NEET 2019

QUESTION PAPER

PHYSICS

1. When a block of mass M is suspended by a long wire of length L, the length of the wire becomes $(L + l)$. The elastic potential energy stored in the extended wire is

(1) Mgl (2) MgL

(3) $\frac{1}{2}Mgl$ (4) $\frac{1}{2}MgL$

2. A mass m is attached to a thin wire and whirled in a vertical circle. The wire is most likely to break when

(1) the mass is at the highest point.

(2) the wire is horizontal.

(3) the mass is at the lowest point.

(4) inclined at an angle of 60° from vertical.

3. Ionized hydrogen atoms and α-particles with same momenta enters perpendicular to a constant magnetic field, B. The ratio of their radii of their paths $r_H : r_\alpha$ will be

(1) 2 : 1 (2) 1 : 2

(3) 4 : 1 (4) 1 : 4

4. Body A of mass $4m$ moving with speed u collides with another body B of mass $2m$, at rest. The collision is head on and elastic in nature. After the collision the fraction of energy lost by the colliding body A is

(1) $\frac{1}{9}$ (2) $\frac{8}{9}$

(3) $\frac{4}{9}$ (4) $\frac{5}{9}$

5. In a double slit experiment, when light of wavelength 400 nm was used, the angular width of the first minima formed on a screen placed 1 m away, was found to be 0.2°. What will be the angular width of the first minima, if the entire experimental apparatus is immersed in water? ($\mu_{water} = 4/3$)

(1) 0.266° (2) 0.15°

(3) 0.05° (4) 0.1°

6. In which of the following devices, the eddy current effect is not used?

(1) Induction furnace

(2) Magnetic braking in train

(3) Electromagnet

(4) Electric heater

7. A soap bubble, having radius of 1 mm, is blown from a detergent solution having a surface tension of $2.5 \times 10^{-2}\,\text{N m}^{-1}$. The pressure inside the bubble equals at a point Z_0 below the free surface of water in a container. Taking $g = 10\ \text{m s}^{-2}$, density of water $= 10^3\,\text{kg m}^{-3}$, the value of Z_0 is

(1) 100 cm (2) 10 cm

(3) 1 cm (4) 0.5 cm

8. Which color of the light has the longest wavelength?

(1) Red (2) Blue

(3) Green (4) Violet

9. A disc of radius 2 m and mass 100 kg rolls on a horizontal floor. Its centre of mass has speed of $20\ \text{cm s}^{-1}$. How much work is needed to stop it?

(1) 3 J (2) 30 kJ

(3) 2 J (4) 1 J

10. The displacement of a particle executing simple harmonic motion is given by

$y = A_0 + A\sin\omega t + B\cos\omega t$

Then the amplitude of its oscillation is given by

(1) $A_0 + \sqrt{A^2 + B^2}$ (2) $\sqrt{A^2 + B^2}$

(3) $\sqrt{A_0^2 + (A + B)^2}$ (4) $A + B$

11. Two similar thin equi-convex lenses, of focal length f each, are kept coaxially in contact with each other such that the focal length of the combination is F_1. When the space between the two lenses is filled with glycerin (which has the same refractive index $(\mu = 1.5)$ as that of glass) then the equivalent focal length is F_2. The ratio $F_1 : F_2$ will be

(1) 2 : 1 (2) 1 : 2

(3) 2 : 3 (4) 3 : 4

12. Increase in temperature of a gas filled in a container would lead to

(1) increase in its mass.

(2) increase in its kinetic energy.

(3) decrease in its pressure.

(4) decrease in intermolecular distance.

13. An electron is accelerated through a potential difference of 10,000 V. Its de Broglie wavelength is (nearly) ($m_e = 9 \times 10^{-31}$ kg)

(1) 12.2×10^{-13} m (2) 12.2×10^{-12} m

(3) 12.2×10^{-14} m (4) 12.2 nm

14. A copper rod of 88 cm and an aluminum rod of unknown length have their increase in length independent of increase in temperature. The length of aluminum rod is

$(\alpha_{Cu} = 1.7\times10^{-5}\ K^{-1}$ and $\alpha_{Al} = 2.2\times10^{-5}\ K^{-1})$

(1) 6.8 cm (2) 113.9 cm

(3) 88 cm (4) 68 cm

15. Pick the wrong answer in the context with rainbow.

(1) When the light rays undergo two internal reflections in a water drop, a secondary rainbow is formed.

(2) The order of colours is reversed in the secondary rainbow.

(3) An observer can see a rainbow when his front is towards the Sun.

(4) Rainbow is a combined effect of dispersion, refraction and reflection of sunlight.

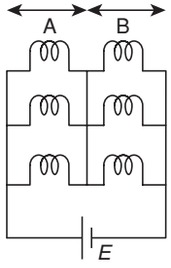
16. A body weighs 200 N on the surface of the Earth. How much will it weigh half way down to the centre of the Earth?

(1) 150 N (2) 200 N

(3) 250 N (4) 100 N

17. Six similar bulbs are connected as shown in the figure with a dc source of emf E and zero internal resistance.

The ratio of power consumption by the bulbs when (i) all are glowing and (ii) in the situation when two from section A and one from section B are glowing, will be



(1) 4 : 9 (2) 9 : 4

(3) 1 : 2 (4) 2 : 1

18. For a p-type semiconductor, which of the following statements is true?

(1) Electrons are the majority carriers and trivalent atoms are the dopants.

(2) Holes are the majority carriers and trivalent atoms are the dopants.

(3) Holes are the majority carriers and pentavalent atoms are the dopants.

(4) Electrons are the majority carriers and pentavalent atoms are the dopants.

19. Average velocity of a particle executing SHM in one complete vibration is

(1) $\frac{A\omega}{2}$ (2) $A\omega$

(3) $\frac{A\omega^2}{2}$ (4) Zero

20. The unit of thermal conductivity is

(1) J m K^{-1} (2) J m^{-1} K^{-1}

(3) W m K^{-1} (4) W m^{-1} K^{-1}

21. A solid cylinder of mass 2 kg and radius 4 cm rotating about its axis at the rate of 3 rpm. The torque required to stop after 2π revolutions is

(1) 2×10^{-6} N m (2) 2×10^{-3} N m

(3) 12×10^{-4} N m (4) 2×10^{6} N m

22. A force $F = 20 + 10y$ acts on a particle in y-direction where F is in newton and y in metre. Work done by this force to move the particle from $y = 0$ to $y = 1$ m is

(1) 30 J (2) 5 J

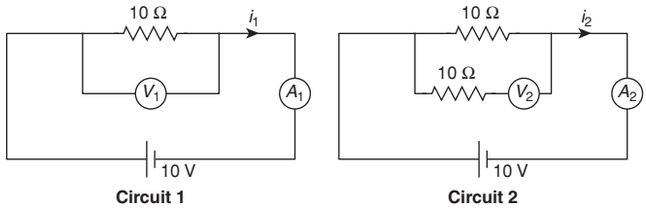
(3) 25 J (4) 20 J

23. Which of the following acts as a circuit protects device?

(1) Conductor (2) Inductor

(3) Switch (4) Fuse

24. In the circuits shown below, the readings of voltmeters and the ammeters will be



(1) $V_2 > V_1$ and $i_1 = i_2$ (2) $V_1 = V_2$ and $i_1 > i_2$

(3) $V_1 = V_2$ and $i_1 = i_2$ (4) $V_2 > V_1$ and $i_1 > i_2$

25. A hollow metal sphere of radius R is uniformly charged. The electric field due to the sphere at a distance r from the centre

(1) increases as r increases for $r < R$ and for $r > R$.

(2) zero as r increases for $r < R$, decreases as r increases for $r > R$.

(3) zero as r increases for $r < R$, increases as r increases for $r > R$.

(4) decreases as r increases for $r < R$ and for $r > R$.

26. At a point A on the Earth's surface the angle of dip, $\delta = +25°$. At a point B on the Earth's surface the angle of dip, $\delta = -25°$. We can interpret that

(1) A and B are both located in the northern hemisphere.

(2) A is located in the southern hemisphere and B is located in the northern hemisphere.

(3) A is located in the northern hemisphere and B is located in the southern hemisphere.

(4) A and B are both located in the southern hemisphere.

27. The total energy of an electron in an atom in an orbit is –3.4 eV. Its kinetic and potential energies are, respectively

(1) –3.4 eV, –3.4 eV (2) –3.4 eV, –6.8 eV

(3) 3.4 eV, –6.8 eV (4) 3.4 eV, 3.4 eV

28. In total internal reflection when the angle of incidence is equal to the critical angle for the pair of media in contact, what will be angle of refraction?

(1) 180° (2) 0°
(3) Equal to angle of incidence (4) 90°

29. The work done to raise a mass m from the surface of the Earth to a height h, which is equal to the radius of the Earth, is

(1) mgR (2) $2mgR$
(3) $\frac{1}{2}mgR$ (4) $\frac{3}{2}mgR$

30. When an object is shot from the bottom of a long smooth inclined plane kept at an angle 60° with horizontal, it can travel a distance x_1 along the plane. But when the inclination is decreased to 30° and the same object is shot with the same velocity, it can travel x_2 distance. Then $x_1 : x_2$ will be

(1) $1:\sqrt{2}$ (2) $\sqrt{2}:1$
(3) $1:\sqrt{3}$ (4) $1:2\sqrt{3}$

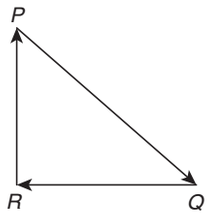
31. α-particle consists of

(1) 2 protons and 2 neutrons only.
(2) 2 electrons, 2 protons and 2 neutrons.
(3) 2 electrons and 4 protons only.
(4) 2 protons only.

32. The speed of a swimmer in still water is 20 m s^{-1}. The speed of river water is 10 m s^{-1} and is flowing due east. If he is standing on the south bank and wishes to cross the river along the shortest path, the angle at which he should make his strokes w.r.t. north is given by

(1) 30° west (2) 0°
(3) 60° west (4) 45° west

33. A particle moving with velocity $\vec{v}$ is acted by three forces shown by the vector triangle PQR. The velocity of the particle will



(1) increase.
(2) decrease.
(3) remain constant.
(4) change according to the smallest force $\overrightarrow{QR}$.

34. Two particles A and B are moving in uniform circular motion in concentric circles of radii r_A and r_B with speed v_A and v_B, respectively. Their time period of rotation is the same. The ratio of angular speed of A to that of B will be

(1) $r_A : r_B$ (2) $v_A : v_B$
(3) $r_B : r_A$ (4) 1 : 1

35. A block of mass 10 kg is in contact against the inner wall of a hollow cylindrical drum of radius 1 m. The coefficient of friction between the block and the inner wall of the cylinder is 0.1. The minimum angular velocity needed for the cylinder to keep the block stationary when the cylinder is vertical and rotating about its axis, will be ($g = 10\ m\,s^{-2}$)

(1) $\sqrt{10}\ rad\,s^{-1}$ (2) $\frac{10}{2\pi}\ rad\,s^{-1}$
(3) $10\ rad\,s^{-1}$ (4) $10\pi\ rad\,s^{-1}$

36. Two parallel infinite line charges with linear charge densities $+\lambda\ C\,m^{-1}$ and $-\lambda\ C\,m^{-1}$ are placed at a distance of $2R$ in free space. What is the electric field mid-way between the two line charges?

(1) Zero (2) $\frac{2\lambda}{\pi\varepsilon_0 R}\ N\,C^{-1}$
(3) $\frac{\lambda}{\pi\varepsilon_0 R}\ N\,C^{-1}$ (4) $\frac{\lambda}{2\pi\varepsilon_0 R}\ N\,C^{-1}$

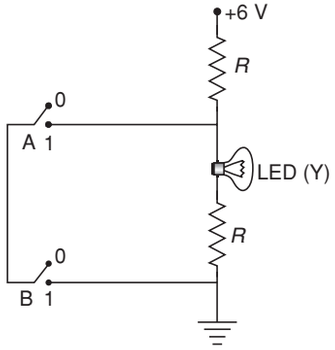
37. Two point charges A and B, having charges $+Q$ and $-Q$, respectively, are placed at certain distance apart and force acting between them is F. If 25% charge of A is transferred to B, then force between the charges becomes

(1) F (2) $\frac{9F}{16}$
(3) $\frac{16F}{9}$ (4) $\frac{4F}{3}$

38. A small hole of area of cross-section 2 mm^2 is present near the bottom of a fully filled open tank of height 2 m. Taking $g = 10\ m\,s^{-2}$, the rate of flow of water through the open hole would be nearly

(1) $12.6 \times 10^{-6}\ m^3\,s^{-1}$ (2) $8.9 \times 10^{-6}\ m^3\,s^{-1}$
(3) $2.23 \times 10^{-6}\ m^3\,s^{-1}$ (4) $6.4 \times 10^{-6}\ m^3\,s^{-1}$

39. The correct Boolean operation represented by the circuit diagram drawn is



(1) AND (2) OR
(3) NAND (4) NOR

40. In which of the following processes, heat is neither absorbed nor released by a system?

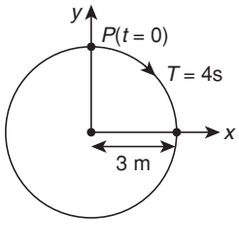
(1) Isothermal (2) Adiabatic
(3) Isobaric (4) Isochoric

41. A 800 turn coil of effective area 0.05 m^2 is kept perpendicular to a magnetic field 5×10^{-5} T. When the plane of the coil is rotated by 90° around any of its coplanar axis in 0.1 s, the emf induced in the coil will be

(1) 2 V (2) 0.2 V

(3) 2×10^{-3} V (4) 0.02 V

42. The radius of circle, the period of revolution, initial position and sense of revolution are indicated in the figure.



y-projection of the radius vector of rotating particle P is

(1) $y(t) = -3\cos 2\pi t$, where *y* in m.

(2) $y(t) = 4\sin\left(\frac{\pi t}{2}\right)$, where *y* in m.

(3) $y(t) = 3\cos\left(\frac{3\pi t}{2}\right)$, where *y* in m.

(4) $y(t) = 3\cos\left(\frac{\pi t}{2}\right)$, where *y* in m.

43. A parallel plate capacitor of capacitance 20 μF is being charged by a voltage source whose potential is changing at the rate of 3 $V s^{-1}$. The conduction current through the connecting wires, and the displacement current through the plates of the capacitor, would be, respectively.

(1) Zero, 60 μA (2) 60 μA , 60 μA

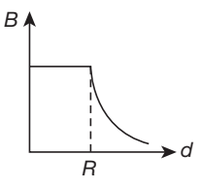
(3) 60 μA , zero (4) Zero, zero

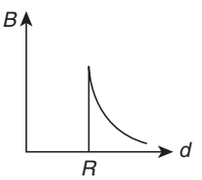
44. In an experiment, the percentage of error occurred in the measurement of physical quantities *A*, *B*, *C* and *D* are 1%, 2%, 3% and 4% respectively. Then the maximum percentage of error in the measurement *X*, where $X = \frac{A^2 B^{1/2}}{C^{1/3} D^3}$, will be

(1) $\left(\frac{3}{13}\right)\%$ (2) 16 %

(3) – 10 % (4) 10 %

45. A cylindrical conductor of radius *R* is carrying a constant current. The plot of the magnitude of the magnetic field *B* with the distance *d* from the centre of the conductor, is correctly represented by the figure:

(1)


(2)


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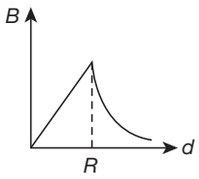

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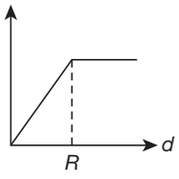


CHEMISTRY

46. The number of sigma (σ) and pi (π) bonds in pent-2-en-4-yne is

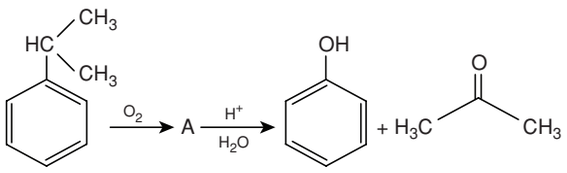
(1) 10 σ bonds and 3 π bonds.

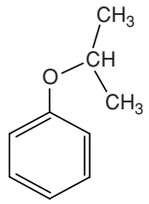
(2) 8 σ bonds and 5 π bonds.

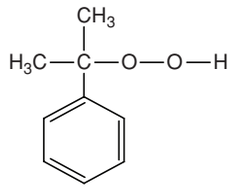
(3) 11 σ bonds and 2 π bonds.

(4) 13 σ bonds and no π bonds.

47. The structure of intermediate A in the following reaction, is



(1)


(2)


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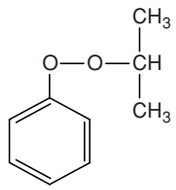

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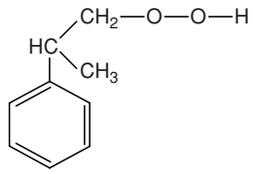
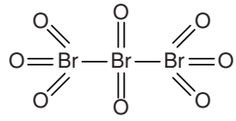
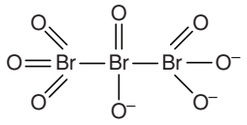
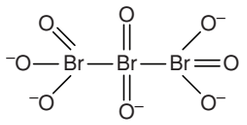
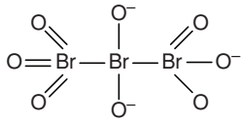


48. The correct structure of tribromooctaoxide is

(1)


(2) 

(3) 

(4) 

49. 4*d*, 5*p*, 5*f* and 6*p* orbitals are arranged in the order of decreasing energy. The correct option is

(1) $5f > 6p > 5p > 4d$ (2) $6p > 5f > 5p > 4d$

(3) $6p > 5f > 4d > 5p$ (4) $5f > 6p > 4d > 5p$

50. Which of the following reactions are disproportionation reaction?

(I) $2Cu^{+} \rightarrow Cu^{2+} + Cu^{0}$

(II) $3MnO_4^{2-} + 4H^{+} \rightarrow 2MnO_4^{-} + MnO_2 + 2H_2O$

(III) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$

(IV) $2MnO_4^{-} + 3Mn^{2+} + 2H_2O \rightarrow 5MnO_2 + 4H^{+}$

Select the correct option from the following

(1) (I) and (II) only (2) (I), (II) and (III)

(3) (I), (III) and (IV) (4) (I) and (IV) only

51. Under isothermal condition, a gas at 300 K expands from 0.1 L to 0.25 L against a constant external pressure of 2 bar. The work done by the gas is (Given that 1 L bar = 100 J)

(1) –30 J (2) 5 kJ

(3) 25 J (4) 30 J

52. Among the following, the one that is not a greenhouse gas is

(1) nitrous oxide. (2) methane.

