Important Instructions:

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on Side-1 and Side-2 carefully with blue/black ball point pen only.

2. The test is of 3 hours duration and this Test Booklet contains 180 questions. Each question carries 4 marks. For each correct response, the candidate will get 4 marks. For each incorrect response, one mark will be deducted from the total scores. The maximum marks are 720.

3. Use Blue/Black Ball Point Pen only for writing particulars on this page/marking responses.

4. Rough work is to be done on the space provided for this purpose in the Test Booklet only.

5. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator before leaving the Room/Hall. The candidates are allowed to take away this Test Booklet with them.

6. The CODE for this Booklet is LL. Make sure that the CODE printed on Side-2 of the Answer Sheet is the same as that on this Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer Sheet.

7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.

8. Use of white fluid for correction is not permissible on the Answer Sheet.
1. The correct order of N-compounds in its decreasing order of oxidation states is
   (1) HNO₃, NO, N₂, NH₄Cl
   (2) HNO₃, NO, NH₄Cl, N₂
   (3) NH₄Cl, N₂, NO, HNO₃
   (4) HNO₃, NH₄Cl, NO, N₂

2. Which one of the following elements is unable to form MF₆⁻ ion?
   (1) Ga
   (2) Al
   (3) In
   (4) B

3. Considering Ellingham diagram, which of the following metals can be used to reduce alumina?
   (1) Fe
   (2) Zn
   (3) Cu
   (4) Mg

4. The correct order of atomic radii in group 13 elements is
   (1) B < Al < In < Ga < Tl
   (2) B < Al < Ga < In < Tl
   (3) B < Ga < Al < In < Tl
   (4) B < Ga < Al < Tl < In

5. Which of the following statements is not true for halogens?
   (1) All form monobasic oxyacids.
   (2) All are oxidizing agents.
   (3) Chlorine has the highest electron-gain enthalpy.
   (4) All but fluorine show positive oxidation states.

6. In the structure of ClF₃, the number of lone pairs of electrons on central atom Cl is
   (1) one
   (2) two
   (3) three
   (4) four

7. Identify the major products P, Q and R in the following sequence of reactions:

   ![Chemical Reaction Diagram]

   (1) CH₃CH₂CH₂CH₂Cl → CH₃CH₂CH₂OH
   (2) CH₃CH₂CH₂CHO → CH₃CH₂CH₂COOH
   (3) CH₃CH₂CH₂OH → CH₃COCH₃
   (4) CH₃(CH₃)₂OH → CH₃(CH₃)₂CO

8. Which of the following compounds can form a zwitterion?
   (1) Aniline
   (2) Acetanilide
   (3) Glycine
   (4) Benzoic acid
9. Regarding cross-linked or network polymers, which of the following statements is **incorrect**?

(1) They contain covalent bonds between various linear polymer chains.
(2) They are formed from bi- and tri-functional monomers.
(3) They contain strong covalent bonds in their polymer chains.
(4) Examples are bakelite and melamine.

10. Nitrilation of aniline in strong acidic medium also gives m-nitroaniline because

(1) In spite of substituents nitro group always goes to only m-position.
(2) In electrophilic substitution reactions amino group is meta directive.
(3) In acidic (strong) medium aniline is present as amine ion.
(4) In absence of substituents nitro group always goes to m-position.

11. The difference between amylose and amylopectin is

(1) Amylopectin have \(1 \rightarrow 4\) \(\alpha\)-linkage and \(1 \rightarrow 6\) \(\alpha\)-linkage
(2) Amylose have \(1 \rightarrow 4\) \(\alpha\)-linkage and \(1 \rightarrow 6\) \(\beta\)-linkage
(3) Amylose is made up of glucose and galactose
(4) Amylopectin have \(1 \rightarrow 4\) \(\alpha\)-linkage and \(1 \rightarrow 6\) \(\beta\)-linkage

12. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with cone. \(\text{H}_2\text{SO}_4\). The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be

(1) 1.4
(2) 3.0
(3) 4.4
(4) 2.8

13. Which of the following oxides is most acidic in nature?

(1) MgO
(2) BeO
(3) CaO
(4) BaO

14. Which oxide of nitrogen is **not** a common pollutant introduced into the atmosphere both due to natural and human activity?

(1) \(\text{N}_2\text{O}_5\)
(2) \(\text{NO}_2\)
(3) \(\text{NO}\)
(4) \(\text{N}_2\text{O}\)

15. The compound A on treatment with \(\text{Na}\) gives B, and with \(\text{PCl}_3\) gives C. B and C react together to give diethyl ether. A, B and C are in the order

(1) \(\text{C}_2\text{H}_5\text{OH}, \text{C}_2\text{H}_5, \text{C}_2\text{H}_5\text{Cl}\)
(2) \(\text{C}_2\text{H}_5\text{OH}, \text{C}_2\text{H}_5\text{Cl}, \text{C}_2\text{H}_5\text{ONa}\)
(3) \(\text{C}_2\text{H}_5\text{OH}, \text{C}_2\text{H}_5\text{ONa}, \text{C}_2\text{H}_5\text{Cl}\)
(4) \(\text{C}_2\text{H}_5\text{Cl}, \text{C}_2\text{H}_5, \text{C}_2\text{H}_5\text{OH}\)

16. The compound \(\text{C}_7\text{H}_8\) undergoes the following reactions:

\[
\text{C}_7\text{H}_8 \xrightarrow{3 \text{Cl}_2/\Delta} \text{A} \xrightarrow{\text{Br}_2/\text{Fe}} \text{B} \xrightarrow{\text{Zn}/\text{HCl}} \text{C}
\]

The product 'C' is

(1) \(m\)-bromotoluene
(2) \(o\)-bromotoluene
(3) \(p\)-bromotoluene
(4) 3-bromo-2,4,6-trichlorotoluene

17. Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. (A) is

(1) \(\text{CH} = \text{CH}\)
(2) \(\text{CH}_2 = \text{CH}_2\)
(3) \(\text{CH}_4\)
(4) \(\text{CH}_3 - \text{CH}_3\)
18. Which of the following molecules represents the order of hybridisation $sp^2$, $sp^2$, $sp$, $sp$ from left to right atoms?

