CBSE AIPMT

SOLVED PAPER 2018

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. A carbon resistor of (47 ± 4.7) kΩ is to be marked with rings of different colours for its identification. The colour code sequence will be `Out of Syllabus`
   (a) Green – Orange – Violet – Gold
   (b) Yellow – Green – Violet – Gold
   (c) Yellow – Violet – Orange – Silver
   (d) Violet – Yellow – Orange – Silver

2. A set of 'n' equal resistors, of value 'R' each, are connected in series to a battery of emf 'E' and internal resistance 'R'. The current drawn is I. Now, the 'n' resistors are connected in parallel to the same battery. Then the current drawn from battery becomes 10 I. The value of 'n' is
   (a) 9   (b) 20   (c) 11   (d) 10

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

   (a)   (b)

   (c)   (d)

4. The power radiated by a black body is P and it radiates maximum energy at wavelength, λ_0. If the temperature of the black body is now changed so that it radiates maximum energy at wavelength $\frac{3}{4}$

   λ_0, the power radiated by it becomes nP. The value of n is `Out of Syllabus`
   (a) $\frac{81}{256}$ (b) $\frac{256}{81}$ (c) $\frac{4}{3}$ (d) $\frac{3}{4}$

5. Two wires are made of the same material and have the same volume. The first wire has cross-sectional area A and the second wire has cross-sectional area 3A. If the length of the first wire is increased by Δl on applying a force F, how much force is needed to stretch the second wire by the same amount ?
   (a) F   (b) 4 F   (c) 6 F   (d) 9 F

6. A sample of 0.1 g of water at 100°C and normal pressure (1.013×10^5 Nm^{-2}) requires 54 cal. of heat energy to convert to steam at 100°C. If the volume of the steam produced is 167.1 cc, the change in internal energy of the sample, is
   (a) 84.5 J   (b) 42.2 J   (c) 208.7 J   (d) 104.3 J

7. A small sphere of radius 'r' falls from rest in a viscous liquid. As a result, heat is produced due to viscous force. The rate of production of heat when the sphere attains its terminal velocity, is proportional to
   (a) r^4 (b) r^5 (c) r^2 (d) r^3

8. The moment of the force, $\bar{F} = 4\hat{i} + 5\hat{j} - 6\hat{k}$ at (2, 0, –3), about the point (2, –2, –2), is given by
   (a) $-7\hat{i} - 4\hat{j} - 8\hat{k}$ (b) $-7\hat{i} - 8\hat{j} - 4\hat{k}$
   (c) $-4\hat{i} - \hat{j} - 8\hat{k}$ (d) $-8\hat{i} - 4\hat{j} - 7\hat{k}$

9. A student measured the diameter of a small steel ball using a screw gauge of least count 0.001 cm. The main scale reading is 5 mm and zero of circular scale division coincides with 25 divisions above the reference level. If screw gauge has a zero error of –0.004 cm, the correct diameter of the ball is
   (a) 0.529 cm   (b) 0.053 cm   (c) 0.525 cm   (d) 0.521 cm

10. A toy car with charge q moves on a frictionless horizontal plane surface under the influence of a

uniform electric field $\vec{E}$. Due to the force $q\vec{E}$, its velocity increases from 0 to 6 m/s in one second duration. At that instant the direction of the field is reversed. The car continues to move for two more seconds under the influence of this field. The average velocity and the average speed of the toy car between 0 to 3 seconds are respectively

(a) 1.5 m/s, 3 m/s   (b) 1 m/s, 3.5 m/s

(c) 1 m/s, 3 m/s   (d) 2 m/s, 4 m/s

11. A block of mass m is placed on a smooth inclined wedge ABC of inclination θ as shown in the figure. The wedge is given an acceleration 'a' towards the right. The relation between a and θ for the block to remain stationary on the wedge is
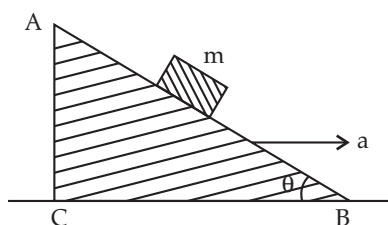
(a) $a = g\tan\theta$ (b) $a = g\cos\theta$

(c) $a = \dfrac{g}{\sin\theta}$ (d) $a = \dfrac{g}{\text{cosec}\,\theta}$

12. An em wave is propagating in a medium with a velocity $\vec{V} = V\hat{i}$. The instantaneous oscillating electric field of this em wave is along $+y$ axis. Then the direction of oscillating magnetic field of the em wave will be along

(a) $-x$ direction.   (b) $-y$ direction.

(c) $+z$ direction.   (d) $-z$ direction.

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

(a) Zero   (b) 30°   (c) 45°   (d) 60°

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

(a) 13.89 H   (b) 1.389 H   (c) 138.88 H (d) 0.138 H

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

(a) 36 cm towards the mirror.

(b) 30 cm towards the mirror.

(c) 36 cm away from the mirror.

(d) 30 cm away from the mirror.

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

(a) 1 : –2   (b) 2 : –1   (c) 1 : –1   (d) 1 : 1

17. An electron of mass m with an initial velocity $\vec{V} = V_0\hat{i}$ $(V_0 > 0)$ enters an electric field $\vec{E} = -E_0\hat{i}$ $(E_0 = $

constant > 0) at $t = 0$. If λ_0 is its de-Broglie wavelength initially, then its de-Broglie wavelength at time t is

(a) λ_0 (b) $\lambda_0 t$

(c) $\lambda_0\left(1 + \dfrac{eE_0}{mV_0}t\right)$ (d) $\dfrac{\lambda_0}{\left(1 + \dfrac{eE_0}{mV_0}t\right)}$

18. When the light of frequency $2\nu_0$ (where ν_0 is threshold frequency), is incident on a metal plate, the maximum velocity of electrons emitted is v_1. When the frequency of the incident radiation is increased to $5\nu_0$, the maximum velocity of electrons emitted from the same plate is v_2. The ratio of v_1 to v_2 is

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

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

Out of Syllabus

(a) 15   (b) 30   (c) 10   (d) 20

20. The volume (V) of a monatomic gas varies with its temperature (T), as shown in the graph. The ratio of work done by the gas, to the heat absorbed by it, when it undergoes a change from state A to state B, is
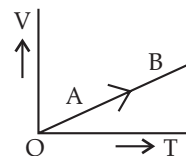
(a) $\dfrac{2}{7}$ (b) $\dfrac{1}{3}$ (c) $\dfrac{2}{3}$ (d) $\dfrac{2}{5}$

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

(a) 16 cm   (b) 12.5 cm   (c) 8 cm   (d) 13.2 cm

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

Out of Syllabus

(a) 12.5%   (b) 6.25%   (c) 20%   (d) 26.8%

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

(Given : Mass of oxygen molecule $(m) = 2.76 \times 10^{-26}$ kg Boltzmann's constant $k_B = 1.38 \times 10^{-23}$ JK^{-1})
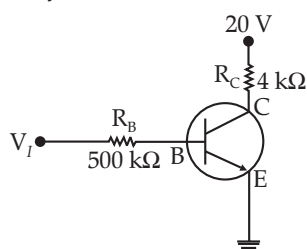
(a) 1.254×10^4 K   (b) 5.016×10^4 K

(c) 8.360×10^4 K   (d) 2.508×10^4 K

24. Unpolarized light is incident from air on a plane surface of a material of refractive index 'μ'. At a particular angle of incidence 'i', it is found that the reflected and refracted rays are perpendicular to each other. Which of the following options is correct for this situation ?

(a) $i = \tan^{-1}\left(\dfrac{1}{\mu}\right)$

(b) $i = \sin^{-1}\left(\dfrac{1}{\mu}\right)$

(c) Reflected light is polarized with its electric vector perpendicular to the plane of incidence

(d) Reflected light is polarized with its electric vector parallel to the plane of incidence

25. In Young's double slit experiment the separation d between the slits is 2 mm, the wavelength λ of the light used is 5896 Å and distance D between the screen and slits is 100 cm. It is found that the angular width of the fringes is 0.20°. To increase the fringe angular width to 0.21° (with same λ and D) the separation between the slits needs to be changed to

(a) 1.7 mm   (b) 2.1 mm   (c) 1.9 mm   (d) 1.8 mm

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

(a) small focal length and small diameter.

(b) large focal length and large diameter.

(c) large focal length and small diameter.

(d) small focal length and large diameter.

27. In the circuit shown in the figure, the input voltage V_i is 20 V, V_{BE} = 0 and V_{CE} = 0. The values of I_B, I_C and β are given by   Out of Syllabus

(a) I_B = 40 μA, I_C = 5 mA, β = 125

(b) I_B = 20 μA, I_C = 5 mA, β = 250

(c) I_B = 25 μA, I_C = 5 mA, β = 200

(d) I_B = 40 μA, I_C = 10 mA, β = 250

28. In a p-n junction diode, change in tempe-rature due to heating

(a) affects the overall V - I characteristics of p-n junction.

(b) does not affect resistance of p-n junction.

(c) affects only forward resistance.

(d) affects only reverse resistance.

29. In the combination of the following gates the output Y can be written in terms of inputs A and B as
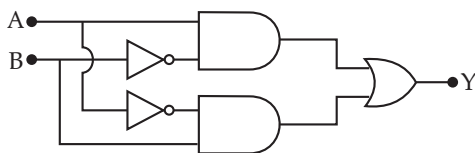
(a) $\overline{A+B}$

(b) $\overline{A \cdot B}$ + A·B

(c) A·$\overline{B}$ + $\overline{A}$·B

(d) $\overline{A \cdot B}$

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

(a) 11.32 A   (b) 14.76 A   (c) 5.98 A   (d) 7.14 A

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

(a) 1.13 W   (b) 2.74 W   (c) 0.43 W   (d) 0.79 W

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

(a) the induced electric field due to the changing magnetic field.

(b) the lattice structure of the material of the rod.

(c) the magnetic field.

(d) the current source.

33. Current sensitivity of a moving coil galvanometer is 5 div/mA and its voltage sensitivity (angular deflection per unit voltage applied) is 20 div/V. The resistance of the galvanometer is

(a) 500 Ω   (b) 250 Ω   (c) 25 Ω   (d) 40 Ω

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

(a) 300 m/s   (b) 350 m/s   (c) 339 m/s   (d) 330 m/s

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

(a) inversely proportional to the distance between the plates.

(b) proportional to the square root of the distance between the plates.

(c) linearly proportional to the distance between the plates.

(d) independent of the distance between the plates.

36. A pendulum is hung from the roof of a sufficiently high building and is moving freely to and fro like a simple harmonic oscillator. The acceleration of the bob of the pendulum is 20 m/s^2 at a distance of 5 m from the mean position. The time period of oscillation is

(a) 1 s   (b) 2 s   (c) π s   (d) 2π s

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

(a) Equal   (b) 10 times greater

(c) 5 times greater   (d) Smaller

38. The kinetic energies of a planet in an elliptical orbit about the Sun, at positions A, B and C are K_A, K_B and K_C, respectively. A_C is the major axis and S_B is perpendicular to A_C at the position of the Sun S as shown in the figure. Then
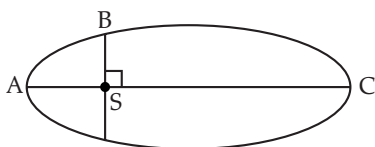
(a) $K_B > K_A > K_C$ (b) $K_B < K_A < K_C$
(c) $K_A > K_B > K_C$ (d) $K_A < K_B < K_C$

39. A solid sphere is in rolling motion. In rolling motion a body possesses translational kinetic energy (K_t) as well as rotational kinetic energy (K_r) simultaneously. The ratio $K_t : (K_t + K_r)$ for the sphere is
   (a) $2 : 5$ (b) $10 : 7$ (c) $5 : 7$ (d) $7 : 10$

40. If the mass of the Sun were ten times smaller and the universal gravitational constant were ten times larger in magnitude, which of the following is not correct ?
   (a) 'g' on the Earth will not change
   (b) Time period of a simple pendulum on the Earth would decrease
   (c) Walking on the ground would become more difficult
   (d) Raindrops will fall faster

41. A solid sphere is rotating freely about its symmetry axis in free space. The radius of the sphere is increased keeping its mass same. Which of the following physical quantities would remain constant for the sphere ?
   (a) Angular momentum
   (b) Rotational kinetic energy
   (c) Moment of inertia
   (d) Angular velocity

42. A body initially at rest and sliding along a frictionless track from a height h (as shown in the figure) just completes a vertical circle of diameter AB = D. The height h is equal to
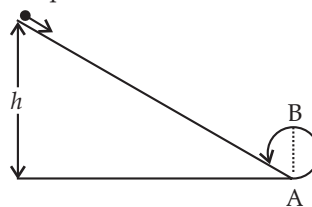
   (a) $\dfrac{5}{4}D$ (b) $\dfrac{7}{5}D$ (c) D (d) $\dfrac{3}{2}D$

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

44. Which one of the following statements is incorrect ?
   (a) Coefficient of sliding friction has dimensions of length.
   (b) Frictional force opposes the relative motion.
   (c) Limiting value of static friction is directly proportional to normal reaction.
   (d) Rolling friction is smaller than sliding friction.

45. A moving block having mass m, collides with another stationary block having mass 4m. The lighter block comes to rest after collision. When the initial velocity of the lighter block is v, then the value of coefficient of restitutio (e) will be
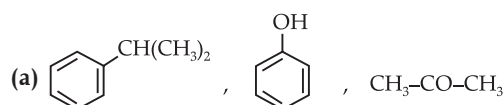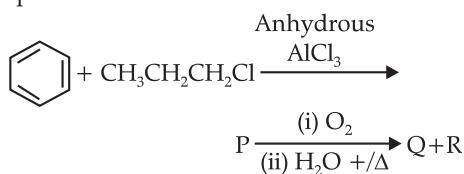   (a) 0.4   (b) 0.8   (c) 0.25   (d) 0.5

CHEMISTRY

46. Iron carbonyl, $Fe(CO)_5$ is
   (a) Dinuclear   (b) Trinuclear
   (c) Mononuclear   (d) Tetranuclear

47. Match the metal ions given in Column I with the spin magnetic moments of the ions given in Column II and assign the correct code
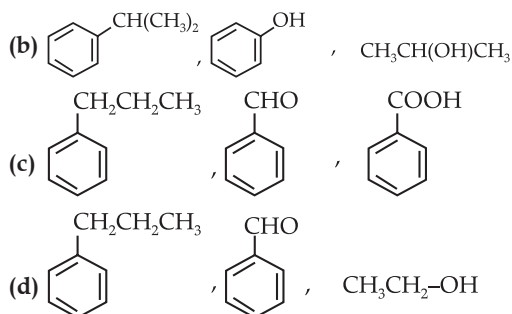
Column I	Column II
A. Co^{3+}	i. $\sqrt{8}$ B.M.
B. Cr^{3+}	ii. $\sqrt{35}$ B.M.
C. Fe^{3+}	iii. $\sqrt{3}$ B.M.
D. Ni^{2+}	iv. $\sqrt{24}$ B.M.
	v. $\sqrt{15}$ B.M.

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

48. Which one of the following ions exhibits d-d transition and paramagnetism as well ?
   (a) MnO_4^{2-} (b) MnO_4^- (c) $Cr_2O_7^{2-}$ (d) CrO_4^{2-}

49. The geometry and magnetic behaviour of the complex $[Ni(CO)_4]$ are
   (a) tetrahedral geometry and paramagnetic.
   (b) square planar geometry and paramag-netic.
   (c) tetrahedral geometry and diamagnetic.
   (d) square planar geometry and diamagnetic.

