BCECE
Engineering Entrance Exam
Solved Paper 2012

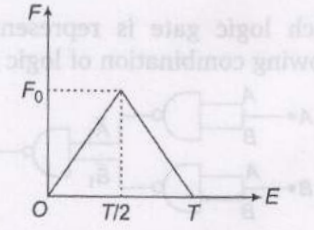
Physics

1. The dimensional formula of wave number is
   (a) $[M^0L^0T^0]$ (b) $[M^0L^{-1}T^0]$
   (c) $[M^0L^0T^{-1}]$ (d) $[M^{-1}L^{-1}T^0]$

2. A body of mass m is moving in a circle of radius r with a constant speed v. If a force $\frac{mv^2}{r}$ is acting on the body towards the centre, then what will be the work done by this force in moving the body over half the circumference of the circle?
   (a) Zero (b) $\frac{mv^2}{r^2}$
   (c) $\frac{mv^2}{r}\times\pi r$ (d) $\frac{\pi r^2}{mv^2}$

3. If under the action of a force $(4\mathbf{i}+\mathbf{j}+3\mathbf{k})$ N, a particle moves from position $\mathbf{r}_1=3\mathbf{i}+2\mathbf{j}-6\mathbf{k}$ to positions $\mathbf{r}_2=14\mathbf{i}+13\mathbf{j}+9\mathbf{k}$, then the work done will be
   (a) 50 J (b) 75 J
   (c) 100 J (d) 175 J

4. A particle of mass m moving with velocity u makes an elastic one dimensional collision with a stationary particle of mass m. They are in contact for a short time T. Their force of interaction increases from zero to F_0 linearly in time $\frac{T}{2}$ and decreases linearly to zero in further time $\frac{T}{2}$ (shown in figure). The magnitude of F_0 is



   (a) $mu/2T$ (b) mu/T
   (c) $2mu/T$ (d) None of these

5. Two planets revolves around the sun with frequencies N_1 and N_2 revolutions per year. If their average radii (orbital) be R_1 and R_2 respectively, then R_1/R_2 is equal to
   (a) $(N_1/N_2)^{2/3}$ (b) $(N_1/N_2)^{3/2}$
   (c) $(N_2/N_1)^{2/3}$ (d) $(N_2/N_1)^{3/2}$

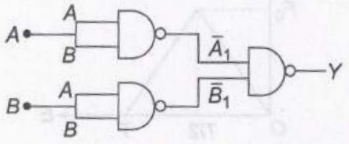
6. To what height water should be filled in a container of height 21 cm, so that it appears as half filled when viewed from the top $\left(\text{Take}_a\mu_w=\frac{4}{3}\right)$
   (a) 12 cm (b) 15 cm
   (c) 10.5 cm (d) 7 cm

7. A progressive wave is represented as $y=0.2\cos\pi\left(0.04t+0.2x-\frac{\pi}{6}\right)$ where distance is expressed in cm and time in second. What will be the minimum distance between two particles having the phase difference of $\frac{\pi}{2}$?
   (a) 4 cm (b) 8 cm
   (c) 25 cm (d) 12.5 cm

8. When the temperature increases, then the frequency of the sound produced by the organ pipe will
(a) unchanged (b) increases
(c) decreases (d) Not definite

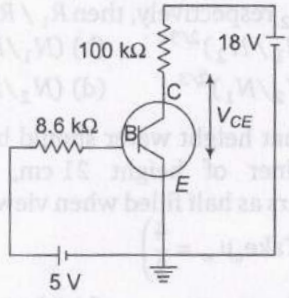
9. The distance between the poles of a horse shoe magnet is 0.1 m and its pole strength is 0.01 A-m. The induction of magnetic field at a point mid way between the poles will be
(a) Zero (b) 2×10^{-5} T
(c) 4×10^{-6} T (d) 8×10^{-7} T

10. Which logic gate is represented by the following combination of logic gates?



(a) OR (b) NAND
(c) XOR (d) None of these

11. For the transistor circuit shown in figure, if $\beta=100$, voltage drop across emitter and base is 0.7 V, then the value of V_{CE} will be