(3) ozone. (4) sulphur dioxide.

53. For the cell reaction

$2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow 2Fe^{2+}(aq) + I_2(aq)$

$E^{o}_{cell} = 0.24\,V$ at 298 K. The standard Gibbs energy ($\Delta_r G^{o}$) of the cell reaction is:

(1) –46.32 kJ mol^{-1}

(2) –23.16 kJ mol^{-1}

(3) 46.32 kJ mol^{-1}

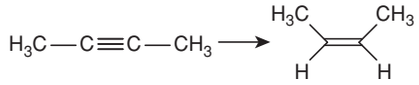
(4) 23.16 kJ mol^{-1}

54. Enzymes that utilize ATP in phosphate transfer require an alkaline earth metal (M) as the cofactor. M is

(1) Be (2) Mg

(3) Ca (4) Sr

55. The most suitable reagent for the following conversion, is



(1) Na/liquid NH_3 (2) H_2, Pd/C, quinoline

(3) Zn/HCl (4) Hg^{2+}/H^{+}, H_2O

56. Which is the correct thermal stability order for H_2E (E = O, S, Se, Te and Po)?

(1) $H_2S < H_2O < H_2Se < H_2Te < H_2Po$

(2) $H_2O < H_2S < H_2Se < H_2Te < H_2Po$

(3) $H_2Po < H_2Te < H_2Se < H_2S < H_2O$

(4) $H_2Se < H_2Te < H_2Po < H_2O < H_2S$

57. Which of the following is incorrect statement?

(1) PbF_4 is covalent in nature.

(2) $SiCl_4$ is easily hydrolyzed.

(3) GeX_4 (X = F, Cl, Br, I) is more stable than GeX_2.

(4) SnF_4 is ionic in nature.

58. Match the following:

(a) Pure nitrogen	(i) Chlorine
(b) Haber process	(ii) Sulphuric acid
(c) Contact process	(iii) Ammonia
(d) Deacon's process	(iv) Sodium azide or Barium azide

Which of the following is the correct option?

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

59. Which of the following diatomic molecular species has only π bonds according to Molecular Orbital Theory?

(1) O_2 (2) N_2

(3) C_2 (4) Be_2

60. For the second period elements the correct increasing order of first ionization enthalpy is:

(1) Li < Be < B < C < N < O < F < Ne

(2) Li < B < Be < C < O < N < F < Ne

(3) Li < B < Be < C < N < O < F < Ne

(4) Li < Be < B < C < O < N < F < Ne

61. The biodegradable polymer is

(1) Nylon-6,6.

(2) Nylon-2-Nylon-6.

(3) Nylon-6.

(4) Buna-S.

62. pH of a saturated solution of $Ca(OH)_2$ is 9. The solubility product (K_{sp}) of $Ca(OH)_2$ is:

(1) 0.5×10^{-15} (2) 0.25×10^{-10}

(3) 0.125×10^{-15} (4) 0.5×10^{-10}

63. If the rate constant for a first order reaction is k, the time (t) required for the completion of 99% of the reaction is given by

(1) $t = 0.693/k$ (2) $t = 6.909/k$

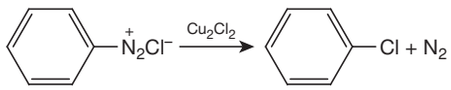
(3) $t = 4.606/k$ (4) $t = 2.303/k$

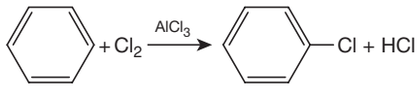
64. The non-essential amino acid among the following is

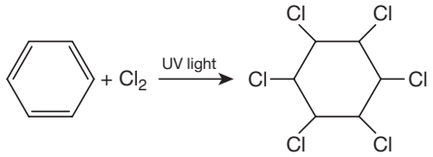
(1) valine. (2) leucine.

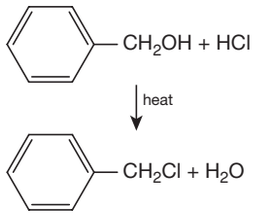
(3) alanine. (4) lysine.

65. Among the following, the reaction that proceeds through an electrophilic substitution, is:

(1) 

(2) 

(3) 

(4) 

66. The mixture that forms maximum boiling azeotrope is

(1) Water + Nitric acid.

(2) Ethanol + Water.

(3) Acetone + Carbon disulphide.

(4) Heptane + Octane.

67. For the chemical reaction

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

the correct option is

(1) $-\frac{1}{3}\frac{d[H_2]}{dt} = -\frac{1}{2}\frac{d[NH_3]}{dt}$ (2) $-\frac{d[N_2]}{dt} = -2\frac{d[NH_3]}{dt}$

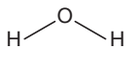
(3) $-\frac{d[N_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$ (4) $3\frac{d[H_2]}{dt} = 2\frac{d[NH_3]}{dt}$

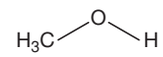
68. The number of moles of hydrogen molecules required to produce 20 moles of ammonia through Haber's process is

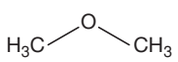
(1) 10 (2) 20

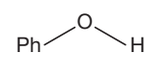
(3) 30 (4) 40

69. The compound that is most difficult to protonate is:

(1) 

(2) 

(3) 

(4) 

70. For an ideal solution, the correct option is

(1) $\Delta_{mix}S = 0$ at constant T and p

(2) $\Delta_{mix}V = 0$ at constant T and p

(3) $\Delta_{mix}H = 0$ at constant T and p

(4) $\Delta_{mix}G = 0$ at constant T and p

71. Conjugate base for Brönsted acids H_2O and HF are

(1) OH^- and H_2F^+, respectively.

(2) H_3O^+ and F^-, respectively.

(3) OH^- and F^-, respectively.

(4) H_3O^+ and H_2F^+, respectively.

72. Which mixture of the solutions will lead to the formation of negatively charged colloidal $[AgI]I^-$ solution?

(1) 50 mL of 1 M $AgNO_3$ + 50 mL of 1.5 M KI

(2) 50 mL of 1 M $AgNO_3$ + 50 mL of 2 M KI

(3) 50 mL of 2 M $AgNO_3$ + 50 mL of 1.5 M KI

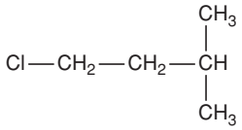
(4) 50 mL of 0.1 M $AgNO_3$ + 50 mL of 0.1 M KI

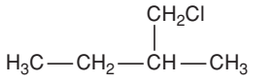
73. Among the following, the narrow spectrum antibiotic is

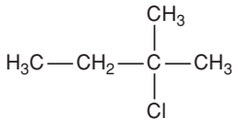
(1) penicillin G. (2) ampicillin.

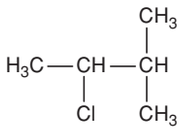
(3) amoxycillin. (4) chloramphenicol.

74. An alkene "A" on reaction with O_3 and $Zn–H_2O$ gives propanone and ethanal in equimolar ratio. Addition of HCl to alkene "A" gives "B" as the major product. The structure of product "B" is

(1) 

(2) 

(3) 

(4) 

75. What is the correct electronic configuration of the central atom in $K_4[Fe(CN)_6]$ based on crystal field theory?

(1) $t_{2g}^4 e_g^2$ (2) $t_{2g}^6 e_g^0$

(3) $e_g^3 t_{2g}^3$ (4) $e_g^4 t_{2g}^2$

76. Identify the incorrect statement related to PCl_5 from the following:

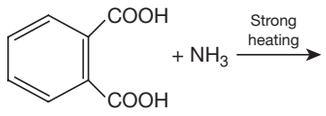
(1) Three equatorial P–Cl bonds make an angle of 120° with each other.

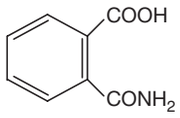
(2) Two axial P–Cl bonds make an angle of 180° with each other.

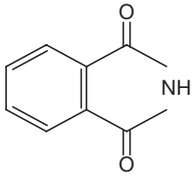
(3) Axial P–Cl bonds are longer than equatorial P–Cl bonds.
(4) PCl_5 molecule is non-reactive.

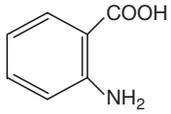
77. Which will make basic buffer?
(1) 50 mL of 0.1 M NaOH + 25 mL of 0.1 M CH_3COOH
(2) 100 mL of 0.1 M CH_3COOH + 100 mL of 0.1 M NaOH
(3) 100 mL of 0.1 M HCl + 200 mL of 0.1 M NH_4OH
(4) 100 mL of 0.1 M HCl + 100 mL of 0.1 M NaOH

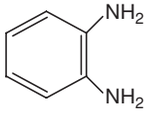
78. The major product of the following reaction is:



(1) 

(2) 

(3) 

(4) 

79. Match the Xenon compounds in Column I with its structure in Column II and assign the correct code.

Column I	**Column II**
(a) XeF_4	(i) pyramidal
(b) XeF_6	(ii) square planar
(c) $XeOF_4$	(iii) distorted octahedral
(d) XeO_3	(iv) square pyramidal

Code:

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

80. The manganate and permanganate ions are tetrahedral, due to
(1) The π-bonding involves overlap of *p*-orbitals of oxygen with *d*-orbitals of manganese.
(2) There is no π-bonding.
(3) The π-bonding involves overlap of *p*-orbitals of oxygen with *p*-orbitals of manganese.
(4) The π-bonding involves overlap of *d*-orbitals of oxygen with *d*-orbitals of manganese.

81. Which of the following species is not stable?
(1) $[SiF_6]^{2-}$ (2) $[GeCl_6]^{2-}$
(3) $[Sn(OH)_6]^{2-}$ (4) $[SiCl_6]^{2-}$

82. For a cell involving one electron $E^{o}_{cell} = 0.59\,V$ at 298 K, the equilibrium constant for the cell reaction is

$$\left[\text{Given that } \frac{2.303RT}{F} = 0.059\,V \text{ at } T = 298\,K\right]$$

(1) 1.0×10^2 (2) 1.0×10^5
(3) 1.0×10^{10} (4) 1.0×10^{30}

83. Which of the following is an amphoteric hydroxide?
(1) $Sr(OH)_2$ (2) $Ca(OH)_2$
(3) $Mg(OH)_2$ (4) $Be(OH)_2$

84. A gas at 350 K and 15 bar has molar volume 20 percent smaller than that for an ideal gas under the same conditions. The correct option about the gas and its compressibility factor (*Z*) is
(1) $Z > 1$ and attractive forces are dominant.
(2) $Z > 1$ and repulsive forces are dominant.
(3) $Z < 1$ and attractive forces are dominant.
(4) $Z < 1$ and repulsive forces are dominant.

85. A compound is formed by cation C and anion A. The anions form hexagonal close packed (hcp) lattice and the cations occupy 75% of octahedral voids. The formula of the compound is
(1) C_2A_3 (2) C_3A_2
(3) C_3A_4 (4) C_4A_3

86. In which case change in entropy is negative?
(1) Evaporation of water
(2) Expansion of a gas at constant temperature
(3) Sublimation of solid to gas
(4) $2H(g) \rightarrow H_2(g)$

87. Which of the following series of transitions in the spectrum of hydrogen atom falls in visible region?
(1) Lyman series (2) Balmer series
(3) Paschen series (4) Brackett series

88. The method used to remove temporary hardness of water is
(1) Calgon's method.
(2) Clark's method.
(3) Ion-exchange method.
(4) Synthetic resins method.

89. Which one is malachite from the following?
(1) $CuFeS_2$ (2) $Cu(OH)_2$
(3) Fe_3O_4 (4) $CuCO_3 \cdot Cu(OH)_2$

90. The correct order of the basic strength of methyl substituted amines in aqueous solution is
(1) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N$
(2) $(CH_3)_3N > CH_3NH_2 > (CH_3)_2NH$
(3) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2$
(4) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N$

BIOLOGY

91. The Earth Summit held in Rio de Janeiro in 1992 was called
(1) to reduce CO_2 emissions and global warming.
(2) for conservation of biodiversity and sustainable utilization of its benefits.
(3) to assess threat posed to native species by invasive weed species.
(4) for immediate steps to discontinue use of CFCs that were damaging the ozone layer.

92. Colostrum the yellowish fluid, secreted by mother during the initial days of lactation is very essential to impart immunity to the new born infants because it contains
(1) natural killer cells. (2) monocytes.
(3) macrophages. (4) immunoglobulin A.

93. Grass leaves curl inwards during very dry weather. Select the most appropriate reason from the following.
(1) Closure of stomata.
(2) Flaccidity of bulliform cells.
(3) Shrinkage of air spaces in spongy mesophyll.
(4) Tyloses in vessels.

94. The shorter and longer arms of a sub-metacentric chromosome are referred to as
(1) *s*-arm and *l*-arm respectively.
(2) *p*-arm and *q*-arm respectively.
(3) *q*-arm and *p*-arm respectively.
(4) *m*-arm and *n*-arm respectively.

95. Respiratory Quotient (RQ) value of tripalmitin is
(1) 0.9 (2) 0.7
(3) 0.07 (4) 0.09

96. Which of the following is a commercial blood cholesterol lowering agent?
(1) Cyclosporin A (2) Statin
(3) Streptokinase (4) Lipases

97. Match the following structures in column I with their respective location in organs in column II.

Column I	**Column II**
(a) Crypts of Lieberkühn	(i) Pancreas
(b) Glisson's Capsule	(ii) Duodenum
(c) Islets of Langerhans	(iii) Small intestine
(d) Brunner's Glands	(iv) Liver

Select the correct option from the following.

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

98. Which of the following is the most important cause for animals and plants being driven to extinction?
(1) Habitat loss and fragmentation
(2) Drought and floods
(3) Economic exploitation
(4) Alien species invasion

99. Which part of the brain is responsible for thermoregulation?
(1) Cerebrum (2) Hypothalamus
(3) Corpus callosum (4) Medulla oblongata

100. Consider following features.
(a) Organ system level of organization.
(b) Bilateral symmetry.
(c) True coelomates with segmentation of body.

Select the correct option of animal groups which possess all the above characteristics
(1) Annelida, Arthropoda and Chordata
(2) Annelida, Arthropoda and Mollusca
(3) Arthropoda, Mollusca and Chordata
(4) Annelida, Mollusca and Chordata

101. Select the correct sequence of organs in the alimentary canal of cockroach starting from mouth.
(1) Pharynx → Oesophagus → Crop → Gizzard → Ileum → Colon → Rectum
(2) Pharynx → Oesophagus → Gizzard → Crop → Ileum → Colon → Rectum
(3) Pharynx → Oesophagus → Gizzard → Ileum → Crop → Colon → Rectum
(4) Pharynx → Oesophagus → Ileum → Crop → Gizzard → Colon → Rectum

102. Which of the following pairs of gases is mainly responsible for greenhouse effect?
(1) Ozone and Ammonia
(2) Oxygen and Nitrogen
(3) Nitrogen and Sulphur dioxide
(4) Carbon dioxide and Methane

103. Which of the following muscular disorders is inherited?
(1) Tetany
(2) Muscular dystrophy
(3) Myasthenia gravis
(4) Botulism

104. The ciliated epithelial cells are required to move particles or mucus in a specific direction. In humans, these cells are mainly present in
(1) bile duct and Bronchioles.
(2) fallopian tubes and Pancreatic duct.
(3) eustachian tube and Salivary duct.
(4) bronchioles and Fallopian tubes.

105. Match the column I with column II.

Column I	**Column II**
(a) P-wave	(i) Depolarization of ventricles
(b) QRS complex	(ii) Repolarization of ventricles

Column I	Column II
(c) T-wave	(iii) Coronary ischemia
(d) Reduction in the size of T-wave	(iv) Depolarization of atria
	(v) Repolarization of atria

Select the correct option.

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

106. Which one of the following is not a method *in situ* conservation of biodiversity?

(1) Biosphere Reserve (2) Wildlife Sanctuary
(3) Botanical Garden (4) Sacred Grove

107. In a species, the weight of newborn ranges from 2 to 5 kg. 97% of the newborn with an average weight between 3 to 3.3 kg survive whereas 99% of the infants born with weight from 2 to 2.5 kg or 4.5 to 5 kg die. Which type of selection process is taking place?

(1) Directional Selection (2) Stabilizing Selection
(3) Disruptive Selection (4) Cyclical Selection

108. The correct sequence of phases of cell cycle is:

(1) $M \rightarrow G_1 \rightarrow G_2 \rightarrow S$ (2) $G_1 \rightarrow G_2 \rightarrow S \rightarrow M$
(3) $S \rightarrow G_1 \rightarrow G_2 \rightarrow M$ (4) $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$

109. How does steroid hormone influence the cellular activities?

(1) Changing the permeability of the cell membrane
(2) Binding to DNA and forming a gene hormone complex
(3) Activating cyclic AMP located on the cell membrane
(4) Using aquaporin channels as second messenger

110. Which of the following statements is not correct?

(1) Lysosomes have numerous hydrolytic enzymes.
(2) The hydrolytic enzymes of lysosomes are active under acidic pH.
(3) Lysosomes are membrane bound structures.
(4) Lysosomes are formed by the process of packaging in the endoplasmic reticulum.

111. Which one of the following statements regarding post-fertilization development in flowering plants is incorrect?

(1) Ovary develops into fruit.
(2) Zygote develops into embryo.
(3) Central cell develops into endosperm.
(4) Ovules develop into embryo sac.