50. The type of isomerism shown by the complex $[CoCl_2(en)_2]$ is
   (a) linkage isomerism
   (b) ionization isomerism
   (c) coordination isomerism
   (d) geometrical isomerism

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

(b) [structure: isopropylbenzene $CH(CH_3)_2$] , [structure: phenol OH] , $CH_3CH(OH)CH_3$

(c) [structure: propylbenzene $CH_2CH_2CH_3$] , [structure: benzaldehyde CHO] , [structure: benzoic acid COOH]

(d) [structure: propylbenzene $CH_2CH_2CH_3$] , [structure: benzaldehyde CHO] , CH_3CH_2-OH

52. Which of the following compounds can form a zwitter ion ?
   (a) Glycine
   (b) Benzoic acid
   (c) Acetanilide
   (d) Aniline

53. For the redox reaction

   $$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$$
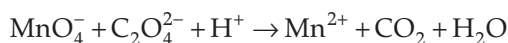
   The correct coefficients of the reactants for the balanced equation are
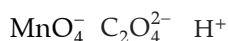
 | | MnO_4^- | $C_2O_4^{2-}$ | H^+ |
   |---|---|---|---|
   | (a) | 5 | 16 | 2 |
   | (b) | 2 | 16 | 5 |
   | (c) | 2 | 5 | 16 |
   | (d) | 16 | 5 | 2 |

54. The correction factor 'a' to the ideal gas equation corresponds to   [Out of Syllabus]
   (a) forces of attraction between the gas molecules.
   (b) electric field present between the gas molecules.
   (c) volume of the gas molecules.
   (d) density of the gas molecules.

55. Which one of the following conditions will favour maximum formation of the product in the reaction,

   $$A_2(g) + B_2(g) \rightleftharpoons X_2(g) \quad \Delta_r H = -XkJ ?$$
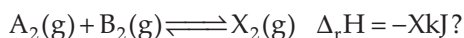
   (a) High temperature and low pressure
   (b) High temperature and high pressure
   (c) Low temperature and low pressure
   (d) Low temperature and high pressure

56. The bond dissociation energies of X_2, Y_2 and XY are in the ratio of 1 : 0.5 : 1. ΔH for the formation of XY is –200 kJ mol^{-1}. The bond dissociation energy of X_2 will be
   (a) 400 kJ mol^{-1}
   (b) 800 kJ mol^{-1}
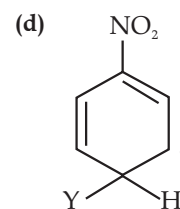   (c) 100 kJ mol^{-1}
   (d) 200 kJ mol^{-1}

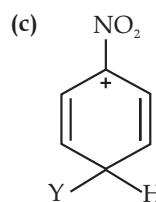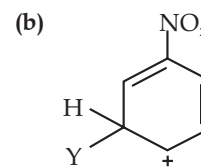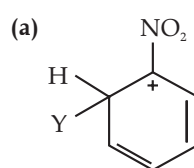57. When initial concentration of the reactant is doubled, the half-life period of a zero order reaction
   (a) remains unchanged
   (b) is tripled
   (c) is doubled
   (d) is halved

58. Which of the following molecules represents the order of hybridization sp^2, sp^2, sp, sp from left to right atoms ?
   (a) $CH_3 - CH = CH - CH_3$
   (b) $CH_2 = CH - CH = CH_2$
   (c) $CH_2 = CH - C \equiv CH$
   (d) $HC \equiv C - C \equiv CH$

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

(a) [structure with NO_2, H, Y]
(b) [structure with NO_2, H, Y]
(c) [structure with NO_2, Y, H]
(d) [structure with NO_2, Y, H]

60. Which of the following is correct with respect to – I effect of the substituents ? (R = alkyl)
   (a) $-NR_2 > -OR > -F$
   (b) $-NH_2 > -OR > -F$
   (c) $-NR_2 < -OR < -F$
   (d) $-NH_2 < -OR < -F$

61. The correct difference between first and second order reactions is that
   (a) the rate of a first-order reaction does depend on reactant concentrations; the rate of a second-order reaction does not depend on reactant concentrations.
   (b) a first-order reaction can catalyzed; a second-order reaction cannot be catalyzed.
   (c) the half-life of a first-order reaction does not depend on $[A]_0$; the half-life of a second-order reaction does depend on $[A]_0$.
   (d) the rate of a first-order reaction does not depend on reactant concentrations; the rate of a second-order reaction does depend on reactant concentrations.

62. Among CaH_2, BeH_2, BaH_2, the order of ionic character is   [Out of Syllabus]
   (a) $BaH_2 < BeH_2 < CaH_2$
   (b) $BeH_2 < BaH_2 < CaH_2$
   (c) $CaH_2 < BeH_2 < BaH_2$
   (d) $BeH_2 < CaH_2 < BaH_2$

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

   $$BrO_4^- \xrightarrow{1.82\ V} BrO_3^- \xrightarrow{1.5\ V} HBrO$$
   $$Br^- \xleftarrow{1.0652\ V} Br^- \xleftarrow{1.595\ V}$$
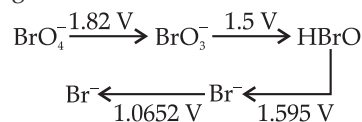
   Then the species undergoing dispro-portionation is
   (a) HBrO
   (b) Br_2
   (c) BrO_4^-
   (d) BrO_3^-

64. In which case is number of molecules of water maximum ?
   (a) 10^{-3} mol of water
   (b) 0.00224 L of water vapours at 1 atm and 273 K
   (c) 0.18 g of water
   (d) 18 mL of water

65. The compound A on treatment with Na gives B, and with PCl$_5$ gives C. B and C react together to give diethyl ether. A, B and C are in the order
   (a) C_2H_5OH, C_2H_5ONa, C_2H_5Cl
   (b) C_2H_5Cl, C_2H_6, C_2H_5OH
   (c) C_2H_5OH, C_2H_5Cl, C_2H_5ONa
   (d) C_2H_5OH, C_2H_6, C_2H_5Cl

66. Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms. (A) is
    (a) CH_4
    (b) $CH_3 - CH_3$
    (c) $CH_2 = CH_2$
    (d) $CH \equiv CH$

67. The compound C_7H_8 undergoes the follow-ing reactions :

    $$C_7H_8 \xrightarrow{3Cl_2/\Delta} A \xrightarrow{Br_2/Fe} B \xrightarrow{Zn/HCl} C$$
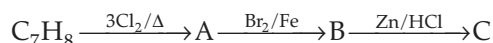
    The product 'C' is
    (a) *p*-bromotoluene.
    (b) 3-bromo-2,4,6-trichlorotoluene.
    (c) *o*-bromotoluene.
    (d) m-bromotoluene.

68. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity ? Out of Syllabus
    (a) NO
    (b) N_2O
    (c) NO_2
    (d) N_2O_5

69. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4. The evolved gaseous mixture is passed through KOH pellets. Weight (in g) of the remaining product at STP will be
    (a) 4.4
    (b) 2.8
    (c) 3.0
    (d) 1.4

70. The difference between amylose and amylopectin is
    (a) amylose is made up of glucose and galactose.
    (b) amylopectin have $1 \to 4$ α-linkage and $1 \to 6$ β-linkage.
    (c) amylose have $1 \to 4$ α-linkage and $1 \to 6$ β-linkage.
    (d) amylopectin have $1 \to 4$ α-linkage and $1 \to 6$ α-linkage.

71. Which of the following oxides is most acidic in nature ?
    (a) CaO
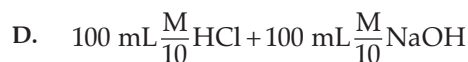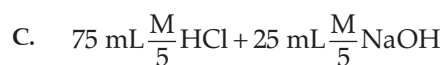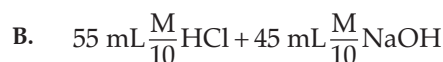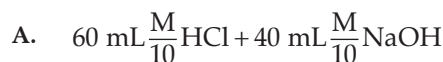   (b) BaO
    (c) BeO
    (d) MgO

72. Nitration of aniline in strong acidic medium also gives *m*-nitroaniline because
    (a) in acidic (strong) medium aniline is present as anilinium ion.
    (b) in absence of substituents nitro group always goes to m-position.
    (c) in electrophilic substitution reactions amino group is meta directive.
    (d) inspite of substituents nitro group always goes to only m-position.

73. Regarding cross-linked or network polymers, which of the following statements is incorrect ? Out of Syllabus
    (a) They contain strong covalents bonds in their polymer chains.
    (b) Examples are bakelite and melamine.
    (c) They are formed from bi- and tri-functional monomers.
    (d) They contain covalent bonds between various linear polymer chains.

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

A. $60 \text{ mL} \dfrac{M}{10} \text{HCl} + 40 \text{ mL} \dfrac{M}{10} \text{NaOH}$

B. $55 \text{ mL} \dfrac{M}{10} \text{HCl} + 45 \text{ mL} \dfrac{M}{10} \text{NaOH}$

C. $75 \text{ mL} \dfrac{M}{5} \text{HCl} + 25 \text{ mL} \dfrac{M}{5} \text{NaOH}$

D. $100 \text{ mL} \dfrac{M}{10} \text{HCl} + 100 \text{ mL} \dfrac{M}{10} \text{NaOH}$

pH of which one of them will be equal to 1 ?
    (a) C
    (b) D
    (c) A
    (d) B

75. On which of the following properties does the coagulating power of an ion depend ? Out of Syllabus
    (a) The sign of charge on the ion alone
    (b) Both magnitude and sign of the charge on the ion
    (c) Size of the ion alone
    (d) The magnitude of the charge on the ion alone

76. The solubility of $BaSO_4$ in water is 2.42×10^{-3} gL^{-1} at 298 K. The value of its solubility product (K_{sp}) will be

    (Given molar mass of $BaSO_4 = 233$ g mol^{-1})
    (a) 1.08×10^{-8} mol^{2}L^{-2}
    (b) 1.08×10^{-14} mol^{2}L^{-2}
    (c) 1.08×10^{-12} mol^{2}L^{-2}
    (d) 1.08×10^{-10} mol^{2}L^{-2}

77. Given van der Waals constant for NH_3, H_2, O_2 and CO_2 are respectively 4.17, 0.244, 1.36 and 3.59, which one of the following gases is most easily liquefied ? Out of Syllabus
   (a) CO_2
    (b) O_2
    (c) H_2
    (d) NH_3

78. Magnesium reacts with an element (X) to form an ionic compound. If the ground state electronic configuration of (X) is $1s^2 2s^2 2p^3$, the simplest formula for this compound is
   (a) Mg_3X_2
    (b) Mg_2X
    (c) MgX_2
    (d) Mg_2X_3

79. Iron exhibits bcc structure at room temperature. Above 900°C, it transforms to fcc structure. The ratio of density of iron at room temperature to that at 900°C (assuming molar mass and atomic radii of iron remains constant with temperature) is Out of Syllabus
    (a) $\dfrac{1}{2}$
    (b) $\dfrac{3\sqrt{3}}{4\sqrt{2}}$
    (c) $\dfrac{4\sqrt{3}}{3\sqrt{2}}$
    (d) $\dfrac{\sqrt{3}}{\sqrt{2}}$
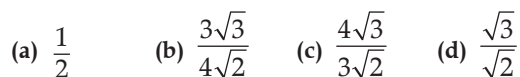
80. Which one is a wrong statement ?
    (a) The value of m for d_{z^2} is zero.
    (b) The electronic configuration of N atom is

$1s^2$	$2s^2$	$2p_x^1$	$2p_y^1$	$2p_z^1$
↑↓	↑↓	↑	↑	↓
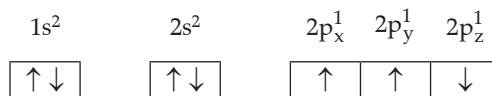
    (c) An orbital is designated by three quantum numbers while an electron in an atom is designated by four quantum numbers.
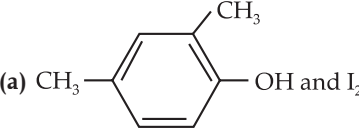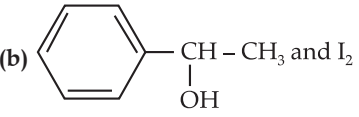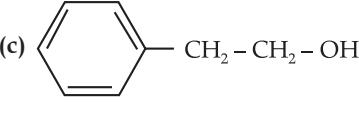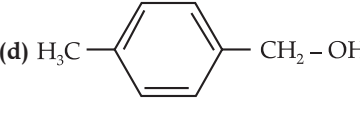   (d) Total orbital angular momentum of electron in 's' orbital is equal to zero.

81. Consider the following species :
CN$^+$, CN$^-$, NO and CN
Which one of these will have the highest bond order ?
(a) CN   (b) CN$^+$ (c) CN$^-$ (d) NO

82. Which of the following statements is not true for halogens ?
(a) Chlorine has the highest electron-gain enthalpy.
(b) All halogens except fluorine show positive oxidation states.
(c) All are oxidizing agents.
(d) All form monobasic oxyacids.

83. Which one of the following elements is unable to form MF_6^{3-} ion ?
(a) In   (b) B   (c) Al   (d) Ga

84. In the structure of ClF_3, the number of lone pair of electrons on central atom 'Cl' is
(a) Three   (b) Four   (c) Two   (d) One

85. Considering Ellingham diagram, which of the following metals can be used to reduce alumina ?
Out of Syllabus
(a) Cu   (b) Mg   (c) Zn   (d) Fe

86. The correct order of atomic radii in group 13 elements is
(a) B < Ga < Al < In < Tl
(b) B < Ga < Al < Tl < In
(c) B < Al < Ga < In < Tl
(d) B < Al < In < Ga < Tl

87. The correct order of N-compounds in its decreasing order of oxidation states is
(a) NH_4Cl, N_2, NO, HNO_3
(b) HNO_3, NH_4Cl, NO, N_2
(c) HNO_3, NO, NH_4Cl, N_2
(d) HNO_3, NO, N_2, NH_4Cl

88. In the reaction
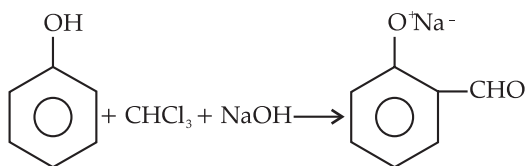
the electrophile involved is
(a) Dichlorocarbene (:CCl_2)
(b) Dichloromethyl anion ($\overset{+}{C}HCl_2$)
(c) Formyl cation ($\overset{+}{C}HO$)
(d) Dichloromethyl cation ($\overset{+}{C}HCl_2$)

89. Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to their
(a) formation of intermolecular H-bonding.
(b) more extensive association of carboxylic acid via van der Waals force of attraction.
(c) formation of carboxylate ion.
(d) formation of intramolecular H-bonding.

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

BIOLOGY

91. Niche is
(a) the functional role played by the organism where it lives.
(b) the range of temperature that the organism needs to live.
(c) the physical space where an organism lives.
(d) all the biological factors in the organism's environment.

92. Which of the following is a secondary pollutant ?
(a) O_3 (b) SO_2
(c) CO_2 (d) CO

93. In stratosphere, which of the following elements acts as a catalyst in degradation of ozone and release of molecular oxygen ?
(a) O   (b) Fe
(c) Cl   (d) C

94. World Ozone Day is celebrated on
(a) 22nd April
(b) 16th September
(c) 21st April
(d) 5th June

95. What type of ecological pyramid would be obtained with the following data ?
Secondary consumer : 120 g
Primary consumer : 60 g
Primary producer : 10 g
(a) Upright pyramid of biomass
(b) Upright pyramid of numbers

(c) Pyramid of energy
(d) Inverted pyramid of biomass

96. Natality refers to
(a) number of individuals entering a habitat.
(b) number of individuals leaving the habitat.
(c) birth rate.
(d) death rate.

