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.
PART A PHYSICS

1. A full wave rectifier circuit along with the input and output are shown in figure.

![Full Wave Rectifier Circuit](image)

The contribution from the diode $D_2$ is/are
- a. $A, C, E$
- b. $B, D, F$
- c. $A, C, E$
- d. $A, B, C, D, E, F$

2. A moving particle has kinetic energy $K$ and wavelength $\lambda$ then, the correct graph related to the particle is
- a. $y$
- b. $y$
  
  ![Graph 1](image)
- c. Both a and b
- d. None of the above

3. In the network shown below

![Network Diagram](image)

If current is 5 A and is decreasing at the rate of $10^{-3}$ A/s, then $V_B - V_A$ will be
- a. 20 V
- b. 10 V
- c. 15 V
- d. 5 V

4. If one of the slit in Young’s double slit experiment is covered with a black opaque paper, then
- a. the fringe width decreases
- b. the bright fringes become fainter
- c. there will be uniform illumination all over the screen
- d. diffraction pattern will be observed

5. The half-life of a radioactive substance is 20 days. The time taken for $\frac{3}{4}$ of its original mass to disintegrate is
- a. 20 days
- b. 40 days
- c. 60 days
- d. 80 days

6. If a resistance coil is made by joining in parallel two resistances each of 10 $\Omega$. An emf of 1.0 V is applied between two ends of coil for 5 min. The heat produced in calories will be
- a. 10.3 cal
- b. 14.3 cal
- c. 16.3 cal
- d. 18.3 cal
7. If a parallel plate capacitor has capacity $C$, on inserting a dielectric slab of relative permittivity $K$ and thickness equal to one-fourth of the plate separation is placed between the plates, then its capacity becomes $C'$. The value of $C'/C$ will be

- $a. \frac{K}{2(K+1)}$
- $b. \frac{2K}{K+1}$
- $c. \frac{5K}{4K+1}$
- $d. \frac{4K}{3K+1}$

8. A body of mass 4 kg is acted upon by a force which causes a displacement in it given by $x = t^2$ m, where $t$ is time in second. The work done by force in 4s is

- $a. 64$ Joules
- $b. 128$ Joules
- $c. 200$ Joules
- $d. 240$ Joules

9. A satellite is a heavily body which revolve around the earth at some height. Suppose a satellite is orbiting around the earth in a circular orbit of radius $R$ from centre of earth then its period of revolution varies as

- $a. R^{3/2}$
- $b. R^2$
- $c. R$
- $d. \sqrt{R}$

10. If a thin uniform wire of length $X$ having linear mass density $D$ is bent into a circular loop (as shown in figure). What will be the moment of inertial of the loop about axis $AB$?

- $a. \frac{3l^2D}{16\pi}$
- $b. \frac{2l^2D}{3\pi}$
- $c. \frac{3l^2D}{8\pi}$
- $d. \frac{8l^2D}{13\pi}$

11. If a sphere rolls down from an inclined plane without slipping, then the ratio of translational energy to its total energy is

- $a. \frac{7}{2}$
- $b. \frac{2}{7}$
- $c. \frac{5}{7}$
- $d. \frac{7}{5}$

12. If a wire is suspended vertically from one of its end is stretched by attaching a weight of 200 N to the lower end. It stretches the wire by 1 mm, then the potential energy stored in the wire is

- $a. 1$ Joule
- $b. 0.1$ Joule
- $c. 0.01$ Joule
- $d. 0.001$ Joule

13. If $E$ denotes electric field in a uniform conductor, $I$ is corresponding current through it and $v_d$ is drift velocity of $e^-$, then the correct graph is

- $a. v_d$
- $b. v_d$
- $c. v_d$
- $d. v_d$

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Space for Rough Work
14. Two batteries of emf $E_1$ and $E_2$ ($E_2 > E_1$) and internal resistance $r_1$ and $r_2$ respectively are connected in parallel as shown in figure.

\[ \text{a. The equivalent emf } E \text{ is smaller than } E_1 \]
\[ \text{b. The equivalent emf } E = E_1 + E_2 \]
\[ \text{c. The equivalent emf } E \text{ is smaller than } E_1 \]
\[ \text{d. The equivalent emf } E_{eq} \text{ of two cell is between } E_1 \text{ and } E_2 \text{ always} \]

15. A rod of mass $m$ and length $l$ is lying on a horizontal table. The work done to make it stand on one end will be

\[ \text{a. } 2mgl \quad \text{b. } mgl \quad \text{c. } \frac{mgl}{2} \quad \text{d. } \frac{mgl}{4} \]

16. Three lenses of focal length +15 cm, +150 cm and +250 cm are available, for making an astronomical telescope. To produced the largest magnification, the focal length of the eye-piece should be

\[ \text{a. } +15 \text{ cm} \quad \text{b. } +150 \text{ cm} \quad \text{c. } +250 \text{ cm} \quad \text{d. None of these} \]

17. Which of the following represent the correct graph between the intensity of incident photons ($I$) and the photoelectric current ($i$) ?

\[ a. \quad b. \quad c. \quad d. \]

18. Two identical rods $MN$ and $OP$, each of length $L$, cross-sectional area $A$ and thermal conductivity $K$ are connected as shown in figure. Ends $M, O$ and $P$ are maintained at temperatures $T_1 = 20^\circ C$, $T_2 = 30^\circ C$ and $T_3 = 40^\circ C$ respectively. The temperature at $N$ is

\[ \text{a. } 32^\circ C \quad \text{b. } 33^\circ C \quad \text{c. } 34^\circ C \quad \text{d. } 35^\circ C \]

19. An electromagnetic wave is propagating in medium with relative magnetic permeability 50 and relative dielectric constant 2. The wave impedance of such medium is

\[ \text{a. } 2000 \Omega \quad \text{b. } 1883 \Omega \quad \text{c. } 1550 \Omega \quad \text{d. } 1222 \Omega \]
20. The distance between the sun and the earth is \( R \). The angular momentum of earth around the sun is proportional to
\[ a. \ R^{2/3} \quad b. \ R \quad c. \ R^{1/2} \quad d. \ R^{3/2} \]

21. A body is acted by a force \( F \) such that \( F \propto \frac{1}{B} \), where \( B \) is distance covered by the body then work done by the force in moving body from points \( x_1 \) and \( x_2 \) is
\[ a. \ k(x_1^2 - x_2^2) \quad b. \ k \left( \frac{x_2^2}{x_1^2} \right) \quad c. \ k \ln \left( \frac{x_2}{x_1} \right) \quad d. \ k \ln \left( \frac{x_2}{x_1} \right) \]

22. A wave motion is described by \( y(x, t) = a \sin (kx - \omega t) \).
Then the ratio of the maximum particle velocity to the wave velocity is
\[ a. \ \frac{\omega}{k} : 1 \quad b. \ \frac{1}{k \omega} : 1 \quad c. \ k \omega : 1 \quad d. \ \omega \omega : 1 \]

23. Equal masses of two substances of densities \( \rho_A \) and \( \rho_B \) are mixed together. The density of the mixture would be
\[ a. \ \sqrt{\rho_A \rho_B} \quad b. \ \frac{\rho_A + \rho_B}{2} \quad c. \ \frac{\rho_A \rho_B}{\rho_A + \rho_B} \quad d. \ \frac{2\rho_A \rho_B}{\rho_A + \rho_B} \]

24. Suppose an infinite number of charges equal to \( q \) are placed along \( x \)-axis at \( x = 1, x = 2, x = 4, x = 8 \ldots \) so on. The value of electric field at origin will be
\[ a. \ \frac{q}{2\pi \varepsilon_0} \quad b. \ \frac{q}{3\pi \varepsilon_0} \quad c. \ \frac{q}{4\pi \varepsilon_0} \quad d. \ \frac{q}{8\pi \varepsilon_0} \]

25. Displacement \( x \) of a particle moving in one dimension is related to time \( t \) by the equation \( t = \sqrt{x} + 2 \). The displacement of the particle when its velocity is zero, is
(Here \( x \) is in metre and \( t \) in second)
\[ a. \ 4 \quad b. \ 2 \quad c. \ 1 \quad d. \ 0 \]

26. In an inductor, the current \( I \) varies with time \( t \) as \( I = 4 + 4t \).
If the emf induced in the inductor is 8 mV, what is self-inductance?
(Here current is in ampere and time is in second)
\[ a. \ 8 \times 10^{-6} \ \text{H} \quad b. \ 6 \times 10^{-6} \ \text{H} \quad c. \ 4 \times 10^{-3} \ \text{H} \quad d. \ 2 \times 10^{-3} \ \text{H} \]

27. If the dimension of a physical quantity is given by \( M^a L^b T^c \), then the physical quantity will be
\[ a. \ \text{acceleration, if } a = 1, b = -1, c = -2 \quad b. \ \text{velocity, if } a = 1, b = 0, c = -1 \]
\[ c. \ \text{pressure, if } a = 1, b = -1, c = -2 \quad d. \ \text{force, if } a = 0, b = -1, c = -2 \]
28. A TV tower has a height of 20 m. The maximum distance upto which TV transmission can be received is equal to (radius of earth = \(6.4 \times 10^6\) m)
   a. \(4 \times 10^3\) m  
   b. \(16 \times 10^3\) m  
   c. \(32 \times 10^6\) m  
   d. \(64 \times 10^6\) m

29. In which of the following case of spherical lenses (as shown in figure), the emergent ray is parallel to incident ray?
   a. \(R_1 > R_2\)  
   b. \(R_1 = R_2\)  
   c. \(R_1 < R_2\)  

30. A metallic triangle is placed in a uniform electric field. In figure which path will the lines of force follow?
   a. 1  
   b. 2  
   c. 3  
   d. 4

31. Two blocks of masses \(m_1 = 1\) kg and \(m_2 = 2\) kg are connected by massless string and placed on a horizontal frictionless surface as shown in figure. A force \(F = 12\) N is applied to mass \(m_1\) as shown. The acceleration of the system is
   a. \(12\) m/s\(^2\)  
   b. \(8\) m/s\(^2\)  
   c. \(4\) m/s\(^2\)  
   d. \(2\) m/s\(^2\)

32. In which case there is no current induced in the coil as shown in figure?
   a. When both moves towards each other  
   b. When magnet moves towards coil  
   c. When coil and magnet both move in same direction with same velocity  
   d. When both moves away from each other with same speed

33. If a block of mass \(M\) is lying on a frictionless surface and an another block of mass \(m\) is lying on this block as shown in figure. If the coefficient of static friction between two blocks is \(\mu\), then the minimum horizontal force \(F\) that must be applied to block of mass \(m\) so that it moves over block of mass \(M\) is
   a. \(\frac{mg}{\mu}\)  
   b. \(mg\)  
   c. \(\mu mg\)  
   d. \(\mu Mg\)
34. In which of the following figure, the p-n diode is forward biased?

