NEET (UG)

SOLVED PAPER 2016 (Phase I)

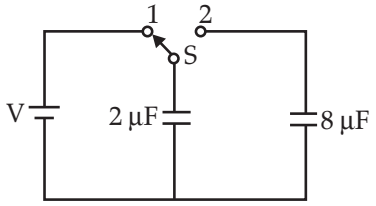
Time : 3 Hours **Max. Marks : 720**

Important Instructions :

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

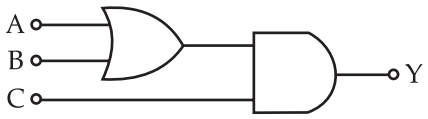
PHYSICS

1. A capacitor of 2 μF is charged as shown in the figure. When the switch S is turned to position 2, the percentage of its stored energy dissipated is



(a) 20% **(b)** 75% **(c)** 80% **(d)** 0%

2. To get output 1 for the following circuit, the correct choice for the input is



(a) A = 1, B = 0, C = 0 **(b)** A = 1, B = 1, C = 0
(c) A = 1, B = 0, C = 1 **(d)** A = 0, B = 1, C = 0

3. A potentiometer wire is 100 cm long and a constant potential difference is maintained across it. Two cells are connected in series first to support one another and then in opposite direction. The balance points are obtained at 50 cm and 10 cm from the positive end of the wire in the two cases. The ratio of emf is Out of Syllabus

(a) 5 : 4 **(b)** 3 : 4 **(c)** 3 : 2 **(d)** 5 : 1

4. When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is $\frac{V}{4}$. The threshold wavelength for the metallic surface is

(a) 5 λ **(b)** $\frac{5}{2}\lambda$ **(c)** 3 λ **(d)** 4 λ

5. Two non-mixing liquids of densities ρ and $n\rho$ ($n > 1$) are put in a container. The height of each liquid is h. A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length pL ($p < 1$) in the denser liquid. The density d is equal to

(a) $\{2 + (n + 1)p\}\rho$ **(b)** $\{2 + (n - 1)p\}\rho$
(c) $\{1 + (n - 1)p\}\rho$ **(d)** $\{1 + (n + 1)p\}\rho$

6. Out of the following options which one can be used to produce a propagating electromagnetic wave ?

(a) A stationary charge.
(b) A chargeless particle.
(c) An accelerating charge.
(d) A charge moving at constant velocity.

7. The charge following through a resistance R varies with time t as $Q = at - bt^2$, where a and b are positive constants. The total heat produced in R is

(a) $\frac{a^3R}{3b}$ **(b)** $\frac{a^3R}{2b}$ **(c)** $\frac{a^3R}{b}$ **(d)** $\frac{a^3R}{6b}$

8. At what height from the surface of earth the gravitation potential and the value of g are -5.4×10^7 J kg^{-2} and 6.0 ms^{-2} respectively ?
(Take, the radius of earth as 6400 km.)

(a) 1600 km **(b)** 1400 km **(c)** 2000 km **(d)** 2600 km

9. Coefficient of linear expansion of brass and steel rods are α_1 and α_2. Lengths of brass and steel rods are l_1 and l_2 respectively. If $(l_2 - l_1)$ is maintained same at all temperatures, which one of the following relations holds good ?

(a) $\alpha_1 l_2^2 = \alpha_2 l_1^2$ **(b)** $\alpha_1^2 l_2 = \alpha_2^2 l_1$
(c) $\alpha_1 l_1 = \alpha_2 l_2$ **(d)** $\alpha_1 l_2 = \alpha_2 l_1$

10. The intensity at the maximum in a Young's double slit experiment is I_0. Distance between two slits is $d = 5\lambda$, where λ is the wavelength of light used in the experiment. What will be the intensity infront of one of the slits on the screen placed at a distance $D = 10\,d$?

(a) $\frac{I_0}{4}$ **(b)** $\frac{3}{4}I_0$ **(c)** $\frac{I_0}{2}$ **(d)** I_0

11. Given the value of Rydberg constant is 10 m^{-1}, the wave number of the last line of the Balmer series in hydrogen spectrum will be

(a) 0.5×10^7 m^{-1} **(b)** 0.25×10^7 m^{-1}

(c) $2.5 \times 10^7\ m^{-1}$ **(d)** $0.025 \times 10^4\ m^{-1}$

12. The ratio of escape velocity at earth (ve) to the escape velocity at a planet (vp) whose radius and mean density are twice as that of earth is

(a) $1:2\sqrt{2}$ **(b)** 1 : 4 **(c)** $1:\sqrt{2}$ **(d)** 1 : 2

13. A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self-inductance of the solenoid is

(a) 3 H **(b)** 2 H **(c)** 1 H **(d)** 4 H

14. A car is negotiating a curved road of radius R. The road is banked at angle θ. The coefficient of friction between the tyres of the car and the road is μ_s. The maximum safe velocity on this road is

(a) $\sqrt{gR\left(\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}\right)}$ **(b)** $\sqrt{\frac{g}{R}\left(\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}\right)}$

(c) $\sqrt{\frac{g}{R^2}\left(\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}\right)}$ **(d)** $\sqrt{gR^2\left(\frac{\mu_s+\tan\theta}{1-\mu_s\tan\theta}\right)}$

15. The magnetic susceptibility is negative for

(a) paramagnetic material only.

(b) ferromagnetic material only.

(c) paramagnetic and ferromagnetic materials.

(d) diamagnetic material only.

16. A siren emitting a sound of frequency 800 Hz moves away from an observer towards a cliff at a speed of 15 ms^{-1}. Then, the frequency of sound that the observer hears in the echo reflected from the cliff is Out of Syllabus

(Take, velocity of sound in air = 330 ms^{-1})

(a) 800 Hz **(b)** 838 Hz **(c)** 885 Hz **(d)** 765 Hz

17. A body of mass 1 kg begins to move under the action of a time dependent force $\vec{F}=\left(2t\hat{i}+3t^2\hat{j}\right)$ N, where $\hat{i}$ and $\hat{j}$ are unit vectors along X and Y axis. What power will be developed by the force at the time (*t*) ?

(a) $(2t^2 + 4t^4)$ W **(b)** $(2t^3 + 3t^4)$ W

(c) $(2t^3 + 4t^5)$ W **(d)** $(2t + 3t^3)$ W

18. From a disc of radius R and mass M, a circular hole of diameter R, whose rim passes through the centre is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis, passing through the centre?

(a) $\frac{13\,MR^2}{32}$ **(b)** $\frac{11\,MR^2}{32}$

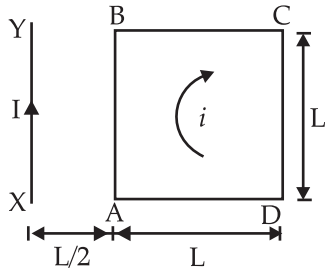
(c) $\frac{9\,MR^2}{32}$ **(d)** $\frac{15\,MR^2}{32}$

19. In a diffraction pattern due to a single slit of width *a*, the first minimum is observed at an angle 30° when light of wavelength 5000 Å is incident on the slit. The first secondary maximum is observed at an angle of

(a) $\sin^{-1}\left(\frac{2}{3}\right)$ **(b)** $\sin^{-1}\left(\frac{1}{2}\right)$

(c) $\sin^{-1}\left(\frac{3}{4}\right)$ **(d)** $\sin^{-1}\left(\frac{1}{4}\right)$

20. A square loop ABCD carrying a current *i*, is placed near and coplanar with a long straight conductor XY carrying a current I, the net force on the loop will be



(a) $\frac{\mu_0 Ii}{2\pi}$ **(b)** $\frac{2\mu_0 IiL}{3\pi}$ **(c)** $\frac{\mu_0 IiL}{2\pi}$ **(d)** $\frac{2\mu_0 Ii}{3\pi}$

21. A black body is at a temperature of 5760 K. The energy of radiation emitted by the body at wavelength 250 nm is U_1, at wavelength 500 nm is U_2 and that at 1000 nm is U_3. Wien's constant, b = 2.88×10^6 nmK. Which of the following is correct ? Out of Syllabus

(a) $U_3 = 0$ **(b)** $U_1 > U_2$ **(c)** $U_2 > U_1$ **(d)** $U_1 = 0$

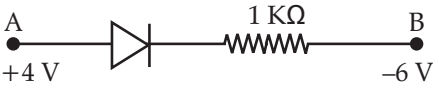
22. An air column, closed at one end and open at the other, resonates with a tunning fork when the smallest length of the column is 50 cm. The next larger length of the column resonating with the same tunning fork is

(a) 100 cm **(b)** 150 cm **(c)** 200 cm **(d)** 66.7 cm

23. The molecules of a given mass of a gas have r.m.s velocity of 200 ms^{-1} at 27°C and $1.0 \times 10^5\ Nm^{-2}$ pressure. When the temperature and pressure of the gas are respectively, 127 °C and $0.05 \times 10^5\ Nm^{-2}$, the rms velocity of its molecules in ms^{-1} is

(a) $\frac{400}{\sqrt{3}}$ **(b)** $\frac{100\sqrt{2}}{3}$ **(c)** $\frac{100}{3}$ **(d)** $100\sqrt{2}$

24. Consider the junction diode as ideal. The value of current flowing through AB is



(a) 10^{-2} A **(b)** 10^{-1} A **(c)** 10^{-3} A **(d)** 0 A

25. If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is

(a) 90° **(b)** 45° **(c)** 180° **(d)** 0°

26. A astronomical telescope has objective and eyepiece of focal lengths 40 cm and 4 cm respectively. To view an object 200 cm away from the objective, the lenses must be separated by a distance

(a) 46.0 cm **(b)** 50.0 cm **(c)** 54.0 cm **(d)** 37.3 cm

27. A *n-p-n* transistor is connected in common emitter configuration in a given amplifier. A load resistance of 800 Ω is connected in the collector circuit and the voltage drop across it is 0.8 V. If the current amplification factor is 0.96 and the input resistance of the circuits is 192 Ω, the voltage gain and the power gain of the amplifier will respectively be Out of Syllabus

(a) 3.69, 3.84 **(b)** 4, 4 **(c)** 4, 3.69 **(d)** 4, 3.84

28. A gas is compressed isothermally to half its initial volume. The same gas is compressed separately

through an adiabatic process until its volume is again reduced to half. Then

(a) compressing the gas through adiabatic process will require more work to be done.

(b) compressing the gas isothermally or adiabatically will require the same amount of work.

(c) which of the case (whether compression through isothermal or through adiabatic process) requires more work will depend upon the atomicity of the gas.

(d) compressing the gas isothermally will require more work to be done.

29. A long straight wire of radius a carries a steady current I. The current is uniformly distributed over its cross-section. The ratio of the magnetic fields B and B′ at radial distances $\frac{a}{2}$ and $2a$ respectively, from the axis of the wire is

(a) $\frac{1}{2}$ **(b)** 1 **(c)** 4 **(d)** $\frac{1}{4}$

30. Match the corresponding entries of Column 1 with Column 2. [Where m is the magnification produced by the mirror]

Column 1		Column 2	
A.	$m = -2$	**a.**	Convex mirror
B.	$m = -\frac{1}{2}$	**b.**	Concave mirror
C.	$m = +2$	**c.**	Real image
D.	$m = +\frac{1}{2}$	**d.**	Virtual image

(a) A → a and c; B → a and d; C → a and b; D → c and d

(b) A → a and d; B → b and c; C → b and d; D → b and c

(c) A → c and d; B → b and d; C → b and c; D → a and d

(d) A → b and c; B → b and c; C → a and d; D → a and d

31. If the velocity of a particle is $v = At + Bt^2$, where A and B are constants, then the distance travelled by it between 1 s and 2 s is

(a) 3 A + 7 B **(b)** $\frac{3}{2}A + \frac{7}{3}B$

(c) $\frac{A}{2} + \frac{B}{3}$ **(d)** $\frac{3}{2}A + 4B$

32. A disc and a sphere of same radius but different masses roll off on two inclined planes of the same altitude and length. Which one of the two objects gets to the bottom of the plane first ?

(a) Sphere

(b) Both reach at the same time

(c) Depends on their masses

(d) Disc

33. Two identical charged spheres suspended from a common point by two massless strings of lengths l, are initially at a distance d ($d << l$) apart because of their mutual repulsion. The charges begin to leak from both the spheres at a constant rate. As a result, the spheres approach each other with a velocity v. Then, v varies as a function of the distance x between the sphere, as

(a) $v \propto x$ **(b)** $v \propto x^{-\frac{1}{2}}$ **(c)** $v \propto x^{-1}$ **(d)** $v \propto x^{\frac{1}{2}}$

34. A particle moves so that its position vector is given by $r = \cos \omega t\ \hat{x} + \sin t,\ \hat{y}$, where ω is a constant.

Which of the following is true ?

(a) Velocity and acceleration both are parallel to r.

(b) Velocity is perpendicular to r and acceleration is directed towards to origin.

(c) Velocity is perpendicular to r and acceleration is directed away form the origin.

(d) Velocity and acceleration both are perpendicular to r.

35. A piece of ice falls from a height h so that it melts completely. Only one-quarter of the heat produced is absorbed by the ice and all energy of ice gets converted into heat during its fall. The value of h is [Latent heat of ice is 3.4×10^5 J/kg and $g = 10$ N/kg]

(a) 544 km **(b)** 136 km **(c)** 68 km **(d)** 34 km

36. A uniform circular disc of radius 50 cm at rest is free to turn about an axis which is perpendicular to its plane and passes through its centre. It is subjected to a torque which produces a constant angular acceleration of 2.0 rad s^{-2}. Its net acceleration in ms^{-2} at the end of 2.0 s is a approximately

(a) 7.0 **(b)** 6.0 **(c)** 3.0 **(d)** 8.0

37. What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop ?

(a) $\sqrt{2gR}$ **(b)** $\sqrt{3gR}$ **(c)** $\sqrt{5gR}$ **(d)** $\sqrt{gR}$

38. A small signal voltage $V(t) = V_0 \sin\omega t$ is applied across an ideal capacitor C

(a) over a full cycle the capacitor C does not consume any energy from the voltage source.

(b) current I(t) is in phase with voltage V(t).

(c) current I(t), leads voltage V(t) by 180°.

(d) current I(t), lags voltage V(t) by 90°.

39. A uniform rope of length L and mass m_1 hangs vertically from a rigid support. A block of mass m_2 is attached to the free end of the rope. A transverse pulse of wavelength λ_1 is produced at the lower end of the rope. The wavelength of the pulse when it reaches the top of the rope is λ_2. The ratio $\frac{\lambda_2}{\lambda_1}$ is

(a) $\sqrt{\frac{m_1 + m_2}{m_2}}$ **(b)** $\sqrt{\frac{m_2}{m_1}}$

(c) $\sqrt{\frac{m_1 + m_2}{m_1}}$ **(d)** $\sqrt{\frac{m_1}{m_2}}$

40. An inductor 20 mH, a capacitor 50 μF and a resistor 40 Ω are connected in series across a source of emf V = 10 sin 340t. The power loss in AC circuit is

(a) 0.67 W **(b)** 0.76 W **(c)** 0.89 W **(d)** 0.51 W

41. An electron of mass m and a photon have same energy E. The ratio of de-Broglie wavelength associated with them is

(a) $\left(\frac{E}{2m}\right)^{\frac{1}{2}}$ **(b)** $c(2mE)^{\frac{1}{2}}$

(c) $\frac{1}{c}\left(\frac{2m}{E}\right)^{\frac{1}{2}}$ **(d)** $\frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$

(*c* being velocity of light)

42. When an α-particle of mass *m* moving with velocity *v* bombards on a heavy nucleus of charge Ze, its distance of closest approach from the nucleus depends on *m* as

(a) $\frac{1}{\sqrt{m}}$ **(b)** $\frac{1}{m^2}$

(c) m **(d)** $\frac{1}{m}$

43. A refrigerator works between 4°C and 30°C. It is required to remove 600 calories of heat every second in order to keep the temperature of the refrigerated space constant. The power required is Out of Syllabus

[Take, 1 cal = 4.2 J]

(a) 23.65 W **(b)** 236.5 W

(c) 2365 W **(d)** 2.365 W

44. A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration, if the kinetic energy of the particle becomes equal to 8×10^{-4} J by the end of the second revolution after the beginning of the motion ?

(a) 0.15 m/s^2 **(b)** 0.18 m/s^2 **(c)** 0.2 m/s^2 **(d)** 0.1 m/s^2

45. The angle of incidence for a ray of light at a refracting surface of a prism is 45°. The angle of prism is 60°. If the ray suffers minimum deviation through the prism, the angle of minimum deviation and refractive index of the material of the prism respectively, are

(a) 30°; $\sqrt{2}$ **(b)** 45°; $\sqrt{2}$

(c) 30°; $\frac{1}{\sqrt{2}}$ **(d)** 45°; $\frac{1}{\sqrt{2}}$

CHEMISTRY

46. The addition of a catalyst during a chemical reaction alters which of the following quantities ?

(a) Internal energy **(b)** Enthalpy

(c) Activation energy **(d)** Entropy

47. Predict the correct order among the following.

(a) lone pair-lone pair > bond pair-bond pair > lone pair-bond pair

(b) bond pair-bond pair > lone pair-bond pair > lone pair-lone pair

(c) lone pair-bond pair > bond pair-bond pair > lone pair-lone pair

(d) lone pair-lone pair > lone pair-bond pair > bond pair-bond pair

48. The correct statement regarding the basicity of arylamines is

(a) Arylamines are generally more basic than alkylamines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring π-electron system.

(b) Arylamines are generally more basic than alkylamines because of aryl group.

(c) Arylamines are generally more basic than alkylamines, because the nitrogen atom in arylamines is *sp*-hybridized.

(d) Arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring π-electron system.

49. When copper is heated with conc. HNO_3 it produces Out of Syllabus

(a) $Cu(NO_3)_2$ and NO

(b) $Cu(NO_3)_2$, NO and NO_2

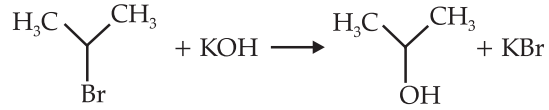
(c) $Cu(NO_3)_2$ and N_2O

(d) $Cu(NO_3)_2$ and NO_2

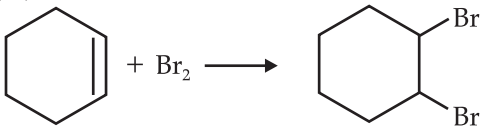
50. For the following reactions,

(i) $CH_3CH_2CH_2Br + KOH \rightarrow CH_3CH = CH_2 + KBr + H_2O$

(ii)



(iii)



Which of the following statement is correct ?

(a) (i) is elimination, reaction, (ii) is substitution and (iii) is addition reaction

(b) (i) is elimination, (ii) and (iii) are substitution reactions

(c) (i) is substitution, (ii) and (iii) are addition reactions

(d) (i) and (ii) are elimination reactions and (iii) is addition reaction

51. Two electrons occupying the same orbital are distinguished by

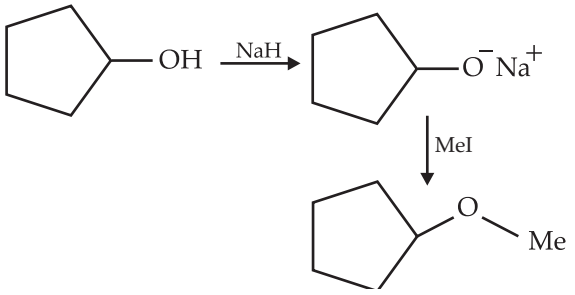
(a) magnetic quantum number.

(b) azimuthal quantum number.

(c) spin quantum number.

(d) principal quantum number.