97. Offsets are produced by
(a) parthenogenesis.
(b) parthenocarpy.
(c) mitotic divisions.
(d) meiotic divisions.

98. The experimental proof for semi-conser-vative replication of DNA was first shown in a
(a) virus.   (b) plant.
(c) bacterium.   (d) fungus.

99. Select the correct match
(a) Francois Jacob and   –   *lac* operon
    Jacques Monod
(b) Matthew Meselson   –   *Pisum sativum*
    and F. Stahl
(c) Alfred Hershey and   –   TMV
    Martha Chase
(d) Alec Jeffreys   –   *Streptococcus pneumoniae*

100. Which of the following has proved helpful in preserving pollen as fossils?
(a) Sporopollenin   (b) Oil content
(c) Cellulosic intine   (d) Pollenkitt

101. Which of the following pairs is wrongly matched?
(a) T. H. Morgan   –   Linkage
(b) XO type sex   –   Grasshopper
    determination
(c) ABO blood grouping   –   Co-dominance
(d) Starch synthesis in   –   Multiple alleles
    pea

102. Which of the following flowers only once in its life-time ?
(a) Papaya   (b) Mango
(c) Jackfruit   (d) Bamboo species

103. Select the correct statement.
(a) Transduction was discovered by S. Altman.
(b) Spliceosomes take part in translation.
(c) Punnett square was developed by a British scientist.
(d) Franklin Stahl coined the term "linkage".

104. The Golgi complex participates in
(a) activation of amino acid.
(b) respiration in bacteria.
(c) formation of secretory vesicles.
(d) fatty acid breakdown.

105. The stage during which separation of the paired homologous chromosomes begins is
(a) zygotene.   (b) diakinesis.
(c) diplotene.   (d) pachytene.

106. Stomatal movement is not affected by
(a) CO_2 concentration.
(b) O_2 concentration.
(c) light.
(d) temperature.

107. Stomata in grass leaf are
(a) barrel shaped.   (b) rectangular.
(c) kidney shaped.   (d) dumb-bell shaped.

108. Which of the following is not a product of light reaction of photosynthesis ?
(a) Oxygen
(b) NADPH
(c) NADH
(d) ATP

109. Which of the following is true for nucleolus?
(a) It is a site for active ribosomal RNA synthesis
(b) It takes part in spindle formation
(c) It is a membrane-bound structure
(d) Larger nucleoli are present in dividing cells

110. Which among the following is not a prokaryote ?
(a) *Oscillatoria*
(b) *Nostoc*
(c) *Mycobacterium*
(d) *Saccharomyces*

111. The two functional groups characteristic of sugars are
(a) carbonyl and hydroxyl.
(b) carbonyl and phosphate.
(c) carbonyl and methyl.
(d) hydroxyl and methyl.

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

Column I		Column II	
(A)	Herbarium	**(i)**	It is a place having a collection of preserved plants and animals.
(B)	Key	**(ii)**	A list that enumerates methodically all the species found in an area with brief description aiding identification.
(C)	Museum	**(iii)**	Is a place where dried and pressed plant specimens mounted on sheets are kept.
(D)	Catalogue	**(iv)**	A booklet containing a list of characters and their alternates which are helpful in identification of various taxa.

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

113. Which one is wrongly matched ?
(a) Unicellular organism – *Chlorella*
(b) Gemma cups – *Marchantia*
(c) Biflagellate zoospores – *Brown algae*
(d) Uniflagellate gametes – *Polysiphonia*

114. After karyogamy followed by meiosis, spores are produced exogenously in
(a) *Saccharomyces.*
(b) *Agaricus.*
(c) *Alternaria.*
(d) *Neurospora.*

115. Winged pollen grains are present in
(a) *Pinus.*
(b) Mango.
(c) *Cycas.*
(d) Mustard.

116. Which of the following is commonly used as a vector for introducing a DNA fragment in human lymphocytes ?
(a) pBR 322
(b) λ phage
(c) Ti plasmid
(d) Retrovirus

117. A 'new' variety of rice was patented by a foreign company, though such varieties have been present in India for a long time. This is related to
(a) basmati.
(b) lerma Rojo.
(c) sharbati sonora.
(d) Co-667.

118. Use of bioresources by multinational companies and organisations without authorisation from the concerned country and its people is called
(a) Bioexploitation.
(b) Biodegradation.
(c) Biopiracy.
(d) Bio-infringement.

119. Select the correct match :
(a) G. Mendel – Transformation
(b) T.H. Morgan – Transduction
(c) $F_2 \times$ Recessive parent – Dihybrid cross
(d) Ribozyme – Nucleic acid

120. The correct order of steps in Polymerase Chain Reaction (PCR) is
(a) Denaturation, Annealing, Extension
(b) Denaturation, Extension, Annealing
(c) Annealing, Extension, Denaturation
(d) Extension, Denaturation, Annealing

121. In India, the organisation responsible for assessing the safety of introducing genetically modified organisms for public use is
(a) Genetic Engineering Appraisal Committee (GEAC).
(b) Research Committee on Genetic Manipulation (RCGM).
(c) Council for Scientific and Industrial Research (CSIR).
(d) Indian Council of Medical Research (ICMR).

122. What is the role of NAD^+ in cellular respiration ?
(a) It is the final electron acceptor for anaerobic respiration.
(b) It is a nucleotide source for ATP synthesis.
(c) It functions as an electron carrier.
(d) It functions as an enzyme.

123. Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other ?
(a) *Viola*
(b) Banana
(c) *Yucca*
(d) *Hydrilla*

124. Pollen grains can be stored for several years in liquid nitrogen having a temperature of
(a) –160°C
(b) –196°C
(c) –80°C
(d) –120°C

125. In which of the following forms is iron absorbed by plants ?
(a) Both ferric and ferrous
(b) Free element
(c) Ferrous
(d) Ferric

126. Double fertilisation is
(a) syngamy and triple fusion.
(b) fusion of two male gametes with one egg.
(c) fusion of one male gamete with two polar nuclei.
(d) fusion of two male gametes of a pollen tube with two different eggs.

127. Oxygen is not produced during photos-ynthesis by
(a) *Chara.*
(b) *Cycas.*
(c) *Nostoc.*
(d) Green sulphur bacteria.

128. Which of the following elements is responsible for maintaining turgor in cells ?
(a) Calcium
(b) Potassium
(c) Sodium
(d) Magnesium

129. Pneumatophores occur in
(a) submerged hydrophytes.
(b) carnivorous plants.
(c) free-floating hydrophytes.
(d) halophytes.

130. Select the wrong statement.
(a) Mitochondria are the powerhouse of the cell in all kingdoms except Monera.
(b) Pseudopodia are locomotory and feed-ing structures in Sporozoans.
(c) Mushrooms belong to Basidiomycetes.
(d) Cell wall is present in members of Fungi and Plantae.

131. Secondary xylem and phloem in dicot stem are produced by [Out of Syllabus]
(a) axillary meristems.
(b) phellogen.
(c) vascular cambium.
(d) apical meristems.

132. Sweet potato is a modified
(a) rhizome.
(b) tap root.
(c) adventitious root.
(d) stem.

133. Which of the following statements is correct?
   (a) Stems are usually unbranched in both *Cycas* and *Cedrus*.
   (b) Horsetails are Gymnosperms.
   (c) *Selaginella* is heterosporous, while *Salvinia* is homosporous.
   (d) Ovules are not enclosed by ovary wall in Gymnosperms.

134. Casparian strips occur in
   (a) endodermis.   (b) cortex.
   (c) pericycle.   (d) epidermis.

135. Plants having little or no secondary growth are

   Out of Syllabus

   (a) cycads.
   (b) conifers.
   (c) deciduous angiosperms.
   (d) grasses.

136. Nissl bodies are mainly composed of
   (a) free ribosomes and RER.
   (b) nucleic acids and SER.
   (c) DNA and RNA.
   (d) proteins and lipids.

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

138. Many ribosomes may associate with a single *m*RNA to form multiple copies of a polypeptide simultaneously. Such strings of ribosomes are termed as
   (a) nucleosome.   (b) plastidome.
   (c) polyhedral bodies. (d) polysome.

139. Which of the following terms describe human dentition?   Out of Syllabus
   (a) Pleurodont, Diphyodont, Heterodont
   (b) Pleurodont, Monophyodont, Homodont
   (c) Thecodont, Diphyodont, Heterodont
   (d) Thecodont, Diphyodont, Homodont

140. Which of the following events does not occur in rough endoplasmic reticulum?
   (a) Phospholipid synthesis
   (b) Cleavage of signal peptide
   (c) Protein glycosylation
   (d) Protein folding

141. Select the incorrect match
   (a) Polytene chromosomes   –   Oocytes of amphibians
   (b) Submetacentric chromosomes   –   L-shaped chromosomes
   (c) Allosomes   –   Sex chromosomes
   (d) Lampbrush chromosomes   –   Diplotene bivalents

142. Which of the following is an amino acid derived hormone?
   (a) Estriol   (b) Estradiol
   (c) Ecdysone   (d) Epinephrine

143. Which of the following structures or regions is incorrectly paired with its functions?

   (a) Corpus callosum – band of fibers connecting left andw right cerebral hemispheres.

   (b) Hypothalamus – production of releasing hormones and regulation of temperature, hunger and thirst.

   (c) Limbic system – consists of fibre tracts that interconnect different regions of brain; controls movement.

   (d) Medulla oblongata – controls respiration and cardiovascular reflexes.

144. Which of the following hormones can play a significant role in osteoporosis?
   (a) Parathyroid hormone and Prolactin
   (b) Estrogen and Parathyroid hormone
   (c) Progesterone and Aldosterone
   (d) Aldosterone and Prolactin

145. The transparent lens in the human eye is held in its place by
   (a) smooth muscles attached to the ciliary body.
   (b) smooth muscles attached to the iris.
   (c) ligaments attached to the iris.
   (d) ligaments attached to the ciliary body.

146. In a growing population of a country,
   (a) pre-reproductive individuals are less than the reproductive individuals.
   (b) reproductive and pre-reproductive individuals are equal in number.
   (c) reproductive individuals are less than the post-reproductive individuals.
   (d) pre-reproductive individuals are more than the reproductive individuals.

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

	Column-I		Column-II
A.	Eutrophication	i.	UV-B radiation
B.	Sanitary landfill	ii.	Deforestation
C.	Snow blindness	iii.	Nutrient enrichment
D.	Jhum cultivation	iv.	Waste disposal

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

148. Which part of poppy plant is used to obtain the drug "Smack"?

(a) Leaves   (b) Roots   (c) Latex   (d) Flowers

149. Which one of the following population interactions is widely used in medical science for the production of antibiotics?

(a) Amensalism   (b) Parasitism
(c) Mutualism   (d) Commensalism

150. All of the following are included in 'ex-situ conservation' except

(a) seed banks.   (b) botanical gardens.
(c) sacred groves.   (d) wildlife safari parks.

151. Which of the following gastric cells indirectly help in erythropoiesis?

(a) Parietal cells   (b) Goblet cells
(c) Mucous cells   (d) Chief cells

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

Column-I		Column-II	
A.	Fibrinogen	(i)	Osmotic balance
B.	Globulin	(ii)	Blood clotting
C.	Albumin	(iii)	Defence mechanism

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

153. Calcium is important in skeletal muscle contraction because it

(a) prevents the formation of bonds between the myosin cross bridges and the actin filament.
(b) detaches the myosin head from the actin filament.
(c) activates the myosin ATPase by binding to it.
(d) binds to troponin to remove the masking of active sites on actin for myosin.

154. Which of the following is an occupational respiratory disorder?

(a) Emphysema   (b) Botulism
(c) Silicosis   (d) Anthracis

155. AGGTATCGCAT is a sequence from the coding strand of a gene. What will be the corresponding sequence of the transcribed *m*RNA?

(a) UCCAUAGCGUA   (b) ACCUAUGCGAU
(c) UGGTUTCGCAT   (d) AGGUAUCGCAU

156. A woman has an X-linked condition on one of her X chromosomes. This chromosome can be inherited by

(a) both sons and daughters.
(b) only grandchildren.
(c) only sons.
(d) only daughters.

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

Column-I		Column-II	
A.	Proliferative Phase	i.	Breakdown of endometrial lining
B.	Secretory Phase	ii.	Follicular Phase
C.	Menstruation	iii.	Luteal Phase

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

158. According to Hugo de Vries, the mechanism of evolution is

(a) minor mutations.
(b) phenotypic variations.
(c) saltation.
(d) multiple step mutations.

159. All of the following are part of an operon except

(a) a promoter.   (b) an enhancer.
(c) structural genes.   (d) an operator.

160. Which of the following options correctly represents the lung conditions in asthma and emphysema, respectively?

(a) Decreased respiratory surface; Infla-mmation of bronchioles
(b) Increased respiratory surface; Infla-mmation of bronchioles
(c) Increased number of bronchioles; Increased respiratory surface
(d) Inflammation of bronchioles; Decreased respiratory surface

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

Column-I		Column-II	
A.	Tricuspid valve	i.	Between left atrium and left ventricle
B.	Bicuspid valve	ii.	Between right ventricle and pulmonary artery
C.	Semilunar valve	iii.	Between right atrium and right ventricle

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

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

Column-I		Column-II	
A.	Tidal volume	i.	2500 – 3000 mL
B.	Inspiratory Reserve volume	ii.	1100 – 1200 mL
C.	Expiratory Reserve volume	iii.	500 – 550 mL
D.	Residual volume	iv.	1000 – 1100 mL

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

163. Hormones secreted by the placenta to maintain pregnancy are
   (a) hCG, progestogens, estrogens, gluco-corticoids.
   (b) hCG, hPL, progestogens, estrogens.
   (c) hCG, hPL, estrogens, relaxin, oxytocin.
   (d) hCG, hPL, progestogens, prolactin.

164. The contraceptive 'SAHELI'
   (a) is a post-coital contraceptive.
   (b) is an IUD.
   (c) increases the concentration of estrogen and prevents ovulation in females.
   (d) blocks estrogen receptors in the uterus, preventing eggs from getting implanted.

165. The difference between spermiogenesis and spermiation is
   (a) in spermiogenesis spermatozoa are formed, while in spermiation sperma-tozoa are released from sertoli cells into the cavity of seminiferous tubules.
   (b) in spermiogenesis spermatozoa from sertoli cells are released into the cavity of seminiferous tubules, while in spermiation spermatozoa are formed.
   (c) in spermiogenesis spermatozoa are formed, while in spermiation spermatids are formed.
   (d) in spermiogenesis spermatids are formed, while in spermiation spermatozoa are formed.

166. The amnion of mammalian embryo is derived from
   (a) ectoderm and endoderm.
   (b) mesoderm and trophoblast.
   (c) endoderm and mesoderm.
   (d) ectoderm and mesoderm.

167. Which of the following animals does not undergo metamorphosis ?
   (a) Starfish   (b) Moth
   (c) Tunicate   (d) Earthworm

168. Which one of these animals is not a homeotherm ?
   (a) *Psittacula*   (b) *Camelus*
   (c) *Chelone*   (d) *Macropus*

169. Which of the following features is used to identify a male cockroach from a female cockroach ?   Out of Syllabus
   (a) Presence of anal cerci
   (b) Forewings with darker tegmina

(c) Presence of caudal styles
(d) Presence of a boat shaped sternum on the 9th abdominal segment

170. Which of the following organisms are known as chief producers in the oceans ?
   (a) Euglenoids
   (b) Cyanobacteria
   (c) Diatoms
   (d) Dinoflagellates

171. Ciliates differ from all other protozoans in
   (a) having two types of nuclei.
   (b) using pseudopodia for capturing prey.
   (c) having a contractile vacuole for remo-ving excess water.
   (d) using flagella for locomotion.

172. Identify the vertebrate group of animals characterized by crop and gizzard in its digestive system   Out of Syllabus
   (a) Osteichthyes.
   (b) Aves.
   (c) Reptilia.
   (d) Amphibia.