![Diode Figures]

35. A positively charged particle enters a magnetic field of value \( B \) \( \hat{i} \) with a velocity \( v \) \( \hat{j} \). The particle will move along

a. z-axis b. – z-axis c. – x-axis d. – y-axis

36. A light is an electromagnetic wave consist of particles called photon, if a photon travelling in air enters into a glass slab of large thickness then which of the following quantities will remain unchanged?

a. velocity b. wavelength c. momentum d. Energy

37. A vessel whose bottom has round holes with diameter of 1 mm is filled with water. Assuming that surface tension acts only at holes, then maximum height upto which water can be filled in vessel without leakage’s (surface tension of water is \( 75 \times 10^{-3} \) N/m, \( g = 10 \) m/s\(^2\))

a. 0.03 mm b. 0.3 m c. 0.3 cm d. 0.03 cm

38. For a streamline flow of water which of the following options is correct

a. Streamlines may be straight or curved b. Two streamlines do not intersect each other c. Only (a) is correct d. Both (a) and (b) are correct

39. The radiations emitted from a radioactive material separated into two groups A and B when a magnetic field is directed into the plane of the paper. According to figure, names of radiation A and B are respectively

![Radioactive Material Diagram]

a. \( \gamma, \alpha \) b. \( \alpha, \gamma \) c. \( \beta, \gamma \) d. \( \alpha, \beta \)
40. Two coherent sources of intensity ratio 100:1 undergoes interference, then the ratio of intensities between minima and maxima will be
   a. \( \frac{3}{4} \)  
   b. \( \frac{11}{12} \)  
   c. \( \frac{81}{121} \)  
   d. \( \frac{144}{212} \)

41. Which one of the energy band diagrams shown in the figure corresponds to that of a semiconductor?
   
   a. 
   b. 
   c. 
   d. 

42. Two springs of spring constant \( k_1 \) and \( k_2 \) have equal maximum velocities, while executing simple harmonic motion. The ratio of their amplitudes will be (masses are equal in both cases)
   a. \( \frac{k_1}{k_2} \)  
   b. \( \frac{k_2}{k_1} \)  
   c. \( \frac{k_1^{1/2}}{k_2^{1/2}} \)  
   d. \( \frac{k_2^{1/2}}{k_1^{1/2}} \)

43. If bullet of mass \( m \) and velocity \( v \) is fired into a large block of mass \( M \). The final velocity of the system
   a. \( \frac{Mv}{M+m} \)  
   b. \( \frac{mv}{M+m} \)  
   c. \( \frac{m}{M}v \)  
   d. \( \frac{M}{m}v \)

44. A plane transparent glass slab is placed over various coloured letters, the letter which appears to be raised the least is
   a. green  
   b. indigo  
   c. violet  
   d. red

45. Two rain drops reach the earth with different terminal velocities having ratio 9:4 then the ratio of their volume is
   a. 3:2  
   b. 4:9  
   c. 9:4  
   d. 27:8

PART B CHEMISTRY

46. The most acidic species among the following one is
   a.  
   b.  
   c.  
   d. 

47. Which of the following has linear geometry?
   a. \( \text{I}_3 \)  
   b. \( \text{I}_2 \)  
   c. \( \text{H}_2\text{O} \)  
   d. \( \text{SO}_2 \)

48. If the mass of electron is \( 9.11 \times 10^{-31} \) kg, Planck’s constant is \( 6.626 \times 10^{-34} \) J-s and uncertainty in position is 0.1 Å, then uncertainty in velocity is
   a. \( 5.79 \times 10^6 \) m/s  
   b. \( 5.79 \times 10^5 \) m/s  
   c. \( 5.79 \times 10^6 \) m/s  
   d. \( 5.79 \times 10^7 \) m/s

49. An electron, a proton and an alpha particle have KE of 16 E, 4E and E respectively. What is the qualitative order of their de-Broglie wavelengths?
   a. \( \lambda_\text{e} < \lambda_\text{p} < \lambda_\alpha \)  
   b. \( \lambda_\text{p} = \lambda_\alpha > \lambda_\text{e} \)  
   c. \( \lambda_\text{p} < \lambda_\text{e} < \lambda_\alpha \)  
   d. \( \lambda_\alpha < \lambda_\text{e} = \lambda_\text{p} \)

50. Which of the following is not paramagnetic?
   a. \( \text{O}_2^2^- \)  
   b. \( \text{B}_2 \)  
   c. \( \text{N}_2^+ \)  
   d. \( \text{O}_2 \)
51. Normality and molarity changes with temperature because they involve volumes. The normality of 0.3 M phosphoric acid, $H_3PO_4$ is
   a. 0.9  
   b. 0.1  
   c. 0.3  
   d. 0.6
52. In a compound, atoms of element $Y$ form CCP lattice and those of element $X$ occupy $2/3^{rd}$ of tetrahedral voids. The formula of compound will be
   a. $X_2P_2$  
   b. $X_4Y_3$  
   c. $X_2Y_3$  
   d. $X_2Y$
53. The solution which maintains its pH constant even upon addition of small amounts of acid or base, is called buffer solution. Which can act as a buffer?
   a. $NH_4Cl + NH_4OH$  
   b. $CH_3COOH + CH_3COONa$  
   c. 40 mL of 0.1 M NaCN + 20 mL of 0.1 M HCN  
   d. All of the above
54. Which of the following reaction is not a redox reaction?
   a. $\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2$  
   b. $\text{Na} + \text{H}_2\text{O} \longrightarrow \text{NaOH} + \frac{1}{2}\text{H}_2$  
   c. $\text{MnCl}_3 \longrightarrow \text{MnCl}_2 + \frac{1}{2}\text{Cl}_2$  
   d. $\text{O}_2 + 2\text{H}_2 \longrightarrow 2\text{H}_2\text{O}$
55. Which of the following has maximum number of unpaired electrons?
   a. $\text{Mg}^{2+}$  
   b. $\text{Ti}^{3+}$  
   c. $\text{Fe}^{3+}$  
   d. $\text{Cu}^{2+}$
56. During electrophilic substitution reaction of fullerene, the hybridisation of carbon atom
   a. remains $sp^2$ in reactant as well as product  
   b. changes from $sp^2$ to $sp^3$  
   c. changes from $sp^3$ to $sp^2$  
   d. cannot be determined
57. Solids are attracted by magnetic field due to the presence of atoms, ions or molecules with unpaired electron, called paramagnetic. Which among the following is paramagnetic?
   a. $\text{Cl}_2\text{O}_7$  
   b. $\text{Cl}_2\text{O}$  
   c. $\text{ClO}_2$  
   d. $\text{Cl}_2\text{O}_5$
58. Count the total number of $\text{S—O}$ bonds, which are having equal length in bisulphate ion?
   a. 3  
   b. 4  
   c. 5  
   d. 6
59. Which of the following statement(s) is/are incorrect about aspirin?
   A. Aspirin is analgesic  
   B. Aspirin is antipyretic  
   C. Aspirin is tranquilizer  
   D. Aspirin doesn’t belong to narcotic analgesic  
   Choose the correct code out of the following.
   a. Only A  
   b. C and D  
   c. A and C  
   d. B and D
60. What will be the product when phenol is treated with $\text{CO}_2$ at 140-200°C?
   a. $o$ and $p$-salicylic acid  
   b. $m$ and $p$-salicylic acid  
   c. $o$ and $m$-salicylic acid  
   d. Benzoic acid

Space for Rough Work
61. Which of the following compound produces acetaldehyde on ozonolysis followed by acidic hydrolysis?

A. \( \text{CH}_3-\text{C} \equiv \text{CH}_2 \)   
B. \( \text{CH}_3-\text{C} \equiv \text{C}-\text{CH}_3 \)  
C. \( \text{CH}_3\text{CH}_2\text{CH} \equiv \text{CH}_2 \)  
D. \( \text{CH}_3-\text{C} \equiv \text{C}-\text{CH}_3 \) 

Choose the correct choice out of the following.

a. A and C  

b. A and B  

c. A, B and C  

d. Only A 

62. What is the intermediate involved in Reimer Tiemann reaction?

a. Carbocation  

b. Carbanion  

c. Carbene  

d. None of these 

63. What will be the product of the following reaction?

\[
\begin{align*}
\text{H} & \quad \text{O} \\
\text{O} & \quad \text{H} \\
\text{CH} \text{MgBr (excess)} & \quad \text{H}_2\text{O}^+ \\
\text{H} \quad \text{O} \\
\end{align*}
\]

a. Propanol  

b. Propanal  

c. Acetaldehyde  

d. None of these 

64. What will be the product if product (B) obtained in following reaction undergo oxidation?

\[
\text{CH}_3\text{Cl} \quad \text{AlCl}_3 \quad (B) \\
\text{AlCl}_3 \\
\]

a. Benzyl alcohol  

b. Benzoic acid  

c. Toluene  

d. None of these 

65. Cyclohexanone on reaction with OH\(^-\) produces.

a.  

b.  

c.  

d. 

66. Maximum oxidation state exhibited by Mn and its magnetic moment in +2 oxidation state will be

a. +2, 5.92 BM  

b. +7, 4.83 BM  

c. +6, 3.87 BM  

d. +7, 5.92 BM 

67. Purification of blood can be done by

a. dialysis  

b. filtration  

c. electrodialysis  

d. coagulation 

68. The oxidation state of Ni in tetracarbonylnickel is

a. +1  

b. +2  

c. 0  

d. +4 

69. The effective atomic number of cobalt in \([\text{Co(NH}_3)_3\text{H}_2\text{O}]^{3+}\) is

a. 36  

b. 33  

c. 24  

d. 30 

70. Which of the amino acid contain aromatic side chain?

a. Histidine  

b. Leucine  

c. Glycine  

d. Valine 

71. Head-to-tail addition takes place in chain growth polymerisation when monomer is

a. \( \text{CH}_2==\text{CH} \)  

b. \( \text{CH}_2==\text{CH}-\text{CH}==\text{CH}_2 \)  

c. \( \text{CH}_2--\text{CH}==\text{OCH}_3 \)  

d. \( \text{CH}_2==\text{CH}==\text{C}==\text{N} \)
72. Histamine is an organic nitrogenous compound involved in local immune response as well as regulating physiological function in the gut and acting as a neurotransmitter. The drug \[ \text{CH}_2\text{CH}_2\text{NH}_2 \] is used as

a. Vasodilator
b. Analgesics
c. Antacid
d. Antiseptic

73. What is the empirical formula of a compound having 40% carbon, 6.66% hydrogen and 53.34% oxygen?

a. \( \text{C}_2\text{H}_2\text{O} \)
b. \( \text{C}_2\text{H}_2\text{O} \)
c. \( \text{CH}_2\text{O} \)
d. \( \text{CHO} \)

74. Saturated solution of \( \text{KNO}_3 \) is used to make ‘salt bridge’ because

a. velocities of both \( \text{K}^+ \) and \( \text{NO}_3^- \) are nearly the same
b. velocity of \( \text{K}^+ \) is greater than that of \( \text{NO}_3^- \)
c. velocity of \( \text{NO}_3^- \) is greater than that of \( \text{K}^+ \)
d. \( \text{KNO}_3 \) is highly soluble in water

75. Molality of aqueous solution of 8.0 M ethanol having density 1.025 g/mL is

a. 12.17
b. 24.34
c. 10.17
d. 14.35

76. Haemoglobin is the iron containing oxygen transport metalloprotein in the red blood cells of all vertebrates as well as the tissue of some invertebrates. The correct statement in respect of protein haemoglobin is that it

a. acts as an oxygen carrier in the blood.
b. forms antibodies and offers resistance to diseased.
c. functions as a catalyst for biological reactions.
d. maintains blood sugar level.