52. The reaction



can be classified as
(a) Alcohol formation reaction
(b) Dehydration reaction
(c) Williamson alcohol synthesis reaction
(d) Williamson ether synthesis reaction

53. The electronic configurations of Eu (Atomic no. 63), Gd (Atomic no. 64) and Tb (Atomic no. 65) are
(a) [Xe] $4f^6\ 5d^1\ 6s^2$, [Xe] $4f^7\ 5d^1\ 6s^2$ and [Xe] $4f^9\ 6s^2$
(b) [Xe] $4f^6\ 5d^1\ 6s^2$, [Xe] $4f^7\ 5d^1\ 6s^2$, and [Xe] $4f^8\ 5d^1\ 6s^2$
(c) [Xe] $4f^7\ 6s^2$, [Xe] $4f^7\ 5d^1\ 6s^2$ and [Xe] $4f^9\ 6s^2$
(d) [Xe] $4f^7\ 6s^2$, [Xe] $4f^5\ 6s^2$ and [Xe] $4f^8\ 5d^1\ 6s^2$

54. At 100°C the vapour pressure of a solution of 6.5 g of a solute in 100 g water is 732 mm. If $K_b = 0.52$, the boiling point of this solution will be
(a) 100°C **(b)** 102°C **(c)** 103°C **(d)** 101°C

55. The correct statement regarding the comparison of staggered and eclipsed conformations of ethane, is
(a) The eclipsed conformation of ethane is more stable than staggered conformation, because eclipsed conformation has no torsional strain.
(b) The eclipsed conformation of ethane is more stable than staggered conformation even though the eclipsed conformation has torsional strain.
(c) The staggered conformation of ethane is more stable than eclipsed conformation, because staggered conformation has no torsional strain.
(d) The staggered conformation of ethane is less stable than eclipsed conformation, because staggered conformation has torsional strain.

56. Which one of the following characteristics is associated with adsorption ? Out of Syllabus
(a) ΔG, ΔH and ΔS all are negative.
(b) ΔG and ΔH are negative but ΔS is positive.
(c) ΔG and ΔS are negative but ΔH is positive.
(d) ΔG is negative but ΔH and ΔS are positive.

57. Match the compounds given in column I with the hybridisation and shape given in column II and mark the correct option.

Column I		Column II	
A.	XeF6	1.	Distorted octahedral
B.	XeO3	2.	Square planar
C.	XeOF4	3.	Pyramidal
D.	XeF4	4.	Square pyramidal

Codes

	A	B	C	D
(a)	1	2	4	3
(b)	4	3	1	2
(c)	4	1	2	3
(d)	1	3	4	2

58. The correct statement regarding a carbonyl compound with a hydrogen atom on its alpha-carbon, is
(a) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration.
(b) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation.
(c) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism.
(d) a carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol.

59. In a protein molecule various amino acids are linked together by
(a) β-glycosidic bond. **(b)** peptide bond.
(c) dative bond. **(d)** α-glycosidic bond.

60. Match items of Column I with the items of Column II and assign the correct code. Out of Syllabus

Column I		Column II	
A.	Cyanide process	1.	Ultrapure Ge
B.	Froth floatation	2.	Dressing of process ZnS
C.	Electrolytic	3.	Extraction of Al reduction
D.	Zone refining	4.	Extraction of Au
		5.	Purification of Ni

Codes

	A	B	C	D
(a)	2	3	1	5
(b)	1	2	3	4
(c)	3	4	5	1
(d)	4	2	3	1

61. Which of the following is an analgesic ?
(a) Penicillin **(b)** Streptomycin
(c) Chloromycetin **(d)** Novalgin

62. Which is the correct statement for the given acids ?
(a) Phosphinic acid is a monoprotic acid while phosphonic acid is a diprotic acid.
(b) Phosphinic acid is a diprotic acid while phosphonic acid is a monoprotic acid.
(c) Both are triprotic acids.
(d) Both are diprotic acids.

63. The pair of electron in the given carbanion, $CH_3C{\equiv}C^-$, is present in which orbitals ?
(a) sp^3 **(b)** sp^2 **(c)** sp **(d)** $2p$

64. Consider the molecules CH_4, NH_3 and H_2O. Which of the given statements is false ?
(a) The H–O–H bond angle in H_2O is larger than the H–C–H bond angle in CH_4.
(b) The H–O–H bond angle in H_2O is smaller than the H–N–H bond angle in NH_3.
(c) The H–C–H bond angle is CH_4 is larger than the H–N–H bond angle in NH_3.
(d) The H–C–H bond angle in CH_4, the H–N–H bond angle in NH_3 and the H–O–H bond angle in H_2O are all greater than 90°.

65. Which one of the following statements is correct when SO_2 is passed through acidified $K_2Cr_2O_7$ solution ?
(a) The solution is decolourized.
(b) SO_2 is reduced.

(c) Green $Cr_2(SO_4)_3$ is formed.
(d) The solution turns blue.

66. The correct thermodynamic conditions for the spontaneous reaction at all temperatures is
(a) $\Delta H > 0$ and $\Delta S < 0$ **(b)** $\Delta H < 0$ and $\Delta S > 0$
(c) $\Delta H < 0$ and $\Delta S < 0$ **(d)** $\Delta H < 0$ and $\Delta S = 0$

67. Natural rubber has
(a) all *trans*-configuration.
(b) alternate *cis* - and *trans*-configuration.
(c) random *cis* - and *trans*-configuration.
(d) all *cis* - configuration.

68. In which of the following options the order of arrangement does not agree with the variation of property indicated against it ?
(a) B < C < N < O (increasing first ionisation enthalpy).
(b) I < Br < Cl < F (increasing electron gain enthalpy).
(c) Li < Na < K < Rb (increasing metallic radius).
(d) $Al^{3+} < Mg^{2+} < Na^+ < F^-$ (increasing ionic size).

69. Which of the following reagents would distinguish *cis* - cyclopenta-1, 2-diol from the *trans*-isomer ?
(a) Ozone
(b) MnO_2
(c) Aluminium isopropoxide
(d) Acetone

70. The product obtained as a result of a reaction of nitrogen with CaC_2 is Out of Syllabus
(a) CaCN **(b)** $CaCN_3$
(c) Ca_2CN **(d)** $Ca(CN)_2$

71. Fog is a colloidal solution of
(a) Gas in liquid **(b)** Solid in gas
(c) Gas in gas **(d)** Liquid in gas

72. Which one of the following orders is correct for the bond dissociation enthalpy of halogen molecules ?
(a) $Cl_2 > Br_2 > F_2 > I_2$ **(b)** $Br_2 > I_2 > F_2 > Cl_2$
(c) $F_2 > Cl_2 > Br_2 > I_2$ **(d)** $I_2 > Br_2 > Cl_2 > F_2$

73. Equal moles of hydrogen and oxygen gases are placed in container with a pin-hole through which both can escape. What fraction of the oxygen escapes in the time required for one-half of the hydrogen to escape ? Out of Syllabus
(a) $\frac{1}{4}$ **(b)** $\frac{3}{8}$ **(c)** $\frac{1}{2}$ **(d)** $\frac{1}{8}$

74. Lithium has a bcc structure. Its density is 530 kg m^{-3} and its atomic mass is 6.94 g mol^{-1}. Calculate the edge length of a unit cell of lithium metal. Out of Syllabus
($N_A = 6.02 \times 10^{23}$ mol^{-1}).
(a) 352 pm **(b)** 527 pm **(c)** 264 pm **(d)** 154 pm

75. Which of the following statements about the composition of the vapour over an ideal 1 : 1 molar mixture of benzene and toluene is correct ? Assume that the temperature is constant at 25°C.
(Given, vapour pressure data at 25°C, benzene = 12.8 kPa, toluene = 3.85 kPa)
(a) The vapour will contain a higher percentage of toluene.
(b) The vapour will contain equal amounts of benzene and toluene.
(c) Not enough information is given to make a prediction.
(d) The vapour will contain a higher percentage of benzene.

76. Which of the following has longest C–O bond length ? (Free C–O bond length in CO is 1.128 Å.)
(a) $[Co(CO)_4]^-$ **(b)** $[Fe(CO)_4]^{2-}$
(c) $[Mn(CO)_6]^+$ **(d)** $Ni(CO)_4$

77. Among the following, the correct order of acidity is
(a) $HClO < HClO_2 < HClO_3 < HClO_4$
(b) $HClO_2 < HClO < HClO_3 < HClO_4$
(c) $HClO_4 < HClO_2 < HClO < HClO_3$
(d) $HClO_3 < HClO_4 < HClO_2 < HClO$

78. In the reaction,

$$H-C\equiv CH \xrightarrow[(ii)\,CH_3CH_2Br]{(i)\,NaNH_2/liq.NH_3} X \xrightarrow[(ii)\,CH_3CH_2Br]{(i)\,NaNH_2/liq.NH_3} Y$$

X and Y are
(a) X = 2-butyne ; Y = 3-hexyne
(b) X = 2-butyne ; Y = 2-hexyne
(c) X = 1-butyne ; Y = 2-hexyne
(d) X = 1-butyne ; Y = 3-hexyne

79. MY and NY_3, two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature. Which statement would be true in regard to MY and NY_3 ?
(a) The molar solubility of MY in water is less than of NY_3.
(b) The salts MY and NY_3 are more soluble in 0.5 M KY than in pure water.
(c) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities.
(d) The molar solubilities of MY and NY_3 in water are identical.

80. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be
(a) slower. **(b)** unchanged.
(c) doubled. **(d)** faster.

81. The product formed by the reaction of an aldehyde with a primary amine is
(a) ketone. **(b)** carboxylic acid.
(c) aromatic acid. **(d)** schiff base.

82. The pressure of H_2 required to make the potential of H_2-electrode zero in pure water at 298 K is
(a) 10^{-12} atm **(b)** 10^{-10} atm **(c)** 10^{-4} atm **(d)** 10^{-14}atm

83. The correct statement regarding RNA and DNA, respectively is
(a) The sugar component in RNA is ribose and the sugar component in DNA is 2′-deoxyribose.
(b) The sugar component in RNA is arabinose and the sugar component in DNA is ribose.
(c) The sugar component in RNA is 2′-deoxyribose and the sugar component in DNA is arabinose.
(d) The sugar component in RNA is arabinose and the sugar component in DNA is 2′-deoxyribose.

84. Which one given below is a non-reducing sugar ?
(a) Lactose **(b)** Glucose **(c)** Sucrose **(d)** Maltose

85. Which of the following statements about hydrogen is incorrect ? Out of Syllabus
(a) Hydrogen never acts as cation in ionic salts.
(b) Hydronium ion, H_3O^+ exists freely in solution.
(c) Dihydrogen does not act as a reducing agent.
(d) Hydrogen has three isotopes of which tritium is the most common.

86. Consider the following liquid-vapour equilibrium

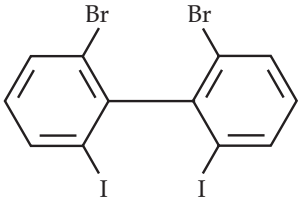
$$\text{Liquid} \rightleftharpoons \text{Vapour}$$

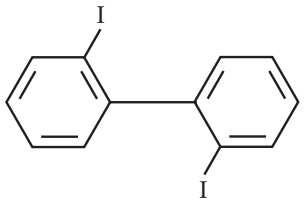
Which of the following relations is correct ?

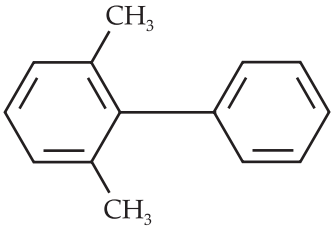
(a) $\frac{d\ln P}{dT} = \frac{-\Delta H_v}{RT}$ **(b)** $\frac{d\ln P}{dT^2} = \frac{-\Delta H_v}{T^2}$

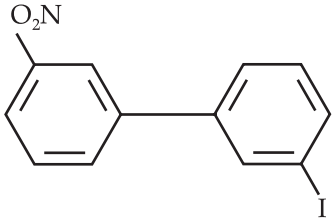
(c) $\frac{d\ln P}{dT} = \frac{-\Delta H_v}{RT^2}$ **(d)** $\frac{d\ln G}{dT^2} = \frac{-\Delta H_v}{RT^2}$

87. Which of the following biphenyls is optically active ?

(a) 

(b) 

(c) 

(d) 

88. Which of the following statements is false ? Out of Syllabus
(a) Ca^{2+} ions are important in blood clotting.
(b) Ca^{2+} ions are not important in maintaining the regular beating of the heart.
(c) Mg^{2+} ions are important in the green parts of plants.
(d) Mg^{2+} ions form a complex with ATP.

89. The ionic radii of A^+ and B^- ions are 0.98×10^{-10} m and 1.81×10^{-10} m. The coordination number of each ion in AB is Out of Syllabus
(a) 4 **(b)** 8 **(c)** 2 **(d)** 6

90. The rate of a first-order reaction is 0.04 mol L^{-1} s^{-1} at 10 sec and 0.03 mol L^{-1} s^{-1} at 20 sec after initiation of the reaction. The half-life period of the reaction is
(a) 34.1 s **(b)** 44.1 s **(c)** 54.1 s **(d)** 24.1 s

BIOLOGY

91. Which of the following characteristic features always holds true for the corresponding group of animals ?

(a)	Viviparous	Mammalia
(b)	Possess a mouth with an upper and a lower jaw	Chordata
(c)	3-chambered heart with one incompletely divided ventricle	Reptilia
(d)	Cartilaginous-endoskeleton	Chondrichthyes

92. Changes in GnRH pulse frequency in females is controlled by circulating levels of
(a) estrogen and inhibin.
(b) progesterone only.
(c) progesterone and inhibin.
(d) estrogen and progesterone.

93. Microtubules are the constituents of
(a) spindle fibres, centrioles and cilia.
(b) centrioles, spindle fibres and chromatin.
(c) centrosome, nucleosome and centrioles.
(d) cilia, flagella and peroxisomes.

94. Mitochondria and chloroplast are
I. semi-autonomous organelles.
II. formed by the division of pre-existing organelles and they contain DNA but lack protein synthesising machinery.
Which one of the following options is correct ?
(a) II is true but I is false.
(b) I is true but II is false.
(c) Both I and II are false.
(d) Both I and II are correct.

95. Photosensitive compound in human eye is made up of
(a) opsin and retinal.
(b) opsin and retinol.
(c) transducin and retinene.
(d) guanosine and retinol.

96. Chrysophytes, euglenoids, dinoflagellates and slime moulds are included in the kingdom
(a) Protista. **(b)** Fungi. **(c)** Animalia. **(d)** Monera.

97. The primitive prokaryotes responsible for the production of biogas from the dung of ruminant animals, include the
(a) thermoacidophiles. **(b)** methanogens.
(c) eubacteria. **(d)** halophiles.

98. Identify the correct statement on 'inhibin'.
(a) It is produced by granulose cells in ovary and inhibits the secretion of FSH.
(b) It is produced by granulose cells in ovary and inhibits the secretion of LH.
(c) It is produced by the nurse cells in testes and inhibits the secretion of LH.
(d) It inhibits the secretion of LH, FSH and prolactin.

99. It is much easier for a small animal to run uphill than for a large animal, because
(a) small animals have a higher metabolic rate.
(b) small animals have low O_2 requirement.
(c) the efficiency of muscles in the large animals is less than the small animals.
(d) it is easier to carry a small body weight.

100. A tall true breeding garden pea plant is crossed with a dwarf true breeding garden pea plant. When the F_1 plants were selfed, the resulting genotypes were in the ratio of
(a) 1 : 2 : 1; tall heterozygous : tall homozygous : dwarf
(b) 3 : 1; tall : dwarf
(c) 3 : 1; dwarf : tall
(d) 1 : 2 : 1; tall homozygous : tall heterozygous : dwarf

101. Depletion of which gas in the atmosphere can lead to an increased incidence of skin cancers
(a) ozone. **(b)** ammonia.
(c) methane. **(d)** nitrous oxide.

102. Which one of the following is a characteristic feature of cropland ecosystem ?
(a) Least genetic diversity
(b) The absence of weeds
(c) Ecological succession
(d) The absence of soil organisms

103. Tricarpellary, syncarpous gynoecium is found in the flowers of
(a) Solanaceae. **(b)** Fabaceae.
(c) Poaceae. **(d)** Liliaceae.

104. In which of the following, all the three are macronutrients ?
(a) Iron, copper, molybdenum
(b) Molybdenum, magnesium, manganese
(c) Nitrogen, magnesium, phosphorus
(d) Boron, zinc, manganese

105. Reduction in pH of blood will
(a) reduce the blood supply to the brain.
(b) decrease the affinity of hemoglobin with oxygen.
(c) release bicarbonate ions by the liver.
(d) reduce the rate of heart beat.

106. Lack of relaxation between successive stimuli in sustained muscle contraction is known as
(a) fatigue. **(b)** tetanus. **(c)** tonus. **(d)** spasm.

107. Which one of the following statements is wrong ?
(a) Golden algae are also called desmids.
(b) *Eubacteria* are also called false bacteria.
(c) Phycomycetes are also called algal fungi.
(d) Cyanobacteria are also called blue-green algae.

108. Which of the following is a restriction endonuclease?
(a) Protease **(b)** DNase I **(c)** RNase **(d)** Hind II

109. Which of the following would appear as the pioneer organisms on bare rocks ?
(a) Liverworts **(b)** Mosses
(c) Green algae **(d)** Lichens

110. Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using the following options.
(a) Both processes can happen together because the diffusion coefficient of water and CO_2 is different.
(b) The above processes happen only during night time.
(c) One process occurs during day time and the other at night.
(d) Both processes cannot happen simultaneously.

111. Cotyledon of maize grain is called
(a) coleorhiza. **(b)** coleoptile.
(c) scutellum. **(d)** plumule.

112. Which of the following guards the opening of hepatopancreatic duct into the duodenum ?
Out of Syllabus
(a) Ileocaecal valve **(b)** Pyloric sphincter
(c) Sphincter of Oddi **(d)** Semilunar valve

113. In the stomach, gastric acid is secreted by the
Out of Syllabus
(a) parietal cells. **(b)** peptic cells.
(c) acidic cells. **(d)** gastrin secreting cells.

114. In the mammals, which blood vessel would normally carry largest amount of urea ?
(a) Dorsal Aorta **(b)** Hepatic Vein
(c) Hepatic Portal Vein **(d)** Renal Vein

115. The term ecosystem was coined by
(a) A G Tansley **(b)** E Haeckel
(c) E Warming **(d)** EP Odum

116. Which of the following is required as inducer(s) for the expression of *lac* operon ?
(a) galactose **(b)** lactose
(c) lactose and galactose **(d)** glucose

117. Which of following is wrongly matched in the given table ?

	Microbe	Product	Application
(a)	*Monascus purpureus*	Statins	Lowering of blood cholesterol
(b)	*Streptococcus*	Streptokinase	Removal of clot from blood vessel
(c)	*Clostridium butylicum*	Lipase	Removal of oil stains
(d)	*Trichoderma polysporum*	Cyclosporin-A	Immunosuppressive drug

118. When does the growth rate of a population following the logistic modal equals zero? The logistic model is given as $\frac{dN}{dt} = rN\left(\frac{1-N}{K}\right)$
(a) when N nears the carrying capacity of the habitat.
(b) when N/K equals zero.
(c) when death rate is greater than birth rate.
(d) when N/K is exactly one.

119. Which one of the following statements is not true ?
(a) Exine of pollen grains is made up of sporopollenin.
(b) Pollen grains of many species cause severe allergies.
(c) Stored pollen in liquid nitrogen can be used in the crop breeding programmes.
(d) Tapetum helps in the dehiscence of anther.

120. In bryophytes and pteridophytes, transport of male gametes requires
(a) insects. **(b)** birds. **(c)** water. **(d)** wind.

121. Which of the following is not a stem modification ?
(a) Thorns of citrus
(b) Tendrils of cucumber
(c) Flattened structures of *Opuntia*
(d) Pitcher of *Nepenthes*

122. Which one of the following cell organelles is enclosed by a single membrane ?
(a) Chloroplasts **(b)** Lysosomes
(c) Nuclei **(d)** Mitochondria

123. Analogous structures are a result of
(a) convergent evolution. **(b)** shared ancestry.
(c) stabilising selection. **(d)** divergent evolution.

124. Which one of the following statements is wrong ?
(a) Cellulose is a polysaccharide.
(b) Uracil is a pyrimidine.
(c) Glycine is a sulphur containing amino acid.
(d) Sucrose is a disaccharide.

125. Proximal end of the filament of stamen is attached to the
(a) connective. **(b)** placenta.
(c) thalamus or petal. **(d)** anther.

126. Which of the following is not required for any of the techniques of DNA fingerprinting available at present ?
(a) Zinc finger analysis
(b) Restriction enzymes
(c) DNA-DNA hybridisation
(d) Polymerase chain reaction

127. Which one of the following characteristics is not shared by birds and mammals ?
(a) Breathing using lungs
(b) Viviparity
(c) Warm blooded nature
(d) Ossified endoskeleton

128. Select the incorrect statement.
(a) LH and FSH triggers ovulation in ovary.
(b) LH and FSH decrease gradually during the follicular phase.
(c) LH triggers secretion of androgens from the leydig cells.
(d) FSH stimulates the sertoli cells which help in spermiogenesis.