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

Column-I		Column-II	
A.	Glycosuria	i.	Accumulation of uric acid in joints
B.	Gout	ii.	Mass of crystallized salts within the kidney
C.	Renal calculi	iii.	Inflammation in glomeruli
D.	Glomerular nephritis	iv.	Presence of glucose in urine

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

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

Column I (Function)		Column II (Part of Excretory system)	
A.	Ultrafiltration	i.	Henle's loop
B.	Concentration of urine	ii.	Ureter
C.	Transport of urine	iii.	Urinary bladder
D.	Storage of urine	iv.	Malpighian corpuscle
		v.	Proximal convoluted tubule

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

175. Among the following sets of examples for divergent evolution, select the incorrect option
   (a) Eye of octopus, bat and man
   (b) Brain of bat, man and cheetah
   (c) Heart of bat, man and cheetah
   (d) Forelimbs of man, bat and cheetah

176. Conversion of milk to curd improves its nutritional value by increasing the amount of
   (a) vitamin E
   (b) vitamin B_{12}
   (c) vitamin A
   (d) vitamin D

177. Which of the following characteristics represent 'Inheritance of blood groups' in humans ?
   A. Dominance
   B. Co-dominance
   C. Multiple allele
   D. Incomplete dominance
   E. Polygenic inheritance

   (a) A, C and E
   (b) B, D and E
   (c) A, B and C
   (d) B, C and E

178. Which of the following is not an autoimmune disease ?
   (a) Vitiligo
   (b) Alzheimer's disease
   (c) Rheumatoid arthritis
   (d) Psoriasis

179. The similarity of bone structure in the forelimbs of many vertebrates is an example of
   (a) adaptive radiation.
   (b) convergent evolution.
   (c) analogy.
   (d) homology.

180. In which disease does mosquito transmitted pathogen cause chronic inflammation of lymphatic vessels ?
   (a) Amoebiasis
   (b) Ringworm disease
   (c) Ascariasis
   (d) Elephantiasis

□□□

Booklet   Batch   RollNumber

Test Center Code

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

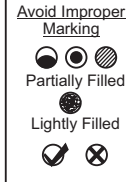Avoid Improper Marking

Partially Filled

Lightly Filled

Name

Test Date

Invigilator's Signature

Student's Signature

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

Booklet: (A) (B) (C) (D) (E) (F) (G) (H) (I) (J)

Batch: 10+1 (S), 10-2 (V), 10-3 (A), Crash (C)

Paper: Paper 1 (1), Paper 2 (2)

1	(a) (b) (c) (d)	6	(a) (b) (c) (d)	11	(a) (b) (c) (d)	16	(a) (b) (c) (d)	21	(a) (b) (c) (d)	26	(a) (b) (c) (d)
2	(a) (b) (c) (d)	7	(a) (b) (c) (d)	12	(a) (b) (c) (d)	17	(a) (b) (c) (d)	22	(a) (b) (c) (d)	27	(a) (b) (c) (d)
3	(a) (b) (c) (d)	8	(a) (b) (c) (d)	13	(a) (b) (c) (d)	18	(a) (b) (c) (d)	23	(a) (b) (c) (d)	28	(a) (b) (c) (d)
4	(a) (b) (c) (d)	9	(a) (b) (c) (d)	14	(a) (b) (c) (d)	19	(a) (b) (c) (d)	24	(a) (b) (c) (d)	29	(a) (b) (c) (d)
5	(a) (b) (c) (d)	10	(a) (b) (c) (d)	15	(a) (b) (c) (d)	20	(a) (b) (c) (d)	25	(a) (b) (c) (d)	30	(a) (b) (c) (d)
31	(a) (b) (c) (d)	36	(a) (b) (c) (d)	41	(a) (b) (c) (d)	46	(a) (b) (c) (d)	51	(a) (b) (c) (d)	56	(a) (b) (c) (d)
32	(a) (b) (c) (d)	37	(a) (b) (c) (d)	42	(a) (b) (c) (d)	47	(a) (b) (c) (d)	52	(a) (b) (c) (d)	57	(a) (b) (c) (d)
33	(a) (b) (c) (d)	38	(a) (b) (c) (d)	43	(a) (b) (c) (d)	48	(a) (b) (c) (d)	53	(a) (b) (c) (d)	58	(a) (b) (c) (d)
34	(a) (b) (c) (d)	39	(a) (b) (c) (d)	44	(a) (b) (c) (d)	49	(a) (b) (c) (d)	54	(a) (b) (c) (d)	59	(a) (b) (c) (d)
35	(a) (b) (c) (d)	40	(a) (b) (c) (d)	45	(a) (b) (c) (d)	50	(a) (b) (c) (d)	55	(a) (b) (c) (d)	60	(a) (b) (c) (d)
61	(a) (b) (c) (d)	66	(a) (b) (c) (d)	71	(a) (b) (c) (d)	76	(a) (b) (c) (d)	81	(a) (b) (c) (d)	86	(a) (b) (c) (d)
62	(a) (b) (c) (d)	67	(a) (b) (c) (d)	72	(a) (b) (c) (d)	77	(a) (b) (c) (d)	82	(a) (b) (c) (d)	87	(a) (b) (c) (d)
63	(a) (b) (c) (d)	68	(a) (b) (c) (d)	73	(a) (b) (c) (d)	78	(a) (b) (c) (d)	83	(a) (b) (c) (d)	88	(a) (b) (c) (d)
64	(a) (b) (c) (d)	69	(a) (b) (c) (d)	74	(a) (b) (c) (d)	79	(a) (b) (c) (d)	84	(a) (b) (c) (d)	89	(a) (b) (c) (d)
65	(a) (b) (c) (d)	70	(a) (b) (c) (d)	75	(a) (b) (c) (d)	80	(a) (b) (c) (d)	85	(a) (b) (c) (d)	90	(a) (b) (c) (d)
91	(a) (b) (c) (d)	96	(a) (b) (c) (d)	101	(a) (b) (c) (d)	106	(a) (b) (c) (d)	111	(a) (b) (c) (d)	116	(a) (b) (c) (d)
92	(a) (b) (c) (d)	97	(a) (b) (c) (d)	102	(a) (b) (c) (d)	107	(a) (b) (c) (d)	112	(a) (b) (c) (d)	117	(a) (b) (c) (d)
93	(a) (b) (c) (d)	98	(a) (b) (c) (d)	103	(a) (b) (c) (d)	108	(a) (b) (c) (d)	113	(a) (b) (c) (d)	118	(a) (b) (c) (d)
94	(a) (b) (c) (d)	99	(a) (b) (c) (d)	104	(a) (b) (c) (d)	109	(a) (b) (c) (d)	114	(a) (b) (c) (d)	119	(a) (b) (c) (d)
95	(a) (b) (c) (d)	100	(a) (b) (c) (d)	105	(a) (b) (c) (d)	110	(a) (b) (c) (d)	115	(a) (b) (c) (d)	120	(a) (b) (c) (d)
121	(a) (b) (c) (d)	126	(a) (b) (c) (d)	131	(a) (b) (c) (d)	136	(a) (b) (c) (d)	141	(a) (b) (c) (d)	146	(a) (b) (c) (d)
122	(a) (b) (c) (d)	127	(a) (b) (c) (d)	132	(a) (b) (c) (d)	137	(a) (b) (c) (d)	142	(a) (b) (c) (d)	147	(a) (b) (c) (d)
123	(a) (b) (c) (d)	128	(a) (b) (c) (d)	133	(a) (b) (c) (d)	138	(a) (b) (c) (d)	143	(a) (b) (c) (d)	148	(a) (b) (c) (d)
124	(a) (b) (c) (d)	129	(a) (b) (c) (d)	134	(a) (b) (c) (d)	139	(a) (b) (c) (d)	144	(a) (b) (c) (d)	149	(a) (b) (c) (d)
125	(a) (b) (c) (d)	130	(a) (b) (c) (d)	135	(a) (b) (c) (d)	140	(a) (b) (c) (d)	145	(a) (b) (c) (d)	150	(a) (b) (c) (d)
151	(a) (b) (c) (d)	156	(a) (b) (c) (d)	161	(a) (b) (c) (d)	166	(a) (b) (c) (d)	171	(a) (b) (c) (d)	176	(a) (b) (c) (d)
152	(a) (b) (c) (d)	157	(a) (b) (c) (d)	162	(a) (b) (c) (d)	167	(a) (b) (c) (d)	172	(a) (b) (c) (d)	177	(a) (b) (c) (d)
153	(a) (b) (c) (d)	158	(a) (b) (c) (d)	163	(a) (b) (c) (d)	168	(a) (b) (c) (d)	173	(a) (b) (c) (d)	178	(a) (b) (c) (d)
154	(a) (b) (c) (d)	159	(a) (b) (c) (d)	164	(a) (b) (c) (d)	169	(a) (b) (c) (d)	174	(a) (b) (c) (d)	179	(a) (b) (c) (d)
155	(a) (b) (c) (d)	160	(a) (b) (c) (d)	165	(a) (b) (c) (d)	170	(a) (b) (c) (d)	175	(a) (b) (c) (d)	180	(a) (b) (c) (d)

ANSWER KEY

No.	Ans	No.	Ans	No.	Ans	No.	Ans	No.	Ans	No.	Ans
1	(c)	31	(d)	61	(c)	91	(a)	121	(a)	151	(a)
2	(d)	32	(d)	62	(d)	92	(a)	122	(c)	152	(a)
3	(d)	33	(b)	63	(a)	93	(c)	123	(c)	153	(d)
4	(b)	34	(c)	64	(d)	94	(b)	124	(b)	154	(c)
5	(d)	35	(d)	65	(a)	95	(d)	125	(d)	155	(d)
6	(c)	36	(c)	66	(a)	96	(c)	126	(a)	156	(a)
7	(b)	37	(d)	67	(d)	97	(c)	127	(d)	157	(b)
8	(a)	38	(c)	68	(d)	98	(c)	128	(b)	158	(c)
9	(a)	39	(c)	69	(b)	99	(a)	129	(d)	159	(b)
10	(c)	40	(a)	70	(d)	100	(a)	130	(b)	160	(d)
11	(a)	41	(a)	71	(c)	101	(d)	131	(c)	161	(d)
12	(c)	42	(a)	72	(a)	102	(d)	132	(c)	162	(c)
13	(c)	43	(d)	73	(a)	103	(c)	133	(d)	163	(b)
14	(a)	44	(a)	74	(a)	104	(c)	134	(a)	164	(d)
15	(c)	45	(c)	75	(b)	105	(c)	135	(d)	165	(a)
16	(c)	46	(c)	76	(d)	106	(b)	136	(a)	166	(d)
17	(d)	47	(d)	77	(d)	107	(d)	137	(a)	167	(d)
18	(d)	48	(a)	78	(a)	108	(c)	138	(d)	168	(c)
19	(d)	49	(c)	79	(b)	109	(a)	139	(c)	169	(c)
20	(d)	50	(d)	80	(b)	110	(d)	140	(a)	170	(c)
21	(d)	51	(a)	81	(c)	111	(a)	141	(a)	171	(a)
22	(d)	52	(a)	82	(b)	112	(a)	142	(d)	172	(b)
23	(c)	53	(c)	83	(b)	113	(d)	143	(c)	173	(a)
24	(c)	54	(a)	84	(c)	114	(b)	144	(b)	174	(c)
25	(c)	55	(d)	85	(b)	115	(a)	145	(d)	175	(a)
26	(b)	56	(b)	86	(a)	116	(d)	146	(d)	176	(b)
27	(a)	57	(c)	87	(d)	117	(a)	147	(b)	177	(c)
28	(a)	58	(c)	88	(a)	118	(c)	148	(c)	178	(b)
29	(c)	59	(b)	89	(a)	119	(d)	149	(a)	179	(d)
30	(a)	60	(c)	90	(b)	120	(a)	150	(c)	180	(d)

ANSWERS WITH EXPLANATIONS

PHYSICS

1. Out of Syllabus

2. Option (d) is correct.
Given:
The value of set of 'n' equal resistors is 'R' each. They are connected in series to the battery of emf 'E'
Internal resistance $= R$
Current drawn $= I$
Let us connect 'n' resistor in Parallel to the same battery.
Current drawn $= 10 I$
To find the value of 'n'
If the resistors are connected in series then $R = nR$
If the resistors are connected in parallel then

$$R = \frac{R}{n}$$

We know that, $\quad I = \dfrac{E}{nR + R}$ ...(i)

$$10I = \frac{E}{\dfrac{R}{n} + R}$$ ...(ii)

By dividing equation (i) by (ii)

$$10 = \frac{(n+1)R}{\left(\dfrac{1}{n} + 1\right)R}$$

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

$$n = 10$$

Therefore, the value of n is 10.

3. Option (d) is correct.
Given:
Internal resistance of a battery is 'r'
'n' is the variable number of identical cells in the given battery.
Here, the terminals of the battery are short-circuited.
i is the current.
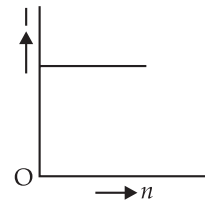
$$I = \frac{n\varepsilon}{nr} = \frac{\varepsilon}{r}$$

So, I is independent of n and I is constant.

Graph (4) shows the correct relationship between I and n.

4. Out of Syllabus

5. Option (d) is correct.
Given:

2 wires are made of the same material and volume

Cross-sectional area of first wire $= A$

Cross-sectional area of second wire $= 3A$

On applying force F, the length of the first wire is increased by Δl

To find:

Force F' need to stretch the second wire to the same length:

Length of wire 1 is shown in the diagram below:
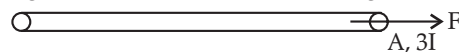
Length of wire 2 is shown in the diagram below:
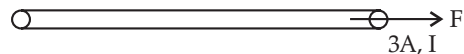
$$F' = \text{force need to stretch wire 2}$$

Now consider

Wire 1, $\qquad \Delta l = \left(\dfrac{F}{AY}\right)3I$ ...(i)

Wire 2, $\qquad \dfrac{F'}{3A} = Y\dfrac{\Delta l}{I}$

$$\Delta l = \left(\frac{F'}{3AY}\right)I$$ ...(ii)

From the above equations (1) & (2) F' can be calculated

$$\Delta l = \left(\frac{F}{AY}\right)3I = \left(\frac{F'}{3AY}\right)I$$

$$F' = 9F$$

Therefore, Force F' need to stretch the second wire to the same length is 9F.

6. **Option (c) is correct.**

Given :

Water taken = 0.1 g

Temperature = 100°C

Pressure = 1.013×10^5 Nm^{-2}

Heat energy needed to convert steam at 100°C is 54 cal.

The volume of steam produced = 167.1 cc

Then, the change in internal energy of water taken = ?

Let,

Heat supplied be ΔQ

Pressure applied be ΔU

Volume of steam produce ΔW

So,

$$\Delta Q = \Delta U + \Delta W$$

Now apply the values given,

$\Rightarrow$ $54 \times 4.18 = \Delta U + 1.013 \times 10^5$ $(167.1 \times 10^{-6} - 0)$

$\Rightarrow$ $\Delta U = 54 \times 4.18 - 1.013 \times 67.1 \times 10^{-1}$

$\Rightarrow$ $\Delta U = 208.7$ J

Therefore, the change in internal energy of the water of 0.1 g is 208.7 J.

7. **Option (b) is correct.**

Given :

The radius of a sphere falls from rest in a viscous liquid is 'r'

Heat is produced due to viscous force.

