SOLVED PAPER
2020 (Phase II)

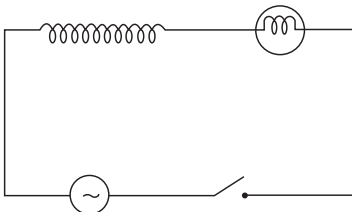**Time : 3 Hours**   **Max. Marks : 720**

Important Instructions :

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

PHYSICS

1. The E.M. wave with shortest wavelength among the following is
   - (a) Ultraviolet rays.
   - (b) X-rays.
   - (c) Gamma-rays.
   - (d) Microwaves.

2. The angular speed of the wheel of a vehicle is increased from 360 rpm to 1200 rpm in 14 second. Its angular acceleration is
   - (a) 2π rad/s^2
   - (b) 28π rad/s^2
   - (c) 120π rad/s^2
   - (d) 1 rad/s^2

3. What happens to the mass number and atomic number of an element when it emits g-radiation?
   - (a) Mass number decreases by four and atomic number decreases by two.
   - (b) Mass number and atomic number remain unchanged.
   - (c) Mass number remains unchanged while atomic number decreases by one.
   - (d) Mass number increases by four and atomic number increases by two.

4. The angle of 1' (minute of arc) in radian is nearly equal to
   - (a) 2.91×10^{-4} rad
   - (b) 4.85×10^{-4} rad
   - (c) 4.80×10^{-6} rad
   - (d) 1.75×10^{-2} rad

5. The magnetic flux linked with a coil (in Wb) is given by the equation
   $$\phi = 5t^2 + 3t + 16$$
   The magnitude of induced emf in the coil at the fourth second will be
   - (a) 33 V
   - (b) 43 V
   - (c) 108 V
   - (d) 10 V

6. The electric field at a point on the equatorial plane at a distance r from the centre of a dipole having dipole moment $\vec{p}$ is given by ($r >>$ separation of two charges forming the dipole, ε_0 - permittivity of free space)
   - (a) $\vec{E} = \dfrac{\vec{P}}{4\pi\varepsilon_0 r^3}$
   - (b) $\vec{E} = \dfrac{2\vec{P}}{4\pi\varepsilon_0 r^3}$
   - (c) $\vec{E} = -\dfrac{\vec{P}}{4\pi\varepsilon_0 r^2}$
   - (d) $\vec{E} = -\dfrac{\vec{P}}{4\pi\varepsilon_0 r^3}$

7. A plano-convex lens of unknown material and unknown focal length is given. With the help of a spherometer we can measure the
   - (a) focal length of the lens.
   - (b) radius of curvature of the curved surface.
   - (c) aperture of the lens.
   - (d) refractive index of the material.

8. A light bulb and an inductor coil are connected to an ac source through a key as shown in the figure below. The key is closed and after sometime an iron rod is inserted into the interior of the inductor. The glow of the light bulb

   - (a) decreases
   - (b) remains unchanged
   - (c) will fluctuate
   - (d) increases

9. The efficiency of a Carnot engine depends upon

   `Out of Syllabus`

   - (a) the temperature of the sink only.
   - (b) the temperatures of the source and sink.
   - (c) the volume of the cylinder of the engine.
   - (d) the temperature of the source only.

10. Out of the following which one is a forward biased diode ?
   - (a)
   - (b)
   - (c)
   - (d)

11. For the circuit shown in the figure, the current I will be

2 V   1Ω   4 V   1Ω

I

4Ω
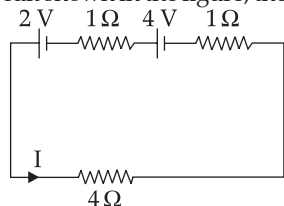
(a) 0.75 A   (b) 1 A   (c) 1.5 A   (d) 0.5 A

12. Two coherent sources of light interfere and produce fringe pattern on a screen. For central maximum, the phase difference between the two waves will be
(a) zero   (b) π (c) $3\pi/2$ (d) $\pi/2$

13. The total energy of an electron in the nth stationary orbit of the hydrogen atom can be obtained by

(a) $E_n = \dfrac{13.6}{n^2} eV$ (b) $E_n = -\dfrac{13.6}{n^2} eV$

(c) $E_n = -\dfrac{1.36}{n^2} eV$ (d) $E_n = -13.6 \times n^2 eV$

14. Identify the function which represents a periodic motion
(a) $e^{\omega t}$ (b) $\log_e(\omega t)$
(c) $\sin \omega t + \cos \omega t$ (d) $e^{-\omega t}$

15. The de Broglie wavelength of an electron moving with kinetic energy of 144 eV is nearly
(a) 102×10^{-3} nm   (b) 102×10^{-4} nm
(c) 102×10^{-5} nm   (d) 102×10^{-2} nm

16. The mean free path l for a gas molecule depends upon diameter, d of the molecule as

(a) $l \propto \dfrac{1}{d^2}$ (b) $l \propto d$ (c) $l \propto d^2$ (d) $l \propto \dfrac{1}{d}$

17. A n-p-n transistor is connected in common emitter configuration (see figure) in which collector voltage drop across load resistance (800 W) connected to the collector circuit is 0.8 V. The collector current is
`Out of Syllabus`

800 W

R_B I_C 0.8 V

I_B
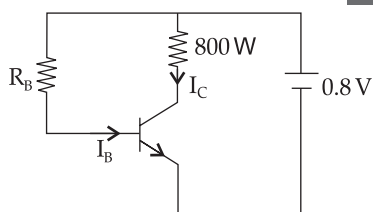
(a) 2 mA   (b) 0.1 mA   (c) 1 mA   (d) 0.2 mA

18. A person sitting in the ground floor of a building notices through the window, of height 1.5 m, a ball dropped from the roof of the building crosses the window in 0.1 s. What is the velocity of the ball when it is at the topmost point of the window ?
($g = 10$ m/s²)
(a) 15.5 m/s   (b) 14.5 m/s   (c) 4.5 m/s   (d) 20 m/s

19. The magnetic field in a plane electromagnetic wave is given by :
$B_y = 2 \times 10^{-7} \sin (\pi \times 10^3 x + 3\pi \times 10^{11} t)$T
Calculate the wavelength.
(a) $\pi \times 10^3$ m   (b) 2×10^{-3} m
(c) 2×10^3 m   (d) $\pi \times 10^{-3}$ m

20. The length of the string of a musical instrument is 90 cm and has a fundamental frequency of 120 Hz. Where should it be pressed to produce fundamental frequency of 180 Hz ?
(a) 75 cm   (b) 60 cm   (c) 45 cm   (d) 80 cm

21. The acceleration of an electron due to the mutual attraction between the electron and a proton when they are 1.6 Å apart is, (m_e; 9×10^{-31} kg, e = 1.6 $\times$ 10^{-19} C) (Take $\dfrac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ Nm² C⁻²)
(a) 10^{24} m/s² (b) 10^{23} m/s² (c) 10^{22} m/s² (d) 10^{25} m/s²

22. The wave nature of electrons was experi-mentally verified by,
(a) de Broglie   (b) Hertz
(c) Einstein   (d) Davisson and Germer

23. Two solid conductors are made up of same material, have same length and same resistance. One of them has a circular cross section of area A_1 and the other one has a square cross section of area A_2. The ratio $\dfrac{A_1}{A_2}$ is
(a) 1.5   (b) 1   (c) 0.8   (d) 2

24. For the circuit given below, the Kirchoff's loop rule for the loop BCDEB is given by the equation

A i_1 B R_2 i_2 C
        ₩₩
E_1 R_1 E_2
                i_3
F   D
        E
        E_3
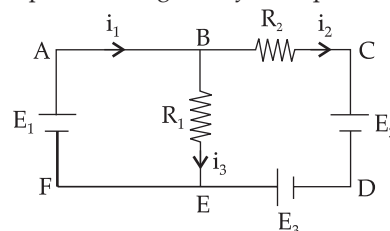
(a) $-i_2 R_2 + E_2 - E_3 + i_3 R_1 = 0$
(b) $i_2 R_2 - E_2 + E_3 - i_3 R_1 = 0$
(c) $i_2 R_2 + E_2 + E_3 + i_3 R_1 = 0$
(d) $-i_2 R_2 + E_2 + E_3 + i_3 R_1 = 0$

25. Three stars A, B, C have surface temperatures T_A, T_B, T_C respectively. Star A appears bluish, star B appears reddish and star C yellowish. Hence,
(a) $T_A > T_B > T_C$ (b) $T_B > T_C > T_A$
(c) $T_C > T_B > T_A$ (d) $T_A > T_C > T_B$

26. A liquid does not wet the solid surface if angle of contact is
(a) equal to 45°   (b) equal to 60°
(c) greater than 90°   (d) zero

27. A point mass 'm' is moved in a vertical circle of radius 'r' with the help of a string. The velocity of the mass is $\sqrt{7gr}$ at the lowest point. The tension in the string at the lowest point is
(a) 6 mg   (b) 7 mg   (c) 8 mg   (d) 1 mg

28. An object is placed on the principal axis of a concave mirror at a distance of 1.5 f (f is the focal length). The image will be at,
(a) $-3f$ (b) $1.5f$ (c) $-1.5f$ (d) $3f$

29. The half life of radioactive sample undergoing a-decay is 1.4×10^{17} s. If the number of nuclei in the sample is 2.0×10^{21}, the activity of the sample is nearly `Out of Syllabus`
(a) 10^4 Bq   (b) 10^5 Bq   (c) 10^6 Bq   (d) 10^3 Bq

30. If the critical angle for total internal reflection from a medium to vacuum is 45°, then velocity of light in the medium is,

(a) 1.5×10^8 m/s　　　(b) $\dfrac{3}{\sqrt{2}} \times 10^8$ m/s

(c) $\sqrt{2} \times 10^8$ m/s　　　(d) 3×10^8 m/s

31. A wheel with 20 metallic spokes each 1 m long is rotated with a speed of 120 rpm in a plane perpendicular to a magnetic field of 0.4 G. The induced emf between the axle and rim of the wheel will be, $(1 \text{ G} = 10^{-4} \text{ T})$

(a) 2.51×10^{-4} V　　　(b) 2.51×10^{-5} V

(c) 4.0×10^{-5} V　　　(d) 2.51 V

32. An ideal gas equation can be written as $P = \dfrac{\rho RT}{M_0}$ where r and M_0 are respectively,

(a) mass density, mass of the gas

(b) number density, molar mass

(c) mass density, molar mass

(d) number density, mass of the gas

33. The variation of electrostatic potential with radial distance r from the centre of a positively charged metallic thin shell of radius R is given by the graph

(a)　　　(b)

(c)　　　(d)
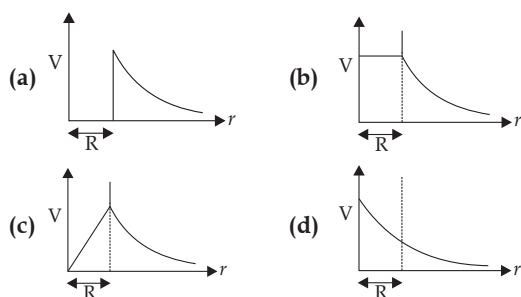
34. Which of the following gate is called universal gate?

(a) OR gate　　　(b) AND gate

(c) NAND gate　　　(d) NOT gate

35. The P-V diagram for an ideal gas in a piston cylinder assembly undergoing a thermo-dynamic process is shown in the figure. The process is
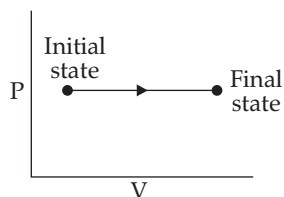
(a) adiabatic　　　(b) isochoric

(c) isobaric　　　(d) isothermal

36. The power of a biconvex lens is 10 dioptre and the radius of curvature of each surface is 10 cm. Then the refractive index of the material of the lens is,

(a) $\dfrac{4}{3}$　(b) $\dfrac{9}{8}$　(c) $\dfrac{5}{3}$　(d) $\dfrac{3}{2}$

37. An intrinsic semiconductor is converted into n-type extrinsic semiconductor by doping it with

(a) Phosphorous　　　(b) Aluminium

(c) Silver　　　(d) Germanium

38. A barometer is constructed using a liquid (density = 760 kg/m³). What would be the height of the liquid column, when a mercury barometer reads 76 cm ? (density of mercury = 13600 kg/m³)

(a) 1.36 m　(b) 13.6 m　(c) 136 m　(d) 0.76 m

39. A wire of length L metre carrying a current of I ampere is bent in the form of a circle. Its magnetic moment is,

(a) I L²/4 A m²　　　(b) I π L²/4 A m²

(c) 2 I L²/π A m²　　　(d) I L²/4π A m²

40. A parallel plate capacitor having cross-sectional area A and separation d has air in between the plates. Now an insulating slab of same area but thickness $d/2$ is inserted between the plates as shown in figure having dielectric constant K $(= 4)$. The ratio of new capacitance to its original capacitance will be,
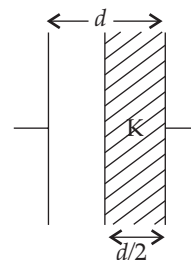

(a) 2 : 1　(b) 8 : 5　(c) 6 : 5　(d) 4 : 1

41. What is the depth at which the value of acceleration due to gravity becomes $1/n$ times the value that at the surface of earth? (radius of earth = R)

(a) R/n^2　　　(b) $R(n-1)/n$

(c) $Rn/(n-1)$　　　(d) R/n

42. Time intervals measured by a clock give the following readings :

1.25 s, 1.24 s, 1.27 s, 1.21 s and 1.28 s.