(1) $HC = C - C = CH$
(2) $CH_2 = CH - C = CH$
(3) $CH_3 - CH = CH - CH_3$
(4) $CH_2 = CH - CH = CH_2$

19. Which of the following carbocations is expected to be most stable?

(1) 

(2) 

(3) 

(4) 

20. Which of the following is correct with respect to $-I$ effect of the substituents? ($R = alkyl$)

(1) $-NH_2 < - OR < - F$
(2) $-NR_2 < - OR < - F$
(3) $-NR_2 > - OR > - F$
(4) $-NH_2 > - OR > - F$

21. In the reaction

$$\text{aryl} + \text{CHCl}_3 + \text{NaOH} \rightarrow \begin{array}{c}
\text{aryl} \\
\text{CHO}
\end{array}$$

the electrophile involved is

(1) dichloromethyl cation ($\text{CHCl}_2$)
(2) formyl cation ($\text{CHO}$)
(3) dichlorocarbene ($\text{CCl}_2$)
(4) dichloromethyl anion ($\text{CHCl}_2$)

22. Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to their

(1) formation of intramolecular H-bonding
(2) formation of carboxylate ion
(3) formation of intermolecular H-bonding
(4) more extensive association of carboxylic acid via van der Waals force of attraction

23. Compound A, $C_8H_{10}O$, is found to react with NaOCl (produced by reacting Y with NaOH) and yields a yellow precipitate with characteristic smell. A and Y are respectively

(1) $\text{H}_3\text{C} - \begin{array}{c}
\text{aryl} \\
\text{CH}_2 - \text{OH} \end{array}$ and $I_2$
(2) $\begin{array}{c}
\text{aryl} \\
\text{CH}_2 - \text{CH}_2 - \text{OH} \end{array}$ and $I_2$
(3) $\text{CH}_3 - \begin{array}{c}
\text{aryl} \\
\text{OH} \end{array}$ and $I_2$
(4) $\begin{array}{c}
\text{aryl} \\
\text{CH} - \text{CH}_3 \end{array}$ and $I_2$
24. Match the metal ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code:

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Co^{3+}</td>
<td>i. $\sqrt{8}$ B.M.</td>
</tr>
<tr>
<td>b. Cr^{3+}</td>
<td>ii. $\sqrt{35}$ B.M.</td>
</tr>
<tr>
<td>c. Fe^{3+}</td>
<td>iii. $\sqrt{3}$ B.M.</td>
</tr>
<tr>
<td>d. Ni^{2+}</td>
<td>iv. $\sqrt{24}$ B.M.</td>
</tr>
<tr>
<td></td>
<td>v. $\sqrt{15}$ B.M.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>iv</td>
<td>v</td>
<td>ii</td>
</tr>
<tr>
<td>(2)</td>
<td>i</td>
<td>ii</td>
<td>iii</td>
</tr>
<tr>
<td>(3)</td>
<td>iii</td>
<td>v</td>
<td>i</td>
</tr>
<tr>
<td>(4)</td>
<td>iv</td>
<td>i</td>
<td>ii</td>
</tr>
</tbody>
</table>

25. Which one of the following ions exhibits d-d transition and paramagnetism as well?

(1) $\text{CrO}_4^{2-}$
(2) $\text{Cr}_2\text{O}_7^{2-}$
(3) $\text{MnO}_4^{2-}$
(4) $\text{MnO}_4^{-}$

26. Iron carbonyl, Fe(CO)$_5$ is

(1) tetranuclear
(2) mononuclear
(3) dinuclear
(4) trinuclear

27. The type of isomerism shown by the complex [CoCl$_2$(en)$_2$] is

(1) Geometrical isomerism
(2) Coordination isomerism
(3) Linkage isomerism
(4) Ionization isomerism

28. The geometry and magnetic behaviour of the complex [Ni(CO)$_4$] are

(1) square planar geometry and diamagnetic
(2) tetrahedral geometry and diamagnetic
(3) tetrahedral geometry and paramagnetic
(4) square planar geometry and paramagnetic

29. Following solutions were prepared by mixing different volumes of NaOH and HCl of different concentrations:

- a. 60 mL $\frac{M}{10}$ HCl + 40 mL $\frac{M}{10}$ NaOH
- b. 55 mL $\frac{M}{10}$ HCl + 45 mL $\frac{M}{10}$ NaOH
- c. 75 mL $\frac{M}{5}$ HCl + 25 mL $\frac{M}{5}$ NaOH
- d. 100 mL $\frac{M}{10}$ HCl + 100 mL $\frac{M}{10}$ NaOH

pH of which one of them will be equal to 1?

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

30. On which of the following properties does the coagulating power of an ion depend?

(1) The magnitude of the charge on the ion alone
(2) Size of the ion alone
(3) The sign of charge on the ion alone
(4) Both magnitude and sign of the charge on the ion

31. Given van der Waals constant for NH$_3$, H$_2$, O$_2$ and CO$_2$ are respectively 4.17, 0.243, 1.36 and 3.59, which one of the following gases is most easily liquefied?

(1) NH$_3$
(2) H$_2$
(3) CO$_2$
(4) O$_2$

32. The solubility of BaSO$_4$ in water is $2.42 \times 10^{-3}$ g L$^{-1}$ at 298 K. The value of its solubility product (K$_{sp}$) will be

(Given molar mass of BaSO$_4$ = 233 g mol$^{-1}$)

(1) $1.08 \times 10^{-10}$ mol$^2$ L$^{-2}$
(2) $1.08 \times 10^{-12}$ mol$^2$ L$^{-2}$
(3) $1.08 \times 10^{-6}$ mol$^2$ L$^{-2}$
(4) $1.08 \times 10^{-14}$ mol$^2$ L$^{-2}$
33. In which case is the number of molecules of water maximum?
(1) 18 mL of water
(2) 0.18 g of water
(3) \(10^{-3}\) mol of water
(4) 0.00224 L of water vapours at 1 atm and 273 K

34. The correct difference between first- and second-order reactions is that
(1) the rate of a first-order reaction does not depend on reactant concentrations; the rate of a second-order reaction does depend on reactant concentrations
(2) the half-life of a first-order reaction does not depend on \([A]_0\); the half-life of a second-order reaction does depend on \([A]_0\)
(3) the rate of a first-order reaction does depend on reactant concentrations; the rate of a second-order reaction does not depend on reactant concentrations
(4) a first-order reaction can be catalyzed; a second-order reaction cannot be catalyzed

35. Among CaH₂, BeH₂, BaH₂, the order of ionic character is
(1) BeH₂ < CaH₂ < BaH₂
(2) CaH₂ < BeH₂ < BaH₂
(3) BaH₂ < BeH₂ < CaH₂
(4) BeH₂ < BaH₂ < CaH₂

36. Consider the change in oxidation state of Bromine corresponding to different emf values as shown in the diagram below:

\[
\begin{align*}
\text{BrO}_4^- & \quad \text{1.82 V} \quad \text{BrO}_3^- & \quad 1.5 \text{ V} \quad \text{HBrO} \\
\text{Br}^- & \quad \text{1.0652 V} \quad \text{Br}_2 & \quad 1.595 \text{ V}
\end{align*}
\]

Then the species undergoing disproportionation is
(1) \text{BrO}_3^-
(2) \text{BrO}_4^-
(3) HBrO
(4) \text{Br}_2