To find, the rate of production of heat is proportional to :

Power = rate of production of heat

Let,

r is the radius of sphere

vt is its terminal speed

Weight of the sphere is balanced by the buoyant force and viscous force

Then,

Weight, w = mg

$\because$ ρ = $\dfrac{m}{V}$

    m = $\dfrac{4}{3}\pi r^3 \rho$ ...   (i)

So, the weight of the sphere w :

$$w = \frac{4}{3}\pi r^3 \rho g$$

We know that,

Buoyant force,

$$F_B = \frac{4}{3}\pi r^3 \sigma g \qquad ....(ii)$$

Here,

σ is density of water

Viscous force, $F_v = 6\pi\mu r v_t$ ...(iii)

Here, μ is viscosity.

By comparing equations (i), (ii) & (iii)

$$w = F_B + F_v$$

$$\frac{4}{3}\pi r^3 \rho g = \frac{4}{3}\pi r^3 \sigma g + 6\pi\mu r v_t$$

$$v_t = \frac{2}{9}\frac{r^2(\rho-\sigma)g}{\mu} \qquad ...(iv)$$

The rate of production of heat when the sphere attains its terminal velocity is equal to work done by the viscous forces,

$$W = \frac{dQ}{dt} = F_v \times v_t$$

$$W = 6\pi\mu r v_t^2$$

$$W = 6\pi\mu r \left(\frac{2}{9}\frac{r^2(\rho-\sigma)g}{\mu}\right)^2$$

$$\frac{dQ}{dt} \propto r^5$$

$\Rightarrow$ Power $\propto r^5$

8. **Option (a) is correct.**

Given :

The moment of the force $\vec{F} = 4\vec{j} + 5\vec{j} - 6\vec{k}$

The force acting the point (2, 0, –3)

The point under construction (2, –2, –2)

We know that,

Moment of force,

$$\vec{F} = 4\vec{j} + 5\vec{j} - 6\vec{k}$$
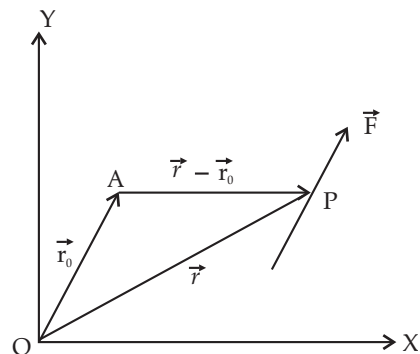
$$\vec{\tau} = \vec{r} - \vec{r}_0 \times \vec{F}$$

$$\vec{r} - \vec{r}_0 = (2\hat{i} + 0\hat{j} - 3\hat{k}) - (2\hat{i} - 2\hat{j} - 2\hat{k})$$

$$= 0\hat{i} + 2\hat{j} - \hat{k}$$

$$\vec{r} = (0\hat{i} + 2\hat{j} - \hat{k})(4\hat{i} + 5\hat{j} - 6\hat{k})$$

$$\vec{\tau} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 2 & -1 \\ 4 & 5 & -6 \end{vmatrix} = -7\hat{i} - 4\hat{j} - 8\hat{k}$$

Hence, the moment of force is $-7\hat{i} - 4\hat{j} - 8\hat{k}$

9. Option (a) is correct.

Given:

The least count of the screw gauge is 0.001 cm

Main scale reading = 5 mm

The zero of circular scale division coincides with 25 divisions

The given screw gauge has a zero error of – 0.004 cm

The diameter of the ball = ?

We know that

Diameter = MSR + CSR ×(Least count) – Zero error

Here,

MSR represents Main Scale Reading

CSR stands for Circular Scale Reading

As we know the values,

Substitute the given values to calculate the diameter of the ball

$$= 0.5 + 25 \times 0.001 - (-0.004)$$

$$= 0.5 + 0.025 + 0.004$$

$$= 0.529 \text{ cm}$$

Therefore, diameter of the ball is 0.529.

10. Option (c) is correct.

Given :

Let, the charge of the car be 'q'

Uniform electric field = $\vec{E}$

Velocity increases from 0 to 6 m/s due to force $q\vec{E}$
Average velocity and the average speed between 0 to 3 s = ?
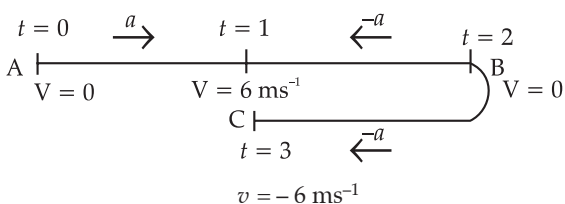
We know that,

$$\text{Acceleration } (a) = \frac{v-u}{t} = \frac{6-0}{1}$$

$$a = 6 \text{ ms}^{-2}$$

By using the value of acceleration, S_1, S_2, S_3 are calculated

For $t = 0$ to $t = 1$ s

't' represents the time

$$S_1 = \frac{1}{2} \times 6(1)^2 = 3 \text{ m} \qquad ...(i)$$

For $t = 1$ s to $t = 2$ s

$$S_2 = 6.1 - \frac{1}{2} \times 6(1)^2 = 3 \text{ m} \quad ...(ii)$$

For $t = 2$ s to $t = 3$ s

$$S_3 = 0 - \frac{1}{2} \times 6(1)^2 = -3 \text{ m}$$

To find the total displacement,

Add S_1, S_2 and S_3

$$S = S_1 + S_2 + S_3 = 3 \text{ m}$$

$$v_{average} = \frac{3}{3} = 1 \text{ ms}^{-1}$$

To find the Average speed

We know that,

$$\text{Speed} = \frac{\text{Total distance travelled}}{\text{time taken}}$$

Total distance travelled = 9 m

$$\text{Average speed} = \frac{9}{3} = 3 \text{ ms}^{-1}$$

Therefore, the average velocity = $v_{average}$

$$= \frac{3}{3} = 1 \text{ ms}^{-1}$$

$$\text{Average speed} = \frac{9}{3} = 3 \text{ ms}^{-1}$$

11. Option (a) is correct.
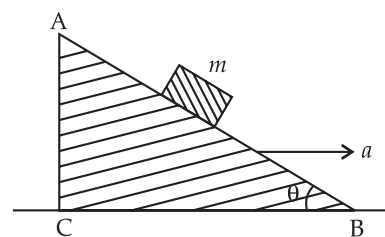
Given :

From the given figure,

ABC is a wedge with the inclination θ

Let,

Mass of the block be 'm'

Acceleration 'a'

Relation between 'a' & θ = ?
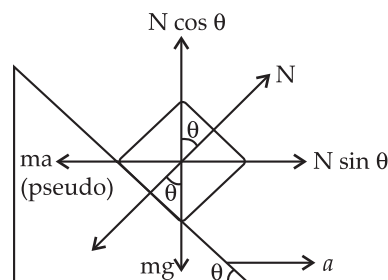
In non-inertial frame,

$$N \sin \theta = ma \qquad \qquad ...(i)$$
$$N \cos \theta = mg \qquad \qquad ...(ii)$$

$$\tan \theta = \frac{a}{g}$$

$$a = g \tan \theta$$

The block will remain constant, when

$$ma \cos \theta = mg \sin \theta \left(\text{Since} \frac{\sin \theta}{\cos \theta} = \tan \theta \right)$$

i.e,

$$a = g \tan \theta$$

12. Option (c) is correct.

Given :

The velocity of em wave is $\vec{V} = V\hat{i}$

The oscillating electric field is along $+y$ axis.

To find the direction of oscillating magnetic field of the em wave.

As we know

Electric field vector is

$$\vec{E} \times \vec{B} = \vec{V}$$

$$(E\hat{j}) \times (\hat{B}) = V\hat{i}$$

Therefore, electric field vector is along $+y$ axis.

So, $\qquad \vec{B} = B\hat{k}$

Therefore, direction of magnetic field vector is along $+z$ direction.

13. Option (c) is correct.

Given :

The refractive index of a prism $= \sqrt{2}$

The angle of prism $= 30°$

The angle of incidence on the prism $= ?$

Normally, the light ray must be incident on silvered surface for retracting the path,

Look at this figure,
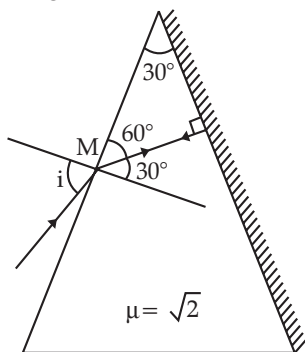
$$A = r + O$$

$$\Rightarrow \qquad \qquad r = 30°$$

Applying Snell's law at point M,

$$\frac{\sin i}{\sin 30°} = \frac{\sqrt{2}}{1}$$

$$\Rightarrow \qquad \qquad \sin i = \sqrt{2} \times \frac{1}{2}$$

Or, $\qquad \qquad \sin i = \frac{1}{\sqrt{2}}$

(i.e) $\qquad \qquad i = 45°$

Therefore, the angle of incidence on the prism is 45°

14. Option (a) is correct.

Given :

Magnetic potential energy $= 25$ mJ

Current in the inductor $= 60$ mA

The inductor is of the inductance $= ?$

Let L be the inductance

Energy stored in an inductor is given as

$$U = \frac{1}{2}LI^2$$

$$L = \frac{2U}{I^2}$$

$$L = \frac{2 \times 25 \times 10^{-3}}{(60 \times 10^{-3})^2}$$

$$L = \frac{25 \times 2 \times 10^6 \times 10^{-3}}{3600}$$

$$L = \frac{500}{36}$$

$$L = 13.89 \text{ H}$$

15. Option (c) is correct.

Given :

The distance of the object from the concave mirror $= 40$ cm

The Focal length of the concave mirror $= 15$ cm

Displaced distance $= 20$ cm

The displacement of the image $= ?$

We know that,

$$\frac{1}{v_1} + \frac{1}{u_i} = \frac{1}{f}$$

$$\frac{1}{v_1} + \frac{1}{-40} = \frac{1}{-15}$$

$$\Rightarrow \qquad \qquad v_1 = -24 \text{ cm}$$

When object is displaced by 20 cm then,

$$\frac{1}{v_2} + \frac{1}{u_i} = \frac{1}{f}$$

$$\frac{1}{v_2} + \frac{1}{-20} = \frac{1}{-15}$$

$$\Rightarrow \qquad \qquad v_2 = -60 \text{ cm}$$

Hence,

$$60 - 24 = 36 \text{ cm}$$

The image is displaced or moved by 36 cm away from the mirror.

16. **Option (c) is correct.**

Given :

Bohr described the hydrogen atom in terms of an electron moving around the nucleus in a circular orbit. He argued that the electron was limited to certain orbits characterized by discrete energies. When an electron moves from a higher energy orbit to a more stable one, it emits energy in the form of a photon.

In a Bohr orbit of the hydrogen atom Kinetic energy k,

$$k = \frac{kze^2}{2r_n}$$

Total energy, $E = \frac{-kze^2}{2r_n}$

So, Kinetic energy : total energy = 1: –1

17. **Option (d) is correct.**

Given :

Initially,

Velocity of mass $(\vec{V}) = V_0 \hat{i} (V_0 > 0)$

Electric field $(\vec{E}) = -E_0 \hat{i}$ $(E_0 = \text{constant} > 0)$

Time $(t) = 0$

If λ_0 is its de-Broglie wavelength initially,

Its de-Broglie wavelength at time t = ?

The wave associated with moving particle is known as matter wave or de-Broglie wave. It propagates in the form of wave packets with group velocity.

According to de-Broglie theory,

The wavelength is given by

$$\lambda = \frac{h}{p} = \frac{h}{mv} = \frac{h}{\sqrt{2mE}}$$

Initial de-Broglie wavelength

$$\lambda_0 = \frac{h}{mV_0}$$

Acceleration of electron

$$a = \frac{eE_0}{m} \qquad (\because F = ma = eE_0)$$

Velocity after time 't'

$$V = \left(V_0 + \frac{eE_0}{m}t\right)$$

$$\lambda = \frac{h}{mV} = \frac{h}{m\left(V_0 + \frac{eE_0}{m}t\right)}$$

$$\lambda = \frac{h}{mV_0\left[1 + \frac{eE_0}{mV_0}t\right]}$$

$$= \frac{\lambda_0}{\left[1 + \frac{eE_0}{mV_0}t\right]}$$

De-Broglie wavelength $(\lambda) = \dfrac{\lambda_0}{1 + \dfrac{eE_0}{mV_0}t}$

18. **Option (d) is correct.**

Given :

Frequency of light $= 2v_0$

v_0 is the frequency of threshold

Velocity of electrons $= v_1$

Frequency increased to $5v_0$

Then,

Velocity of electrons $= v_2$

The ratio of v_1 to $v_2 = ?$

Using Einstein's photoelectric equation,

$$E = W_0 + k_{max}$$

Given that the light of frequency, $2v_0$ is incident on a metal plate,

Then,

$$h(2v_0) = hv_0 + \frac{1}{2}mv_1^2$$

$$hv_0 = \frac{1}{2}mv_1^2 \qquad ...(i)$$

Now, considering the second case, $5v_0$ is incident on a metal plate, (i.e) the light of frequency,

$$h(5v_0) = hv_0 + \frac{1}{2}mv_1^2$$

$$4hv_0 = \frac{1}{2}mv_2^2 \qquad ...(ii)$$

Using equations (i) & (ii)

$$\frac{1}{4} = \frac{v_1^2}{v_2^2}$$

$$\frac{v_1}{v_2} = \frac{1}{2}$$

Therefore,

The ratio of v_1 to v_2 is $\dfrac{1}{2}$.

19. Out of Syllabus

20. **Option (d) is correct.**

It is given that the volume of a monoatomic gas varies with its temperature.

To find : Work done by the gas.

Since the pressure is constant, it is evident from the graph that the process is isobaric.

$$dQ = nC_p dT$$

We know that $Cp = \frac{5}{2}R$

$$dQ = n\left(\frac{5}{2}R\right)dT$$

$$dW = PdV = nRdT$$

Required ratio $= \dfrac{dW}{dQ}$

$$= \frac{nRdT}{n\left(\dfrac{S}{2}R\right)dT} = \frac{2}{5}$$

Therefore, the work done by the gas $= \dfrac{2}{5}$

21. Option (d) is correct.

Given :

The fundamental frequency in an open organ pipe is equal to the third harmonic of a closed organ pipe.

The fundamental frequency for open organ pipe is $\dfrac{v}{2l'}$

The frequency for third harmonic for closed organ pipe is $\dfrac{3v}{4l'}$

So,

$$\frac{v}{2l'} = \frac{3v}{4l}$$

$$l' = \frac{4l}{3 \times 2} = \frac{2l}{3}$$

Substitute $\qquad l = 20$

$$l' = \frac{2 \times 20}{3}$$

$$l' = \frac{40}{3}$$

$$l' = 13.33 \text{ cm}$$

Therefore, the length of the open organ pipe is 13.33 cm $\approx$ 13.2 cm

22. Out of Syllabus

23. Option (c) is correct.

Given :

Mass of oxygen molecule $(m) = 2.76 \times 10^{-26}$ kg

Boltzmann's constant $(k_B) = 1.38 \times 10^{-23}$ JK^{-1}

For the oxygen molecule to escape from earth's atmosphere its velocity must be equal to the escape velocity of earth.

We know that the escape velocity of the earth is 11200 m/s

$$V_{escape} = 11200 \text{ ms}^{-1}$$

The formula for escape velocity is,

$$V_{escape} = \sqrt{\frac{3k_B T}{m}}$$

Here,

$$\sqrt{\frac{3k_B T}{m}} = 11200 \text{ ms}^{-1}$$

From the above equation the temperature can be calculated by

$$T = \frac{11200^2 \times 2.76 \times 10^{-26}}{3 \times 1.38 \times 10^{-23}}$$

$$T = 8.360 \times 10^4 \text{ K}$$

24. Option (c) is correct.

Refractive index is the measure of bending of a ray of light when passing from one medium into another. The value of refractive index varies from medium to medium.

From the question, it is given that the reflected and refracted rays are found to be perpendicular to each other.