(a) Zero (b) 5 V
(c) 10 V (d) 13 V

12. If a uniform solid sphere and a disc of same mass and same radius rolls down on an inclined smooth plane from rest to the same distance, then the ratio of the time taken by them will be
(a) 15 : 14
(b) $\sqrt{14}:\sqrt{15}$
(c) 14 : 15
(d) $15^2:14^2$

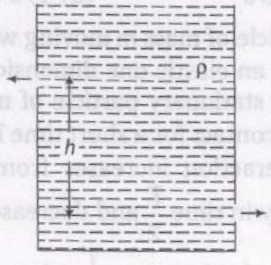
13. If a stone is projected from ground with a velocity 50 ms^{-1} and at an angle of 30°, it takes 3 s to cross a wall. How far beyond the wall the stone will strike the ground? (Take $g=10\,ms^{-2}$)
(a) 50.5 m (b) 91.5 m
(c) 86.6 m (d) 100 m

14. For a body starting from rest, what will be the ratio of the distance travelled by the body during the 4th and 3rd second during its journey?
(a) $\frac{7}{5}$ (b) $\frac{7}{3}$ (c) $\frac{5}{7}$ (d) $\frac{3}{7}$

15. If the compressibility of water is σ (sigma) per unit atmospheric pressure, then the decrease in volume V due to p, atmospheric pressure will be
(a) $\sigma V/p$ (b) σpV
(c) σ/pV (d) $\sigma p/V$

16. A soap film of surface tension 3×10^{-2} Nm^{-1} formed in a rectangular frame, can support a straw. If the length of the film is 10 cm, then the mass of the straw that film can support is
(a) 0.06 g (b) 0.6 g
(c) 6 g (d) 60 g

17. There are two identical small holes of area of cross section a on the either sides of a tank containing a liquid of density ρ (shown in figure). The difference in height between the holes is h. Tank is resting on a smooth horizontal surface. Horizontal force which will has to be applied on the tank to keep it in equilibrium is



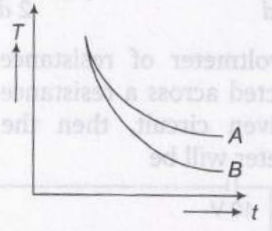
(a) $\frac{2gh}{\rho a}$ (b) $\frac{\rho gh}{a}$ (c) $gh\rho a$ (d) $2\rho agh$

18. Certain amount of an ideal gas of molecular mass M is contained in a closed vessel. If the vessel is moving with a constant velocity v, then the rise in temperature of the gas when the vessel is suddenly stopped will be
(Take $\gamma = \frac{C_p}{C_V}$)

(a) $\frac{Mv^2}{2R(\gamma+1)}$ (b) $\frac{Mv^2}{2R(\gamma-1)}$

(c) $\frac{Mv^2(\gamma-1)}{2R}$ (d) $\frac{Mv^2(\gamma+1)}{2R}$

19. Water and turpentine oil (specific heat less than that of water) are both heated to same temperature. Equal amounts of both are then placed in identical calorimeters and then left in air



(a) A and B will represent cooling curves of water and oil respectively
(b) B and A will represent cooling curves of water and oil respectively
(c) their cooling curves will be identical
(d) None of the above

20. By suspending a mass of 0.50 kg a spring is stretched by 8.20 m. If a mass of 0.25 kg is suspended, then its period of oscillation will be (Take $g = 10\,ms^{-2}$)

(a) 0.137 s (b) 0.328 s
(c) 0.628 s (d) 1.000 s

21. If the period of revolution of a nearest satellite around a planet of radius R is T then its period of revolution around another planet, having radius $3R$ and same density will be

(a) T (b) $3T$
(c) $3\sqrt{3}T$ (b) $9T$

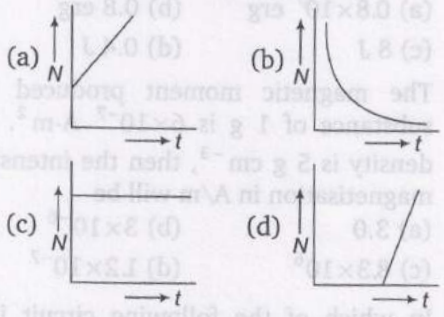
22. A body of mass m is suspended from a string of length l. What is the minimum horizontal velocity that should be given to the body at its lowest position so that it may complete one full revolution in the vertical plane with the point of suspension as the centre of the circle?

