1. The test is of 3 hours duration and 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.

2. The question paper contains three parts A, B and C of Physics, Chemistry and Biology respectively.


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 handover the Answer Sheet to the invigilator in the Room/Hall. The candidates are allowed to take away this Test Booklet with them.

6. Immediately fill the particulars on this page of the test booklet with blue/black ball point pen. Use of pencil is strictly prohibited.

7. Blank papers, clipboards, log tables, slide rules, calculators, cameras, cellular phones, pagers and electronic gadgets are not allowed.

8. You are not allowed to go anywhere before the end of the test.

9. Write your name and roll number in the space provided on the bottom of this page.

Name of the Candidate (in Capital Letters) .................................................................

Roll Number (in Figures) ..........................................................................................

in Words ....................................................................................................................

.................................................................
1. The dominant mechanism for motion of charge carriers in forward and reverse biased silicon $p$-$n$ junction are
   a. diffusion in forward biased, drift in reverse bias  
   b. drift in forward biased, drift in reverse biased  
   c. diffusion in both forward and reverse bias  
   d. drift in both forward and reverse bias

2. If binding energy of electron in a hydrogen atom is 13.6 eV, then energy required to remove the electron from the first excited state of $\text{Li}^{++}$ is
   a. 13.6 eV  
   b. 3.4 eV  
   c. 30.6 eV  
   d. 122.4 eV

3. Magnetic field does not cause deflection in
   a. $\alpha$-rays  
   b. $\beta$-rays  
   c. $\text{H}$-atom  
   d. None of these

4. For a telescope, larger the diameter of the objective lens,
   a. greater is the magnifying power  
   b. greater is the resolving power  
   c. smaller is the magnifying power  
   d. smaller is the resolving power

5. An X-rays tube operate at 10 kV. The ratio of X-rays wavelength to that of de-Broglie is
   a. 1 : 10  
   b. 10 : 1  
   c. 1 : 100  
   d. 100 : 1

6. During melting of an ice slab at 273 K at atmospheric pressure
   a. positive work is done by ice water system on the atmosphere  
   b. positive work is done on ice water system by the atmosphere  
   c. internal energy of ice water system decreases  
   d. None of the above

7. The ratio of $C_p$ and $C_V$ depends on temperature $T$ according to relation
   a. $\gamma \propto T$  
   b. $\gamma \propto T$  
   c. $\gamma \propto \frac{1}{T}$  
   d. $\gamma \propto \sqrt{T}$

8. A body executing SHM with an amplitude $A$. At what displacement from the mean position is potential energy of the body is one-fourth of its total energy
   a. $\frac{A}{4}$  
   b. $\frac{A}{2}$  
   c. $\frac{3A}{4}$  
   d. None of these

9. A capillary tube of radius $R$ is immersed in water and water rises in it to a height $H$. Mass of water in capillary tube is $M$. If the radius of tube is doubled, mass of water that will rise in capillary will be
   a. $M$  
   b. $\frac{M}{2}$  
   c. $2M$  
   d. $4M$

10. Two bodies of mass 1 kg and 3 kg have position vector $\mathbf{i} + 2\mathbf{j} + \mathbf{k}$ and $-3\mathbf{i} - 2\mathbf{j} + \mathbf{k}$, respectively. The centre of mass of this system has a position vector
   a. $2\mathbf{i} - \mathbf{j} - 2\mathbf{k}$  
   b. $-2\mathbf{i} - \mathbf{j} + \mathbf{k}$  
   c. $-\mathbf{i} + \mathbf{j} + \mathbf{k}$  
   d. $-2\mathbf{i} + 2\mathbf{k}$

11. A thin circular ring of mass $M$ and radius $R$ is rotating in a horizontal plane about an axis vertical to its plane with a constant angular velocity $\omega$. If two objects each of mass $m$ be attached gently to opposite ends of a diameter of the ring, the ring will then rotate with an angular velocity
   a. $\frac{\omega M}{M + m}$  
   b. $\frac{\omega (M - 2m)}{M + 2m}$  
   c. $\frac{\omega M}{M + 2m}$  
   d. $\frac{\omega (M + 2m)}{M}$
12. If a faulty thermometer has its fixed points marked as 5°C and 95°C. If the temperature measured by the faulty thermometer is 59°C, then the correct temperature of the body on celsius scale is
   a. 30°C  b. 60°C  c. 120°C  d. None of these

13. An open organ pipe produces fundamental note. All of a sudden, one of its ends is closed. If again fundamental note is emitted, the frequency of note will be
   a. half  b. double  c. same  d. None of these

14. Two spheres of the same material have radii 1 m and 4 m and temperatures 4000 K and 2000 K respectively. The ratio of energy radiated per second by the first sphere to that by the second is
   a. 1 : 1  b. 16 : 1  c. 4 : 1  d. 1 : 9

15. Two wires of the same length and same material but radii in the ratio of 1:2 are stretched by unequal forces to produce equal elongation. The ratio of forces is
   a. 1:4  b. 1:2  c. 2:1  d. 1:√2

16. Which of the following is not the cause of low conductivity of electrolytes?
   a. high resistance offered by the solution to the motion of ions  
   b. ionisation of salt  
   c. low number of density of charge carriers  
   d. low drift velocity of ions

17. A ball is released from the top of a tower and exactly 1s later another ball is released. The distance between two balls 2 s after the release of second ball is \( (\frac{9.8}{2} \text{ m/s}^2) \).
   a. 14.5 m  b. 24.5 m  c. 34.5 m  d. None of these

18. Pick out which one of these is for AND, NAND and NOT gates, respectively
   a. III, II and I  b. III, II and IV  c. II, III and IV  d. II, IV and III

19. The equivalent resistance between points A and D is (given wire used is idle)
   a. zero  b. R  c. 2R  d. None of these

Space for Rough Work
20. The electrostatic potential $V$ at a distance $r$ from the centre of a charged metallic sphere of radius $R$ for $r < R$ will vary according to relation

$\text{a. } V \propto \frac{1}{r}$
$\text{b. } V \propto r$
$\text{c. } V \propto \frac{1}{r^2}$
$\text{d. } V \propto r^0$

21. Three capacitors of equal capacity $C$ are connected as shown in figure, the equivalent capacitance of the combination between $A$ and $B$ is

- $a. C$
- $b. 2C$
- $c. \frac{C}{2}$
- $d. None$

22. $P, Q$ and $R$ are three points in a uniform electric field. The electric potential is

- $a. minimum$ at $R$
- $b. minimum$ at $Q$
- $c. minimum$ at $P$
- $d. Same$ at all three points

23. A motor pumps water continuously through a hose. Water leaves the hose with velocity $v$ and $m$ is the mass flowing per unit length of water jet, then the rate at which kinetic energy is imparted to water is

- $a. \frac{1}{2} m v^2$
- $b. \frac{1}{2} m^2 v$
- $c. \frac{1}{2} m v^3$
- $d. m v^3$

24. Two bodies are thrown with same initial velocity at angles $\theta$ and $(90^\circ - \theta)$ with horizontal. The ratio of their horizontal ranges are

- $a. 1$
- $b. \frac{1}{2}$
- $c. \tan^2 \theta$
- $d. None$ of these

25. A 10 m long wire of resistance 20 $\Omega$ is connected in series with a battery of emf 3 V (negligible internal resistance) and a resistance of 10 $\Omega$, then the potential gradient along the wire is

- $a. 0.1$
- $b. 0.2$
- $c. 0.4$
- $d. None$ of these

26. If the cold junction of a thermocouple is lowered then the neutral temperature

- $a. decreases$
- $b. increases$
- $c. remains the same$
- $d. approaches inversion temperature$

27. Two square metal plates of same thickness and material are connected in series as shown in figure. The length of $B$ is twice the length of $A$. If resistance of $A$ is represented by $R_A$ and resistance of $B$ is denoted by $R_B$, then $\frac{R_A}{R_B}$ is

- $a. 1$
- $b. 2$
- $c. \frac{1}{2}$
- $d. None$ of these
28. A magnet of magnetic moment $M$ is rotated through 360° in a magnetic field $H$, the work done will be
   a. 0 b. $2MH$ c. $-MH$ d. $-2MH$

29. Earth’s magnetic field always has a horizontal component except at
   a. magnetic pole b. equator c. at altitude of 60° d. at altitude of 45°

30. What is self-inductance of a coil which produces 5 V, when current in it changes from 3 A to 2 A in one millisecond.
   a. 5 mH b. 5 H c. 50 H d. $-5$ mH

31. A voltmeter has a resistance of $G$ Ohm and range of $V$ volt. The value of resistance used in series to convert it into a voltmeter of range $nV$ volt is
   a. $nG$ b. $\frac{G}{(n-1)}$ c. $(n-1)G$ d. $\frac{G}{n}$

32. A particle of mass $m_1$ is moving with a velocity $v_1$ and another particle of mass $m_2$ moving with a velocity $v_2$. Both of them have same momentum but different kinetic energy $E_1$ and $E_2$ respectively. If $m_1 > m_2$, then
   a. $E_1 > E_2$ b. $E_1 = E_2$ c. $\frac{E_1}{E_2} = \frac{m_1}{m_2}$ d. $E_1 < E_2$

33. A 5 m aluminium wire ($Y=7\times10^{10}$ N/m$^2$) of diameter 3 mm supports a 40 kg mass. In order to have same elongation in a copper wire ($Y=12\times10^{10}$ N/m$^2$) of same length under same weight, the diameter should be, in mm
   a. 2.0 b. 2.3 c. 1.75 d. 5.0

34. A transverse wave is represented by the equation $y = y_0 \sin \frac{2\pi}{\lambda} (vt - x)$. For what value of $\lambda$ is maximum particle velocity equal to two times of the wave velocity
   a. $\lambda = 2\pi y_0$ b. $\lambda = \pi y_0$ c. $\lambda = \frac{\pi y_0}{3}$ d. $\lambda = \frac{\pi y_0}{2}$

35. If angle between two vectors $\mathbf{X}$ and $\mathbf{Y}$ is 120°, then its resultant $\mathbf{Z}$ will be

36. If length of rod $X$ is $(2.25 \pm 0.02)$ cm and that of $Y$ is $(5.19 \pm 0.02)$ cm, then rod $Y$ is longer than rod $X$ by
   a. $(2.94 \pm 0.02)$ b. $(2.94 \pm 0.00)$ c. $(2.94 \pm 0.04)$ d. None of these

37. If a radioactive nucleus decays by two different processes, the half-life for first process is $t_1$ and for second process it is $t_2$, then the effective half-life $t$ of the nucleus is given by
   a. $t = t_1 + t_2$ b. $\sqrt{t} = \sqrt{t_1} + \sqrt{t_2}$ c. $t^{-1} = t_1^{-1} + t_2^{-1}$ d. None of these

Space for Rough Work
38. A TV tower has a height of 80m. If average density of population is 3000 persons per km$^2$, then the population covered by TV tower is
   a. 40 lakh
   b. 80 lakh
   c. 96 lakh
   d. 192 lakh