129. The amino acid, tryptophan is the precursor for the synthesis of
(a) thyroxine and tri-iodothyronine.
(b) estrogen and progesterone.
(c) cortisol and cortisone.
(d) melatonin and serotonin.

130. Joint Forest Management Concept was introduced in India during Out of Syllabus
(a) 1970s **(b)** 1980s **(c)** 1990s **(d)** 1960s

131. One of the major components of cell wall of most fungi is
(a) peptidoglycan. **(b)** cellulose.
(c) hemicellulose. **(d)** chitin.

132. A complex of ribosomes attached to a single strand of RNA is known as
(a) polymer. **(b)** polypeptide.
(c) okazaki fragment. **(d)** polysome.

133. Which of the following features is not present in the phylum–Arthropoda ?
(a) Metameric segmentation
(b) Parapodia
(c) Jointed appendages
(d) Chitinous exoskeleton

134. Asthma may be attributed to
(a) allergic reaction of most of the cells in the lungs.
(b) inflammation of the trachea.
(c) accumulation of fluid in the lungs.
(d) bacterial infection of the lungs.

135. Pick out the correct statements.
I. Haemophilia is a sex-linked recessive disease.
II. Down's syndrome is due to aneuploidy.
III. Phenylketonuria is an autosomal recessive gene disorder.
IV. Sickle cell anaemia is an X-linked recessive gene disorder.
(a) II and IV are correct. **(b)** I, III and IV are correct.
(c) I, II and III are correct. **(d)** I and IV are correct.

136. The two polypeptides of human insulin are linked together by
(a) phosphodiester bonds.
(b) covalent bonds.
(c) disulphide bridges.
(d) hydrogen bonds.

137. The coconut water from tender coconut represents
(a) fleshy mesocarp.
(b) free-nuclear proembryo.
(c) free-nuclear endosperm.
(d) endocarp.

138. Which of the following is not a feature of the plasmids?
(a) Circular structure
(b) Transferable
(c) Single-stranded
(d) Independent replication

139. Which is the National Aquatic Animal of India ?
(a) River dolphin **(b)** Blue whale
(c) Sea-horse **(d)** Gangetic shark

140. The *Avena* curvature is used for bioassay of
(a) GA_3 **(b)** IAA **(c)** ethylene. **(d)** ABA

141. Which of the following is the most important cause of animals and plants being driven to extinction?
(a) Alien species invasion
(b) Habitat loss and fragmentation
(c) Co-extinctions
(d) Over-exploitation

142. Which of the following approaches does not give the defined action of contraceptive ?

	Microbe	Product
(a)	Intra uterine devices	Increase phagocytosis of sperms, suppress sperm motility and fertilising capacity of sperms
(b)	Hormonal contraceptives	Prevents/retards the entry of sperms, prevents ovulation and fertilisation
(c)	Vasectomy	Prevents spermatogenesis
(d)	Barrier methods	Prevents fertilisation

143. In a test cross involving F_1 dihybrid flies, more parental-type offspring were produced than the recombinant type offspring. This indicates
(a) chromosomes failed to separate during meiosis.
(b) the two genes are linked and present on the same chromosome.
(c) both of the characters are controlled by more than one gene.
(d) the two genes are located on two different chromosomes.

144. A typical fat molecule is made up of
(a) one glycerol and three fatty acid molecules.
(b) one glycerol and one fatty acid molecule.
(c) three glycerol and three fatty acid molecules.
(d) three glycerol molecules and one fatty acid molecule.

145. Match the terms in Column I with their description in Column II and choose the correct option.

Column I		Column II	
A.	Dominance	1.	Many genes govern a single character
B.	Co-dominance	2.	In a heterozygous organism, only one allele expresses itself
C.	Pleiotropy	3.	In a heterozygous organism, both alleles express themselves
D.	Polygenic	4.	A single gene inheritance influences many characters

Codes

	A	B	C	D
(a)	2	3	4	1
(b)	4	1	2	3
(c)	4	3	1	2
(d)	2	1	4	3

146. Which of the following statements is not correct ?
(a) Insects that consume pollen or nectar without bringing about pollination are called pollen nectar robbers.
(b) Pollen germination and pollen tube growth are regulated by chemical components of pollen interacting with those of the pistil.
(c) Some reptiles have also been reported as pollinators in some plant species.
(d) Pollen grains of many species can germinate on the stigma of a flower, but only one pollen tube of the same species grows into the style.

147. Which of the following features is not present in *Periplaneta americana* ?
(a) Indeterminate and radial cleavage during embryonic development.
(b) Exoskeleton composed of N-acetylglucosamine.
(c) Metamerically segmented body.
(d) Schizocoelom as body cavity.

148. Water soluble pigments found in plant cell vacuoles are
(a) chlorophylls. **(b)** carotenoids.
(c) anthocyanins. **(d)** xanthophylls.

149. A cell at telophase stage is observed by a student in a plant brought from the field. He tells his teacher that this cell is not like other cells at telophase stage. There is no formation of cell plate and thus the cell is containing more number of chromosomes as compared to other dividing cells. This would result in
(a) polyploidy. **(b)** somaclonal variation.
(c) polyteny. **(d)** aneuploidy.

150. A plant in your garden avoids photorespiratory losses, has improved water use efficiency, shows high rates of photosynthesis at high temperatures and has improved efficiency of nitrogen utilisation. In which of the following physiological groups would you assign this plant ?
(a) C_4 **(b)** CAM
(c) Nitrogen-fixer **(d)** C_3

151. In higher vertebrates, the immune system can distinguish self-cells and non-self. If this property is lost due to genetic abnormality and it attacks self-cells, then it leads to
(a) graft rejection.
(b) auto-immune disease.
(c) active immunity.
(d) allergic response.

152. Emerson's enhancement effect and red drop have been instrumental in the discovery of
(a) two photosystems operating simultaneously.
(b) photophosphorylation and cyclic electron transport.
(c) oxidative phosphorylation.
(d) photophosphorylation and non-cyclic electron transport.

153. Select the correct statement.
(a) *Salvinia*, *Ginkgo* and *Pinus* all are gymnosperms.
(b) *Sequoia* is one of the tallest trees.
(c) The leaves of gymnosperms are not well adapted to extremes of climate.
(d) Gymnosperms are both homosporous and heterosporous.

154. Which of the following is not a characteristic feature during mitosis in somatic cells ?
(a) Disappearance of nucleolus
(b) Chromosome movement
(c) Synapsis
(d) Spindle fibres

155. Blood pressure in the pulmonary artery is
(a) more than that in the carotid.
(b) more than that in the pulmonary vein.
(c) less than that in the venae cavae.
(d) same as that in the aorta.

156. Which of the following structures is homologous to the wing of a bird ?
(a) Wing of a moth **(b)** Hind limb of rabbit
(c) Flipper of whale **(d)** Dorsal fin of a shark

157. Seed formation without fertilisation in flowering plants involves the process of
(a) budding. **(b)** somatic hybridisation.
(c) apomixis. **(d)** sporulation.

158. Name the chronic respiratory disorder caused mainly by cigarette smoking
(a) asthma. **(b)** respiratory acidosis.
(c) respiratory alkalosis. **(d)** emphysema.

159. Spindle fibres attach on to
(a) kinetochore of the chromosome.
(b) centromere of the chromosome.
(c) kinetosome of the chromosome.
(d) telomere of the chromosome.

160. In context of amniocentesis, which of the following statement is incorrect ?
(a) It is used for prenatal sex determination.
(b) It can be used for detection of down syndrome.
(c) It can be used for detection of cleft palate.
(d) It is usually done when a woman is between 14-16 weeks pregnant.

161. Stems modified into flat green organs performing the functions of leaves are known as
(a) phyllodes. **(b)** phylloclades.
(c) scales. **(d)** cladodes.

162. In a chloroplast the highest number of protons are found in
(a) lumen of thylakoids. **(b)** inter membrane space.
(c) antennae complex. **(d)** stroma.

163. Nomenclature is governed by certain universal rules. Which one of the following is contrary to the rules of nomenclature ?
(a) The first word in a biological name represents the genus name and the second is a specific epithet.
(b) The names are written in Latin and are Italicised.
(c) When written by hand, the names are to be underlined.
(d) Biological names can be written in any language.

164. In meiosis crossing over is initiated at
(a) leptotene. **(b)** zygotene.
(c) diplotene. **(d)** pachytene.

165. Antivenom injection contains preformed antibodies while polio drops that are administered into the body contain Out of Syllabus
(a) harvested antibodies. **(b)** gamma globulin.
(c) attenuated pathogens. **(d)** activated pathogens.

166. The *Taq* polymerase enzyme is obtained from
(a) *Thiobacillus ferrooxidans.*
(b) *Bacillus subtilis.*
(c) *Pseudomonas subtilis.*
(d) *Thermus aquaticus.*

167. Which of the following most appropriately describes haemophilia ?
(a) X-linked recessive gene disorder
(b) Chromosomal disorder
(c) Dominant gene disorder
(d) Recessive gene disorder

168. The standard petal of a papilionaceous corolla is also called
(a) pappus. **(b)** vexillum. **(c)** corona. **(d)** carina.

169. Which part of the tobacco plant is infected by *Meloidogyne incognita* ?
(a) Leaf **(b)** Stem **(c)** Root **(d)** Flower

170. Which of the following statements is wrong for viroids?
(a) They are smaller than viruses.
(b) They cause infections.
(c) Their RNA is of high molecular weight.
(d) They lack a protein coat.

171. Which of the following statements is not true for cancer cells in relation to mutations ?
(a) Mutations destroy telomerase inhibitor.
(b) Mutations inactivate the cell control.
(c) Mutations inhibit production of telomerase.
(d) Mutations in proto-oncogenes accelerate the cell cycle.

172. Which type of tissue correctly matches with its location?

	Tissue	Location
(a)	Areolar tissue	Tendons
(b)	Transitional	Tip of nose epithelium
(c)	Cuboidal epithelium	Lining of stomach
(d)	Smooth muscle	Wall of intestine

173. Which of the following pairs of hormones are not antagonistic (having opposite effects) to each other ?
(a) Insulin Glucagon
(b) Aldosterone Atrial Natriuretic Factor
(c) Relaxin Inhibin
(d) Parathormone Calcitonin

174. Specialised epidermal cells surrounding the guard cells are called
(a) subsidiary cells. **(b)** bulliform cells.
(c) lenticels. **(d)** complementary cells.

175. Fertilisation in humans is practically feasible only if
(a) the ovum and sperms are transported simultaneously to ampullary - isthmic junction of the fallopian tube.
(b) the ovum and sperms are transported simultaneously to ampullary-isthmic junction of the cervix.
(c) the sperms are transported into cervix within 48 hrs of release of ovum in uterus.
(d) the sperms are transported into vagina just after the release of ovum in fallopian tube.

176. Which one of the following is the start codon ?
(a) UGA **(b)** UAA **(c)** UAG **(d)** AUG

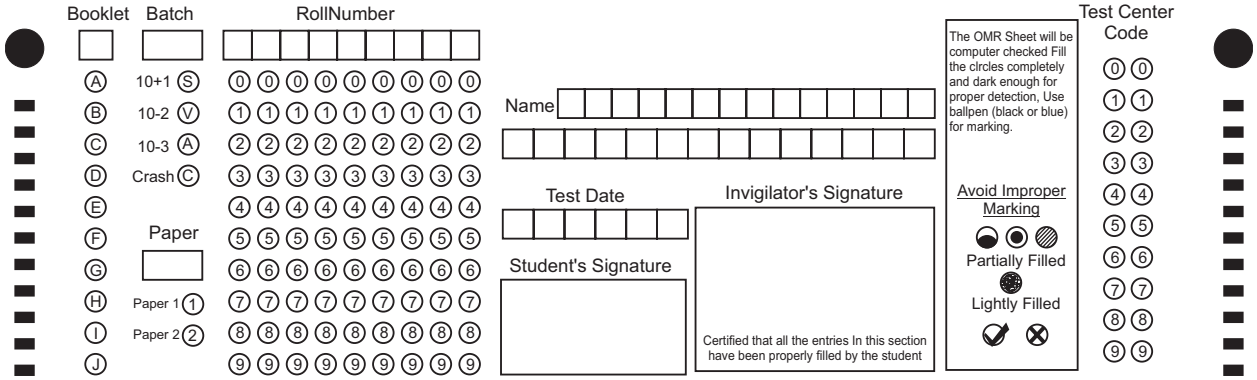
177. A river with an inflow of domestic sewage rich in organic waste may result in
(a) increased population of aquatic food web organisms.
(b) an increased production of fish due to biodegradable nutrients.
(c) death of fish due to lack of oxygen.
(d) drying of the river very soon due to algal bloom.

178. Following are the two statements regarding the origin of life
I. The earliest organisms that appeared on the earth were non-green and presumably anaerobes.
II. The first autotrophic organisms were the chemoautotrophs that never released oxygen.
Of the above statements which one of the following options is correct ?
(a) II is correct but I is false.
(b) Both I and II are correct.
(c) Both I and II are false.
(d) I is correct but II is false.

179. A system of rotating crops with legume or grass pasture to improve soil structure and fertility is called
(a) contour farming. **(b)** strip farming.
(c) shifting agriculture. **(d)** ley farming.

180. Gause's principle of competitive exclusion states that
(a) competition for the same resources excludes species having different food preferences.
(b) no two species can occupy the same niche indefinitely for the same limiting resources.
(c) larger organisms exclude smaller ones through competition.
(d) more abundant species will exclude the less abundant species through competition.

❐❐❐



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

ANSWER KEY

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

NEET (UG)

SOLVED PAPER 2016 (Phase I)

ANSWERS WITH EXPLANATIONS

PHYSICS

1. Option (c) is correct.

Given,

Capacitance of the capacitor

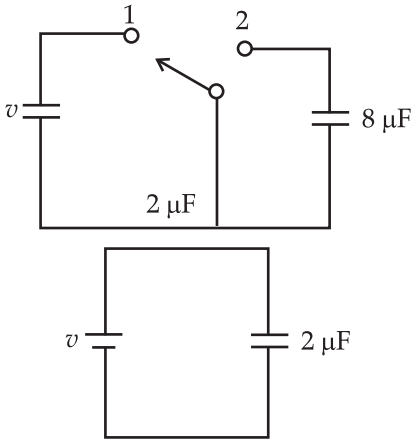
$(C_1) = 2\,\mu F$

Capacitance of second capacitor

$(C_2) = 8\mu F$

Case I

When switch was at point 1,



Energy stored in the capacitor

$$(E_1) = \frac{1}{2}CV^2$$

$$\Rightarrow \quad E_1 = \frac{1}{2}\left(2\times10^{-6}\right)V^2 \qquad ...(i)$$

Case II

When switch is at point 2, then charge will start to flow from C_1 to C_2, when both the flow capacitor become at the equal potential, the charge will stop to.

So, potential of the capacitor

$$V_1 = \frac{q}{C_1 + C_2}$$

$$V_1 = \frac{C_1V}{C_1 + C_2} \qquad (\text{Here } q = C_1V)$$

So, the final energy of the capacitor

$$E_2 = \frac{1}{2}(C_1 + C_2)V_1^2$$

$$\Rightarrow \quad E_2 = \frac{1}{2}(2+8)\times10^{-6}\left(\frac{C_1V}{C_1 + C_2}\right)^2$$

$$\Rightarrow \quad E_2 = \frac{1}{2}10\times10^{-6}\frac{\left(2\times10^{-6}\right)^2\times V^2}{\left(10\times10^{-6}\right)^2}$$

$$\Rightarrow \quad E_2 = \frac{1}{2}\times\frac{2^2\times10^{-6}V^2}{10}$$

$$\Rightarrow \quad E_2 = \frac{4\times10^{-6}V^2}{2\times10}$$

Hence, required loss in percentage

$$\Delta u = \left(\frac{E_1 - E_2}{E_1}\right)\times100$$

percentage loss of energy

$$= \frac{\frac{2\times10^{-6}V^2}{2} - \frac{4\times10^{-6}V^2}{20}}{\frac{2\times10^{-6}V^2}{2}}$$

$$= \frac{\frac{20\times10^{-6}V^2 - 4\times10^{-6}V^2}{20}\times100}{\frac{2\times10^{-6}V^2}{2}}$$

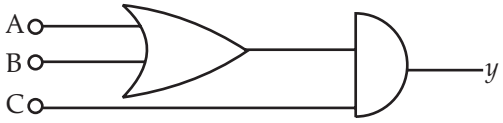
$$= \frac{2\times16\times10^{-6}V^2}{2\times2\times10^{-6}V^2}\times100$$

$= 80\%$

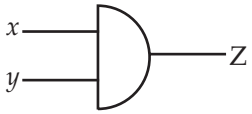
Hence, the required percentage of stored energy is 80%

2. Option (c) is correct.

We know,

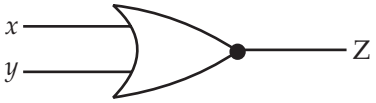


For AND gate



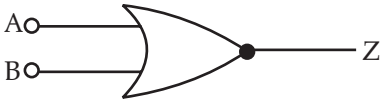
Z = x.y

For OR gate

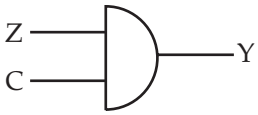


Z = x + y

Now, proceeding for the given circuit for Z = A +B



Now,



Y = Z.C

$\Rightarrow$ Y = (A +B) .C

= (1 + 0) .1 = 1.1 = 1

Now, checking from the given option for A + B

1 + 0 = 1, 1 + 1 = 1, 0 + 1 = 1, 0 + 0 = 0,

For A.B = 0.1 = 0, 1.1 = 1, 0.0 = 0

(a) (1 + 0) . 0 = 0

A	B	C	Y
1	0	0	0

(b)

A	B	C	Y
1	1	0	0

(c)

A	B	C	Y
1	0	1	1

(d)

A	B	C	Y
0	1	0	0

3. Out of Syllabus

4. Option (c) is correct.

Given,

The wavelength of the radiation = λ

Stopping potential = V

New wavelength of the radiation = 2λ

New stopping potential = $\frac{V}{4}$

The threshold wavelength for the metallic surface = ?

We know that, as per photo-electric equation

$$eV = \frac{hc}{\lambda} \quad \phi$$

where ϕ is the work function of the material, λ is the wavelength of incident photon and $\phi = \frac{hc}{\lambda_{th}}$, here λ_{th} is the threshold wavelength.

Now, substituting the values for case I and II

$$eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_{th}} \quad ...(i)$$

For case II

$$eV/4 = \frac{hc}{2\lambda} - \frac{hc}{\lambda_{th}}$$

$$eV = \frac{2hc}{\lambda} - \frac{4hc}{\lambda_{th}} \quad ...(ii)$$

From equation (i) and (ii)

$$eV = \frac{hc}{\lambda} - \frac{hc}{\lambda_{th}}$$

$$eV = \frac{hc}{\lambda} - \frac{4hc}{\lambda_{th}}$$

$$- \quad - \quad +$$

$$0 = -\frac{hc}{\lambda} + \frac{3hc}{\lambda_{th}}$$

$$\Rightarrow \quad \frac{3hc}{\lambda_{th}} = \frac{hc}{\lambda}$$

$$\Rightarrow \quad \lambda_{th} = \frac{3\lambda hc}{hc}$$

$$\Rightarrow \quad \lambda_{th} = 3\lambda$$

Hence, threshold wavelength for the metallic surface is 3λ.

5. Option (c) is correct.

Given,

Densities of non-mixing liquids = ρ and $n\rho$

$n > \lambda$

The height of each liquid = h

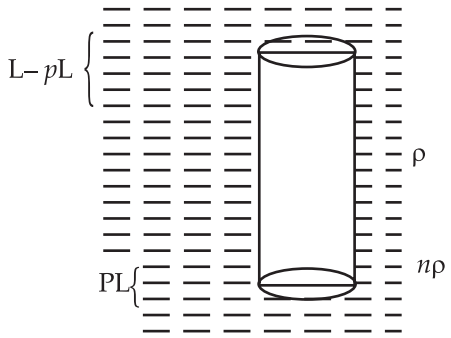
Length of solid cylinder = L

Density of cylinder = d

Length in the denser liquid = pL ($p < 1$)

The density d is equal to = ?

Let cross-section area of cylinder be A.