77. Which of the following is used as an antifreeze in cars for cooling the engine?

a. 10% (V/V) ethanol solution in water
b. 35% (V/V) solution of ethylene glycol
c. 45% (V/V) solution of ethylene glycol
b. 20% (V/V) ethanol solution in water

78. Which of the following has strongest hydrogen bonding?

a. \( \text{O—H} \cdots \text{N} \)
b. \( \text{F—H} \cdots \text{F} \)
c. \( \text{O—H} \cdots \text{O} \)
d. \( \text{O—H} \cdots \text{F} \)

79. The unit of 1st and zero order reaction in term of molarity are respectively

a. \( \text{s}^{-1}, \text{M} \)
b. \( \text{s}^{-1}, \text{M} \)
c. \( \text{Ms}^{-1} \)
d. \( \text{M}, \text{s}^{-1} \)

80. Carbocations are stabilized by three main structural factors. Such factors are neighboring carbon atoms, neighboring carbon-carbon multiple bonds and neighboring atoms with lone pairs. Most stable among the following carboxations is

a. \bBox{B} \bBox{C}
b. \( \text{C}_2\text{H}_5—\text{CH}_3 \)
c. \( \text{C}_2\text{H}_5—\text{CH}_3 \)
d. \( \text{CH}_3—\text{CH}—\text{CH}_3 \)

81. Borax, disodium tetraborate is an important boron compound, a mineral, and a salt of boric acid. The number of terminal \( \text{B} —\text{OH} \) present in borax is

a. 3
b. 4
c. 5
d. 6
82. The most reactive substrate towards $S_N2$ reaction among the following is
   a. \[
   \begin{array}{c}
   \text{Cl} \\
   \end{array}
   \]
   b. \[
   \begin{array}{c}
   \text{Cl} \\
   \end{array}
   \]
   c. \[
   \begin{array}{c}
   \text{Cl} \\
   \end{array}
   \]
   d. \[
   \begin{array}{c}
   \text{Cl} \\
   \end{array}
   \]

83. Which of the following pair of solution is expected to show isotonic at same temperature?
   a. 0.2 M urea and 0.2 M KCl
   b. 0.1 M urea and 0.2 M CaCl$_2$
   c. 0.1 M KCl and 0.1 M Na$_2$SO$_4$
   d. 0.1 M Ca(NO$_3$)$_2$ and 0.1 M Na$_2$SO$_4$

84. Solubility of CaCl$_2$ in term of solubility product ($K_{sp}$) can be given as
   a. \[K_{sp}^{1/3}\]
   b. \[\frac{K_{sp}^{1/2}}{2}\]
   c. \[\frac{K_{sp}}{4}\]
   d. \[\frac{K_{sp}^{1/2}}{2}\]

85. Molarity of a solution obtained by mixing 800 mL 0.6 M HCl with 200 mL 1 M HCl will be
   a. 0.4 M
   b. 1.6 M
   c. 0.68 M
   d. 1.68 M

86. Product of the following reaction will be
   \[
   \begin{array}{c} \\
   \text{Cl} \\
   \end{array} + \text{HCl} \rightarrow \text{?} \\
   \begin{array}{c} \\
   \text{Cl} \\
   \end{array}
   \]
   a. \[
   \begin{array}{c}
   \text{Cl} \\
   \end{array}
   \]
   b. \[
   \begin{array}{c}
   \text{Cl} \\
   \end{array}
   \]
   c. \[
   \begin{array}{c}
   \text{Cl} \\
   \end{array}
   \]
   d. \[
   \begin{array}{c}
   \text{Cl} \\
   \end{array}
   \]

87. For a reversible reaction
   \[
   \text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}
   \]
   Activation energy of the backward reaction is lower than that of forward reaction. The slope of $k$ versus $1/T$ graph will be
   a. zero
   b. \[-\frac{H}{2.303 R}\]
   c. \[\frac{H}{2.303 R}\]
   d. \[-\frac{\Delta H}{R}\]

88. pH of 0.5 M aqueous solution of HF ($K_a = 2 \times 10^{-4}$) is
   a. 2
   b. 4
   c. 6
   d. 10

89. Insulin production and its action in human body are responsible for the level of diabetes. This compound belongs to which of the following categories?
   a. A co-enzyme
   b. A hormone
   c. An enzyme
   d. An antibiotic

90. The reaction rate for a reactant or product in a particular reaction is intuitively defined as how fast or slow a reaction takes place. Effect of temperature on reaction rate is given by
   a. Claisen-Clapeyron equation
   b. Arrhenius equation
   c. Gibbs-Helmholtz equation
   d. Kirchhoff’s equation
PART C  BIOLOGY

91. What is not correct about Darwinism?
   a. Struggle for existence
   b. Within each species, there are variations
   c. Over production
   d. Inheritance of variations to offsprings

92. Which of the chemical used in bonding technique?
   a. Shift’s reagent
   b. Giemsa
   c. Quinacrine mustard
   d. Tritiated thymidine

93. Match the following columns.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Isoalleles</td>
<td>1. Rare crossing over</td>
</tr>
<tr>
<td>B. Pseudoalleles</td>
<td>2. $i^A_1$ and $i^A_2$</td>
</tr>
<tr>
<td>C. Inhibitor gene</td>
<td>3. Epistatic gene</td>
</tr>
</tbody>
</table>

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

94. Which of the following shape graph is obtained by exponential growth?
   a. S-shaped
   b. J-shaped
   c. Straight line
   d. Parallel line

95. Categorised the following diseases as endotoxic and exotoxic?
   I. Food poisoning
   II. Bubonic plague
   III. Dysentery
   IV. Tetanus
   a. I-Endotoxic, II-Exotoxic, III-Endotoxic, IV-Exotoxic
   b. I-Exotoxic, II-Exotoxic, III-Endotoxic, IV-Endotoxic
   c. I-Exotoxic, II-Endotoxic, III-Endotoxic, IV-Exotoxic
   d. I-Exotoxic, II-Endotoxic, III-Endotoxic, IV-Endotoxic

96. Two or more species which are inhabiting the same or overlapping areas are known as
   a. sympatric species
   b. allopatric species
   c. sibling species
   d. neopatric species

97. Which of the following is a heterocrine gland?
   I. Pancrease
   II. Gonads
   III. Gastric gland
   IV. Parathyroid
   a. I, II, III and IV
   b. I and II only
   c. I, II and III
   d. I and IV
98. Which one of the following option is correct about the active transport?
   a. Active transport releases energy
   b. Active transport requires energy
   c. Active transport produces ATP
   d. Active transport produces a toxic substance

99. Suppose evolution on earth had occurred in such a way that there are 96 amino acids instead of 20. DNA has 12 different types of bases and DNA synthesis occurs in the same way as today. The minimum number of bases per DNA codon would be
   a. 12
   b. 2
   c. 8
   d. 3

100. Which phytohormone has vital inhibitory property with respect to seed germination?
   a. IAA
   b. GA₃
   c. ABA
   d. 2,4-D

101. Pick out the wrong statement.
   a. In polygonum type of ovule, the functional haploid megaspore enlarge in size and by means of three successive mitotic divisions, gives rise to an eight-nucleate embryo sac.
   b. Sporopollenin makes the exine of spores and pollen grains of plants providing resistance to biodegradation.
   c. Pollen kit material is secreted by tapetum
   d. Occurance of more than four spores from a spore mother cell is called polyspor.

102. In the given diagram, parts labelled as A, B, C, D, E and F are respectively identified as

![Diagram with labels A, B, C, D, E, F]

   a. Polar nuclei Egg Antipodals Filiform apparatus Central cell Synergids
   b. Synergids Filiform apparatus Egg Central cell Polar nuclei Antipodals
   c. Antipodals Polar nuclei Central cell Egg Synergids Filiform apparatus
   d. Polar nuclei Central cell Egg Antipodal Filiform apparatus Synergids

103. Which of the following is supposed to be the most direct evidence of organic evolution?
   a. vestigial organ
   b. embryos
   c. fossils
   d. morphology
104. Match the scientists and their contribution to evolution.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Charles Darwin</td>
<td>1. Mutation theory</td>
</tr>
<tr>
<td>B. Lamarck</td>
<td>2. Germ plasm theory</td>
</tr>
<tr>
<td>C. Hugo de Vries</td>
<td>3. Origin of species</td>
</tr>
<tr>
<td>D. Ernst Haeckel</td>
<td>4. Philosophie zoologique</td>
</tr>
<tr>
<td></td>
<td>5. Biogenetic law</td>
</tr>
</tbody>
</table>

Codes
- A B C D
- a. 1 2 3 4
- b. 3 4 1 5
- c. 5 1 2 3
- d. 2 3 4 5

105. Which of the following is true regarding ABO blood group?
- a. co-dominance  
- b. incomplete dominance
- c. epistasis     
- d. multiple alleles

106. Antibody is produced by antigenic interaction of which of the cells or organ?
- a. spleen       
- b. monocytes     
- c. lymphocytes   
- d. leucocytes

107. In angiosperms, functional megaspore develops as a result of free nuclear division into
- a. embryo sac    
- b. ovule         
- c. endosperm     
- d. zygote

108. The major role of minor elements inside living organisms is to act as
- a. constituents of hormones 
- b. binder of cell structure
- c. cofactors of enzymes    
- d. building blocks of important amino acids

109. An unfair claim to novelty and invention come under
- a. economic piracy    
- b. resource piracy    
- c. intellectual piracy 
- d. theft

110. A protoxin is
- a. lipid          
- b. intracellular lipid
- c. extracellular crystalline protein
- d. a primitive toxin

111. The Wildlife Protection Act was enacted in
- a. 1980   
- b. 1972   
- c. 1969   
- d. 1981

112. Genetically Modified Organisms (GMO) are developed by rDNA Technology and genetic engineering. They are useful
- a. enhancing food nutritional value
- b. reduction in the post-harvest losses
- c. increasing the tolerance power of crops against the abiotic stresses
- d. All of the above

113. ADA : Adenosine deaminase enzyme does not function. It occurs as a result of
- a. hormonal defect   
- b. genetic defect    
- c. hereditary defect  
- d. None of these