112. Concanavalin A is

(1) an alkaloid. (2) an essential oil.
(3) a lectin. (4) a pigment.

113. Which one of the following equipments is essentially required for growing microbes on a large scale, for industrial production of enzymes?

(1) BOD incubator (2) Sludge digester
(3) Industrial oven (4) Bioreactor

114. Consider the following statement.

(A) Coenzyme or metal ion that is tightly bound to enzyme protein is called prosthetic group.
(B) A complete catalytic active enzyme with its bound prosthetic group is called apoenzyme.

Select the correct option.

(1) Both (A) and (B) are true.
(2) (A) is true but (B) is false.
(3) Both (A) and (B) are false.
(4) (A) is false but (B) is true.

115. Purines found both in DNA and RNA are

(1) adenine and thymine. (2) adenine and guanine.
(3) guanine and cytosine. (4) cytosine and thymine.

116. Select the correct sequence for transport of sperm cells in male reproductive system.

(1) Testis → Epididymis → Vasa efferentia → Rete testis → Inguinal canal → Urethra
(2) Seminiferous tubules → Rete testis → Vasa efferentia → Epididymis → Vas deferens → Ejaculatory duct → Urethra → Urethral meatus
(3) Seminiferous tubules → Vasa efferentia → Epididymis → Inguinal canal → Urethra
(4) Testis → Epididymis → Vasa efferentia → Vas deferens → Ejaculatory duct → Inguinal canal → Urethra → Urethral meatus

117. Match the hominids in column I with their correct brain size in column II.

Column I	Column II
(a) *Homo habilis*	(i) 900 cc
(b) *Homo neanderthalensis*	(ii) 1350 cc
(c) *Homo erectus*	(iii) 650–800 cc
(d) *Homo sapiens*	(iv) 1400 cc

Select the correct option.

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

118. Variations caused by mutation, as proposed by Hugo de Vries are

(1) random and directional.
(2) random and directionless.
(3) small and directional.
(4) small and directionless.

119. Which of the following pair of organelles does not contain DNA?

(1) Mitochondria and Lysosomes
(2) Chloroplast and Vacuoles

(3) Lysosomes and Vacuoles
(4) Nuclear envelope and Mitochondria

120. Due to increasing air-borne allergens and pollutants, many people in urban areas are suffering from respiratory disorder causing wheezing due to
(1) benign growth on mucous lining of nasal cavity.
(2) inflammation of bronchi and bronchioles.
(3) proliferation of fibrous tissues and damage of the alveolar walls.
(4) reduction in the secretion of surfactants by pneumocytes.

121. Select the incorrect statement.
(1) Male fruit fly is heterogametic.
(2) In male grasshoppers 50% of sperms have no sex-chromosome.
(3) In domesticated fowls, sex of progeny depends on the type of sperm rather than egg.
(4) Human males have one of their sex chromosome much shorter than the other.

122. DNA precipitation out of a mixture of biomolecules can be achieved by treatment with
(1) Isopropanol.
(2) Chilled ethanol.
(3) Methanol at room temperature.
(4) Chilled chloroform.

123. Select the correct group of biocontrol agents.
(1) *Bacillus thuringiensis*, Tobacco mosaic virus, Aphids
(2) *Trichoderma*, Baculovirus, *Bacillus thuringiensis*
(3) *Oscillatoria*, *Rhizobium*, *Trichoderma*
(4) *Nostoc*, *Azospirillium*, Nucleopolyhedrovirus

124. Select the incorrect statement.
(1) Inbreeding increases homozygosity.
(2) Inbreeding is essential to evolve purelines in any animal.
(3) Inbreeding selects harmful recessive genes that reduce fertility and productivity.
(4) Inbreeding helps in accumulation of superior genes and elimination of undesirable genes.

125. Match the following organisms in column I with the products they produce in column II.

Column I	**Column I**
(a) *Lactobacillus*	(i) Cheese
(b) *Saccharomyces cerevisiae*	(ii) Curd
(c) *Aspergillus niger*	(iii) Citric Acid
(d) *Acetobacter aceti*	(iv) Bread
	(v) Acetic Acid

Select the correct option.

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

126. What is the direction of movement of sugars in phloem?
(1) Non-multidirectional (2) Upward
(3) Downward (4) Bi-directional

127. In some plants, the female gamete develops into embryo without fertilization. This phenomenon is known as
(1) Autogamy. (2) Parthenocarpy.
(3) Syngamy. (4) Parthenogenesis.

128. Persistent nucellus in the seed is known as
(1) Chalaza. (2) Perisperm.
(3) Hilum. (4) Tegmen.

129. What map unit (centimorgan) is adopted in the construction of genetic maps?
(1) A unit of distance between two expressed genes representing 10% cross over.
(2) A unit of distance between two expressed genes representing 100% cross over.
(3) A unit of distance between genes on chromosomes, representing 1% cross over.
(4) A unit of distance between genes on chromosomes, representing 50% cross over.

130. What would be the heart rate of a person if the cardiac output is 5 L, blood volume in the ventricles at the end of diastole is 100 mL and at the end of ventricular systole is 50 mL?
(1) 50 beats per minute (2) 75 beats per minute
(3) 100 beats per minute (4) 125 beats per minute

131. *Thiobacillus* is a group of bacteria helpful in carrying out
(1) Nitrogen fixation.
(2) Chemoautotrophic fixation.
(3) Nitrification.
(4) Denitrification.

132. Which of the following factors is responsible for the formation of concentrated urine?
(1) Low levels of antidiuretic hormone.
(2) Maintaining hyperosmolarity towards inner medullary interstitium in the kidneys.
(3) Secretion of erythropoietin by Juxtaglomerular complex.
(4) Hydrostatic pressure during glomerular filtration.

133. Which of the following statements regarding mitochondria is incorrect?
(1) Outer membrane is permeable to monomers of carbohydrates, fats and proteins.
(2) Enzymes of electron transport are embedded in outer membrane.
(3) Inner membrane is convoluted with infoldings.
(4) Mitochondrial matrix contains single circular DNA molecule and ribosomes.

134. Xylem translocates
(1) water only.
(2) water and mineral salts only.

(3) water, mineral salts and some organic nitrogen only.
(4) water, mineral salts, some organic nitrogen and hormones.

135. Cell in G_0 phase
(1) exit the cell cycle.
(2) enter the cell cycle.
(3) suspend the cell cycle.
(4) terminate the cell cycle.

136. Which of the statements given below is not true about formation of annual rings in trees?
(1) Annual ring is a combination of springwood and autumn wood produced in a year
(2) Differential activity of cambium causes light and dark bands of tissue early and late wood respectively.
(3) Activity of cambium depends upon variation in climate.
(4) Annual rings are not prominent in trees of temperate region.

137. Which of the following ecological pyramids is generally inverted?
(1) Pyramid of numbers in grassland
(2) Pyramid of energy
(3) Pyramid of biomass in a forest
(4) Pyramid of biomass in a sea

138. Placentation in which ovules develop on the inner wall of the ovary or in peripheral part, is
(1) basal. (2) axile.
(3) parietal. (4) free central.

139. Which of the following protocols did aim for reducing emission of chlorofluorocarbons into the atmosphere?
(1) Montreal Protocol (2) Kyto Protocol
(3) Gothenburg Protocol (4) Geneva Protocol

140. Which of the following contraceptive methods do involve a role of hormone?
(1) Lactational amenorrhea, Pills, Emergency contraceptives.
(2) Barrier method, Lactational amenorrhea, Pills.
(3) CuT, Pills, Emergency contraceptives.
(4) Pills, Emergency contraceptives, Barrier methods.

141. Tidal Volume and Expiratory Reserve Volume of an athlete is 500 mL and 1000 mL, respectively. What will be his Expiratory Capacity if the Residual Volume is 1200 mL?
(1) 1500 mL (2) 1700 mL
(3) 2200 mL (4) 2700 mL

142. What is the fate of the male gametes discharged in the synergid?
(1) One fuses with egg other(s) degenerate(s) in the synergid.
(2) All fuse with the egg.
(3) One fuses with the egg, other(s) fuse(s) with synergid nucleus.
(4) One fuses with the egg and other fuses with central cell nuclei.

143. What is the site of perception of photoperiod necessary for induction of flowering in plants?
(1) Lateral buds (2) Pulvinus
(3) Shoot apex (4) Leaves

144. Select the correctly written scientific name of Mango which was first described by Carolus Linnaeus.
(1) *Mangifera indica* Car. Linn.
(2) *Mangifera indica* Linn.
(3) *Mangifera indica*
(4) *Mangifera Indica*

145. Following statements describe the characteristics of the enzyme restriction endonuclease. Identify the incorrect statement.
(1) The enzyme cuts DNA molecule at identified position within the DNA.
(2) The enzyme binds DNA at specific sites and cuts only one of the two strands.
(3) The enzyme cuts the sugar-phosphate backbone at specific sites on each strand.
(4) The enzyme recognizes a specific palindromic nucleotide sequence in the DNA.

146. From evolutionary point of view, retention of the female gametophyte with developing young embryo on the parent sporophyte for some time, is first observed in:
(1) Liverworts (2) Mosses
(3) Pteridophytes (4) Gymnosperms

147. In *Antirrhinum* (Snapdragon), a red flower was crossed with a white flower and in F_1 generation pink flowers were obtained. When pink flowers were selfed, the F_2 generation showed white, red and pink flowers. Choose the incorrect statement from the following.
(1) This experiment does not follow the Principle of Dominance.
(2) Pink color in F_1 is due to incomplete dominance.
(3) Ratio of F_2 is $\frac{1}{4}$ (Red) : $\frac{2}{4}$ (Pink) : $\frac{1}{4}$ (White)
(4) Law of Segregation does not apply in this experiment.

148. Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalyzed by
(1) Aldolase. (2) Hexokinase.
(3) Enolase. (4) Phosphofructokinase.

149. Drug called 'Heroin' is synthesized by
(1) methylation of morphine.
(2) acetylation of morphine.
(3) glycosylation of morphine.
(4) nitration of morphine.

150. Select the hormone-releasing Intra-Uterine Devices.
(1) Vaults, LNG-20
(2) Multiload 375, Progestasert

(3) Progestasert, LNG-20
(4) Lippes Loop, Multiload 375

151. A gene locus has two alleles *A*, *a*. If the frequency of dominant allele *A* is 0.4, then what will be the frequency of homozygous dominant, heterozygous and homozygous recessive individuals in the population?
(1) 0.36(*AA*); 0.48(*Aa*); 0.16(*aa*)
(2) 0.16(*AA*); 0.24(*Aa*); 0.36(*aa*)
(3) 0.16(*AA*); 0.48(*Aa*); 0.36(*aa*)
(4) 0.16(*AA*); 0.36(*Aa*); 0.48(*aa*)

152. Which of the following is true for Golden rice?
(1) It is Vitamin A enriched, with a gene from daffodil.
(2) It is pest resistant, with a gene from *Bacillus thuringiensis*.
(3) It is drought tolerant, developed using *Agrobacterium* vector.
(4) It has yellow grains, because of a gene introduced from a primitive variety of rice.

153. *Pinus* seed cannot germinate and established without fungal association. This is because
(1) its embryo is immature.
(2) it has obligate association with mycorrhizae.
(3) it has very hard seed coat.
(4) its seeds contain inhibitors that present germination.

154. Which of the following features of genetic code does allow bacteria to produce human insulin by recombinant DNA technology?
(1) Genetic code is not ambiguous.
(2) Genetic code is redundant.
(3) Genetic code is nearly universal.
(4) Genetic code is specific.

155. Which of the following sexually transmitted diseases is not completely curable?
(1) Gonorrhoea
(2) Genital warts
(3) Genital herpes
(4) Chlamydiasis

156. Which of the following statements is incorrect?
(1) Viroids lack a protein coat.
(2) Viruses are obligate parasites.
(3) Infective constituent in viruses is the protein coat.
(4) Prions consist of abnormally folded proteins.

157. Match the following organisms in column I with their respective characteristics in column II.

Column I	**Column II**
(a) *Pila*	(i) Flame cells
(b) *Bombyx*	(ii) Comb plates
(c) *Pleurobrachia*	(iii) Radula
(d) *Taenia*	(iv) Malpighian tubules

Select the correct option from the following.

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

158. Expressed Sequence Tags (ESTs) refers to
(1) Genes expressed as RNA.
(2) Polypeptide expression.
(3) DNA polymorphism.
(4) Novel DNA sequences.

159. Which is of the following statements is incorrect?
(1) Morels and truffles are edible delicacies.
(2) *Claviceps* is a source of many alkaloids and LSD.
(3) Conidia are produced exogenously and ascospores endogenously.
(4) Yeasts have filamentous bodies with long thread-like hyphae.

160. Match Column I with Column II.

Column I	**Column II**
(a) Saprophyte	(i) Symbiotic association of fungi with plant roots
(b) Parasite	(ii) Decomposition of dead organic materials
(c) Lichens	(iii) Living on living plants or animals
(d) Mycorrhiza	(iv) Symbiotic association of algae and fungi

Choose the correct answer from the option given below.

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

161. Which of the following glucose transporters is insulin-dependent?
(1) GLUT I (2) GLUT II
(3) GLUT III (4) GLUT IV

162. Which of the following immune responses is responsible for rejection of kidney graft?
(1) Auto-immune response
(2) Humoral immune response
(3) Inflammatory immune response
(4) Cell-mediated immune response

163. Use of an artificial kidney during hemodialysis may result in
(a) Nitrogenous waste build-up in the body.
(b) Non-elimination of excess potassium ions.
(c) Reduced absorption of calcium ions from gastrointestinal tract.
(d) Reduced RBC production.

Which of the following options is the most appropriate?

(1) (a) and (b) are correct. (2) (b) and (c) are correct.
(3) (c) and (d) are correct. (4) (a) and (d) are correct.

164. Which of the following statements is correct?

(1) Cornea is an external, transparent and protective proteinaceous covering of the eye-ball.
(2) Cornea consists of dense connective tissue of elastin and can repair itself.
(3) Cornea is convex, transparent layer which is highly vascularized.
(4) Cornea consists of dense matrix of collagen and is the most sensitive portion the eye.

165. The frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes was explained by

(1) T.H. Morgan (2) Gregor J. Mendel
(3) Alfred Sturtevant (4) Sutton Boveri

166. Match the following genes of the Lac operon in column I with their respective products in column II.

Column I	**Column II**
(a) *i* gene	(i) β-galactosidase
(b) *z* gene	(ii) Permease
(c) *a* gene	(iii) Repressor
(d) *y* gene	(iv) Transacetylase

Select the correct option.

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

167. It takes very long time for pineapple plants to produce flowers. Which combination of hormones can be applied to artificially induce flowering in pineapple plants throughout the year to increase yield?

(1) Auxin and Ethylene
(2) Gibberellin and Cytokinin
(3) Gibberellin and Abscisic acid
(4) Cytokinin and Abscisic acid

168. Identify the cells whose secretion protects the lining of gastrointestinal tract from various enzymes.

(1) Chief Cells (2) Goblet Cells
(3) Oxyntic Cells (4) Duodenal Cells

169. Which of the following can be used as a biocontrol agent in the treatment of plant disease?

(1) *Trichoderma* (2) *Chlorella*
(3) *Anabaena* (4) *Lactobacillus*

170. Phloem in gymnosperms lacks

(1) Albuminous cells and sieve cells.
(2) Sieve tubes only.
(3) Companion cells only.
(4) Both sieve tubes and companion cells.

171. Extrusion of second polar body from egg nucleus occurs

(1) after entry of sperm but before fertilization.
(2) after fertilization.
(3) before entry of sperm into ovum.
(4) simultaneously with first cleavage.

172. Under which of the following conditions will there be no change in the reading frame of following mRNA?

5′ AACAGCGGUGCUAUU 3′

(1) Insertion of G at 5th position.
(2) Deletion of G from 5th position.
(3) Insertion of A and G at 4th and 5th positions respectively.
(4) Deletion of GGU from 7th, 8th and 9th positions.

173. The concept of "*Omnis cellula-e cellula*" regarding cell division was first proposed by

(1) Rudolf Virchow. (2) Theodor Schwann.
(3) Schleiden. (4) Aristotle.

174. What triggers activation of protoxin to active Bt toxin of *Bacillus thuringiensis* in bollworm?

(1) Body temperature
(2) Moist surface of midgut
(3) Alkaline pH of gut
(4) Acidic pH of stomach

175. Identify the correct pair representing the causative agent of typhoid fever and the confirmatory test for typhoid.

(1) *Plasmodium vivax* / UTI test
(2) *Streptococcus pneumoniae* / Widal test
(3) *Salmonella typhi* / Anthrone test
(4) *Salmonella typhi* / Widal test

176. What is the genetic disorder in which an individual has an overall masculine development gynaecomastia, and is sterile?

(1) Turner's syndrome (2) Klinefelter's syndrome
(3) Edward syndrome (4) Down's syndrome

177. Polyblend, a fine powder of recycled modified plastic, has proved to be a good material for

(1) Making plastic sacks
(2) Use as a fertilizer
(3) Construction of roads
(4) Making tubes and pipes

178. Which of these following methods is the most suitable for disposal of nuclear waste?

(1) Shoot the waste into space.
(2) Bury the waste under Antarctic ice-cover.
(3) Dump the waste within rocks under deep ocean.
(4) Bury the waste within rocks deep below the Earth's surface.

179. Match the following hormones in column I with the respective disease in column II.

Column I	**Column II**
(a) Insulin	(i) Addison's disease
(b) Thyroxin	(ii) Diabetes insipidus
(c) Corticoids	(iii) Acromegaly
(d) Growth Hormone	(iv) Goiter
	(v) Diabetes mellitus

Select the correct option.

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

180. Select the correct option.

(1) 8th, 9th and 10th pairs of ribs articulate directly with the sternum.

(2) 11th and 12th pairs of ribs are connected to the sternum with the help of hyaline cartilage.