37. For the redox reaction
\[
\text{MnO}_4^- + \text{C}_2\text{O}_4^{2-} + \text{H}^+ \rightarrow \text{Mn}^{2+} + \text{CO}_2 + \text{H}_2\text{O}
\]
the correct coefficients of the reactants for the balanced equation are
\[
\begin{align*}
\text{MnO}_4^- & \quad \text{C}_2\text{O}_4^{2-} & \quad \text{H}^+ \\
(1) & \quad 16 & \quad 5 & \quad 2 \\
(2) & \quad 2 & \quad 5 & \quad 16 \\
(3) & \quad 5 & \quad 16 & \quad 2 \\
(4) & \quad 2 & \quad 16 & \quad 5
\end{align*}
\]

38. Which one of the following conditions will favour maximum formation of the product in the reaction,
\[
\text{A}_2(g) + \text{B}_2(g) \rightleftharpoons \text{X}_2(g) \quad \Delta H = -X \text{kJ}
\]
(1) Low temperature and high pressure
(2) Low temperature and low pressure
(3) High temperature and low pressure
(4) High temperature and high pressure

39. When initial concentration of the reactant is doubled, the half-life period of a zero order reaction \(\frac{\Delta t}{t}\) is halved
(2) is doubled
(3) remains unchanged
(4) is tripled

40. The bond dissociation energies of X₂, Y₂ and XY are in the ratio of 1 : 0.5 : 1. ΔH for the formation of XY is 200 kJ mol⁻¹. The bond dissociation energy of X₂ will be
(1) 200 kJ mol⁻¹
(2) 100 kJ mol⁻¹
(3) 400 kJ mol⁻¹
(4) 800 kJ mol⁻¹

41. The correction factor 'a' to the ideal gas equation corresponds to
(1) density of the gas molecules
(2) volume of the gas molecules
(3) forces of attraction between the gas molecules
(4) electric field present between the gas molecules
42. Which one is a **wrong** statement?
(1) Total orbital angular momentum of electron in 's' orbital is equal to zero.
(2) An orbital is designated by three quantum numbers while an electron in an atom is designated by four quantum numbers.
(3) The value of \( m \) for \( d^2 \) is zero.
(4) The electronic configuration of N atom is
\[
\begin{array}{c}
1s^2 \\ 2s^2 \\ 2p_x^1 2p_y^1 2p_z^1 \\
\end{array}
\]

43. Magnesium reacts with an element (X) to form an ionic compound. If the ground state electronic configuration of (X) is \( 1s^2 2s^2 2p^3 \), the simplest formula for this compound is
(1) \( \text{Mg}_2X_3 \)
(2) \( \text{MgX}_2 \)
(3) \( \text{Mg}_3X_2 \)
(4) \( \text{Mg}_2X \)

44. Iron exhibits bcc structure at room temperature. Above 900°C, it transforms to fcc structure. The ratio of density of iron at room temperature to that at 900°C (assuming molar mass and atomic radii of iron remains constant with temperature) is
\[
\frac{\sqrt{3}}{\sqrt{2}}
\]
(1) \( \frac{\sqrt{3}}{\sqrt{2}} \)
(2) \( \frac{4\sqrt{3}}{3\sqrt{2}} \)
(3) \( \frac{1}{2} \)
(4) \( \frac{3\sqrt{3}}{4\sqrt{2}} \)

45. Consider the following species:
- \( \text{CN}^+ \)
- \( \text{CN}^- \)
- \( \text{NO} \)
- \( \text{CN} \)
Which one of these will have the highest bond order?
(1) \( \text{NO} \)
(2) \( \text{CN}^- \)
(3) \( \text{CN} \)
(4) \( \text{CN}^+ \)

46. In a growing population of a country,
(1) pre-reproductive individuals are more than the reproductive individuals.
(2) reproductive individuals are less than the post-reproductive individuals.
(3) pre-reproductive individuals are less than the reproductive individuals.
(4) reproductive and pre-reproductive individuals are equal in number.

47. Match the items given in Column I with those in Column II and select the **correct** option given below:

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Eutrophication</td>
<td>i. UV-B radiation</td>
</tr>
<tr>
<td>b. Sanitary landfill</td>
<td>ii. Deforestation</td>
</tr>
<tr>
<td>c. Snow blindness</td>
<td>iii. Nutrient enrichment</td>
</tr>
<tr>
<td>d. Jhum cultivation</td>
<td>iv. Waste disposal</td>
</tr>
</tbody>
</table>

(1) | ii | i | iii | iv |
(2) | i | iii | iv | ii |
(3) | i | ii | iv | iii |
(4) | \( \varphi \) | \( \vartheta \) | jy | i | ii |

48. Which part of poppy plant is used to obtain the drug "Smack"?
(1) Flowers
(2) Latex
(3) Leaves
(4) Roots

49. Which one of the following population interactions is widely used in medical science for the production of antibiotics?
(1) Commensalism
(2) Mutualism
(3) Amensalism
(4) Parasitism

50. All of the following are included in 'Ex-situ conservation' except
(1) Wildlife safari parks
(2) Sacred groves
(3) Seed banks
(4) Botanical gardens
51. AGGTATCGCAT is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed mRNA?
   (1) AGGUACGCAU
   (2) UGGTUTCGCAT
   (3) UCCAUAGCGUA
   (4) ACCUAUGCGAU

52. According to Hugo de Vries, the mechanism of evolution is
   (1) Multiple step mutations
   (2) Saltation
   (3) Minor mutations
   (4) Phenotypic variations

53. Match the items given in Column I with those in Column II and select the correct option given below:

   Column I          Column II
   a. Proliferative Phase i. Breakdown of endometrial lining
   b. Secretory Phase ii. Follicular Phase
   c. Menstruation iii. Luteal Phase

   a   b   c
   (1) iii   ii   i
   (2) i    iii   ii
   (3) iii   i    ii
   (4) ii   iii   i

54. All of the following are part of an operon except
   (1) an operator
   (2) structural genes
   (3) a promoter
   (4) an enhancer

55. A woman has an X-linked condition on one of her X chromosomes. This chromosome can be inherited by
   (1) Only daughters
   (2) Only sons
   (3) Both sons and daughters
   (4) Only grandchildren

56. Which of the following options correctly represents the lung conditions in asthma and emphysema, respectively?
   (1) Inflammation of bronchioles; Decreased respiratory surface
   (2) Increased number of bronchioles; Increased respiratory surface
   (3) Decreased respiratory surface; Inflammation of bronchioles
   (4) Increased respiratory surface; Inflammation of bronchioles

57. Match the items given in Column I with those in Column II and select the correct option given below:

   Column I          Column II
   a. Tricuspid valve i. Between left atrium and left ventricle
   b. Bicuspid valve ii. Between right ventricle and pulmonary artery
   c. Semilunar valve iii. Between right atrium and right ventricle

   a   b   c
   (1) iii   i    ii
   (2) i     iii   ii
   (3) ii    i    iii
   (4) i     ii   iii