114. Which of the following bond is formed during the condensation of monosaccharides?
- a. Covalent bond     
- b. Glycosidic bond   
- c. Peptide bond      
- d. Ionic bond
115. Match the following columns.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Rabbit</td>
<td>1. <em>Panthera tigris</em></td>
</tr>
<tr>
<td>B. Tiger</td>
<td>2. <em>Platianista</em></td>
</tr>
<tr>
<td>C. Ganges Dolphin</td>
<td>3. <em>Oryctolagus</em></td>
</tr>
<tr>
<td>D. Dog</td>
<td>4. <em>Canis lupus familiaris</em></td>
</tr>
</tbody>
</table>

Codes

\[
\begin{array}{cccc}
A & B & C & D \\
\hline
a. 1 & 3 & 2 & 4 \\
\hline
b. 1 & 4 & 3 & 2 \\
\hline
c. 3 & 2 & 4 & 1 \\
\hline
d. 2 & 1 & 4 & 3 \\
\end{array}
\]

116. Provirus differs from prophage in
   a. integration of copy DNA of a retrovirus with host chromosome (DNA)
   b. integration of RNA with host DNA
   c. integration of genetic DNA with host DNA
   d. All of the above

117. At what age group, measles vaccines should be given to a children?
   a. During pregnancy
   b. 16 years
   c. 5-6 years
   d. 9-15 months

118. There are two portal system in body. One of them Hypophysial portal system is found in
   a. brain
   b. kidney
   c. liver
   d. heart

119. Identify wheather the given statements are the characteristic of cleavage or typical mitosis.
   I. DNA synthesis occurs at the normal rate.
   II. Nuclear/cytoplasmic ratio increases as cleavage progresses.
   III. Size of daughter cells decreases.
   IV. Interphase is long
   a. Cleavage – I, II
   Typical mitosis – III, IV
   b. Cleavage – I
   Typical mitosis – II, III, IV
   c. Cleavage – II
   Typical mitosis – I, III, IV
   d. Cleavage – II, III
   Typical mitosis – I, IV

120. Addiction of LSD leads to
   a. hallucination
   b. damage to kidney
   c. mental and emotional disturbance
   d. damage to lungs

121. In frog, the pharynx communicates with tympanic cavity ventrally through
   a. semi-circular canal
   b. Bidder’s canal
   c. Eustachian tube
   d. horizontal canal

122. Which one of the statement is not correct?
   a. The rate of absorption of water is almost directly proportional to the rate of transpiration.
   b. Soil temperature, soil aeration, relative humidity, amount of soil water and transpiration are factors affect the absorption.
   c. Water is removed in the form of vapours during transpiration.
   d. If the atmosphere is humid, it increases the rate of transpiration.
123. Cystic fibrosis is caused due to
   a. recessive sex-linked gene on X-chromosome
   b. recessive autosomal gene on chromosome 7
   c. dominant sex-linked gene on X-chromosome
   d. dominant autosomal gene on chromosome 11

124. Identify the state of glandular tissue of mammary glands during the following conditions.
   I. Non-pregnant woman
   II. Pregnant woman
   III. On the infant’s birth
   IV. After menopause
   a. I–Atrophy
   II–Influence of oxytocin
   III–Scanty
   IV–Influence of oestrogen
   b. I–Influence of oestrogen
   II–Scanty
   III–Influence of prolactin and oxytocin
   IV–Atrophy
   c. I–Scanty
   II–Influence of oestrogen and progesterone
   III–Influence of prolactin
   IV–Atrophy
   d. I–Influence of progesterone
   II–Influence of prolactin
   III–Influence of oxytocin
   IV–Atrophy

125. Cholesterol and phospholipids concentration is highest in
   a. striated muscle
   b. involuntary muscle
   c. cardiac muscle
   d. smooth muscle

126. Consider the following statements.
   I. Green muffler scheme involves the growing green plants along roadside to reduce air pollution.
   II. Delhi became the first city of the world to use CNG for its public transport system and autorickshaws by the end of 2002.
   III. In India, the Air (Prevention and Control of Pollution) Act came into force in 1981 but was amended in 1987 to include noise as an air pollutant.

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

127. Motor nerve arising from the floor of midbrain is
   a. hypoglossal
   b. abducens
   c. pathetic
   d. ophthalmic

128. Match the following columns.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Iron bacteria</td>
<td>Carboxydomonas, Bacillus oligocarbophilus</td>
</tr>
<tr>
<td>B. Hydrogen bacteria</td>
<td>Beggiatoa, Thiothrix</td>
</tr>
<tr>
<td>C. Sulphur bacteria</td>
<td>Bacillus pentotrophs</td>
</tr>
<tr>
<td>D. Carbon bacteria</td>
<td>Leptothrix and Cladothrix</td>
</tr>
</tbody>
</table>

Codes
   A B C D
   a. 4 2 3 1
   b. 3 4 1 2
   c. 4 3 2 1
   d. 2 3 4 1
129. Consider the following statements.
   I. Perienth is the collective name of the non-essential floral organs if there is no distinction between sepals and petals.
   II. The term tepals is used to describe the perianth lobes, which appear like petals.
   III. The corolla of *Hibiscus* is polypetalous and twisted.
   IV. Ovary is superior perigynous flower.

Which of the statements given above are correct?
   a. I, II and III
   b. I, III and IV
   c. II, III and IV
   d. All of these

130. “Nothing in biology makes sense except in the light of evolution” who said this?
   a. Hugo de Vries
   b. Charles Darwin
   c. Jean Baptiste de Lamarck
   d. Theodosius Dobzhansky

131. Which system or the body grants a patent?
   a. Local body
   b. State government
   c. Central government
   d. Legal system

132. AIDS symptom appear because it causes
   a. autoimmunity
   b. reduction in number of killer T-cells
   c. reduction in number of helper T-cells
   d. non-production of interferons

133. Protein coat of a virus enclosing nucleic acid is known as
   a. genome
   b. vector
   c. plasmid
   d. capsid

134. Morphan’s syndrome is caused by
   a. epistatic genes
   b. codominant genes
   c. pleiotropic genes
   d. polymeric genes

135. Restriction enzyme cuts DNA at palindromic base sequences which happens to be
   a. TATAGC
   b. AAGTTC
   c. GTATATC
   d. GAATTC

136. Tetany results due to the deficiency of
   a. insulin
   b. epinephrine
   c. parathyroid hormone
   d. thyroxine

137. Which one of the statement given below is not correct?
   a. Sulphur is constituent of certain amino acid. The amino acid form the protein by polymerisation.
   b. A regular supply of nitrogen to the plants is maintained through nitrogen cycle.
   c. Biological nitrogen fixation is the second most important natural process and the major source of nitrogen fixation, which is performed by two types of prokaryotes; bacteria and cyanobacteria.
   d. Incorporation of nitrogen into amino acid is called ammonification.

138. Match the following columns.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Miscarriage</td>
<td>1. Premature degeneration of corpus luteum</td>
</tr>
<tr>
<td>B. Pregnancy test</td>
<td>2. Animal pole</td>
</tr>
<tr>
<td>C. Luteal phase</td>
<td>3. Progesterone secretion</td>
</tr>
<tr>
<td>D. Polar bodies</td>
<td>4. hCG</td>
</tr>
</tbody>
</table>
139. How many bones are fused to become the total count of 206?
   a. 270
   b. 250
   c. 350
   d. 370

140. Which of the following is incorrect about grasslands?
   a. Pampas – South America
   b. Velds – South Africa
   c. Downs – USA
   d. Prairies – Canada

141. PCR uses which of the following?
   a. Primase
   b. RNA polymerase
   c. Taq polymerase
   d. Ligase

142. Thermocycler is used in
   a. micropropagation
   b. hybridisation
   c. PCR
   d. fermentation

143. The infective stage of Plasmodium is found in insect vector is
   a. trophozoite stage
   b. amoeboid stage
   c. ookinetic stage
   d. sporozoite stage

144. Pick out the wrong statement.
   a. Double fertilisation is unique to gymnosperms and monocotyledons.
   b. Egg apparatus of angiosperms consist of two synergids and one egg cell.
   c. In porogamy, pollen tube enters the ovule through the micropyle.
   d. The ovule attached to the placenta of ovary wall by funicle.

145. Number of nephrons in a kidney is equal to
   a. the number of Bowman’s capsule
   b. sum of Bowman’s capsule and Malpighian capsules
   c. sum of Bowman’s capsule and glomeruli
   d. double the number of Bowman’s capsule

146. In which of the following germination will be maximum?
   R = Red light 660 m\(\mu\)
   Fr = Far light 730 m\(\mu\)
   a. Seeds + R + Fr + R + Fr
   b. Seeds + R + Fr
   c. Seeds + R + Fr + R
   d. Seeds + R

147. Shikimic acid can be made from
   a. xylulose
   b. erythrose -4- phosphate
   c. ribulose
   d. None of these

148. Consider the following statements and choose the correct option given below.
   I Nepenthes khasiana is a green plant but shows heterotrophic nature for nitrogen supply, therefore, is called as carnivorous.
   II Frankia is symbiont in root nodules of several legume plants like Pisum sativum.
   a. Statement I is correct, II is incorrect.
   b. Statement I is incorrect, II is correct.
   c. Both are correct
   d. Both are incorrect
149. Morphogenesis is controlled by
   a. gibberellin and cytokinin    b. auxin and cytokinin
   c. auxin and gibberellin       d. gibberellin and zeatin

150. Match the item in column I with column II and choose the correct alternatives.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Pneumatophores</td>
<td>1.</td>
</tr>
<tr>
<td>B. Haustoria</td>
<td>2.</td>
</tr>
<tr>
<td>C. Prop roots</td>
<td>3.</td>
</tr>
<tr>
<td>D. Tubercular storage roots</td>
<td>4. Screw pine</td>
</tr>
</tbody>
</table>

Codes
A  B  C  D
a. 2  4  1  3
b. 2  3  4  1
c. 4  1  2  3
d. 3  2  4  1

151. Which one of the following is not correct?
   a. In case of malic acid, amount of CO$_2$ released is more than O$_2$ consumed and thus value of RQ is more than 1.
   b. Cork cells are dead cells and hence do not respire.
   c. In glycolysis, 4 ATP molecules are produced and two are used, hence net gain of ATP is two through direct synthesis.
   d. Photorespiration is a useful phenomenon.

152. Active uptake of minerals by roots mainly depends on the
   a. light    b. temperature    c. humidity    d. availability of oxygen

153. Dentist’s nerve is
   a. VII$^{th}$ cranial nerve    b. if$^{th}$ cranial nerve
   c. X$^{th}$ cranial nerve      d. V$^{th}$ cranial nerve

154. Glucose phosphates formed in photosynthesis are Asymmetrically labelled it is called
   a. Warburg’s effect
   b. Pasteur’s effect
   c. Dicken’s effect
   d. Gibb’s effect

155. Which of the following characteristic does not occur in *Pinus*?
   a. Pollen grains are produced in such a large number as to form yellowish cloud.
   b. Each vascular bundle in the long shoot of *Pinus* consists of xylem facing towards the centre of the shoot.
   c. *Pinus* is a homosporous gymnosperm.
   d. Microsporophyll of *Pinus* bears two oblong microsporangia abaxially on the proximal part.