39. What will be the time constant for the given circuit?
   ![Circuit Diagram]
   a. $RC$
   b. $2.5RC$
   c. $1.2RC$
   d. $6RC$

40. Two particles 1 and 2 of masses $M_1$ and $M_2$ respectively enter in a uniform magnetic field as shown in figure. If $v_1$ and $v_2$ are their respective velocities then (assume both particles have same charge)
   ![Particle Diagram]
   a. $M_1v_1 < M_2v_2$
   b. $M_1v_1 > M_2v_2$
   c. $M_1v_1 = M_2v_2$
   d. None of these

41. The effective resistance of 'n' number of resistors when connected in parallel is $A$ ohm. If one of the resistor is removed then the effective resistance becomes $B$ ohm, then the resistance of resistor which is removed is
   a. $\frac{AB}{B - A}$
   b. $\frac{AB}{A - B}$
   c. $\frac{A + B}{AB}$
   d. None of these

42. If the density of water at the surface of the lake is $D$. The bulk modulus of water is $B$, then the density of lake water at a depth where the pressure is $n \rho$? ($\rho$: atmospheric pressure)
   a. $\frac{DB}{B + (n - 1)\rho}$
   b. $\frac{DB}{B - (n - 1)\rho}$
   c. $\frac{DB}{B + (n + 1)\rho}$
   d. None of these

43. If the flux linked with a circuit is given by $\phi = t^3 + 3t - t$. The graph between time ($x$-axis) and induced emf ($y$-axis) will be a
   a. straight line through the origin
   b. straight line with positive intercept
   c. parabola through origin
   d. parabola not through origin

44. Relative permittivity and permeability of a material are $\varepsilon_r$ and $\mu_r$ respectively. Which of the following values of these quantities are allowed for a diamagnetic material?
   a. $\varepsilon_r = 0.5$, $\mu_r = 15$
   b. $\varepsilon_r = 15$, $\mu_r = 0.5$
   c. $\varepsilon_r = 0.5$, $\mu_r = 0.5$
   d. $\varepsilon_r = 15$, $\mu_r = 15$

45. A length of wire carries a steady current. It is bent first to form a circular of one turn. The same length is now bent more sharply to give a double loop of smaller radius. The magnetic field at centre caused by the same current is
   a. double of its first value
   b. quarter of its first value
   c. four times of its first value
   d. same as the first value
46. Today artificial sweeteners and other sugar substitutes are found in a variety of food and beverages marketed as “sugar-free”. Which of the following is most powerful artificial sweetener?

47. A greenhouse gas is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of greenhouse effect. Among the following which one is not a greenhouse gas?
   a. CO₂  b. CH₄  c. O₂  d. Vapour of water

48. Nyctalopia also called ‘Night Blindness’ is a condition making it difficult or impossible to see in relative low light. It is symptom of several eye diseases. It may exist from birth, or be caused by injury or malnutrition. It is caused in human due to deficiency of vitamin

49. Those polymers which get decomposed by the process of biodegradation are known as biodegradable polymer. Among the following, the biodegradable polymer is
   a. cellulose  b. polyethene  c. PVC  d. nylon 6

50. The shapes of NO₃⁻ and CO₃⁻ are
   a. triangular planar  b. tetrahedral and triangular planar respectively  c. tetrahedral  d. angular and triangular planar respectively

51. Compare the acidic strength of reaction product, B with respect to phenol, A and choose the correct order. Chemical reaction is

   \[ \text{A} \quad \text{CH₃} \quad \text{[O]} \quad \text{Alc KMnO₄} \quad \text{Product B} \]

   a. A > B  b. A < B  c. A = B  d. None of these

52. What will be correct stereochemistry of product obtained on reaction of but-2-ene with OSO₄?

   a.  b.  c.  d. None of these

53. Product obtained on reaction 2-methyl cyclohexene with mCPBA followed by hydrolysis is

   a.  b.  c.  d.
54. Which of the following is the product of Hofmann elimination of?

\[
\text{CH}_3\text{N} (\text{CH}_3)_2 \quad \text{b. } \text{NH}_2 + (\text{CH}_3)_2\text{N} \\
\text{c. } \text{CH}_2 + (\text{CH}_3)_2\text{NOH} \quad \text{d. } + (\text{CH}_3)_4\text{N}^+ \text{OH}^-\]

55. Which of the following will give positive carbylamine test?

a. N, N-diethyl aniline  
b. N-methyl propyl amine  
c. N, N-diethyl butyl amine  
d. 2, 4-dimethyl aniline

56. IUPAC name of A is

\[
\text{A} \quad \text{COOH} \quad \text{C} \quad \text{N} \quad \text{CH} \quad \text{CH} \\
\text{a. } 3 \text{ methyl } 2 \text{ chloro butanoic acid} \quad \text{b. } 2 \text{ methyl } 3 \text{ chloro butanoic acid} \\
\text{c. } 3 \text{ chloro } 2 \text{ methyl butanoic acid} \quad \text{d. } 2 \text{ chloro } 3 \text{ carboxy, } 2, 3\text{-dimethyl propane}
\]

57. Which of the following will give positive carbylamine test?

a. N, N-diethyl aniline  
b. N-methyl propyl amine  
c. N, N-diethyl butyl amine  
d. 2, 4-dimethyl aniline

58. \[
\text{CH}_3\text{CH} = \text{CH} \quad \text{O}_3/\text{NaOH} \quad X \quad \text{Zn/CH}_3\text{COOH} \quad Y, Y \text{ is}
\]

a. CH\text{OH}  
b. CH\text{CH}_2\text{OH}  
c. CH\text{COOH}  
d. CH\text{OH}

59. Which one of the following is correct order?

a. —OH > —OR (order of —I effect)  
b. —CH\text{3} > —CO\text{3} > Cl\text{2} (order of +I power)  
c. —F > —OH > —NH\text{2} (order of —I effect)  
d. —NO > SO\text{2}R — SO\text{3}H — NO\text{2} (set of meta directors)

60. Vitamin B-12 also called cobalamin is a water soluble vitamin with a peyrroline the normal functioning of the brain and nervous system and for the formation of blood. Deficiency of vitamin B-12 causes

a. scurvey  
b. bery-bery  
c. night blindness  
d. None of these

61. Bond order of CO is equal to bond order of

a. Be\text{2}  
b. O\text{2}^-  
c. N\text{2}^-  
d. N\text{2}

62. Effective magnetic moment of Ce\text{3}^+ ion is

a. zero  
b. 1.83  
c. 2.83  
d. 1.73

63. Which of the following has highest 2\text{nd} ionisation energy?

a. O  
b. N  
c. C  
d. B

64. Which of the following is a lanthanide?

a. Curium  
b. Californium  
c. Erbium  
d. Americium
65. Magnetic moment of K₄[Fe(CN)₆(H₂O)] is
   a. 0   b. 4.92   c. 3.87   d. 2.83

66. IUPAC name of [Cr(H₂O)₄Cl₂] Cl is
   a. tetraaquadichlorochromate
   b. tetraaquadichlorochromium (III) chloride
   c. tetra aquadichlorochromium (II) chloride
   d. dichlorotetraaquachromium (III) chloride

67. Which of the following electronic configuration is correct for chromium?
   a. [Ar] 3d⁴ 4s²   b. [Ar] 3d⁶ 4s¹   c. [Ar] 3d⁴ 4s¹   d. [Ar] 3d⁵ 4s²

68. The magnetic quantum number of 29th electron of copper is
   a. +1   b. −3   c. −1   d. −2

69. Poorest reducing agent among following is
   a. atomic hydrogen   b. nascent hydrogen   c. dihydrogen   d. All have same reducing strength

70. Which of the following elements do not impart colour to flame?
   Ca, Mg, Li, Na, K, Rb
   a. Ca and Mg   b. Li and Na   c. K and Rb   d. Na and K

71. Which of the following code is correct regarding allotrops of carbon?
   I. Carbon exist in more than one allotropic form
   II. Diamond is semiconductor while graphite is conductor
   III. Diamond has layered structure while graphite has tetrahedral structure
   IV. Diamond is non-conductor of electricity
   a. I and II are correct   b. II and III are incorrect
   c. I and IV are incorrect   d. All are correct

72. Bases which keep BH₂ in monomeric form is
   a. NH₃   b. THF   c. DIGLYME   d. All of these

73. Which of the following shows correct Lewis acidic strength order of trihalides of boron?
   a. BCl₃ > BB₃ > BF₃ > BI₃   b. BF₃ < BB₃ < BCl₃ < BI₃
   c. BF₃ < BCl₃ < BB₃ < BI₃   d. BF₃ > BCl₃ > BB₃ > BI₃

74. Which of the following is correct when water and ice are at equilibrium at temperature 0°C is?
   a. G_ice > G_H₂O   b. G_ice < G_H₂O
   c. G_ice = G_H₂O = 0   d. G_ice = G_H₂O ≠ 0

Space for Rough Work
75. Which of the following reaction will not be affected by change in pressure?
   a. $H_2 + I_2 \rightleftharpoons 2HI$
   b. $N_2 + 3H_2 \rightleftharpoons 2NH_3$
   c. $PCl_5 \rightleftharpoons PCl_3 + Cl_2$
   d. $CaO + CO_2 \rightarrow CaCO_3$

76. Among the following which one is not a redox reaction?
   a. $CaCO_3 \rightarrow CaO + CO_2$
   b. $Na + H_2O \rightarrow NaOH + \frac{1}{2}H_2$
   c. $MnCl_2 \rightarrow MnCl_3 + Cl_2$
   d. $O_2 + 2H_2 \rightarrow 2H_2O$

77. How much time is required to do the electroplating of Ag layer on a coffee tray (30 cm × 15 cm) to a thickness of 1 mm using a constant current of 1.0 A. Given that density of Ag is 10.5 g/cm$^3$.
   a. 7720 s
   b. 120 min
   c. 772 s
   d. 77.2 s

78. Which of the following order is correct regarding rate of diffusion of gases?
   a. $PCl_3 > SO_3 > SO_2 > CO_2$
   b. $CO_2 > SO_2 > PCl_3 > SO_3$
   c. $SO_2 > SO_3 > PCl_3 > CO_2$
   d. $CO_2 > SO_2 > SO_3 > PCl_3$

79. Packing fraction of simple cubic crystal lattice is
   a. 38%
   b. 74%
   c. 68%
   d. 52.4%

80. For antifluorite structure coordination number of cations and anions are respectively
   a. 6 and 6
   b. 4 and 8
   c. 8 and 4
   d. 4 and 4

81. In the reaction, $N_2O_4 \rightarrow 2NO_2$, a is that part of $N_2O_4$ which dissociates, then the number of moles at equilibrium will be
   a. $(1 - \alpha)^2$
   b. $3\alpha$
   c. $\alpha$
   d. $1 + \alpha$