58. Match the items given in Column I with those in Column II and select the correct option given below:

   Column I          Column II
   a. Tidal volume i. 2500 - 3000 mL
   b. Inspiratory Reserve ii. 1100 - 1200 mL
   c. Expiratory Reserve iii. 500 - 550 mL
   d. Residual volume iv. 1000 - 1100 mL

   a   b   c   d
   (1) iii   ii   i    iv
   (2) iii   i    iv   ii
   (3) iv    iii   ii   i
   (4) i     iv   ii   iii
59. Nissl bodies are mainly composed of
(1) Proteins and lipids
(2) DNA and RNA
(3) Free ribosomes and RER
(4) Nucleic acids and SER

60. Which of the following terms describe human dentition?
(1) Thecodont, Diphyodont, Homodont
(2) Thecodont, Diphyodont, Heterodont
(3) Pleurodont, Diphyodont, Heterodont
(4) Pleurodont, Monophyodont, Homodont

61. Many ribosomes may associate with a single mRNA to form multiple copies of a polypeptide simultaneously. Such strings of ribosomes are termed as
(1) Polysome
(2) Polyhedral bodies
(3) Nucleosome
(4) Plastidome

62. Which of these statements is incorrect?
(1) Enzymes of TCA cycle are present in mitochondrial matrix.
(2) Glycolysis occurs in cytosol.
(3) Oxidative phosphorylation takes place in outer mitochondrial membrane.
(4) Glycolysis operates as long as it is supplied with NAD that can pick up hydrogen atoms.

63. Which of the following events does not occur in rough endoplasmic reticulum?
(1) Protein folding
(2) Protein glycosylation
(3) Phospholipid synthesis
(4) Cleavage of signal peptide

64. Select the incorrect match:
(1) Lampbrush – Diplotene bivalents
(2) Allosomes – Sex chromosomes
(3) Polytenes – Oocytes of amphibians
(4) Submetacentric – L-shaped chromosomes

65. Which of the following is an amino acid derived hormone?
(1) Epinephrine
(2) Ecdysone
(3) Estril
(4) Estradiol

66. Which of the following structures or regions is incorrectly paired with its function?
(1) Medulla oblongata: controls respiration and cardiovascular reflexes.
(2) Limbic system: consists of fibre tracts that interconnect different regions of the brain; controls movement.
(3) Corpus callosum: band of fibers connecting left and right cerebral hemispheres.
(4) Hypothalamus: production of releasing hormones and regulation of temperature, hunger and thirst.

67. Which of the following hormones can play a significant role in osteoporosis?
(1) Aldosterone and Prolactin
(2) Progesterone and Aldosterone
(3) Parathyroid hormone and Prolactin
(4) Estrogen and Parathyroid hormone

The transparent lens in the human eye is held in its place by
(1) ligaments attached to the ciliary body
(2) ligaments attached to the iris
(3) smooth muscles attached to the ciliary body
(4) smooth muscles attached to the iris
69. Which of the following animals does not undergo metamorphosis?
(1) Earthworm ✓
(2) Tunicate
(3) Starfish
(4) Moth ✓

70. Which one of these animals is not a homeotherm?
(1) Macropus
(2) Chelone
(3) Psittacula
(4) Camelus

71. Which of the following features is used to identify a male cockroach from a female cockroach?
(1) Presence of a boat shaped sternum on the 9th abdominal segment
(2) Presence of caudal styles
(3) Presence of anal cerci ✓
(4) Forewings with darker tegmina ✓

72. Which of the following organisms are known as chief producers in the oceans?
(1) Dinoflagellates ✓
(2) Diatoms
(3) Euglenoids ✓
(4) Cyanobacteria ✓

73. Ciliates differ from all other protozoans in
(1) using flagella for locomotion ✓
(2) having a contractile vacuole for removing excess water ✓
(3) having two types of nuclei
(4) using pseudopodia for capturing prey

74. Identify the vertebrate group of animals characterized by crop and gizzard in its digestive system.
(1) Amphibia
(2) Reptilia ✓
(3) Osteichthyes
(4) Aves

75. Among the following sets of examples for divergent evolution, select the incorrect option:
(1) Forelimbs of man, bat and cheetah
(2) Heart of bat, man and cheetah
(3) Eye of octopus, bat and man
(4) Brain of bat, man and cheetah

76. Conversion of milk to curd improves its nutritional value by increasing the amount of
(1) Vitamin D
(2) Vitamin A ✓
(3) Vitamin E
(4) Vitamin B12 ✓

77. Which of the following characteristics represent 'Inheritance of blood groups' in humans?
(a) Dominance ✓
(b) Co-dominance ✓
(c) Multiple allele ✓
(d) Incomplete dominance ✓
(e) Polygenic inheritance ✓
(1) b, c and e
(2) a, b and c
(3) a, c and e
(4) b, d and e

78. Which of the following is not an autoimmune disease?
(1) Psoriasis
(2) Rheumatoid arthritis
(3) Vitiligo
(4) Alzheimer's disease

79. The similarity of bone structure in the forelimbs of many vertebrates is an example of
(1) Homology ✓
(2) Analogy
(3) Adaptive radiation ✓
(4) Convergent evolution

80. In which disease does mosquito transmitted pathogen cause chronic inflammation of lymphatic vessels?
(1) Elephantiasis ✓
(2) Ascariasis ✓
(3) Amoebiasis ✓
(4) Ringworm disease
81. Match the items given in Column I with those in Column II and select the correct option given below:

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Glycosuria</td>
<td>i.</td>
</tr>
<tr>
<td>b. Gout</td>
<td>ii.</td>
</tr>
<tr>
<td>c. Renal calculi</td>
<td>iii.</td>
</tr>
<tr>
<td>d. Glomerular nephritis</td>
<td>iv.</td>
</tr>
</tbody>
</table>

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

82. Match the items given in Column I with those in Column II and select the correct option given below:

<table>
<thead>
<tr>
<th>Column I (Function)</th>
<th>Column II (Part of Excretory System)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Ultrafiltration</td>
<td>i. Henle's loop</td>
</tr>
<tr>
<td>b. Concentration of urine</td>
<td>ii. Ureter</td>
</tr>
<tr>
<td>c. Transport of urine</td>
<td>iii. Urinary bladder</td>
</tr>
<tr>
<td>d. Storage of urine</td>
<td>iv. Malpighian corpuscle</td>
</tr>
<tr>
<td></td>
<td>v. Proximal convoluted tubule</td>
</tr>
</tbody>
</table>

a b c d
(1) iv v ii iii ✓
(2) iv i ii iii ✓
(3) v iv i iii
(4) v iv i ii

83. Hormones secreted by the placenta to maintain pregnancy are
(1) hCG, hPL, progestogens, prolactin
(2) hCG, hPL, estrogens, relaxin, oxytocin
(3) hCG, progestogens, estrogens, glucocorticoids
(4) hCG, hPL, progestogens, estrogens

84. The contraceptive ‘SAHEL’
(1) blocks estrogen receptors in the uterus, preventing eggs from getting implanted.
(2) increases the concentration of estrogen and prevents ovulation in females.
✓ is a post-coital contraceptive.
(4) is an IUD. ❌

85. The difference between spermiogenesis and spermiation is
(1) In spermiogenesis spermatids are formed, while in spermiation spermatozoa are formed.
(2) In spermiogenesis spermatozoa are formed, while in spermiation spermatids are formed.
(3) In spermiogenesis spermatozoa are formed, while in spermiation spermatozoa are released from sertoli cells into the cavity of seminiferous tubules.
(4) In spermiogenesis spermatozoa from sertoli cells are released into the cavity of seminiferous tubules, while in spermiation spermatozoa are formed.