(3) Each rib is a flat thin bone and all the ribs are connected dorsally to the thoracic vertebrae and ventrally to the sternum.

(4) There are seven pairs of vertebrosternal, three pairs of vertebrochondral and two pairs of vertebral ribs.

ANSWER KEY

Physics

1. (3)	**2.** (3)	**3.** (1)	**4.** (2)	**5.** (2)	**6.** (4)	**7.** (3)	**8.** (1)	**9.** (1)	**10.** (2)
11. (2)	**12.** (2)	**13.** (2)	**14.** (4)	**15.** (3)	**16.** (4)	**17.** (2)	**18.** (2)	**19.** (4)	**20.** (4)
21. (1)	**22.** (3)	**23.** (4)	**24.** (3)	**25.** (2)	**26.** (3)	**27.** (3)	**28.** (4)	**29.** (3)	**30.** (3)
31. (1)	**32.** (1)	**33.** (3)	**34.** (4)	**35.** (3)	**36.** (3)	**37.** (2)	**38.** (1)	**39.** (3)	**40.** (2)
41. (4)	**42.** (4)	**43.** (2)	**44.** (2)	**45.** (3)					

Chemistry

46. (1)	**47.** (2)	**48.** (1)	**49.** (1)	**50.** (1)	**51.** (1)	**52.** (4)	**53.** (1)	**54.** (2)	**55.** (2)
56. (3)	**57.** (1)	**58.** (4)	**59.** (3)	**60.** (2)	**61.** (2)	**62.** (1)	**63.** (3)	**64.** (3)	**65.** (2)
66. (1)	**67.** (3)	**68.** (3)	**69.** (4)	**70.** (3)	**71.** (3)	**72.** (2)	**73.** (1)	**74.** (3)	**75.** (2)
76. (4)	**77.** (3)	**78.** (2)	**79.** (2)	**80.** (1)	**81.** (4)	**82.** (3)	**83.** (4)	**84.** (3)	**85.** (3)
86. (4)	**87.** (2)	**88.** (2)	**89.** (4)	**90.** (1)					

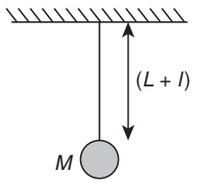
Biology

91. (2)	**92.** (4)	**93.** (2)	**94.** (2)	**95.** (2)	**96.** (2)	**97.** (3)	**98.** (1)	**99.** (2)	**100.** (1)
101. (1)	**102.** (4)	**103.** (2)	**104.** (4)	**105.** (1)	**106.** (3)	**107.** (2)	**108.** (4)	**109.** (2)	**110.** (4)
111. (4)	**112.** (3)	**113.** (4)	**114.** (2)	**115.** (2)	**116.** (2)	**117.** (3)	**118.** (2)	**119.** (3)	**120.** (2)
121. (3)	**122.** (2)	**123.** (2)	**124.** (3)	**125.** (2)	**126.** (4)	**127.** (4)	**128.** (2)	**129.** (3)	**130.** (3)
131. (4)	**132.** (2)	**133.** (2)	**134.** (4)	**135.** (1)	**136.** (4)	**137.** (4)	**138.** (3)	**139.** (1)	**140.** (1)
141. (1)	**142.** (4)	**143.** (4)	**144.** (2)	**145.** (2)	**146.** (3)	**147.** (4)	**148.** (2)	**149.** (2)	**150.** (3)
151. (3)	**152.** (1)	**153.** (2)	**154.** (3)	**155.** (3)	**156.** (3)	**157.** (2)	**158.** (1)	**159.** (4)	**160.** (4)
161. (4)	**162.** (4)	**163.** (3)	**164.** (4)	**165.** (3)	**166.** (3)	**167.** (1)	**168.** (2)	**169.** (1)	**170.** (4)
171. (1)	**172.** (4)	**173.** (1)	**174.** (3)	**175.** (4)	**176.** (2)	**177.** (3)	**178.** (4)	**179.** (3)	**180.** (4)

ANSWERS WITH EXPLANATIONS

PHYSICS

1. Given, when a block of mass M is suspended by a wire of length L, the length of the wire becomes $(L + l)$. That is, extension in length of wire is l.



We know that elastic potential energy stored is given as

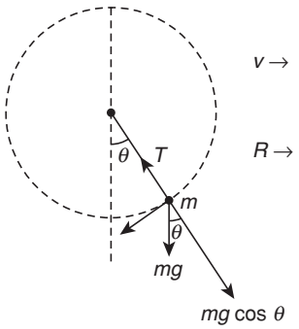
$$\text{Potential energy} = \frac{1}{2} \times \text{Force} \times \text{Extension}$$

Now, the force acting on the system is due to gravity,
force = Mg

$$\text{Potential energy} = \frac{1}{2} \times Mg \times l = \frac{1}{2} Mgl$$

Answer (3)

2. Here, mass m is attached to a thin wire and whirled in a vertical circle. If T is tension in string and $\frac{mv^2}{k}$ is centripetal force acting, then from figure, we have



$$T - mg\cos\theta = \frac{mv^2}{R} \Rightarrow T = \frac{mv^2}{R} + mg\cos\theta$$

When $\theta = 0°$, the tension in the string will be maximum. That is,

$$T_{max} = \frac{mv^2}{R} + mg$$

So, the wire is most likely to break when $\theta = 0°$ or the mass is at lowest point.

Answer (3)

3. We know that when a charged particle enters a magnetic field it experiences a force due to which it follows a circular trajectory. The radius of the circular path is given as,

$$r = \frac{mv}{qB}$$

where m is mass of charged particle, v is velocity of charged particle, q is charge on particle, B is magnetic field.

Given, ionized hydrogen atoms and α-particles have some momenta. Therefore,

$$r \propto \frac{1}{q}$$

Now the charge on ionized hydrogen atom and α-particle is

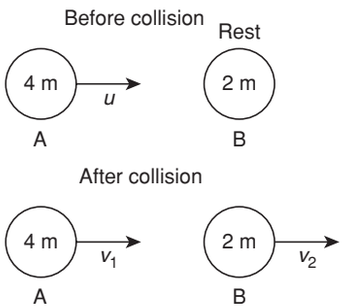
$$q_\alpha = 2q_H \Rightarrow \frac{q_H}{q_\alpha} = \frac{1}{2}$$

Therefore, $\frac{r_H}{r_\alpha} = \frac{q_\alpha}{q_H} = \frac{2}{1}$

Thus, the ratio of radii of paths of ionized hydrogen atom and α-particles is 2 : 1.

Answer (1)

4.



Given, body A of mass $4m$ collides with body B of mass $2m$

Speed of body A = u; Speed of body B = 0.

Let v_1 and v_2 be speed of body A and B after collision. Therefore,

$$v_1 = \frac{(4m - 2m)u}{(4m + 2m)} = \frac{2m}{6m} \times 4 = \frac{4}{3}$$

Thus, fraction of energy lost by body A is

$$E = \frac{\text{Initial energy} - \text{Final energy}}{\text{Initial energy}}$$

$$E = \frac{\frac{1}{2}(4m)u^2 - \frac{1}{2}(4m) \times v_1^2}{\frac{1}{2}(4m)u^2} = \frac{u^2 - v_1^2}{u^2}$$

$$E = \frac{u^2 - \left(\frac{u}{3}\right)^2}{u^2} = \frac{u^2 - \frac{u^2}{9}}{u^2} = 1 - \frac{1}{9} = \frac{8}{9}$$

Fraction of energy lost by body A is $\frac{8}{9}$.

Answer (2)

5. Given, in double sit experiment wavelength of light used, λ = 400 nm; angular width of first minima, $\theta = 0.2°$; distance of screen, $D = 1$ m.

We know that for a double sit experiment the angular width of first minima is

$$\theta = \frac{\lambda}{2d};\ d \text{ is distance between slits}$$

$$\Rightarrow \quad \theta \propto \lambda \qquad \text{(i)}$$

So, when apparatus is immersed in water

$$\theta' \propto \lambda' \qquad \text{(ii)}$$

Dividing the two equations, we get

$$\frac{\theta}{\theta'} = \frac{\lambda}{\lambda'} = \frac{\lambda}{\lambda/\mu} \Rightarrow \frac{\theta}{\theta'} = \mu \Rightarrow \theta' = \frac{\theta}{\mu} = \frac{0.2}{4/3} = 0.15°$$

Answer (2)

6. When changing magnetic field is applied to magnetic material an emf is induced in the material according to Faraday's law of electromagnetic induction. This emf circulate currents within the body of the material. The circulating currents are called Eddy currents. Eddy current effect is not used in electric heater.

Answer (4)

7. Pressure inside soap bubble is given as

$$P = P_0 + \frac{4T}{R}$$

where T is surface tension, R is radius of bubble, P_0 is atmospheric pressure.

Pressure at point Z_0 below surface of water is

$$P_{20} = P_0 + \rho g Z_0$$

Given, $P = P_{20}$

$$\Rightarrow \quad P_0 + \frac{4T}{R} = P_0 + \rho g Z_0$$

$$\Rightarrow \quad \frac{4T}{R} = \rho g Z_0 \ \Rightarrow\ Z_0 = \frac{4T}{R\rho g}$$

Substituting the given values, we get

$$Z_0 = \frac{4 \times 2.5 \times 10^{-2}}{10^3 \times 10 \times 10^{-3}} = 1 \text{ cm}$$

Value of Z_0 is 1 cm.

Answer (3)

8. Red colour of the light has the longest wavelength among the given options.

Answer (1)

9. Given, mass of disc = 100 kg, radius of disc = 2 m, speed of centre of mass = $20\,\text{cm s}^{-1} = 20 \times 10^{-2}\,\text{m s}^{-1}$

Work done needed to stop is equal to total energy of the disc. Therefore,

W = Total energy = (Translational kinetic energy) + (Rotational kinetic energy)

Now total energy is $E = E_T + E_R$.

We know that, Translational kinetic energy

$E_T = \frac{1}{2}mv^2$, where m is mass of disc, v is velocity of centre of mass.

Rotational kinetic energy

$$E_R = \frac{1}{2}I\omega^2$$

where I is moment of inertia about centre and ω is angular velocity. Also, the moment of inertia I is given as

$$I = \frac{1}{2}mr^2$$

where r is radius of disc and angular velocity is $\omega = \frac{v}{r}$. Thus,

$$E_R = \frac{1}{2}\left(\frac{1}{2}mr^2\right) \times \frac{(v)^2}{(r)^2} = \frac{1}{4}mv^2$$

Hence, $E = E_T + E_R = \frac{1}{2}mv^2 + \frac{1}{4}mv^2 = \frac{3}{4}mv^2$

$$\Rightarrow \quad E = \frac{3}{4} \times 100 \times (20 \times 10^{-2})^2 = 3\text{J}$$

Therefore, work done to stop the disc is 3 J.

Answer (1)

10. Given, displacement of particle

$$y = A_0 + A\sin\omega t + B\cos\omega t$$

Here, two simple harmonic motion are superimposed with a phase difference of $\phi = \pi/2$. Therefore,

$$y = A_0 + \sqrt{A^2 + B^2}\sin(\omega t + \phi)$$

or $$y = A_0 + \sqrt{A^2 + B^2}\cos\omega t$$

where A_0 is the mean position and $\sqrt{A^2 + B^2}$ is the amplitude. Thus, the amplitude of oscillation of particle is given by $\sqrt{A^2 + B^2}$.

Answer (2)

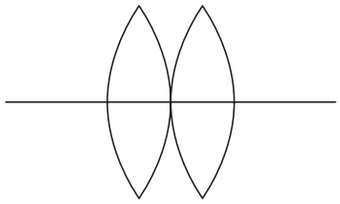
11. Given, two thin equi-convex lenses of focal length f each are kept coaxially in contact, the focal length of combination = F_1.

When the space between two lenses is filled with glycerin, the equivalent focal length = F_2.

Now, when two thin equi-convex lens are kept coaxially, then focal length of the combination is given by

$$\frac{1}{F_1} = \frac{1}{f} + \frac{1}{f} = \frac{2}{f}$$

$$\Rightarrow F_1 = \frac{f}{2}$$



When the space between two lenses is filled with glycerin which has refractive index same as glass then the combination acts as a single lens of focal length f. Therefore, $F_2 = f$.

Then ratio $\frac{F_1}{F_2} = \frac{f}{2} \times \frac{1}{f} = \frac{1}{2}$.

That is, $F_1 : F_2$ is 1: 2.

Answer (2)

12. We know that the kinetic energy of a gas depends on its temperature as

$$E = \frac{3}{2}k_B T$$

where k_B is Boltzmann's constant. Therefore, on increase in temperature of a gas filled in a container would lead to increase in its kinetic energy.

Answer (2)

13. We know that when an electron is accelerated from rest through a potential difference V, the gain in kinetic energy of electron is

$$eV = \frac{1}{2}mv^2 \qquad \text{(i)}$$

where m is mass of electron, v is velocity of electron, e is electronic charge. Also, according to de Broglie's relation, wavelength is

$$\lambda = \frac{h}{mv} \qquad \text{(ii)}$$

From Eq. (i), we have $v = \sqrt{\frac{2eV}{m}}$

Substitute value of v in Eq. (ii), we get

$$\lambda = \frac{h}{m}\sqrt{\frac{m}{2eV}} = \frac{h}{\sqrt{2meV}}$$

Substituting value of $h = 6.6 \times 10^{-34}$ J s, $m = 9 \times 10^{-31}$ kg and $e = 1.6 \times 10^{-19}$ C, we get $\frac{h}{\sqrt{2me}} \approx 12.27$ Å

$$\Rightarrow \lambda = \frac{12.27}{\sqrt{V}}\text{Å}$$

Now, given $V = 10{,}000$ V, so

$$\lambda = \frac{12.27}{\sqrt{10000}}\text{Å} = \frac{12.27}{100}\text{Å} = 12.27 \times 10^{-2}\text{Å}$$

or, $\lambda = 12.27 \times 10^{-2} \times 10^{-10}\,\text{m}$ $(\because 1\,\text{Å} = 10^{-10}\,\text{m})$

$\lambda = 12.27 \times 10^{-12}\,\text{m}$

Therefore, de Broglie wavelength is 12.27×10^{-12} m.

Answer (2)

14. We know, $l' = l(1 + \alpha \Delta T)$

where l is original length, ΔT is change in temperature. Therefore,

For copper, $l'_{Cu} = l_{Cu}(1 + \alpha_{Cu}\Delta T)$ (i)

For aluminum, $l'_{Al} = l_{Al}(1 + \alpha_{Al}\Delta T)$ (ii)

Since increase in length does not depend on temperature, so

$$(\Delta l)_{Cu} = (\Delta l)_{Al}$$

$\Rightarrow (l'_{Cu} - l_{Cu}) = (l'_{Al} - l_{Al})$

Using Eq. (i) and (ii), we get

$$l_{Cu}\alpha_{Cu}\Delta T = l_{Al}\alpha_{Al}\Delta T$$

$$\Rightarrow \qquad l_{Cu}\alpha_{Cu} = l_{Al}\alpha_{Al} \Rightarrow l_{Al} = \frac{l_{Cu}\alpha_{Cu}}{\alpha_{Al}}$$

Substituting the values, we get

$l_{Al} = \dfrac{88 \times 1.7 \times 10^{-5}}{2.2 \times 10^{-5}} = 68$ cm; length of aluminum rod is 68 cm.

Answer (4)

15. From the given statements, option (3) is incorrect. In order to see a rainbow, the observer should have his back towards the Sun.

Answer (3)

16. Given, body weighs 200 N on the surface of the Earth.

We know that the acceleration due to gravity varies with altitude as

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

where g is acceleration due to gravity at Earth's surface, d is distance or depth from Earth's surface, r is radius of Earth.

Here we have to calculate weight half way, that is, $d = \dfrac{r}{2}$.

Therefore,

$$g' = g\left(1 - \frac{r/2}{r}\right) = g\left(1 - \frac{1}{2}\right) = \frac{g}{2}$$

Now, weight $w = mg \Rightarrow w \propto g$

$\Rightarrow$ weight half way down to centre of Earth is

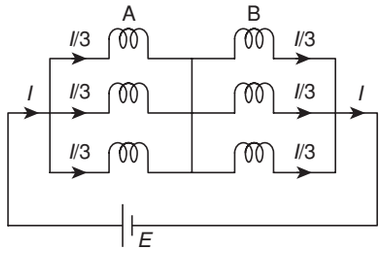
$$w' \propto g' \Rightarrow w' \propto \frac{g}{2}$$

or, $$w' = \frac{w}{2}$$

Therefore, $$w' = \frac{200}{2} = 100\ \text{N}$$

Answer (4)

17. ***Case I:*** When all bulbs are glowing.



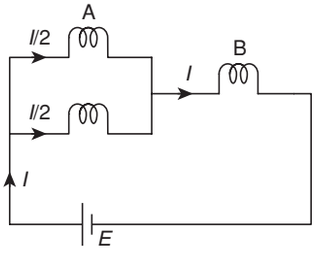
The equivalent resistance in this case is

$$R_{eq} = \frac{2R}{3}$$

where R is resistance of each bulb.
Therefore, power consumed

$$P = \frac{E^2}{R_{eq}} = \frac{E^2}{\frac{2}{3}R} = \frac{3}{2}\frac{E^2}{R}$$

Case 2: Two bulbs from section A and one from section B are glowing.



The equivalent resistance in this case is

$$R'_{eq} = \frac{R}{2} + R = \frac{3}{2}R$$

Therefore, power consumed

$$P' = \frac{E^2}{R'_{eq}} = \frac{E^2}{\frac{3}{2}R} = \frac{2}{3}\frac{E^2}{R}$$

Then ratio of power consumption of bulbs in both cases will be

$$\frac{P}{P'} = \left(\frac{3}{2}\frac{E^2}{R}\right) \times \left(\frac{3R}{2E^2}\right) = \frac{9}{4}$$

Thus, ratio will be 9 : 4.

Answer (2)

18. p-type semiconductor is formed by adding trivalent impurity to pure semiconductor. The resulting semiconductor has large number of holes created in it. So, for p-type semiconductor statement given in option (2) is correct.