What is the percentage relative error of the observations?

(a) 2 %　(b) 4 %　(c) 16 %　(d) 1.6 %

43. Three identical spheres, each of mass M, are placed at the corners of a right angle triangle with mutually perpendicular sides equal to 2 m (see figure). Taking the point of intersection of the two mutually perpendicular sides as the origin, find the position vector of centre of mass.
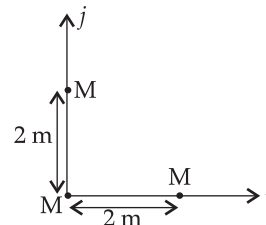
(a) $2(\hat{i} + \hat{j})$　(b) $(\hat{i} + \hat{j})$　(c) $\dfrac{2}{3}(\hat{i} + \hat{j})$　(d) $\dfrac{4}{3}(\hat{i} + \hat{j})$

44. The equivalent resistance between A and B for the mesh shown in the figure is

(a) 7.2 Ω　(b) 16 Ω　(c) 30 Ω　(d) 4.8 Ω
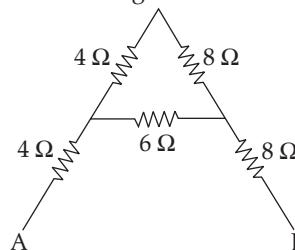
45. Calculate the acceleration of the block and trolly system shown in the figure. The co-

Trolly
10 kg
2 kg
Block

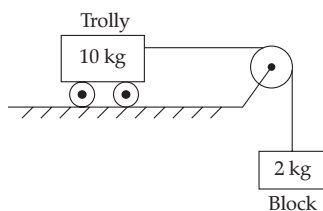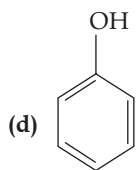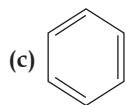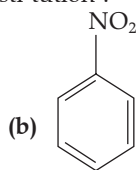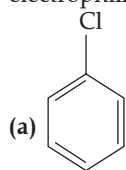efficient of kinetic friction between the trolly and the surface is 0.05. ($g = 10$ m/s^2, mass of the string is negligible and no other friction exists).
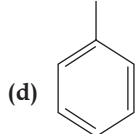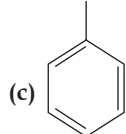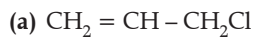(a) 1.25 m/s^2 (b) 1.50 m/s^2
(c) 1.66 m/s^2 (d) 1.00 m/s^2

CHEMISTRY

46. Which of the following statement is NOT true about acid rain ?   `Out of Syllabus`
(a) It is due to reaction of SO_2, NO_2 and CO_2 with rain water.
(b) Causes no damage to monuments like Taj Mahal.
(c) It is harmful for plants.
(d) Its pH is less than 5.6

47. The oxidation number of the underlined atom in the following species are given:
(a) $\underline{Cu}_2\underline{O}$ is –1   (b) $\underline{Cl}O_3{}^-$ is +5
(c) $K_2\underline{Cr}_2O_7$ is +6   (d) $H\underline{Au}Cl_4$ is +3
Identify the incorrect option.

48. Reaction of propanamide with ethanolic sodium hydroxide and bromine will give
(a) ethylamine.   (b) methylamine.
(c) propylamine.   (d) aniline.

49. A liquid compound (x) can be purified by steam distillation only if it is
(a) steam volatile, immiscible with water.
(b) not steam volatile, miscible with water.
(c) steam volatile, miscible with water.
(d) not steam volatile, immiscible with water.

50. Among the compounds shown below which one revealed a linear structure ?
(a) NO_2 (b) HOCl   (c) O_3 (d) N_2O

51. Which of the following compound is most reactive in electrophilic aromatic substi-tution ?

(a) [benzene ring with Cl]
(b) [benzene ring with NO_2]
(c) [benzene ring]
(d) [benzene ring with OH]

52. Which of the following will NOT undergo S_N1 reaction with OH ?
(a) $CH_2 = CH - CH_2Cl$ (b) $(CH_3)_3$ CCl
(c) [benzene ring with CH_2CH_2Cl]
(d) [benzene ring with CH_2Cl]

53. Which of the following is not true about chloramphenicol ?   `Out of Syllabus`
(a) It inhibits the growth of only gram-positive bacteria.
(b) It is a broad spectrum antibiotic.
(c) It is not bactericidal.
(d) It is bacteriostatic.

54. Which of the following statement is correct about Bakelite ?   `Out of Syllabus`
(a) It is a cross linked polymer.
(b) It is an addition polymer.
(c) It is a branched chain polymer.
(d) It is a linear polymer.

55. If for a certain reaction ΔH is 30 kJ mol^{-1} at 450 K, the value of ΔS (in JK^{-1} mol^{-1}) for which the same reaction will be spontaneous at the same temperature is
(a) 70   (b) –33   (c) 33   (d) –70

56. Match the element in column I with that in column II.

Column-I		Column-II	
(A)	Copper	(i)	Non-metal
(B)	Fluorine	(ii)	Transition metal
(C)	Silicon	(iii)	Lanthanoid
(D)	Cerium	(iv)	Metalloid

Identify the correct match :
(a) (A)-(ii), (B)-(iv), (C)-(i), (D)-(iii)
(b) (A)-(ii), (B)-(i), (C)-(iv), (D)-(iii)
(c) (A)-(iv), (B)-(iii), (C)-(i), (D)-(ii)
(d) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)

57. Which of the following is a free radical substitution reaction ?
(a) Benzene with $Br_2/AlCl_3$
(b) Acetylene with HBr
(c) Methane with $Br_2/h\nu$
(d) Propene with HBr/$(C_6H_5COO)_2$

58. The reaction of concentrated sulphuric acid with carbohydrates ($C_{12}H_{22}O_{11}$) is an example of
(a) Dehydration   (b) Oxidation
(c) Reduction   (d) Sulphonation

59. Which of the following substituted phenols is the strongest acid ?

(a) [benzene ring with OH at top and NO_2 at bottom]
(b) [benzene ring with OH at top and OCH_3 at bottom]

(c) [structure: phenol with C_2H_5 para]

(d) [structure: phenol with CH_3 para]

60. Match the compounds of Xe in column I with the molecular structure in column II.

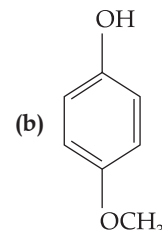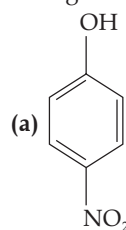| Column-I		Column-II	
(A)	XeF_2	(i)	Square planar
(B)	XeF_4	(ii)	Linear
(C)	XeO_3	(iii)	Square pyramidal
(D)	$XeOF_4$	(iv)	Pyramidal

(a) (A)-(ii) (B)-(i) (C)-(iii) (D)-(iv)
(b) (A)-(ii) (B)-(iv) (C)-(iii) (D)-(i)
(c) (A)-(ii) (B)-(iii) (C)-(i) (D)-(iv)
(d) (A)-(ii) (B)-(i) (C)-(iv) (D)-(iii)

61. The half-life for a zero order reaction having 0.02 M initial concentration of reactant is100 s. The rate constant (in mol L^{-1} s^{-1}) for the reaction is
(a) 1.0×10^{-4} (b) 2.0×10^{-4}
(c) 2.0×10^{-3} (d) 1.0×10^{-2}

62. Identify the incorrect statement from the following
(a) Zirconium and Hafnium have identical radii of 160 pm and 159 pm, respectively as a consequence of lanthanoid contrac-tion.
(b) Lanthanoids reveal only +3 oxidation state.
(c) The lanthanoid ions other than the f^0 type and the f^{14} type are all paramagnetic.
(d) The overall decrease in atomic and ionic radii from lanthanum to lutetium is called lanthanoid contraction.

63. Match the following aspects with the respective metal.

	Aspects		Metal
(A)	The metal which reveals a maximum number of oxidation states	(i)	Scandium
(B)	The metal although placed in 3d block is considered not as a transition element	(ii)	Copper
(C)	The metal which does not exhibit variable oxidation states	(iii)	Manganese
(D)	The metal which in +1 oxidation state in aqueous solution undergoes disproportionation	(iv)	Zinc

Select the correct option
(a) (A)-(i) (B)-(iv) (C)-(ii) (D)-(iii)

(b) (A)-(iii) (B)-(iv) (C)-(i) (D)-(ii)
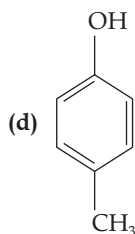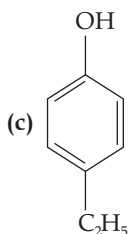(c) (A)-(iii) (B)-(i) (C)-(iv) (D)-(ii)
(d) (A)-(ii) (B)-(iv) (C)-(i) (D)-(iii)

64. If 8 g of a non-electrolyte solute is dissolved in 114 g of n-octane to reduce its vapour pressure to 80%, the molar mass (in g mol^{-1}) of the solute is [Given that molar mass of n-octane is 114 g mol^{-1}]
(a) 40   (b) 60   (c) 80   (d) 20

65. Match the coordination number and type of hybridization with distribution of hybrid orbitals in space based on Valence bond theory.

Coordination number and type of hybridization		Distribution of hybrid orbitals in space	
(A)	$4, sp^3$	(i)	trigonal bipyramidal
(B)	$4, dsp^2$	(ii)	octahedral
(C)	$5, sp^3d$	(iii)	tetrahedral
(D)	$6, d^2sp^3$	(iv)	square planar

Select the correct option
(a) (A)-(ii) (B)-(iii) (C)-(iv) (D)-(i)
(b) (A)-(iii) (B)-(iv) (C)-(i) (D)-(ii)
(c) (A)-(iv) (B)-(i) (C)-(ii) (D)-(iii)
(d) (A)-(iii) (B)-(i) (C)-(iv) (D)-(ii)

66. The number of angular nodes and radial nodes in 3s orbital are
(a) 0 and 2, respectively   (b) 1 and 0, respectively
(c) 3 and 0, respectively   (d) 0 and 1, respectively

67. Identify the correct statement from the following.
(a) The order of hydration enthalpies of alkaline earth cations
$Be^{2+} < Mg^{2+} < Ca^{2+} < Sr^{2+} < Ba^{2+}$
(b) Lithium and Magnesium show some similarities in their physical properties as they are diagonally placed in periodic table.
(c) Lithium is softer among all alkali metals.
(d) Lithium chloride is deliquescent and crystallizes as a hydrate, $LiCl \cdot H_2O$.