(a) $v = \sqrt{2lg}$ (b) $v = \sqrt{3lg}$
(c) $v = \sqrt{4lg}$ (d) $v = \sqrt{5lg}$

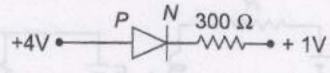
23. Rest mass energy of an electron is 0.54 MeV. If velocity of the electron is $0.8\,C$, then its kinetic energy will be

(a) 0.36 MeV
(b) 0.41 MeV
(c) 0.48 MeV
(d) 1.32 MeV

24. Which one of the following graphs represents the graph between the instantaneous concentration N of a radioactive element and time t?



25. In the circuit given below the value of current is

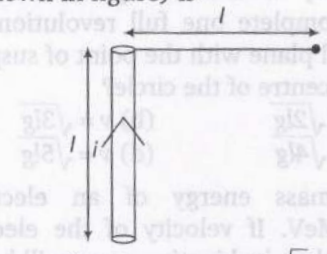


(a) 0 (b) 10^{-2} A
(c) 10^{2} A (d) 10^{-3} A

26. In a diode AM detector, the output circuit consists of $R = 1\,k\Omega$ and $C = 10\,pF$. A carrier signal of 100 k Hz is to be detected. Is it good?

(a) Yes
(b) No
(c) Information is not sufficient
(d) None of the above

27. Let a straight wire of length l carries a current i. The magnitude of magnetic field produced by the current at point P (as shown in figure) is



(a) $\frac{\mu_0 i}{2\sqrt{2}\pi l}$ (b) $\frac{\sqrt{2}\mu_0 i}{8\pi l}$

(c) $\frac{\mu_0 i}{4\pi l}$ (d) $\frac{\sqrt{2}\mu_0 i}{\pi l}$

28. 0.8 J work is done in rotating a magnet by 60°, placed parallel to a uniform magnetic field. How much work is done in rotating it 30° further?

(a) 0.8×10^7 erg (b) 0.8 erg

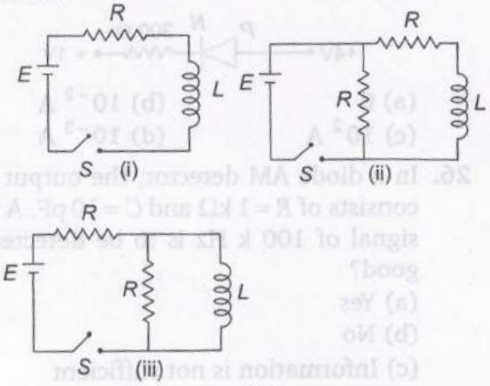
(c) 8 J (d) 0.4 J

29. The magnetic moment produced in a substance of 1 g is 6×10^{-7} A-m^2. If its density is 5 g cm^{-3}, then the intensity of magnetisation in A/m will be

(a) 3.0 (b) 3×10^{-6}

(c) 8.3×10^6 (d) 1.2×10^{-7}

30. In which of the following circuit is the current maximum just after the switch S is closed?



(a) (i) (b) (ii)

(c) (iii) (d) Both (ii) and (iii)

31. Let ABC is a right angled triangle in which $AB = 3$ cm and $BC = 4$ cm and $\angle ABC = 90°$. The three charges +15, +12 and −20 esu are placed on A, B and C respectively. The force acting on B will be

(a) Zero (b) 25 dyne

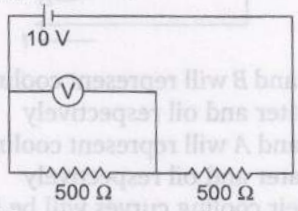
(c) 30 dyne (d) 150 dyne

32. Four plates of same area of cross-section are joined as shown in figure. The distance between each plate is d. The equivalent capacity between A and B will be