Answer (2)

19. Average velocity of a particle is given as,

$$\text{Average velocity} = \frac{\text{Displacement}}{\text{Time}}$$

Since displacement of particle executing SHM in one complete vibration is zero so average velocity is zero.

Answer (4)

20. Thermal conductivity is the ability of a material to conduct heat. Unit of thermal conductivity is W $m^{-1} K^{-1}$.

Answer (4)

21. Given, mass of solid cylinder = 2 kg, radius = 4 cm = 4 × 10^{-2} m, initial rate of rotation = 3 rpm, angular frequency,

$$\omega_0 = 3 \times \frac{2\pi}{60} = \frac{\pi}{10} \text{ rad s}^{-1}$$

Using,

$$\omega^2 = \omega_0^2 - 2\alpha\theta$$

where ω^2 is final angular frequency which is zero. Therefore,

$$0 = \left(\frac{\pi}{10}\right)^2 - 2 \times \alpha \times (2\pi \text{ revolution})$$

$$\Rightarrow \quad \left(\frac{\pi}{10}\right)^2 = 2\alpha(2\pi \text{ revolution})$$

$$= 2\alpha \; 2\pi \times 2\pi \text{ rad}$$

$$\Rightarrow \alpha = \left(\frac{\pi}{10}\right)^2 \times \frac{1}{(2\pi)^2 \times 2} = \frac{1}{800} \text{ rad s}^{-2}$$

Thus, torque required to stop after 2π revolutions is $\tau = I\alpha$. where I is moment of inertia.

$$\tau = \frac{mR^2\alpha}{2} \qquad \left(\because \text{for solid cylinder } I = \frac{mR^2}{2}\right)$$

$$\Rightarrow \quad \tau = \frac{2 \times (4 \times 10^{-2})^2}{2} \times \frac{1}{800} = 2 \times 10^{-6} \text{ N m}$$

Hence, torque required is 2×10^{-6} N m.

Answer (1)

22. Given, force, $F = 20 + 10y$ acts on particle in y direction.

We know that work done by a variable force F to move particle from point a to b is

$$W = \int_a^b F dy$$

Therefore, work done in moving particle from $y = 0$ to $y = 1$ is

$$W = \int_{y=0}^{y=1} (20 + 10y) dy = \left(20y + \frac{10y^2}{2}\right)_0^1$$

$W = 20(1 - 0) + 5(1^2 - 0^2) = 20 + 5 = 25$ J

Answer (3)

23. Fuse is used as a circuit protection device.

Answer (4)

24. We know that

Resistance of ideal ammeter = 0
Resistance of ideal voltmeter = ∞
Therefore, in circuit 2, when 10 Ω resistor is connected in series with voltmeter, it will not affect the total resistance.
So equivalent resistance in both circuits is $R = 10\ \Omega$.
Given, applied voltage, $V = 10$ V
Therefore, by Ohm's law

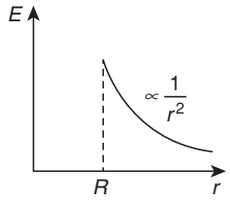
$$I = \frac{V}{R} = \frac{10}{10} = 1 \text{ A}$$

Hence, readings of voltmeters and ammeters will be

$$V_1 = V_2$$
$$i_1 = i_2$$

Answer (3)

25. For hollow metal sphere, the electric field varies as shown in the following figure, where R is radius of sphere.



Therefore, for $r < R$, electric field is zero.
for $r > R$, electric field decreases as $\frac{1}{r^2}$.

Answer (2)

26. We know that the angle of dip is positive in northern hemisphere and negative in southern hemisphere. So, point A is located in northern hemisphere and point B is located in southern hemisphere.

Answer (3)

27. Given, Total energy of an electron = −3.4 eV

Kinetic energy = − (Total energy)
Therefore, kinetic energy = 3.4 eV
Potential energy = 2 × Total energy
= 2(−3.4) eV = −6.8 eV
Thus, kinetic and potential energies are 3.4 eV and −6.8 eV, respectively.

Answer (3)

28. When light travels from denser medium to rarer medium, and the angle of incidence is greater than a certain critical angle then the light bounce back to the denser medium at the interface. This phenomenon is called total internal reflection. When the angle of incidence is equal to critical angle, the angle of refraction is 90°.

Answer (4)

29. Work done to raise mass m from surface of Earth to height h will be
W = Final potential energy – Initial potential energy

Therefore, $W = \frac{-GmM}{(R+h)} - \left(\frac{-GmM}{R}\right)$

where G is gravitation constant, m is mass of body, M is mass of Earth, R is radius of Earth and h is height above Earth upto which body is raised.
Given $h = R$,

$$W = \frac{-GmM}{2R} + \frac{GmM}{R} = \frac{GmM}{2R}$$

Now, acceleration due to gravity

$$g = \frac{GM}{R^2} \Rightarrow \frac{GM}{R} = gR$$

$$\Rightarrow \quad W = \frac{gRm}{2}$$

Thus, work done to raise mass m from the surface of Earth to height h will be $\frac{1}{2}mgR$.

Answer (3)

30. ***Case 1:*** When inclination is 60°, object can travel distance x_1.

Case 2: When inclination is 30°, object can travel distance x_2.

Using equation,

$$v^2 = u^2 - 2as$$

where v is final velocity, u is initial velocity, a is acceleration, s is distance travelled.

$$\Rightarrow \qquad s = \frac{u^2}{2a} \qquad (\because \text{final velocity is zero})$$

Now acceleration, $a = g \sin\theta$

$$s = \frac{u^2}{2g\sin\theta} \Rightarrow s \propto \frac{1}{\sin\theta}$$

For case 1, $x_1 \propto \frac{1}{\sin 60°}$.

For case 2, $x_2 \propto \frac{1}{\sin 30°}$.

Dividing the two equations, we get

$$\frac{x_1}{x_2} = \frac{\sin 30°}{\sin 60°} = \frac{1/2}{\sqrt{3}/2} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \qquad \frac{x_1}{x_2} = \frac{1}{\sqrt{3}}$$

Thus, ratio $x_1 : x_2$ is $1 : \sqrt{3}$.

Answer (3)

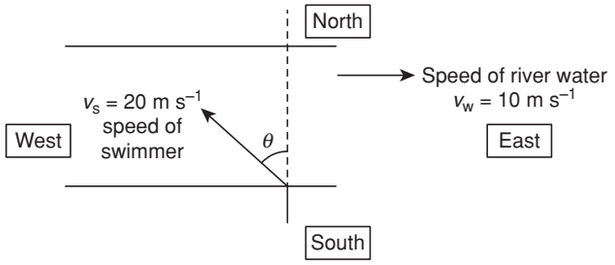
31. α-particle is a positively charged particle identical to nucleus of helium atom, therefore, α particle consists of 2 protons and 2 neutrons.

$$\alpha = {}^4He_2^{2+} \text{ (helium nucleus)}$$

Answer (1)

32. Given, speed of swimmer $= 20 \text{ m s}^{-1}$, speed of river water $= 10 \text{ m s}^{-1}$ due east.

Swimmer is standing on south bank and he wanted to cross the river along shortest path.



Let the swimmer strokes at an angle θ w.r.t. north, then

$$\sin\theta = \frac{v_w}{v_s} = \frac{10}{20} = \frac{1}{2}$$

$$\Rightarrow \qquad \theta = \sin^{-1}\left(\frac{1}{2}\right) \Rightarrow \theta = 30° \text{ west}$$

Answer (1)

33. The particle is acted by three forces. Net force acting on particle is

$$\vec{F} = \vec{F}_P + \vec{F}_Q + \vec{F}_R = 0$$

Thus, net force acting on particle is zero.

So, by Newton's second law of motion acceleration, $\vec{a} = 0$. Therefore, velocity of the particle will remain constant.

As $\vec{a} = \frac{d\vec{v}}{dt} \Rightarrow \frac{d\vec{v}}{dt} = 0 \Rightarrow \vec{v}$ is constant.

Answer (3)

34. Given, particles A and B are moving in uniform circular motion, therefore, time period of rotation is same.

Speed of particles A and B are v_A and v_B. Radii of concentric circles are r_A and r_B.

We know that time period of rotation is

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

where ω is angular velocity.

Since time period of rotation is same, therefore,

$$T_A = T_B \Rightarrow \frac{2\pi}{\omega_A} = \frac{2\pi}{\omega_B}$$

$$\Rightarrow \qquad \omega_A = \omega_B$$

Thus, ratio of angular speed of A to that of B will be 1 : 1.

Answer (4)

35. For the cylinder to keep the block stationary

$$\mu N = mg$$

where μ is coefficient of friction, N is normal, m is mass of block, g is acceleration due to gravity. Therefore,

$$N = \frac{mg}{\mu}$$

Substituting all values, we get

$$N = \frac{10 \times 10}{0.1} = 1000 \text{ N}$$

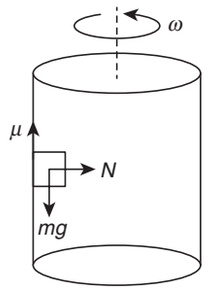
Since the block is rotating about its axis, so

$$N = \frac{m\omega^2}{R} \Rightarrow \omega = \sqrt{\frac{NR}{m}}$$

Now, on substituting values we get

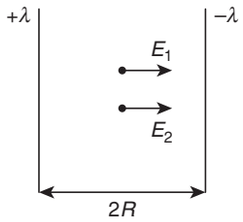
$$\omega = \sqrt{\frac{1000 \times 1}{10}} = 10 \text{ rad s}^{-1}$$

Thus, maximum angular velocity needed will be 10 rad s^{-1}.



Answer (3)

36. Given, two parallel infinite line charges with linear charge densities are placed at a distance of $2R$.



Electric field mid-way between two-line charges will be sum of electric field due to individual line charges, that is, $\vec{E} = \vec{E}_1 + \vec{E}_2$.
We know, electric field due to infinite line charge will be

$$E_1 = \frac{\lambda}{2\pi\varepsilon_0 R} = E_2$$

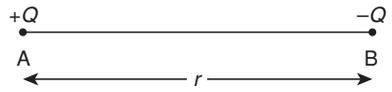
Therefore, $E = E_1 + E_2 = \frac{\lambda}{2\pi\varepsilon_0 R} + \frac{\lambda}{2\pi\varepsilon_0 R} = \frac{\lambda}{\pi\varepsilon_0 R}$

Hence, electric field mid-way between two-line charges will be $\frac{\lambda}{\pi\varepsilon_0 R}$ N C^{-1}.

Answer (3)

37. Given, two-point charges having charge $+Q$ and $-Q$ are placed at certain distance apart (see figure). Force acting between them is F. So

$$F = \frac{-1}{4\pi\varepsilon_0}\frac{Q^2}{r^2} \quad \text{(i)}$$



When 25% charge of A is transferred to B, then

$$Q_A = Q - \frac{Q}{4} = \frac{3}{4}Q$$

$$\Rightarrow Q_B = -Q + \frac{Q}{4} = \frac{-3}{4}Q$$

Then the force between the charges is

$$F' = \frac{1}{4\pi\varepsilon_0}\frac{Q_A Q_B}{r^2} = \frac{-1}{4\pi\varepsilon_0}\frac{\left(\frac{3}{4}Q^2\right)}{r^2} = -\frac{9}{16}\frac{1}{4\pi\varepsilon_0}\frac{Q^2}{r^2}$$

or $F' = \frac{9}{16}F$ (using (i))

Answer (2)

38. We know, rate of flow of water = Av

where, A is cross-section area, v is velocity of efflux.
Also, $v = \sqrt{2gh}$

where g is acceleration due to gravity, h is height of hole. Therefore, rate of flow of water = $A\sqrt{2gh}$

Given, $A = 2$ mm$^2 = 2 \times 10^{-6}$ m^2, $g = 10$ m s^{-2}, $h = 2$ m.

Thus, rate of flow $= 2\times10^{-6}\sqrt{2\times10\times2} = 2\times10^{-6}\times2\sqrt{10}$

$$= 12.6\times10^{-6}\text{ m}^3\text{s}^{-1}$$

Hence, rate of flow of water through the open hole will be nearly 12.6×10^{-6} m^3 s^{-1}.

Answer (1)

39. In given circuit diagram, following are the possible states:

when only switch A is on, LED glows;
when only switch B is on, LED glows;
when switch A and B both are on, LED does not glow;
when switch A and B both are off, LED glows.

Therefore, the truth table will be

A	B	Output	(LED)
0	0	1	(ON)
0	1	1	(ON)
1	0	1	(ON)
1	1	0	(OFF)

Thus, the circuit can be represented by NAND.

Answer (3)

40. In adiabatic processes, since $\Delta Q = 0$, therefore, heat is neither absorbed nor released by the system.

Answer (2)

41. Induced emf in the coil is given as

$$\varepsilon = \frac{-d\phi}{dt} \quad \text{(i.e. rate of change of flux)}$$

Now flux through the coil when it is kept in magnetic field will be

$$\phi_1 = (\vec{B}\cdot\vec{A})N = NBA\cos0° = NBA$$

Flux through the coil when it is rotated by 90° will be

$$\phi_2 = (\vec{B}\cdot\vec{A})N = NBA\cos90° = 0$$

Therefore, $\varepsilon = \frac{-(\phi_2 - \phi_1)}{dt} = \frac{-(0 - NBA)}{dt} = +\frac{NBA}{dt}$

Given, $N = 800$, $B = 5\times10^{-5}$ T, $A = 0.05$ m^2, $dt = 0.1$. Hence,

$$\varepsilon = \frac{800\times5\times10^{-5}\times0.05}{0.1} = 0.02\text{ V}$$

So emf induced in coil will be 0.02 V.

Answer (4)

42. We know, angular frequency is

$$\omega = \frac{2\pi}{T};\ T \text{ is time period}$$

$$\Rightarrow \omega = \frac{2\pi}{4} = \frac{\pi}{2}$$

Thus, y projection of radius vector will be
$y = A\cos\omega t$
Here, amplitude $A = 3$ m

Therefore, $y(t) = 3\cos\left(\frac{\pi t}{2}\right)$

Answer (4)

43. Current through the capacitor is given as

$$i = \frac{dQ}{dt}$$

where Q is charge on capacitor.
Also, $Q = CV$
where C is capacitance and V is potential. Therefore,

$$i = \frac{d}{dt}(CV) = C\frac{dV}{dt}$$

Now $C = 20\ \mu F = 20 \times 10^{-6}$ F and $\frac{dV}{dt} = 3\ V\,s^{-1}$

Therefore, $i = 20 \times 10^{-6} \times 3 = 60 \times 10^{-6}$ A $= 60\ \mu A$

Since we know that conduction current through the connecting wires is equal to the displacement current through the plates of capacitor. So both the currents are 60 μA.

Answer (2)

44. Percentage of error in measurement of $A = 1\%$

Percentage of error in measurement of $B = 2\%$

Percentage of error in measurement of $C = 3\%$

Percentage of error in measurement of $D = 4\%$

Now $X = \frac{A^2 B^{1/2}}{C^{1/3} D^3}$

On differentiating, we get

$$\frac{\Delta X}{X} = \frac{2\Delta A}{A} + \frac{1}{2}\frac{\Delta B}{B} + \frac{1}{3}\frac{\Delta C}{C} + \frac{3\Delta D}{D} \quad (1)$$

Percentage of error in measurement of X is

$$\frac{\Delta X}{X} \times 100$$

Therefore, from Eq. (1)

$$\frac{\Delta X}{X} \times 100 = 2\left(\frac{\Delta A}{A} \times 100\right) + \frac{1}{2}\left(\frac{\Delta B}{B} \times 100\right) + \frac{1}{3}\left(\frac{\Delta C}{C} \times 100\right) + 3\left(\frac{\Delta D}{D} \times 100\right)$$

$$= 2 \times (1\%) + \frac{1}{2}(2\%) + \frac{1}{3}(3\%) + 3(4\%)$$

$$= (2 + 1 + 1 + 12)\ \% = 16\ \%$$

Therefore, percentage of error in measurement of X is 16 %.

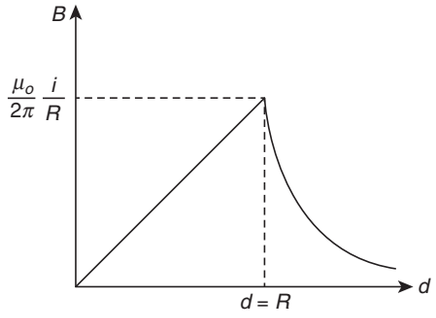
Answer (2)

45. We know

$$B = \frac{\mu_0}{2\pi}\frac{id}{R^2}, \quad \text{for } d \le R$$

$$B = \frac{\mu_0}{2\pi}\frac{i}{d}, \quad \text{for } d > R$$

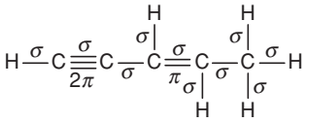
So, the plot of magnetic field with distance d can be best represented by figure given in option (3).



Answer (3)

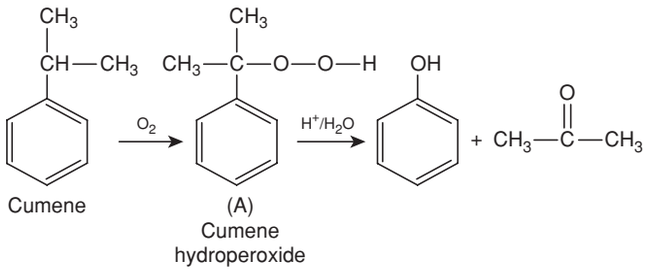
Chemistry

46. The number of σ and π bonds in pent-2-en-4-yne is 10 and 3 respectively.



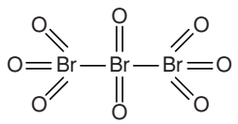
Answer (1)

47.



Answer (2)

48. The correct structure of tribromooctaoxide is as follows:



Answer (1)

49. Smaller the value of $(n + l)$ for a particular subshell, smaller will be its energy. If for two subshells, the $(n + l)$ value is the same then the subshell having higher value of n will have higher energy.