82. $\Delta E^0$ of combustion of isobutylene is $-x$ kJ mol$^{-1}$. The value of $\Delta H^0$ is
   a. $\Delta E^0$
   b. $> \Delta E^0$
   c. $= zero$
   d. $< \Delta E^0$

83. A plot of $\log \frac{x}{m}$ versus $\log p$ for adsorption of a gas on a solid gives a straight line with slope equal to
   a. $\frac{1}{n}$
   b. $\log K$
   c. $-\log K$
   d. $n$

84. The half-life time of a first order reaction is $1.26 \times 10^{14}$ s, then rate constant of this reaction will be
   a. $5.5 \times 10^{-10}$ s$^{-1}$
   b. $5.5 \times 10^{-14}$ s$^{-1}$
   c. $6.6 \times 10^{-14}$ s$^{-1}$
   d. None of these

85. Which of the following forms cationic micelles above certain concentration?
   a. Urea
   b. Sodium dodecyl sulphate
   c. Sodium acetate
   d. Cetyltrimethylammonium bromide

86. 0.5 g of a metal on oxidation give 0.79 g of its oxide. The equivalent weight of the metal is
   a. 10
   b. 14
   c. 20
   d. 40

87. What will be the value of relative lowering of vapour pressure when 3 g urea is dissolved in 45 g of water?
   a. 0.05
   b. 0.04
   c. 0.02
   d. 0.01

88. Which of the following will not show tautomerism?
   a. cyclohexen-1-ol
   b. pentanone
   c. acetone
   d. 2-methyl pentan-1-ol

89. Rate constant of any reaction with 20% complete in 10 min is
   a. 0.223
   b. 0.0223
   c. 0.0322
   d. 0.322

90. Which of the following contain N–N bond?
   $N_2O_4, N_2O_3, N_2O_5$
   a. $N_2O_4, N_2O_3$ and $N_2O_5$
   b. $N_2O_5$ and $N_2O_4$
   c. $N_2O_3$ and $N_2O_5$
   d. $N_2O_3$ and $N_2O_4$
PART C BIOLOGY

91. Match the following columns.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Viral diseases</td>
<td>1. Taeniasus and ascariasis</td>
</tr>
<tr>
<td>B. Bacterial diseases</td>
<td>2. Malaria</td>
</tr>
<tr>
<td>C. Protozoan diseases</td>
<td>3. Rabies and polio</td>
</tr>
<tr>
<td>D. Helminthic diseases</td>
<td>4. Cholera and TB</td>
</tr>
<tr>
<td></td>
<td>5. Syphilis</td>
</tr>
</tbody>
</table>

Codes

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1</td>
<td>4</td>
<td>2</td>
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<tr>
<td>3</td>
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<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

92. Match the following columns.

<table>
<thead>
<tr>
<th>Column I (Stop codon)</th>
<th>Column II (Also known as)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. UAG</td>
<td>1. Opal</td>
</tr>
<tr>
<td>B. UAA</td>
<td>2. Ochre</td>
</tr>
<tr>
<td>C. AGA</td>
<td>3. Amber</td>
</tr>
<tr>
<td>D. Umber</td>
<td></td>
</tr>
</tbody>
</table>

Codes

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

93. Which one is obtained by acetylation of morphine?

a. Charas
b. Cocaine
c. Smack
d. Crack

94. According to the human genome project, select the incorrect statement.

a. The goal of HGP was to identity or determine 3 billion chemical base pair
b. It was launched in 1980 2 completed in 1990
c. Two major approaches involved i.e., ESTs (Expressed Sequence Tags) and sequence annotation
d. SNPs or single nucleotide polymorphism occur in humans.

95. Cambium is the example of which of the following types apical of meristem?

a. Apical meristem
b. Lateral meristem
c. Marginal meristem
d. Intercalary meristem

96. Which of the following are true for serum sickness?

I. It is an genetic disorder.
II. It is a reaction that is similar to an allergy.
III. Corticosteroid is generally first line of management/treatment for serum sickness.
IV. Sulfa drugs cannot involve in its etiology.

a. II and III  b. I and IV  c. I and III  d. II and IV
97. Identify the markings of below ecological pyramid from following options, if 1–Herbivores; 2–Secondary predator; 3–Decay detrivoves; 4–Primary predators; 5–Autotrophs

```
A B C D E
a. 2 1 3 4 5
b. 4 1 3 5 2
c. 3 5 2 1 4
d. 5 3 2 1 4
```

98. Which of the following statements is not correct for interferons?
   a. They are mainly glycoprotein in nature
   b. They are produced by plasma B-cells only
   c. They form the body’s second line of defence
   d. They provide a temporary protection against microbes

99. In reference to the mRNA, select the incorrect option.
   a. mRNA is linear
   b. It carries coded information
   c. It does not require any processing
   d. Nitrogen bases are unmodified.

100. Which one of the statements given below is not correct?
    a. Insectivorous plants are autotrophic and heterotrophic as they capture insects to overcome their N₂ deficiency
    b. Sulphur is main constituent of chlorophyll
    c. The most important diseases due to copper deficiency are exanthema and reclamation
    d. Nif gene is present in Rhizobium

101. Which of the following are the causes of insulin resistance?
    I. Polycystic ovary disease
    II. Hemochromatosis
    III. Lipodystrophy
    IV. Mutations of melanocortin receptors
    a. I and IV
    b. I, II, III and IV
    c. II and III
    d. II and IV

102. Which part of male reproductive system is the site of sperm maturation and storage?
    a. Vas deferens
    b. Testes
    c. Epididymis
    d. Seminal vesicle

103. Which of the followings is not correctly matched?
    a. Cancer of muscle tissue – Myoma
    b. Cancer of adipose tissue – Lipomas
    c. Blood cancer – Leukaemia
    d. Cancer of glial cells of CNS – Melanomas
104. Which of the following statement(s) is/are correct for RAPD?
   I. It stands for Random Altered Polygenic DNA.
   II. It stands for Random Amplified Polymorphic DNA.
   III. It is used to study phylogeny of diverse plant and animal species.
   IV. It is very easy to distinguish whether a DNA segment is amplified from heterozygous or homozygous.
   a. I and IV  
   b. II and III  
   c. II and IV  
   d. I, II, III and IV

105. Which one of the following is not correct?
   a. The minerals, particularly Ca\(^{2+}\), K\(^{+}\) and Na\(^{+}\) maintain the permeability of cytomembranes.
   b. Minerals like Cu, As, impart toxic effect on the proplasm under specific condition.
   c. Several elements particularly Fe, Ca, Mg, Zn, Cu, Cl act as metallic catalyst in biochemical reactions.
   d. Mg, K and Ca are essential microelements.

106. Identify the marking in below graphs.

   ![Graph A]
   ![Graph B]

   A  B  C
   a. Allopatric  Sympatric  Parapatric
   b. Sympatric  Parapatric  Allopatric
   c. Parapatric  Allopatric  sympatric
   d. Allopatric  Parapatric  Sympatric

107. Which of the following is/are true for Leber’s hereditary Optic Neuropathy (LHON)
   I. It is mitochondrial myopathy.
   II. It is characterised by short stature.
   III. It is characterised by acromegaly.
   IV. It is characterised by visual lose.
   a. All are false  
   b. II and III  
   c. I and IV  
   d. II and IV

108. C\(_4\)-plants differ from C\(_3\)-plants in respect to
   a. Number of CO\(_2\) molecules used.
   b. Substrate, which accept the CO\(_2\) molecules.
   c. Number of ATP formed.
   d. Number of O\(_2\) formed.
109. In the process of ATP synthesis, oligomycin and DCCD act at which place in figure

![Diagram of ATP synthesis](image)

a. A  

b. B  

c. C  

d. D

110. Match the following columns.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Macrophytes</td>
<td>1. Rooted plants in shallow water</td>
</tr>
<tr>
<td>B. Phagotrophs</td>
<td>2. Animals ingest food</td>
</tr>
<tr>
<td>C. Abiotic components</td>
<td>3. Temperature</td>
</tr>
<tr>
<td>D. Hydrophytes</td>
<td>4. Plants of dry areas</td>
</tr>
<tr>
<td></td>
<td>5. Plants of aquatic nasitants</td>
</tr>
</tbody>
</table>

a. 5 4 3 2  
b. 1 2 3 4  
c. 1 2 3 5  
d. 4 3 2 1

111. In the modern era, due to excess stress and faulty life styles, mental problems are on increasing trend. Arrange the given component in correct sequence of cycle.

![Cycle diagram](image)

Components are
1. Avoid treatment
2. Silence and hiding
3. Stigma
4. Symptoms of mental illness
5. Discrimination

a. 3 1 2 4 5  
b. 5 4 3 1 2  
c. 4 3 5 2 1  
d. 1 4 5 2 3

112. Assertion (A) The leaves of cauliflower become flaccid and gray in molybdenum deficiency.

Reason (R) Cauliflower plant is affected by whiptail disease in molybdenum deficiency.

a. Both A and R are true and R is correct explanation of A  
b. Both A and R are true, but R is not the correct explanation of A  
c. A is true but R is false  
d. A is false but R is true
113. Identify the incorrect combination from given options.
   a. Periyar — Elephant
   b. Sunderban — Tiger
   c. Dachigam National Park — Snow leopard.
   d. Rann of Kutch — Wild ass

114. Match the following columns

<table>
<thead>
<tr>
<th>Column I (Mode of preservation of fossils)</th>
<th>Column II (Comment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Adpression</td>
<td>1. Chdcalcified remains of plant tissue</td>
</tr>
<tr>
<td>B. Fusain</td>
<td>2. Most commonly found plant fossils</td>
</tr>
<tr>
<td>C. Petrifications</td>
<td>3. Provide fine details</td>
</tr>
<tr>
<td>D. Moulds and costs</td>
<td>4. Pith casts is it subset</td>
</tr>
</tbody>
</table>

   a. 2 3 1 4
   b. 1 4 3 2
   c. 4 2 1 3
   d. 2 1 3 4

115. Preparation of Fallopian tube for conveying developing embryo to uterus is aided by which of the following homona
   a. human placental lactogen
   b. oxytocin
   c. progesterone
   d. prolactin

116. Which of the following are desirable properties for an ideal DNA markers ?
   I. Highly polymorphic nature
   II. Codominant inheritance
   III. Frequent occurrence in genome
   IV. High reproducibility

   a. I and IV  
   b. II and III
   c. I, II, III and IV
   d. I and III

117. Crown gall disease is caused which of the following pathogen.
   a. virus
   b. bacteria
   c. fungi
   d. protozoans

118. Which of the following is not an autotrophic microbe that fix atmospheric nitrogen?
   a. Anabaena
   b. Rhizobium
   c. Nostoc
   d. Oscillatoria