Let cross-section area of cylinder be A.
Applying archimedes principle,
upthrust force = weight of cylinder

$\Rightarrow$ $n\rho \times A \times pL \times g + A \times (L - pL)\,\rho g = LA\,dg$
$\Rightarrow$ $n\rho\, A\, pL\, g + A\rho gL - A\rho Lpg = LA\,dg$
$\Rightarrow$ $LAg\,(n\rho\, p + \rho - p\rho) = LAgd$
$\Rightarrow$ $p\rho\,(n-1) + \rho = d$
$\Rightarrow$ $d = \rho\{p(n-1) + 1\}$

6. Option (c) is correct.

(a) A stationary charge can produce only electric field but it can not produce magnetic field. Hence, option (a) is incorrect.

(b) A chargeless particle neither can produce electric field nor magnetic field hence option (b) is incorrect.

(c) An accelerating charge can produce electric and magnetic field, If a charged particle accelerates (moves faster, slower or changes direction), it produces both an electric field (because the particle is charged) and a magnetic field (because the particle is moving) as piratical is accelerated so produces time varying magnetic field which varies with space to so leads to generation of EM wave the electromagnetic wave will produce.

(d) A charge moving at constant velocity can produce only constant electric field and magnetic field, so it can not produce electromagnetic wave.

7. Option (d) is correct.

Given,

Charge flowing through the resistance (R)

$$Q = at - bt^2$$

a, b are positive constant

R is resistance and t is time.

We know,

Current $(I) = \dfrac{dQ}{dt}$

So $$I = \frac{d}{dt}\left(at - bt^2\right)$$

$\Rightarrow$ $$I = a - 2bt$$

$$I = 0, \text{ at } t = \frac{a}{2b}$$

but $$P = \frac{W}{t} = \frac{dW}{dt}$$

$\Rightarrow$ $dW = P.dt$

Here, w is heat (energy)

$\Rightarrow$ We know

$$P = I^2 R$$

Hence

$$dW = I^2 R\, dt$$

Now, integrating both side of the given equation

$$\int_0^w dW = \int_0^{t=a/2b} I^2 R dt$$

$$\Rightarrow W = \int_0^{t=a/2b} (a - 2bt)^2\, R dt$$

$$\Rightarrow W = \int_0^{t=a/2b} \left(a^2 + 4b^2t^2 - 4abt\right) R dt$$

$$\Rightarrow W = R\left[\int_0^{t=a/2b} a^2 dt + \int_0^t 4b^2t^2 dt - \int_0^t 4abt dt\right]$$

$$\Rightarrow W = R\left[a^2t + \frac{4b^2t^3}{3} - \frac{4abt^2}{2}\right]_0^{\frac{a}{2b}}$$

$$\Rightarrow W = R\left[a^2t + \frac{4b^2t^3}{3} - \frac{4abt^2}{2}\right]_0^{\frac{a}{2b}}$$

$$\Rightarrow W = R\left[a^2\left(\frac{a}{2b}\right) + \frac{4b^2}{3}\left(\frac{a}{2b}\right)^3 - \frac{4ab}{2}\left(\frac{a}{2b}\right)^2\right]$$

$$\Rightarrow W = R\left[\frac{a^3}{2b} + \frac{4a^3b^2}{3\times 8b^3} - \frac{4ab}{2}\cdot\frac{a^2}{4b^3}\right]$$

$$\Rightarrow W = R\left[\frac{a^3}{2b} + \frac{a^3}{6b} - \frac{a^3}{2b}\right]$$

$$\Rightarrow W = R\left[\frac{a^3}{2b} + \frac{a^3}{6b} - \frac{a^3}{2b}\right]$$

$$\Rightarrow W = \frac{Ra^3}{2b}\left[1 + \frac{1}{3} - 1\right]$$

$$\Rightarrow W = \frac{Ra^3}{2b} \times \frac{1}{3}$$

$$\Rightarrow W = \frac{Ra^3}{6b}$$

8. Option (d) is correct.

Given,

Gravitational potential at certain height

$$(V) = -5.4 \times 10^7 \text{ J/kg}^{-2}$$

Value of (g') = 6.0 m/s^2

Radius of earth(R) = 6400 km

Height from the surface of earth (h) = ?

Gravitational potential of certain height (V)

$$V = \frac{-GM}{R+h} \quad ...(i)$$

Gravitational acceleration of certain height

$$g' = \frac{GM}{(R+h)^2} \quad ...(ii)$$

From equation (i) and (ii)

$$\frac{V}{g'} = \frac{\frac{GM}{R+h}}{\frac{GM}{(R+h)^2}}$$

$$\Rightarrow \quad \frac{V}{g'} = \frac{(R+h)^2}{R+h}$$

$$\Rightarrow \quad \frac{V}{g'} = (R+h)$$

$$\Rightarrow \quad h = \frac{V}{g'} - R$$

Now, substituting the values,

$$h = \frac{-\left(-5.4\times10^7\right)}{6.0}\frac{J}{kg^2}\times\frac{s^2}{m} - 6400\,km$$

$$\Rightarrow \quad h = \frac{5.4\times10^7}{6}\frac{kg-m^2}{s^2}\frac{s^2}{kg^2.m} - 6400\ km$$

$\Rightarrow$ h = 0.9 × 107 m – 6400 km

$\Rightarrow$ h = 9000 km – 6400 km

$\Rightarrow$ h = 2600 km

Hence, the height from the surface of the earth be 2600 km.

9. Option (c) is correct.

Given,

Coefficient of linear expansion of brass = α_1

Coefficient of linear expansion of steel rod = α^2

Length of brass rod = l_1

Length of steel rod = l_2

$l_2 - l_1$ maintained at same temperature.

Let the increase in the temperature of rod = ΔT

Let new length of the rods become l'_1 and l'_2.

After increasing the temperature of rod, new length of brass rod

$$l'_1 = l_1(1 + \alpha_1 \Delta T) \quad ...(i)$$

For new length of steel rod

$$l'_2 = l_2(1 + \alpha_2 \Delta T) \quad ...(ii)$$

but it is given,

$$l'_1 - l'_2 = l_1 - l_2$$

$$\Rightarrow \quad l_1(1 + \alpha_1 \Delta T) - l_2(1 + \alpha_2 \Delta T) = l_1 - l_2$$

$$\Rightarrow \quad l_1 - l_2 + (l_1\alpha_1 \Delta T - l_2\alpha_2 \Delta T) = l_1 - l_2$$

$$\Rightarrow \quad l_1\alpha_1 \Delta T - l_2\alpha_2 \Delta T = 0$$

$$\Rightarrow \quad l_1\alpha_1 = l_2\alpha_2$$

10. Option (c) is correct.

Given,

Maximum intensity of light in young's double slit experiment = I_0

Distance between two slits (d) = 5λ

λ = Wavelength of light

Screen distance from slit (D) = 10d

Intensity of light, in front of one slit = ?

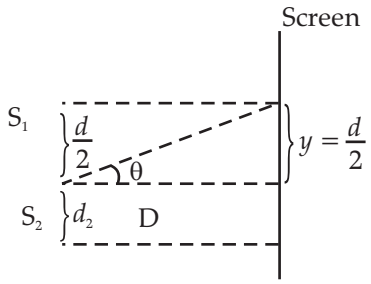
Intensity of light

$$I = I_0 \cos^2\left(\frac{\phi}{2}\right) \quad ...(i)$$

ϕ = phase difference

$$\Rightarrow \quad \phi = \frac{2\pi}{\lambda} \times \text{path difference } (\Delta X)$$

$$\Rightarrow \quad \phi = \frac{2\pi}{\lambda}\Delta X \quad ...(ii)$$



$$\Delta X = d\tan\theta$$

$$\Delta X = d\frac{y}{D}$$

$$\Rightarrow \quad \Delta X = \frac{d\times\frac{d}{2}}{D}$$

$$\Rightarrow \quad \Delta X = \frac{d\times\frac{d}{2}}{10d}$$

$$\Rightarrow \quad \Delta X = \frac{d}{20}$$

but $d = 5\lambda$

$$\therefore \quad \Delta X = \frac{5\lambda}{20}$$

$$\Delta X = \frac{\lambda}{4} \quad ...(iii)$$

From the equation (ii) and (iii)

$$\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{4}$$

$$\Rightarrow \quad \phi = \frac{\pi}{2}$$

Now substituting the value of ϕ in the equation (i)

$$I = I_0 \cos^2\left(\frac{\phi}{2}\right)$$

$$\Rightarrow \quad I = I_0 \cos^2\left(\frac{\phi}{2}\right)$$

$$\Rightarrow \quad I = I_0 \cos^2\left(\frac{1}{2} \times \frac{\pi}{2}\right)$$

$$\Rightarrow \quad I = I_0 \cos^2\left(\frac{\pi}{4}\right)$$

$$\Rightarrow \quad I = I_0\left(\frac{1}{\sqrt{2}}\right)^2 \qquad \left(\because \cos\frac{\pi}{4} = \frac{1}{\sqrt{2}}\right)$$

$$\Rightarrow \quad I = I_0\left(\frac{1}{2}\right)$$

$$I = \frac{I_0}{2}$$

Hence, intensity infornt of one of the slit on screen will be $\frac{I_0}{2}$.

11. Option (b) is correct.

Given,

Value of Rydberg constant (R) = 10 m^{-1}

Wave number of last line of Balmer series in hydrogen spectrum = ?

$$\frac{1}{\lambda} = R\left(\frac{1}{h_1^2} - \frac{1}{h_2^2}\right)$$

For the last line in Balmer series

$$h_1 = 2, h_2 = \infty$$

So, $$\frac{1}{\lambda} = 10\left(\frac{1}{2^2} - \frac{1}{\infty}\right)$$

$$\Rightarrow \quad \frac{1}{\lambda} = 10\left(\frac{1}{4} - 0\right)$$

$$\Rightarrow \quad \frac{1}{\lambda} = \frac{10}{4}$$

$$\Rightarrow \quad \frac{1}{\lambda} = 2.5\ m^{-1}$$

Note : In the question value of Rydberg constant should be $10^7\ m^{-1}$.

$$\frac{1}{\lambda} = 10^7\left(\frac{1}{2^2} - \frac{1}{\infty}\right)$$

$$\Rightarrow \quad \frac{1}{\lambda} = 10^7\left(\frac{1}{4}\right)\frac{1}{m}$$

or $$\frac{1}{\lambda} = \frac{10^7}{4}$$

$$\Rightarrow \quad \frac{1}{\lambda} = 0.25 \times 10^7\ m^{-1}$$

So, the wave number of the last line of the Balmer series in hydrogen spectrum will be $0.25 \times 10^7\ m^{-1}$.

12. Option (a) is correct.

Given,

Let the radius of earth be R_e and density be P_e.

Escape velocity on earth = V_e

For other planet,

Radius (R_p) = 2 R_e

Density (ρ_p) = 2 P_e

Escape velocity on other planet = V_p

We know, escape velocity on earth

$$V_e = \sqrt{\frac{2GM}{R_e}}$$

Here M is the Mass of earth.

Mass = density × volume

Mass of earth(M) = $\rho_e = \frac{4}{3}\pi R_e^3$

Let the mass of planet (M_p).

$$M_p = \rho_p \times V_p$$

$$\Rightarrow \quad M_p = 2\rho_e \times \frac{4}{3}\pi(R_p)^3$$

$$\Rightarrow \quad M_p = 2\rho_e \times \frac{4}{3}\pi(2R_e)^3$$

$$\Rightarrow \quad M_p = 2\rho_e \times \frac{4}{3}\pi R_e^3 \times 8$$

$$\Rightarrow \quad M_p = 8 \times 2\left(\rho_e \times \frac{4}{3}\pi R_e^3\right)$$

$$\left(\because M_e = \rho_e \times \frac{4}{3}\pi R_e^3\right)$$

So $$M_p = 16\, M_e$$

$$V_p = \sqrt{\frac{2GM_p}{R_p^2}}$$

$$\Rightarrow \quad V_p = \sqrt{\frac{2G(16M_e)}{(2Re)}} \qquad (\because M_p = 16\, M_e)$$

$$\Rightarrow \quad V_p = \sqrt{\frac{2GM_e}{R_e}\left(\frac{16}{2}\right)}$$

$$\Rightarrow \quad V_p = V_e\sqrt{8}$$

$$\Rightarrow \quad V_p = 2\sqrt{2}V_e$$

$$\Rightarrow \quad \frac{V_e}{V_p} = \frac{1}{2\sqrt{2}}$$

Hence, the required ratio in the escape velocity on earth and other planet

$$V_e : V_p = 1 : 2\sqrt{2}$$

13. Option (c) is correct.

Given,

Number of turns in solenoid (N) = 1000

Current (I) = 4 A

Magnetic flux (ϕ) = 4×10^{-3} Wb

Self inductance of the solenoid (L) = ?

Total flux linked with solenoid (ϕ) = Nϕ

Now, substituting the values

$$\phi = 1000 \times 4 \times 10^{-3} \text{ Wb}$$

$$\Rightarrow \quad \phi = 4 \text{ Wb}$$

Now, we know,

Self-inductance ϕ = LI

Now, substituting the values,

$$4 \text{ Wb} = L \times 4 \text{ A}$$

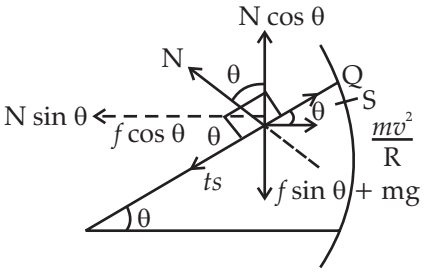
$$\Rightarrow \quad L = \frac{4\text{Wb}}{4\text{A}}$$

$$\Rightarrow \quad L = 1 \text{ H}$$

Hence, the self-inductance of the solenoid be 1 H.

14. Option (a) is correct.

Given,



Radius of curved road = R

Banking angle of road = θ

Coefficient of friction between the tyres of the car and road = μ_s

Maximum safe velocity on this road = ?

Now, from the above free-body-diagram

Let f be the friction force and N be the normal reaction.

Now, applying force balance equation

Vertical force

$$N\cos\theta = mg + f\sin\theta$$

$$\Rightarrow \quad mg = N\cos\theta - f\sin\theta \qquad ...(i)$$

For horizontal force

$$N\sin\theta + f\cos\theta = \frac{mv^2}{R} \qquad ...(ii)$$

From equation (i) and (ii)

$$\frac{\frac{mv^2}{R}}{mg} = \frac{N\sin\theta + f\cos\theta}{N\cos\theta - f\cos\theta}$$

$$\Rightarrow \quad \frac{mv^2}{mRg} = \frac{N\sin\theta + \mu_s\cos\theta}{N\cos\theta - \mu_s N\sin\theta}$$

$$\left(\because f = \mu_s N\right)$$

$$\Rightarrow \quad \frac{v^2}{Rg} = \frac{N\left(\sin\theta + \mu_s\cos\theta\right)}{N\left(\cos\theta - \mu_s\sin\theta\right)}$$

$$\Rightarrow \quad v^2 = Rg\left(\frac{\sin\theta + \mu_s\cos\theta}{\cos\theta - \mu_s\sin\theta}\right)$$

$$\Rightarrow \quad v = \sqrt{Rg\left[\frac{\cos\theta\left(\tan\theta + \mu_s\right)}{\cos\theta\left(1 - \mu_s\tan\theta\right)}\right]}$$

$$\Rightarrow \quad v = \sqrt{Rg\left[\frac{\tan\theta + \mu_s}{1 - \mu_s\tan\theta}\right]}$$

Hence, the maximum safe velocity on the road will be

$$= \sqrt{Rg\left[\frac{\tan\theta + \mu_s}{1 - \mu_s\tan\theta}\right]}$$

15. Option (d) is correct.

Magnetic susceptibility is the property of the material, in which we put any material in the external magnetic field then it gets magnetize. It is also called magnetizability.

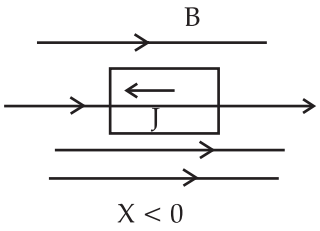
$$X_m = \frac{J}{B_0}$$

and $\quad \mu_r = 1 + x_m$

For diamagnetic material, $\mu_r < 1$,

So $\quad x_{m\text{H}} < 1$

$X_m < 0$ (negative)

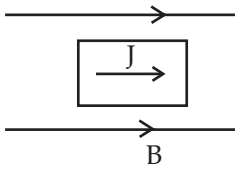


For Para magnetic material/Ferromagnetic material

$$\mu_r > 1$$

So $x_m + 1 > 1$

$x_m > 0$ (Positive)



16. Out of Syllabus

17. Option (c) is correct.

Given,

Mass of body (m) = 1kg

Time dependent force (F) $= \left(2t\hat{i} + 3t^2\hat{j}\right)$N

Here $\hat{i}$ and $\hat{j}$ are unit vector along to X and Y respectively

Power developed by the force at time (t) = ?

We know,

Acceleration

$$(\vec{a}) = \frac{d\vec{v}}{dt}$$

$$\Rightarrow \quad d\vec{v} = \vec{a} \times dt \qquad ...(i)$$

but force (F) = ma

$$\Rightarrow \quad \vec{a} = \frac{F}{m}$$

$$\Rightarrow \quad \vec{a} = \frac{\left(2t\hat{i} + 3t^2\hat{j}\right)}{1}$$

$$\Rightarrow \quad \vec{a} = 2t\hat{i} + 3t^2\hat{j} \qquad ...(ii)$$

From equation (i) and (ii)

$$d\vec{v} = \left(2t\hat{i} + 3t^2\hat{j}\right)dt$$

Now, taking the integration of both side of the given equation

$$\int_o^v d\vec{v} = \int_o^t (2tdt)\hat{i} + \int_o^t \left(3t^2dt\right)\hat{j}$$

$$\Rightarrow \quad \vec{v} = \frac{2t^2}{2}\hat{i} + \frac{3t^3}{3}\hat{j}$$

$$\Rightarrow \quad \vec{v} = t^2\hat{i} + t^3\hat{j}$$

But, we know,

Power (P) = $\vec{f}.\vec{v}$

$$\Rightarrow \quad P = \left(2t\hat{i} + 3t^2\hat{j}\right)\left(t^2\hat{i} + t^3\hat{j}\right)$$

$$\Rightarrow \quad P = (2t^3 + 4t^5)\ W$$

18. Option (a) is correct.

Given,

Radius of disc = R

Mass of disc = M

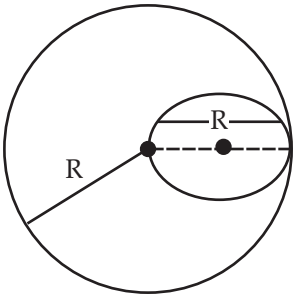
Diameter of circular hole on the disc = R

So, radius of the hole of the disc $= \frac{R}{2}$

Moment of inertia of the remaining disc about the centre = ?

Mass density of the disc

$$\rho = \frac{\text{total mass}}{\text{total area}}$$



$$\Rightarrow \quad \rho = \frac{M}{\pi R^2}$$

Let the mass of the removed pact from the hole = M′

So, $M' = \rho \times \pi\left(\frac{R}{2}\right)^2$

$$\Rightarrow \quad M' = \frac{M}{\pi R^2}\frac{\pi R^2}{4}$$

$$\Rightarrow \quad M' = \frac{M}{R}$$

Now, applying parallel axis theorem to calculate moment of inertia of removed part

$$I_1 = M'\left(\frac{R}{2}\right)^2 + \frac{1}{2}M'\left(\frac{R}{2}\right)^2$$

$$\Rightarrow \quad I_1 = \left(\frac{M}{4}\right)\left(\frac{R^2}{4}\right) + \frac{1}{2}\left(\frac{M}{4}\right)\left(\frac{R}{2}\right)^2$$

$$\Rightarrow \quad I_1 = \frac{MR^2}{4\times 4} + \frac{MR^2}{2\times 4\times 4}$$

$$\Rightarrow \quad I_1 = \frac{MR^2}{16} + \frac{MR^2}{32}$$

$$\Rightarrow \quad I_1 = \frac{2MR^2}{32} + \frac{MR^2}{32}$$

$$\Rightarrow \quad I_1 = \frac{3MR^2}{32}$$

Moment of inertia of the disc about the center

$$I = \frac{MR^2}{2}$$

Now, applying the superposition principal to calculated moment of inertia of the remaining disc about the center

$$I_{net} = I - I_1$$

$$\Rightarrow \quad I_{net} = \frac{MR^2}{2} - \frac{3MR^2}{32}$$

$$\Rightarrow \quad I_{net} = \frac{16MR^2}{32} - \frac{3MR^2}{32}$$

$$\Rightarrow \quad I_{net} = \frac{13MR^2}{32}$$

19. Option (c) is correct.

Given,

Width of the single slit = a

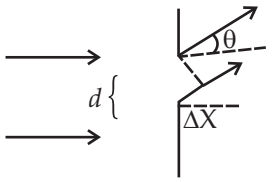
The angle at which first minimum is observed (θ) = 30°

Light of wavelength (λ) = 5000 Å

(λ) = 5000×10^{-10} m

The angle at which first secondary maxima observed (θ') = ?