86. The amnion of mammalian embryo is derived from
(1) ectoderm and mesoderm
(2) endoderm and mesoderm
(3) ectoderm and endoderm
(4) mesoderm and trophoblast
87. Which of the following gastric cells indirectly help in erythropoiesis?
(1) Chief cells
(2) Mucous cells
(3) Parietal cells
(4) Goblet cells

88. Match the items given in Column I with those in Column II and select the correct option given below:

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Fibrinogen</td>
<td>i. Osmotic balance</td>
</tr>
<tr>
<td>b. Globulin</td>
<td>ii. Blood clotting</td>
</tr>
<tr>
<td>c. Albumin</td>
<td>iii. Defence mechanism</td>
</tr>
</tbody>
</table>

89. Calcium is important in skeletal muscle contraction because it
(1) binds to troponin to remove the masking of active sites on actin for myosin.
(2) activates the myosin ATPase by binding to it.
(3) prevents the formation of bonds between the myosin cross bridges and the actin filament.
(4) detaches the myosin head from the actin filament.

91. Oxygen is not produced during photosynthesis by
(1) Green sulphur bacteria
(2) Nostoc
(3) Chara
(4) Cycas

92. Pollen grains can be stored for several years in liquid nitrogen having a temperature of
(1) – 120°C
(2) – 80°C
(3) – 160°C
(4) – 196°C

93. In which of the following forms is iron absorbed by plants?
(1) Ferric
(2) Ferrous
(3) Both ferric and ferrous
(4) Free element

94. Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other?
(1) Hydrilla
(2) Yucca
(3) Viola
(4) Banana

95. What is the role of NAD\(^+\) in cellular respiration?
(1) It functions as an enzyme.
(2) It functions as an electron carrier.
(3) It is the final electron acceptor for anaerobic respiration.
(4) It is a nucleotide source for ATP synthesis.

96. Double fertilization is:
(1) Fusion of two male gametes of a pollen tube with two different eggs
(2) Fusion of one male gamete with two polar nuclei
(3) Syngamy and triple fusion
(4) Fusion of two male gametes with one egg

97. Which of the following elements is responsible for maintaining turgor in cells?
(1) Magnesium
(2) Sodium
(3) Calcium
(4) Potassium
98. The correct order of steps in Polymerase Chain Reaction (PCR) is
   (1) Extension, Denaturation, Annealing
   (2) Annealing, Extension, Denaturation
   (3) Denaturation, Annealing, Extension
   (4) Denaturation, Extension, Annealing

99. Select the correct match:
   (1) Ribozyme  -  Nucleic acid
   (2) F₂ × Recessive parent  -  Dihybrid cross
   (3) G. Mendel  -  Transformation
   (4) T.H. Morgan  -  Transduction

100. Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called
   (1) Bio-infringement
   (2) Biopiracy
   (3) Bioexploitation
   (4) Biodegradation

101. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is
   (1) Indian Council of Medical Research (ICMR)
   (2) Council for Scientific and Industrial Research (CSIR)
   (3) Genetic Engineering Appraisal Committee (GEAC)
   (4) Research Committee on Genetic Manipulation (RCGM)

102. A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to
   (1) Co-667
   (2) Sharbatgi Sonora
   (3) Basmati
   (4) Lerma Rojo

103. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes?
   (1) Retrovirus
   (2) Ti plasmid
   (3) pBR 322
   (4) λ phage

104. Plants having little or no secondary growth are
   (1) Grasses
   (2) Deciduous angiosperms
   (3) Cycads
   (4) Conifers

105. Select the wrong statement:
   (1) Cell wall is present in members of Fungi and Plantae.
   (2) Mushrooms belong to Basidiomycetes.
   (3) Mitochondria are the powerhouse of the cell in all kingdoms except Monera.
   (4) Pseudopodia are locomotory and feeding structures in Sporozoans.

106. Secondary xylem and phloem in dicot stem are produced by
   (1) Apical meristems
   (2) Vascular cambium
   (3) Axillary meristems
   (4) Phellogen

107. Sweet potato is a modified
   (1) Stem
   (2) Adventitious root
   (3) Rhizome
   (4) Tap root

108. Pneumatophores occur in
   (1) Halophytes
   (2) Free-floating hydrophytes
   (3) Submerged hydrophytes
   (4) Carnivorous plants

109. Which of the following statements is correct?
   (1) Ovules are not enclosed by ovary wall in gymnosperms.
   (2) Selaginella is heterosporous, while Salvinia is homosporous.
   (3) Stems are usually unbranched in both Cycas and Cedrus.
   (4) Horsetails are gymnosperms.

110. Casparian strips occur in
   (1) Epidermis
   (2) Pericycle
   (3) Endodermis
   (4) Cortex
118. Winged pollen grains are present in
(1) Mustard
(2) Cycas
(3) Pinus
(4) Mango

119. After karyogamy followed by meiosis, spores are produced exogenously in
(1) Neurospora
(2) Alternaria
(3) Saccharomyces
(4) Agaricus

120. Which one is wrongly matched?
(1) Uniflagellate gametes – Polysiphonia
(2) Bisflagellate zoospores – Brown algae
(3) Unicellular organism – Chlorella
(4) Gemma cups – Marchantia

121. Match the items given in Column I with those in Column II and select the correct option given below:

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Herbarium</td>
<td>i. It is a place having a collection of preserved plants and animals.</td>
</tr>
<tr>
<td>b. Key</td>
<td>ii. A list that enumerates methodically all the species found in an area with brief description aiding identification.</td>
</tr>
<tr>
<td>c. Museum</td>
<td>iii. Is a place where dried and pressed plant specimens mounted on sheets are kept.</td>
</tr>
<tr>
<td>d. Catalogue</td>
<td>iv. A booklet containing a list of characters and their alternates which are helpful in identification of various taxa.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>iv</td>
<td>iii</td>
<td>ii</td>
</tr>
<tr>
<td>iii</td>
<td>ii</td>
<td>i</td>
<td>iv</td>
</tr>
<tr>
<td>iii</td>
<td>iv</td>
<td>i</td>
<td>ii</td>
</tr>
<tr>
<td>ii</td>
<td>iv</td>
<td>iii</td>
<td>i</td>
</tr>
</tbody>
</table>
122. Niche is
(1) all the biological factors in the organism’s environment
(2) the physical space where an organism lives
(3) the functional role played by the organism where it lives
(4) the range of temperature that the organism needs to live