119. Which of the following is/are the first most common sign of pregnancy?
   I. Amenorrhea
   II. Quickening
   III. Ballottement of foetus
   IV. Foetal movement perceived by examiner

   a. I, II, III and IV
   b. I and IV
   c. Only I
   d. II and III

120. Choose the incorrect statement.
   a. Sieve tube elements resemble RBCs in being without nucleus in the mature state
   b. Root hairs are found in zone of maturation
   c. The common bottle cork is a product of xylem
   d. Water containing cavities in vascular bundles are found in maize
121. If your Renal Plasma Flow is 650 mL/min and Glomerular Filtration Rate is 125 mL/min. Calculate your Filtration Fraction.
   a. Given informations are not complete  
   b. 0.19  
   c. 0.5  
   d. 5.5

122. In summer vacation you have visited to your friend’s residence. He informed you that recently he has donated his kidney to his father. When you enquired further, you have been told that your friend had opted for laproscopic way of kidney donation, instead of open way of kidney donation. What might be the correct reason for it?
   I. Your friend’s age is below is 18 year.  
   II. It is less painful method.  
   III. When laproscopic method is followed, other kidney does a quick hypertrophy.  
   IV. Incision is not visible (cosmetic reason).  
   a. II and IV  
   b. All are true  
   c. All are false  
   d. I and II

123. Below pie diagram shows the global biodiversity and proportionate numbers of vertebrates. Identify the markings if
   I. Fishes  
   II. Amphibians  
   III. Mammals  
   IV. Birds  
   V. Reptiles  
   a. II I IV V III  
   b. V III I IV II  
   c. III IV V II I  
   d. I IV III II V

124. A man has six daughters, what is the probability of next child being a son?
   a. 10%  
   b. 50%  
   c. 100%  
   d. 75%

125. Which of the following gland do not secrete proteinaceous hormones?
   a. Pancreas  
   b. Thyroid gland  
   c. Parathyroid gland  
   d. Gonads
126. In the given below fluid mosaic model of cell membrane, identify the markings,

If

I. Hydrophobic tails
II. Cholesterol
III. Integral protein
IV. Hydrophilic heads

A B C D
a. IV I III II
b. I III II IV
c. III II IV I
d. IV I III II

127. The aleurone layer in maize grain is specially rich in which of the following molecules

a. starch  b. proteins  c. lipids  d. cellulose

128. Study the following chain

Sun
↓
Given 1000 units energy to phytoplanktons
↓
Phytoplanktons are consumed by herbivorous zooplankton, and in turn received A unit of energy.
↓
Carnivorous zooplanktons eat the herbivorous zooplankton and get B unit of energy.
↓
Carnivorous fish takes carnivorous zooplanktons and received C unit of energy.
↓
In last, Tunas find their turn and engulf carnivore fishes to get D unit of energy.

Identify A, B, C and D
If

I. 0.1 unit
II. 10 unit
III. 100 unit
IV. 1 unit
A B C D
a. II III IV I
b. IV I III II
c. III II IV I
d. Given information is not sufficient to answer

129. Intertribal hybrids were first obtained by which of the following scientist

130. Label the given graph.

![Graph](image)

(i) (ii) (iii)

a. Log phase Exponential phase Stationary phase
b. Exponential phase Log phase Stationary phase
c. Stationary phase Log phase Exponential phase
d. Log phase Stationary phase Exponential phase

131. Identify the incorrect statement(s) from following options

I. Glycolate is formed, in illuminated chloroplast of C₃ plants.
II. For every 2 glycolate molecules that leaves the chloroplast, one glycerate, derived from glycolate
III. One of the 4 carbons from the two glycolates is lost as CO₂.
IV. As 3-phosphoglycerate, the 3 remaining carbons can reenter the Calvin cycle.

a. II and IV  
b. I and III  
c. None of these statement is false  
d. I and II

132. Choose the incorrect pair from the following options.

a. Ethylene — Gas hormone  
b. Abscisic acid — Flowering hormone  
c. Auxin — To grow  
d. Gibberellins — Gibberella fujikuroi

133. Which of the following option is true regarding Flavr Savr?

a. It is toxic insecticidal protein  
b. It is slow ripening tomato  
c. It is transgenic tomato  
d. Its a pesticide variety

134. The formation of acetyl coenzyme from pyruvic acid is the result of its

a. reduction  
b. dehydration  
c. dephosphorylation  
d. oxidative decarboxylation

135. Assertion (A) Linnaeus system of animal classification is essentially an artificial system, yet it has become a natural system.

Reason (R) Similarities forming the basis in Linnaeus systems are indicative of genetic relationship.

a. Both A and R are true and R is the correct explanation of A  
b. Both A and R are true, but R can't explain A  
c. Only A is the true and R is false  
d. A is false and R is true

136. Your one of the relatives has just married. She called you and requested to suggest the most appropriate method of contraception. Which of the following contraception would be your first suggested choice?

a. Oral contraceptive pills  
b. IUDS (Intrauterine devices)  
c. Tubectomy  
d. I-pill
137. Taxonomic hierarchy refers to one of the following statement.
   a. nomenclature of plants and animal species by highly qualified group of individual
   b. classification of all the species based on the phylogenetic analysis
   c. classification of species on the basis of level in which they are present in food chain
   d. stepwise arrangement of all categories for classification of plants and animals

138. Spironolactone acts at which part of the nephron.
   a. Its site of action depends upon it concentration
   b. It is still the matter of research
   c. It acts on collecting tubules
   d. It acts on PCT

139. In a given case if CO₂ liberated during respiration is more than the volume of O₂ used, the substance will be
   a. fats
   b. organic acid
   c. protein
   d. carbohydrate

140. In the following processes of synthesis of norepinephrine identify the markings correctly.

   1. A → Dopa
   2. Dopa → Dopamine
   3. Transport of dopamine into the vesicles
   4. Dopamine → Norepinephrine

   If I. Tyrosine  II. Hydroxylation  III. Decarboxylation  IV. Phenylalanin

   A B C D
   a. IV II III III
   b. I II III III
   c. I III II II
   d. IV III II II

141. Choose the correct statement in reference to primary myofilament.
   a. They are more than secondary myofilament
   b. Primary myofilament have smooth surface
   c. Primary myofilament consists of two proteins
   d. They slide during muscle contraction

142. In a type of apomixis known as adventive embryony, embryos develop directly from the
   a. endosperm
   b. nucellus or integuments
   c. synergids
   d. antipodals

143. Which of the following is true for the arrangement of the nuclei in a Polygonum type of embryo sac in the angiospermic plants?
   a. 2 + 4 + 2
   b. 2 + 3 + 3
   c. 3 + 2 + 3
   d. 3 + 3 + 2

144. Which of the following is agranulocytic type of white blood cells?
   a. Lymphocyte
   b. Neutrophil
   c. Basophil
   d. Eosinophil

145. Which of the following option is correct for the life span of WBC?
   a. 10 months
   b. 10 weeks
   c. Less than 10 days
   d. Less than 10 hours

146. Consider the following statements.
   I. C₄ species have greater rate of CO₂ assimilation than C₃ species.
   II. CO₂ compensation point is very high in C₄ plants.
   III. The process of photorespiration involves the chloroplasts, peroxysomes and mitochondria.

   Which of the statements given above are correct?
   a. I and II
   b. I and III
   c. II and III
   d. I, II and III
147. Which of the following EEG waves of Brain occur mainly in children and in adults during stress?
   a. Alpha waves  
   b. Beta waves  
   c. Delta waves  
   d. Theta waves

148. Gossamer silk is produced by which of the following organism?
   a. Silkmoth  
   b. Scorpion  
   c. Tusser moth  
   d. Spider

149. Which of the following theories explains the structure of protoplasm?
   a. Surface-tension theory  
   b. Colloidal theory  
   c. Sol-gel theory  
   d. Viscosity theory

150. Which of the following is a connecting link as well as a living fossil?
   a. Latimeria  
   b. Neopilina  
   c. Euglena  
   d. Archaeopteryx

151. What is true about the first living organisms?
   a. They originated in an oxidising atmosphere.  
   b. They were aerobic  
   c. Made their own food.  
   d. Obtained energy by fermentation of organic molecules

152. Correct sequence of stage in evolution of Modern man.
   I. Australopithecus  
   II. Homo erectus  
   III. Neanderthal man  
   IV. Cro-magnon man  
   V. Modern man  
   a. V, III, I, IV, II  
   b. I, II, III, IV, V  
   c. III, II, I, V, IV  
   d. II, IV, V, I, III

153. Vermis is found in which of the following brain structure.
   a. cerebrum  
   b. medulla oblongata  
   c. cerebellum  
   d. brain stem

154. Mental retardation is commonly associated with genetic diseases, but it is not related with one of the genetic defect.
   a. trisomy 21  
   b. phenylalanine hydroxylase  
   c. myelinisation of neuron  
   d. Y-chromosome

155. Which of the following is principal cation of blood plasma?
   a. $Mg^{2+}$  
   b. $K^+$  
   c. $Na^{+}$  
   d. $Ca^{2+}$

156. The genes, which remain confined to differential region of Y-chromosome are
   a. holandric genes  
   b. autosomal genes  
   c. completely sex-linked genes  
   d. mutant genes

157. Which of the following statement is not correct?
   a. Pineal gland secretes serotonin and melatonin  
   b. Adrenaline is an amine  
   c. Kidney do not secrete steroid hormones  
   d. Oxytocin is secreted by posterior lobe of pituitary
158. Which among the following is a function of restriction enzyme in nature?
   a. Plasmids
   b. Destroy foreign DNA
   c. Destroy phage DNA
   d. Splice up DNA of the cells

159. Choose the incorrect statement.
   a. RNA is a genetic material
   b. DNA replication is semiconservative
   c. Ribonucleoside → Nitrogenous base → Ribonucleotide
   d. Adenine and guanine are purines

160. Which transgenic food crop helps in solving the problem of night blindness?
   a. Transgenic maize
   b. Golden rice
   c. Bt soyabean
   d. Bt brinjal

161. Down’s syndrome is due to
   a. non-disjunction of chromosome
   b. duplication
   c. crossing over
   d. linkage

162. Which of the following is incorrect?
   I. Stabilising selection — Favours average size individuals.
   II. Disruptive selection — Favours exotic species
   III. Directional selection — Favours both small and large sized individuals
   IV. Industrial melanism — Supports evolution by use and disuse
   a. All except II
   b. All except I
   c. All of these
   d. None of these

163. Why the tropical deciduous trees shed their leaves?
   a. To protect itself from heat and water
   b. To enhance rate of respiration and rate of absorption
   c. To reduce the rate of transpiration
   d. To save energy

164. GMFs have proven their importance as
   a. they cause less damage to environment
   b. they allow the increase of crop quantity
   c. they improve profitability
   d. they improve convinence for customers

165. Which is not X-linked?
   a. Duchenne muscular dystrophy
   b. Protanopia
   c. GbPD deficiency
   d. Congential adrenal hyperplasia

166. The cell is fully turgid when one of the following condition fulfilled.
   a. Diffusion pressure deficit = Turgor pressure
   b. Diffusion pressure deficit = Suction pressure
   c. Osmotic pressure = Diffusion pressure deficit
   d. Diffusion pressure deficit = Zero

