 1)\ /\ Cl_2\ (P_2)\ /\ Pt$. If $P_2 > P_1$, then the E_{cell} of the cell will be

(a) $E_{cell} = -\ \frac{0.059}{2}\ log\frac{P_2}{P_1}$ (b) $E_{cell} = -\ 0.059\ log\frac{P_2}{P_1}$

(c) $E_{cell} = +\ \frac{0.059}{2}\ log\frac{P_1}{P_2}$ (d) $E_{cell} = -\ \frac{0.059}{2}\ log\frac{P_1}{P_2}$

120. Autocatalysis is a process where

(a) reactants act as catalyst
(b) solvent acts as catalyst
(c) heat produced in the reaction acts as catalyst
(d) products act as catalyst

*****

SPACE FOR ROUGH WORK