156. Which of the following is associated with C$_2$-cycle?
   a. Respiration
   b. Photorespiration
   c. Dark reaction of photosynthesis
   d. Conversion of fat into sugar

157. The original ration 9:3:3:1 ratio become modified into what ratio in dominant epistasis?
   a. 9:3:4    b. 12:3:1    c. 13:3    d. 9:7

158. Which among the following is largest chromosome?
   a. X-chromosome
   b. Polytene chromosome
   c. Supernumery chromosome
   d. Lampbrush chromosome
159. Debove’s membrane is a layer of
   a. epithelial tissue    b. connective tissue
   c. muscular tissue    d. All of these

160. Epiphytes like vanda develop special layer of absorptive tissue velamen consisting of 4 or 5 layers of long polygonal cells. Velamen takes part in
   a. absorption of water from soil    b. absorption of moisture from air
   c. exchange of gases    d. transpiration

161. Which of the following are subunit of 80S ribosome?
   a. 60S and 20S    b. 50S and 40S
   c. 60S and 40S    d. 60S and 50S

162. Which of the following is the basis of biological concept of species?
   a. Morphological feature    b. Method of reproduction
   c. Morphology and method of reproduction    d. Reproductive isolation

163. Little’s leaf disease of brinjal takes place due to which one of the following reason?
   a. Copper    b. Molybdenum    c. Manganese    d. MLO

164. First reaction in photosynthesis is
   a. photolysis of water    b. formation of NADPH₂
   c. formation of ATP    d. excitation of chlorophyll molecule

165. Silent valley National Park is located in
   a. Himalayas    b. Kerala
   c. Nilgiri Hills    d. Tamil Nadu

166. Select the correct statements.
   I. Pneumatophores are seen in Rhizophora.
   II. Adventitious aerial roots are seen in banyan tree.
   III. In tridax the stem is decumbent.
   IV. If the stem is jointed with solid nodes and hollow internodes, it is called caudex.
   V. Maize and sugarcane have prop roots.
   a. I, II and III    b. I, III and IV    c. II, IV and V    d. II, IV and III

167. Abnormal development of spinal cord is
   a. myelodysplasia    b. tabes dorsalis
   c. syringomyelia    d. neuritis

168. Which of the following show molecular homology?
   a. Proteins in humans blood and blood of insects
   b. Mouth parts of cockroach, honeybee, mosquito
   c. Proteins in blood of man and ape
   d. Fats in body of man and monkey

169. During the DNA replication, the term leading strand is applied to which of the following strand.
   a. strand replicating in 3’ → 5’ direction continuously
   b. strand replicating in 3’ → 5’ direction discontinuously
   c. strand replicating in 5’ → 3’ direction discontinuously
   d. strand replicating in 5’ → 3’ direction continuously
170. Vegetative propagation in mint and *Chrysanthemum* occurs by
   a. rhizome  b. sucker  c. runner  d. stolen

171. Super Bug — a biotechnological achievement is useful in
   a. treatment of cancer  b. espionage  
   c. biodegradation  d. bioremediation of oil spills

172. Which of the following is not an example of secondary structure of protein?
   a. Fibroin of silk  b. Ribonuclease  c. Haemoglobin  d. Hair keratin

173. Which of the following component of blood does not enter into the nephron?

174. Which among the following is ‘prinbow box’?
   a. 5’ TAATTAG’3  b. 3’ TAATTAG’5
   c. 5’ TATATTAG 3’  d. 5’ TATAATG 3’

175. Which of the following is correctly matched?
   a. Wings of honeybee and crow – Homologous
   b. Thorn of *Bougainvillea* and tendrils of *Cucurbita* – Analogous
   c. Nephridia of earthworm and malpighean tubules of cockroach – Excretory
   d. Nictitating membrane and blindspot in human eye – Vestigial

176. Which one of the following was observed for the first time by Trenb?
   a. Entry of pollen tube into the ovule through the micropyle in *Casuarina*.
   b. Entry of pollen tube into ovule through the chalaza in *Casuarina*.
   c. Entry of pollen tube into the ovule through the integuments in *Hibiscus*.
   d. Entry of pollen tube into the ovule through the chalaza in *Hibiscus*.

177. Vector is transmitting agent & organism of a disease. In case of filariasis, it is spread by
   a. sandfly  b. tse-tse fly  c. rat flea  d. Culex

178. Scientific name of Java men is
   a. *Homo rhodesiensis*  b. *Homo erectus*
   c. *Pithecanthropus erectus*  d. *Sinanthropus pekinensis*

179. Phylloclade is photosynthetic, succulent specialized plant part found in
   a. Asparagus  b. *Opuntia*  
   c. Lilium  d. *Euphorbia*

180. Eye of the molluscan group that resembles vertebrate eyes are
   a. pelecypoda  b. scaphopoda  
   c. cephalopoda  d. gastropoda
1. (b) When the diode will be forward biased, then they will conduct. In positive half-cycle, diode $D_1$ will be forward biased and it will conduct. In negative half-cycle, diode $D_1$ will be reverse biased and it will be off. But during the negative half-cycle, the diode $D_2$ will conduct. Hence, the junction diode $D_2$ will provide output only when it will be forward biased. This is the case for negative half-cycles at B, D and F.

2. (c) As,
$$\lambda = \frac{h}{mv}$$
and
$$K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$$
$$\Rightarrow \lambda = \frac{h}{\sqrt{2mK}}$$
So, graph between $\lambda$ vs $\sqrt{K}$ will be rectangular hyperbola.
and $\lambda$ vs $\frac{1}{\sqrt{K}}$ will be straight line.

3. (c) Given $L = 5$ mH = $5 \times 10^{-3}$ H
$$\frac{di}{dt} = 10^3$ \text{ A/s}$
$$R = 1 \Omega$

To find The potential difference $V_B - V_A$

Solution Voltage across inductance
$$V = L \frac{di}{dt} = (5 \times 10^{-3}) (10^3) = 5 $V$

Now, $V_A - (5 \times 1 + 15 + 5 = V_B$
or $V_B - V_A = 15 $V$

4. (d) If one of the slit in Young’s double slit experiment is covered with a black opaque paper, then we will obtain a single slit diffraction pattern on the screen.

5. (b) $T_{v/2} = 20$ days
$$N = N_0 = \frac{3}{4} N_0 = \frac{N_0}{4}$$
$$N = N_0 \left( \frac{1}{2} \right)^n \Rightarrow \frac{1}{4} = \left( \frac{1}{2} \right)^n \Rightarrow n = 2$$
∴ Time taken = 2 half-lives = $2 \times 20 = 40$ day

6. (b) As two resistances are in parallel combination
So, the effective resistance $R' = \frac{10 \times 10}{10 + 10} = 5 \Omega$

Heat produced $= \frac{v^2}{R'} \times t = \frac{1^2}{5} \times 5 \times 60 J = 60 \frac{60}{4.2} \text{ cal} = 14.3 \text{ cal}$

7. (d) $C = \frac{\varepsilon_0 A}{d}$ and $C' = \frac{\varepsilon_0 A}{d - \frac{d}{4} \left( 1 - \frac{1}{K} \right)} = \frac{4 \varepsilon_0 A}{3d + \frac{d}{K}}$
$$\Rightarrow C' = \frac{4K}{(3K + 1) \left( \frac{\varepsilon_0 A}{d} \right)} = \frac{4KC}{(3K + 1)}$$
$$\Rightarrow \frac{C}{C'} = \frac{4K}{(3K + 1)}$$

8. (b) Velocity of body at time $t$ is given by
$$v = \frac{dx}{dt} = \frac{d}{dt} \left( t^2 \right) = 2t$$

Now, at $t = 0$ s, initial velocity $v_i = 0$
at $t = 4$ s, final velocity $v_f = 8$

Work done = Increase in KE
$$\frac{1}{2} mv_f^2 - \frac{1}{2} mv_i^2$$
$$= \frac{1}{2} m (v_f^2 - v_i^2)$$
$$= \frac{1}{2} \times 4 \times (8^2 - 0^2) = 128 \text{ J}$$

9. (a) As given a satellite is orbiting around the earth in a circular orbit of radius $R$ from centre of earth, then its period of revolution can be find out by considering its speed given as,
$$\text{Speed of satellite } v = \sqrt{\frac{GM}{R}}$$
∴ Its period of revolution is $= \frac{2\pi R}{v} = \frac{2\pi}{\sqrt{GM}} R^{3/2}$

10. (c) The moment of inertia of a circular loop about diameter is $= \frac{MR^2}{2}$ [$R$ is radius, $M$ is mass]
∴ Moment of inertia about $AB$ will be
$$I_{AB} = \frac{MR^2}{2} + \frac{MR^2}{2} = \frac{3}{2} MR^2$$
$$\Rightarrow I_{AB} = \frac{3}{2} MR^2$$

As linear mass density is $D$
∴ Mass of loop $M = LD$ ... (ii)
and length of wire is $L$.
∴ Radius of circular loop will be $R = \frac{L}{2\pi}$ ... (iii)

From Eqs. (i), (ii) and (iii), we get
$$I_{AB} = \frac{3}{2} (LD) \left( \frac{L}{2\pi} \right)^2 = \frac{3L^2D}{8\pi^2}$$
(b) \( (KE)_{\text{rotation}} = \frac{1}{2} I_k \omega^2 = \frac{1}{2} \left( \frac{2}{5} MR^2 \right) \omega^2 \)
\( = \frac{1}{5} MR^2 \omega^2 \)  
\( (KE)_{\text{translation}} = \frac{1}{2} MV^2 = \frac{1}{2} MR^2 \omega^2 \)
\( \therefore I = \frac{2}{5} MR^2 \)

(KE)_{\text{Total}} = \frac{7}{10} MR^2 \omega^2

\therefore \quad \frac{(KE)_{\text{rotation}}}{(KE)_{\text{Total}}} = \frac{2}{7}

12. (b) As elastic potential energy,
\[ U = \frac{1}{2} \times \text{stress} \times \text{strain} \times \text{volume} \]
\[ = \frac{1}{2} \times F \times \frac{\Delta l}{l} \times \frac{1}{2} F \Delta l \]
\[ = \frac{1}{2} \times 200 \times 10^{-3} = 0.1 \text{ J} \]

13. (a) \( V = iR \)  
\( EL = iR \)  
\( E = \frac{iR}{L} = \frac{\frac{\rho}{A}}{\frac{\rho}{A}} \)
\[ = \frac{E}{n} = \frac{A_e \rho}{A} \]
\[ \Rightarrow E = n \rho \text{ or } \rho = E \]
So, graph will be a straight line.