For 4*d*: $(n + l) = 4 + 2 = 6$; For 5*p*: $(n + l) = 5 + 1 = 6$; For 6*p*: $(n + l) = 6 + 1 = 7$; For 5*f*: $(n + l) = 5 + 3 = 8$

Hence, the correct order of decreasing energy will be $5f > 6p > 5p > 4d$.

Answer (1)

50. Disproportionation reactions are redox reactions in which an element in a compound is simultaneously oxidized as well as reduced.

$$2\overset{+1}{Cu^+} \rightarrow \overset{+2}{Cu^{2+}} + \overset{0}{Cu}$$

$$3\overset{+6}{Mn}O_4^{2-} + 4H^+ \rightarrow 2\overset{+7}{Mn}O_4^- + \overset{+4}{Mn}O_2 + 2H_2O$$

Answer (1)

51. We know $w = -p_{ext}\Delta V$

$$= -2 \times (0.25 - 0.1)$$

$$= -0.3\ L\ bar$$

$$= -0.3 \times 100\ J = -30\ J$$

Answer (1)

52. The gases that contribute to greenhouse effect are called greenhouse gases. These include CO_2, CH_4, H_2O, ozone, chlorofluorocarbons and nitrogen oxides etc.

Answer (4)

53. We have $\Delta G^o = -nFE^o$

For the given reaction, $n = 2$, therefore,

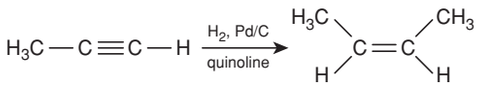
$$\Delta G^o = -2 \times 96500 \times 0.24$$
$$= -46320\,J\,mol^{-1}$$
$$= -46.320\,kJ\,mol^{-1}$$

Answer (1)

54. Enzymes that utilize ATP in phosphate transfer require magnesium as the cofactor.

Answer (2)

55. Lindlar's catalyst can be used to prepare *cis*-alkenes from disubstituted alkynes.



cis-2-butene

Answer (2)

56. On moving down the group the thermal stability for H_2E decreases due to decrease in bond energy of H−E. Hence the correct order of stability is $H_2Po < H_2Te < H_2Se < H_2S < H_2O$.

Answer (3)

57. PbF_4 is ionic in nature.

Answer (1)

58.
- Pure nitrogen: Sodium azide or Barium azide
- Haber process: Ammonia
- Contact process: Sulphuric acid
- Deacon's process: Chlorine

Answer (4)

59. According to molecular orbital, only C_2 has π bonds.

$$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 = \pi 2p_y^2$$

Answer (3)

60. The effective nuclear charge (Z_{eff}) increases in a period, hence IE increases. Hence, the correct order of increasing ionization energy is Li < B < Be < C < O < N < F < Ne.

Exception:

(i) Be > B. Be has fully-filled ns^2 orbitals and hence higher IE value.

(ii) N > O. N has half-filled electronic configuration and hence higher IE value.

Answer (2)

61. The biodegradable polymer is Nylon-2-Nylon-6.

Answer (2)

62. We know pH + pOH = 14

Therefore, $9 + pOH = 14 \Rightarrow pOH = 5 \Rightarrow [OH^-] = 10^{-5}$

The reaction involved is $Ca(OH)_2 \rightleftharpoons Ca^{2+} + 2OH^-$

Also, $[Ca^{2+}] = \frac{10^{-5}}{2}$

$$K_{sp} = [Ca^{2+}][OH^-]$$
$$= \left(\frac{10^{-5}}{2}\right)(10^{-5})^2 = 0.5 \times 10^{-15}$$

Answer (1)

63. For first order reaction, we have

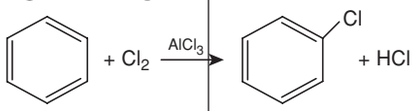
$$k = \frac{2.303}{t}\log\frac{a}{a-x}$$
$$= \frac{2.303}{t}\log\frac{100}{100-99}$$
$$= \frac{2.303}{t}\log 10^2$$
$$= \frac{2.303}{t} \times 2 \Rightarrow t = \frac{4.606}{k}$$

Answer (3)

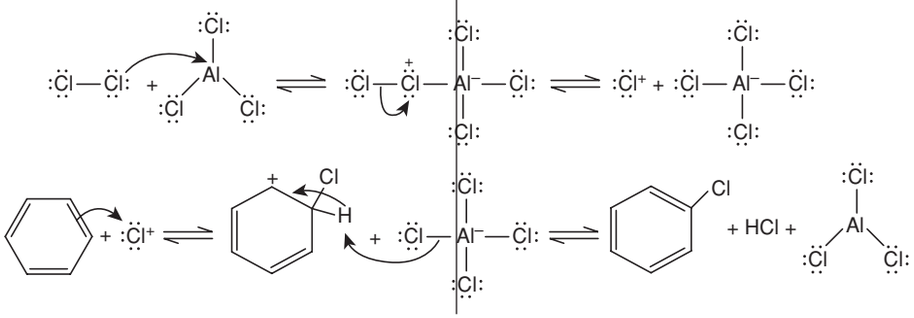
64. Alanine is the non-essential amino acid.

Answer (3)

65. Halogenation of benzene ring proceeds through an electrophilic substitution reaction.



Mechanism:



Answer (2)

66. A mixture of nitric acid and water exist as an azeotrope of composition nitric acid (68%) + water (32%) by mass. It is a maximum boiling (negative deviation) azeotrope. These solutions will boil at a higher boiling point than any of its pure components.

Answer (1)

67. For the reaction $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$

Rate of reaction is given as

$$-\frac{d[N_2]}{dt}=-\frac{1}{3}\frac{d[H_2]}{dt}=\frac{1}{2}\frac{d[NH_3]}{dt}$$

Answer (3)

68. The reaction involved in the Haber's process is $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$

2 mol of NH_3 is produced by 3 mol of H_2

20 mol of NH_3 will be produced by $\frac{3}{2}\times 20 = 30$ mol of H_2

Answer (3)

69. Protonation will be most difficult in case of phenol as lone pair of electrons on oxygen atom gets involved in the resonance with the benzene ring.

Answer (4)

70. The conditions of ideal solution are as follows:

$$\Delta H_{mix}=0,\ \Delta S_{mix}>0,\ \Delta G<0, \Delta V_{mix}=0$$

Answer (3)

71. Two substances that differ from each other only by one proton are referred to as a conjugate acid-base pair. Removing one H^+ (both the atom and the charge) from both H_2O and HF leaves OH^- and F^- ions respectively.

Answer (3)

72. The reaction that will be involved in the formation of negatively charged colloidal solution is as follows:

$$AgNO_3+KI(\text{excess}) \rightarrow [AgI]I^- + KNO_3$$

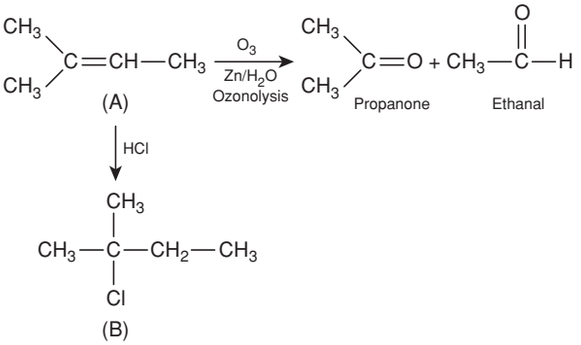
As KI is maximum in case of option (2), hence, it will form negatively charged colloids.

Answer (2)

73. A narrow spectrum antibiotic is only effective against Gram-positive or Gram-negative bacteria. For example, Penicillin G.

Answer (1)

74.

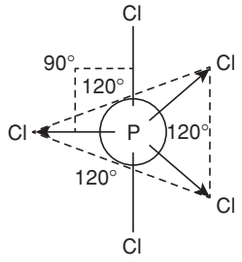


Answer (3)

75. In the presence of a strong-field ligand CN^-, etc., the electrons pair up because Δ_o is large enough to overcome the energy required to pair up the electron in the same orbital, that is pairing energy (P). This results in filling of the lower energy t_{2g} d-orbitals. Thus, the electronic configuration of Fe^{2+} in complex $K_4[Fe(CN)_6]$ is $t_{2g}^6 e_g^0$.

Answer (2)

76. Phosphorus in PCl_5 is sp^3d hybridized. All five hybrid orbitals in sp^3d hybridization are not equal. There are three equatorial P–Cl and two axial P–Cl bonds in PCl_5 with angle 120° and 90° respectively. The structure of PCl_5 is as follows:



PCl_5 is reactive due to weaker axial P–Cl bond.

Answer (4)

77. Out of the given options, NaOH is a strong base, so its conjugate acid is a weak. Similarly, HCl is a strong acid so its conjugate base is weaker. CH_3COOH is a weak acid, so its conjugate base is stronger. NH_4OH is a weak base, so its conjugate acid is stronger.

$$NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$$
$$NaOH + HCl \rightarrow NaCl + H_2O$$
$$NH_4OH + HCl \rightarrow NH_4Cl + H_2O$$

So, 1 mol of NaOH reacts with 1 mol of CH_3COOH

For (1): $\frac{50}{1000}\times 0.1$ mol of NaOH reacts with

$\frac{25}{1000}\times 0.1$ M of CH_3COOH

As no. of moles of CH_3COOH is less, it is wholly consumed in the reaction. So, unreacted NaOH = 0.005 − 0.0025 = 0.0025 mol

For salt hydrolysis of weak acid (CH_3COOH) and strong base (NaOH), we have

$$pH=\frac{1}{2}\left[pK_w+pK_a+\log\left[CH_3COO^-\right]\right]$$

$$V_{total}=50+25=75 \text{ mL}$$

$$[CH_3COO^-]=\frac{0.0025\times 75}{1000}=0.0001875 \text{ M}$$

So,

$$pH=7+\frac{pK_a}{2}+\log(0.0001875)=7+\frac{pK_a}{2}-3.72=3.27+\frac{pK_a}{2}$$

So, it forms an acidic buffer.

For (2): $\frac{100}{1000} \times 0.1$ mol of NaOH reacts with

$\frac{100}{1000} \times 0.1$ M of CH_3COOH

As no. of moles of NaOH and CH_3COOH are equal, both are wholly consumed in the reaction.

For salt hydrolysis of weak acid (CH_3COOH) and strong base (NaOH), we have

$$pH = \frac{1}{2}\left[pK_w + pK_a + \log\left[CH_3COO^-\right]\right]$$

$$V_{total} = 100 + 100 = 200 \text{ mL}$$

$$[CH_3COO^-] = \frac{0.01 \times 200}{1000} = 0.002 \text{ M}$$

So, $pH = 7 + \frac{pK_a}{2} + \log(0.002) = 7 + \frac{pK_a}{2} - 2.69 = 4.3 + \frac{pK_a}{2}$

So, it forms an acidic buffer.

For (3): $\frac{200}{1000} \times 0.1$ mol of NH_4OH reacts with

$\frac{100}{1000} \times 0.1$ M of HCl

As no. of moles of HCl is less, it is wholly consumed in the reaction. So, unreacted $NH_4OH = 0.02 - 0.01 = 0.01$ mol
For salt hydrolysis of strong acid (HCl) and weak base (NH_4OH), we have

$$pH = \frac{1}{2}\left[pK_w + pK_b - \log\left[NH_4Cl\right]\right]$$

$$V_{total} = 200 + 100 = 300 \text{ mL}$$

$$[NH_4Cl] = \frac{0.01 \times 300}{1000} = 0.003 \text{ M}$$

So, $pH = 7 + \frac{pK_b}{2} - \log(0.003) = 7 + \frac{pK_b}{2} + 2.69 = 9.69 + \frac{pK_b}{2}$

So, it forms a basic buffer.

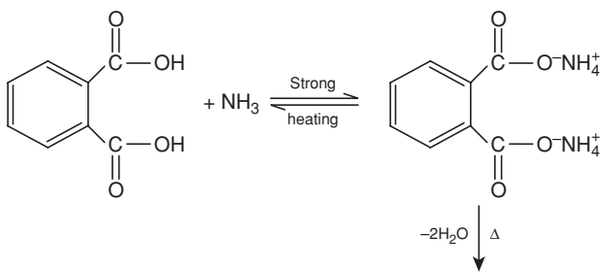
For (4): $\frac{100}{1000} \times 0.1$ mol of NaOH reacts with

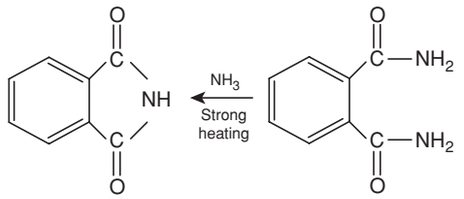
$\frac{100}{1000} \times 0.1$ M of HCl

As no. of moles of HCl and NaOH are equal, they completely react with each other and no buffer is formed.

Answer (3)

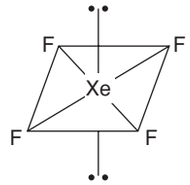
78.



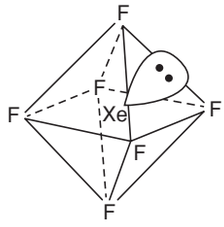


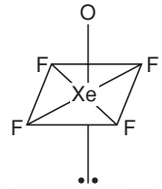
Answer (2)

79. The structure of XeF_4 is square planar.

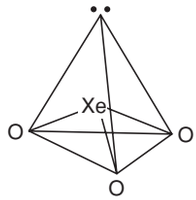


The structure of XeF_6 is a distorted octahedron.





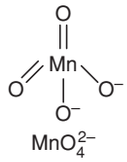
Square pyramidal
(Octahedral with one position unoccupied)
Xenon oxyfluoride
$XeOF_4$



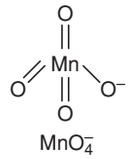
Pyramidal
Xenon trioxide
XeO_3

Answer (2)

80. In manganate and paramanganate, the π bonding involves the overlap of *p*-orbitals of oxygen with *d*-orbitals of manganese which leads to their tetrahedral structure.



MnO_4^{2-}



MnO_4^-

Answer (1)

81. Silicon cannot form the complex $[SiCl_6]^{2-}$ as size of silicon is smaller and due to steric hinderence, silicon cannot bear six big Cl^- ions.

Answer (4)

82. We know, $E_{cell} = E^o_{cell} - \frac{0.059}{n}\log Q$ (i)

Substituting $E_{cell} = 0$, $Q = K_{eq}$ and $n = 1$ in Eq. (i), we get

$$0 = E^{o}_{cell} - \frac{0.059}{1}\log K_{eq}$$

$$\log K_{eq} = \frac{E^{o}_{cell}}{0.059} \Rightarrow \log K_{eq} = \frac{0.59}{0.059} = 10 \Rightarrow K_{eq} = 10^{10} = 1\times10^{10}$$

Answer (3)

83. $Be(OH)_2$ is amphoteric, but the hydroxides of Mg, Ca, Sr and Ba are basic.

Answer (4)

84. We know that compressibility factor is given by $Z = \frac{pV_m}{RT}$

For ideal gas, $Z = 1$, so $V_{m,ideal}$ is RT/p. Now for the given gas, $V_{m,real} = 0.8V_{m,ideal} = 0.8RT/p$. Substituting in the above equation, we get

$$Z_{real} = \frac{pV_{m,real}}{RT} = \frac{p}{RT}\times\frac{0.8RT}{p} = 0.8$$

So, $Z < 1$. The compressibility factor Z is the deviation of ideal behavior of gases. Also, as the molar volume of real gas is lower and at low pressure of 15 bar, the molecules move freely, thus making $Z < 1$, indicating that attractive forces are dominant.

Answer (3)

85. As C occupies 75% of octahedral voids in hcp lattice, we have

no. of C atoms $= \frac{75}{100}\times 6$

And no. of anions = 6 as they form hcp.
Now, the ratio of C: A is

$$\frac{75}{100}\times 6 : 6 \Rightarrow 75 : 100 \Rightarrow 3 : 4$$

Answer (3)

86. For all the processes mentioned in option (1), (2) and (3) entropy is positive as randomness or disorder increases.For option (4), the entropy is negative as number of molecules decreases.

Answer (4)

87. Balmer series of lines lies in the visible spectrum of hydrogen.

Answer (2)

88. Temporary hardness occurs due to bicarbonates of calcium and magnesium. It can be removed by Clark method. The reaction involves:

$$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3\downarrow + 2H_2O$$

$$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3\downarrow + Mg(OH)_2\downarrow + 2H_2O$$

Answer (2)

89. Malachite is a carbonate ore. Its formula is $Cu(OH)_2{\cdot}CuCO_3$/ $Cu_2(OH)_2CO_3$.

Answer (4)

90. In aqueous state, inductive effect, solvation effect and steric hindrance of the alkyl group determine the basic strength of amines. Hence, the correct order of basicity is $(CH_3)_2NH > (CH_3)NH_2 > (CH_3)_3N > NH_3$.

Answer (1)

Biology

91. The Convention on Biological Diversity (CBD) conceptualized at Rio de Janeiro at UN Conference on Environment and Development (the Earth Summit) held from 3–14 June 1992. It was called upon to take appropriate measures for conservation of biodiversity and sustainable utilization of its benefits.

Answer (2)

92. Colostrum is the first fluid secreted by the mammary glands after childbirth and is rich in IgA. However, they only protect for a short time and then disappear.

Answer (4)

93. In epidermis, there are groups of bigger cells called the motor cells or bulliform cells. These cells are present slightly below or above the usual level of epidermis. These cells help in rolling of leaves in dry weather.

Answer (2)

94. In sub-metacentric chromosome, centromere is positioned a little above the centre giving rise to a short and a long arm of the chromosome. The two arms are labeled as *p*-arm for the shorter of the two and *q*-arm for the longer arm.