Path difference, for maximum



Intensity (ΔX) = $m\lambda = a \sin\theta$

Path difference, for minimum intensity (ΔX)

$$= \left(m + \frac{1}{2}\right) \times a \sin\theta$$

Calculation for first minimum

$$m\lambda = a \sin\theta$$

$$\Rightarrow \quad \lambda = a \sin\theta \qquad (m = 1)$$

$$\Rightarrow \quad \sin\theta = \frac{\lambda}{a} = \frac{5000 \times 10^{-10}\,\text{m}}{a}$$

$$\Rightarrow \quad a = \frac{5 \times 10^{-7}}{\sin 30^\circ}\,\text{m}$$

$$\Rightarrow \quad a = \frac{5 \times 10^{-7}}{\frac{1}{2}}\,\text{m}$$

$$\Rightarrow \quad a = 5 \times 2 \times 10^{-7}\,\text{m}$$

$$\Rightarrow \quad a = 10 \times 10^{-7}\,\text{m}$$

Path difference for secondary maxima

$$a \sin\theta' = \left(m + \frac{1}{2}\right)\lambda$$

($m = 1$)

$$\Rightarrow \quad 10 \times 10^{-7} \sin\theta' = \left(1 + \frac{1}{2}\right) 5000 \times 10^{-10}$$

$$\Rightarrow \quad \sin\theta' = \frac{3}{2} \times \frac{5 \times 10^{-7}}{10 \times 10^{-7}}$$

$$\Rightarrow \quad \sin\theta' = \frac{3}{4}$$

$$\Rightarrow \quad \theta' = \sin^{-1}\left(\frac{3}{4}\right)$$

Hence, the first secondary maximum is observed at

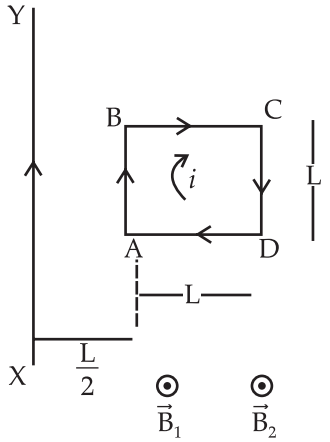
$$= \sin^{-1}\left(\frac{3}{4}\right)$$

20. Option (d) is correct.

Given,

Current in the loop ABCD = i

Current in the wire XY = I



Here, AB and CD will contribute the force but BC and DA will not experiences the force because BC and AD are perpendicular to XY.

We know that force

$$\vec{F} = i\vec{L} \times \vec{B}$$

But force on AB due to XY

$$\vec{B}_{AB} = \frac{\mu_o}{2\pi} \frac{I}{\frac{L}{2}}$$

$$\Rightarrow \quad \vec{B}_{AB} = \frac{\mu_o}{2\pi} \frac{2I}{L}$$

Magnetic field due to XY on CD

$$\vec{B}_{CD} = \frac{\mu_o}{2\pi} \frac{I}{\left(\frac{L}{2} + L\right)}$$

$$\vec{B}_{CD} = \frac{\mu_o}{2\pi} \frac{I}{\frac{3L}{2}}$$

$$\Rightarrow \qquad \vec{B}_{CD} = \frac{\mu_o}{2\pi}\frac{2I}{3L}$$

Hence, net force on wire AB and CD

$$\vec{F} = iL \times \vec{B}_{AB} - iL \times \vec{B}_{CD}$$

$$\Rightarrow \qquad \vec{F} = \frac{i\mu_o I}{2\pi L} - \frac{iL\mu_o 2I}{2\pi \times 3L}$$

$$\Rightarrow \qquad \vec{F} = \frac{2\mu_o IiL}{2\pi L} - \frac{2\mu_o IiL}{2\pi \times 3L}$$

$$\Rightarrow \qquad \vec{F} = \frac{2\mu_o IiL}{2\pi L} - \frac{2\mu_o IiL}{6\pi L}$$

$$\Rightarrow \qquad \vec{F} = \frac{2\mu_o Ii}{2\pi} - \frac{2\mu_o Ii}{6\pi}$$

$$\Rightarrow \qquad \vec{F} = \frac{6\mu_o Ii}{6\pi} - \frac{2\mu_o Ii}{6\pi}$$

$$\Rightarrow \qquad \vec{F} = \frac{4\mu_o Ii}{6\pi}$$

$$\Rightarrow \qquad \vec{F} = \frac{2\mu_o Ii}{3\pi}$$

Hence, net force on the loop will be $\frac{2}{3}\frac{\mu_o Ii}{\pi}$.

21. Out of Syllabus

22. Option (b) is correct.

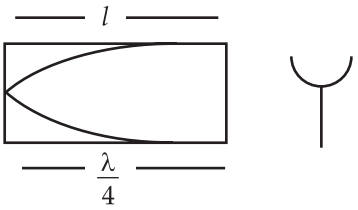
Given,

Air, Column is closed at one end and open at other end.

Smallest length of air column = 50 cm

Next larger length of the column resonating with the same tuning fork = ?

For closed organ pipe, first minimum resonating length

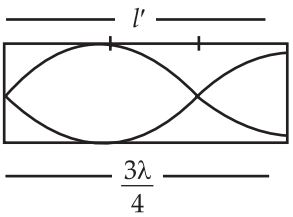


$$l = \frac{\lambda}{4}$$

$$\Rightarrow \qquad \lambda = 4l \qquad \text{...(i)}$$

Next higher length of air column

$$l' = \frac{3\lambda}{4}$$



So, $\qquad l' = \frac{3\lambda}{4}$

$$\Rightarrow \qquad l' = \frac{3 \times 4l}{4}$$

($\lambda = 4l$ from equation (ii))

$$\Rightarrow \qquad l' = 3l$$

Now, substituting the value of l.

So $\qquad l' = 3 \times 50$ cm

$l' = 150$ cm

23. Option (a) is correct.

Given,

R.M.S. velocity of a gas molecule

$(V_{rms})_1 = 200$ m/s

Temperature $(T_i) = 27°C$

T_i in kelvin $= 27 + 273 = 300$ K

$$\left(\because t\text{K} = t°\text{C} + 273\right)$$

Pressure $(P_i) = 1.0 \times 10^5$ N/m^2

Now, if temperature $(T_f) = 127°C$

$$\left(\because T_k = T_c + 273\right)$$

Temperature in kelvin $(T_f) = (127 + 273)$

$= 400$ K

Pressure $(P_f) = 0.05 \times 10^5$ N/m^2

The r.m.s. velocity of the molecule

$(V_{rms})_2 = ?$

The r.m.s. velocity of gas molecule

$$(V_{rms}) = \sqrt{\frac{3RT}{m}}$$

V_{rms} does not depend on pressure

$$\frac{(V_{rms})_1}{(V_{rms})_2} = \frac{\sqrt{\frac{3RT_i}{m}}}{\sqrt{\frac{3RT_f}{m}}}$$

$$\Rightarrow \qquad (V_{rms})_2 = (V_{rms})_1 \sqrt{\frac{T_f}{T_i}}$$

Now, substituting the values

$$(V_{rms})_2 = 200\sqrt{\frac{400\text{K}}{300\text{K}}} \text{ m/s}$$

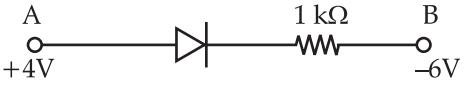
$$\Rightarrow \qquad (V_{rms})_2 = 200\sqrt{\frac{4}{3}} \text{ m/s}$$

$$\Rightarrow \qquad (V_{rms})_2 = \frac{200 \times 2}{\sqrt{3}} \text{m/s}$$

$$\Rightarrow \qquad (V_{rms})_2 = \frac{400}{\sqrt{3}} \text{m/s}$$

24. Option (a) is correct.

Given,



Diode is ideal

Value of current through AB = ?

$$R = 1\ K\Omega$$

$$\Rightarrow \quad E = 1000\ \Omega$$

We know, $V = IR$

$$\Rightarrow \quad I = \frac{V}{R}$$

$$\Rightarrow \quad I = \frac{V_A - V_B}{R}$$

$$\Rightarrow \quad I = \frac{4-(-6)}{1000}A$$

$$\Rightarrow \quad I = \frac{10}{1000}A$$

$$\Rightarrow \quad I = 10^{-2}\ A$$

25. Option (a) is correct.

Let the two vectors are $\vec{P}$ and $\vec{Q}$ and angle between them is θ

As per the given question,

Magnitude of sum of two vector

= Magnitude of difference of two vectors

$$|\vec{P}+\vec{Q}| = |\vec{P}-\vec{Q}|$$

$\Rightarrow$ Now, squaring both side

$$(|\vec{P}+\vec{Q}|)^2 = (|\vec{P}-\vec{Q}|)^2$$

$$\Rightarrow (\vec{P}^2)^2 + (\vec{Q})^2 + 2|\vec{P}||\vec{Q}|\cos\theta$$

$$= (\vec{P})^2 + (\vec{Q})^2 - 2|\vec{P}||\vec{Q}|\cos\theta$$

$$\Rightarrow \quad 2|\vec{P}||\vec{Q}|\cos\theta + 2|\vec{P}||\vec{Q}|\cos\theta = 0$$

$$\Rightarrow \quad 4|\vec{P}||\vec{Q}|\cos\theta = 0 = \cos 90°$$

$$\Rightarrow \quad \cos\theta = \cos\left(\frac{\pi}{2}\right)$$

$$\Rightarrow \quad \theta = \frac{\pi}{2} = 90°$$

26. Option (c) is correct.

Given,

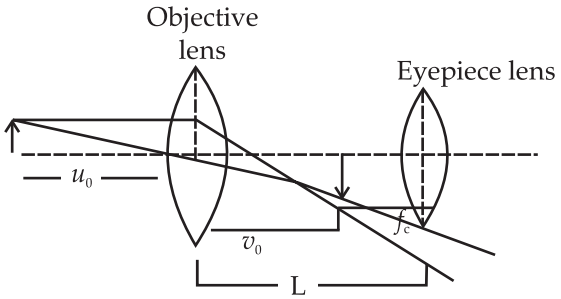
For astronomical telescope,

Focal length of objective lens (f_o) = 40 cm

Focal length of eyepiece lens (f_e) = 4 cm

Distance between object and objective lens (u_o) = 200 cm

The distance between the objective lens and eyepiece lens (d) = ?



Let the distance between length be (l) and image formed by objective lens be v_o.

So, tube length(l) = distance between lenses

$$= v_o + f_e$$

Calculation for objective lens

$$\frac{1}{v_o} - \frac{1}{u_o} = \frac{1}{f_o}$$

$$\Rightarrow \quad \frac{1}{v_o} - \frac{1}{(-200)} = \frac{1}{40}$$

$$\Rightarrow \quad \frac{1}{v_o} = \frac{1}{40} - \frac{1}{200}$$

$$\Rightarrow \quad \frac{1}{v_o} = \frac{5-1}{200}$$

$$\Rightarrow \quad \frac{1}{v_o} = \frac{4}{200}$$

$$v_o = 50\ cm$$

So, for normal adjustment, distance between objective and eyepiece lens

$$(l) = v_o + f_e$$

$$\Rightarrow \quad (l) = (50 + 4)\ cm$$

$$\Rightarrow \quad (l) = 54\ cm$$

27. Out of Syllabus

28. Option (a) is correct.

Isothermal compression :

Let the initial volume of the gas be (V_i) = V

After isothermal compression, new volume

$$(V_f) = \frac{V}{2}$$

Adiabatic compression :

Initial volume = (V_i) = V

Final volume = $(V_f) = \frac{V}{2}$

For isothermal compression

$$W = nRT\ In\left[\frac{V_f}{V_i}\right]$$

$$W = nRT \text{ In } \left(\frac{V}{\frac{2}{V}}\right)$$

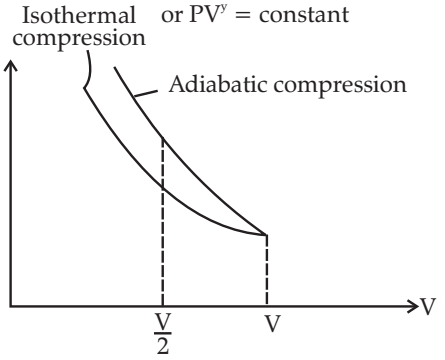
$$W = nRT \text{ In } \left(\frac{1}{2}\right)$$

or we can write,

$$PV = nRT \text{ In } \left(\frac{1}{2}\right)$$

For adiabatic compression (W)

$$= \frac{k\left(V_f^{1-y} - V_i^{1-y}\right)}{1-y}$$



So, we can conclude that,

Area under the curve adiabatic compression > Area under isothermal compression

Hence, compression the gas through adiabatic process will require more work to be done.

29. Option (b) is correct.

Given,

Radius of long straight wire = a

Value of steady current = I

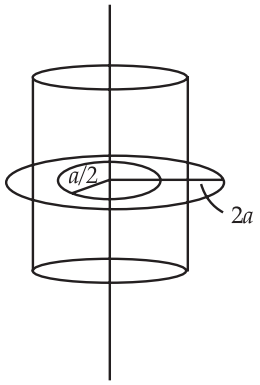
Magnetic field at radial distance $\frac{a}{2}$ = B

Magnetic field at radial distance ($2a$) = B′

B : B′ = ?

For closed amperian loop,

Applying Amper's circuital law



$$\oint B.dl = \mu_o I_{enclosed}$$

For smaller loop,

$$\oint B.\left(2\pi\frac{a}{2}\right) = \mu_o I' \qquad \left(I' = \frac{I}{\pi a^2} \times \frac{\pi a^2}{4}\right)$$

$$B \,.\, 2\pi\frac{a}{2} = \frac{\mu_o I}{r}$$

$$\Rightarrow \qquad B = \frac{\mu_o I}{4\pi a} \qquad \text{...(i)}$$

For larger loop

$$\oint B' \times 2\pi(2a) = \mu_o I$$

$$\Rightarrow \qquad B' \times 4\pi a = \mu_o I$$

$$\Rightarrow \qquad B' = \frac{\mu_o I}{4\pi a} \qquad \text{...(ii)}$$

Now, from equation (i) and (ii)

$$\frac{B}{B'} = \frac{\frac{\mu_o I}{4\pi a}}{\frac{\mu_o I}{4\pi a}}$$

$$\Rightarrow \qquad \frac{B}{B'} = \frac{\left(\frac{\mu_o I}{4\pi a}\right)}{\frac{1}{4}\left(\frac{\mu_o I}{4\pi a}\right)}$$

$$\Rightarrow \qquad \frac{B}{B'} = \frac{4}{4} = \frac{1}{1}$$

30. Option (d) is correct.

From the given question,

Column 1		Column 2	
A.	$m = -2$	a.	Convex mirror
B.	$m = -\frac{1}{2}$	b.	Concave mirror
C.	$m = +2$	c.	Real image
D.	$m = +\frac{1}{2}$	d.	Virtual image

We know,

Magnification for mirror (m) = $\frac{-v}{u}$

Where v is image position from mirror u is object position from mirror.

For (A) $\qquad m = -2 = \frac{-v}{u}$

$$\Rightarrow \qquad v = 2u$$

Here u, and v have the same sign, so mirror is concave mirror and image is real.

$A \rightarrow b, c$

For (B) $\qquad m = \frac{-1}{2} = \frac{-v}{u}$

$$\Rightarrow \qquad 2v = u$$

u and v are of same sign and image will be real.

$B \rightarrow b, c$

For (C) $m = +2 = \dfrac{-v}{u}$

$\Rightarrow \quad v = -2u$

Here u and v are in opposite sign but magnification is greater than 1, hence image be virtual and mirror be convex mirror.

$c \rightarrow a, d$

For (D) $m = +\dfrac{1}{2} = \dfrac{-v}{u}$

$$v = \frac{-u}{2}$$

Here, u and v are in opposite sign but u and magnification is lesser than 1.

Hence, mirror will be convex and image will be virtual.

$d \rightarrow a, d$

31. Option (b) is correct.

Given,

Velocity of the particle, $v = At + Bt^2$

A and B are constant.

Distance travelled between 1s to 2s = ?

We know that $v = \dfrac{dx}{dt}$

$\Rightarrow \quad dx = v.dt$

Now, taking the integration of the given equation

$$\int dx = \int v.dt$$

$$\Rightarrow \quad x = \int_{t_1=1}^{t_2=2} \left(At + Bt^2\right) dt$$

$$\Rightarrow \quad x = \left[\frac{At^2}{2} + \frac{Bt^3}{3}\right]_1^2$$

$$\Rightarrow \quad x = \left[\frac{A2^2}{2} + \frac{B.2^3}{3} - \frac{A.1^2}{2} - \frac{B1^3}{3}\right]$$

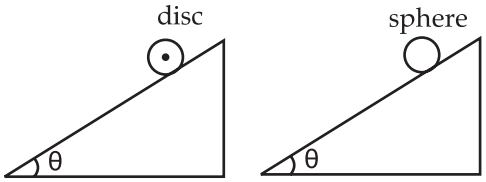
$$\Rightarrow \quad x = \left[\frac{4A}{2} + \frac{8B}{3} - \frac{A}{2} - \frac{B}{3}\right]$$

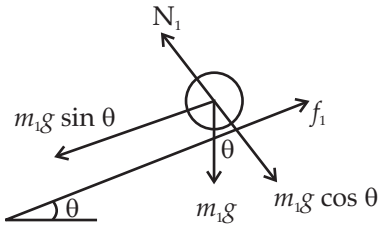
$$\Rightarrow \quad x = \left[\frac{3A}{2} + \frac{7B}{3}\right]$$

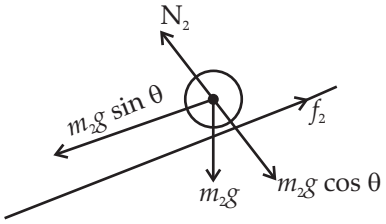
32. Option (a) is correct.

Let radius of disc and sphere be R and their masses are m_1 and m_2 respectively.

Let the angle of inclination of the inclined plane be θ and friction force on each block be f_1 and f_2.







Let the normal reaction by disc be N_1 and moment of inertia be $I_1 = \dfrac{1}{2} m_1 R^2$ (about center) and acceleration a_1

Let the normal reaction by sphere be N_2 and moment of inertia be $I_2 = 2/5\ mR^2$ (about center) and acceleration be a.