167. Which of the following statement(s) is/are true for vaccine?
   a. collection of attenuated disease causing bacteria and virus
   b. collection of microorganism
   c. collection of killed a disease causing bacteria and virus
   d. Both (a) and (c)
168. Which of the following is the golden age of reptiles?
   a. Mesozoic era  b. Archaeozoic era
   c. Coenozoic era  d. Paraeozoic era

169. In our nature, cleistogamous type of flowers are
   a. animal pollinated  b. insect-pollinated
   c. bird pollinated  d. self-pollinated

170. Which of the following is not an autosomal recessive trait?
   a. Phenylketonuria  b. Cystic fibrosis  c. Albinism  d. Polydactyly

171. Blunt ends are produced by which of the following restriction enzyme?
   a. Alu I  b. Pst I  c. Sma I  d. Hind III

172. Bolistic technique is characterisation of
   a. germplasm conservation  b. conjugation
   c. tissue culture  d. gene transfer process

173. Auxin (IAA) was isolated by Thiamann in 1935 from
   a. bryophytes  b. algae  c. fungi  d. pteridophytes

174. Under given suitable conditions, the diffusion pressure deficit will be more than osmotic pressure.
   a. When osmotic pressure is equal to turgor pressure
   b. When osmotic pressure is less than turgor pressure
   c. When osmotic pressure is greater than turgor pressure
   d. When turgor pressure is negative

175. Viriods differ from viruses in having
   a. naked DNA molecule only  b. naked DNA packed with viral genome
   c. satellite RNA packed with viral genome only  d. naked RNA molecule only

176. The joint between atlas and axis is called
   a. angular joint  b. pivot joint  c. saddle joint  d. hinge joint

177. Which one of the following is Permanent cure of Adenosine Deaminase (ADA) deficiency is
   a. enzyme replacement therapy
   b. introducing isolated gene from marrow cells producing ADA into the cells at early embryonic stages
   c. injecting the functional ADA, CDNA into the patient
   d. administering adenosine deaminase through injections

178. Which of the following is correct pairing of site of action and substrate of rennin?
   a. Mouth-starch  b. Stomach-fat
   c. Stomach-caseinogen  d. Small intestine-fat

179. Which of the following stabilises microtubules and interferes with mitosis?

180. Which of the following is an example of gene silencing?
   a. Bt brinjal  b. Bt cotton  c. Golden rice  d. Flavr savr tomato
1. (a) In p-n junction, the diffusion of majority carriers takes place when junction is forward biased and drifting of minority carrier takes place across the junction when reverse biased.

2. (c) First excited state of lithium ($Z = 3$) corresponds to $n = 2$

\[ \text{Energy required} = 13.6 \frac{Z^2}{n^2} \text{eV} = 13.6 \left( \frac{3^2}{2^2} \right) \text{eV} = 30.6 \text{eV} \]

3. (c) As, an atom is electrically neutral so it is not deflected in magnetic field.

4. (b) If the aperture (diameter) of the telescope objective be the $D$, then the minimum angular separation ($\Delta \theta$) between two distant objects, whose images are just resolved by the telescope, is $\Delta \theta = \frac{1.22 \lambda}{D}$

While resolving power $= \frac{1}{\Delta \theta} = \frac{D}{1.22 \lambda}$

\[ \therefore \text{Greater the value of } D \text{ greater will be resolving power.} \]

5. (b) de-Broglie wavelength $\lambda = \frac{h}{\sqrt{2eVm}}$

X-ray wavelength $\lambda' = \frac{hc}{eV} \sqrt{\frac{2eVm}{h}} = \frac{2m}{e} \cdot \frac{2m}{e} \cdot \frac{2m}{e} = 3 \times 10^6 \times \sqrt{\frac{2 \times 9 \times 10^{-31}}{1.6 \times 10^{-19} \times 10 \times 10^{12}}} = 10$

\[ \Rightarrow \frac{\lambda'}{\lambda} = 10 \]

6. (b) During melting of ice, volume decreases.

\[ \therefore \text{Positive work is done on the system by the atmosphere.} \]

7. (a) The ratio of heat capacity at constant pressure ($C_p$) to heat capacity at constant volume ($C_v$) is known as the heat capacity ratio or isentropic expansion factor.

\[ C_p = \gamma \text{ does not depend upon temperature.} \]

8. (b) According to question,

Potential energy $= \frac{1}{4} \text{ (total energy)}$

\[ \Rightarrow \frac{1}{2} m \omega^2 v^2 = \frac{1}{2} \left( \frac{2m\omega^2 A^2}{4} \right) \]

\[ \Rightarrow \omega = \frac{A}{2} \]

9. (c) Since, $h = \frac{2T \cos \theta}{\rho g}$ i.e., $h \propto \frac{1}{r}$

As, $r$ changes to $2r$ then $h$ will become $\frac{h}{2}$

Mass of water in tube $= \text{volume} \times \text{density} = \pi (2r)^2 \frac{h}{Z} \rho = 2(\pi r^2 \rho) = 2M$

10. (b) $r_{cm} = \frac{m_1 r_1 + m_2 r_2}{m_1 + m_2}$

Here, $m_1 = 1 \text{ kg}; \ r_1 = \hat{i} + 2\hat{j} + \hat{k}$

\[ m_2 = 3 \text{ kg}; \ r_2 = -3\hat{i} - 2\hat{j} + \hat{k} \]

\[ \Rightarrow r_{cm} = \left( (\hat{i} + 2\hat{j} + \hat{k})x1 + (-3\hat{i} - 2\hat{j} + \hat{k})x3 \right) \]

\[ = \frac{1}{4} = \frac{8\hat{i} - 4\hat{j} + 4\hat{k}}{4} \]

\[ \Rightarrow \omega' = \frac{M \omega}{M + 2m} \]

11. (c) As masses are added to the ring gently, there will be no torque and angular momentum will be conserved

\[ I \omega = I' \omega' \]

\[ \Rightarrow \omega' = \frac{MR \omega}{MR + mR} \]

\[ \Rightarrow \omega = \frac{M \omega}{M + 2m} \]

12. (b) If, $T_c$ is the correct temperature on Celsius scale then,

\[ T_c - 0 = \frac{x - \text{lower fixed point}}{\text{upper fixed point} - \text{lower fixed point}} \]

\[ \frac{T_c}{100} = \frac{59 - 5}{95 - 5} = \frac{54}{90} = \frac{3}{5} \]

\[ T_c = \frac{300}{5} = 60^\circ \]

13. (a) In open pipe $v = \frac{v}{2L}$

In closed pipe $v' = \frac{v}{4L}$

\[ \therefore \frac{v'}{v} = \frac{1}{2} \]

14. (a) Energy radiated per second by a body which has surface area $A$ at temperature $T$ given by Stefan's law is

\[ E = \sigma A T^4 \]

\[ \Rightarrow \frac{E_1}{E_2} = \left( \frac{r_1}{r_2} \right)^2 \left( \frac{T_1}{T_2} \right)^4 = \left( \frac{1}{4} \right)^2 \left( \frac{4000}{2000} \right)^4 \]

\[ \Rightarrow \frac{E_1}{E_2} = \frac{16}{16} = 1 : 1 \]
15. (a) As, \( Y = \frac{F_1}{A \Delta I} \)
According to question, \( Y = \Delta l \) are constant.
So, \( F \propto A \Rightarrow F_1F_2 = \frac{\pi l_1^2}{\pi l_2^2} = \frac{1}{4} \)

16. (b) Low conductivity is due to low drift velocity of ions, high resistance offered by the solution to the motion of ions and low number of density of charge carriers.

17. (b) As, second ball falls for 2 s
\( h_2 = \frac{1}{2} g(2)^2 \)
In mean time, first ball has fallen for
\( (2 + 1) = 3 \) s
So, \( h_1 = \frac{1}{2} g(3)^2 \)
∴ Distance between two balls 2 s after release of 2nd ball
\( = h_1 - h_2 = \frac{1}{2} g(3^2 - 2^2) = 24.5 \text{ m} \)

18. (d) Symbols in question are as follows
I. OR gate II. AND gate
III. NOT gate IV. NAND gate

19. (c) As the wire is idle so resistor between \( B \) and \( C \) has same potential so it is useless,
∴ Equivalent figure is
∴ Equivalent resistance between \( A \) and \( D = 2R \)

20. (d) At an internal point \( (r < R) \) in a charged conducting sphere
\( V_n = V_{\text{surface}} = \frac{q}{4\pi e_0 R} = \text{constant} \)
∴ \( V \propto r^0 \)

21. (b) Here 3rd capacitor is ineffective as potential difference across 3rd capacitor is zero, so equivalent figure will be

\( \therefore \) Equivalent capacitance between \( A \) and \( B \)
\( = C + C = 2C \)

22. (a) As electric potential decreases in direction of electric field.
∴ \( V_A > V_B > V_1 \)
Potential is minimum at \( R \).

23. (c) As the mass flowing per unit length is \( m \) and velocity of water is \( v \).
∴ Rate at which kinetic energy is imparted to water
\( = \frac{1}{2}(mv^2) = \frac{1}{2} mv^3 \)

24. (a) In case of projectile,
The horizontal range \( R = \frac{u^2}{g} \sin 2\theta \)
In first case \( R_1 = \frac{u^2}{g} \sin 2\theta \)
In second case \( R_2 = \frac{u^2}{g} \sin (180^\circ - \theta) \)
\( = \frac{u^2}{g} \sin (180^\circ - \theta) = \frac{u^2}{g} \sin 2\theta \)
∴ \( \frac{R_1}{R_2} = 1 \)

25. (b) Current \( i = \frac{V}{R} = \frac{3}{10 + 20} = 0.1 \) A
∴ Potential difference across 20 \( \Omega = 0.1 \times 20 = 2 \) V
Potential gradient
\( = \frac{\text{Potential difference across 20 } \Omega}{\text{length of 20 } \Omega \text{ wire}} = \frac{2}{10} = 0.2 \text{ V} \cdot \text{m}^{-1} \)

26. (c) The neutral temperature of a given thermocouple is independent of temperature of cold junction.