Answer (2)

95. Respiratory quotient (RQ) is defined as the ratio of volume of CO_2 evolved to the amount of O_2 consumed. When fats (e.g., seeds of castor, sesame, etc.) serve as substrates, RQ is less than 1. This is because, they are more reduced than carbohydrates, hence they require more oxygen to complete their oxidation. Oxidation of tripalmitin is:

$$2C_{51}H_{98}O_6 + 145O_2 \rightarrow 57CO_2 + 52H_2O$$

$$RQ = \frac{102CO_2}{145O_2} = 0.7$$

Answer (2)

96.
- Cyclosporin A is produced by the fungus *Trichoderma polysporum* and *Cylindrocarpon lucidum*. It is used as an immunosuppressive agent.
- Statins are produced by the yeast *Monascus purpureus*. They are used as agents that lower the blood-cholesterol.
- Streptokinase is produced by *Streptomyces sp*. It works as a tissue plasminogen activator. It helps in dissolving blood clots inside the blood vessels, has fibrinolytic effect.
- Lipase is produced by *Bacillus sp*, *Pseudomoans sp*, etc. It is used in detergents for digestion of lipids.

Answer (2)

97.
- The small intestinal mucosa contains intestinal glands or crypts of Lieberkühn, which are deep crevices lined by epithelial cells.
- The hepatic lobule serves as the structural and functional unit of the liver. A thin connective sheath covers each lobule and is called Glisson's capsule.
- Tail region of pancreas constitute 1% of the cells organized into clusters called pancreatic islets (islets of Langerhans),

which secretes the hormones, glucagon, insulin, somatostatin and pancreatic polypeptide.
- The sub-mucosa of the duodenum contains duodenal glands, also called Brunner's glands, which secrete an alkaline mucus that helps neutralize gastric acid in the chyme

Answer (3)

98. Habitat loss and fragmentation is the primary reason for the loss of biodiversity. It can be of three major kinds:
- Habitat destruction: A bulldozer felling the trees is the iconic example of habitat destruction. Other ways of directly destroying the habitat include filling of wetlands, mowing fields, etc.
- Habitat fragmentation: The terrestrial wildlife habitat is fragmented by roads and development. The habitat of aquatic species is fragmented by dams and water diversions.The loss and fragmentation of habitat make it difficult for migratory species to find places to rest and feed along their migration routes.
- Habitat degradation: Pollution, invasive species and disruption of ecosystem processes are some of the ways habitats can become degraded to such an extent that they no longer support native wildlife.

Answer (1)

99. Hypothalamus functions as the body's thermostat. If the temperature of blood flowing through the hypothalamus is above normal, the hypothalamus directs the autonomic nervous system to stimulate activities that promote heat loss. When blood temperature is below normal, by contrast, the hypothalamus generates impulses that promote heat production and retention.

Answer (2)

100.
- Annelids exhibit organ system level of organization. Their bodies exhibit bilateral symmetry. They are coelomates. They show tube-within-a-tube body plan. They have a soft elongated body that is metamerically segmented.
- Arthropods exhibit organ system level of organization. Their bodies are bilaterally symmetrical. They are coelomates. The slightly elongated body is segmented.
- Chordates exhibit organ system level of organization. Their bodies exhibit bilateral symmetry. They are coelomates. They use heteromeric segmentation.
- Molluscs exhibit organ system level of organization. Their bodies exhibit bilateral symmetry. They are coelomates. The body is covered by a single layer of epidermis and has unstriped muscles that occur in bundles, except *Neopilina* which is a segmented mollusc.

Answer (1)

101. The alimentary canal of cockroach is divided into three parts—foregut (stomodaeum), midgut (mesenteron) and hindgut (proctodaeum).
- Foregut extends from mouth to gizzard. The mouth open is a short tubular pharynx which then opens into the tubular oesophagus that extends up to the thorax. A big bag-like structure called crop is present in the thorax. It extends up to the abdomen. The crop opens into a gizzard or proventriculus which is pear-shaped.
- At the junction of foregut and midgut, 6–8 blind tubular hepatic or gastric or mesenteric caeca are present. At at the junction of midgut and hindgut, 100–150 yellow filaments called Malpighian tubules are present.
- The hindgut consists of three parts—the ileum which is short and tubular, the colon which is long and coiled and the rectum which is broad.

Answer (1)

102. The major greenhouse gases are water vapor, carbon dioxide, methane, some oxides of nitrogen and chlorofluorocarbons (CFCs). These gases in Earth's atmosphere are strong absorbers in the infrared range and they absorb radiation emitted by the warmed surfaces of the Earth. Once warmed, they re-emit this radiation that reaches back to the Earth's surface, making it warmer than it otherwise would be. In trapping heat this way, the gases act like glass in a greenhouse, hence, the effect is called the greenhouse effect.

Answer (4)

103. Muscular dystrophy refers to a group of inherited muscle-destroying diseases that cause progressive degeneration of skeletal muscle fibers. The most common form of muscular dystrophy is Duchenne muscular dystrophy (DMD).

Answer (2)

104. The columnar and cuboidal epithelial cells bearing cilia in their apical surface are called columnar ciliated epithelium and cuboidal ciliated epithelium, respectively.
- Columnar ciliated epithelium lines some bronchioles (small tubes) of respiratory tract, uterine (fallopian) tubes, uterus, some paranasal sinuses, central canal of spinal cord and ventricles of brain.
- Cuboidal ciliated epithelium lines parts of nephrons in kidneys.

Answer (4)

105.
- P-wave represents atrial depolarization or excitation, which spreads from the SAN through contractile fibers in both atria leads to their contraction.
- QRS complex represents rapid ventricular depolarization, as the action potential spreads through ventricular contractile fibers.
- T-wave indicates ventricular repolarization. It occurs just as the ventricles are starting to relax.
- The T-wave is flatter than normal when the heart muscle is receiving insufficient oxygen, as, for example, in coronary ischemia.

Answer (1)

106.
- *In situ* conservation refers to protecting an endangered species in its natural habitat. *In situ* approach includes protection of a group of ecosystems through a network of protected areas, such as biodiversity hotspots, national parks, sanctuaries, biosphere reserves and sacred groves and lakes.
- *Ex situ* conservation involves the conservation of genetic resources of species away from their area of origin or development. This includes off-site collection such as botanical garden, zoos, etc., and gene banks.

Answer (3)

107. In stabilizing selection, the most common traits of the individuals are selected over those that are unusual or extreme. The alleles that

cause extreme traits in the individuals are eliminated. For example, in this case both the light weighted and heavy weighted new borne are not surviving than those closer to the average weight, as stabilizing selection selects the latter. Hence, stabilizing selection reduces variation but does not change the mean value.

Answer (2)

108. The correct sequence of phases of cell cycle is: $G_1 \rightarrow S \rightarrow G_2 \rightarrow M$.

The cell cycle can be divided into two major phases:

(i) Interphase: The interphase or the resting phase is the part of the cell cycle during which a cell grows, replicates cell organelles and DNA, assembles the "machinery" of mitosis and condenses its DNA. It is the period between two cell divisions. The interphase is divided into the following three phases: G_1 (represents the time gap between the last cell division and the start of DNA replication), S (represents replication of DNA) and G_2 phase (represents the time gap between the end of DNA replication and the beginning of cell division).

(ii) Mitosis (M) phase: In M phase, the duplicated chromosomes are separated into two nuclei.

Answer (4)

109. A free lipid-soluble hormone molecule diffuses from the blood, through interstitial fluid, and through the lipid bilayer of the plasma membrane into the target cell. The hormone binds to and activates receptors located within the cytosol or nucleus. The activated receptor–hormone complex then alters gene expression. It turns specific genes of the nuclear DNA on or off.

Answer (2)

110. Lysosomes are small, membrane-bound organelles that originate from the Golgi apparatus in animal cells. They are vesicular structures containing several digestive hydrolytic enzymes and help in cell's waste disposal, by digesting compounds that enter the cell by phagocytosis or endocytosis.

Answer (4)

111.
- The central cell after triple fusion becomes the primary endosperm cell and develop into the endosperm. Zygote develops into an embryo by a process known as embryogenesis or embryogeny. Most zygote develops only after certain amount of endosperm is formed to provide nutrition to the developing embryo.
- The fruit is a ripened ovary of the flower. It contains one or more seeds depending on the number of ovules present in the ovary. The development of ovules into seeds and ovary into fruits take place simultaneously.

Answer (4)

112. Concanavalin A (Con A) is a plant lectin that is purified from jack beans. Con A binds to the mannose residues of various glycoproteins and activates lymphocytes.

Answer (3)

113. A bioreactor is a vessel in which generally a substrate of lower value (raw material) is utilized by cells to produce products that are of higher commercial value such as specific enzymes, plant, fungal or bacterial cells. The biological processes are carried out under closely monitored and tightly controlled conditions.

Answer (4)

114.
- An apoenzyme is the inactive protein part of an enzyme, which makes the enzyme catalytically active by attaching with cofactor to form holoenzyme (conjugated enzyme).
- Prosthetic group is a cofactor which is permanently associated with their protein (apoenzyme), often by covalent bonds. For example, a haem prosthetic group is tightly bound to a number of proteins such as catalases and cytochromes.

Answer (2)

115. Adenine and guanine are larger, 9-membered double-ring bases called purines; thymine, uracil and cytosine are smaller, 6-membered single-ring bases called pyrimidines.

Answer (2)

116.
- Rete testis is a network of delicate tubules in the testis that carries sperms from seminiferous tubules to efferent ducts.
- Vasa efferentia are a series of coiled efferent ducts through which the sperms move into epididymis.
- Epididymis is a comma shaped organ on the posterior border of each testes which help in storage, movement, nutrition and maturation of sperms.
- Vasa deferentia is a less convoluted, thicker, longer duct which conveys sperm during sexual arousal from the epididymis to the urethra and can also store sperms.
- The distal urethra enlarges within the glans penis and forms a terminal slit-like opening, the urethral meat.

Answer (2)

117.
- *Homo habilis* (Skillful humans) was the first human-like organism among all the hominid fossils. Their brain was large and was about 650–800 cc.
- *Homo neanderthalensis* had large brains of about 1400 cubic centimeters, but the frontal lobe of the brain responsible for thinking was flattened.
- *Homo erectus* evolved from *Homo habilis*. Their brain size was large (about 900 cc).
- *Homo sapiens sapiens* brain size was 1200–1600 cubic centimeters.

Answer (3)

118. Hugo de Vries observed the sudden appearance of new phenotypes in the evening primroses growing in his experimental garden. He thought they were new species and called the novel plants "sports". In 1901, he introduced the term mutation to describe the origin of these "sports". These "sports" were the result of translocations. He believed that it occurred suddenly and was due to a single step large mutation. He called this as saltation. He later proposed mutation theory of evolution which states that new species originate suddenly as a result of large, discontinuous variations.

Answer (2)

119. An autonomous organelle implies that it is able to sustain by itself without requiring any assistance from the cell. Mitochondrion and chloroplast are largely self-sustainable in having their own DNA and ability to replicate themselves and, in producing their own RNA and ribosomes and also in their ability to make some of their own proteins. They divide by fission.

Answer (3)

120. The most common causes of wheezing include: Asthma (a chronic respiratory condition that causes spasms and swelling in the bronchial tubes) and Bronchitis (inflammation of the lining of the bronchial tubes).

Answer (2)

121. In domesticated fowls, females are heterogametic with autosomes and ZW allosomes; while males are homogametic with autosomes and ZZ allosomes. The male gametes are similar with allosome Z, while the female gametes are dissimilar and of two types—one half have allosome Z and the other half have allosome W. The offspring is female, or male depends on the fertilizing ovum.

Answer (3)

122. The most commonly used method for DNA concentration is by ethanol precipitation. In the presence of Na^+ ions and at a temperature of –20°C or less, precipitation of polymeric nucleic acids can be efficiently done. If the solution of DNA is thick, the ethanol can be layered on top of the sample and the molecules can precipitate at the interface. If a glass rod is pushed through the ethanol into the DNA solution, the DNA molecules adhere to the glass rod and can be pulled out of the solution in the form of long fiber. The advantage of ethanol precipitation is that it leaves behind short-chain and monomeric nucleic acid components in solution. Hence, the ribonucleotides that are produced by ribonuclease treatment are lost at this stage.

Answer (2)

123.
- *Trichoderma* are present in the soil and mainly associated with the plant roots. They serve as a common biocontrol agent to treat plant diseases by acting as parasites on other fungi and obtaining nutrition from them.
- Baculoviruses have been used as biopesticides in crop fields.
- *Bacillus thuringiensis* (Bt) is an important microbial biocontrol agent that produces a toxin called thurioside. This toxin causes a disease that affects caterpillars and the larvae of other insect pests including gypsy moths mainly Indian meal moth in stored grains.

Answer (2)

124. Inbreeding refers to the mating between the closely related individuals for 4–6 generations within the same breed. If the parent stock contains desirable characteristics, then these are inherited by the offspring. It is used to develop pure lines as it increases homozygosity. The harmful recessive genes that are uncovered as a result of this, can be weeded out from the population. Once the harmful genes are eliminated, the population consists of superior desirable genes. This increases the productivity of the population.

Answer (3)

125.
- Production of lactic acid (2–3%) by the *Lactobacillus* facilitates coagulation of milk protein into curd.
- In bread, the baker's yeast (*Saccharomyces cerevisiae*) is added to a mixture of flour, water, salt and sugar to produces gas that makes the dough rise.
- The mold *Aspergillus niger* makes citric acid when molasses is used as the fermentation substrate.
- Acetic acid (vinegar) is made from ethyl alcohol by *Acetobacter aceti*.

Answer (2)

126. Since the source-sink relationship is variable, the direction of movement in the phloem can be upwards or downwards, that is bi-directional. This contrasts with that of xylem where the movement is always unidirectional, that is upwards.

Answer (4)

127. Parthenogenesis is the process of formation of an embryo from an unfertilized egg. It is observed rarely in angiosperms. It can be of two types:
- Haploid parthenogenesis: In this, the unfertilized haploid egg develops into an embryo, e.g., *Datura*, *Solanum nigrum*, etc.
- Diploid parthenogenesis: In this, the cells of the embryo sac are diploid (apospory), e.g., *Taraxacum*.

Answer (4)

128. In some seeds such as black pepper and beet, remnants of nucellus are persistent. These persistent remains of nucellus in the seed is called perisperm. It surrounds the embryo sac within the ovule. It is the main nutritive tissue in gymnosperms.

Answer (2)

129. The genetic distance between two loci is measured in centimorgan (cM) which is related to the recombinant frequency as 1 cM = 1% recombinant frequency (approximately). This distance in cM is used in linkage maps or chromosome mapping. Thus, recombinant frequency helps in chromosome mapping and generation of linkage maps.

Answer (3)

130. Given,
Cardiac output = 5 L or 5000 mL
Blood volume in ventricles at the end of diastole = 100 mL
Blood volume in ventricles at the end of systole = 50 mL
Stroke volume = 100 – 50 = 50 mL
We know,
Cardiac output = Stroke volume × Heart rate
Putting the given values in this, we get:
5000 mL = 50 mL × Heart rate
So, Heart rate = 100 beats per minute

Answer (3)

131. Some nitrite, nitrates and ammonium compounds are returned back to the atmosphere by anaerobic bacteria (*Pseudomonas aeruginosa*, *Micrococcus denitrificans*, *Thiobacillum denitrificans*) via a process, called denitrification.

Answer (4)

132. Water passes out of the filtrate as it moves down the collecting duct. This movement occurs as a result of the osmotic gradient created by both the movement of urea out of the collecting duct and the movement of electrolytes out of the

ascending limb. This passage of small amounts of urea into the medullary interstitium helps maintain osmolarity and large amounts of water could be reabsorbed to produce a concentrated urine.

Answer (2)

133. The outer mitochondrial membrane is composed of lipid by weight. It houses several different enzymes involved in diverse activities, like, oxidation of epinephrine, the degradation of tryptophan, and the elongation of fatty acids.

- The inner mitochondrial membrane is composed of more than 100 different polypeptides and has a very high protein/lipid ratio. It is highly impermeable and has special membrane transporters which regulate the entry of molecules and ions into the matrix. It has a peculiar organization, wherein a series of invaginated membranous sheets, called cristae are formed.
- Mitochondrial matrix houses of single circular DNA molecule, ribosomes and an array of enzymes.

Answer (2)

134. Xylem transport involves transport of water, minerals, organic compounds and harmones from the xylem sap to the other parts of the plant. Minerals are carried as inorganic ions or organic molecules.

Answer (4)

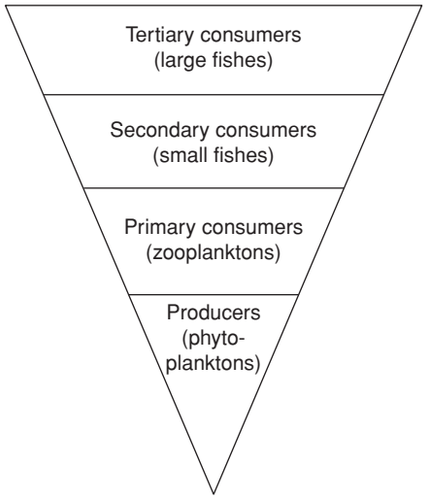
135. The cells that have stopped dividing, are present in a stage preceding the initiation of DNA synthesis. Cells that are arrested in this state are said to be in the G_0 or quiescent stage. They are metabolically active but they must receive a growth-promoting signal to proceed from G_0 into G_1 phase and thus re-enter the cell cycle.

Answer (1)

136. Activity of the vascular cambium is affected by variation in the climate. During the winter, cambium stops dividing and in spring season it regains its activity and starts dividing. The cambium becomes more active due to favorable environment and divide actively to produce large number of vessels with wider lumen, the secondary xylem formed during this period of pronounced activity is called spring wood (early wood). It is light in color. During the autumn season, the activity of cambium is less and vessels produced are generally of smaller size and have narrow lumen, tracheids and wood fibers are produced in larger numbers. The secondary wood formed during this period of time is called autumn wood (late wood). It is dark in color. these two types of wood appear in the form of distinct concentric circles known as the annual rings. Such distinction is observed in tree growing in temperate regions only due to the existence of distinct summer and winter seasons.