For disc

Force balance equation along to plane

$$mg \sin \theta - f_2 = m_1 a_1 \qquad \text{...(i)}$$

Applying torque equation about center

$$f_2 R = I_1 \alpha_1$$

(Here α_1 is the angular acceleration of disc)

$$\Rightarrow \quad f_2 = \frac{I_1 \alpha_1}{R} \qquad \text{...(ii)}$$

From equation (i) and (ii)

$$m_1 g \sin \theta - \frac{I_1 \alpha_1}{R} = m_1 a_1$$

$$\Rightarrow \quad m_1 g \sin \theta - \frac{m_1 R^2}{2} \frac{\alpha_1}{R} = m_1 a_1$$

$$\Rightarrow \quad m_1 g \sin \theta - \frac{m_1 R \alpha}{2} = m_1 a_1$$

$$\Rightarrow \quad m_1 a + \frac{m_1 \alpha}{2} = m_1 g \sin \theta \qquad \left(\because a = R\alpha\right)$$

$$\Rightarrow \quad m_1 \left(a_1 + \frac{a_1}{2}\right) = m_1 g \sin \theta$$

$$\Rightarrow \quad \frac{3a_1}{2} = g \sin \theta$$

$$\Rightarrow \quad a_1 = \frac{2}{3} g \sin \theta$$

For sphere

Applying force balance equation

$$m_2 g \sin\theta - f_2 = m_2 a_2 \quad ...(iii)$$

Applying torque equation

$$f_2 R = I_2 \alpha_2 \quad ...(iv)$$

(Here, α_2 is the angular acceleration of disc)

$$f_2 = \frac{I_2 \alpha_2}{R}$$

Now, solving equation (iii) and (iv)

$$m_2 g \sin\theta - \frac{I_2 \alpha_2}{R} = m_2 a_2$$

$$\Rightarrow \quad m_2 g \sin\theta - \frac{2}{5}\frac{m_2 R^2 \alpha_2}{R} = m_2 a_2$$

$$\Rightarrow \quad m_2 g \sin\theta - \frac{2}{5} m_2 R\alpha_2 = m_2 a_2$$

$$\Rightarrow \quad m_2 g \sin\theta = m_2 a_2 + \frac{2}{5} m_2 a_2 \qquad (\because R\alpha_2 = a_2)$$

$$\Rightarrow \quad m_2 g \sin\theta = m_2 a_2 \left(1 + \frac{2}{5}\right)$$

$$\Rightarrow \quad g \sin\theta = \frac{7}{5} a_2$$

$$\Rightarrow \quad a_2 = \frac{5}{7} g \sin\theta$$

Now, comparing a_1 and a_2

$$\frac{5}{7} g \sin\theta > \frac{2}{3} g \sin\theta$$

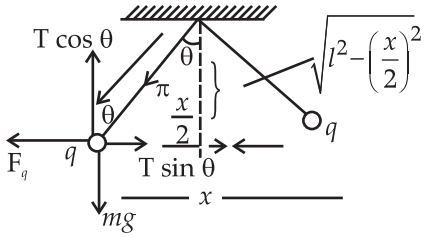
Hence, we can conclude that $a_2 > a_1$

Hence, sphere will reach first to the ground.

33. Option (b) is correct.

Let the mass of each block be m and length of each string be l

Initially, the distance between two sphere be d.



After the leakage of the charge, sphere approaches to each other with the velocity v.

Now, applying force balance equation

$$T\cos\theta = mg \quad ...(i)$$

(Vertical force balance)

$$T\sin\theta = F_q \quad ...(ii)$$

(Horizontal force)

Now, from equation (i) and (ii)

$$\frac{T\sin\theta}{T\cos\theta} = \frac{F_q}{mg}$$

$$\Rightarrow \quad \tan\theta = \frac{F_q}{mg}$$

$$\Rightarrow \quad \frac{\frac{x}{2}}{\sqrt{l^2 - \left(\frac{x}{2}\right)^2}} = \frac{1}{4\pi\varepsilon_o}\frac{q^2}{x^2} \times \frac{1}{mg}$$

$$\Rightarrow \quad \frac{x}{2\sqrt{l^2 - \frac{x}{4}}} = \frac{1}{4\pi\varepsilon_o}\frac{q^2}{x^2 mg}$$

$$\Rightarrow \quad \frac{1}{4\pi\varepsilon_o}\frac{q^2}{x^2 mg} = \frac{x}{2\sqrt{l^2}} \qquad \left(\because l >> x \text{ so } \frac{x^2}{4} \simeq 0\right)$$

$$\Rightarrow \quad \frac{q^2}{4\pi\varepsilon_o x^2 mg} = \frac{x}{2l}$$

$$\Rightarrow \quad \frac{q^2}{4\pi\varepsilon_o mg} = \frac{x^3}{2l}$$

$$\Rightarrow \quad q^2 = \frac{4\pi\varepsilon_o}{2l} mg\, x^3$$

$$\Rightarrow \quad q = \sqrt{\frac{4\pi\varepsilon_o\, mg}{2l}}\, x^{3/2}$$

$$\Rightarrow \quad q \propto x^{3/2}$$

$$\left(\text{Here } \sqrt{\frac{4\pi\varepsilon_o mg}{2l}} \text{ is constant}\right)$$

Now, taking differentiation with respect to t.

$$\frac{dq}{dt} \propto \frac{3}{2} x^{\frac{1}{2}} \frac{dx}{dt}$$

$$\Rightarrow \quad \frac{dq}{dt} \propto \sqrt{x}\, V$$

$$\Rightarrow \quad V \propto \frac{1}{\sqrt{x}}$$

$$\Rightarrow \quad V \propto x^{\frac{-1}{2}}$$

34. Option (b) is correct.

Given,

Position vector of the particle

$$r = \cos \omega t \hat{x} + \sin \omega t \, \hat{y} \quad \text{...(i)}$$

ω is constant.

We know that

$$V = \frac{dr}{dt}$$

Now, taking the differentiation of equation (i)

$$V = \frac{dr}{dt} = \omega(-\sin \omega t)\hat{x} + \omega \cos \omega \, \hat{y} \quad \text{...(ii)}$$

For acceleration $(a) = \frac{dv}{dt}$

Now, taking the second derivative of equation (i)

$$a = \frac{dv}{dt}$$

$$\Rightarrow \quad a = \omega \frac{d}{dt}(-\sin \omega t \, \hat{x} + \cos \omega t \, \hat{y})$$

$$\Rightarrow \quad a = \omega(-\omega \cos \omega t \, \hat{x} - \sin \omega t . \omega \, \hat{y})$$

$$\Rightarrow \quad a = -\omega^2(\cos \omega t \, \hat{x} + \sin \omega t \, \hat{y}) \quad \text{...(iii)}$$

From equation (i) and (iii)

$$a = \omega^2 r$$

or $a = \omega^2(-r)$

So, we can conclude that acceleration and displacement are parallel to each other.

Now, checking for velocity and displacement

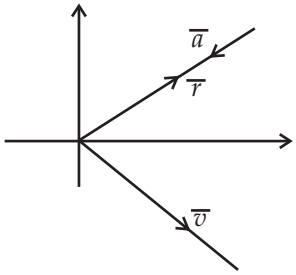
$$V.r = \omega(-\sin \omega t \, \hat{x} + \cos \omega t \, \hat{y})(\cos \omega t \, \hat{x} + \sin \omega t \, \hat{y})$$

$$= \omega(-\sin \omega t . \cos \omega t + \sin \omega t . \cos \omega t)$$

$$= \omega \times 0$$

$$= 0$$

Hence, we can conclude that V and r are parallel to each other.



Hence, velocity is perpendicular to r and acceleration is directed away towards the origin.

35. Option (b) is correct.

Given,

Height from which ice falls = h

Ice melts completely, after absorbing the heat.

Let the mass of ice be m and gravitational acceleration be $g = 10$ m/s^2

Potential energy of ice at height $(h) = mgh$

Heat absorbed by the ice = $\frac{mgh}{4}$

Energy required to melt the ice = mL

Now applying the conservation of energy

$$\frac{mgh}{4} = \text{mL}$$

$$\Rightarrow \quad h = \frac{4\text{L}}{g}$$

Latent heat of ice (L) = 3.4×10^5 J/kg

Now, substituting the values

$$h = \frac{4 \times 3.4 \times 10^5 \text{ J/kg}}{10 \text{ m/s}^2}$$

$$\Rightarrow \quad h = 4 \times 3.4 \times 10^4 \text{ m}$$

$$\Rightarrow \quad h = 136 \times 10^3 \text{ m}$$

$$\Rightarrow \quad h = 136 \text{ km}$$

36. Option (d) is correct.

Given,

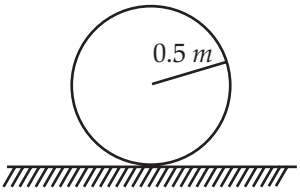
Radius of circular disc (R) = 50 cm

Angular acceleration (α) = 2.0 rad/s^2

Net acceleration at the end of

($t = 2.0$ s) (a) = ?

Let the angular speed be ω initial angular acceleration be $\omega_o = 0$



So $$\alpha = \frac{\omega - \omega_o}{t}$$

$$\Rightarrow \quad \omega = \alpha t$$

$$\Rightarrow \quad \omega = (2 \times 2) \text{ rad/s}$$

$$\Rightarrow \quad \omega = 4 \text{ rad/s}$$

Centripetal acceleration

$$(a_c) = \text{R}\omega^2$$

$$= (50 \times 10^{-2}) \times 4^2$$

$$= 0.5 \times 16 \text{ m/s}^2$$

$$= 8 \text{ m/s}^2$$

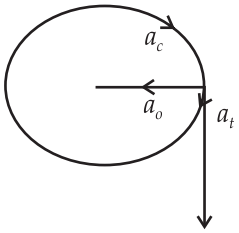
Linear acceleration of disc

$$a_t = \text{R}\alpha$$

$$\Rightarrow \quad a_t = 2 \times 50 \times 10^{-2} \text{ m/s}^2$$

$$\Rightarrow \quad a_t = 1 \text{ m/s}^2$$

Hence, net acceleration



$$a_{net} = \sqrt{a_c^2 + a_t^2}$$

$$\Rightarrow \quad a_{net} = \sqrt{8^2 + 1^2}$$

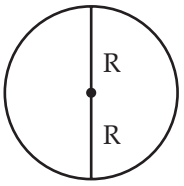
$$\Rightarrow \quad a_{net} = \sqrt{64 + 1}\ \text{m/s}^2$$

$$\Rightarrow \quad a_{net} = \sqrt{65} \simeq \sqrt{8^2}$$

$$a_{net} = 8\ \text{m/s}^2$$

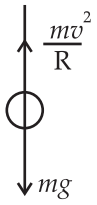
37. Option (c) is correct.

Let mass of body be m and velocity at which it is entering into the vertical loop be v



So, initial kinetic energy = $\frac{1}{2}mv^2$

When it reaches to top of the circular path then the velocity becomes v_1, then it will complete circular path $\frac{mv^2}{R}$



$$\Rightarrow \quad v_1 = \sqrt{Rg}$$

So minimum energy required to complete the circular path

$$= \frac{1}{2}mv_1^2 + mg(2R)$$

Now, applying the conservation of energy

$$\frac{1}{2}mv^2 = \frac{1}{2}mv_1^2 + 2mgR$$

$$\Rightarrow \quad \frac{mv^2}{2} = \frac{1}{2}m\left(\sqrt{Rg}\right)^2 + 2mgR$$

$$\Rightarrow \quad \frac{mv^2}{2} = \frac{mgR}{2} + 2mgR$$

$$\Rightarrow \quad \frac{mv^2}{2} = \frac{mgR}{2} + \frac{4mgR}{2}$$

$$\Rightarrow \quad \frac{mv^2}{2} = \frac{5mgR}{2}$$

$$\Rightarrow \quad v^2 = 5gR$$

$$\Rightarrow \quad v = \sqrt{5gR}\ \text{m/s}$$

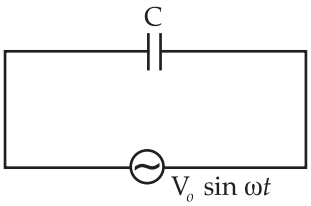
38. Option (a) is correct.

Given,

Small signal voltage $V(t) = V_o \sin \omega t$

Capacitance of the capacitor be C.

For the pure capacitive circuit,



The phase difference between voltage and current will be $\frac{\pi}{2}$

For this case, voltage leads current by $\frac{\pi}{2}$.

So, power developed $P = VI \cos \phi$

$$\Rightarrow \quad P = VI \cos\left(\frac{\pi}{2}\right)$$

$$\Rightarrow \quad P = VI(0)$$

$$\Rightarrow \quad P = 0$$

Over a full cycle, the capacitor c does not consume any energy from the voltage source.

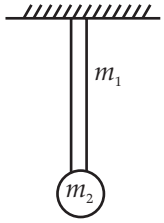
39. Option (a) is correct.

Given,

Length of the rope = L

Mass of the rope = m_1

Mass of the block = m_2



Wavelength of the pulse at the top = λ_2

Wavelength of the pulse at the bottom = λ_1

Let the mass per unit length of string be μ and Tension at bottom of the string be T_2 and tension at the top of the rope be T_1

We know that the velocity of wave in the string be

$$v = \sqrt{\frac{T}{\mu}}$$

But velocity of the wave (v) = $f\lambda$
where f is the frequency.

So, we can conclude that $v \propto \lambda$

$\Rightarrow \quad \lambda \propto \sqrt{T}$

Hence,

$$\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{T_1}}{\sqrt{T_2}}$$

But $T_1 = m_2 g$

and $T_2 = (m_1 + m_2)g$

Now, substituting the values

$$\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{m_2 g}}{\sqrt{(m_1 + m_2)g}}$$

$$\Rightarrow \quad \frac{\lambda_1}{\lambda_2} = \sqrt{\frac{m_2}{m_1 + m_2}}$$

Hence, $$\frac{\lambda_2}{\lambda_1} = \sqrt{\frac{m_1 + m_2}{m_2}}$$

40. Option (d) is correct.

Given,

Inductance of the inductor (L) = 20 mH

Capacitance of the capacitor (C) = 50 μF

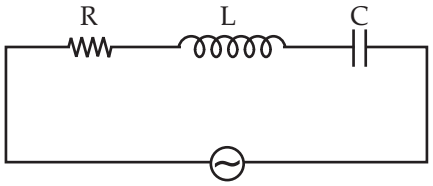
Resistance of the resistor (R) = 40 Ω

Emf of the source (e)= 10 sin 340 t

General equation of source voltage (v)

$= V_o \sin \omega t$

Power loss in AC circuit = ?



Power loss in AC circuit (P) = $I_v^2 R$ ...(i)

But $$I_v = \frac{V_{rms}}{Z}$$ ...(ii)

Here Z is the reactance of the circuit ;

So, $$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$X_L = 2\pi f L$

$\omega = 340$

$\Rightarrow \quad 2\pi f = 340$

$$\Rightarrow \quad f = \frac{340}{2\pi}$$

$$\Rightarrow \quad X_L = 2\pi \times \frac{340}{2\pi} \times 20 \times 10^{-3}\,\Omega$$

$\Rightarrow \quad X_L = 6.8\,\Omega$

And $$X_C = \frac{1}{\omega C}$$

$$\Rightarrow \quad X_C = \frac{1}{2\pi f C}$$

$$\Rightarrow \quad X_C = \frac{1}{50 \times 10^{-6} \times 2\pi \times \frac{340}{2\pi}}$$

$$\Rightarrow \quad X_C = \frac{1}{50 \times 340 \times 10^{-6}}\,\Omega$$

$\Rightarrow \quad X_C = 58.82\,\Omega$

Hence, $$Z = \sqrt{40^2 + (58.82 - 6.8)^2}$$

$\Rightarrow \quad Z = \sqrt{1600 + 52^2}\ \Omega$

$\Rightarrow \quad Z = \sqrt{1600 + 2704}\ \Omega$

$\Rightarrow \quad Z = \sqrt{4304}\ \Omega$

Now, from equation (ii)

$$I_v = \left(\frac{V_o}{\sqrt{2}}\right) \times \frac{1}{Z} \qquad \left(\because V_{rms} = \frac{V_o}{\sqrt{2}}\right)$$

$$\Rightarrow \quad I_v = \left(\frac{10}{\sqrt{2}}\right) \frac{1}{\sqrt{4304}}$$

Hence, power loss in the AC circuit

$$P = \left(\frac{10}{\sqrt{2}} \times \frac{1}{\sqrt{4304}}\right)^2 40\ \text{W}$$

$$\Rightarrow \quad P = \frac{100}{2 \times 4304} \times 40$$

$$\Rightarrow \quad P = \frac{4000}{8608} \simeq 0.51\,\text{W}$$

41. Option (d) is correct.

Given,

Mass of electron = m

de-Broglie's wavelength for an electron

$$\lambda_e = \frac{h}{P}$$ ...(i)

So, kinetic energy of the electron

$$(E) = \frac{P^2}{2m}$$ ...(ii)

From equation (i) and (ii)

$$\lambda_e = \frac{h}{\sqrt{2mE}}$$ ...(iii)

$\left(\because p = \sqrt{2mE}\right)$

We know, energy of photon

$$E = \frac{hc}{\lambda_p}$$

$$\lambda_p = \frac{hc}{E} \quad ...(iv)$$

Here λ_p be the wave length of photon.

From equation (iii) and (iv)

$$\frac{\lambda_e}{\lambda_p} = \frac{\frac{h}{\sqrt{2mE}}}{\frac{hc}{E}}$$

$$\Rightarrow \quad \frac{\lambda_e}{\lambda_p} = \frac{E}{c\sqrt{2mE}}$$

$$\Rightarrow \quad \frac{\lambda_e}{\lambda_p} = \frac{1}{c}\sqrt{\frac{E}{2m}}$$

$$\Rightarrow \quad \frac{\lambda_e}{\lambda_p} = \frac{1}{c}\left(\frac{E}{2m}\right)^{\frac{1}{2}}$$

42. Option (d) is correct.

Given,

Mass of α-particle = m

Velocity = v

Charge of the heavy nucleus = Ze

Here, energy will remain constant.

So, applying the conservation of energy

Initial kinetic energy of α-particle =

Potential energy of α-particle

$$\Rightarrow \quad \frac{1}{2}mv^2 = \frac{2Ze^2}{4\pi\varepsilon_o r_o^2}$$

So, we can conclude that $r_o \propto \frac{1}{m}$

43. Out of Syllabus

44. Option (d) is correct.

Given,

Mass of the particle (m) = 10 g

$= 10 \times 10^{-3}$ kg

Radius of circular path (R) = 6.4 cm

At the end the second revolution, energy of the particle (E) = 8×10^{-4} J

Let the velocity of the particle = v

and acceleration of the particle be a.

So, kinetic energy of the particle

$$\frac{1}{2}mv^2 = 8 \times 10^{-4}\ \text{J}$$

$$\Rightarrow \quad v^2 = \frac{2 \times 8 \times 10^{-4}\ \text{J}}{10 \times 10^{-3}\ \text{kg}}$$

$$\Rightarrow \quad v = \sqrt{\frac{16}{100}} = \frac{4}{10}$$

$$\Rightarrow \quad v = 0.4\ \text{m/s}$$

Initial velocity of the particle (u) = 0

Now, applying the newton's third law

$$v^2 = u^2 + 2as$$

$$\Rightarrow \quad \text{Here } s_1 = (2\pi R)$$

($\because$ In one revolution total distance covered be $s = 2\pi R$)

Total path length after the end of second revolution

$$s = 2s_1$$

$$s = 2 \times 2\pi R$$

So, $\quad v^2 = u^2 + 2a\,(4\pi R)$

Now, substituting the values

$$v^2 = 0 + 2 \times a \times 4\pi R$$

$$\Rightarrow \quad \left(\frac{4}{10}\right)^2 = 8\pi \times 6.4 \times 10^{-2}\, a$$

$$\Rightarrow \quad a = \frac{16}{100 \times 8\pi \times 6.4 \times 10^{-2}}\ \text{m/s}^2$$

$$\Rightarrow \quad a = \frac{160}{8\pi \times 64}\ \text{m/s}^2$$

$$\Rightarrow \quad a = \frac{160}{8 \times 3.14 \times 64}\ \text{m/s}^2$$

$$\Rightarrow \quad a = 0.099$$

$$\Rightarrow \quad a \simeq 0.1\ \text{m/s}^2$$

45. Option (a) is correct.

Given,

Angle of incidence at a refracting surface of a prism (i) = 45°

Prism angle (A) = 60°

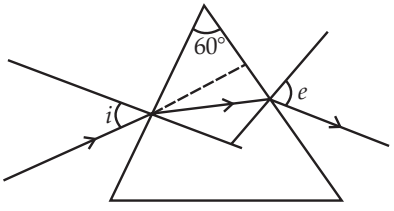
The angle of minimum deviation

(δ_m) = ?

Refractive index of the material of the prism

(μ) = ?

We know,



For minimum deviation

$$i = e = 45°$$

(e is angle of emergent)

So, $\delta_m = i + e - A$

($\because \delta_m + A = i + e$)

Now, substituting the values

$$\delta_m = 45° + 45° - 60°$$

$$\Rightarrow \quad \delta_m = 30°$$

Now, applying the prism formula

$$\frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \mu$$

$$\Rightarrow \quad \mu = \frac{\sin\left(\frac{60°+30°}{2}\right)}{\sin\left(\frac{60°}{2}\right)}$$

$$\Rightarrow \quad \mu = \frac{\sin\left(\frac{90°}{2}\right)}{\sin 30°}$$

$$\Rightarrow \quad \mu = \frac{\sin 45°}{\sin 30°}$$

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

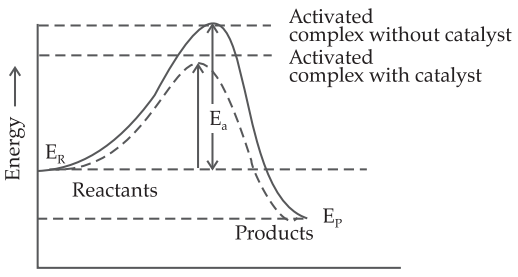
$$\Rightarrow \quad \mu = \frac{2}{\sqrt{2}}$$

$$\Rightarrow \quad \mu = \sqrt{2}$$

Hence, the refractive index of the material be $\sqrt{2}$

CHEMISTRY

46. Option (c) is correct.



A catalyst provides an alternate path to the reaction which lower activation energy.