At the angle of incidence 'i' (Brewster's angle), the reflected light rays and refracted rays are perpendicular to each other. In this situation the reflected light ray will be polarized with its electric vector perpendicular to the plane of incidence. Also, $\tan i = \mu$ (Brewster's angle).
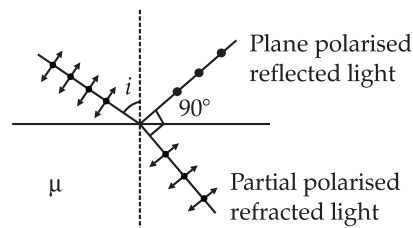
25. Option (c) is correct.

Given :

Distance between slits $(d) = 2$ mm

Wavelength of light used $(\lambda) = 5896$ Å

Distance between screen and slits $(D) = 100$ cm

Angular width = 0.20°

To find :

Distance between slits (d) when the angular width = 0.21°

We know that the angular width formula is $\dfrac{\lambda}{d}$

Angular width $= \dfrac{\lambda}{d}$

When Angular width = 0.20°

$$0.20° = \frac{\lambda}{2} \qquad \text{...(i)}$$

When Angular width = 0.21°

$$0.21° = \frac{\lambda}{d} \qquad \text{...(ii)}$$

Dividing (i) by (ii) we get,

$$\frac{0.20}{0.21} = \frac{d}{2}$$

Therefore,

$$d = 1.9 \text{ mm}$$

26. Option (b) is correct.

For telescope the angular magnification is calculated

by $\dfrac{f_0}{f_B}$, Hence, the focal length of the objective lens

must have a larger value than that of the eyepiece.

Angular resolution is given by the formula

Angular resolution $= \dfrac{D}{1.22\lambda}$

This shows that the angular resolution is directly proportional to the diameter.

Thus for an astronomical refracting telescope to have large angular magnification, it should have larger focal length and large diameter.

27. Out of Syllabus

28. Option (a) is correct.

A *p-n* junction diode is a two-terminal or two-electrode semiconductor device that allows electrical current in one direction only, while blocking electrical current in the opposite or reverse direction.

Due to heating the number of electron-hole pairs will increase thereby changing the overall resistance of the diode.

Because of this there is a change in both the forward and reverse biasing.

29. Option (c) is correct.

There are seven basic logic gates : AND, OR, XOR, NOT, NAND, NOR, and XNOR.

Given :
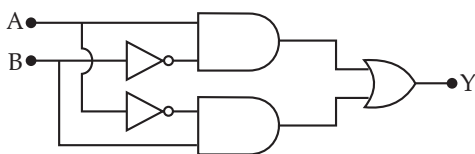
From the given circuit,

The output of two AND gates are $\overline{A}\cdot B$ and $A\cdot\overline{B} + \overline{A}\cdot B$ respectively.

Therefore the output of NOR gate will be
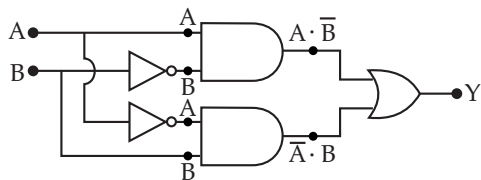
$$Y = (A\cdot\overline{B} + \overline{A}\cdot B)$$

30. Option (a) is correct.

Given :

Mass per unit length of the metallic rod

$$\left(\dfrac{m}{l}\right) = 0.5 \text{ kmg}^{-1}$$

Magnetic field (B) $= 0.25$ T

$$\theta = 30°$$

To find : The current flowing in the rod to keep it stationary (I).
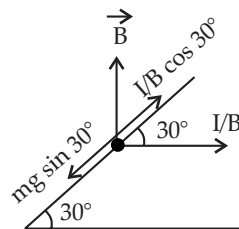
For equilibrium,

$$mg \sin 30° = I / B \cos 30°$$

Substituting the values, we get

$$I = \dfrac{mg}{B} \tan 30°$$

$$\left(\text{Since } \dfrac{\sin 30°}{\cos 30°} = \tan 30°\right)$$

$$I = \dfrac{0.5 \times 9.8}{0.25 \times \sqrt{3}} = 11.32 \text{ A}$$

31. Option (d) is correct.

Given :

Inductor (L) $= 20$ mH

Capacitor (C) $= 100$ μF

Resistor (R) $= 50$ Ω

$$V = 10 \sin(314\,t)$$

To find : Power loss in the circuit.

Power loss in the circuit is calculated by the formula;

$$P_{av} = \left(\dfrac{V_{RMS}}{Z}\right)^2 R$$

Where Z is;

$$z = \sqrt{R^2 + \left(\omega L - \dfrac{1}{\omega C}\right)^2}$$

$$= 56 \text{ Ω}$$

Substituting the value of Z in the power loss formula, we get :

$$P_{av} = \left(\dfrac{10}{(\sqrt{2})56}\right) \times 50$$

$$P_{av} = \dfrac{10^2}{(\sqrt{2})^2 (56)^2} \times 50$$

$$P_{av} = \dfrac{100}{2 \times 3136} \times 50$$

$$P_{av} = \dfrac{5000}{6272} \Rightarrow 0.79 \text{ W}$$

Therefore, the power loss in the circuit is 0.79 W.

32. Option (d) is correct.

When we turn on the power supply in the electromagnet, the electric current produces the

magnetic field. The electric current from the source is also responsible for pushing the diamagnetic rod upwards and out of the hori-zontal magnetic field.

33. Option (b) is correct.

Given :

Current sensitivity of a moving coil galvano-meter = 5 div/mA

Voltage sensitivity = 20 div/V

To find: The resistance of the galvanometer.

The current sensitivity of a galvanometer is calculated by

$$I_S = \frac{NBA}{C} = 5 \text{ div/mA}$$

The voltage sensitivity of a galvanometer is calculated by

$$V_S = \frac{NBA}{CR_G} = 20 \text{ div/V}$$

So, the resistance of galvanometer is given by the formula

$$R_G = \frac{I_S}{V_S}$$

$$= \frac{5 \times 1}{20 \times 10^{-3}}$$

$$= \frac{5 \times 10^3}{20} \Rightarrow \frac{5 \times 1000}{20}$$

$$= \frac{5000}{20} = 250 \ \Omega$$

Therefore, the resistance of the moving coil galvanometer is 250 Ω.

34. Option (c) is correct.

Given :

Room temperature = 27°C

Resonance 1(L_1) = 20 cm

Resonance 2(L_2) = 73 cm

Frequency of tuning fork (v) = 320 Hz

To find : Velocity of sound in air at 27°C

The velocity of sound can be calculated by the formula

$$V = 2(v)[L_2 - L_1]$$

$$= 2 \times 320[73 - 20] \times 10^{-2}$$

$$= 2 \times 320[53] \times 10^{-2}$$

$$= 2 \times 16960 \times 10^{-2}$$

$$= 33920 \times 10^{-2}$$

$$= 339.2 \text{ ms}^{-1} \text{ or } 339 \text{ m/s}$$

Therefore the velocity of sound in air at 27°C is 339 m/s

35. Option (d) is correct.

The electrostatic force is also known as the Coulomb force or Coulomb interaction. It's the attractive or repulsive force between two electrically charged objects in this case two metal plates.

For an isolated capacitor the charge Q is constant

The electric field is given by the formula

$$E = \frac{Q}{2A\varepsilon_0}$$

Force on the plate is given by the formula

$$F = QE$$

$$F_{plate} = \frac{Q^2}{2A\varepsilon_0}$$

From the above equation it is clear that F is independent of the distance between plates.

36. Option (c) is correct.

Given :

The acceleration of the bob of the pendulum (a) = 20 m/s²

Distance (y) = 5 m

To find : Time period of oscillation

In simple harmonic oscillator the acceleration is given by the formula

$$|a| = \omega^2 y$$

Since we know that (a) = 20 ms⁻¹ and distance (y) = 5 m

Substituting the value of a in the equation we get,

$$20 = \omega^2(5)$$

$$\Rightarrow \qquad \omega^2 = \frac{20}{5}$$

$$\Rightarrow \qquad \omega^2 = 4$$

$$\omega = 2 \text{ rad/s}$$

The time period of oscillation is given by the formula

$$T = \frac{2\pi}{\omega}$$

Substituting the value of ω in the above equation,

$$T = \frac{2\ne}{2} = \pi \text{ s}$$

37. Option (d) is correct.

We know that,

$$h = \frac{1}{2} \frac{eE}{m} t^2$$

Therefore,

$$t = \sqrt{\frac{2hm}{eE}}$$

From the above equation we can clearly say that the time is directly proportional to mass.

$$t \propto \sqrt{m}$$

Mass of electron is 9.1 ×10⁻³¹ Kg

Mass of proton is 1.67 ×10⁻²⁷ Kg

Thus it is evident that electron has lesser mass than proton. As time is directly proportional to mass, the electrons with lower mass take lesser time to fall.

Therefore, the time taken for the fall of electron is lesser when compared to the time taken for the protons to fall.

38. Option (c) is correct.

Given:

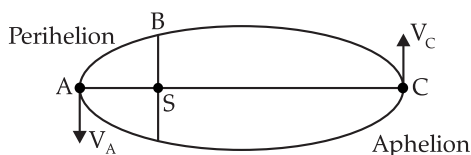Kinetic energies of the planet at positions,

$$A = K_A$$

$$B = K_B$$

$$C = K_C$$

Since *mvr = constant* The speed of the planet will be maximum when it is nearer to the sun (i.e., The distance between the sun and planet is minimum).

We know that if speed is more than kinetic energy will also be more.

It is clear from the above picture that at position A the planet is closest to the sun followed by B and C.

Therefore the correct increasing order of Kinetic energies is $K_A > K_B > K_C$

39. Option (c) is correct.

To find : The ratio $K_t : (K_t + K_r)$

Let translational kinetic energy be K_t and rotational kinetic energy be K_r

Kinetic energy is calculated by the formula;

$$K = \frac{1}{2}mv_2$$

Translational kinetic energy is given by the formula;

$$K_t = \frac{1}{2}\ mv^2$$

Rotational kinetic energy is given by the formula;

$$K_r = \frac{1}{2}I\omega^2 = \frac{1}{2} \times \frac{2}{5} \times mr^2 \times \frac{v^2}{r^2}$$

$$= \frac{1}{5}mv^2$$

$$K_t : (K_t + K_r) = \frac{K_t}{K_t + K_r}$$

$$\frac{K_t}{K_t + K_r} = \frac{\dfrac{1}{2mv^2}}{\dfrac{1}{2mv^2} + \dfrac{1}{5}mv^2}$$

$$= \frac{\dfrac{1}{2mv^2}}{\left(\dfrac{1}{2} + \dfrac{1}{5}\right)mv^2} = \frac{\dfrac{1}{2}}{\dfrac{7}{10}} = \frac{5}{7}$$

The ratio $K_t : (K_t + K_r)$ for the sphere is 5 : 7.

40. Option (a) is correct.

We know that, $g = \dfrac{GM}{R^2}$

(i) It is clear from the above equation that g depends on G.

Thus if G is ten times greater the value of g increases.

(ii) We also know that if gravitational force increases it would be harder to walk on the ground and raindrops will fall faster.

(iii) The time period of a simple pendulum is $\dfrac{1}{\sqrt{g}}$.

Therefore, if g increases the time period decreases.

41. Option (a) is correct.

It is given that the solid sphere is rotating freely in free space, In free space there will be no external torque acting on it.
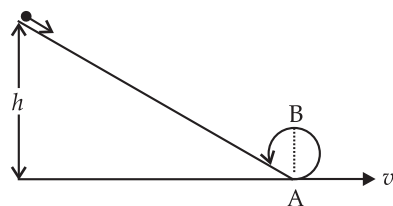
$$\tau_{ex} = 0$$

$$\frac{dL}{dt} = 0$$

$$L = constant$$

If radius increases keeping the mass constant, then rotational kinetic energy and angular velocity will change but the angular moment will remain constant.

42. Option (a) is correct.

It is given that the track is friction less and AB = D

Since the track is frictionless the total mechanical energy is conserved.

Total mechanical energy at start = Total mechanical energy at 'B'

$$mgh = \frac{1}{2}mv_L^2 + mgD$$

$$h = \frac{v_L^2}{2g}$$

For complete rotation the minimum speed required is

$$v_L = \sqrt{rg} = \sqrt{\frac{Dg}{2}}$$

Substituting the above value, we get;

$$mgh = \frac{1}{2}m\frac{D}{2}g + mgD$$

Taking *mg* common on both the sides,

$$mg(h) = mg\left(\frac{D}{4}\right) + D$$

$$h = \frac{D + 4D}{4}$$

$$h = \frac{5D}{4}$$

Therefore, the height h is equal to $\frac{5D}{4}$.

43. Option (d) is correct.

It is given that all three objects have the same mass, radius and angular speed.

Work done is the change in kinetic energy. If there is more kinetic energy the work done will eventually be more.

Kinetic energy is given by the equation

K.E. $= \dfrac{I\omega^2}{2}$ (Where I is the moment of inertia)

Since Kinetic energy is directly proportional to the moment of inertia, the higher the moment of inertia of the objects then higher will be its kinetic energy.

$$W_A : W_B : W_C = \frac{2}{5}MR^2 : \frac{1}{2}MR^2 : MR^2$$

$$= \frac{2}{5} : \frac{1}{2} : 1$$

$$= 4 : 5 : 10$$

Hence,

$W_C > W_B > W_A$

44. Option (a) is correct.

Sliding friction is given by the formula;

$$f = \mu_s\, N$$

The coefficient of sliding friction is;

$$\mu_s = \frac{f}{N}$$

Where,

f = the static force of sliding friction

N = perpendicular force that pushes the objects together

Since both f and N refer to force, they have similar unit (newton). Hence, they cancel each other and the coefficient of sliding friction is dimensionless. Thus it is not possible for the coefficient of sliding friction to have dimensions of length.

The statement (a) says that the coefficient of sliding friction has dimensions of length.

Therefore the statement (a) is wrong.

45. Option (c) is correct.

Given:

The mass of the stationary block $= 4\,m$

To find : The value of coefficient of restitution (e)

By using the law of conservation of the linear momentum,

$$mv + 4m \times 0 = 4mv' + 0$$

$$v' = \frac{v}{4}$$

The value of coefficient of restitution (e) is given by the formula

$$e = \frac{\text{Relative velocity of separation}}{\text{Relative velocity of approach}}$$

We know that

V = Relative velocity of approach

V' = Relative velocity of separation

$$= \frac{\dfrac{V}{4}}{V}$$

$$e = \frac{1}{4} = 0.25$$

Therefore, the value of coefficient of restitution (e) will be 0.25.

CHEMISTRY

46. Option (c) is correct.

$Fe(CO)_5$

EAN $= (Z) - (O.N.) + 2 \times (C.N.)$

$= 26 - 0 + 2 \times 5$

$= 26 + 10$

$= 36$

Since only one central metal atom/ion is present and it follows EAN rule. So, it is mononuclear.

Where, Z = Atomic Number

EAN = Effective Atomic Number

O.N. = Oxidation Number

C.N. = Coordination Number

47. Option (d) is correct.

Magnetic moment (μ) $= \sqrt{n(n+2)}$ B.M.

(a) $Co^{3+} = 1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 4s^0\, 3d^6$

$n = 4 \Rightarrow \sqrt{4(4+2)}$ B.M $= \sqrt{24}$ B.M

(b) $Cr^{3+} = 1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 4s^0\, 3d^3$

$n = 3 \Rightarrow \sqrt{3(3+2)}$ B.M. $= \sqrt{15}$ B.M.