27. (a) If \( l \) and \( d \) be length and thickness of plate \( A \), then
\( R_A = \rho \frac{l}{a} = \frac{\rho l}{2 \times d} = \frac{\rho l}{d} \)
and \( R_B = \rho \frac{2l}{2 \times d} = \frac{\rho l}{d} \)
∴ \( \frac{R_A}{R_B} = 1 \)

28. (a) \( W = -Mh(\cos \theta_1 - \cos \theta_2) \)
\( = -Mh(\cos 360^\circ - \cos 0^\circ) = 0 \)

29. (a) At magnetic pole, total intensity of earth’s magnetic field is along the vertical.
∴ It has no horizontal component. Hence, the work done will be zero.
30. (a) \( \frac{dl}{dt} = \frac{(2-3)}{10^{-3}} = -10^3 \text{ A } / \text{s} \)

As, \( e = -L \frac{dl}{dt} \)

\( 5 = -L(-10^3) \)

\( L = \frac{5}{10^3} = 5 \text{ mH} \)

31. (c) \( I_g = \frac{V}{G} \)

and \( R = \frac{nV}{I_g} - 2G = \frac{nV}{V/G} = (n-1)G \)

32. (d) \( KE = \frac{p^2}{2m} = \frac{p^2_x/2m_x}{p^2_y/2m_y} \Rightarrow E_1 = m_y/L \)

\( \text{As, } m_1 > m_2 \Rightarrow E_1 < E_2 \)

33. (b) \( Y = \frac{F}{A/1} = \frac{4F}{\pi D^2} \times \frac{l}{A/1} \)

\( \Rightarrow \quad D = \frac{4lF}{\pi Y/1} \Rightarrow D = \frac{1}{\sqrt{Y}} \)

\( \therefore \quad \frac{D_1}{D_0} = \frac{Y_{1/1}}{Y_{2/2}} \)

\( D_0 = 3(7\times10^{10}) \quad \text{m} = 2.3 \text{ mm} \)

34. (b) \( \text{Particle velocity } = \frac{dy}{dt} \)

\( \left( \frac{dy}{dt} \right) = \left( \frac{2\pi}{\lambda} \right) y_0 \cos \frac{2\pi}{\lambda} (vt - x) \)

\( \left( \frac{dy}{dt} \right)_{\text{max}} = y_0 \frac{2\pi v}{\lambda} \quad \text{(:, : cos } \theta = 1 \text{)} \)

Given, \( \left( \frac{dy}{dt} \right)_{\text{max}} = 2v \)

\( y_0 \frac{2\pi v}{\lambda} = 2v \quad \Rightarrow \quad \lambda = \pi y_0 \)

35. (b) If \( |Z| \) is resultant between \( X \) and \( Y \), then

\( |Z| = \sqrt{X^2 + Y^2 + 2XY \cos 120^o} \)

\( = \sqrt{X^2 + Y^2 - XY} \quad \text{[as } \cos 120^o = -\frac{1}{2}] \)

Similarly \( |X - Y| = \sqrt{X^2 + Y^2 - 2XY \cos 120^o} \)

\( = \sqrt{X^2 + Y^2 + XY} \)

\( \Rightarrow \quad |X - Y| < |Z| \)

36. (c) Given length of rod \( X \) is \( L_x = 2.25 \pm 0.02 \)

and length of rod \( Y \) is \( L_y = 5.19 \pm 0.02 \)

Rod \( Y \) is longer, then rod \( X \) by

\( \Delta L = L_y - L_x \)

\( = (5.19 \pm 0.02) - (2.25 \pm 0.02) \)

\( = (2.94 \pm 0.04) \text{ cm} \)

37. (c) Decay constant for first process, \( \lambda_1 = \frac{0.693}{t_1} \)

and decay constant for second process, \( \lambda_2 = \frac{0.693}{t_2} \)

the probability of an active nucleus decays by first process in small time is \( \lambda_1 dt \), similarly for second process it is \( \lambda_2 dt \).

Total probability it decays by first process or by second process is \( (\lambda_1 dt + \lambda_2 dt) \)

If \( \lambda \) is effective decay constant, then

\( \lambda dt = \lambda_1 dt + \lambda_2 dt \)

\( \Rightarrow \quad \lambda = \lambda_1 + \lambda_2 \)

\( \therefore \quad \lambda = \frac{0.693}{t_1} + \frac{0.693}{t_2} \Rightarrow \frac{1}{t} = \frac{1}{t_1} + \frac{1}{t_2} \)

\( \Rightarrow \quad t^{-1} = t_1^{-1} + t_2^{-1} \)

38. (c) The maximum distance upto which TV transmission can be received, \( d = \sqrt{\frac{2R}{hR}} \)

\( = \sqrt{\frac{2\times80 \times 6.4 \times 10^6}{32 \times 10^6}} = 32 \times 10^6 \text{ m} = 32 \text{ km} \)

How maximum are covered = \( \pi d^2 \)

\( = 3.14 \times (32)^2 \)

\( = 3215.36 \approx 3200 \text{ km}^2 \)

\( \therefore \quad \text{Population covered} = 3200 \times 3000 = 96 \text{ lakh} \)

39. (c) Time constant in \( R-C \) circuit is given by \( \frac{l}{R} \)

Equivalent capacitance \( = \frac{2R \times 3R}{2R + 3R} = \frac{6R}{5} \)

\( \therefore \quad l = \frac{6R}{5} \times C = \frac{6RC}{5} = 1.2RC \)

40. (b) If \( R \) be the radius of a particle of mass \( M \) and charge \( q \) moving with velocity \( v \) perpendicular to a uniform magnetic field \( B \) given as then

\( \frac{MV^2}{R^2} = qvB \)

\( \Rightarrow \quad MV = qRB \)

\( \therefore \quad \text{For particle 1, } M_{v_1} = qR_{B_1} \quad \text{ ...(i)} \)

and for particle 2, \( M_{v_2} = qR_{B_2} \quad \text{ ...(ii)} \)

On dividing Eq. (i) by Eq. (ii), we get

\( \therefore \quad \frac{M_{v_1}}{M_{v_2}} = \frac{R_{B_1}}{R_{B_2}} \)

According to the figure \( R_1 > R_2 \)

\( \therefore \quad M_{v_1} > M_{v_2} \)
41. (a) When $n$ resistors are connected in parallel, then
\[
\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n} = \frac{1}{A} \quad \text{...(a)}
\]
when $n^{\text{th}}$ resistor is removed, then
\[
\frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_{n-1}} = \frac{1}{B} \quad \text{...(b)}
\]
Subtracting (b) from (a), we get
\[
\frac{1}{R_n} = A - \frac{1}{B} \implies R_n = \frac{AB}{B - A}
\]
42. (a) Pressure at surface of lake $= p$ (atoms pressure)
Pressure at the depth $= np$ (given)
\[\therefore \text{change in pressure } (\Delta p) = np - p\]
Suppose $V$ is the volume of a certain mass $M$ of water at the surface then $M = DV$
Now decrease in volume due to increase in pressure $\Delta p$ is
\[\Delta V = \frac{V \Delta p}{B}\]
Volume of the mass $M$ of water at given depth is
\[V' = V - \Delta V = V - \frac{V \Delta p}{B} = V \left(1 - \frac{\Delta p}{B}\right) = \frac{V}{B}(B - \Delta p)\]
Density of water at that depth is
\[D' = \frac{M}{V'} = \frac{DV}{V'(B - \Delta p)} = \frac{DB}{B - \Delta p} = \frac{DB}{B - (n-1)p}\]
43. (d) $\phi = t^3 + 3t - t$
\[\therefore \text{induced emf } \epsilon = -\frac{d\phi}{dt} = -(3t^2 + 3) = -3t^2 - 3\]
at $t = 0$, $\epsilon = -3V$
\[\therefore \text{Slope of graph will be a lambda not through origin} \]
44. (b) For diamagnetic material $0 < \mu < 1$
and for any material $\epsilon_n > 1$
So, (b) is correct.
45. (a) For first case the wire of length $L$ is bent to form a circular coil of one turn, $L = 2\pi r_1$
Similarly, for second case
\[L = 4\pi r_2\]
Now, $2\pi r_1 = 4\pi r_2 \implies r_2 = \frac{r_1}{2}$
\[B_1 = \frac{\mu_0 l}{2r_1} \text{ and } B_2 = \frac{\mu_0 l}{2r_2} = \left(\frac{r_1}{2r_2}\right)^2\]
\[B_2 = 2B_1\]
46. (c) Alitame is an artificial sweetener developed by Pfizer in the early 1980s. Alitame has several distinct advantages over aspartame. Alitame is more stabler than aspartame and 2000 times more sweetner than sugar.
47. (c) $O_2$ is used in respiration. High concentration of $O_2$ means well atmosphere. It does not causes greenhouse effect, hence $O_2$ is not a greenhouse gas.
48. (a) Vitamin A is a group of unsaturated nutritional organic compounds, that includes retinol, retinal, retinoic acid and several provitamin A carotenoids, among which beta carotene is the most important. Vitamin A is the vitamin whose deficiency may cause night blindness.
49. (a) Cellulose in a biodegradable polymer which occurs in nature and degrade easily.
50. (a) Structure of $NO_3^-$ is
\[
\begin{array}{c}
\text{N} \\
\vdots \\
\text{O} \\
\end{array}
\]
\[H = \frac{V + M - C + A}{2} = \frac{5 + 1}{2} = \frac{6}{2} = 3\]
Hybridisation = $sp^2$
Shape = triangular planar
Structure of $CO_3^{2-}$ is
\[
\begin{array}{c}
\text{O} \\
\vdots \\
\text{C} \\
\end{array}
\]
\[H = \frac{V + M - C + A}{2} = \frac{4 + 2}{2} = 3\]
Hybridisation = $sp^2$
Shape = triangular planar
51. (b) $\text{CH}_3\text{[o]}\text{Alc KMnO}_4\rightarrow \text{COOH}$
Benzonic acid
\[
\begin{array}{c}
\text{OH} \\
\vdots \\
\text{CH}_3 \\
\end{array}
\]
Phenol
\[
\begin{array}{c}
\text{OH} \\
\vdots \\
\text{CH}_3 \\
\end{array}
\]
Benzonic acid
$\text{OSO}_4\rightarrow \text{cis-2, 3 diol}$
53. (b) 
mCPBA causes formation of epoxide ring from less hindered side and ringopening will also occur from less hindered side.

54. (c) Chemical reaction occurring in given reaction is as follows

55. (d) Only primary amine undergoes positive carbylamine test

56. (c) 
\[ \text{Cl} \quad \text{COOH} \]

\[ \therefore \text{COOH is more senior than Cl.} \]

\[ \therefore \text{Numbering starts from COOH.} \]

Parent chain \( \rightarrow \) butan-1-oic acid

IUPAC name = 3 chloro-2-methyl butanoic acid

57. (d) \( \text{o-nitrophenol is steam volatile due to intramolecular hydrogen bonding while } p-\text{nitrophenol is less volatile due to intermolecular H-bonding hence they can be separated by steam distillation only.} \)

58. (a) 
\[ \text{C} \quad \text{H} \]

\[ \text{NaO}_3 \rightarrow \text{COOH} \quad \text{ZnCH}_3\text{COOH} \rightarrow \text{CH}_2\text{OH} \quad \text{CH}_3\text{OH} \]

1\text{st} \text{step is ozonolysis and 2\text{nd} \text{step is reductive.}} \text{Whole step is known as reductive ozonolysis.} \)

59. (c) Problem is based on concept of Inductive effect and electronegativity of element. As } F \text{ is most electronegative element with smallest size rather than } —\text{OH} \text{ and } —\text{NH}_2 \text{ where O and N has larger size as well as lower electronegative than } F. \)

\[ —\text{F} \quad —\text{OH} \quad —\text{NH}_2 \]

\text{Electronegativity decreases.}

\[ \rightarrow \text{Inductive effect decreases.} \]

\[ \rightarrow \text{Hence, correct order is (c).} \]

While all other are conceptually very wrong.