68. Deficiency of which vitamin causes osteomalacia ?
(a) Vitamin A   (b) Vitamin D
(c) Vitamin K   (d) Vitamin E

69. Identify the wrongly matched pair.

	Molecule	Shape or geometry of molecule
(a)	PCl_5	Trigonal planar
(b)	SF_6	Octahedral
(c)	$BeCl_2$	Linear
(d)	NH_3	Trigonal pyramidal

70. $CH_3CH_2CH = CH_2 \xrightarrow[\text{H}_2\text{O,H}_2\text{O}_2,\text{OH}^-]{\text{B}_2\text{H}_6} Z$
What is Z ?
(a) $CH_3CH_2CH_2CH_2OH$ (b) $CH_3CH_2CHCH_3$ with $|$ OH below
(c) $CH_3CH_2CH_2CHO$ (d) $CH_3CH_2CH_2CH_3$

71. Identify the reaction from following having top position in EMF series (Std. red. potential) according to their electrode potential at 298 K.
    (a) $Mg^{2+} + 2e^- \rightarrow Mg(s)$ (b) $Fe^{2+} + 2e^- \rightarrow Fe(s)$
    (c) $Au^{3+} + 3e^- \rightarrow Au(s)$ (d) $K^+ + 1e^- \rightarrow K(s)$

72. Match the elements in Column I with methods of purification in Column II.   Out of Syllabus

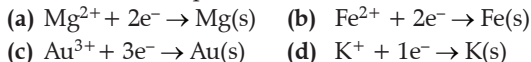| Column I		Column II	
(A)	Boron	(i)	Van Arkel method
(B)	Tin	(ii)	Mond's process
(C)	Zirconium	(iii)	Liquation
(D)	Nickel	(iv)	Zone refining

    (a) (A)-(iv) (B)-(iii) (C)-(i) (D)-(ii)
    (b) (A)-(iv) (B)-(iii) (C)-(ii) (D)-(i)
    (c) (A)-(ii) (B)-(i) (C)-(iv) (D)-(iii)
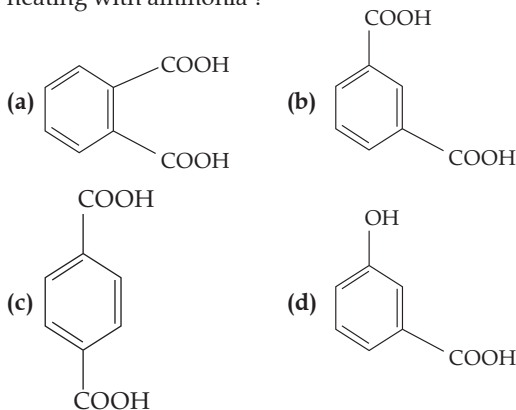   (d) (A)-(iii) (B)-(iv) (C)-(i) (D)-(ii)

73. Which among the following salt solutions is basic in nature ?
    (a) Ammonium chloride   (b) Ammonium sulphate
    (c) Ammonium nitrate   (d) Sodium acetate

74. In which of the sols, the colloidal particles are with negative charge ?   Out of Syllabus
    (a) TiO_2 (b) Haemoglobin
    (c) Starch   (d) Hydrated Al_2O_3

75. Which of the following acid will form an (a) Anhydride on heating and (b) Acid imide on strong heating with ammonia ?

    (a) [benzene ring with COOH and COOH ortho]
    (b) [benzene ring with COOH and COOH meta]
    (c) [benzene ring with COOH and COOH para]
    (d) [benzene ring with OH and COOH]

76. In a typical fuel cell, the reactants (R) and product (P) are
    (a) R = $H_2(g)$, $O_2(g)$; P = $H_2O_2(l)$
    (b) R = $H_2(g)$, $O_2(g)$; P = $H_2O(l)$
    (c) R = $H_2(g)$, $O_2(g)$, $Cl_2(g)$; P = $HClO_4(aq)$
    (d) R = $H_2(g)$, $N_2(g)$; P = $NH_3(aq)$

77. In collision theory of chemical reaction, Z_{AB} represents
    (a) the fraction of molecules with energies greater than E_a
    (b) the collision frequency of reactants, A and B
    (c) steric factor
    (d) the fraction of molecules with energies equal to E_a

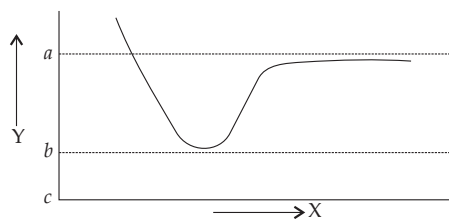78. Which of the following statement is not true about glucose ?
    (a) It is an aldohexose.

(b) It contains five hydroxyl groups.
(c) It is a reducing sugar.
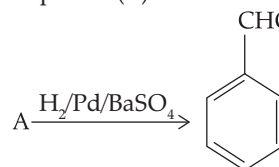(d) It is an aldopentose.

79. The potential energy (Y) curve for H_2 formation as a function of internuclear distance (X) of the H atoms is shown below.
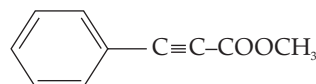

    The bond energy of H_2 is
    (a) $(b - a)$ (b) $\dfrac{(c - a)}{2}$ (c) $\dfrac{(b - a)}{2}$ (d) $(c - a)$

80. Identify compound (A) in the following reaction :

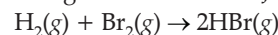 $A \xrightarrow{H_2/Pd/BaSO_4}$ [benzene ring with CHO]

    (a) Benzoyl chloride   (b) Toluene
    (c) Acetophenone   (d) Benzoic acid

81. How many (i) sp^2 hybridised carbon atoms and (ii) π bonds are present in the following compound ?

    [benzene ring]$-C\equiv C-COOCH_3$

    (a) 7, 5   (b) 8, 6   (c) 7, 6   (d) 8, 5

82. At standard conditions, if the change in the enthalpy for the following reaction is -109 kJ mol^{-1}
    $$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$$
    Given that bond energy of H_2 and Br_2 is 435 kJ mol^{-1} and 192 kJ mol^{-1}, respectively, what is the bond energy (in kJ mol^{-1}) of HBr?
    (a) 368   (b) 736   (c) 518   (d) 259

83. The minimum pressure required to compress 600 dm^3 of a gas at 1 bar to 150 dm^3 at 40°C is   Out of Syllabus
    (a) 4.0 bar   (b) 0.2 bar   (c) 1.0 bar   (d) 2.5 bar

84. What is the role of gypsum, $CaSO_4 \cdot 2H_2O$ in setting of cement? Identify the correct option from the following: Out of Syllabus
    (a) To fasten the setting process
    (b) To provide water molecules for hydration process
    (c) To help to remove water molecules
    (d) To slow down the setting process

85. Which of the following oxide is amphoteric in nature?
    (a) SnO_2 (b) SiO_2 (c) GeO_2 (d) CO_2

86. Which one of the following reactions does not come under hydrolysis type reaction ?   Out of Syllabus
    (a) $SiCl_4(l) + 2H_2O(l) \rightarrow SiO_2(s) + 4HCl(aq)$
    (b) $Li_3N(s) + 3H_2O(l) \rightarrow NH_3(g) + 3LiOH(aq)$
    (c) $2F_2(g) + 2H_2O(l) \rightarrow 4HF(aq) + O_2(g)$
    (d) $P_4O_{10}(s) + 6H_2O(l) \rightarrow 4H_3PO_4(aq)$

87. Which one of the following compounds shows both, Frenkel as well as Schottky defects ?   Out of Syllabus
    (a) AgBr   (b) AgI   (c) NaCl   (d) ZnS

88. One mole of carbon atom weighs 12 g, the number of atoms in it is equal to (Mass of carbon 12 is 1.9926×10^{-23} g)
    (a) 1.2×10^{23}
    (b) 6.022×10^{22}
    (c) 12×10^{22}
    (d) 6.022×10^{23}

89. Isotonic solutions have same
    (a) vapour pressure
    (b) freezing temperature
    (c) osmotic pressure
    (d) boiling temperature

90. The solubility product for a salt of the type AB is 4×10^{-8}. What is the molarity of its standard solution ?
    (a) 2×10^{-4} mol/L
    (b) 16×10^{-16} mol/L
    (c) 2×10^{-16} mol/L
    (d) 4×10^{-4} mol/L

BIOLOGY

91. In some plants, thalamus contributes to fruit formation. Such fruits are termed as
    (a) false fruits.
    (b) aggregate fruits.
    (c) true fruits.
    (d) parthenocarpic fruit.

92. First discovered restriction endonuclease that always cuts DNA molecule at a particular point by recognising a specific sequence of six base pairs is
    (a) EcoRI.
    (b) adenosine deaminase.
    (c) thermostable DNA polymerase.
    (d) Hind II.

93. Which of the following statements is incorrect?
    (a) Biomass decreases from first to fourth trophic level.
    (b) Energy content gradually increases from first to fourth trophic level.
    (c) Number of individuals decreases from first trophic level to fourth trophic level.
    (d) Energy content gradually decreases from first to fourth trophic level.

94. The term 'Nuclein' for the genetic material was used by
    (a) Franklin.
    (b) Meischer.
    (c) Charagaff.
    (d) Mendel.

95. Chromosomal theory of inheritance was proposed by
    (a) Sutton and Boveri.
    (b) Bateson and Punnet.
    (c) T. H. Morgan.
    (d) Watson and Crick.

96. Phycoerythrin is the major pigment in
    (a) red algae.
    (b) blue green algae.
    (c) green algae.
    (d) brown algae.

97. Identify the statement which is incorrect.
    (a) Sulphur is an integral part of cysteine.
    (b) Glycine is an example of lipids.
    (c) Lecithin contains phosphorus atom in its structure.
    (d) Tyrosine possesses aromatic ring in its structure.

98. Which of the following statements is incorrect about gymnosperms ?
    (a) They are heterosporous.
    (b) Male and female gametophytes are free living.
    (c) Most of them have narrow leaves with thick cuticle.
    (d) Their seeds are not covered.

99. A species which was introduced for ornamentation but has become a trouble-some weed in India
    (a) *Parthenium hysterophorus*
    (b) *Eichhornia crassipes*
    (c) *Prosopis juliflora*
    (d) *Trapa spinosa*

100. Correct position of floral parts over thalamus in mustard plant is

(a) gynoecium occupies the highest position, while the other parts are situated below it.
(b) margin of the thalamus grows upward, enclosing the ovary completely, and other parts arise below the ovary.
(c) gynoecium is present in the centre and other parts cover it partially.
(d) gynoecium is situated in the centre, and other parts of the flower are located at the rim of the thalamus, at the same level.

101. In recombinant DNA technology, antibiotics are used
    (a) to keep medium bacteria-free.
    (b) to detect alien DNA.
    (c) to impart disease-resistance to the host plant.
    (d) as selectable markers.

102. According to Alexander von Humboldt
    (a) Species richness decreases with increasing area of exploration
    (b) Species richness increases with increasing area, but only up to limit
    (c) There is no relationship between species richness and area explored.
    (d) Species richness goes on increasing with increasing area of exploration

103. Which of the following is incorrect for wind-pollinated plants ?
    (a) Well exposed stamens and stigma
    (b) Many ovules in each ovary
    (c) Flowers are small and not brightly coloured
    (d) Pollen grains are light and non-sticky

104. Which of the following is the correct floral formula of Liliaceae ?
    (a) $\% \; \male \; C_{1+2+(2)} \; A_{(9)+1} \; \underline{G}_1$
    (b) $\oplus \; \female \; \male \; K_{(5)} \; \widehat{C_{(5)} \; A_5} \; \underline{G}_{(2)}$
    (c) $Br \; \oplus \; \male \; \widehat{P_{(3+3)} \; A_{3+3}} \; \underline{G}_{(3)}$
    (d) $\oplus \; \male \; K_{(5)} \; \widehat{C_{(5)} \; A_5} \; \underline{G}_{(2)}$

105. In the polynucleotide chain of DNA, a nitrogenous base is linked to the –OH of
    (a) 2'C pentose sugar.
    (b) 3'C pentose sugar.
    (c) 5'C pentose sugar.
    (d) 1'C pentose sugar.

106. In *Glycine max*, the product of biological nitrogen fixation is transported from the root nodules to other parts as
    (a) ammonia.
    (b) glutamate.
    (c) nitrates.
    (d) ureides.

107. The number of contrasting characters studied by Mendel for his experiments was
(a) 14   (b) 4   (c) 2   (d) 7

108. Attachment of spindle fibers to kinetochores of chromosomes becomes evident in
(a) Anaphase
(b) Telophase
(c) Prophase
(d) Metaphase

109. Match the items in Column-I with those in Column-II

	Column I		Column II
(A)	Herbivores-Plants	(i)	Commensalism
(B)	Mycorrhiza-Plants	(ii)	Mutualism
(C)	Sheep-Cattle	(iii)	Predation
(D)	Orchid-Tree	(iv)	Competition

Select the correct option from following
(a) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)
(b) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)
(c) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)
(d) (A)-(i), (B)-(iii), (C)-(iv), (D)-(ii)

110. Vegetative propagule in *Agave* is as
(a) rhizome.
(b) bulbil.
(c) offset.
(d) eye.

111. Match the following :
(A) Aquaporin   (i) Amide
(B) Asparagine   (ii) Polysaccharide
(C) Abscisic acid   (iii) Polypeptide
(D) Chitin   (iv) Carotenoids

Select the correct option :
(a) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii)
(b) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)
(c) (A)-(ii), (B)-(i), (C)-(iv), (D)-(iii)
(d) (A)-(iii), (B)-(i), (C) -(ii), (D)-(iv)

112. Which of the following elements helps in maintaining the structure of ribosomes ?
(a) Magnesium
(b) Zinc
(c) Copper
(d) Molybdenum

113. Who coined the term 'Kinetin' ?
(a) Skoog and Miller
(b) Darwin
(c) Went
(d) Kurosawa

114. In the following in each set a conservation approach and an example of method of conservation are given
(A) *In situ* conservation - Biosphere Reserve
(B) *Ex situ* conservation - Sacred groves
(C) *In situ* conservation - Seed bank
(D) *Ex situ* conservation - Cryo preservation

Select the option with correct match of approach and method
(a) (A) and (C)
(b) (A) and (D)
(c) (B) and (D)
(d) (A) and (B)

115. Embryological support for evolution was proposed by
(a) Ernst Heckel.
(b) Karl Ernst von Baer.
(c) Charles Darwin.
(d) Alfred Wallace.