123. Which of the following is a secondary pollutant?
(1) CO
(2) CO₂
(3) O₃
(4) SO₂

124. In stratosphere, which of the following elements acts as a catalyst in degradation of ozone and release of molecular oxygen?
(1) Carbon
(2) Cl
(3) Oxygen
(4) Fe

125. World Ozone Day is celebrated on
(1) 5th June
(2) 21st April
(3) 22nd April
(4) 16th September

126. What type of ecological pyramid would be obtained with the following data?
Secondary consumer: 120 g
Primary consumer: 60 g
Primary producer: 10 g
(3) Inverted pyramid of biomass
(2) Pyramid of energy
(3) Upright pyramid of biomass
(4) Upright pyramid of numbers

127. Natality refers to
(1) Death rate
(2) Birth rate
(3) Number of individuals entering a habitat
(4) Number of individuals leaving the habitat

128. The Golgi complex participates in
(1) Fatty acid breakdown
(2) Formation of secretory vesicles
(3) Activation of amino acid
(4) Respiration in bacteria

129. Stomata in grass leaf are
(1) Dumb-bell shaped
(2) Kidney shaped
(3) Barrel shaped
(4) Rectangular

130. Which of the following is not a product of light reaction of photosynthesis?
(1) ATP
(2) NADH
(3) Oxygen
(4) NADPH

131. Which of the following is true for nucleolus?
(1) Larger nucleoli are present in dividing cells.
(2) It is a membrane-bound structure.
(3) It is a site for active ribosomal RNA synthesis.
(4) It takes part in spindle formation.

132. The two functional groups characteristic of sugars are
(1) hydroxyl and methyl
(2) carbonyl and methyl
(3) carbonyl and hydroxyl
(4) carbonyl and phosphate

133. Stomatal movement is not affected by
(1) Temperature
(2) Light
(3) CO₂ concentration
(4) O₂ concentration

134. Which among the following is not a prokaryote?
(1) Saccharomyces
(2) Mycobacterium
(3) Oscillatoria
(4) Nostoc

135. The stage during which separation of the paired homologous chromosomes begins is
(1) Pachytene
(2) Diplotene
(3) Zygotene
(4) Diakinesis
136. The volume (V) of a monatomic gas varies with its temperature (T), as shown in the graph. The ratio of work done by the gas, to the heat absorbed by it, when it undergoes a change from state A to state B, is

![Graph showing the relationship between volume and temperature]

137. The fundamental frequency in an open organ pipe is equal to the third harmonic of a closed organ pipe. If the length of the closed organ pipe is 20 cm, the length of the open organ pipe is

<table>
<thead>
<tr>
<th>Option</th>
<th>Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>13.2</td>
</tr>
<tr>
<td>(2)</td>
<td>8</td>
</tr>
<tr>
<td>(3)</td>
<td>16</td>
</tr>
<tr>
<td>(4)</td>
<td>12.5</td>
</tr>
</tbody>
</table>

138. At what temperature will the rms speed of oxygen molecules become just sufficient for escaping from the Earth’s atmosphere?

Given:
- Mass of oxygen molecule (m) = 2.76 x 10^{-26} kg
- Boltzmann's constant k_B = 1.38 x 10^{-23} J K^{-1}

<table>
<thead>
<tr>
<th>Option</th>
<th>Temperature (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>2.508 x 10^4</td>
</tr>
<tr>
<td>(2)</td>
<td>8.360 x 10^4</td>
</tr>
<tr>
<td>(3)</td>
<td>1.254 x 10^4</td>
</tr>
<tr>
<td>(4)</td>
<td>5.016 x 10^4</td>
</tr>
</tbody>
</table>

139. The efficiency of an ideal heat engine working between the freezing point and boiling point of water, is

<table>
<thead>
<tr>
<th>Option</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>26.8</td>
</tr>
<tr>
<td>(2)</td>
<td>20</td>
</tr>
<tr>
<td>(3)</td>
<td>12.5</td>
</tr>
<tr>
<td>(4)</td>
<td>6.25</td>
</tr>
</tbody>
</table>

140. A carbon resistor of (47 ± 4.7) kΩ is to be marked with rings of different colours for its identification. The colour code sequence will be

- (1) Violet – Yellow – Orange – Silver
- (2) Yellow – Violet – Orange – Silver
- (3) Green – Orange – Violet – Gold
- (4) Yellow – Green – Violet – Gold

141. A set of 'n' equal resistors, of value 'R', each, are connected in series to a battery of emf 'E' and internal resistance 'R'. The current drawn is I. Now, the 'n' resistors are connected in parallel to the same battery. Then the current drawn from battery becomes 10 I. The value of 'n' is

<table>
<thead>
<tr>
<th>Option</th>
<th>Value of n</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>10</td>
</tr>
<tr>
<td>(2)</td>
<td>11</td>
</tr>
<tr>
<td>(3)</td>
<td>9</td>
</tr>
<tr>
<td>(4)</td>
<td>20</td>
</tr>
</tbody>
</table>

142. A battery consists of a variable number 'n' of identical cells (having internal resistance 'r' each) which are connected in series. The terminals of the battery are short-circuited and the current I is measured. Which of the graphs shows the correct relationship between I and n?

<table>
<thead>
<tr>
<th>Option</th>
<th>Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>![Graph 1]</td>
</tr>
<tr>
<td>(2)</td>
<td>![Graph 2]</td>
</tr>
<tr>
<td>(3)</td>
<td>![Graph 3]</td>
</tr>
<tr>
<td>(4)</td>
<td>![Graph 4]</td>
</tr>
</tbody>
</table>
143. An em wave is propagating in a medium with a velocity \( \vec{V} = V \hat{i} \). The instantaneous oscillating electric field of this em wave is along \(+y\) axis. Then the direction of oscillating magnetic field of the em wave will be along

1. \(-z\) direction
2. \(+z\) direction
3. \(-x\) direction
4. \(-y\) direction

144. The magnetic potential energy stored in a certain inductor is 25 mJ, when the current in the inductor is 60 mA. This inductor is of inductance

1. 0.136 H
2. 136.88 H
3. 13.89 H
4. 1.389 H

145. The refractive index of the material of a prism is \( \sqrt{2} \) and the angle of the prism is 30°. One of the two refracting surfaces of the prism is made a mirror inwards, by silver coating. A beam of monochromatic light entering the prism from the other face will retrace its path (after reflection from the silvered surface) if its angle of incidence on the prism is