(c) $Fe^{3+} = 1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 4s^0\, 3d^5$

$$n = 5 \Rightarrow \sqrt{5(5+2)} \text{ B.M.} = \sqrt{35} \text{ B.M.}$$

(d) $Ni^{2+} = 1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^6\, 4s^0\, 3d^8$ [⇅|⇅|⇅|↑|↑]
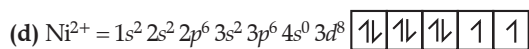
$$n = 2 \Rightarrow \sqrt{2(2+2)} \text{ B.M.} = \sqrt{8} \text{ B.M.}$$

48. Option (a) is correct.

CrO_4^{2-}	Cr^{6+}	diamagnetic
$Cr_2O_7^{2-}$	Cr^{6+}	diamagnetic
MnO_4^{-}	Mn^{7+}	diamagnetic
MnO_4^{2-}	Mn^{6+}	paramagnetic
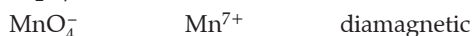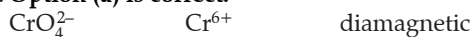
In MnO_4^{2-}, unpaired electron is present, so, *d-d* transition is possible.

49. Option (c) is correct.
Tetrahedral geometry and diamagnetic

$Ni \to 3d^8\, 4s^2$ [⇅|⇅|⇅|↑|↑]   [⇅]
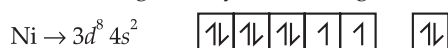
CO is Strong Field Ligand, so unpaired electron will get paired.

[⇅|⇅|⇅|⇅|⇅]
     □   [□|□|□]
    $3d$

    ↑   ↑ ↑ ↑
   CO   CO CO CO
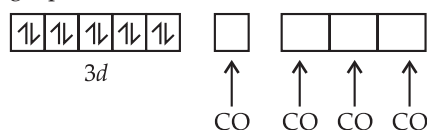
sp^3 hybridization

tetrahedral and diamagnetic

50. Option (d) is correct.

Trans   cis
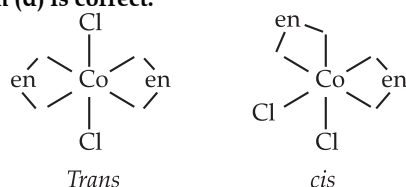
Geometrical isomerism

51. Option (a) is correct.
Mechanism :

$CH_3-CH_2-CH_2-Cl \xrightarrow{AlCl_3} CH_3-CH_2-\overset{+}{C}H_2 + AlCl_4^-$
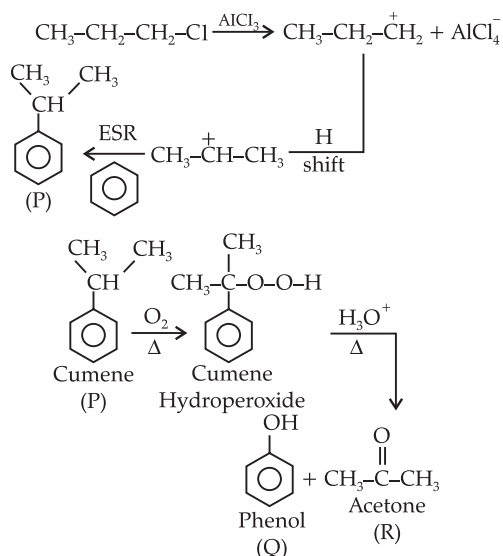
52. Option (a) is correct.
The molecule which forms zwitter ion is Glycine.

$HOOC - CH_2 - NH_2 \leftrightarrow {}^{-}OOC - CH_2 - NH_{3+}$
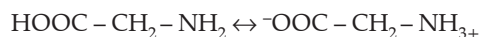
                 Zwitter ion

53. Option (c) is correct.

$\overset{(+7)}{MnO_4^-} \longrightarrow Mn^{2+}$; $5e^-$ gain   ...(i)

$\overset{(+3)}{C_2O_4^{2-}} \longrightarrow 2\overset{(+4)}{CO_2}$; $5e^-$ gain   ...(ii)

Multiplying (i) by 2 and (ii) by 5 to balance e^-

$2MnO_4^- + 5C_2O_4^{2-} \longrightarrow 2Mn^{2+} + 10CO_2$

On balancing charges,

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
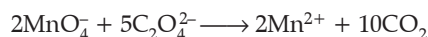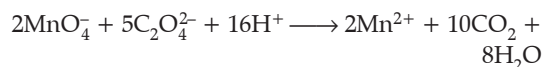
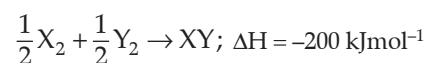**54.** [Out of Syllabus]

55. Option (d) is correct.
For reaction, $\Delta H = -ve$, and

$$\Delta n_g = -ve$$

So, High pressure and Low temperature favour product formation.

56. Option (b) is correct.
Let B.E. of X_2, Y_2 & XY are x, $0.5x$ and x kJmol^{-1} respectively.

$\frac{1}{2}X_2 + \frac{1}{2}Y_2 \to XY$; $\Delta H = -200$ kJmol^{-1}

$\Delta H = -200 = \Sigma(B.E.)_{Reactant} - \Sigma(B.E.)_{Product}$

$= \left[\frac{1}{2}x + \frac{1}{2}(0.5x) \right] - [1x]$

$= 0.75x - x$

$-200 = -0.25x$

$x = +800$ kJmol^{-1}

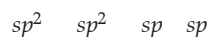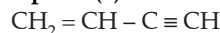**57. Option (c) is correct.**
doubled

Half life of a zero order reaction, $t_{1/2} = \dfrac{[A]_0}{2K}$
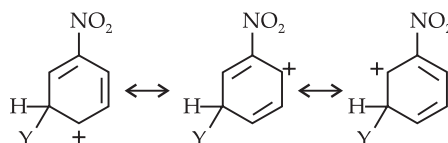
     If $[A]_0 = $ doubled

     $t_{1/2}$ also gets doubled.

58. Option (c) is correct.
$CH_2 = CH - C \equiv CH$

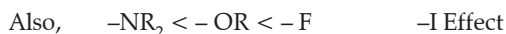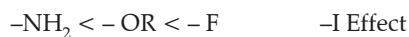$sp^2 \quad sp^2 \quad sp \quad sp$

59. Option (b) is correct.
$-NO_2$ group is meta-directing group.

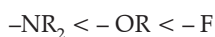More stable due to less e^- withdrawing effect of $-NO_2$.

60. Option (c) is correct.

Based on Electronegativity

$$-NH_2 < -OR < -F \qquad -I \text{ Effect}$$

Also, $\quad -NR_2 < -OR < -F \qquad -I \text{ Effect}$

But based on R = alkyl group

The correct order is
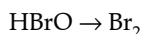
$$-NR_2 < -OR < -F$$

61. Option (c) is correct.

For first order reaction,
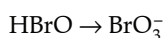
$$t_{1/2} = \text{independent of concentration}$$

For second order reaction, $\qquad t_{1/2} \propto \dfrac{1}{[A]_0}$

62. Out of Syllabus
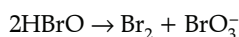
63. Option (a) is correct.

After calculating the $E°_{cell}$ corresponding to each compound undergoing disproportionation reaction, the reaction for which $E°_{cell}$ comes out +ve, is spontaneous.

$$HBrO \rightarrow Br_2$$

$\quad E° = 1.595$ V, Standard Reduction Potential (Cathode)

$$HBrO \rightarrow BrO_3^-$$

$\quad E° = -1.5$ V, Standard Oxidation Potential (Anode)

$$2HBrO \rightarrow Br_2 + BrO_3^-$$

$\quad E°_{cell} = 1.595 - 1.5$

$\qquad = 0.095$ V

$E°_{cell} > 0$

So, Spontaneous.

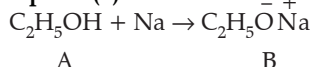**64. Option (d) is correct.**

(a) 10^{-3} mol of water $= 10^{-3} \times N_A$ molecules

(b) 0.00224 L of water $= 0.00224/22.4$ moles $= 0.0001$ moles $= 0.0001 \times N_A$ molecules

(c) 0.18 g of water $= 0.01$ moles $= 0.01 \times N_A$ molecules

(d) 18 mL of water $= 18$ g of water $= 1 \times N_A$ molecules

65. Option (a) is correct.

$$C_2H_5OH + Na \rightarrow C_2H_5O^-\overset{+}{Na}$$
$$\quad\quad A \quad\quad\quad\quad\quad\quad B$$

$$C_2H_5OH + PCl_5 \rightarrow C_2H_5Cl$$
$$\quad\quad\quad\quad\quad\quad\quad\quad C$$

$$C_2H_5O^-\overset{+}{Na} + C_2H_5Cl \rightarrow C_2H_5-O-C_2H_5$$
$$\quad B \quad\quad\quad\quad C \quad\quad\quad \text{diethylether}$$

$\qquad S_N2$ mechanism : Williamson's synthesis

66. Option (a) is correct.

$$CH_4 \xrightarrow[hv]{Br_2} CH_3 - Br \xrightarrow[ether]{Na} CH_3 - CH_3$$
$$\text{(less than four 'C')}$$

67. Option (d) is correct.

m-bromotoluene
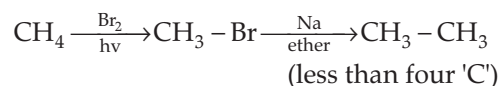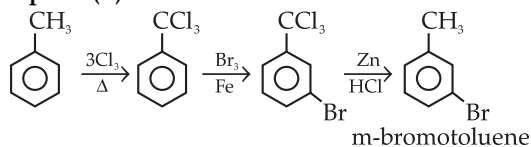
68. Out of Syllabus

69. Option (b) is correct.

Moles of HCOOH $= 2.3/46 = 0.05$ moles
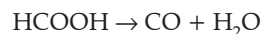
$$HCOOH \rightarrow CO + H_2O$$
$$\qquad\qquad\qquad (H_2O \text{ is absorbed by } H_2SO_4)$$

Initial moles	0.05	0	0
Final moles	0	0.05	0.05

Moles of $H_2C_2O_4 = 4.5/90 = 0.05$ moles

$$H_2C_2O_4 \rightarrow CO + CO_2 + H_2O$$
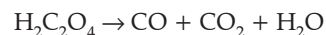
Initial moles	0.05	0	0	0
Final moles	0	0.05	0.05	0.05

$(H_2O$ is absorbed by H_2SO_4 and CO_2 is absorbed by KOH)

So, the remaining product is only CO.

Mole of CO formed from both the reactions

$$= 0.05 + 0.05 = 0.1 \text{ moles}$$

Left mass of CO $=$ moles $\times$ molar mass

$$= 0.1 \times 28$$

$$= 2.8 \text{ g}$$

70. Option (d) is correct.

Amylose is long unbranched chain with α-D-Glucose with held by C_1-C_4 glycosidic linkages whereas Amylopectin is branched chain polymer of α-D-Glucose unit in which chain is formed by C_1-C_4 glycosidic linkages while branching occurs by C_1-C_6 glycosidic linkages.

71. Option (c) is correct.

In metals moving down the group metallic character increases, so, acidic nature decreases hence most acidic will be BeO.

72. Option (a) is correct.
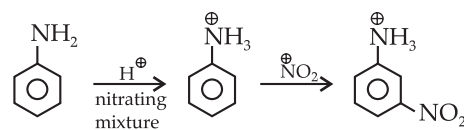
In acidic medium aniline is protonated to form anilinium ion which dreews electron benzene ring gives m-product in ESR metadirecting.

73. Out of Syllabus

74. Option (a) is correct.

As $N_1V_1 > N_2V_2$

So, acid is left at the end of the reaction.

So, final solution $= [H^+] = \dfrac{N_1V_1 - N_2V_2}{V_1 + V_2}$

$$= \dfrac{\dfrac{1}{5} \times 75 - \dfrac{1}{5} \times 25}{75 + 25}$$
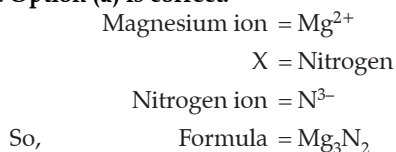
$$= \dfrac{1}{10} = 0.1$$

$$pH = -\log[H^+] = 1$$

75. Out of Syllabus

76. Option (d) is correct.

Molar mass of $BaSO_4$ = 233 gmol^{-1}

Solubility of $BaSO_4$ = 2.42 × 10^{-3} gL^{-1}

= 2.42 × 10^{-3}/233 molL^{-1}

s = 1.038 × 10^{-5} molL^{-1}

K_{sp} = s^2 = (1.038 × 10^{-5})^2

= 1.08 × 10^{-10} mol^{2}L^{-2}

77. Out of Syllabus

78. Option (a) is correct.

Magnesium ion = Mg^{2+}

X = Nitrogen

Nitrogen ion = N^{3-}

So,   Formula = Mg_3N_2

79. Out of Syllabus

80. Option (b) is correct.

The correct configuration of N is

| ⇅ | | ⇅ | | ↑ | ↑ | ↑ |

81. Option (c) is correct.

Ion/Species	Total Electron	Bond Order
CN	13	2.5
CN$^+$	12	2
CN$^-$	14	3
NO	15	2.5

82. Option (b) is correct.

(1) Chlorine has the highest electron gain enthalpy. True

(2) All halogens except fluorine show positive oxidation state. Not true as in HOF fluorine is assumed to show +1 Oxidation state.

(3) All are oxidizing agents. True

(4) All form monobasic oxyacids. True

83. Option (b) is correct.

Boron belongs to 2nd period and it does not have vacant d orbital.

84. Option (c) is correct.

Hybridisation (H) = $\frac{1}{2}[7 + 3] = 5$

Lone pair of electrons (L.P) = 5 – 3 = 2

85. Out of Syllabus

86. Option (a) is correct.

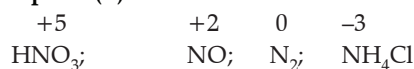In group 13, atomic radii are given as :

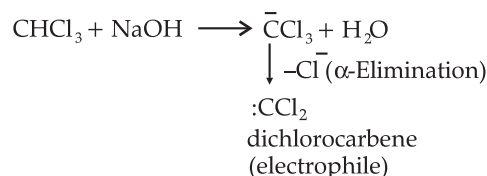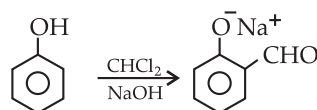| B	Ga	Al	In	Tl
85	135	143	167	170

∴ Correct order of increasing atomic radii :

B < Ga < Al < In < Tl

87. Option (d) is correct.

+5	+2	0	–3
HNO_3;	NO;	N_2;	NH_4Cl

88. Option (a) is correct.

$CHCl_3 + NaOH \longrightarrow \bar{C}Cl_3 + H_2O$

↓ $-\bar{Cl}$ (α-Elimination)

:CCl_2
dichlorocarbene
(electrophile)

89. Option (a) is correct.

Carboxylic acid has higher boiling point than aldehyde, ketone and even alcohols of comparable molecular mass.

This is due to more extensive association through intermolecular H-bonding and this hydrogen bonding is present even in vapour state.

Intramolecular
hydrogen bonding
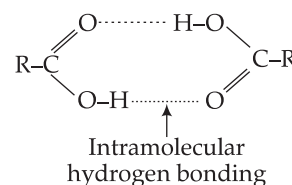
90. Option (b) is correct.

The compound possessing ketomethyl $CH_3–C = O$ or alcohol which on oxidation gives keto-methyl group gives haloform reaction.
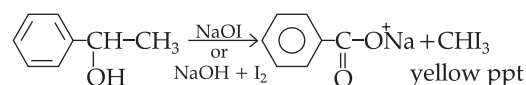
BIOLOGY

91. Option (a) is correct.

Each organism has an invariably defined range of conditions that it can tolerate, diversity in the resources and utilises it as a distinct functional role in the ecological system, all these together comprise its niche.