116. During non-cyclic photophosphorylation, when electrons are lost from the reaction centre at PS II, what is the source which replaces these electrons ?

(a) Oxygen
(b) Water
(c) Carbon dioxide
(d) Light

117. In a mitotic cycle, the correct sequence of phases is
(a) S, G_1, G_2, M
(b) G_1, S, G_2, M
(c) M, G_1, G_2, S
(d) G_1, G_2, S, M

118. Inclusion bodies of blue-green, purple and green photosynthetic bacteria are
(a) contractile vacuoles.
(b) gas vacuoles.
(c) centrioles.
(d) microtubules.

119. Large, empty colourless cells of the adaxial epidermis along the veins of grass leaves are
(a) lenticels.
(b) guard cells.
(c) bundle sheath cells.
(d) bulliform cells.

120. The biosynthesis of ribosomal RNA occurs in
(a) ribosomes.
(b) golgi apparatus.
(c) microbodies.
(d) nucleolus.

121. Which of the following is incorrect about cyanobacteria?
(a) They are photoautotrophs.
(b) They lack heterocysts.
(c) They often form blooms in polluted water bodies.
(d) They have chlorophyll a similar to green plants.

122. Which of the following statements about cork cambium is incorrect ?
(a) It forms secondary cortex on its outer side.
(b) It forms a part of periderm.
(c) It is responsible for the formation of lenticels.
(d) It is a couple of layers thick.

123. Select the incorrect statement.
(a) Transport of molecules in phloem can be bidirectional.
(b) Movement of minerals in xylem is unidirectional.
(c) Unloading of sucrose at sink does not involve the utilisation of ATP.
(d) Elements most easily mobilised in plants from one region to another are: phosphorus, sulphur, nitrogen and potassium.

124. Air (Prevention and Control of Pollution) Act was amended in 1987 to include among pollutants
(a) Vehicular exhaust
(b) Allergy causing pollen
(c) Noise
(d) Particulates of size 2.5 micrometer or below

125. Inhibitory substances in dormant seeds cannot be removed by subjecting seeds to
(a) gibberellic acid
(b) nitrate
(c) ascorbic acid
(d) chilling conditions

126. Match the following techniques or instru-ments with their usage

(A)	Bioreactor	(i)	Separation of DNA fragments
(B)	Electrophoresis	(ii)	Production of large quantities of products
(C)	PCR	(iii)	Detection of pathogen, based on antigen - antibody reaction
(D)	ELISA	(iv)	Amplification of nucleic acids

Select the correct option from following
(a) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)
(b) (A)-(ii), (B)-(i), (C)-(iv), (D)-(iii)
(c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)
(d) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)

127. Which of the following statements is incorrect?
(a) RuBisCO is a bifunctional enzyme.
(b) In C_4 plants, the site of RuBisCO activity is mesophyll cell.
(c) The substrate molecule for RuBisCO activity is a 5-carbon compound.
(d) RuBisCO action requires ATP and NADPH.

128. Which of the following statements is incorrect regarding the phosphorus cycle?
(a) Phosphates are the major form of phosphorus reservoir.
(b) Phosphorus solubilising bacteria facilitate the release of phosphorus from organic remains.
(c) There is appreciable respiratory release of phosphorus into atmosphere.
(d) It is sedimentary cycle.

129. After about how many years of formation of earth, life appeared on this planet?
(a) 500 billion years   (b) 50 million years
(c) 500 million years   (d) 50 billion years

130. In a mixture, DNA fragments are separated by
(a) bioprocess engineering.
(b) restriction digestion.
(c) electrophoresis.
(d) polymerase chain reaction.

131. Identify the correct features of Mango and coconut fruits.
 (i) In both fruit is a drupe
 (ii) Endocarp is edible in both
 (iii) Mesocarp in coconut is fibrous, and in mango it is fleshy
 (iv) In both, fruit develops from mono-carpellary ovary
Select the correct option from below
(a) (i), (iii) and (iv) only   (b) (i), (ii) and (iii) only
(c) (i) and (iv) only   (d) (i) and (ii) only

132. The impact of immigration on population density is
(a) negative.
(b) both positive and negative.
(c) neutralised by natality.
(d) positive.

133. Male and female gametophytes do not have an independent free living existence in
(a) Pteridophytes.   (b) Algae.
(c) Angiosperms.   (d) Bryophytes.

134. Match the following concerning the activity function and the phytohormone involved

(A)   Fruit ripener   (i)   Abscisic acid
(B)   Herbicide   (ii) GA_3
(C)   Bolting agent   (iii) 2, 4-D
(D)   Stress hormone   (iv) Ethephon

Select the correct option from following
(a) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)
(b) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
(c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)
(d) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)

135. Pyruvate dehydrogenase activity during aerobic respiration requires
(a) calcium.   (b) iron.
(c) cobalt.   (d) magnesium.

136. The rate of decomposition is faster in the ecosystem due to following factors except
(a) detritus rich in sugars
(b) warm and moist environment
(c) presence of aerobic soil microbes
(d) detritus richer in lignin and chitin

137. For the commercial and industrial produc-tion of citric acid, which of the following microbes is used?
(a) *Aspergillus niger*   (b) *Lactobacillus sp*
(c) *Saccharomyces cerevisiae* (d) *Clostridium butylicum*

138. Which of the following STDs are not curable?
(a) Genital herpes, Hepatitis B, HIV infection
(b) Chlamydiasis, Syphilis, Genital warts
(c) HIV, Gonorrhoea, Trichomoniasis
(d) Gonorrhoea, Trichomoniasis, Hepatitis B

139. Spooling is
(a) amplification of DNA.
(b) cutting of separated DNA bands from the agarose gel.
(c) transfer of separated DNA fragments to synthetic membranes.
(d) collection of isolated DNA.

140. The phenomenon of evolution of different species in a given geographical area starting from a point and spreading to other habitats is called
(a) saltation   (b) co-evolution
(c) natural selection   (d) adaptive radiation

141. The best example for pleiotropy is
(a) skin colour.   (b) phenylketoneuria.
(c) colour blindness.   (d) ABO Blood group.

142. In cockroach, identify the parts of the foregut in correct sequence   `Out of Syllabus`
(a) Mouth → Oesophagus → Pharynx → Crop → Gizzard
(b) Mouth → Crop → Pharynx → Oesophagus → Gizzard
(c) Mouth → Gizzard → Crop → Pharynx → Oesophagus
(d) Mouth → Pharynx → Oesophagus → Crop → Gizzard

143. Match the following columns and select the correct option

	Column-I		Column-II
(A)	Pituitary hormone	(i)	Steroid
(B)	Epinephrine	(ii)	Neuropeptides
(C)	Endorphins	(iii)	Peptides, proteins
(D)	Cortisol	(iv)	Biogenic amines

(a) (A)-(iv), (B)-(i), (C)-(ii), (D)-(iii)
(b) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
(c) (A)-(iv), (B)-(iii), (C)-(i), (D)-(ii)
(d) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)

144. Which of the following options does correctly represent the characteristic features of phylum Annelida ?
(a) Triploblastic, unsegmented body and bilaterally symmetrical.
(b) Triploblastic, segmented body and bilaterally symmetrical.
(c) Triploblastic, flattened body and acoelomate condition.
(d) Diploblastic, mostly marine and radially symmetrical.

145. Match the following columns and select the correct option

	Column-I		Column-II
(A)	Dragonflies	(i)	Biocontrol agents of several plant pathogens
(B)	*Bacillus thuringiensis*	(ii)	Get rid of Aphids and mosquitoes
(C)	*Glomus*	(iii)	Narrow spectrum insecticidal applications
(D)	Baculoviruses	(iv)	Biocontrol agents of lepidopteran plant pests
		(v)	Absorb phosphorus from soil

(a) (A)-(iii), (B)-(v), (C)-(iv), (D)-(i)
(b) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)
(c) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(v)
(d) (A)-(ii), (B)-(iv), (C)-(v), (D)-(iii)

146. Intrinsic factor that helps in the absorption of vitamin B12 is secreted by
(a) Goblet cells
(b) Hepatic cells
(c) Oxyntic cells
(d) Chief cells

147. Hormones stored and released from neurohypophysis are
(a) thyroid stimulating hormone and oxytocin
(b) oxytocin and vasopressin
(c) follicle stimulating hormone and leutinizing hormone
(d) prolactin and vasopressin

148. Match the following columns and select the correct option :

	Column - I		Column - II
(i)	Typhoid	(A)	*Haemophilus influenzae*
(ii)	Malaria	(B)	*Wuchereria bancrofti*
(iii)	Pneumonia	(C)	*Plasmodium vivax*
(iv)	Filariasis	(D)	*Salmonella typhi*

(a) (i)-(D), (ii)-(C), (iii)-(A), (iv)-(B)
(b) (i)-(C), (ii)-(D), (iii)-(B), (iv)-(A)
(c) (i)-(A), (ii)-(C), (iii)-(B), (iv)-(D)
(d) (i)-(A), (ii)-(B), (iii)-(D), (iv)-(C)

149. In human beings, at the end of 12 weeks (first trimester) of pregnancy, the following is observed
(a) Eyelids and eyelashes are formed
(b) Most of the major organ systems are formed
(c) The head is covered with fine hair
(d) Movement of the foetus

150. Match the following columns and select the correct option

	Column - I		Column - II
(A)	Rods and Cones	(i)	Absence of photoreceptor cells
(B)	Blind Spot	(ii)	Cones are densely packed
(C)	Fovea	(iii)	Photoreceptor cells
(D)	Iris	(iv)	Visible coloured portion of the eye

(a) (A)-(iii), (B)-(i), (C)-(ii), (D)-(iv)
(b) (A)-(ii), (B)-(iii), (C)-(i), (D)-(iv)
(c) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
(d) (A)-(ii), (B)-(iv), (C)-(iii), (D)-(i)

151. The size of Pleuropneumonia - like Organism (PPLO) is
(a) 0.02 μm (b) 1-2 μm (c) 10-20 μm (d) 0.1 μm

152. The proteolytic enzyme rennin is found in
Out of Syllabus
(a) intestinal juice (b) bile juice
(c) gastric juice (d) pancreatic juice

153. Match the following group of organisms with their respective distinctive characteristics and select the correct option :

	Organisms		Characteristics
(A)	Platyhelminthes	(i)	Cylindrical body with no segmentation
(B)	Echinoderms	(ii)	Warm blooded animals with direct development
(C)	Hemichordates	(iii)	Bilateral symmetry with incomplete digestive system
(D)	Aves	(iv)	Radial symmetry with indirect development

(a) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)
(b) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)
(c) (A)-(iv), (B)-(i), (C)-(ii), (D)-(iii)
(d) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)

154. Cyclosporin A, used as immuno suppression agent, is produced from
(a) *Monascus purpureus*
(b) *Saccharomyces cerevisiae*
(c) *Penicillium notatum*
(d) *Trichoderma polysporum*

155. Select the correct statement from the following
(a) Gel electrophoresis is used for amplifi-cation of a DNA segment.
(b) The polymerase enzyme joins the gene of interest and the vector DNA.
(c) Restriction enzyme digestions are performed by incubating purified DNA molecules with the restriction enzymes of optimum conditions.
(d) PCR is used for isolation and separation of gene of interest.