1. 60°
2. 45°
3. zero
4. 30°

146. An object is placed at a distance of 40 cm from a concave mirror of focal length 15 cm. If the object is displaced through a distance of 20 cm towards the mirror, the displacement of the image will be

1. 30 cm away from the mirror
2. 36 cm away from the mirror
3. 36 cm towards the mirror
4. 30 cm towards the mirror

147. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is

1. 1 : 1
2. 1 : -1
3. 1 : -2
4. 2 : -1

148. An electron of mass \( m \) with an initial velocity \( \vec{V} = V_0 \hat{i} \) (\( V_0 > 0 \)) enters an electric field \( \vec{E} = -E_0 \hat{i} \) (\( E_0 = \) constant > 0) at \( t = 0 \). If \( \lambda_0 \) is its de-Broglie wavelength initially, then its de-Broglie wavelength at time \( t \) is

1. \[ \frac{\lambda_0}{\left( 1 + \frac{eE_0 t}{mV_0} \right)} \]
2. \( \lambda_0 \left( 1 + \frac{eE_0 t}{mV_0} \right) \)
3. \( \lambda_0 \)
4. \( \lambda_0 t \)

149. When the light of frequency \( 2v_0 \) (where \( v_0 \) is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is \( v_1 \). When the frequency of the incident radiation is increased to \( 5v_0 \), the maximum velocity of electrons emitted from the same plate is \( v_2 \). The ratio of \( v_1 \) to \( v_2 \) is

1. 1 : 2
2. 1 : 4
3. 2 : 1
4. 4 : 1

150. For a radioactive material, half-life is 10 minutes. If initially there are 600 number of nuclei, the time taken (in minutes) for the disintegration of 450 nuclei is

1. 20
2. 10
3. 15
4. 30
151. Unpolarised light is incident from air on a plane surface of a material of refractive index \( \mu \). At a particular angle of incidence \( \theta \), it is found that the reflected and refracted rays are perpendicular to each other. Which of the following options is correct for this situation?

(1) Reflected light is polarised with its electric vector parallel to the plane of incidence

(2) Reflected light is polarised with its electric vector perpendicular to the plane of incidence

\[ i = \tan^{-1} \left( \frac{1}{\mu} \right) \]

\[ i = \sin^{-1} \left( \frac{1}{\mu} \right) \]

152. In Young's double slit experiment the separation \( d \) between the slits is 2 mm, the wavelength \( \lambda \) of the light used is 5896 Å and distance \( D \) between the screen and slits is 100 cm. It is found that the angular width of the fringes is 0·20°. To increase the fringe angular width to 0·21° (with same \( \lambda \) and \( D \)) the separation between the slits needs to be changed to

(1) 1·8 mm

(2) 1·9 mm

(3) 1·7 mm

(4) 2·1 mm

153. An astronomical refracting telescope will have large angular magnification and high angular resolution, when it has an objective lens of

(1) small focal length and large diameter

(2) large focal length and small diameter

(3) small focal length and small diameter

(4) large focal length and large diameter

154. In the circuit shown in the figure, the input voltage \( V_i \) is 20 V, \( V_{BE} = 0 \) and \( V_{CE} = 0 \). The values of \( I_B \), \( I_C \) and \( \beta \) are given by

\[ R_B \]

\[ V_i \]

\[ 500 \, \text{kΩ} \]

\[ 4 \, \text{kΩ} \]

(1) \( I_B = 40 \, \mu A, \, I_C = 10 \, mA, \, \beta = 250 \)

(2) \( I_B = 25 \, \mu A, \, I_C = 5 \, mA, \, \beta = 200 \)

(3) \( I_B = 40 \, \mu A, \, I_C = 5 \, mA, \, \beta = 125 \)

(4) \( I_B = 20 \, \mu A, \, I_C = 5 \, mA, \, \beta = 250 \)

155. In a p-n junction diode, change in temperature due to heating

(1) affects only reverse resistance

(2) affects only forward resistance

(3) affects the overall V – I characteristics of p-n junction

(4) does not affect resistance of p-n junction

156. In the combination of the following gates the output \( Y \) can be written in terms of inputs \( A \) and \( B \) as

(1) \( \overline{A} \cdot B \)

(2) \( A \cdot \overline{B} + \overline{A} \cdot B \)

(3) \( \overline{A + B} \)

(4) \( \overline{A} \cdot B + A \cdot B \)
157. Current sensitivity of a moving coil galvanometer is 5 div/mA and its voltage sensitivity (angular deflection per unit voltage applied) is 20 div/V. The resistance of the galvanometer is

- (1) 40 Ω
- (2) 25 Ω
- (3) 500 Ω
- (4) 250 Ω

158. A metallic rod of mass per unit length 0.5 kg m⁻¹ is lying horizontally on a smooth inclined plane which makes an angle of 30° with the horizontal. The rod is not allowed to slide down by flowing a current through it when a magnetic field of induction 0.25 T is acting on it in the vertical direction. The current flowing in the rod to keep it stationary is

- (1) 7.14 A
- (2) 5.98 A
- (3) 11.32 A
- (4) 14.76 A

159. An inductor 20 mH, a capacitor 100 μF and a resistor 50 Ω are connected in series across a source of emf, V = 10 sin 314 t. The power loss in the circuit is

- (1) 0.79 W
- (2) 0.43 W
- (3) 1.13 W
- (4) 2.74 W

160. A thin diamagnetic rod is placed vertically between the poles of an electromagnet. When the current in the electromagnet is switched on, then the diamagnetic rod is pushed up, out of the horizontal magnetic field. Hence the rod gains gravitational potential energy. The work required to do this comes from

- (1) the current source
- (2) the magnetic field
- (3) the induced electric field due to the changing magnetic field
- (4) the lattice structure of the material of the rod

161. A tuning fork is used to produce resonance in a glass tube. The length of the air column in this tube can be adjusted by a variable piston. At room temperature of 27°C two successive resonances are produced at 20 cm and 73 cm of column length. If the frequency of the tuning fork is 320 Hz, the velocity of sound in air at 27°C is

- (1) 330 m/s
- (2) 339 m/s
- (3) 300 m/s
- (4) 350 m/s

162. The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge Q and area A, is

- (1) independent of the distance between the plates.
- (2) linearly proportional to the distance between the plates.
- (3) inversely proportional to the distance between the plates.
- (4) proportional to the square root of the distance between the plates.