92. Option (a) is correct.

Ozone is a secondary pollutant. Secondary pollutant are not emitted directly by a source but formed when

primary pollutants react with other molecules in the atmosphere.

93. Option (c) is correct.

In presence of Cl (catalyst), ozone degrades releasing molecular oxygen (O_2) causing ozone depletion.

94. Option (b) is correct.

World Ozone day is celebrated on 16th September.

95. Option (d) is correct.

The given data pertains to an inverted pyramid of biomass as found in an aquatic ecosystem.

96. Option (c) is correct.

Natality refers to birth rate. Number of individuals entering a habitat is immigration. Death rate is known as mortality. Number of individuals exiting a habitat is known as emigration.

97. Option (c) is correct.

Offsets are units of vegetative propagation (asexual reproduction) and are produced by mitotic divisions. Sexual reproduction involves meiosis. Parthenocarpy is formation of fruit without fertilisation. Parthenogenesis is the process by which female gamete develops in to new organism without fertilisation.

98. Option (c) is correct.

Semi-conservative DNA replication was first shown in bacterium *Escherichia coli* by Meselson and Stahl.

99. Option (a) is correct.

Francois Jacob and Jacques Monod proposed the model of gene regulation known as *lac* operon. Matthew Meselson and Franklin Stahl gave experimental proof for semi-conservative model of replication. The unequivocal proof that DNA is the genetic material came from the experiments of Alfred Hershey and Martha Chase. DNA fingerprinting technique was developed by Alec Jeffreys.

100. Option (a) is correct.

Pollen grains are well preserved as fossils because of the presence of sporopollenin. Sporopollenin, one of the most resistant organic materials known. It can withstand high temperatures and strong acids and alkali. No enzyme degrades sporopollenin.

101. Option (d) is correct.

Starch synthesis in pea seeds is controlled by one gene. It has two alleles (B and b). Here, a single gene produces more than one effect.

102. Option (d) is correct.

The bamboo species flower only once in their life time, generally after 50-100 years, produce large number of fruits and die.

103. Option (c) is correct.

Punnet square was developed by a British geneticist Reginald C. Punnet. Franklin Stahl and Meselson proved semi-conservative mode of DNA replication. Morgan coined the term linkage. Transduction was discovered by Zinder and Lederberg.

104. Option (c) is correct.

The Golgi apparatus receives proteins and lipids from the ER. It modifies them, concentrates and packs them into secretory vesicles that are formed by budding off from the trans-golgi surface.

105. Option (c) is correct.

Diplotene is recognised by the dissolution of the synaptonemal complex and the tendency of the recombined homologous chromosomes of the bivalents to separate from each other.

106. Option (b) is correct.

Stomatal movement is not affected by O_2 concentration whereas light, temperature and CO_2 concentration affect the stomatal movement.

107. Option (d) is correct.

Stomata in monocots are dumb-bell shaped Grass is a monocot.

108. Option (c) is correct.

NADPH, ATP and oxygen are products of light reaction, while NADH is a product of respiration process.

109. Option (a) is correct.

Nucleous is a non-membranous structure and is a site of r-RNA synthesis.

110. Option (d) is correct.

Saccharomyces i.e., yeast is an eukaryote. *Mycobacterium* is a bacterium. *Oscillatoria* and *Nostoc* are cyanobacteria.

111. Option (a) is correct.

Sugar, a carbohydrate is polyhydroxy aldehyde, ketone or their derivatives, which means they have carbonyl and hydroxyl groups.

112. Option (a) is correct.

The correct matches are as follows-

Herbarium is a place or a store house of plant specimens where they are dried, pressed, preserved and systematically arranged on sheets.

Key is a booklet and considered as a taxonomical aid which contains list of characters and their alternates. It helps in the identification of various taxa such as class, order, family, genus and species.

Museum is a place where preserved plants and animal specimens are kept and used for study and reference.

Catalogue is the means of recording description. It is a list that enumerates methodically all the species found in a particular place with brief description which helps in correct identification.

113. Option (d) is correct.

Polysiphonia is a member of Rhodophyceae (red algae) and reproduce asexually by non-motile spores and sexually by non-motile gametes.

114. Option (b) is correct.

Agaricus a genus of basidiomycetes, basidiospores

are produced 4 spores exogenously. *Alternaria*, a genus of deuteromycetes does not produce sexual spores. Neurospora a genus of ascomycetes produces. *Saccharomyces*, a unicellular ascomycetes produces spores endogenously ascospores endogenously.

115. Option (a) is correct.
The pollen grain has two air sacs or wings for making it light and are dispersed by air currents.

116. Option (d) is correct.
Retrovirus is commonly used as a vector for introducing a DNA fragment in human lymphocytes as in gene therapy of ADA deficiency.

117. Option (a) is correct.
In 1997, an American company got patent rights on Basmati rice through the US Patent and Trademark Office. This allowed the company to sell a 'new' variety of Basmati, in the US and abroad.

118. Option (c) is correct.
Biopiracy is the term used to refer to the use of bio-resources by multinational companies and other organisations without proper authorisation from the countries and people concerned without compensatory payment.

119. Option (d) is correct.
Ribozyme, a catalytic RNA is a nucleic acid. Transduction was discovered by Zinder and Lederberg. Morgan coined the term linkage. G. Mendel is the father of genetics.

120. Option (a) is correct.
Each cycle of PCR has three steps : (1) Denatura-tion, (2) Primer annealing, (3) Extension of primers.

121. Option (a) is correct.
Indian Government has set up organisations such as GEAC (Genetic Engineering Approval Committee), which will make decisions regarding the validity of GM research and the safety of introducing GM-organisms for public services.

122. Option (c) is correct.
NAD^+ act as an electron carrier in cellular respiration.

123. Option (c) is correct.
A very close relationship exists between a species of moth and *Yucca* where both species cannot complete their life cycles without each other.

124. Option (b) is correct.
Pollen grains of large number of species can be stored for several years in liquid nitrogen having a temperature of -196°C. This method is known as cryopreservation. These stored pollen grains can be later used as pollen banks in crop breeding programmes.

125. Option (d) is correct.
Plants obtain iron in the form of ferric ions (Fe^{3+}). It is required in larger amounts in comparison to other micronutrients. It is an important constituent of proteins involved in the transfer of electrons like ferredoxin and cytochromes.

126. Option (a) is correct.
Pollen tube releases two male gametes in to synergids. *Syngamy*- fusion of one male gamete with egg cell to form diploid zygote. *Triple fusion*-fusion of other male gamete with two polar nuclei to produce triploid primary endosperm nucleus (PEN). Syngamy along with triple fusion is called Double fertilisation.

127. Option (d) is correct.
Green sulphur bacteria do not use water as source of proton, therefore they do not evolve water. They use H_2S as the hydrogen donor, and the oxidation product is sulphur or sulphate.

128. Option (b) is correct.
Potassium is involved in stomatal opening and closing.

129. Option (d) is correct.
Pneumatophores occur in halophytes such as mangroves e.g., *Rhizophora*, *Avicennia* growing in swampy areas.

130. Option (b) is correct.
Pseudopodia are locomotory and feeding structures in amoeboid protozoans. The remaining options are correct.

131. Out of Syllabus

132. Option (c) is correct.
Sweet potato is a modified adventitious root for storage of food.

133. Option (d) is correct.
Gymnosperms are plants in which ovules are not enclosed by any ovary wall and remain exposed, both before and after fertilisation. Horsetails are Pteridophytes. Stems are branched in *Cycas* and unbranched in *Cedrus*.

134. Option (a) is correct.
Endodermis have casparian strips on radial and inner tangential wall. It is rich in suberin.

135. Out of Syllabus

136. Option (a) is correct.
Nissl granules are composed of free ribosomes and RER. They are responsible for protein synthesis.

137. Option (a) is correct.
Oxidative phosphorylation occurs in inner mitochondrial membrane.

138. Option (d) is correct.
Ribosomes may occur singly as monosomes or in rosettes and helical groups called polysomes. The different ribosomes of a polysome are connected with a strand of *m*-RNA. Nucleosome is a basic unit of DNA packaging in eukaryotes. Plastidome are the plastids of a cell when they are referred to a functional unit. Polyhedral bodies are involved in carbon fixation are present in autotrophic bacteria.

139. Out of Syllabus

140. Option (a) is correct.
Phospholipid synthesis is not the function of RER.

Smooth endoplasmic reticulum are involved in lipid synthesis.

141. Option (a) is correct.
Polytene chromosomes are found in salivary glands of insects and are also called as salivary chromosomes.

142. Option (d) is correct.
Epinephrine is derived from amino acid tyrosine by the removal of carboxylic group.

143. Option (c) is correct.
The limbic system is emotional brain and controls all emotions in our body but not movements.

144. Option (b) is correct.
Estrogen promotes the activity of osteoblast and inhibits osteoclast. In an ageing female osteoporosis occurs due to deficiency of estrogen.

145. Option (d) is correct.
Lens in the human eye is held in its place by suspensory ligaments attached to the ciliary body.

146. Option (d) is correct.
In a growing population the younger population size is large than the reproductive group.

147. Option (b) is correct.
Eutrophication is the excessive growth of algae in water bodies due to the nutrient enrichment particularly with nitrogen and phosphate.

Sanitary landfills are the areas where wastes are disposed in a depression after compaction and covered with dirt.

Snow blindness is the inflammation of cornea caused by the high doses of UV-B radiations. Prolonged exposure of this radiation may permanently damage the cornea.

Jhum cultivation is also known as shifting cultivation. It is a technique in which tribal population slash and burn forests to make it agriculture land. It results in deforestation.

148. Option (c) is correct.
Heroin is commonly called as smack. It is obtained from the latex of poppy plant.

149. Option (a) is correct.
In amensalism, one species is harmed whereas the other is unaffected. Antibiosis also shows this feature where the antibiotics released by the microbial group (*Penicillium*). Has affect on other microbes (such as *Staphylococcus*).

150. Option (c) is correct.
Sacred groves is a type of *in-situ* conservation.

151. Option (a) is correct.
Parietal cells are source of HCl and intrinsic factor. HCl converts iron present in diet from ferric to ferrous form for its easier absorption and use during erythropoiesis.

152. Option (a) is correct.
Fibrinogen is a protein present in the plasma of the blood. It plays an essential role in blood clotting. Globulins are involved in defence mechanism as antibodies are derived from γ-globulin (γ = gamma, greek letter). Albumin is a blood protein and maintains osmotic pressure of the blood.

153. Option (d) is correct.
Signal for contraction increases Ca^{++} level in the sarcoplasm. Increase in Ca^{++} level leads to the binding of calcium ions with a subunit of troponin on actin filament and thereby removing the masking of active sites for myosin.

154. Option (c) is correct.
Occupational disorders are due to the occupation of the individual. Silicosis is due to chronic exposure of silica dust in workers involved in crushing or stone breaking industries. Botulism is a form of food poisioning caused by *Clostridium botulinum*. Anthracis is a serious infectious disease affecting domestic animals and is caused by *Bacillus anthracis*. Emphysema is mainly cased by smoking cigarette.

155. Option (d) is correct.
Coding strand and *m*RNA has same nucleotide sequence except, 'T'-Thymine is replaced by 'U'-Uracil in *m*RNA.

156. Option (a) is correct.
The woman being a carrier, both son and daughter can inherit the X-chromosomes. The son only can be diseased.

157. Option (b) is correct.
The correct matches are as follows-

Follicular Phase is also known as proliferative phase. During this phase, the primary follicles in the ovary grow to become a fully mature Graafian follicle under the influence of Follicle stimulating hormone.

Secretory Phase is also called as luteal phase because of the persistence of corpus luteum. This corpus luteum secretes progesterone which is essential for the growth and thickening of endometrium.

Menstruation or menstrual phase occurs due to the breakdown of endometrial lining in the absence of pregnancy. Due to this blood oozes out from the ruptured endometrial blood vessels and pass out through the vaginal opening.

158. Option (c) is correct.
Hugo de Vries believed that mutation caused speciation and hence called it saltation (Single step large mutation).

159. Option (b) is correct.
Operon concept is for prokaryotes and enchancer sequences are present in eukaryotes.

160. Option (d) is correct.

Asthma is due to inflammation of bronchi and bronchioles. Emphysema is a chronic disorder in which alveolar walls are damaged due to which respiratory surface is decreased.

161. Option (d) is correct.

The correct matches are as follows-

Tricuspid valve is present between the right atrium and right ventricle. During ventricular contraction, it prevents blood to move from right ventricle into right atrium.

Bicuspid valve or mitral valve is present between the left atrium and left ventricle. During ventricular contraction, it prevents blood to move from left ventricle into left atrium.

Semilunar valve is present between the right ventricle and pulmonary artery.

162. Option (c) is correct.

Tidal volume is the volume of air inspired or expired during a normal respiration. It is approx. 500 ml. Inspiratory reserve volume average 2500–3000 ml and is the additional volume of air inspired forcibly. Expiratory reserve volume is the additional volume of air of a person can expire forcibly and averages 1000–1100 ml. Residual volume is the volume of air remaining in the lungs even after a forcible expiration.

163. Option (b) is correct.

Placenta acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc. These hormones are necessary for the maintenance of pregnancy.

164. Option (d) is correct.

Saheli the new oral contraceptive pill for the female contains a non-steroidal preparation. It contains centchroman which blocks estrogen receptors in the uterus.

165. Option (a) is correct.

Spermiogenesis is conversion of spermatids into spermatozoa whereas spermiation is the release of the sperm from sertoli cells into the lumen of seminiferous tubule.

166. Option (d) is correct.

The amnion, chorion, allantois and yolk sac are the extraembryonic or foetal membranes. Amnion is formed from ectoderm on the inner side and mesoderm on outer side.

167. Option (d) is correct.

In earthworm development is direct i.e., there is no larval stage and hence no metamorphosis.

168. Option (c) is correct.

Homeotherm animals are warm blooded i.e., they are able to maintain a constant body temperature. Birds and mammals are homeotherm. Turtle belong to the class Reptilia which are poikilotherms or cold-blooded.

169. Out of Syllabus

170. Option (c) is correct.

Diatoms are the chief producers in the oceans.

171. Option (a) is correct.

Ciliates such as *Paramoecium* differs from other protozoans in having two types of nuclei i.e., macronucleus and micronucleus.

172. Out of Syllabus

173. Option (a) is correct.

Glycosuria is condition in which there is presence of glucose in the urine. This is observed when the blood glucose level rises above 180 mg/100 ml of blood. Gout is due to deposition of uric acid crystals in the joint. Renal calculi are precipitates of calcium phosphate produced in the pelvis of the kidney. Glomerulus nephritis refers to the inflammation of glomeruli of kidney.

174. Option (c) is correct.

Ultrafiltration refers to the filtration of blood through malpighian corpuscles. Concentration of urine refers to water absorption from glomerular filtrate in the medulla by the counter-current mechanism in Henle's loop. Transport of urine from kidney to the urinary bladder is through ureter.

175. Option (a) is correct.

Divergent evolution occurs in the same structures which have developed along different directions due to adaptation to different needs, examples, forelimbs, heart, brain of vertebrates. Eyes of octopus, bat and man are examples showing convergent evolution.

176. Option (b) is correct.

Curd is more nourishing than milk and has enriched presence of vitamins specially Vitamin B_{12}.

177. Option (c) is correct.

$I^A i$, $I^B i$: Dominant - recessive relationship $I^A I^B$: Co-dominance, I^A, I^B and i : Three different allelic forms of gene i.e., multiple allelism.

178. Option (b) is correct.

Alzheimer's disease is due to deficiency of neurotransmitter acetylcholine.

179. Option (d) is correct.

In different vertebrates the forelimbs perform different functions but they have similar anatomical structure.

180. Option (d) is correct.

Elephantiasis is caused by roundworm, *Wuchereria bancrofti* and is transmitted by *Culex* mosquito.

❑❑❑