156. The increase in osmolarity from outer to inner medullary interstitium is maintained due to
(i) close proximity between Henle's loop and vasa recta.
(ii) counter current mechanism.
(iii) selective secretion of HCO_3^- and hydrogen ions in PCT.
(iv) higher blood pressure in glomerular capillaries.
(a) Only (ii)   (b) (iii) and (iv)
(c) (i), (ii) and (iii)   (d) (i) and (ii)

157. The yellowish fluid "colostrum" secreted by mammary glands of mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant. This type of immunity is called as
(a) Passive immunity   (b) Active immunity
(c) Acquired immunity   (d) Autoimmunity

158. Match the following columns with reference to cockroach and select the correct option Out of Syllabus

	Column - I		Column - II
(A)	Grinding of the food particles	(i)	Hepatic caecal
(B)	Secrete gastric juice	(ii)	10th segment
(C)	10 pairs	(iii)	Proventriculus
(D)	Anal cerci	(iv)	Spiracles
		(v)	Alary muscles

(a) (A)-(iii), (B)-(i), (C)-(iv), (D)-(ii)
(b) (A)-(iv), (B)-(iii), (C)-(v), (D)-(ii)
(c) (A)-(i), (B)-(iv), (C)-(iii), (D)-(ii)
(d) (A)-(ii), (B)-(iii), (C)-(i), (D)-(iv)

159. RNA interference is used for which of the following purposes in the field of biotechnology ?
(a) To develop a plant tolerant to abiotic stresses
(b) To develop a pest resistant plant against infestation by nematode
(c) To enhance the mineral usage by the plant
(d) To reduce post harvest losses

160. E.coli has only 4.6×10^6 base pairs and completes the process of replication within 18 minutes; then the average rate of polymerisation is approximately
(a) 2000 base pairs/second   (b) 3000 base pairs/second
(c) 4000 base pairs/second   (d) 1000 base pairs/second

161. Progestogens alone or in combination with estrogens can be used as a contraceptive in the form of
(a) Implants only
(b) Injections only
(c) Pills, injections and implants
(d) Pills only

162. According to Central Pollution Control Board [CPCB] what size (in diameter) of particulate is responsible for causing greater harm to human health ?
(a) 3.5 micrometers   (b) 2.5 micrometers
(c) 4.0 micrometers   (d) 3.0 micrometers

163. The Total Lung Capacity (TLC) is the total volume of air accomodated in the lungs at the end of a forced inspiration. This includes
(a) RV; IC (Inspiratory Capacity); EC (Expiratory Capacity); and ERV
(b) RV; ERV; IC and EC
(c) RV; ERV; VC (Vital Capacity) and FRC (Functional Residual Capacity)
(d) RV (Residual Volume); ERV (Expiratory Reserve Volume); TV (Tidal Volume); and IRV (Inspiratory Reserve Volume)

164. Select the correct option of haploid cells from the following groups
(a) Primary oocyte, Secondary oocyte, Spermatid
(b) Secondary spermatocyte, First polar body, Ovum
(c) Spermatogonia, Primary spermatocyte, Spermatid
(d) Primary spermatocyte, Secondary spermatocyte, Second polar body

165. During Meiosis 1, in which stage synapsis takes place ?
(a) Pachytene   (b) Zygotene
(c) Diplotene   (d) Leptotene

166. Match the following columns and select the correct option :

	Column - I		Column - II
(A)	Smooth endoplasmic reticulum	(i)	Protein synthesis
(B)	Rough endoplasmic reticulum	(ii)	Lipid synthesis
(C)	Golgi complex	(iii)	Glycosylation
(D)	Centriole	(iv)	Spindle formation

(a) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)
(b) (A)-(iii), (B)-(i), (C)-(ii), (D)-(iv)
(c) (A)-(iv), (B)-(ii), (C)-(i), (D)-(iii)
(d) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)

167. Select the correct statement
(a) Atrial Natriuretic Factor increases the blood pressure.
(b) Angiotensin II is a powerful vasodilator.
(c) Counter current pattern of blood flow is not observed in vasa recta.
(d) Reduction in Glomerular Filtration Rate activates JG cells to release renin.

168. Which of the following is associated with decrease in cardiac output ?
(a) Sympathetic nerves
(b) Parasympathetic neural signals
(c) Pneumotaxic centre
(d) Adrenal medullary hormones

169. Inbreeding depression is
(a) reduced motility and immunity due to close inbreeding.
(b) decreased productivity due to mating of superior male and inferior female.

(c) decrease in body mass of progeny due to continued close inbreeding.

(d) reduced fertility and productivity due to continued close inbreeding.

170. Select the incorrectly matched pair from following
(a) Chondrocytes - Smooth muscle cells
(b) Neurons - Nerve cells
(c) Fibroblast - Areolar tissue
(d) Osteocytes - Bone cells

171. The laws and rules to prevent unauthorised exploitation of bio-resources are termed as -
(a) Biopatenting   (b) Bioethics
(c) Bioengineering   (d) Biopiracy

172. Match the following columns and select the correct option :

Column - I		Column - II
(A) Ovary	(i)	Human chorionic Gonadotropin
(B) Placenta	(ii)	Estrogen and Progesterone
(C) Corpus luteum	(iii)	Androgens
(D) Leydig cells	(iv)	Progesterone only

(a) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)
(b) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)
(c) (A)-(i), (B)-(iii), (C)-(ii), (D)-(iv)
(d) (A)-(ii), (B)-(i), (C)-(iv), (D)-(iii)

173. Match the following columns and select the correct option

Column - I		Column - II
(A) *Aptenodytes*	(i)	Flying fox
(B) *Pteropus*	(ii)	Angel fish
(C) *Pterophyllum*	(iii)	Lamprey
(D) *Petromyzon*	(iv)	Penguin

(a) (A)-(iii), (B)-(iv), (C)-(ii), (D)-(i)
(b) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)
(c) (A)-(iv), (B)-(i), (C)-(ii), (D)-(iii)
(d) (A)-(ii), (B)-(i), (C)-(iv), (D)-(iii)

174. A Hominid fossil discovered in Java in 1891, now extinct, having cranial capacity of about 900 cc was
(a) *Homo erectus*   (b) Neanderthal man
(c) *Homo sapiens*   (d) *Australopithecus*

175. Match the following events that occur in their respective phases of cell cycle and select the correct option

(A) G_1 phase   (i) Cell grows and organelle duplication

(B) S phase   (ii) DNA replication and chromosome duplication

(C) G_2 phase   (iii) Cytoplasmic growth

(D) Metaphase in M-phase (iv) Alignment of chromosomes

(a) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)
(b) (A)-(iii), (B)-(iv), (C)-(i), (D)-(ii)
(c) (A)-(iv), (B)-(i), (C)-(ii), (D)-(iii)
(d) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)

176. Match the following columns and select the correct option :

Column - I		Column - II
(A) Pneumotaxic Centre	(i)	Alveoli
(B) O_2 dissociation curve	(ii)	Pons region of brain
(C) Carbonic anhydrase	(iii)	Haemoglobin
(D) Primary site	(iv)	RBC of exchange of gases

(a) (A)-(i), (B)-(iii), (C)-(ii), (D)-(iv)
(b) (A)-(ii), (B)-(iii), (C)-(iv), (D)-(i)
(c) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)
(d) (A)-(iv), (B)-(i), (C)-(iii), (D)-(ii)

177. Which is the basis of genetic mapping of human genome as well as DNA finger printing ?
(a) Polymorphism in DNA sequence
(b) Single nucleotide polymorphism
(c) Polymorphism in hnRNA sequence
(d) Polymorphism in RNA sequence

178. Which of the following conditions cause erythroblastosis foetalis ?
(a) Mother Rh^{+ve} and foetus Rh^{-ve}
(b) Mother Rh^{-ve} and foetus Rh^{+ve}
(c) Both mother and foetus Rh^{-ve}
(d) Both mother and foetus Rh^{+ve}

179. All vertebrates are chordates but all chordates are not vertebrates, why ?
(a) Notochord is replaced by vertebral column in adult of some chordates.
(b) Ventral hollow nerve cord remains throughout life in some chordates.
(c) All chordates possess vertebral column.
(d) All chordates possess notochord throughout their life.

180. Match the following columns and select the correct option

Column - I		Column - II
(A) Gout	(i)	Decreased levels of estrogen
(B) Osteoporosis	(ii)	Low Ca^{++} ions in the blood
(C) Tetany	(iii)	Accumulation of uric acid crystals
(D) Muscular dystrophy	(iv)	Auto immune disorder
	(v)	Genetic disorder

(a) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)
(b) (A)-(iii), (B)-(i), (C)-(ii), (D)-(v)
(c) (A)-(iv), (B)-(v), (C)-(i), (D)-(ii)
(d) (A)-(i), (B)-(ii), (C)-(iii), (D)-(iv)

☐☐☐

Booklet Batch RollNumber

Ⓐ 10+1 Ⓢ
Ⓑ 10-2 Ⓥ
Ⓒ 10-3 Ⓐ
Ⓓ Crash Ⓒ
Ⓔ
Ⓕ Paper
Ⓖ
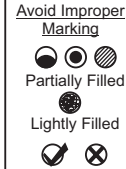Ⓗ Paper 1 ①
Ⓘ Paper 2 ②
Ⓙ

Name

Test Date   Invigilator's Signature

Student's Signature

Certified that all the entries In this section have been properly filled by the student

The OMR Sheet will be computer checked Fill the clrcles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code

ANSWER KEY

1	(c)		31	(a)		61	(a)		91	(a)		121	(b)
2	(a)		32	(c)		62	(b)		92	(d)		122	(a)
3	(b)		33	(b)		63	(b)		93	(b)		123	(c)
4	(a)		34	(c)		64	(a)		94	(b)		124	(c)
5	(b)		35	(c)		65	(b)		95	(a)		125	(c)
6	(d)		36	(d)		66	(a)		96	(a)		126	(b)
7	(b)		37	(a)		67	(b)		97	(b)		127	(b)
8	(a)		38	(b)		68	(b)		98	(b)		128	(c)
9	(b)		39	(d)		69	(a)		99	(b)		129	(c)
10	(d)		40	(b)		70	(a)		100	(a)		130	(c)
11	(b)		41	(b)		71	(c)		101	(a)		131	(a)
12	(a)		42	(d)		72	(a)		102	(b)		132	(d)
13	(b)		43	(c)		73	(d)		103	(b)		133	(c)
14	(c)		44	(b)		74	(c)		104	(c)		134	(c)
15	(a)		45	(a)		75	(a)		105	(d)		135	(d)
16	(a)		46	(b)		76	(b)		106	(d)		136	(d)
17	(c)		47	(a)		77	(b)		107	(d)		137	(a)
18	(b)		48	(a)		78	(d)		108	(d)		138	(a)
19	(b)		49	(a)		79	(a)		109	(b)		139	(d)
20	(b)		50	(d)		80	(a)		110	(b)		140	(d)
21	(c)		51	(d)		81	(c)		111	(a)		141	(b)
22	(d)		52	(c)		82	(a)		112	(a)		142	(d)
23	(b)		53	(a)		83	(a)		113	(a)		143	(b)
24	(b)		54	(a)		84	(d)		114	(b)		144	(b)
25	(d)		55	(a)		85	(a)		115	(a)		145	(d)
26	(c)		56	(b)		86	(c)		116	(b)		146	(c)
27	(c)		57	(c)		87	(a)		117	(b)		147	(b)
28	(a)		58	(a)		88	(d)		118	(b)		148	(a)
29	(a)		59	(a)		89	(c)		119	(d)		149	(b)
30	(b)		60	(d)		90	(a)		120	(d)		150	(a)

151	(d)
152	(c)
153	(a)
154	(d)
155	(c)
156	(d)
157	(a)
158	(a)
159	(b)
160	(a)
161	(c)
162	(b)
163	(d)
164	(b)
165	(b)
166	(a)
167	(d)
168	(b)
169	(d)
170	(a)
171	(a)
172	(d)
173	(c)
174	(a)
175	(d)
176	(b)
177	(a)
178	(b)
179	(a)
180	(b)

ANSWERS WITH EXPLANATIONS

PHYSICS

1. Option (c) is correct.

Wavelength of EM wave $\propto \dfrac{1}{\text{Energy}}$, the given options Gamma – rays has maximum energy, shortest wavelength.

2. Option (a) is correct.

Angular acceleration $(\alpha) = \propto \dfrac{\omega_f - \omega_i}{t}$

$$\omega_i = 360 \text{ rpm}$$

$$= 360 \times \dfrac{2\pi}{60} \text{ rad/s}$$

$$\omega_f = 1200 \text{ rpm}$$

$$= 1200 \times \dfrac{2\pi}{60} \text{ rad/s}$$

$$\therefore \quad \alpha = \dfrac{40\pi - 12\pi}{14}$$

$$= 2\pi \text{ rad/s}^2$$

3. Option (b) is correct.

As γ particle does not have any charge and mass, therefore, γ radiation does not changes mass number or atomic number.

4. Option (a) is correct.

1 minute of arc $= \dfrac{1}{60°}$ and $1° = \dfrac{\pi}{180°}$ rad

$\therefore \quad$ 1 minute of arc $= \dfrac{1}{60°} \times \dfrac{\pi}{180°}$ rad

$$= 2.91 \times 10^{-4} \text{ rad}$$

5. Option (b) is correct.

Magnitude of induced EMF $= \left| \dfrac{d\phi}{dt} \right|$

$$= \left| \dfrac{d}{dt}(5t^2 + 3t + 16) \right|$$

$$= |10t + 3|$$

At $\quad t = 4$

$$\varepsilon = 10(4) + 3 = 43 \text{ V}$$

6. Option (d) is correct.

At equatorial position of dipole, electric field is given by

$$\vec{E} = \dfrac{K\vec{P}}{r^3}$$

$$\Rightarrow \qquad \vec{E} = -\dfrac{\vec{P}}{4\pi\varepsilon_0 r^3}$$

[(–) ve sign indicates direction of electric field is opposite to dipole moment]

7. Option (b) is correct.

Spherometer is used to measure radius of spherical surface.

8. Option (a) is correct.

Due to insertion of iron rod, inductance of coil increases, thus increasing the impedance (z) of circuit, thus decreasing current. Hence, brightness decreases.