60. (b) \( \text{Vitamin B-12 also called cobalamin is a water-soluble vitamin with a key role in the normal functioning of the brain and nervous system and for the formation of blood. Deficiency of vitamin B-12 causes beri-beri disease.} \)

61. (d) Bond order of CO is 3 and bond order of \( \text{N}_2 \) is also 3.

\[ \text{It can be easily calculated using formula} \]

\[ \text{Bond order} = \frac{\text{Nb} - \text{Na}}{2} \]

\[ \text{where, } \text{Nb} = \text{number of electrons in BMO.} \]

\[ \text{Na} = \text{number of electrons in ABMO.} \]

62. (d) Electronic configuration of Ce = [Xe] 4f\(^5\) 5d\(^3\) 6s\(^2\)

\[ \text{Electronic configuration of } \text{Ce}^{3+} = [\text{Xe}] 4f^1 5d^0 6s^0 \text{ i.e., } n = 1 \]

\[ \mu = \sqrt{n(n + 2)} = \sqrt{(1 + 2)} = \sqrt{3} = 1.73 \]

63. (a) Electronic configuration of oxygen is \( 1s^2\ 2s^2\ 2p^4 \)

\[ \text{O}(2p^4) \rightarrow \text{O}(2p^3) \rightarrow \text{O}(2p^2) \]

\[ \text{Half filled electronic configuration} \]

64. (c) \( \text{The lanthanide or lanthanoid is the series of chemical elements. It comprises the fifteen metallic chemical elements with atomic number 57 through 71 from lanthanum through lutetium. Erbium (} z = 68) \text{ is a lanthanide while other three are actinide.} \)

65. (a) \( \text{Let oxidation state of Fe in } K_3\text{[Fe(CN)}_3\text{(H}_2\text{O)}]\text{is } x \)

\[ (+1) \times 3 + x + 5 \times (−1) + 0 = 0 \]

\[ +3 + x − 5 = 0 \]

\[ x = 5 − 3 = +2 \]

\[ \text{Magnetic moment of } \text{Fe}^{2+} \text{ can be calculated as } \mu = \sqrt{n(n + 2)} \text{ BM} \]

\[ \text{where } n = \text{number of unpaired electrons} \]

\[ \text{electronic configuration of Fe}^{2+} \text{ in } [\text{Fe(CN)}_3\text{(H}_2\text{O)}]\text{is } = [\text{Ar}] 3d^{6}4s^{2}4p^{0} \]

\[ n = 0 \quad : \quad \mu = 0 \]

66. (b) \( \text{Alphabetically ligand is written first with ending at } —\text{O— followed by metal ending at ium and then negative end of coordination compound.} \)

\[ \text{tetra aqua} \quad \text{for } 4\text{H}_2\text{O} \]

\[ \text{dichloro} \quad \text{for } 2\text{Cl} \]

\[ \text{chromium (III)} \quad \text{for } \text{Cr}^{3+} \]

\[ \text{chloride} \quad \text{for } \text{Cl}^{-} \]

IUPAC name = tetraaquadichlorochromium (III) chloride
67. (b) This electronic configuration is correct due to extra stable half filled electronic configuration.

\[
3d^5\quad 4s^1
\]

68. (b) Valence shell electronic configuration of Cu is

\[
3d^9\quad 4s^2
\]

Here m for 29th electron is – 1.

69. (c) Dihydrogen has complete duplet and less reactive but more stable among all above given atomic hydrogen, nascent hydrogen and dihydrogen.

70. (a) Ca and Mg don’t impart colour to flame due to low value of atomic size which requires high amount of energy to excite electron from ground state energy to excited state energy level.

71. (b) Diamond is non-conductor while graphite is conductor. Diamond has tetrahedral structure while graphite has layered structure.

72. (d) all three have lone pairs of electrons to form a co-ordinate bond with electron deficient boron atom in BH$_3$. Due which BH$_3$ keeps in monomeric form.

73. (c) This cannot be explained on the basis of electronegativity of substituent attached actually. This can be explained on the basis of $\rho_c$ - $\rho_s$ back bonding, greater the $\rho_c$ - $\rho_s$ back bonding lower is its lewis acidic strength

74. (d) When water and ice are at equilibrium at temperature 0°C, then $\Delta G = 0$

where, $\Delta G = G_{\text{ice}} - G_{\text{water}}$

\[
G_{\text{ice}} - G_{\text{water}} = 0
\]

\[
G_{\text{ice}} = G_{\text{water}} \neq 0
\]

75. (a) $H_2 + I_2 \rightarrow 2HI$

Since $\Delta n = 2 - 2 = 0$

Hence, this given reaction will not be affected by change in pressure.

76. (a) Redox reaction means, the reaction in which oxidation as well as reduction takes place simultaneously.

\[
\text{CaCO}_3 \rightarrow \text{Ca}^{2+} + 2\text{CO}_2^{-} + \text{C}^{4-} + \text{O}_2^{-}
\]

In this reaction there is no change in oxidation number of any atom. Hence this reaction is not a redox reaction.

77. (a) Volume of Ag metal required to coat the coffee tray

\[
= 30 \times 15 \times 2 \times 0.1 = 90 \text{ cm}^3
\]

Mass of Ag required

\[
= \frac{\text{Volume of Ag}}{\text{Density of Ag}} = \frac{90}{10.5} = 8.57 \text{ g}
\]

Gram equivalent of Ag

\[
= \frac{8.57}{108} = 0.08
\]

Number of Faraday passed = 0.08

Number of Coulomb’s passed = 0.08 x 96500

\[
= 7720 \text{ C}
\]

time = 7720 s

78. (d) Rate of diffusion $\propto \frac{1}{M}$

As mass of molecule increases, rate of diffusion decreases

\[
\text{CO}_2 \quad \text{SO}_2 \quad \text{SO}_3 \quad \text{PCL}_3
\]

\[
M = 44 \quad 64 \quad 80 \quad 138.5
\]

$\rightarrow$ mas of compound increases $\rightarrow$ rate of diffusion decreases

79. (d) The packing fraction is the fraction of volume in a crystal structure that is occupied by atoms.

\[
\phi = \frac{4/3 \pi r^3}{a^3} = \frac{\pi}{6} = 0.524
\]

Packing fraction = 0.524 x 100

\[
= 52.4\%
\]

The packing fraction for

HCP = 0.74

FCC = 0.74

BCC = 0.68

Diamond cubic = 0.34

80. (b) Antifluorite structure has opposite arrangement of ions than fluorite structure.

For antifluorite structure

Coordination number of cation = 4

Coordination number of anion = 8

81. (b) \[
\text{N}_2\text{O}_5 \rightarrow 2\text{NO}_2
\]

Initially

\[
1 - \alpha \quad 2\alpha
\]

At equilibrium

\[
1 - \alpha + 2\alpha = 1 + \alpha
\]

Total moles at equilibrium = $1 - \alpha + 2\alpha = 1 + \alpha$
82. (b) We know that

\[ \Delta H^o = \Delta E^o + \Delta n_f RT \]

For the reaction

\[ \text{CH}_2=\text{CH}_2 + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 4\text{H}_2\text{O} \]

\[ \Delta n_f = 4 - 7 = -3 \]

\[ \therefore \Delta H^o = \Delta E^o - \Delta n_f RT \quad [\because \Delta n_f = \text{negative}] \]

i.e., \[ \Delta H^o < \Delta E^o \]

83. (a) According to Freundlich adsorption isotherm

\[ x = k p^{1/n} \]

Taking log on both sides

\[ \log x = \frac{1}{n} \log p + \log K \]

Compare with \[ y = mx + c \]

So slope, \[ m = \frac{1}{n} \]

Slope = \[ \frac{1}{x} + C \]

84. (b) Given Half-life time of a first order reaction = \[ 1.26 \times 10^{14} \] s

To find The rate constant of this reaction.

Solution \[ K = \frac{0.693}{t_{1/2}} \]

where, \[ K = \text{rate constant}, \ t_{1/2} = \text{half-life time} \]

\[ t_{1/2} = \frac{0.693}{1.26 \times 10^{14}} \]

\[ = 5.5 \times 10^{-14} \text{ s}^{-1} \]

85. (d) \[ R(\text{NH}_3)_3 \text{Br} \rightarrow R(\text{NH}_3)_3^+ + \text{Br}^- \]

Alkyl trimethyl ammonium ions aggregates to form cationic micelles.

86. (b) Equivalent Weight

\[ = \frac{\text{weight of metal}}{\text{weight of oxygen combined}} \times 8 \]

\[ = \frac{0.79}{0.5} \times 8 = 14 \]

87. (c) \[ n_B = \frac{3}{60} = 0.05 \]

\[ \Rightarrow n_A = \frac{45}{18} = 2.5 \]

we know that

\[ \frac{\Delta P}{P^o} = x_B = \frac{0.05}{2.5 + 0.5} = 0.0196 = 0.02 \]

88. (d) \[ \text{OH} \quad \text{no tautomerism} \]

89. (b) \[ K = \frac{2.303}{t} \log a = \frac{2.303}{10} \log \frac{100}{80} \]

\[ = \frac{2.303}{10} \log 5 - \log 4 \]

\[ = \frac{2.303}{10} (0.70 - 0.47) \]

\[ K = 0.0223 \]

90. (d) \[ \text{N}_2\text{O}_4 \text{ and N}_2\text{O}_3 \text{ has one N}--\text{N} \text{ bond as shown below} \]

91. (b) Syphilis is a spirochaetal disease, which is sexually transmitted.

Viral diseases - Rabies and Polio
Bacteria diseases - Cholera and TB
Protozoan diseases - Malaria
Helminthic diseases - Taeniasus and Ascariasis

92. (d) In the genetic code, a stop codon (or termination codon) is a nucleotide triplet within messenger RNA that signals a termination of translation. In DNA, UGA is represented by TGA, which is also called as umber.

93. (c) In the acetylation of morphine to yield heroin (diacetylmorphine) the phenolic OH group on the 3-carbon is the first to react to give, as an intermediate, 3-O-monoacetyl morphine, which is further acetylated to heroin.
It is commonly called brown sugar, being cheap considered poor man’s heroin.

94. (b) HGP stands for Human Genome Project with a primary goal of determining the sequence of chemical base pairs which make up human DNA and of identifying and mapping the total genes of the human genome from both a physical and functional stand point. The HGP was launched in 1990 and completed in 2003.

95. (b) Lateral meristems are present along the side of the stem, vascular cambium in the gymnosperms and the angiosperms is a good example of lateral meristems.

96. (a) During serum sickness, the immune system falsely identifies a protein in antiserum as a potentially harmful substances (antigen), which initiate the allergy like (hypersensitivity) reaction. Corticosteroid, antihistamine and AIDS are best drugs for such condition.