14. (d) The equivalent internal resistance of two cells between A and B \( r_{eq} = \frac{r_1 r_2}{r_1 + r_2} \)

(Parallel combination case of resistances)

If \( E \) is the equivalent emf of the two cells in parallel between A and B, then
\[ E_{eq} = \frac{E_1 + E_2}{r_1 + r_2} \]
\[ E_{eq} = \frac{E_1 + E_2}{r_1 + r_2} \]
\[ E_{eq} = \frac{E_1 r_2 + E_2 r_1}{(r_1 + r_2)} \]
\[ \therefore E_{eq} = E_1 r_2 + E_2 r_1 \]
As \( E_2 > E_1 \Rightarrow E_1 < E < E_2 \)

[For all values of \( r_1 \) and \( r_2 \)]

15. (c) Centre of mass of rod will lie at length \( \frac{l}{2} \)
\[ \therefore \text{Work done} = \text{change in potential energy} \]
\[ = \text{Final PE} - \text{Initial PE} \]
\[ = mg \left( \frac{l}{2} \right) - mg (0) = mg \frac{l}{2} \]

16. (a) As, magnification \( m = \frac{l}{l_e} \left( 1 + \frac{l}{l_e} \right) \)
So, \( m \propto \frac{l}{l_e} \)

\( \therefore \) In order to produce largest magnification the focal length of eye-piece should be small i.e., +15 cm lens is used.

17. (a) As, photoelectric current varies linearly with intensity of incident photon.
i.e., \( I \propto I_0 \) so, (a) is correct.

18. (a) Let \( T_n \) be the temperature at \( N \). The rate of flow of heat from \( O \) towards \( N \) is
\[ \frac{Q_1}{t} = \frac{KA (T_2 - T_n)}{L/2} \]
The rate of flow of heat from \( P \) towards \( N \)
\[ \frac{Q_2}{t} = \frac{KA (T_3 - T_n)}{L/2} \]
The rate of flow of heat from \( N \) towards \( M \)
\[ \frac{Q_3}{t} = \frac{KA (T_n - T_1)}{L} \]

In the steady state, (the rate at which heat enter at \( N \) = rate at which heat leaves \( N \))
\[ i.e., \quad \frac{Q_1}{t} + \frac{Q_2}{t} = \frac{Q_3}{t} \]
\[ 2KA (T_2 - T_n) + 2KA (T_3 - T_n) = KA (T_n - T_1) \]

or \( 2(T_2 - T_n) + 2(T_3 - T_n) = (T_n - T_1) \)

Which gives \( T_n = \frac{T_1 + 2T_2 + 2T_3}{5} \)
\[ = \frac{20 + 2 \times 20 + 2 \times 40}{5} = 32^\circ \text{C} \]

19. (b) Given Relative magnetic permeability = 50
Dielectric constant = 2

To find Wave impedance.

Solution The impedance is given as
\[ Z = \sqrt{\frac{\mu_r \mu_0}{\varepsilon_r \varepsilon_0}} = \sqrt{\frac{\mu_r}{\varepsilon_r}} \]
\[ = \sqrt{\frac{50}{2}} \times 376.6 \Omega = 1883 \Omega \]

20. (c) Angular momentum of earth around the sun
\[ L = \omega \times mR^2 \]
\[ \therefore L \propto R^2 \omega \]  
\( \therefore L \propto R^2 \)  
\[ \therefore T^2 \propto R^3 \]  
(Kepler’s law)
\[ \Rightarrow T \propto R^{3/2} \]
Now,
\[ \omega = \frac{2\pi}{T} \propto R^{-3/2} \]  
Now, putting the value of \( \omega \) from Eq. (ii) to (i)
\[ \therefore L \propto R^2 R^{-3/2} \]
\[ \Rightarrow L \propto R^{5/2} \]
21. (c) As, \( F \propto \frac{1}{B} \Rightarrow F = \frac{k}{B} \)

Now, work done \( W = \int_{x_1}^{x_2} F \cdot dB = \int_{x_1}^{x_2} k \ln \left( \frac{x_2}{x_1} \right) \).

22. (c) As, \( y(x, t) = a \sin(kx - \omega t) \)

Particle velocity \( \frac{dy}{dt} = -a \omega \cos(kx - \omega t) \)

Maximum particle velocity \( \frac{dy}{dt} \) \( \text{max} = \frac{a \omega}{k} \)

Wave velocity \( v = \frac{\omega}{k} \)

From Eqs. (i) and (ii), we get

\[
\frac{dy}{dt} \bigg|_{\text{max}} = \frac{a \omega}{k} \cdot \frac{a \omega}{k}
\]

23. (d) The density of mixture is

\[
\rho = \frac{m_A + m_B}{m_A + m_B} = \frac{(m_A + m_B)}{(m_A + m_B)}
\]

As, \( m_A = m_B = m \)

\[
\rho = \frac{2m}{m} = \frac{2}{1} = 2
\]

24. (b) As the charges are placed along the same straight line, the electric field at \( x = 0 \) will be directed along \( x \)-axis and its magnitude is given by

\[
E = \frac{1}{4\pi \varepsilon_0} \left[ \frac{q}{r^2} + \frac{q}{(r + \Delta)^2} + \frac{q}{(r + 2\Delta)^2} + \ldots \ldots \right]
\]

Squaring both sides

\[
x = t^2 + 4 - 4t
\]

26. (d) As, \( |e| = L \frac{dl}{dt} \)

\[
8 \times 10^{-3} = L \frac{d(4 + 4t)}{dt}
\]

\[
8 \times 10^{-3} = L (4)
\]

\[
L = 2 \times 10^{-3} \text{ H}
\]

27. (c) Pressure = \( \frac{F}{A} \)

\[
\rho = \frac{F}{A} = \frac{m \cdot a}{A}
\]

\[
= \left[ \frac{\text{ML}^{-2}}{\text{L}^2} \right] = \left[ \text{ML}^{-1} \text{T}^{-2} \right]
\]

\[
\therefore \quad a = 1, b = -1, c = -2
\]

28. (b) \( d_{\text{max}} = \sqrt{2} hR \)

\[
= \sqrt{2} \times 6.4 \times 10^6 \times 20
\]

\[
= 16 \times 10^3 \text{ m}
\]

29. (d) In this part the radii of curvature of two faces (convex and concave) of a lens are equal. \( i.e., R_1 = R_2 \)

So, the incident and emergent rays will be parallel.

30. (d) The electric field is always perpendicular to the surface of a conductor. On the surface of a metallic triangle line 4 represent the correct line.

31. (c) We can consider \( m_1 \) and \( m_2 \) as a combined system.

\[
F = m_1 a
\]

\[
F = m_2 a
\]

Minimum force \( F = f_s \)

\[
= \mu mg
\]

32. (c) When coil and magnet both move in the same direction with same velocity, so there will be no change in flux and due to this, no current will induce.

33. (c) The block of mass \( m \) will move over block of mass \( M \), if the force \( F \) applied to \( m \) exceeds the force of static friction \( f_s \) between the two blocks.

Minimum force \( F = f_s \)

\[
= \mu mg
\]
34. (c) p-n diode will be forward biased, if p end is connected to higher potential (i.e., +7 V) and n end is connected to lower potential. (i.e., +5 V)

35. (b) Force on the charged particle in magnetic field is

\[ F = q (v \times B) = qvB (-\hat{k}) \]

which is – z-axis

36. (d) Frequency remains constant on refraction or reflection.

As now, energy of a photon = \( hf \).

37. (a) According to question by force belong

\[ T(2\pi r) = \frac{h}{gA} \]

\[ \Rightarrow T(2\pi r) = \frac{h}{pg(\pi r^2)} \]

\[ h = \frac{2T}{gr^2} = \frac{2 \times (75 \times 10^{-3})}{10^2 \times 10 \times (0.5 \times 10^{-3})} = 0.03 \text{ m} \]

38. (d) Streamlines are a family of curves that are instantaneously tangent to the velocity vector of the flow. Hence, streamlines may be straight or curved and two streamlines do not intersect each other.

39. (d) α-particles are positively charged whereas β-particles are negatively charged. So by Fleming’s left hand rule which states that if we stretch the first finger, central finger and thumb of our right hand in mutually perpendicular directions then, first finger shows the direction of magnetic field, second finger shows the direction of current and thumb shows the movement of the wire hence, correct choice is (d).

40. (c) Given, \( \frac{h}{l_2} = \frac{100}{1} \), i.e., \( l_1 = 100k \), \( l_2 = k \)

(k is proportionality constant)

Intensity at maxima is

\[ I_{\text{max}} = l_1 + l_2 + 2 \sqrt{l_1 l_2} = 100 + 1 + 2 \sqrt{100 \times 1} = 121 \]

Intensity at minima is

\[ I_{\text{min}} = l_1 + l_2 - 2 \sqrt{l_1 l_2} = 100 + 1 - 2 \sqrt{100 \times 1} = 81 \]

\[ \therefore \frac{I_{\text{min}}}{I_{\text{max}}} = \frac{81}{121} \]

41. (d) In semiconductor, the forbidden energy gap between valence band and conduction band is very small almost equal to \( kT \), also valence band is completely filled while conduction band is empty.

42. (b) As, \( \omega = \sqrt{\frac{k}{m}} \) \( \Rightarrow \omega \propto \sqrt{k} \)

Hence, the angular frequency is directly proportional to the square root of spring constant.

and maximum velocity = \( Ao \) (\( A \) is amplitude)

Now for equal maximum velocity

\[ \frac{A_1}{A_2} = \frac{\omega_2}{\omega_1} \]

\[ k_2 = \left( \frac{k_2}{k_1} \right)^{1/2} \]

43. (b) By conservation of linear momentum

\[ mv + 0 = (M + m) v' \]

where, \( v = \) initial velocity, \( m = \) mass of bullet

\( v' = \) final velocity

\( M = \) mass of block

\[ v' = \frac{mv}{(M + m)} \]

44. (d) Apparent depth

\[ \frac{\text{Real depth}}{\mu} \]

As, \( \mu = A + \frac{B}{\lambda^2} \) (Cauchy’s relation)

\( \mu \) is least for red and red have maximum wavelength.

45. (d) As, terminal velocity is given by

\[ v = \frac{2(\rho - \sigma)gr^2}{9 \eta} \]

\[ \Rightarrow v \propto r^2 \]

\[ \therefore \frac{v_1}{v_2} = \frac{r_1^2}{r_2^2} \Rightarrow \frac{r^2}{r_2^2} = \frac{9}{4} \Rightarrow \frac{r_1}{r_2} = \frac{3}{2} \]

Now, Volume of 1st drop = \( 4/3 \pi r^3 \)

Volume of 2nd drop = \( 4/3 \pi r_2^3 \)

\[ = \left( \frac{r_1}{r_2} \right)^3 = \left( \frac{3}{2} \right)^3 = \frac{27}{8} \]

46. (b) After loosing \( \text{H}^+ \), the conjugate base formed become more stable due to aromaticity hence \( \text{CH}_3 \) is most acidic among all.