9. Out of Syllabus

10. Option (d) is correct.

In forward biases p – terminal is connected to higher potential and n – terminal is connected to lower potential.

11. Option (b) is correct.

Applying KVL

$$-4I - 1I + 4 - 1 \times I + 2 = 0$$

$$\Rightarrow \qquad\qquad I = 1 \text{ A}$$

12. Option (a) is correct.

In YDSE,

Path difference, $\Delta x = d\sin\theta$ …(i)

and phase difference, $\Delta d = \dfrac{2\pi}{\lambda}\Delta x$ …(ii)

For central maxima $\quad \theta = 0$

using equation (i) and (ii)

$$\Delta d = 0$$

13. Option (b) is correct.

For H – atom, Total energy

$$E = \dfrac{-13.6}{n^2}\text{eV}$$

14. Option (c) is correct.

A periodic function is one which repeats itself after a fixed internal of time. e^{-wt}, $\log_e(\omega t)$ and e^{-wt} are either continuously increasing or decreasing.

$\sin wt + \cos wt$

$= \mathrm{sqr}t(2) \, (\sin wt \cos 45 + \cos wt \sin 45)$

$= \mathrm{sqr}t(2) \sin (wt + 45)$

Hence, from the above equation we can say that it will repeat after fixed interval.

15. Option (a) is correct.

de-Broglie wavelength is given by

$$\lambda = \frac{h}{\sqrt{2m(\mathrm{KE})}}$$

Mass of electron $(m) = 9.1 \times 10^{-31}$

Kinetic Energy of electron (KE) = 144 eV

$\qquad\qquad = 144 \times 1.6 \times 10^{-19}$ J

of h, m and KE in the de Broglie wavelength equation, we will get correct answer.

16. Option (a) is correct.

$$\text{Mean free path, } l = \frac{RT}{\sqrt{2}\pi d^2 N_A P}$$

$$l \propto \frac{1}{d^2}$$

17. Out of Syllabus

18. Option (b) is correct.

Applying second equation of motion, for 0.1 s. duration of time in which ball is passing through window

$$\Rightarrow \qquad 1.5 = u \times (0.1) + \frac{1}{2} \times 10 \times (0.1)^2$$

u = velocity at topmost point

$$\Rightarrow \qquad\qquad u = 14.5 \text{ m/s}$$

19. Option (b) is correct.

Comparing the given equation with standard equation of EM wave

$$B = B_0 \sin(kx + wt)$$

$$\Rightarrow \qquad k = \frac{2\pi}{\lambda} = \pi \times 10^3$$

$$\Rightarrow \qquad \lambda = 2 \times 10^{-3} \text{ m}$$

20. Option (b) is correct.

The problem is asking for new length for required frequency.

$$\text{Initial condition,} \qquad 120 = \frac{V}{2 \times 90} \qquad\qquad \ldots(i)$$

$$\text{Required condition, } 180 = \frac{V}{2 \times l} \qquad\qquad \ldots(ii)$$

$$\text{(i)} \div \text{(ii)} \qquad \frac{120}{180} = \frac{l}{90} \Rightarrow l = 60$$

21. Option (c) is correct.

Acceleration of electron will be

$$a = \frac{1}{4\pi\varepsilon_0} \frac{e \times e}{r^2 \times m_e}$$

$$= \frac{9 \times 10^9 \times (1.6 \times 10^{-19})^2}{(1.6 \times 10^{-10})^2 \times 9.1 \times 10^{-31}}$$

$$\approx 10^{22} \text{ m/s}^2$$

22. Option (d) is correct.

Davisson and Germer experiment demon-strates wave nature of electron

23. Option (b) is correct.

$$R = \frac{\rho l}{A}$$

R, ρ and l are same for both conductors.

∴ Area will also be same.

24. Option (b) is correct.

Applying KVL for BCDEB

$$\Rightarrow -i_2 R_2 + E_2 - E_3 + i_3 R_1 = 0$$

$$\Rightarrow \quad i_2 R_2 - E_2 + E_3 - i_3 R_1 = 0$$

25. Option (d) is correct.
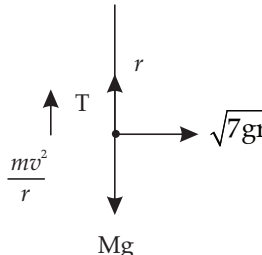
According to Wein's displacement law $\lambda \propto \dfrac{1}{T}$

$$\lambda_{\text{red}} > \lambda_{\text{yellow}} > \lambda_{\text{blue}}$$

$$\therefore \qquad\qquad T_{\text{red}} < T_{\text{yellow}} < T_{\text{blue}}$$

$$\Rightarrow \qquad\qquad T_A > T_C > T_B$$

26. Option (c) is correct.

If angle of contact is obtuse (> 90°) then liquid particles do not stick to the surface of solid.

27. Option (c) is correct.

$$T - Mg = \frac{mv^2}{r}$$

$$\Rightarrow \quad T = Mg + \frac{mv^2}{r}$$

$$= Mg + \frac{m}{r}(7gr)$$

$$\Rightarrow \quad T = 8\,Mg$$

28. Option (a) is correct.

Applying mirror's formula

$$\frac{1}{V} + \frac{1}{(-1.5f)} = \frac{1}{(-f)}$$

$$\Rightarrow \qquad\qquad \frac{1}{V} = -\frac{1}{3f}$$

$$\Rightarrow \qquad\qquad V = -3f$$

29. Out of Syllabus

30. Option (b) is correct.

Relation between critical angle (C) and refractive index (μ) is

$$\mu = \frac{1}{\sin C}$$

$$\Rightarrow \quad \mu = \frac{1}{\sin 45°} = \sqrt{2}$$

Now, $\quad \mu = \dfrac{C}{V}$

$$\Rightarrow \quad V = \frac{C}{\sqrt{2}} = \frac{3}{\sqrt{2}} \times 10^8$$

31. Option (a) is correct.

Induced EMF between axle (center) and rim (Circumference) of wheel

$$\varepsilon = \frac{1}{2} B\omega r^2$$

$$= \frac{1}{2} \times 0.4 \times 10^{-4} \times 120 \times \frac{2\pi}{60} \times 1^2$$

$$= 2.51 \times 10^{-4} \text{ V}$$

Note: There was no use of number of spokes as EMF will be same for each spoke.

32. Option (c) is correct.

$$PV = nRT$$

$$\Rightarrow \quad PV = \frac{m}{M_0} RT$$

Hence, $\quad P = \dfrac{m}{V}$ (mass density)

$$\Rightarrow \quad M_0 = \text{molar mass}$$

33. Option (b) is correct.

For a metallic shell (hollow sphere) Potential inside shell $(r < R) = \dfrac{KQ}{R}$ (constant)

and potential outside shell $(r > R) = \dfrac{KQ}{r}$

34. Option (c) is correct.

With the help of NAND gates, other gates can be obtained. Thus, it is called universal gate.

35. Option (c) is correct.

As pressure remains constant, the process is isobaric.

36. Option (d) is correct.

$$\text{Power} = \frac{1}{f}$$

$$\therefore \quad f = 0.1 \text{ m} = 10 \text{ cm}$$

Now by len's makers formula

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{10} = (\mu - 1)\left(\frac{1}{(+10)} - \frac{1}{(-10)}\right)$$

$$\Rightarrow \quad \mu = \frac{3}{2}$$

37. Option (a) is correct.

n–type semiconductor is obtained when intrinsic semiconductor is doped with pentavalent impurity.

38. Option (b) is correct.

As $\quad 760X = 13600 \times 76$

so, $\quad X = 13.6$ m will be the answer.

39. Option (d) is correct.

Magnetic moment

$$M = \text{Current} \times \text{Area}$$
$$= I \times \pi R^2$$

Length, $L = 2\pi R$

$$\Rightarrow \quad R = \frac{L}{2\pi}$$

$$\therefore \quad M = I \times \pi \left(\frac{L}{2\pi}\right)^2$$

$$\Rightarrow \quad M = \frac{IL^2}{4\pi} A m^2$$

40. Option (b) is correct.

$$\text{Original Capacitance} = \frac{A\varepsilon_0}{d}$$

$$\text{New capacitance} = \frac{A\varepsilon_0}{\left\{\left(d - \dfrac{d}{2}\right) + \dfrac{d}{2k}\right\}} = \frac{8A\varepsilon_0}{5d}$$

$\therefore$ Ratio will be 8 : 5

41. Option (b) is correct.

Value of 'g' at a depth 'd' is given by

$$g' = g\left(1 - \frac{d}{R}\right)$$

Given $\quad g' = \dfrac{g}{n}$

$$\therefore \quad \frac{g}{n} = g\left(1 - \frac{d}{R}\right)$$

$$\Rightarrow \quad \frac{d}{R} = \left(\frac{n-1}{n}\right)$$

$$\Rightarrow \quad d = \left(\frac{n-1}{n}\right)R$$

42. Option (d) is correct.

Mean time interval will be

$$T_M = \frac{1.25 + 1.24 + 1.27 + 1.21 + 1.28}{5}$$

$$= \frac{6.25}{5} = 1.25 \text{ s}$$

$\therefore$ Absolute errors will be 0 s, 0.01 s, 0.02 s, 0.04 s and 0.03 s respectively

$\Rightarrow$ Mean absolute error

$$\Rightarrow \quad \Delta T = \frac{0 + 0.01 + 0.02 + 0.04 + 0.03}{5} = 0.02 \text{ s}$$

$$\therefore \quad \text{Percentage error} = \frac{0.02}{1.25} \times 100 = 1.6\%$$

43. Option (c) is correct.

$$\vec{r}_{CM} = \frac{M_1\vec{r}_1 + M_2\vec{r}_2 + M_3\vec{r}_3}{M_1 + M_2 + M_3}$$

$$= \frac{M(0) + M(2\hat{i}) + M(2\hat{j})}{3M}$$

$$= \frac{2}{3}(\hat{i} + \hat{j})$$
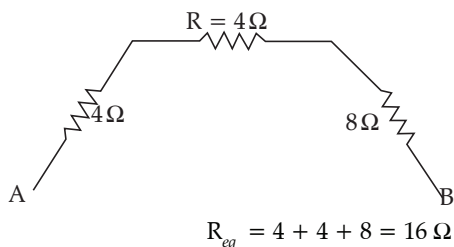
44. Option (b) is correct.

Upper 4 Ω and 8 Ω are in series and their equivalent is parallel to 6 Ω.

∴ Equivalent of above mentioned resistors is

$$\frac{1}{R} = \frac{1}{(4+8)} + \frac{1}{6}$$

$$\Rightarrow \qquad R = 4\ \Omega$$

Now circuit becomes

∴ $R_{eq} = 4 + 4 + 8 = 16\ \Omega$

45. Option (a) is correct.

For 2 kg block

$$2g - T = 2a \qquad \qquad …(i)$$

For 10 kg Trolly

$$T - (0.05)10g = 10a \qquad …(ii)$$

Solving (i) and (ii) $1.5g = 12a$

$$\Rightarrow \qquad a = \frac{5}{4} = 1.25\ \text{m/s}^2$$
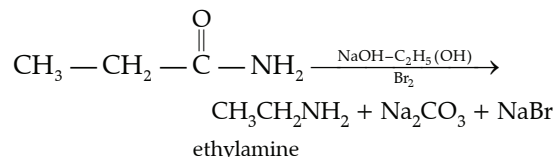

CHEMISTRY

46. Out of Syllabus

47. Option (a) is correct.

In Cu_2O, the oxidation no. of O is –2. Rest all are correct.

48. Option (a) is correct.

Hoffmann bromamide reaction

$$CH_3 — CH_2 — \overset{\overset{O}{\|}}{C} — NH_2 \xrightarrow[\text{Br}_2]{\text{NaOH}-C_2H_5(\text{OH})}$$

$$CH_3CH_2NH_2 + Na_2CO_3 + NaBr$$

ethylamine

49. Option (a) is correct.

The compound should be steam volatile and immiscible with water. Aniline is separated from aniline-water mixture by applying this method.
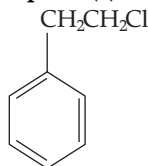
50. Option (d) is correct.

N_2O is linear.

51. Option (d) is correct.

Phenol will be more reactive as it has ring activating group attached directly to the ring. –OH group will activate the ring due to both +I and +M effects.

52. Option (c) is correct.

will not undergo as it is primary halo compound otherwise all the other compounds are allyl, tertiary and benzyl which form stable carbocation.

53. Out of Syllabus

54. Out of Syllabus

55. Option (a) is correct.

$$\Delta G = \Delta H - T\Delta S$$

for spontaneity, $\Delta G < 0$

$$\Delta H - T\Delta S < 0$$

$$30000 < 450 \times \Delta S$$

$$66.67 < \Delta S$$

so, ΔS should be more than 66.67. Therefore, 70 is the correct answer here.