97. (c) Interferons are produced by any microbe-infected cell. They induce the healthy cell to synthesise antimicrobial proteins that check microbial multiplication.

98. (b) mRNA undergoes additional processing, i.e., capping and tailing.

99. (c) Sulphur is not the constituent of chlorophyll. The main constituent of chlorophyll is magnesium.

100. (b) Causes of insulin resistance includes

- Mutation that causes genetic obesity (e.g., melanocortin receptor mutation).
- Lipodystrophy (lipid accumulation in liver).
- Pregnancy
- Hemochromatosis (tissue ion accumulation)

102. (c) Epididymis is a long tube which is highly coiled. It has three regions, i.e., upper widel head (caput), middle narrow body (corpus) and lower widel tail (cauda). Sperms attains maturity in the caput region of epididymis.

103. (d) Cancer of glial cells of CNS–glioma, whereas cancerous growth of melanocytes–Melanomas.

104. (b) RAPD is used in PCR analysis.

105. (d) Mg, K and Ca are essential macrolelements. Macronutrients are required by plants in larger amounts.

106. (d) During allopatric speciation a population splits into two geographically isolated population. In parapatric speciation there is only partial separation of the zones of two diverging populations afforded by geography. Sympatric speciation refers to the formation of two or more descendant species from a single ancestral species all occupying the same geographic location.

107. (c) LHON is an mitochondrial disease (myopathy), which is characterised by progressive loss of central vision due to degeneration of optic nerves and retina.

108. (b) In C₃-plants, CO₂ combines with RuBP to form phosphoglyceric acid, on the other hand in C₄-plants, carbon dioxide is first picked up by phosphoenol pyruvate to form oxaloacetic acid.

109. (a) Either oligomycin or DCCD blocks the H⁺ leak in membranes depleted of F₁. Thus oligomycin and DCCD inhibit the interacting with F₀.

110. (c) The correct matched pairs are

- Macrophytes — Rooted plants in shallow water
- Phagotrophs — Animals ingest food
- Abiotic components — Temperature
- Hydrophytes — Plants of aquatic nasitants
- Plants of dry areas are called xerophytes.

111. (c) The devastating effects of mental illness
112. (a) Cauliflower plants very commonly show whiptail disease. The leaves first shown an interveinal mottling and the leaf margins may become gray and flaccid and finally brown.

113. (c) Dachigam National Park mainly preserves Hangul.

114. (d) Plants fossils can be preserved by many ways some of them are adpression (compression), petrifications, moulds, authigenic, mineralisation, fusain etc.

115. (c) Progesterone is secreted by corpus luteum. It inhibits the release of FSH so that it may not develop additional follicle and eggs.

116. (c) Polymorphism involves the existence of different forms (alleles) of the same gene in plants or a population of plants. These differences are tracked as molecular markers to identify desired genes. All given options are desirable properties for ideal DNA marker.

117. (a) Crown gall’s disease is caused in plants by A. tumefaciens, a bacteria. They enter a portion their own DNA in DNA of the plant.

118. (b) The nodules on the roots of leguminous plants formed by the symbiotic association of fungi acts as biofertilizers.

119. (c) Generally amenorrhea (cessation of menses) is the first and most common sign of pregnancy. Quickening (perception of foetal movements by mother) occurs at 16 weeks after conception.

120. (c) The common bottle cork produce from Quercus suber. It is a product of phellogen.

121. (b) Filtration fraction, which is the fraction of plasma that filters through the glomerular membrane is calculated by

$$\text{Filtration fraction} = \frac{\text{GFR}}{\text{RPF}}$$

GFR — Glomerular Filtration Rate = 125 mL/min
RPF — Renal Plasma Flow = 650 mL/min

Thus, filtration fraction = \(\frac{125}{650} = 0.19\)

122. (a) Laproscopic method is less painful.

The kidney retrieval vision (6 cm) is not visible as it is placed over the pubic hair.

123. (c) Student read the following diagram carefully as it is given in NCERT and depicts important information.
132. (b) Abscisic acid is a naturally occurring growth inhibitor. It acts as a stress hormone. It causes abscission of leaves and promotes senescence. It initiates flowering only in certain short day plants.

133. (c) Transgenic tomato is popularly known as Flavr savr.

134. (d) Pyruvic acid is oxidatively decarboxylated to form acetyl Co-A.

135. (c) The entire living world was divided by Linnaeus into two kingdoms. This system has become an essential artificial system of classification. The members in the classification are classified on the basis of genetic relationship. The member of Animalia kingdom do not possess chlorophyll perform locomotion and lack cell wall, while the members of kingdom—Plantae possess chlorophyll cellulosic cell wall, but have no power of locomotion.

136. (a) OCPs is the contraception of choice for newly married women.

137. (d) Taxonomic hierarchy is the stepwise arrangement of all categories for classification of plants and animals. The category in taxonomic hierarchy are kingdom → Division → Class → Order → Family → Genus → Species.

138. (c) Spironolactone acts predominantly as a competitive antagonist of the aldosterone receptor and belongs to a class of pharmaceutical drugs known as potassium sparing diuretics.

139. (b) \[ \frac{\text{CO}_2 \text{ liberated}}{\text{O}_2 \text{ used}} = \text{Respiratory Quotient (RQ)} \]

RQ is more than 1 in case of organic acid, whereas fat, protein and carbohydrate RQ is less than 1.

140. (c) The complete processes of synthesis of norepinephrine includes

- Tyrosine → Dopa
- Dopa → Dopamine
- Dopamine → Norepinephrine

141. (c) Secondary myofilament have rough surface due to projectile head and do not slide during muscle contraction. Also they are fewer in number.

142. (b) Agamospermy occurs mainly in two forms

- Gametophytic apomixis: The embryo arises from an unfertilized egg cell (i.e., by parthenogenesis) in a gametophyte that was produced from a cell that did not complete meiosis.
- Adventitious embryony: An embryo is formed directly from nucellus or integument tissue.

143. (c) In angiosperm (dicots), the polygonum type of embryo sac is most common. In this embryo sac, the arrangement of the nuclei is 3 + 2 + 3, i.e., 3 in antipodal cells, 2 as polar nuclei and 3 in egg apparatus (2 in synergids and 1 in egg cell).

144. (a) There are two types of agranulocytes

- Lymphocytes: They includes natural killer T-cells. These are agranulocytic type of white blood cells.
- Monocytes: They share the vacuum cleaner function of neutrophils and they are not white blood cells like granulocytes, neutrophils, eosionophils and basophils etc.

145. (c) WBC (White Blood Cells) are cells of the immune system involved in defending the body against both infections disease and foreign materials. The live less than 10 days only.

146. (b) CO₂ compensation point is very low in C₃-plants, i.e., 0 to 5 ppm, whereas high CO₂ compensation point is found in C₄-plants, i.e., 25 to 100 ppm.

147. (d) Brain waves are of four types i.e., α, β, δ and θ. Frequency of theta wave is 4-7/s and they occur mainly in children. Alpha waves are typical to an awake resting person. Beta waves occur during intense mental activity and delta waves occur in deep sleep and serious brain disorder.

148. (d) The extremely fine silk used for ballooning by spiders is known as gossamer.

149. (b) Colloidal theory of protoplasm has been given by Fischer.

150. (b) Neopilina is a connecting link between Annelida and Mollusca.

151. (d) The first living organisms originated in a reducing atmosphere. They were anaerabic and heterotrophs.

152. (b) Australopithecus (first ape man) → Homo habilis → Homo erectus → Neanderthal → Cro-magnon → Homo sapiens sapiens.

153. (c) Vermis is a small median portion of cerebellum. The cerebellum is very large and well-developed. It forms about one eighth of the brain mass.

154. (d) Y-chromosome. Mental retardation is not related with Y-chromosome. In human, function of Y-chromosome is less and it controls the maleness, i.e., body hairs, testes, etc.

155. (c) Sodium and chloride are principle cation and anion is blood plasma respectively.

156. (a) Holandric genes are the Y-linked genes that are responsible for the transfer of characters from father to son, e.g., pinna hair.

157. (c) Dihydroxy cholecalciferol is a steroid hormone which is secreted by kidney by using cholecalciferol. This hormone helps in $Ca^{2+}$ absorption and bone formation.
158. (c) Restriction enzyme protects host cell from phage by destroying its DNA by methylation of nucleotides.

159. (c) Ribonucleoside is formed by ribose sugar + nitrogenous base.

160. (b) Golden rice contains 35 micrograms of betacarotene per gram. Betacarotene is very good for the healthy eyes and essential too.

161. (a) Down's syndrome is due to the non-disjunction of 21st chromosome. The individual contains 47 chromosome in this syndrome.

162. (b) Disruptive selection Favours both small sized and large sized individuals. Directional selection population charges towards one particular direction. Industrial melanism—Supports natural selection.

163. (c) To prevent loss of water, tropical deciduous forest trees shed their leaves.

164. (c) GMFs or Genetically Modified Food improve profitability. Soon, genetically modified crops will have better shelf life too.

165. (d) Congenital adrenal hyperplasia results from hypersecretion of adrenal hormones due to deficiency of enzyme 21-hydroxylase (most commonly).

166. (d) In a fully turgid cell, diffusion pressure deficit = Zero As, Turgor pressure = Osmotic pressure

167. (d) Vaccines are collection of killed or attenuated disease causing bacteria and virus to elicit immune response as a measure to protect a patient from disease.

168. (a) Mesozoic era is the age of reptiles and gymnosperms.

169. (d) Autogamy is a type of self-pollination, which occurs between anther and stigma of same flower.

170. (d) Polydactyly and bradydactyly are disorders of defective autosomal dominant gene. It is a disease of more than fives digits in fingers and toes and small sized fingers respectively. Polydactyly is caused by dominant gene, one parent carries the defective gene and half of the children inherit it.

171. (a) Alu I is obtained from Arthrobacter luteus which recognises the sequence AGCT.

172. (d) Microprojectile bombardment is used for cereal transformation. It involves acceleration of gold particles coated with plasmid DNA for directly introducing the DNA into plant cells.

173. (c) Thiamine is isolated from Rhizopus scinus (fungus).

174. (d) When turgor pressure is negative, diffusion pressure deficit will be more than osmotic pressure. DPD of a cell mainly depends upon OP.

175. (d) Viroids bears naked RNA molecules, while the viruses don’t bear naked RNA molecules.

176. (b) Pivot joint is a type of diarthrosis. In this type of joint, the axis of a convex articular surface is parallel with the longitudinal axis of the bone. In other words, pivot joint having articular end of one bone is fixed, while the other can rotate over it.

177. (b) Introduction of isolated gene from marrow cells producing ADA into the cells at early embryonic stages is the permanent cure of ADA deficiency.

178. (c) Rennin occurs in gastric juice and is a constituent of rennet. It coagulates milk by converting caseinogen to casein.

179. (c) The anticancer agent taxol stabilises microtubules and interferes with mitosis.

180. (d) Gene silencing is a mechanism by which cells shutdown large sections of chromosomal DNA.