47. (a) The structure of \( \text{H}_2 \) \( \text{O} \) is determined as follows \( \text{H}_2 \) \( \text{O} \) has 2 bond pairs and 3 lone pairs. According to VSEPR theory, geometry is linear and can be represented as follows

\[ \text{O} \rightarrow \text{H}_2 \rightarrow \text{O} \]

Geometry = linear

Hybridisation = sp\(^3\)d
48. (c) According to Hisenberg uncertainty principle

\[ \Delta x \cdot \Delta p = \frac{h}{4\pi} \]

\[ \Delta x \cdot m \Delta v = \frac{h}{4\pi} \]

\[ \Delta x \cdot \Delta v = \frac{h}{4\pi m} \]

\[ \Delta v = \frac{h}{4\pi m \cdot \Delta x} \]

\[ = 6.626 \times 10^{-34} \]

\[ = 4 \times 3.14 \times 9.11 \times 10^{-33} \times 0.1 \times 10^{-10} \]

\[ = 6.626 \times 10^{-34} \]

\[ = 4 \times 3.14 \times 0.1 \times 10^{-41} \]

\[ = 6.626 \times 10^{-34} + 0.4 \times 3.14 \]

\[ = 6.626 \times 10^{-17} \]

\[ = 5.79 \times 10^6 \text{ m/s} \]

49. (a) The expression for the de-Broglie wavelength is

\[ \lambda = \frac{h}{p} \]

i.e., \[ \lambda \propto \frac{1}{\sqrt{mE}} \] and \[ m \gg E \]

Thus, correct order is \( \lambda_e > \lambda_p > \lambda_{\alpha} \).

50. (a) Molecular orbital electronic configuration of \( \text{O}_2^- \) is

\[ \sigma_1s^2 \sigma^*1s^2 \sigma^*2s^2 \sigma^*2p^2 \pi_2^*2p^2 \]

Unpaired electrons = 0 i.e., diamagnetic.

51. (d) Since, \( \text{H}_3\text{PO}_4 \) is a diprotic acid

\[ \therefore \quad n = 2 \Rightarrow N = M \times 2 \]

\[ N = 2 \times 0.3 = 0.6 \]

52. (b) In CCP, total number of atoms = 4

\[ \therefore \quad \text{Total } Y \text{ atoms} = 4 \]

\[ \text{Total number of tetrahedral voids} = 8 \]

\[ \text{Total } X \text{ atom} = \frac{8 \times 2}{3} = \frac{16}{3} \]

Formula = \( X_{16/3}Y_4 = X_{16}Y_{12} \text{ or } X_{4}Y_{3} \)

53. (d) Buffer is a solution of weak acid and a conjugate of weak acid or a weak base and a conjugate of weak base

\( \text{e.g., } \text{NH}_4\text{Cl} + \text{NH}_3\text{OH}, \text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}, \text{NaCN} + \text{HCN} \)

54. (b) \( \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \)

Since, there is no change in the oxidation state of element, it is not a redox reaction.

55. (c) Electronic configuration of \( \text{Fe}^{2+} \) is

\[
\begin{array}{cccccc}
1 & 1 & 1 & 1 & 1 & 1 \\
3d^6 \\
\end{array}
\]

\[ n = 4 \]

while \( \text{Mg}^{2+} \) has \( n = 0 \)

\( \text{Ti}^{3+} \) has \( n = 0 \)

\( \text{Cu}^{2+} \) has \( n = 1 \)

56. (b) This problem includes concept of allotropic form of carbon (fullerene) and electrophilic substitution reaction of fullerene.

When fullerene undergo electrophilic substitution, it undergo changes of hybridisation of carbon from \( sp^2 \) to \( sp^3 \).

57. (c) Molecules | Total number of electrons | Magnetic behaviour

| Cl\(_2\)O \(_7\) | 7 \( \times \) 2 + 7 \( \times \) 6 = 14 + 42 = 56 | Diamagnetic |
| Cl\(_2\)O | 7 \( \times \) 2 + 6 = 20 | Diamagnetic |
| ClO\(_2\) | 7 \( \times \) 1 + 6 \( \times \) 2 = 19 | Paramagnetic |
| ClO\(_2\) | 7 \( \times \) 2 + 6 \( \times \) 5 = 44 | Diamagnetic |

58. (a) Structure of bisulphate ion is

\[
\begin{align*}
\text{Resonance structures of HSO}_4^- \\
\text{Resonance hybrid}
\end{align*}
\]

All three bond lengths are equal.

59. (b) Aspirin is used to lower down the temperature so it is antipyretic it is also to cure the headache, so known as analgesic.

But other two statements \( c \) and \( d \) are wrong.

60. (a) Chemical reaction involved in given reaction is as follows

\[
\begin{align*}
\text{OH} & \rightarrow \text{OH} + \text{CO}_2 + \text{COOH} + \text{OH} \\
\text{OH} & \rightarrow \text{OH} + \text{CO}_2 + \text{COOH} + \text{OH}
\end{align*}
\]
61. (b) A. \[ \text{CH}_3\text{C} \equiv \text{CH}_2 \xrightarrow{\text{O}_3} \text{CH}_3\text{CHO} + \text{HCHO} \]
   Acetaldehyde
   B. \[ \text{CH}_3\text{C} \equiv \text{C} \quad \xrightarrow{\text{O}_3} \quad 2\text{CH}_2\text{CHO} \]
   Acetaldehyde
   C. \[ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{C} \equiv \text{H} \xrightarrow{\text{O}_3} \text{CH}_3\text{CH}_2\text{CHO} + \text{HCHO} \]
   Propanal

62. (c) \[ \text{CHCl}_3 + \text{NaOH} \rightarrow \text{CCl}_2 \text{H} \]
   Dichlorocarbene

63. (a) Vinyl derivatives containing electron releasing group readily undergo head to tail addition polymerisation.

64. (b) B on oxidation produces benzoic acid

65. (c) This is an example of aldol condensation reaction.

66. (d) Maximum oxidation state of Mn is found in K\(\text{MnO}_4\) is +7.
   \[ \text{Mn}^{2+} \text{ state has five unpaired electrons.} \]
   \[ \mu = \sqrt{5(5+2)} = 5.92 \text{ BM} \]

67. (c) Purification of blood is done by dialysis.

68. (c) Co is a neutral ligand.

69. (a) \(\text{EAN} = (\text{atomic number} - \text{oxidation state} + 2 \times \text{CN})\)
   \[ = 27 - 3 + 2 \times 6 \]
   \[ = 24 + 12 = 36 \]

70. (a) Histidine contain imidizole (an aromatic compound) as a side chain

71. (a) Vinyl derivatives containing electron releasing group readily undergo head to tail addition polymerisation.

72. (a) Histamine is secreted from the basophils and other inflammatory cells. During inflammation, which causes dilation of blood vessel (vasodilation).

73. (c)

<table>
<thead>
<tr>
<th>Atom</th>
<th>Atomic Mass (a)</th>
<th>Percentage (b)</th>
<th>(\frac{b}{a} = x)</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>12</td>
<td>40</td>
<td>3.33</td>
<td>1</td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>6.66</td>
<td>6.66</td>
<td>2</td>
</tr>
<tr>
<td>O</td>
<td>16</td>
<td>53.34</td>
<td>3.33</td>
<td>1</td>
</tr>
</tbody>
</table>

Hence, empirical formula = \(\text{CH}_2\text{O}\)

74. (a) Velocities of both \(\text{K}^+\) and \(\text{NO}_3^-\) are nearly the same in \(\text{KNO}_3\), so it is used to make salt bridge.

75. (a) Mass of 1 L solution of ethanol = 1025 g
   Mass of solute in 1.0 L = 8 \times 46 = 368 g
   Mass of solvent = 1025 - 368 = 657 g
   Molality \(m\) = \(\frac{8}{657}\) \times 1000 = 12.17

76. (a) Haemoglobin act as an oxygen carrier in the blood because four \(\text{Fe}^{2+}\) ions of haemoglobin can bind with 4 molecules of \(\text{O}_2\) and form oxyhaemoglobin.
   \(\text{Hb} + \text{O}_2 \rightarrow \text{oxyhaemoglobin}\)

77. (b) 35% solution of ethylene glycol is used as an anti-freeze in cars for cooling the engine because at this concentration it lowers the freezing point of water to 255.4 K. This is why this solution is used as an anti-freeze agent.

78. (b) F is most electronegative and smaller in size hence it has strongest \(\text{H}\)-bonding in
   \[ \text{F} \rightarrow \text{H} \ldots \ldots \text{F} \]
97. (a) 
\[ R = k[A]^1 \]  
(first order)  
mol L\(^{-1}\) s\(^{-1}\) = k mol L\(^{-1}\) s\(^{-1}\)  
Unit of \( k \) = s\(^{-1}\)  
\[ R = k [A]^0 \]  
(Zero order reaction)  
mol L\(^{-1}\) s\(^{-1}\) = k  
Unit of \( k \) = mol L\(^{-1}\) s\(^{-1}\)

90. (a) Due to resonance of 3-propyl ring through \( \sigma \)-bond resonance (a) has highest stability.

100. (b) Effect of temperature on reaction rate is given by Arrhenius equation.  
\[ K = A e^{-\frac{E_a}{RT}} \]

101. (d) Differences among the individuals are called variations. Adaptive modifications are caused through the struggle for existence.

102. (b) Schiff’s reagent is used in feulgen technique. Quinacrine mustard is used in flourescence microscopy. Tritiated thymidine is used in autoradiography.

103. (d) Isoalleles Alleles producing similar phenotypes but distinguishable amongst themselves through changed optima, e.g., \( A^1 \), \( A^2 \), \( A^3 \)

Pseudoalleles Genes lying side by side, producing related phenotypic effect and distinguishable through a rare crossing over, e.g., star (dominant) and asteroid (recessive) traits in Drosophila.

Suppressor or Inhibitor Gene A non-lethal gene, which inhibits the effect of a non-allelic dominant gene without producing its own effect (c.f. epistatic, gene).

104. (b) Exponential growth occurs when resources are abundant, population passes well beyond the carrying capacity of the ecosystem.

Hence, it is shown that this graph is J-shaped graph.

105. (c) Exotoxins are released as soon as produced. Endotoxins are retained in the bacterial cells and released when bacterial die and disintegrate.

106. (a) Sympatric species are the species that live in the same area but are prevented from successful reproducing by reproductive isolation mechanism. Allopatric species are the species that live in separate non-overlapping geographic areas. The population of related organisms are unable to cross breed because of geographical speciation.

107. (b) Pancreas and gastric glands are which have both exercise and endocrine tissue. Exercise secretion poured into the respective duetseptun where as endocrine secretion directly goes to blood/target organ.
98. (b) Active transport is the movement of a substance from a region of lower concentration to region of higher concentration, i.e., against the concentration gradient. This process involves the movement of free energy gradient, they require the expenditure of energy from the break down of ATP and are therefore, sensitive to factors affecting metabolism.