56. Option (b) is correct.

Copper is a transition metal, Fluorine is a non metal, Silicon is a metalloid and Cerium is a lanthanoid. So, (b) is correctly matched.

57. Option (c) is correct.

For free radical formation heat (H), Electricity (C), Light (L), Peroxide (P), Radical (R) is required.

As the reaction will occur in presence of sunlight.

Hence, Bromination of Methane in a free radical reaction.

58. Option (a) is correct.

Conc. sulphuric acid behaves as dehydrating agent for carbohydrates.

$$C_{12}(H_2O)_n + \text{Conc. } H_2SO_4 \rightarrow$$

$$12C + (nH_2O + H_2SO_4)$$
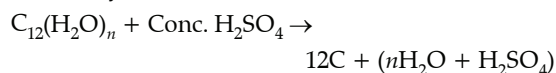
59. Option (a) is correct.

p-nitrophenol has $-NO_2$ group attached directly to ring. Due to –I and –M effect it will stabilise the phenoxide ion formed by release of H^+ ion.

60. Option (d) is correct.

XeF_2 = Linear
XeF_4 = Square planar
XeO_3 = Pyramidal
$XeOF_4$ = Square pyramidal

61. Option (a) is correct.

$$k = [R_0]/2t_{1/2}$$

$$k = \frac{0.02}{2 \times 100}$$

$$k = 10^{-4}\ \text{mol L}^{-1}\ \text{s}^{-1}$$

62. Option (b) is correct.

Lanthanoids show variable oxidation state out of which +3 is most stable. Apart from +3, lanthanoids show +2 and +4 oxidation states.

63. Option (b) is correct.

Mn reveals maximum numbers of different oxidation states. Zinc is although placed with transition metal but it is not a transition metal as per definition. Sc shows only +3 oxidation state. Copper undergoes disproportionation when in +1 state. So, (b) is correctly matched.

64. Option (a) is correct.

$$X = \frac{8}{M}$$

$$X_{n\text{-octane}} = \frac{114}{114} = 1$$

$$P°_{n\text{-octane}} - P°_{n\text{-octane}}X = 0.2P°_{n\text{-octane}}$$
$$P°_{n\text{-octane}}(1 - X_{n\text{-octane}}) = 0.2P°_{n\text{-octane}}$$
$$(1 - X_{n\text{-octane}}) = 0.2$$
$$X_{solute} = 0.2$$

$$\frac{8}{M} = 0.2$$

$$M = \frac{8}{0.2}$$

$$M = 40$$

65. Option (b) is correct.

sp^3 is tetrahedral, dsp^2 is square planar, sp^3d is trigonal bipyramidal, d^2sp^3 is octahedral.

66. Option (a) is correct.

0 angular nodes and 2 radial nodes.
No. of angular nodes $= l$
No. of Radial nodes $= n - l - 1$
Given for $3s$ orbital $n = 3$, $l = 0$
No. of angular nodes $= 0$
No. of radial nodes $= 2$

67. Option (b) is correct.

Due to the diagonal relationship between elements Li (period 2) and Mg (period 3), their physical properties are identical.

68. Option (b) is correct.

Osteomalacia refers to a marked softening of your bones, most often caused by severe vitamin D deficiency.
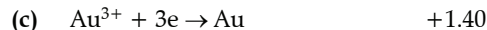
69. Option (a) is correct.

PCl_5 is trigonal bipyramidal.
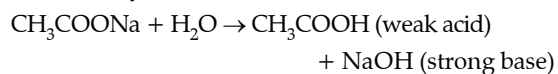
70. Option (a) is correct.

Reaction is hydroboration-oxidation. It adds water across double bond to give anti markonikov's product.
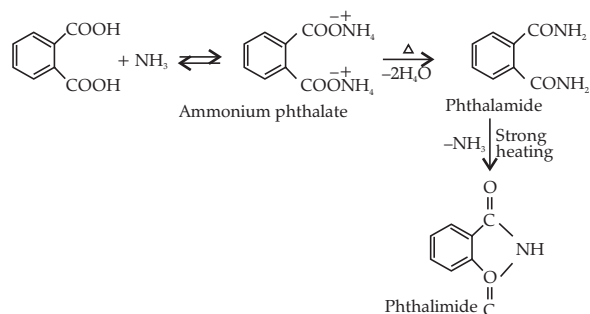
71. Option (c) is correct.
Au is least reactive of all the given metals. So, it will be at the top in EMF series as compared to other given metals.

Reduction gald reaction	E/V at 298 K
(a) $Mg^{2+} + 2e \rightarrow Mg$	–2.36
(b) $Fe^{2+} + 2e \rightarrow Fe$	–0.44
(c) $Au^{3+} + 3e \rightarrow Au$	+1.40
(d) $K^+ + e \rightarrow K$	–2.93

72. Out of Syllabus

73. Option (d) is correct.

Sodium acetate is a salt of strong base and weak acid, so the nature of the solution will be basic. All the other given salts are salts of strong acid and weak base. So, they all will form acidic solution.

$$CH_3COONa + H_2O \rightarrow CH_3COOH \text{ (weak acid)}$$
$$+ NaOH \text{ (strong base)}$$

74. Out of Syllabus

75. Option (a) is correct.

Phthalic acid undergoes dehydration on heating to form acid anhydride and on heating with ammonia it forms ammonium phthalate which further forms phthalamide by dehydration and on strong heating further it finally forms Phthalimide.

76. Option (b) is correct.

In fuel cell, H_2 and O_2 combine to form water.

77. Option (b) is correct.

From Arrhenius equation,
We get, $k = A \times e^{-Ea/RT}$
k = rate constant,
$e^{-Ea/RT}$ = Fraction of molecules with energy greater than E_a at TK.
Again $A = P \times Z_{AB}$ = Arrhenius fractor of frequency where P = Steric factor Z_{AB} = collision frequency of reactants A and B i.e., no. of binary collision between A and B in unit volume.
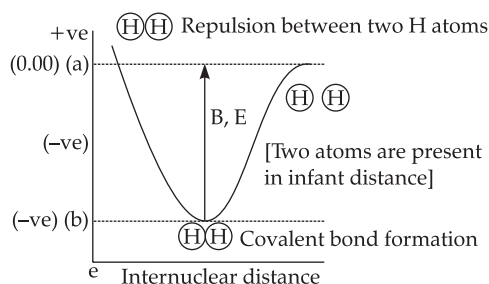
78. Option (d) is correct.

Glucose had 6 carbon atoms. So, it is a aldohexose but not aldopentose.

79. Option (a) is correct.

Bond energy of H-H bond is the difference in energy due to bond formation. In the given graph, a is the amount of energy in atomic form while b is the amount of energy in bonded form. So, bond energy will be $b - a$.
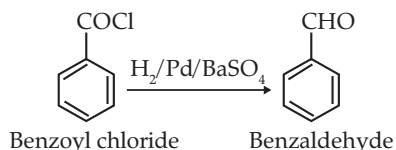
+ve — (H)(H) Repulsion between two H atoms
(0.00) (a)
(–ve)   (H) (H)
                          B, E   [Two atoms are present
(–ve) (b)   in infant distance]
              e (H)(H) Covalent bond formation
        Internuclear distance

80. Option (a) is correct.

Rosenmund reaction (partial-reduction).

COCl   CHO

$\xrightarrow{H_2/Pd/BaSO_4}$

Benzoyl chloride   Benzaldehyde

81. Option (c) is correct.

There are 7 sp^2 hybridized C. Six in benzene ring and one of C=O and 6 pi-bonds, 3 in benzene ring, 2 in triple bond and 1 in C=O.

82. Option (a) is correct.

$$- 2\Delta H_{HBr} + \Delta H_{H_2} + \Delta H_{Br_2} = -109$$
$$2 \times \Delta H_{HBr} + 435 + 192 = -109$$

$$2 \times \Delta H_{HBR} = -627 - 109$$
$$2 \times \Delta H_{HBR} = -736$$
$$\Delta H_{HBr} = -368 \text{ kJ/mole}$$

So, bond energy of H – Br bond is 368 kJ/mole.

83. Out of Syllabus

84. Out of Syllabus

85. Option (a) is correct.

SnO_2 is amphoteric in nature.

86. Out of Syllabus

87. Out of Syllabus

88. Option (d) is correct.

Avogadro's Number = no. of particles in one mole of any substance.

89. Option (c) is correct.

Isotonic Solutions will have same osmotic pressure.

90. Option (a) is correct.

$K_{sp} = s^2$

So, Solubility,

$$s = \sqrt{K_{sp}} = \sqrt{4 \times 10^{-8}}$$
$$= 2 \times 10^{-4} \text{ mol/L}$$

BIOLOGY

91. Option (a) is correct.

In false fruits, there is involvement of other parts along with ovary in formation of fruit.

92. Option (d) is correct.

Hind II was the first restriction enzyme to be isolated. This enzyme was first isolated from *Haemophilus influenzae* Ry13 strain II. So, the enzyme was shortly labelled as *Hind II*.

93. Option (b) is correct.

Energy content gradually decreases from first to fourth trophic level.

94. Option (b) is correct.

Nuclein was used by Friedrich Miescher to describe the nuclear material he discovered in 1869, which today is known as DNA.

95. Option (a) is correct.

Sutton and Boveri proposed chromosomal theory of inheritance in early 1900's. It is the fundamental theory of genetics.

96. Option (a) is correct.

Phycoerythrin (PE) is a red protein-pigment complex from the light-harvesting phycobiliprotein family, present in red algae.

97. Option (b) is correct.

Glycine is an example of amino acid.

98. Option (b) is correct.

The statement male and female gametophytes are free living is incorrect about gymnosperms. The correct information regarding this statement is as follows-

In gymnosperms, male and female gametophytes do not have independent free-living existence. They remain within the sporangia retained on the sporophytes. All other given statements are correct.

99. Option (b) is correct.

Eichhornia crassipes is called water hyacinth was introduced for ornamentation but has become a troublesome weed in India.

100. Option (a) is correct.

In mustard plant, gynoecium occupies the highest position, while the other parts are situated below it.

101. Option (a) is correct.

Antibiotics are used to keep the medium bacteria free. Antibiotic resistance genes are used as selectable markers.

102. Option (b) is correct.

According to Alexander von Humboldt, species richness increases with increasing area, but only up to limit.

103. Option (b) is correct.

The statement wind pollinated plants have many ovules in each ovary is incorrect. Rather, wind pollinated plants have single ovule in each ovary. Rest all the other given statements are correct.

104. Option (c) is correct.

The correct floral formula of Liliaceae is

$$Br \oplus \underset{+}{\oslash} \widehat{P}_{(3+3)} A_{3+3} \underline{G}_{(3)}$$
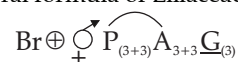
The flowers of the Liliaceae family are bracteate, actinomorphic, bisexual. The perianth is with 6

tepals, arranged in two whorls (3+3), often united into a tube, valvate aestivation. The androecium is with 6 stamens, 3+3, epipetalous. Gynoecium is with tricarpellary, syncarpous, trilocular with many ovules, ovary superior, axile placentation.

105. Option (d) is correct.

In the polynucleotide chain of DNA, a nitro-genous base is linked to the –OH of 1'C pentose sugar.

106. Option (d) is correct.

In *Glycine max* (Soyabean) the product of biological nitrogen fixation is transported with the help of xylem vessels, from the root nodules to other parts in the form of ureides. It is investigated that, in Soyabean nodules the major part of fixed ammonia in symbiotic state of rhizobia is rapidly excreted to the cytosol of infected cells in nodules and then with the help of glutamine synthetase pathway, the ammonia is assimilated into amino acids. The fixed nitrogen is then assimilated into ureides and followed by transportation to other parts.

107. Option (d) is correct.

Mendel studied 7 contrasting characters for his hybridisation experiments.

108. Option (d) is correct.

During metaphase spindle fibres attach to kinetochores of chromosomes.

109. Option (b) is correct.

Herbivores - Plants shows **predation** type of interaction, in which an animal called predator (Herbivores) kills and consumes the other weaker animal called (prey).

Mycorrhiza - Plants show **mutualism** in which both the interacting species are benefitted.

Sheep - Cattle show **competition** for the same limited resources like grass.

Orchid - Tree shows **commensalism** in which orchid is benefitted by getting shelter on the tree while the tree is neither harmed nor benefitted.

110. Option (b) is correct.

Bulbil is a vegetative propagule of *Agave*.

111. Option (a) is correct.

Aquaporin are membrane proteins (**polypeptide**) for passive transport of water.

Asparagine is beta-amide derivative of aspartic acid. It carries more nitrogen than amino acid.

Abscisic acid (ABA) is **carotenoid** derivative plant hormone.

Chitin is homopolymer of N-acetylglucosamine, considered as homopolysaccharide.