47. Option (d) is correct.

According to VSEPR theory, lone pair of electrons is more diffused state than bond pair electrons. So, the order repulsion is as follows: lone pair – lone pair > lone pair –bond pair > bond pair – bond pair.

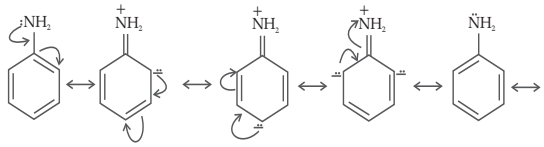
48. Option (d) is correct.

$R \rightarrow \ddot{N}H_2$, $Ar - \ddot{N}H_2$

Alkyl amine Aryl amine

In alkyl amine, electron releasing group *i.e.*, alkyl group is attached with nitrogen atoms, the repulsion between bond pair – lone pair more increases. Alkyl amine donates lone pair of electron very quickly. Therefore alkyl amine possesses higher basicity.

On the other hand is aryl amine, the aromatic ring is directly attached with nitrogen atom *i.e.*, amine group. Nitrogen atom is more electronegative than carbon. So – NH_2 group have – I effect but lone pair of electron on nitrogen is attached with the conjugated system. So there is +M effect present. Here, +M effect is overpowered the – I effect. Lone pair of electron is delocalised to the ring and gets stabilized through the resonance as follows.



Therefore the tendency to donate lone pair of electron decreases *i.e.*, basicity of aryl amine is less compaired with alkyl amine.

49. Out of Syllabus

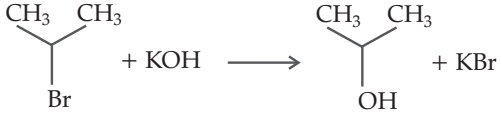
50. Option (a) is correct.

(A) Elimination reaction

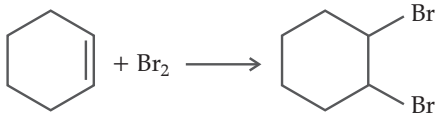
$CH_3CH_2CH_2Br + KOH \rightarrow$

$CH_3CH = CH_2 + KBr + H_2O$

(B) Substitution reaction



(C) Addition reaction



51. Option (c) is correct.

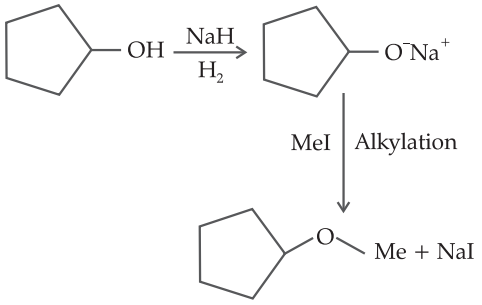
Two electrons occupying the same orbital possessing the same orbital values of n, l, m_l are same but the forth quantum number *i.e.*, spin quantum is different having

$$m_s = +\frac{1}{2} \text{ and}$$

$$m_s = -\frac{1}{2}$$

52. Option (d) is correct.

The final product is ether. When sodium alkoxide is treated with methyl iodide, ether is formed. This reaction is known as Williamson ether synthesis.



53. Option (c) is correct.

Electronic configuration of Eu, Gd, Tb respectively are as follows.

$$_{63}\text{Eu} = [\text{Xe}]\,4f^7\,6s^2$$

$$_{64}\text{Gd} = [\text{Xe}]\,4f^7\,5d^1\,6s^2$$

$$_{65}\text{Tb} = [\text{Xe}]\,4f^9\,6s^2$$

54. Option (d) is correct.

From Raoult's Law we get,

$$\frac{p^o - p_S}{p_S} = \frac{n_2}{n_1} = \frac{760-732}{760} = \frac{n_2}{\frac{100}{18}}$$

$$\Rightarrow \quad n_2 = \frac{28\times 100}{760\times 18} = 0.2046 \text{ moles}$$

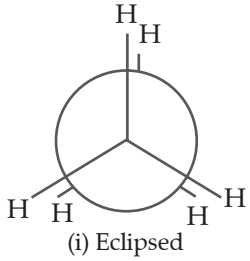
$$\Delta T_b = K_b \times m$$

$$\Rightarrow \quad T_b - T_b^0 = K_b \times \frac{n_2 \times 1000}{W(s)}$$

$$\Rightarrow \quad T_b - 100°C = \frac{0.52\times 0.2046\times 1000}{100} = 1.06$$

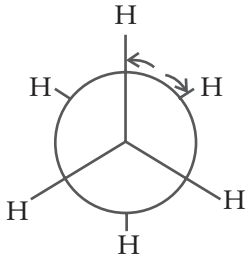
$$\Rightarrow \quad T_b = 101.06°C \approx 101°C$$

55. Option (c) is correct.



(i) Eclipsed

Angle of rotation or angle of tortion or dilectral angle



(ii) Staggered

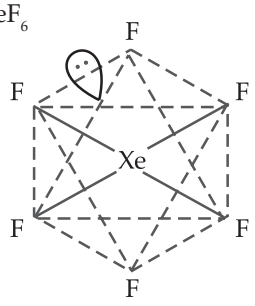
(Newman's projections of ethane)

Magnitude of torsional strain depends upon the angle of rotation around the C—C bond axis. The staggered conformation of ethane is more stable than eclipsed conformation because staggered conformation has no torsional strain.

56. Out of Syllabus

57. Option (d) is correct.

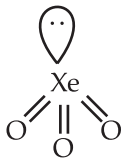
XeF_6



Distorted octahedral

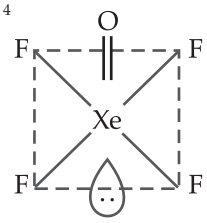
(sp^3d^3)

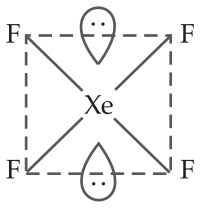
XeO_3



Pyramidal (sp^3)

$XeOF_4$ XeF_4

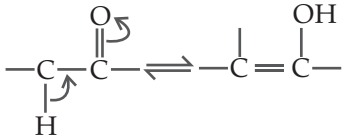




Square pyramidal (sp^3d^2) Square planar (sp^3d^2)

58. Option (c) is correct.

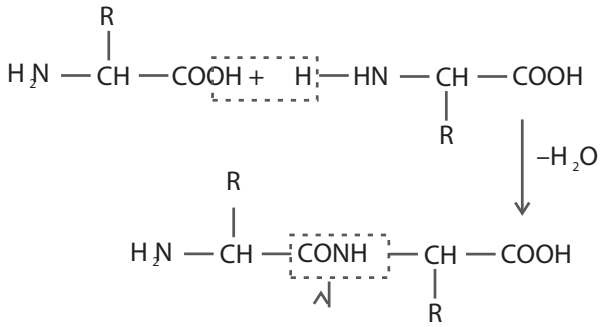
Keto-enol tautomerism :



Keto form enol form

59. Option (b) is correct.

Amino acids are the structural unit of protein. Two or more amino acids are linked through peptide linkage (—CONH—). These are known as peptide bond.



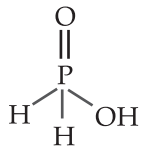
Peptide linkage

60. Out of Syllabus

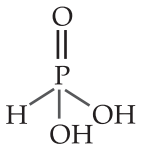
61. Option (d) is correct.

Novalgin is an analgesic while streptomycin, chloromycetin and penicillin are antibiotics.

62. Option (a) is correct.

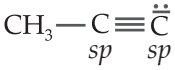


Hypophosphorous acid or
Phosphonic acid (monoprotic)



Orthophospho acid or
Phosphonic acid (Diprotic)

63. Option (c) is correct.

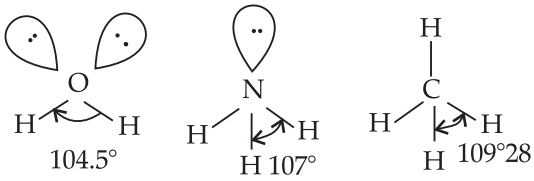


The pair of electron is present in the *sp* orbital.

64. Option (a) is correct.

The lone pair (*l.p*) of electrons is more diffused than the bond pair (*b.p*) of electrons. According to VSEPR theory the order of repulsion is as follows

l.p – l.p > l.p – b.p > b.p – b.p



Therefore H — O — H bond angle in H_2O is smaller than the H — C — H bond angle in CH_4.

65. Option (c) is correct.

$$K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$$

Green

66. Option (b, d) is correct.

According to Gibb's Helmholtz equation we get,

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

When $\Delta H < 0$ and $\Delta S > 0$

$$\Delta G = (-ve) - T(+ve),$$

Then at all temperature,

$$\Delta G = -ve,$$

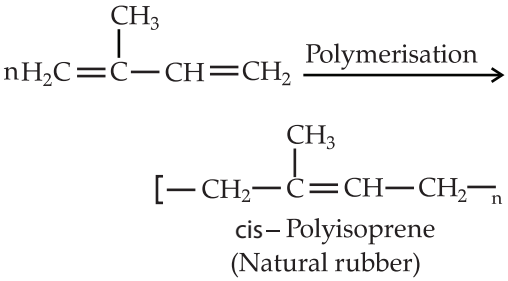
spontaneous reaction

And when $\Delta H < 0$ and $\Delta S = 0$

$\Delta G = (-ve) - T(0) = -ve$ at all temperatures.

67. Option (d) is correct.

Chemically natural rubber is *cis*-poly isoprene



cis – Polyisoprene
(Natural rubber)

68. Option (a, b) is correct.

First ionisation energy is the minimum of energy required to remove the electron from an isolated gaseous atom in it's lowest energy state that is ground state to form a gaseous cation. Half filled orbital is more stable than partial filled orbital. Therefore the order is

$$B < C < O < N$$

Electron gain enthalpy is the amount of energy released when an electron is added to an isolated gaseous atom to form an gaseous ion. Though F is more electronegative than Cl. But inter electronic repulsion for F is more than Cl. So the order is

$$I < Br < F < Cl$$

Down the group atomic radius increases due to addition of extra electronic shell.

Li < Na < K < Rb (increasing metallic radius)

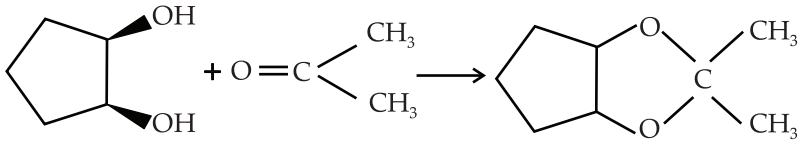
Nuclear per electron attraction is related with ionic radius inversly. Therefore increasing ionic size is

$$Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$$

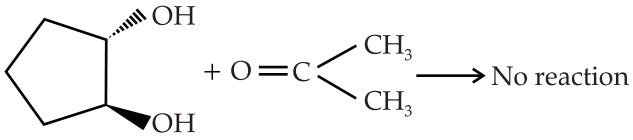
(for iso-electronic species)

69. Option (d) is correct.

With acetone *cis* – cyclopenta – 1, 2 – diol can formed ketal but acetone can't react with transcyclopenta –1, 2 diol.



cis – cyclopenta –1, 2 – diol | Acetone | Cyclic ketal



Trans – cyclopenta –1, 2 – diol | Acetone

70. Out of Syllabus

71. Option (d) is correct.

Fog is a colloidal solution in which disperse phase is liquid and dispersion medium is gas.

72. Option (a) is correct.

Enthalpy of bond dissociation decreases as the bond distance increases from F_2 to I_2 on account of increase of size of atom down the group. As the size of atom is small, the electron – electron repulsions between the lone pair experienced greater. Thus, bond dissociation enthalpy of F_2 is smaller than Cl_2 even than that of Br_2. Therefore the order of bond dissociation enthalpy is

$$Cl_2 > Br_2 > F_2 > I_2$$

73. Out of Syllabus

74. Out of Syllabus

75. Option (d) is correct.

$$P_B = x_B P^o_B$$

And $$P_T = x_T P^o_T$$

P_B = vapour pressure of benzene solution

x_B = mole fraction of benzene

P^o_B = vapour pressure of pure benzene

P_T, x_T, P^o_T have their usual meaning.

Again $x_B = \frac{1}{2}$ and $x_T = \frac{1}{2}$ (By the problem)

$$P_B = \frac{1}{2} \times P^o_B = \frac{1}{2} \times 12.8 \text{ kPa} = 6.4 \text{ kPa}$$

$$P_T = \frac{1}{2} \times P^o_T = \frac{1}{2} \times 3.85 \text{ kPa} = 1.925 \text{ kPa}$$

Therefore the vapour will contain a high percentage of benzene because partial pressure of benzene is higher compared to that of toluene.

76. Option (b) is correct.

The interaction between lone pair of electron and vacant orbital is known as back bonding. When metal is in metal carbonyl complex metal possesses negative charge the tendency of back bonding increases and that is why bond length of C—O bond increases while bond length of metal carbon bond decreases. On account of above phenomenon $[Fe(CO)_4]^{2-}$ has longest C—O bond length among the given complexes and the order is

$[Mn(CO)_6]^+ < Ni(CO)_4 < [Co(CO)_4]^- < [Fe(CO)_4]^{2-}$

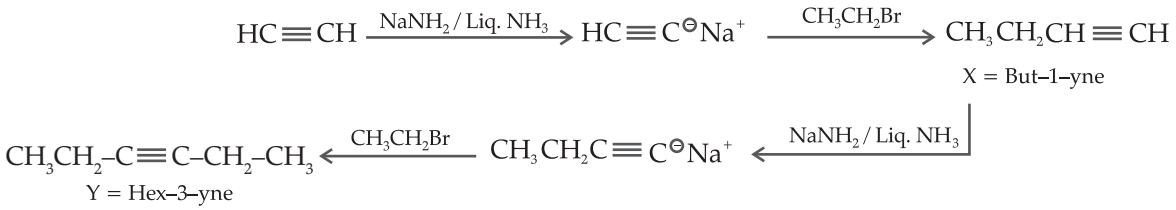
77. Option (a) is correct.

Acidity ∝ oxidation state

Therefore acidity order in

$$\overset{+1}{HClO} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4}$$

78. Option (d) is correct.



X = But–1–yne

Y = Hex–3–yne

79. Option (a) is correct.

For MY ; $MY \rightleftharpoons M^+ + Y^-$

$s \quad s \quad s$

$\therefore$ Solubility product (K_{sp}) = $[M^+]\,[Y^-]$

$= s \times s = s^2$

$$\Rightarrow s = \sqrt{K_{sp}} = \sqrt{6.2 \times 10^{-13}} = 7.874 \times 10^{-7}$$

For NY_3; $NY_3 \rightleftharpoons N^{3+} + 3Y^-$

$s \quad s \quad 3s$

$K_{sp} = [N^{3+}]\,[Y^-]^3$

$= s \times (3s)^3 = 27s^4$

$$s = \sqrt[4]{\frac{6.2 \times 10^{-13}}{27}} = 3.89 \times 10^{-4}$$

Hence molar solubility of MY in water is less than that of NY_3.

80. Option (a) is correct.

Nitration of benzene is an electrophilic substitution reaction where electrophile is nitronium ion $\left(NO_2^+\right)$.

The nitronium ion is formed by the following reaction.

$$2H_2SO_4 + HNO_3 \rightarrow 2HSO_4^- + NO_2^+ + H_3O^+$$

When large amount of $KHSO_4$ is added to the mixture, the rate of nitration decreases due to presence common ion effect of HSO_4^- ion and lowers the concentration of NO_2^+ ion.

81. Option (d) is correct.

The product formed by the reaction of an aldehyde with a primary amine is Schiff base.

$$R-CH=O + H_2N-R \xrightarrow{-H_2O} R-CH=N-R$$

Schiff's base

82. Option (d) is correct.

For water, pH = 7

$-\log [H^+] = 7$

$\Rightarrow \quad [H^+] = 10^{-7}$

$2H^+(aq) + 2e^- \rightarrow H_2(g)$

$$E_{cell} = E^o_{cell} - \frac{0.0591}{2}\log\frac{p_{H_2}}{[H^+]^2}$$

$$\Rightarrow \quad 0 = 0 - \frac{0.0591}{2}\log\frac{p_{H_2}}{[H^+]^2}$$

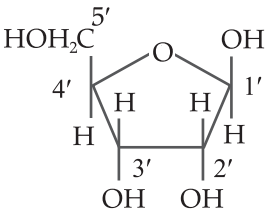
$$\Rightarrow \quad \frac{p_{H_2}}{[10^{-7}]^2} = 1$$

$\because \quad [\log 1 = 0]$

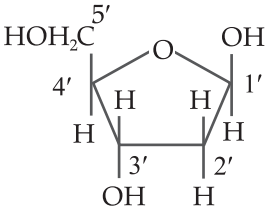
$\Rightarrow \quad p_{H_2} = 10^{-14}$ atm

83. Option (a) is correct.

The sugar unit of DNA in deoxyribose and that of RNA is ribose. C–atoms of pentose sugar are distinguished from the C-atoms of nitrogenous base by marking them with numbers like 1′, 2′, 3′ (giving priority as 1, 2 and so on)



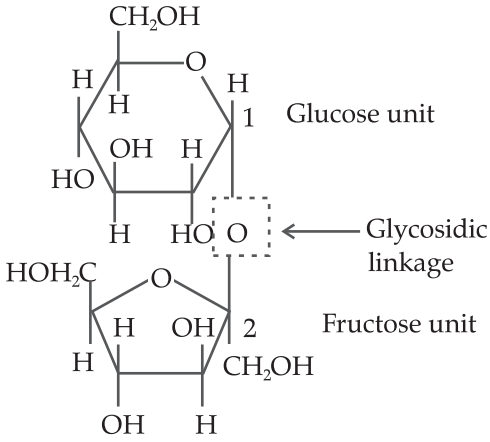
D – ribose



D – 2 – deoxyribose

84. Option (c) is correct.

When two monosaccharide units are linked through their respective carbonyl groups (reducing centres), the disaccharide is known as non reducing *e.g.* Sucrose.



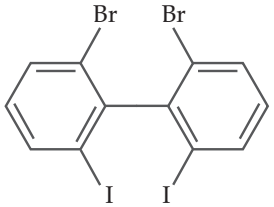
85. Out of Syllabus

86. Option (c) is correct.

The equation is Clausius – Clapeyron equation

87. Option (a) is correct.

Substituted biphenyl can have a chiral axis when steric (Vander Waal's repulsion) interaction between ortho substituents are sufficient to stop rotation of aromatic ring relative to each other about the bond joining the two rings.



Optically active

88. Out of Syllabus

89. Out of Syllabus

90. Option (d) is correct.

We know rate constant for first order reaction,

$$K = \frac{2.303}{t_2 - t_1} \log \frac{[A]_1}{[A]_2}$$

$$\Rightarrow \quad K = \frac{2.303}{t_2 - t_1} \log \frac{[\text{rate}]_1}{[\text{rate}]_2}$$

$$\Rightarrow \quad K = \frac{2.303}{20 - 10} \log \frac{0.04}{0.03} = 0.0287 \text{ s}^{-1}$$

$$\therefore \quad T_{1/2} = \frac{0.693}{K} = \frac{0.693}{0.0287 \text{ sec}^{-1}} = 24.14 \text{ s}$$

BIOLOGY

91. Option (d) is correct.

The animals that belong to class Chondrichthyes are marine animals. They have streamlined body. The mouth is located on the ventral side. Their endoskeleton is cartilaginous. Notochord is present throughout the life. Gill slits are separated without operculum.

92. Option (d) is correct.

At the age of puberty, the gonadotropin releasing hormones stimulates the anterior pituitary to secrete FSH and LH. These two hormones stimulate the follicular growth, secretion of estrogen. When the estrogen levels increase, give negative feedback effect on secretion of FSH and LH. After ovulation, the corpus luteum secrets large amounts of progesterone. Both the estrogen and progesterone changes in the GnRH pulse frequency in females during every menstrual cycle.