99. (b) If one base is coding one amino acid, then \( (12)^1 = 12 \) but there are 96 amino acids. Suppose, two bases form one codon, then \( (12)^2 = 144 \) This is sufficient to code 96 or 20 amino acids and hence two, bases form one codon.

100. (c) Abscisic acid inhibits synthesis of RNA and proteins. It has been shown that ABA regulate the expression of certain genes during seed maturation and certain stress condition such as heat shock, adaptation to low temperature and tolerance.

101. (c) In insect pollinated plants, a sticky material is deposited on the pollen grains known as 'pollen kit material', which is secreted by the tapetum.

102. (c) Antibodies plays an important role in immune system of the body. They are produced by lymphocytes in response to antigenic stimulation.

103. (c) The study of fossils palaeontology concluded that evolution has taken place from simple to complex in a gradual manner. e.g., Archaeopteryx.

104. (b) • August Weismann proposed the Germplasm theory.
• Mutation theory was proposed by Charles darwin
• Origin of species was proposed by Charles darvission
• Philosopie zoologie was proposed by Lamarck
• Biogenetic law was given by Ernst Haeckel.

105. (d) Two dominant gene can expresses their character when are present with each other.

106. (c) Antibodies plays an important role in immune system of the body. They are produced by lymphocytes in response to antigenic stimulation.

107. (a) Embryo sac is a cell that develops in the ovule of flowering plants. It is equivalent to the female gametophyte of lower plants, although it is very much reduced. Typically it contains eight nuclei formed by free nuclear division of megaspore mother cell. Megaspore mother cell divides by meiosis to give rise to four haploid megaspores. One of the megaspores develops into the embryo sac the others abort.

108. (c) Though trace elements are required for various functions most of these have a significant role in enzyme activities (e.g., zinc activates carboxylases, carbonic anhydrase and various dehydrogenases).

109. (c) An unfair claim to novalty and invention comes under intellectual piracy.

110. (c) A protoxin is extracellular crystalline protein.

111. (b) In 1980, Forest Conservation Act was enacted.

112. (d) Examples of GMO are Tracy, Bt brinjal, Golden rice.

113. (b) ADA is a genetic defect.

114. (b) A molecule of water is usually produced at each condensation. It is an example of dehydration synthesis.

115. (d) Rabbit — Platianista
   Tiger — Panthera tigers
   Ganges Dolphin — Cavis lupus familiaris
   Oog — Oryctologus

116. (a) Prophage is integrated DNA of temperate lysogenic phage virus with bacterial DNA is lysogeny. Provirus is copy DNA (CDNA) formed by retrovirus with host chromosome as in AIDS virus. Protovirus is the first cell in origin of life.

117. (d) One dose of measles vaccine is given to childrens at the age of 9-15 months.

118. (a) Hypophysial portal system is the blood vessel which carries blood from hypothalamus to pars distalis of pituitary.

119. (d) Cleavage occurs in zygote and interphase is short in it. Size of daughter cells decreases but the total mass of blastomere remains the same during cleavage.

120. (d) Alters thoughts, feelings, perceptions, cause illusions.

121. (c) On each lateral side of the buccopharyngeal cavity, the opening of the eustachian tube can be seen...
which connects the cavity of middle ear with the bucopharyngeal cavity.

122. (d) If the atmosphere is humid, it reduces the rate of transpiration, when the air is dry, the rate of transpiration increases.

123. (b) Cystic fibrosis is characterised by excessive thick mucous clogging in lungs, liver and pancreas anomalies.

124. (c) Breast occur in both males and females, but require estrogen for growth. It contains connective tissue, glandular tissue, fatty tissue, milk duct and nipple.

125. (c) Cardiac muscles have the highest concentration of cholesterol and phospholipids.

126. (c) Green muffler scheme involves the growing green plants along roadsides to reduce noise pollution.

127. (c) Pathetic or trochlear nerve arises from the floor of midbrain. This motor nerve is distributed to superior oblique eye muscles. It helps in the rotation of eyeball.

128. (c) Iron bacteria – *Ferrobacillus, Leptothrix and Cladothrix*

   Hydrogen bacteria – *Bacillus pentotrophs*

   Sulphur bacteria – *Beggiatoa, Thiothrix and Thiobacillus*

   Carbon bacteria – *Carboxydomonas, Bacillus oligocarbophilus*

129. (a) Ovary is half inferior in perigynous flower.

130. (d) It is a 1973 essay criticising anti-evolution creatianism and espousing theistic evolution.

131. (d) Legal system grants a patent.

132. (c) AIDS – Acquired Immuno Deficiency Syndrome, disorder of cell mediated immune system of body helper killer cells are attacked by AIDS virus.

133. (d) Capsid is the protein coat of virus, enclosing the nucleic acid in it.

134. (c) Morphan’s syndrome is characterised by slender body, limb elongation, hypermobility in joints, lens dislocation, etc.

135. (d) It cleaves DNA between G and A in the base sequence GAATTC.

136. (c) Deficiency of parathyroid hormone leads to low serum calcium and high serum phosphate which is responsible for tetany.

137. (d) Incorporation of nitrogen into amino acids is called nitrogen assimilation. It is required for protein synthesis.

138. (b) Premature degeneration of corpus luteum is the common cause of miscarriage at about 10 – 12 weeks of pregnancy. During pregnancy, hCG may be detected in the urine.

Luteal (secretary) phase is characterised by the formation of corpus luteum and progesterone secretion.

The ovum shows polarity and animal pole is the side where polar bodies are present.

139. (a) Human skeleton is made up of 270 bones, which are fused to become 206.

140. (c) Downs are grasslands of Australia.

141. (c) *Taq* polymerase is used for amplification of DNA in Polymerase Chain Reaction (PCR) along with vent polymerase, which is obtained from *T. litoralis*.

142. (c) Thermocycler is used to amplify segments of DNA via PCR and is also known as DNA amplifier.

143. (d) When the mosquito bites man, sporozoites present in the salivary gland of female Anopheles are injected into the blood of the man.

144. (a) True fertilisation together with triple fusion is known as double fertilisation, a unique phenomenon only occurs in angiosperms (absent in gymnosperms) and first time demonstrated by Nawaschin in *Fritillaria* and *Lilium*.

145. (a) Nephrons all the structural and functional unit of kidneys. They are also known as uriniferous tubule.

146. (c) Red light promoter seed germination. The germination of seed depend on the light given in last exposure.

147. (b) PPP provides erythrose-4-phosphate, which is required for the synthesis of shikimic acid.

The later is a precursor of aromatic ring compounds.

148. (a) Frankia is symbiont in root nodules of several non-legume plants like *Casuarina* and *Alnus*.

149. (b) Because in some species auxins and gibberllins have same effect.

150. (a) Pneumatophores – *Asparagus* Haustoria – *Viscum* Prop roots – *Screw pine* Tubercular storage roots – *Heritiera*

151. (d) Photorespiration is a wasteful phenomenon and no ATP and NADH formation occurs here.

152. (d) Active uptake of minerals by roots mainly depends on the availability of oxygen.
153. (d) Dentists nerve in 5th cranial nerve. It is so named because the dentist desentisizes, it with some local anaesthetic agents before pulling out a tooth.

154. (d) Asymmetric labelling of glucose phosphate formed in photosynthesis is called Gibb’s effect.

155. (c) Pinus is heterosporous. The sporogenesis results in the formation of micro and megaspores representing the first gametophyte cells.

156. (b) Because glycollic acid (A 2-Carbon compound) is used in photospiration. Hence, it is also called as C2-cycle.

157. (b) Dominant Epistasis—When the dominant allele at one locus e.g., A produces a certain phenotype regardless of the allelic condition of the other locus, then the A locus is epistatic to the B locus.

158. (d) Lampbrush chromosome were first observed in Salamander oocytes in 1882 and is largest chromosome.

159. (b) Debove’s membrane refers to a layer of connective tissue cells between the epithelium and basement tissue of respiratory and intestinal epithelia.

160. (b) These roots hang in the air and possess velamen for absorbing moisture directly from atmosphere.

161. (c) 80s subunit → 60 s subunit → 28s rRNA, ss-rRNA
       Cribosome → 40 s subunit → 18s rRNA → 33 Protien

162. (d) According to biological species concept, species is a population or series of population in which members can interbreed freely with each other but not with other species.

163. (b) Littles leaf disease of brinzal caused by MLO (Mycoplasma like organism)

164. (d) Photosynthesis is manufacture of organic compounds inside the chlorophyll containing cells from CO2 and water with the help of sunlight. Photosynthetic unit occur in the form of two distinct groups called pigment systems. The first reaction in photosynthesis is excitation of chlorophyll molecule.

165. (b) Silent valley National Park with core zone of 236.7 km2 is located in Nilgiri hills, Palakkad district of Kerala.

166. (a) Caudex is the woody or thickened persistent base of an herbaceous perennial. Maize and sugarcane have stilt root. Prop roots are presents in banyan tree.

167. (a) Myelodysplasia results when bone marrow cells produce damaged cells that don’t mature properly. This can lead to low number of red or white blood cells and platelets.

168. (c) Homology seen amongst the molecules is molecular homology. The phylogeny of an organism can be traced by using base sequence in nucleic acids and amino acids sequence of proteins in related organisms.

169. (d) The term leading strand is given to the replicated strand of DNA, which grows in 5’ → 3’ and continuously.

170. (b) Mint and Chrysanthemum bears suckers at the base of aerial shoots. After growing for some distance suckers grow out and produce new crowns.

171. (d) Pseudomonas putida is a super bug a genetically modified bacterium, an achievement by AM Chakraborty as 4 plasmids of different bacteria, so as to decompose all types of hydrocarbons in petroleum. This genetically engineered bacterium is used in bioremediation of oil spills.

172. (c) Haemoglobin is an example of quaternary structure.

173. (d) Ultrasound do not filter plasma protein. Glomerulus can filter all the constituents of plasma except proteins (colloids).

174. (d) Prom box also called TATA box is rich in 7 bp long sequence in promoter region of DNA. It assists directly in RNA polymerase-II to the promoter region of DNA during transcription because RNA polymerase II cannot recognise the initiation site on its own.

175. (c) In plants homologous organs are thorn of Bougainvillea or a Cucurbita tendril, both arises in the axillary position. Wings of insect are analogous to wings of a bird.

176. (b) Trenlb observed entry of pollen tube into the ovule through chalazal end in Casuarina. This is known as chalazogamy.

177. (d) Filariasis or elephantiasis is caused by the filarial worm, Wuchereria bancrofti. Vector of filariasis is Culex fatigan mosquito.

178. (c) Homo erectus include three fossils-Java ape man, Peking man and Heidelberg man.

179. (b) The phylloclade is special modified photosynthetic stem present mostly in xerophytes. Usually they retain water in the form of mucilage e.g., Opuntia, Casuarina and Ruscus.

180. (c) Cephalopods are regarded as the top of invertebrate evolution in terms of learned behaviour they exhibit. e.g., Sepia, Octopus, Nautilus.