112. Option (a) is correct.

Magnesium is required for maintaining the structure of ribosomes.

113. Option (a) is correct.

Term kinetin was coined by Skoog and Miller.

114. Option (b) is correct.

The correct match of approach and method are-

In-situ (on site) conservation - Biosphere Reserve

Ex-situ (off site) conservation - Cryopreservation

On the other hand, the other given options are corrected as-

Ex-situ conservation - Seed banks

In-situ conservation - Sacred groves

115. Option (a) is correct.

Ernst Heckel provided the embryological support for evolution.

116. Option (b) is correct.

Water replaces lost electrons from reaction centre at PS II.

117. Option (b) is correct.

$G_1 \rightarrow S \rightarrow G_2 \rightarrow M$.

118. Option (b) is correct.

Gas vacuoles are inclusion bodies of blue-green, purple and green photosynthetic bacteria.

119. Option (d) is correct.

Large, empty colourless cells of the adaxial epidermis along the veins of grass leaves are called bulliform cells.

120. Option (d) is correct.

Biosynthesis of *r*RNA occurs in nucleolus.

121. Option (b) is correct.

Cyanobacteria like *Nostoc*, *Anabaena*, etc. possess specialised cells called heterocysts (sites of nitrogen fixation). These are large cells with thick walls and impermeable to oxygen.

122. Option (a) is correct.

Cork cambium is also known as phellogen. It cut off cells on both sides, i.e. the outer cells differentiate into cork (phellem) while the inner cells differentiate into secondary cortex (phelloderm).

123. Option (c) is correct.

Unloading of sucrose at sink involves the utilisation of ATP.

124. Option (c) is correct.

Air (Prevention and Control of Pollution) Act was amended in 1987 to include noise among pollutants.

125. Option (c) is correct.

Subjecting seeds to ascorbic acid cannot be used to remove inhibitory substances in dormant seeds.

126. Option (b) is correct.

Bioreactor – vessel in which large quantities of products can be prepared. Electrophoresis – separation of DNA based on size. PCR – Polymerase Chain Reaction, ELISA – Enzyme Linked Immunosorbent Assay.

127. Option (b) is correct.

In C_4 plants, the site of RuBisCO activity is bundle sheath cells.

128. Option (c) is correct.

Phosphorus is not released during respiration. Rocks are major reservoir of phosphorus. Phosphorous cycle is sedimentary cycle. Carbon is released during respiration.

129. Option (c) is correct.

Life on earth appeared 500 million years after formation of earth.

130. Option (c) is correct.

Separation of DNA fragments occurs by electrophoresis.

131. Option (a) is correct.

Endocarp is not edible in both mango and coconut. Instead, it is edible only in coconut whereas in mango, the pericarp is well differentiated into an outer thin epicarp, a middle fleshy edible mesocarp and an inner stony hard endocarp.

132. Option (d) is correct.

In immigration individuals of same species enter a population from elsewhere; so it will increase the population density and has positive impact.

133. Option (c) is correct.

In angiosperms, male and female gametophytes do not have free living existence.

134. Option (c) is correct.

Ethephon is the most widely used compound as a source of ethylene. It is known to control **fruit ripening** in tomatoes and apples.

Auxin like **2, 4-D** (2, 4-dichlorophenoxyacetic acid) is widely used as **herbicide** and weedicide.

GA (Gibberellic Acid) helps in promoting internode elongation (**bolting**) just before their reproductive phase.

Abscisic acid is known as **stress hormone** because its production is stimulated under stress (unfavourable conditions.)

135. Option (d) is correct.

Pyruvic acid is converted into acetyl CoA with the help of pyruvate dehydrogenase complex. Pyruvate dehydrogenase requires magnesium, CoA, NAD^+, TPP and lipoic acid.

136. Option (d) is correct.

The rate of decomposition is slow if it contains lignin, chitin, tannins (phenolics) and cellulose.

137. Option (a) is correct.

Microbe used for industrial production of citric acid is *Aspergillus niger.*

138. Option (a) is correct.

Genital herpes, Hepatitis B, HIV infection are incurable STD's.

139. Option (d) is correct.

Spooling is collection of isolated DNA. PCR (Polymerase Chain Reaction) – amplification of DNA. Blotting – transfer of DNA to membranes.

140. Option (d) is correct.

The phenomenon of evolution of different species in a given geographical area starting from a point and spreading to other habitats is called adaptive radiation.

141. Option (b) is correct.

Best example for pleiotropy is phenylketonuria. Pleiotropic genes have multiple phenotypes.

142. Out of Syllabus

143. Option (b) is correct.

Epinephrine/adrenaline is a catecholamine and a biogenic amine. Cortisol is a steroid. Endorphins are natural painkiller.

144. Option (b) is correct.

Annelids exhibit metameric segmentation, bilateral symmetry and triploblastic (three germ layers) condition.

145. Option (d) is correct.

Dragonflies are used as biocontrol agents to get rid of aphids and mosquitoes.

The bacteria, *Bacillus thuringiensis* are used as biocontrol agents. Their toxin genes have been introduced into several plants to control the attack by insect pests such as lepidopterans (tobacco budworm, armyworm).

Many members of the genus *Glomus* form mycorrhiza (symbiotic associations with plants). In this, the fungal symbiont absorbs phosphorus from soil and transfers it to the plant.

Baculoviruses belongs to the genus Nucleopolyhedrovirus. These viruses are excellent for species-specific, narrow spectrum insecticidal applications.

146. Option (c) is correct.

Oxyntic cells/parietal cell secrete intrinsic factor for absorption of vit B_{12}.

147. Option (b) is correct.

Oxytocin and vasopressin are stored and released from neurohypophysis.

148. Option (a) is correct.

The correct matches are as follows-

	Column - I		Column - II
(i)	Typhoid	(D)	*Salmonella typhi* (bacterium)
(ii)	Malaria	(C)	*Plasmodium vivax* (protozoan)
(iii)	Pneumonia	(A)	*Haemophilus influenzae* (bacterium)
(iv)	Filariasis	(B)	*Wuchereria bancrofti* (helminth)

149. Option (b) is correct.

End of first trimester, major organs systems are formed.

150. Option (a) is correct.

The inner layer of the eye (retina) contains **photoreceptor or visual cells**, i.e. rods and cones. Both of these contain light sensitive proteins called photopigments.

In the eye, the point of exit of optic nerves through the retina does not have rods and cones and thus produces a **blind spot**. At this spot, no image is formed.

The **fovea centralis** is a thinned-out portion of the retina where only the cones are densely packed. At this point, visual acuity is greatest.

Iris is the visible coloured portion of the eye. The pigment present in it gives characteristic colour to the eyes.

151. Option (d) is correct.

The size of Pleuropneumonia - like Organism (PPLO) is 0.1 μm.

152. Out of Syllabus

153. Option (a) is correct.

The correct matches of organisms with their respective distinctive characteristics are as follows-

Platyhelminthes- The body is bilaterally symmetrical and the digestive system is simple and incomplete with only one opening (mouth).

Echinoderms- The adults have radial (pentamerous) symmetry. Reproduces sexually with external fertilisation and development is indirect.

Hemichordates- They has soft, cylindrical and unsegmented body (divisible into proboscis, collar and trunk).

Aves- They maintains constant body temperature (warm blooded). Reproduces sexually with internal fertilisation and development is direct.

154. Option (d) is correct.

Cyclosporin A, an immunosuppressant used in organ transplantation and other cases is obtained from *Trichoderma polysporum.*

155. Option (c) is correct.

Gel Electrophoresis – separation of DNA fragments. Ligase- join DNA fragments. PCR – amplification of DNA.

156. Option (d) is correct.

The increase in osmolarity from outer to inner medullary interstitium, i.e., from 300 mOsmolL^{-1} in the cortex to about 1200 mOsmolL^{-1} in the inner medulla is maintained due to close proximity between henle's loop and vasa recta as well as counter current mechanism.

Other statements can be corrected as- PCT helps in selective secretion of H$^+$, ammonia and K$^+$ ions and absorption of HCO$_3^-$ from the filtrate.

Blood pressure in glomerular capillaries is responsible for glomerular filtration and not for counter current mechanism.

157. Option (a) is correct.

Passive immunity - Antibodies directly pass from mother to baby to provide immunity.

158. Out of Syllabus

159. Option (b) is correct.

RNA interference is used to protect the tobacco plant from attack of nematode *Meloidegyne incognita.*

160. Option (a) is correct.

The average rate of polymerisation of DNA in *E.coli* is 2000 bp per second. It has only 4.6×10^6 bp and completes the process of replication within 18 minutes.

161. Option (c) is correct.

Progestogens alone or in combination with estrogens can be used as a contraceptive in the form of pills, injection and implants.

162. Option (b) is correct.

According to Central Pollution Control Board [CPCB] 2.5 micrometer (in diameter) of particulate matter is responsible for causing greater harm to human health.

163. Option (d) is correct.

Total Lung Capacity (TLC) = TV+ IRV + ERV+ RV.

164. Option (b) is correct.

Secondary spermatocyte, first polar body and ovum have 23 chromosomes and are considered to be haploid (*n*).

165. Option (b) is correct.

Synapsis takes place during zygotene stage.

166. Option (a) is correct.

The correct match is as follows-

	Column - I		Column - II
(A)	Smooth endoplasmic reticulum	(i)	Lipid synthesis
(B)	Rough endoplasmic reticulum	(ii)	Protein synthesis
(C)	Golgi complex	(iii)	Glycosylation
(D)	Centriole	(iv)	Spindle formation

167. Option (d) is correct.

ANF decreases blood pressure. Angiotensin II – powerful vasoconstrictor. Vasa recta has counter current mechanism.

168. Option (b) is correct.

Parasympathetic nerves decrease cardiac output.

169. Option (d) is correct.

Reduced fertility and productivity due to continued close inbreeding is called inbreeding depression**.**

170. Option (a) is correct.

Chondrocytes are cartilage cells.

171. Option (a) is correct.

The laws and rules to prevent unauthorized exploitation of bio-resources are termed as biopatenting.

172. Option (d) is correct.

Ovaries produce and release two groups of sex hormones- **estrogen and progesterone.**

Placenta also acts as an endocrine tissue and produces hormone like **human chorionic gonadotropin**, human placental lactogen.

Corpus luteum secretes large amount of **progesterone** which is essential to maintain endometrium.

Leydig cells synthesise and secrete the testicular hormones called **androgens.**

173. Option (c) is correct.

Aptenodytes common name is **penguin** and it is classified under class Aves.

Pteropus is **flying fox**. It is categorised under class Mammalia.

Pterophyllum is commonly known as **angel fish**. It is a bony fish, classified under osteichthyes.

Petromyzon is called as **lamprey**. It classified under cyclostomata.

174. Option (a) is correct.

A hominid fossil discovered in Java in 1891, now extinct, having cranial capacity of about 900 cc was *Homo erectus***.**

175. Option (d) is correct.

The correct match of the events that occur in their respective phases of cell cycle -

G$_1$ phase - Cell becomes metabolically active. It continuously grows and duplicates the organelles.

S phase - Actual synthesis or replication of DNA takes place. Here, overall amount of DNA doubles per cell but chromosomes only duplicates (no increase in number).

G_2 phase - Cytoplasmic growth of cell continues and prepares to undergo division.

Metaphase in M-phase - Chromosomes gets aligned along metaphase plate through spindle fibres to both poles.

176. Option (b) is correct.

Pneumotaxic centre primarily limits the inspiration. It is present in the pons region of the brain.

O_2 dissociation curve is also known as oxygen haemoglobin dissociation curve. It is obtained on plotting percentage saturation of haemoglobin with O_2 against the pO_2.

Carbonic anhydrase (zinc containing enzyme) is mainly present in the RBCs and its minute quantity is present in the plasma.

Alveoli are the primary sites of exchange of gases.

177. Option (a) is correct.

Polymorphism in DNA sequence is the basis of genetic mapping of human genome as well as DNA finger printing.

178. Option (b) is correct.

Mother Rh^{-ve} and foetus Rh^{+ve} causes erythro-blastosis foetalis.

179. Option (a) is correct.

All chordates have a notochord but only in adult of some chordates or vertebrates, the notochord is replaced by a cartilaginous or bony vertebral column. So, all chordates are not vertebrates. All vertebrates are chordates as they have notochord during the embryonic stage.

180. Option (b) is correct.

The correct match is as follows-

Gout- It is the type of arthritis that occurs mainly due to defect or accumulation of uric acid crystals in the joints.

Osteoporosis- In this, reduction in bone tissue mass occurs. It is majorly caused due to decreased level of estrogen and more common in women.

Tetany- It is characterised by periodic painful muscular spasms and tremors. It is caused by low Ca^{++} ions in the blood.

Muscular dystrophy- It is genetic (inborn) disorder of muscles associated with muscle dysfunction and deterioration.

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