163. An electron falls from rest through a vertical distance h in a uniform and vertically upward directed electric field E. The direction of electric field is now reversed, keeping its magnitude the same. A proton is allowed to fall from rest in it through the same vertical distance h. The time of fall of the electron, in comparison to the time of fall of the proton is

- (1) smaller
- (2) 5 times greater
- (3) equal
- (4) 10 times greater

164. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is 20 m/s² at a distance of 5 m from the mean position. The time period of oscillation is

- (1) 2π s
- (2) π s
- (3) 1 s
- (4) 2 s
165. The power radiated by a black body is $P$ and it radiates maximum energy at wavelength, $\lambda_0$. If the temperature of the black body is now changed so that it radiates maximum energy at wavelength $\frac{3}{4}\lambda_0$, the power radiated by it becomes $nP$. The value of $n$ is

(1) $\frac{3}{4}$
(2) $\frac{4}{3}$
(3) $\frac{81}{256}$
(4) $\frac{256}{81}$

166. Two wires are made of the same material and have the same volume. The first wire has cross-sectional area $A$ and the second wire has cross-sectional area $3A$. If the length of the first wire is increased by $\Delta l$ on applying a force $F$, how much force is needed to stretch the second wire by the same amount?

(1) $9F$
(2) $6F$
(3) $F$
(4) $4F$

167. A small sphere of radius $r$ falls from rest in a viscous liquid. As a result, heat is produced due to viscous force. The rate of production of heat when the sphere attains its terminal velocity, is proportional to

(1) $r^3$
(2) $r^2$
(3) $r^4$
(4) $r^5$

168. A sample of 0.1 g of water at 100°C and normal pressure ($1.013 \times 10^5$ Nm$^{-2}$) requires 54 cal of heat energy to convert to steam at 100°C. If the volume of the steam produced is 167.1 cc, the change in internal energy of the sample, is

(1) 104.3 J
(2) 208.7 J
(3) 84.5 J
(4) 42.2 J

169. A body initially at rest and sliding along a frictionless track from a height $h$ (as shown in the figure) just completes a vertical circle of diameter $AB = D$. The height $h$ is equal to

(1) $\frac{3}{2}D$
(2) $D$
(3) $\frac{5}{4}D$
(4) $\frac{7}{5}D$

170. Three objects, $A$ : (a solid sphere), $B$ : (a thin circular disk) and $C$ : (a circular ring), each have the same mass $M$ and radius $R$. They all spin with the same angular speed $\omega$ about their own symmetry axes. The amounts of work ($W$) required to bring them to rest, would satisfy the relation

(1) $W_C > W_B > W_A$
(2) $W_A > W_B > W_C$
(3) $W_A > W_C > W_B$
(4) $W_B > W_A > W_C$

171. A moving block having mass $m$, collides with another stationary block having mass $4m$. The lighter block comes to rest after collision. When the initial velocity of the lighter block is $v$, then the value of coefficient of restitution ($e$) will be

(1) 0.5
(2) 0.25
(3) 0.4
(4) 0.8

172. Which one of the following statements is incorrect?

(1) Rolling friction is smaller than sliding friction.
(2) Limiting value of static friction is directly proportional to normal reaction.
(3) Coefficient of sliding friction has dimensions of length.
(4) Frictional force opposes the relative motion.
173. The kinetic energies of a planet in an elliptical orbit about the Sun, at positions A, B and C are $K_A$, $K_B$ and $K_C$, respectively. AC is the major axis and SB is perpendicular to AC at the position of the Sun S as shown in the figure. Then

(1) $K_A < K_B < K_C$
(2) $K_A > K_B > K_C$
(3) $K_B > K_A > K_C$
(4) $K_B < K_A < K_C$

174. A solid sphere is in rolling motion. In rolling motion a body possesses translational kinetic energy ($K_t$) as well as rotational kinetic energy ($K_r$) simultaneously. The ratio $K_t : (K_t + K_r)$ for the sphere is

(1) 7 : 10
(2) 5 : 7
(3) 2 : 5
(4) 10 : 7

175. A solid sphere is rotating freely about its symmetry axis in free space. The radius of the sphere is increased keeping its mass same. Which of the following physical quantities would remain constant for the sphere?

(1) Angular velocity
(2) Moment of inertia
(3) Angular momentum
(4) Rotational kinetic energy

176. If the mass of the Sun were ten times smaller and the universal gravitational constant were ten times larger in magnitude, which of the following is not correct?

(1) Raindrops will fall faster.
(2) Walking on the ground would become more difficult.
(3) 'g' on the Earth will not change.
(4) Time period of a simple pendulum on the Earth would decrease.

177. A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm. The main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of -0.004 cm, the correct diameter of the ball is

(1) 0.521 cm
(2) 0.525 cm
(3) 0.529 cm
(4) 0.535 cm

178. The moment of the force, $\mathbf{F} = 4 \mathbf{i} + 5 \mathbf{j} - 6 \mathbf{k}$ at (2, 0, -3), about the point (2, -2, -2), is given by

(1) $-8 \mathbf{i} - 4 \mathbf{j} - 7 \mathbf{k}$
(2) $-4 \mathbf{i} - 2 \mathbf{j} - 8 \mathbf{k}$
(3) $-7 \mathbf{i} - 4 \mathbf{j} - 8 \mathbf{k}$
(4) $-7 \mathbf{i} - 8 \mathbf{j} - 4 \mathbf{k}$

179. A toy car, with charge $q$ moves on a frictionless horizontal plane surface under the influence of a uniform electric field $E$. Due to the force $qE$, its velocity increases from 0 to 6 m/s in one second duration. At that instant the direction of the field is reversed. The car continues to move for two more seconds under the influence of this field. The average velocity and the average speed of the toy car between 0 to 3 seconds are respectively

(1) 2 m/s, 4 m/s
(2) 1 m/s, 3 m/s
(3) 1.5 m/s, 3 m/s
(4) 1 m/s, 3.5 m/s

180. A block of mass $m$ is placed on a smooth inclined wedge ABC of inclination $\theta$ as shown in the figure. The wedge is given an acceleration 'a' towards the right. The relation between $a$ and $\theta$ for the block to remain stationary on the wedge is

(1) $a = \frac{g}{\csc \theta}$
(2) $a = \frac{g}{\sin \theta}$
(3) $a = g \tan \theta$
(4) $a = g \cos \theta$
1 mol = 18 g
18 g = \( \frac{6.022 \times 10^{23}}{18} \times 18 \)

Ni-28 d²

Para: \( \text{sp}^3 \rightarrow \text{Tet} \)

dsp²- sg.
SPACE FOR ROUGH WORK
Read carefully the following instructions:

1. Each candidate must show on demand his/her Admit Card to the Invigilator.

2. No candidate, without special permission of the Superintendent or Invigilator, would leave his/her seat.

3. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign the Attendance Sheet twice. **Cases where a candidate has not signed the Attendance Sheet second time will be deemed not to have handed over the Answer Sheet and dealt with as an unfair means case.**

4. Use of Electronic/Manual Calculator is prohibited.

5. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.

6. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.

7. The candidates will write the Correct Test Booklet Code as given in the Test Booklet/Answer Sheet in the Attendance Sheet.