Answer (4)

137. Pyramids of biomass in oceans are generally "inverted" because the total biomass of consumers (fish) outweighs the biomass of producers (phytoplankton). The inverted pyramid in oceans is based on the life span of organisms at difficult trophic levels.



Answer (4)

138.

- In parietal placentation, the gynoecium is multicarpellary but the ovary is unilocular. Placenta bearing ovules is present on the inner or peripheral wall of the ovary. A false septum (replum) divides unilocular ovary into two chambers. For example, mustard, *Argemone*, etc.
- In basal placentation, the basal portion of the unilocular ovary has the placenta which bears a single ovule.
- In axile placentation, the ovules are borne on the placenta of the central axis.
- In free central placentation, the central axis bears ovules and the septa are absent.

Answer (3)

139. The Montreal Protocol consists of 20 articles and 5 annexes and sets the elimination of Ozone depleting substances as the final objective. In 1989, this protocol was amended by 82 nations in Helniski, it was called Helniski declaration. Pledge was made to phase out CFCs by 2000. India joined the Montreal Protocol in May 1991.

Answer (1)

140. Lactational amenorrhea means immediately after parturition, during period of lactation, there is absence of menstruation, thus chances of pregnancy are extremely low. It is because there is high level of prolactin.

Hormonal methods are the most effective means of birth control.

- Oral contraceptives (the pill) are tablets that contain hormones (either progestogens or progestogen-estrogen combinations) designed to prevent pregnancy.
- Emergency contraception (EC) (morning after pill) consists of progestin and estrogens or progestin alone to prevent pregnancy following unprotected sexual intercourse.

Answer (1)

141. Expiratory capacity (EC) is the sum of tidal volume and expiratory reserve volume (TV + ERV) and is the total volume a person can expire after normal inspiration. Given,

Tidal Volume = 500 mL

Expiratory Reserve Volume = 1000 mL
So, Expiratory Capacity = 500 + 1000 = 1500 mL

Answer (1)

142. After entering one of the synergids, the pollen tube releases the two male gametes into the cytoplasm of synergid.

- Fusion of sperm cell (male gamete) with egg cell (female gamete) to form a diploid zygote. This process is known as syngamy or generative fertilization.
- Fusion of the other sperm cell with two polar nuclei to form primary endosperm cell containing triploid nucleus also known as primary endosperm nucleus (PEN) in the central cell of embryo sac. This process is known as triple fusion as it involves fusion of three haploid nuclei.

Answer (4)

143. Photoperiodic induction takes place when a plant has reached minimum vegetative growth sufficient for it to flower. The change from vegetative to reproductive or flowering phase takes place in the shoot apex. Hence, it was expected that the shoot apices would receive the photoperiodic signals. However, in reality, the signals of photoperiodism are perceived by the leaves.

Answer (4)

144. If the organism has been first described by a scientist or author, his name appears in abbreviated form after the specific epithet in roman script. For example, Carolus Linnaeus described mango for the first time, hence, the name is written as *Mangifera indica* Linn.

Answer (2)

145. The restriction endonucleases function by first inspecting the length of a DNA sequence and finding its specific recognition sequence at which the DNA molecule is to be cut. After recognition of the specific sequence, the restriction endonuclease binds to the DNA and cuts each of the two strands of the double helix at specific points in their sugar-phosphate backbones. They cut the DNA strand a little away from the centre of palindrome sites, but between the same two bases on the opposite sides. As a result of the cut, single stranded portion of the helix are left at the ends.

Answer (2)

146. In pteridophytes, the male antherozoid and female egg fuse to form a diploid zygote which develops into a multicellular, well-differentiated sporophyte. Apart from this, the female gametophyte is large and serves as nutritive tissue in heterosporous forms. This indicates that the heterosporous pteridophytes might have given rise to the seed habit in plants. However, they cannot be called true seeds as the megasporangium does not have integuments and the resting phase of embryo.

Answer (3)

147. On crossing homozygous red (*RR*) and white flowered plants (*rr*) of snapdragons (*Antirrhinum majus*), they produce heterozygotes (*Rr*) that have pink flowers in F_1 generation. Thus, neither the red nor the white color trait is dominant. This is called incomplete dominance or partial dominance.

In the F_2 generation, the red (*RR*), pink (*Rr*) and white (*rr*) flower plants are produced in the ratio of 1:2:1. So, both phenotypic and genotypic ratios appear to be same, that is, 1:2:1. Here the two alleles of a gene interact with each other in the heterozygous condition and produce intermediate phenotype. Thus, it follows law of segregation.

Answer (4)

148. In the first step of glycolysis, phosphoryl group of ATP is transferred to glucose to form glucose-6-phosphate (G6P) in the presence of glucokinase (or hexokinase) enzyme. This step uses one ATP. This reaction is catalyzed by the enzyme hexokinase (HK) in the presence of magnesium ions.

Answer (2)

149. Heroin (brown sugar, smack, diacetyl morphine), an opioid, is prepared from morphine. It is a semisynthetic opiate. Its potency is much higher than natural opiate. It slows down respiratory activity, causes constriction of pupil of eye, decreases glandular secretions, impairs the digestion, and produces nausea, vomiting and sterility.

Answer (2)

150. Intra-Uterine Devices (IUDs) are small objects made of plastic, copper, or stainless steel that is inserted by a health-care professional such as doctors or nurses into the cavity of the uterus through vagina. The hormone releasing IUDs are Progestasert, LNG-20, etc. IUDs prevent fertilization from taking place by blocking sperm from entering the fallopian tubes. They also enhance phagocytosis of the sperms.

Answer (3)

151. Frequency of the *A* allele in the population, $p = 0.4$

Frequency of the *a* allele in the population, q
Hardy-Weinberg equilibrium, which states that the amount of genetic variation in a population will
remain constant from one generation to the next if the disturbing factors are absent. The binomial
expansion of $(p + q)^2$ is

$$p^2 + 2pq + q^2 = 1$$

Frequency of the homozygous genotype *AA*, $p^2 = 0.16$

$$0.16 + 2 \times 0.4 \times q + q^2 = 1$$
$$q^2 + 0.8\,q - 0.84 = 0$$
$$q^2 + 0.14\,q - 0.6\,q - 0.84 = 0$$
$$q\,(q + 0.14) - 0.6\,(q - 0.14) = 0$$
$$q = -0.14 \text{ (not possible)}$$
$$q = 0.6$$

Frequency of the homozygous genotype *aa*, $q^2 = 0.36$
Frequency of the heterozygous genotype *Aa*, $2pq = 0.48$

Answer (3)

152. Golden rice is a transgenic variety of rice (*Oryza sativa*) that is so named because of its yellow color grains due the presence of large quantities of β-carotene (provitamin A or inactive state of vitamin A). Two genes, a plant phytoene synthase, *psy* from daffodil (*Narcissus pseudonarcissus*) and a bacterial phytoene desaturase (*crt1*) from soil bacterium *Erwinia uredovora*¸ are incorporated into rice genome.

Answer (1)

153. Mycorrhiza is a symbiotic association of fungi with the root systems of some plants. The fungal hyphae either form a dense network around the young roots or they penetrate the cells of

the roots. The large surface area of the fungal hyphae is helpful in increasing the absorption of water and minerals from the soil. In return, they get sugar and nitrogenous compounds from the host plants. The mycorrhizal association is obligate in some plants. For example, *Pinus* seeds do not germinate and establish in the absence of mycorrhizal.

Answer (2)

154.
- The genetic code is unambiguous or specific as one codon specifically codes for one amino acid only.
- The genetic code is degenerate, or redundant, because a single amino acid may be coded for by more than one codon.
- The genetic code is nearly universal, that is in general, the codons have the same meaning in all living organisms. Thus, clearly this feature allows bacteria to produce human insulin by recombinant DNA technology.

Answer (3)

155. Except for Genital herpes caused by herpes simplex virus type 2 (HSV-2), HIV caused by human immunodeficiency virus and hepatitis B caused by hepatitis B virus, other sexually transmitted diseases are curable.

Gonorrhea is caused by bacterium *Neisseria gonorrhoeae*, Chlamydiasis is caused by bacterium *Chlamydia trachomatis* and genital warts are caused by the human papillomavirus (HPV).

Answer (3)

156. Viruses are acellular infectious agents. They are made up of a nucleic acid core and a surrounding protein coat called a capsid. Viruses can replicate, or multiply, only inside a living host cell. They are called obligate intracellular parasites. Their infective constituents are nucleic acids DNA and RNA and not proteins.

Answer (3)

157.
- *Pila*, commonly known as apple snail, belongs to Molluscs. Its body is divided into head, foot and visceral hump. The buccal cavity contains radula with transverse rows of teeth to cut through grasses.
- *Bombyx*, commonly known as silkworm, belongs to Arthropoda. The excretion is either through green glands, coxal glands or Malpighian tubules which are slender projections from the digestive tract. The fluid passes through the walls of the Malpighian tubules to and from the blood.
- *Pleurobrachia*, commonly known as sea gooseberry, belongs to Ctenophora. Eight rows of ciliated comb plates are present externally on their transparent body. These help in locomotion.
- *Taenia*, commonly known as tapeworm, belongs to Platyhelminthes. Excretion of excess water and waste material (chiefly ammonia) is through a network of fine tubules containing specialized bulb-like cells called flame cells.

Answer (2)

158. In Expressed sequence tags (ESTs), all the genes that were expressed as RNA were to be identified. It refers to a short sub-segment of a segment of complementary DNA (cDNA) that can be used to identify a gene transcript.

Answer (1)

159. Most fungi, such as moulds and mushrooms, are multicellular, but yeasts are unicellular. The body of a fungus is called a thallus as most multicellular fungi consist of a mycelium which is a loosely organized mass of thread-like structures called hyphae. The mycelium is not formed in unicellular fungi, for example, yeast. However, sometimes the yeasts cells stick in chains and form false colonies or pseudomycelium.

Answer (4)

160.
- A saprophyte or saprotroph is an organism which gets its energy from dead and decaying organic matter. This may be decaying pieces of plants or animals.
- A parasite is an organism that lives on or in a host organism and gets its food from or at the expense of its host.
- Lichens are symbiotic associations between sac fungi or, occasionally, club fungi and either cyanobacteria (*Gloeocapsa*, *Scytonema*, *Nostoc*, *Rivularia*, etc.) or green algae (e.g., *Cocomyxa*, *Cladophora*, *Pleurococcus*, etc.).
- A mycorrhiza is a symbiotic association between a fungus and a plant.

Answer (4)

161. GLUT IV is insulin-dependent and is responsible for the majority of glucose transport into muscle and adipose cells in anabolic conditions.

Answer (4)

162. During organ transplantation, the immune system recognizes the proteins in the transplanted organ as foreign and mounts cell-mediated immune responses against them. This phenomenon is known as graft rejection.

Answer (4)

163. If a person's kidneys are so impaired by disease or injury that the kidneys are unable to function adequately, then blood must be cleansed artificially by dialysis. Often, there is anemia in these patients because the kidneys no longer produce enough erythropoietin for adequate red blood cell production. Because the kidneys are no longer able to convert vitamin D to calcitriol, which is needed for adequate calcium absorption from the small intestine, osteomalacia also may occur.

Answer (3)

164. Cornea is the exposed and transparent coat of eyeball that covers the colored iris. Because it is curved, the cornea helps focus light onto the retina. Since cornea does not get any blood supply, hence its transplantation is successful.

Answer (4)

165. Morgan's student Alfred Sturtevant used the frequency of recombination between gene pairs on the same chromosome as a measure of the distance between genes and mapped their position on the chromosome.

Answer (3)

166.
- *i* gene is a constitutive gene as it is always undergoing protein synthesis to produce more repressor protein and is not controlled by the promoter.
- *z* gene codes for the enzyme β-galactosidase that hydrolyzes disaccharide lactose into monosaccharides glucose and galactose.

- *a* gene codes for the enzyme β-galactoside transacetylase, the biological role of which is unknown.
- *y* gene codes for the enzyme β-galactoside permease that increases cell permeability to β-galactosides.

Answer (3)

167. Flowering can be initiated in certain fruits such as pineapple by applying auxins. NAA is generally used auxin. Ethylene also initiates flowering in melon, mangoes and pineapples. It also synchronizes fruit-set in pineapples.

Answer (1)

168. Goblet cells are present in the epithelium and secrete mucus. The intestinal juice or succus entericus is formed by the secretions of goblet as well as brush border cells. It is a clear yellow fluid, contains water and mucus and is slightly alkaline (pH 7.8) which is suitable for enzymatic activities. The alkaline pH of intestinal juice is due to the high bicarbonate ion (HCO_3^-) content of pancreatic juice. Both mucus and the bicarbonates protect the mucosa of the intestine from acid.

Answer (2)

169. *Trichoderma* are present in the soil and mainly associated with the plant roots. They serve as a common biocontrol agent to treat plant diseases by acting as parasites on other fungi and obtaining nutrition from them. Some of its species can activate the plant defense mechanisms and may help in controlling organisms other than fungi.

Answer (1)

170.
- In gymnosperms and pteridophytes, sieve elements lack sieve tubes. They have sieve plates in linear rows and they are named as sieve cells. Sieve cells which are considerably elongated with tapering end walls.
- In gymnosperms and pteridophytes, companion cell is replaced by albuminous cell. It is also known as Strasburger cell. The feature that distinguishes it from other parenchymatous elements of phloem are its connections with the sieve cells.

Answer (4)

171. Once a secondary oocyte is formed, it begins meiosis II but then stops in metaphase II due to accumulation of metaphase promoting factor (MPF). The mature (Graafian) follicle soon ruptures and releases its secondary oocyte, a process known as ovulation. At ovulation, the secondary oocyte is expelled into the pelvic cavity together with the first polar body and corona radiata. If fertilization occur, then meiosis II resumes. The sperms are present in the fallopian tube that breakdowns MPF and promotes synthesis of anaphase promoting complex (APC). One of the sperms penetrates the secondary oocyte, which then splits into two haploid cells, again of unequal size. The larger cell is the ovum, or mature egg; the smaller one is the second polar body. The nuclei of the sperm cell and the ovum then unite, forming a diploid zygote.

Answer (1)

172. Original reading frame

5'AAC AGC GGU GCU AUU 3'
Asn Ser Gly Ala Ile

- Insertion of G at 5th position will shift the reading frame:

5'AAC AGG CGG UGC UAU U 3'
Asn Arg Arg Cys Tyr

- Deletion of G at 5th position will shift the reading frame:

5'AAC ACG GUG CUA UU 3'
Asn Thr Val Leu

- Insertion of A and G at 4th and 5th positions will shift the reading frame:

5'AAC AGA GCG GUG CUA UU3'
Asn Arg Ala Val Leu

- Deletion of GGU from 7th, 8th and 9th positions will keep the reading frame same:

5'AAC AGC GCU AUU 3'
Asn Ser Ala Ile

Answer (4)

173. Rudolf Virchow, a German pathologist who in 1855 explained the third tenet of the cell theory, "Cells can arise only by division from a pre-existing cell (*Omnis cellula e cellula*)", thus completing the classical cell theory. This also explained the theory of cell lineage that indicates that since all cells arise from pre-existing cells, they have a common lineage.

Answer (1)

174. The protein produced by the *cry* gene of *B. thuringiensis* can kill certain insects such as lepidopterans (tobacco budworm, armyworm), coleopterans (beetles) and dipterans (flies and mosquitoes). The protein crystals are produced in an inactive form (protoxin) in the bacteria. However, when the insect ingests the toxin, it gets converted to its active form in its gut which has an alkaline pH. The toxin then binds to the surface of midgut epithelial cells making its membrane porous. This leads to the influx of ions and water that causes the cells to swell and ultimately lyse leading to the death of the insects.

Answer (3)

175.
- Widal test is used to diagnose the *Salmonella typhi* causing typhoid.
- UTI test is done to detect urinary tract infection.
- Anthrone test is a general test for all carbohydrates.

Answer (4)

176. Zygote with an extra Y (XYY) develops into a physically normal male who is likely to be taller than average. The individual has 47 chromosomes ($2n + 1$). This condition is called Klinefelter syndrome, which is characterized by mental retardation, underdevelopment of genitalia (leading to sterility) and the presence of feminine physical characteristics such as breast enlargement (gynaecomastia).

Answer (2)

177. Discarded plastic is used for laying roads. The waste that is collected is shredded and stored for about seven days to dry. It is then mixed with bitumen and is used in making roads. With the help from R.V. College of Engineering and Bangalore City Corporation, Ahmed Khan mixed polyblend and bitumen that could withstand rain. The lifespan of bitumen road that was generally of three years increased to six to seven years with polyblend.

Answer (3)

178. Nuclear waste is an extremely potent pollutant and has to be dealt with maximum care. It has been recommended that storage of nuclear waste, after sufficient pre-treatment, should be done in properly shielded containers buried between the rocks 500 m beneath the Earth's surface.

Answer (4)

179.
- Diabetes mellitus is caused by an inability to produce or use insulin. Because insulin is unavailable to aid transport of glucose into body cells, blood glucose level is high and glucose "spills" into the urine (glucosuria).
- When the intake of iodine in the diet is inadequate, the resultant low level of thyroid hormone in the blood stimulates secretion of TSH, which causes thyroid gland enlargement and thus goiter.
- Hyposecretion of glucocorticoids and aldosterone causes Addison's disease.
- Hypersecretion of growth hormone during adulthood is called acromegaly.

Answer (3)

180. The first seven pairs of ribs that have costal cartilages and attach directly to the sternum are called true (vertebrosternal) ribs.
- The remaining five pairs of ribs are termed false ribs because their costal cartilages either attach indirectly to the sternum or do not attach to the sternum at all. The cartilages of the eighth, ninth and tenth pairs of ribs attach to one another and then to the hyaline cartilage of the seventh pair of ribs. These false ribs are called vertebrochondral ribs.
- The eleventh and twelfth pairs of ribs are false ribs designated as floating (vertebral) ribs because the costal cartilages at their anterior ends do not attach to the sternum at all. These ribs attach only posteriorly to the thoracic vertebrae.

Answer (4)

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