93. Option (a) is correct.

The electron microscopic structure of cilia shows the presence of axoneme. It possesses a number of microtubules which are arranged parallel to the long axis. The axoneme has nine pairs of peripheral microtubules arranged radially and a pair of central microtubules. They are common constituents of spindle fibers, centrioles and cilia.

94. Option (b) is correct.

Mitochondria and chloroplast are called semi-autonomous organelles. Because they have their own DNA and 70S ribosomes. They are distributed between the two daughter cells during cytokinesis. But they are formed by the division of pre-existing organelles. They can synthesize their own protein and have self-replication mechanism. Hence, they are called semi-autonomous organelles.

95. Option (a) is correct.

The retina consists of two cells called rods and cones. The rods contain reddish-purple pigment called rhodopsin. The rhodopsin is made up of two proteins called opsin and retinal. The aldehyde form of vitamin-A is called retinal. Retinol is alcohol form of vitamin-A. Upon absorption of light, the retinol is converted into retinal.

96. Option (a) is correct.

The protists are single celled eukaryotic cells. Most of the members of protists are plants, animals and fungi. Chrysophytes, Dinoflagellates, Euglenoids, Protozoan, and slime moulds are included in the kingdom Protista.

97. Option (b) is correct.

Bacteria which can live in extreme conditions like extreme salty areas, hot springs and marshy areas. They are called archaebacteria. They have different structure of cell wall which help them to survive in extreme conditions. Methanogens is one of a kind of archaebacteria that lives in the gut of ruminants like cows and buffaloes. They produce methane gas during the process of fermentation in the gut.

98. Option (a) is correct.

Ovary secretes three main hormones called estradiol, progesterone, and inhibin. The inhibin is secreted by granulosa cells of ovarian follicles and corpus luteum. The anterior pituitary is the target organ of inhibin and inhibits the secretion of FSH.

99. Option (a) is correct.

If the rate of metabolism is observed when an organism is in resting and relaxed position at normal temperature, it is called basal metabolic rate(BMR). The BMR is always inversely proportional to the body weight. The small animal will have more BMR, so that they can get more energy. So they can run uphill easily than that of the larger animals.

100. Option (d) is correct.

Parents : Tall (TT) × Dwarf (tt)

Gametes : (T) × (t)

F_1-generation (Tt)

(Heterozygous tall)

When F_1 is self-pollinated, they produce two types of gametes with T and t. They are represented in the given checker board.

	Pollen grain		
	(T)	(t)
Egg (T)	(TT)	(Tt)
Egg (t)	(Tt)	(tt)

Offsprings with TT are homozygous tall 25%

Offsprings with Tt are heterozygous tall 50%

Offsprings with tt are homozygous dwarf 25%

Phenotypic ratio is 1 : 3

Genotypic ratio is 1 : 2 : 1

101. Option (a) is correct.

Ozone is one of the greenhouse gases. It is located at the height of 16-23 km from the surface of the earth. When oxygen absorbs ultra violet rays, it is converted into ozone. It is a layer formed in the stratosphere of atmosphere. It prevents the entry of UV to reach the earth. Due to the release of CFCs, it is depleted. This can lead to form holes in the ozone layer and will allow to reach the UV radiation to earth to cause skin cancer.

102. Option (a) is correct.

The cropland ecosystem is a natural ecosystem. It can operate as self-regulating system without any manipulations and without direct interference. It is one of the largest anthropogenic ecosystems with less diversity and higher productivity.

103. Option (d) is correct.

The members of Liliaceae are called 'Lily family'. They are a characteristic representative of monocotyledonous plant. They show solitary or cymose inflorescence. The androecium consists of six stamen. The gynoecium is tricarpellary, syncarpous, superior ovary, trilocular with several ovules. The plants like onion, garlic, indigo, and tulip belong to this family.

104. Option (c) is correct.

The elements like carbon, hydrogen, oxygen, nitrogen, phosphorous, sulphur, potassium, magnesium and calcium are examples of macronutrients. The elements like iron, copper, manganese, zinc, molybdenum, boron, nickel, and chlorine are examples of micronutrients.

105. Option (b) is correct.

The effect of pCO_2, and hydrogen ion concentration on oxygen affinity of hemoglobin is called Bohr effect. At tissues level, there is low pO_2, high pCO_2, and low pH in the blood. These conditions lead to dissociation of oxyhemoglobin into oxygen and hemoglobin. The oxygen dissociation curve shifts to the right.

106. Option (b) is correct.

Sustained contraction of muscles due to repeated stimulus is called tetanus. It is caused by *Clostridium tetani*. The tetanus toxins block glycine release. This will cause overstimulation and spastic paralysis of muscles.

107. Option (b) is correct.

The true bacteria are called eubacteria. They have rigid cell wall, flagellum and are motile. Cyanobacteria, photosynthetic, and chemosynthetic autotrophs belong to these eubacteria.

108. Option (d) is correct.

The restriction endonucleases are called molecular scissors which cut the DNA at a specific sequence. They cleave a DNA molecule at unique sites. *EcoRI* and *Hind* II are examples restriction endonucleases.

109. Option (d) is correct.

Lichens are symbiotic association between algae and fungi. The algal component is called phycobiont and fungal component is called mycobiont. The lichens release some acids which dissolve the rock particles. This will cause weathering of rocks to form soil. The lichens are pioneer organisms on bare rocks.

110. Option (a) is correct.

The stomata is the only opening through which exchange of gases like oxygen, carbon dioxide, and water will take place. But, diffusion of carbon dioxide and water vapour occurs together as it depends on the partial pressure of their respective gases inside of the cells and surrounding air.

111. Option (c) is correct.

The embryo of monocotyledonous seed is small and situated in a groove at one of the endosperms. It has one large and shield shaped cotyledon called scutellum. It also consists of a short axis with a plumule and a radicle. The plumule and radicle are present in a sheath called coleoptile and coleorhiza respectively. So, the cotyledons of maize are called scutellum.

112. Out of Syllabus

113. Out of Syllabus

114. Option (b) is correct.

Proteins and amino acids are metabolised in the liver. During this metabolism, the $-NH_3$ of amino acids are converted into urea. This urea is collected into the hepatic vein. There it is filtered in the kidney.

115. Option (a) is correct.

The term ecosystem was coined by AG Tansley. He proposed that, abiotic factors are physical and chemical conditions. The living things are called biotic factor. He proposed that both biotic and abiotic factors are components of nature and inter-related to each other.

116. Option (b) is correct.

Lac operon consists of one regulatory gene and three structural genes. The structural genes are needed to metabolise lactose. *Lac* operon is induced by lactose. Hence, it is called inducible operon. So, lactose is an inducer to express the three structural genes.

117. Option (c) is correct.

Clostridium butylicum produces butyric acid by the process of fermentation. It does not produce lipase. Lipase is produced by *Candida albicans*.

118. Option (d) is correct.

In logistics growth model population growth equation can be described as follows:

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

Where, N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

When $\frac{N}{K} = 1$ then $\frac{K-N}{L} = 0$

Therefore, $\frac{dN}{dt} = 0$

119. Option (d) is correct.

The microsporangium is surrounded by four layers called epidermis, endothecium, middle layer and tapetum. Tapetum is the innermost layer which provides nourishment for the developing pollen grains. It contains dense cytoplasm.

120. Option (c) is correct.

Most of the primitive plants like algae, bryophytes, and pteridophytes lives in water. Most of them are aquatic plants. They use water as transporting medium for their reproduction. They use water for the transfer of male gametes to reach the female gametes to carry out fertilisation.

121. Option (d) is correct.

Nepenthes is an insectivorous plant. Their pitcher is a kind of modified leaf which is used to trap insects.

122. Option (b) is correct.

Lysosome is spherical shaped organelle. It is covered with single membrane. It contains degradative enzymes. It is called suicidal bags of the cell. The remaining organelles are double membrane structures.

123. Option (a) is correct.

Analogous structure is the result of convergent evolution. The structure and design of organs are different but they have similar functions. Such type of evolution is called convergent evolution. The eye of the octopus and mammals is an example of convergent evolution.

124. Option (c) is correct.

Glycine is a simple amino acid. It has an aliphatic side chain. The functional group R is replaced by hydrogen atom. It is not a Sulphur containing amino acid. Cysteine and methionine are sulphur containing amino acid.

125. Option (c) is correct.

Stamen is the male part of the flower. It has two parts called filament and anther. Filament is long and slender stalk like structure. The terminal part is bilobed structure called anther. The proximal end of the filament is attached to either thalamus or petals of the flower.

126. Option (a) is correct.

Zinc finger is a small protein consisting of a loop of amino acids which protrude from zinc binding site. It is also called zinc finger motif. It forms a DNA binding domain found in several transcription factor. The zinc finger analysis is not required for techniques of DNA finger printing.

127. Option (b) is correct.

Birds are oviparous animals whereas mammals are viviparous animals. The viviparity is not shared by both birds and mammals. The remaining characteristics are shared by both of them.

128. Option (b) is correct.

The female reproductive cycle is called menstrual cycle. It has two phases called follicular and luteal phase. During follicular phase, higher levels of estrogen stimulates the anterior pituitary to reduce the secretion of FSH and LH. Hence, the FSH and LH rise steadily during follicular phase.

129. Option (d) is correct.

Thyroxine and tri-iodothyronine are derived from tyrosine which has iodine. Melatonin and serotonin are derived from tryptophan amino acid.

130. Out of Syllabus

131. Option (d) is correct.

Chitin is a kind of polysaccharide. It is made up of N-acetyl glucosamine or galactosamine. It is found mainly in the cell wall of fungi and exoskeleton of arthropods.

132. Option (d) is correct.

The ribosome are the sites of protein synthesis. Bacteria consist of 70S ribosomes. Several ribosomes are attached to a single messenger RNA to form a chain like structure called polyribosomes, simply called polysome.

133. Optiossn (b) is correct.

Parapodia are a pair of lateral appendage found in annelids like Nereis. These parapodia helps in swimming.

134. Option (a) is correct.

Asthma is an allergic disease which involves the severe inflammation and constriction of bronchioles. Some species of pollen grain can cause severe allergic reaction of mast cells in the lungs. This leads to asthma.

135. Option (c) is correct.

The sickle cell anemia is an example of autosomal recessive disorder. It is caused due to frame shift mutation which leads to the replacement of valine in the place of glutamic acid. These results in the formation of abnormal hemoglobin. The remaining three options are correct.

136. Option (c) is correct.

Insulin is a hormone produced by the beta cells of Islet of langerhans. It is synthesised as pro-insulin. It is made up of two polypeptide chain A and B in the initial stage along with a stretch of C peptide. Later these two polypeptides are linked by disulphide linkage by removing a stretch of C-peptide.

137. Option (c) is correct.

The primary endosperm nucleus undergoes successive nuclear division to develop free nuclear endosperm. Then formation of cell wall occurs to become cellular. The coconut water from tender coconut is nothing but free-nuclear endosperm. It is made up of thousands of nuclei surrounding the white kernel. It is rich in nutrients and cytokinin.

138. Option (c) is correct.

Plasmid is an extrachromosomal DNA of bacteria. It is double stranded, circular DNA. Discovery of plasmid lead to the revolution in biotechnology approaches in research field.

139. Option (a) is correct.

The Ganges River Dolphin was declared officially as National Aquatic Animal of India in the year of 1801 to save from extinction. It resides in freshwater and brackish water.

140. Option (b) is correct.

The *Avena* curvature test is a kind of bioassay. It is used for the bioassay of auxin growth regulators.

141. Option (b) is correct.

All the above-mentioned options cause loss of biodiversity. Among them the habitat loss and fragmentation is the most important cause to drive the plant and animals to extinction.

142. Option (c) is correct.

The sterilisation procedure in the males is known as 'vasectomy'. It is a kind of surgical intervention that blocks the transport of gametes. A small part of vas deference is removed or tied by a small incision on the scrotum. It does not affect the process of spermatogenesis.

143. Option (b) is correct.

Test cross is used to determine the genotype of a tall plant at F_2 generation. When a dominant phenotype is crossed with recessive parent, the parental types of offspring are produced. Because two gene were linked and located on the same chromosome.

144. Option (a) is correct.

A fat molecule consists of a glycerol moiety linked with three fatty acids molecules by three ester bonds. Depending on the type of fat, the three fatty acids may be of the same or different types attached with ester bonds.

145. Option (a) is correct.

Dominant character is expressed in heterozygous organisms only, In co-dominance, both the heterozygous alleles are expressed. Pleiotropy is a single gene which can influence many characters. A single character governed by many genes is called polygenic inheritance.

146. Option (d) is correct.

The pollen grains of other species is incompatible. They do not germinate on the stigma. The pollen grains of the same species are germinated to produce pollen tubes. Only one pollen tube can penetrate through style and reach the embryo sac to release their male gametes.

147. Option (a) is correct.

During the embryonic development, *Periplaneta americana* shows the presence of determinate cleavage, but not intermediate and radial cleavage. It develops into nymph which is similar to its parent.

148. Option (c) is correct.

Anthocyanin is a water-soluble pigment found in vacuoles of plant cells. The colour of it depends on the pH of the fluid in vacuole. It may be red, blue, purple or black.

149. Option (a) is correct.

A condition in which, a cell with more than two genomes is called polyploidy. It can be autopolyploid or allopolyploid. Autopolyploid can be triploid, tetraploid, pentaploid, hexaploidy and so on. A cell containing more number of chromosomes shows the presence of polyploidy.

150. Option (a) is correct.

C_4 plants are well adapted to dry tropical regions. They have special leaf anatomy to tolerate higher temperature, shows response to high light intensity. They lack photorespiration and have more productivity of biomass, because they have efficient use of nitrogen mechanism.

151. Option (b) is correct.

The higher vertebrate have developed memory-based acquired immunity. This will enable them to differentiate foreign organisms. If this property is lost due to genetic disorders, our immune system will attack self-cells. This is called auto-immune disease. Rheumatoid arthritis is an example of auto-immune disease.

152. Option (a) is correct.

The quantum yield dropped very sharply when chlorella was illuminated with red light wave length more than 680 nm. This effect is called 'red drop'. He concluded that there are two different reaction centers involved in photosynthesis of green algae. These two reactions centers are called photosystem I and II. The irradiated light with the wave length of 680 and 700 nm above, increased rate of photosynthesis was observed. This is called enhancement effect.

153. Option (b) is correct.

Gymnosperms are plants with naked seeds. The seeds remain exposed. They are not enclosed in fruits. They are either medium sized or tall trees. *Sequoia* is a giant redwood tree which is one of the tallest tree species.

154. Option (c) is correct.

Pairing of homologous chromosomes during zygotene is called synapsis. It is accomplished by synaptonemal complex. Zygotene is sub-phase of prophase-1 of meiosis-I. The remaining options are characteristics of somatic mitosis.

155. Option (b) is correct.

The blood pressure in pulmonary artery is more than pulmonary vein. Hence, the wall of pulmonary artery is thick and elastic. The walls of pulmonary vein are thin.

156. Option (c) is correct.

If we observe the internal structure and anatomy of forelimbs of some animals, they show some common pattern in the arrangement of bones. But their functions are different. This type of evolution is

called divergent evolution and the organs are called homologous organs. The wings of birds and flippers of whales are modified fore limbs. These two organs have same pattern in the arrangement of bones, but differ in their functions.

157. Option (c) is correct.

Generally, the seeds are produced after fertilisation. But in some flowering plants, seeds are produced without fertilisation. This is called apomixis. Apomixis is a kind of asexual reproduction which mimics the sexual reproduction. For e.g., some species of *Asteraceae* and grasses.

158. Option (d) is correct.

Emphysema is a kind of chronic obstruction pulmonary disease. It is caused due to chronic cigarette smoking. It is characterised by breakdown of alveolar walls. This will reduce the ability to oxygen in the blood.

159. Option (a) is correct.

During metaphase of mitosis, the spindle fibers arising from the centrioles are attached to the kinetochore of the chromosome. During anaphase, the spindle fibers are contracted to pull the chromosome towards the poles. This will segregate the chromosome into daughter nuclei.

160. Option (c) is correct.

Some of the amniotic fluid is collected from the developing foetus to detect some genetic disorders like down syndrome, sex determination, hemophilia, and survivability of the foetus between 14-16 weeks pregant. It is not used to determine the cleft palate. It can be detected by sonography.

161. Option (b) is correct.

Phylloclades are modified stems. The stem is succulent and fleshy. They can carry out photosynthesis like leaves. The leaves are modified as spine or thorns. This is a characteristic of desert plant.

162. Option (a) is correct.

The process of splitting of water molecule by activated chlorophyll is called photolysis. The photolysis takes place in the lumen of the thylakoid. During photolysis, more protons are produced. These protons are used to reduce NADP to $NADPH_2$ in the stroma.

163. Option (d) is correct.

The system of providing a name with two components is called binomial nomenclature. This system was introduced by Carolus Linnaeus. The biological names must be written in Latin language and printed in italics. But the names are not written in any language.

164. Option (c) is correct.

The prophase-I of meiosis-I is divided into five phases called Leptotene, Zygotene, Pachytene, Diplotene, and Diakinesis. The crossing over takes place during pachytene. The chromosomes look like '*X*' during crossing over.

165. Out of Syllabus

166. Option (d) is correct.

Thermus aquaticus is a kind of thermophile which can live in hot springs. It can tolerate high temperature. The term Taq is derived from 'T' of Thermus 'aq' of aquaticus. Taq DNA polymerase is an enzyme used to replicate DNA. It is used in Polymerase chain reaction to clone DNA segments.

167. Option (a) is correct.

Haemophilia is X-linked recessive disorder. It is caused by mutations in X-chromosome. It is not inherited from father to son. The males are affected with this disorder because of single X-chromosome. The daughter acts as carriers of this disease. The X-linked recessive disorders tend to skip generation.

168. Option (b) is correct.

Among five petals, there is a largest petal which overlaps the two lateral wing petals, which in turn overlap the two smallest anterior petals. This type of aestivation is called vexillary or papilionaceous.

169. Option (c) is correct.

Meloidogyne incognita is a nematode parasite. It infects the roots of tobacco plants and cause severe reduction in the yield. RNA interference is adapted to prevent this infestation.

170. Option (c) is correct.

Viroids are virus like agents which is smaller than viruses. It is composed of naked strands of RNA. They do not have capsid coat. They have low molecular weight of RNA.

171. Option (c) is correct.

The two ends of the chromosomes are called telomere. The structural integrity and individuality of chromosome is maintained by telomere. When telomeres are damaged, they are highly unstable and tend to fuse with broken ends. Telomerase induce cancers in cells. The telomerase inhibitors are used as anti-cancer agents.

172. Option (d) is correct.

The inner lining of stomach contains columnar epithelium, Tendons connect muscles with bones, Tip of the nose contains elastic cartilage. The walls of the stomach contain smooth muscles.

173. Option (c) is correct.

Relaxin hormone is secreted by ovary during pregnancy. It helps in parturition. It also softens the public symphysis and relax the cervix. The hormone inhibin decreases the secretion of FSH and LH.

174. Option (a) is correct.

In the vicinity of guard cells, the cells become specialised in their shape and size called subsidiary cells. The stomatal aperture, guard cells and subsidiary cells together called stomatal apparatus.

175. Option (a) is correct.

The fertilisation in human beings is practically possible when the ovum and sperms are transported simultaneously to ampullary – isthmic junction of the fallopian tube.

176. Option (d) is correct.

The code which has at least three letters is called triplet code. There are about 64 codons to code for 20 amino acids. Among them AUG is the start codon. UAA, UAG, and UGA are called stop codon.

177. Option (c) is correct.

A river with inflow of domestic sewage which is rich in organic waste is decomposed by microbes. They use more dissolved oxygen during this process and causes depletion of oxygen. This results in increased biological oxygen demand. This will cause death of fishes due to lack of oxygen.

178. Option (b) is correct.

Chemoautotrophs are the earliest microorganisms on the earth. They do not carryout photolysis to release oxygen. Hence both the statements are correct.

179. Option (d) is correct.

Ley farming involves the rotation of crops with legume plants and grass pasture to improve the fertility and health of the soil. This method can also help in preventing pest by disrupting their life cycles.

180. Option (b) is correct.

Gause's 'Competitive Exclusion Principle' states that two closely related organisms compete for the same limiting resources in the same niche and cannot co-exist. The inferior one will be eliminated from the community.

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