(a) $\frac{2\varepsilon_0 A}{d}$ (b) $\frac{\varepsilon_0 A}{d}$

(c) $\frac{3\varepsilon_0 A}{d}$ (d) $\frac{3\varepsilon_0 A}{2d}$

33. If a voltmeter of resistance 1000 Ω is connected across a resistance of 500 Ω in the given circuit, then the reading of voltmeter will be



(a) 1 V (b) 2 V (c) 6 V (d) 4 V

34. In the grid circuit of a triode a signal $E = 2\sqrt{2}\cos\omega t$ is applied. If $\mu = 14$ and $r_p = 10$ kΩ, then rms current flowing through $R_L = 12$ kΩ will be

(a) 1.5 mA (b) 1.27 mA

(c) 10 mA (b) 12.4 mA

35. A rigid body of mass m rotates with angular velocity ω about an axis at a distance a from the centre of mass C. The radius of gyration about C is K. Then, kinetic energy of rotation of the body about new parallel axis is

(a) $\frac{1}{2}mK^2\omega^2$ (b) $\frac{1}{2}ma^2\omega^2$

(c) $\frac{1}{2}m(a+K^2)\omega^2$ (d) $\frac{1}{2}m(a^2+K^2)\omega^2$

36. The angle of contact between glass and water is 0° and it rises in a capillary upto 6 cm when its surface tension is 70 dyne/cm. Another liquid of surface tension 140 dyne/cm, angle of contact 60° and relative density 2 will rise in the same capillary by

(a) 3 cm (b) 16 cm
(c) 12 cm (d) 24 cm

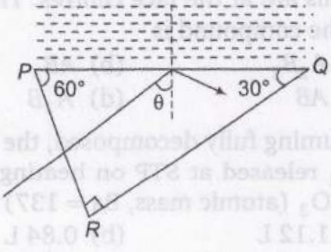
37. If the height of a mercury barometer is 75 cm at sea level and 50 cm at the top of a hill and the ratio of density of mercury to that of air is 10^4 then the height of the hill is

(a) 1.25 km (b) 2.5 km
(c) 250 m (d) 750 m

38. If the displacement equation of a particle from its mean position is given as $y = 0.2\sin(10\pi t + 1.5\pi)\cos(10\pi t + 1.5\pi)$ then, the motion of particle is

(a) non-periodic
(b) periodic but not SHM
(c) SHM with period 0.2 s
(d) SHM with period 0.1 s

39. Let PQR is a right angled prism with other angles as 60° and 30°. PQ has a thin layer of liquid and light falls normally on the face PR as shown in figure. If the refractive index of prism is 1.5, then for total internal reflection, maximum refractive index of liquid will be



(a) 1.2 (b) 1.3
(c) 1.4 (d) 1.5

40. According to corpuscular theory of light, the different colours of light are due to

(a) different size of the corpuscles
(b) different electromagnetic waves
(c) different force of attraction among the corpuscles
(d) None of the above

41. An antenna is a device

(a) that converts radio frequency signal into electromagnetic theory
(b) that converts electromagnetic energy into radio frequency signal
(c) that converts guided electromagnetic waves into free space electromagnetic waves and *vice-versa*
(d) None of the above

42. A resistor R, inductor L and a capacitor C are connected in series to an oscillator of frequency ν. If the resonant frequency is ν_r, then the current lags behind the voltage, when

(a) $\nu = 0$ (b) $\nu < \nu_r$
(c) $\nu > \nu_r$ (d) $\nu = \nu_r$

43. The instantaneous values of current and voltage in an AC circuit are $i = 100\sin 314t$ amp and $e = 200\sin\left(314t + \frac{\pi}{3}\right)$ V respectively. If the resistance is 1Ω, then the reactance of the circuit will be

(a) $\sqrt{3}\,\Omega$ (b) $100\sqrt{3}\,\Omega$
(c) $-200\sqrt{3}\,\Omega$ (d) $-200/\sqrt{3}\,\Omega$

44. When green light is incident on the surface of a metal, it emits photo electrons but there is no such emission with yellow colour light. Which one of the colour can produce emission of photo electrons?

(a) Red (b) Indigo
(c) Orange (d) None of these

45. If an electron jumps from the 4th orbit to the 2nd orbit of hydrogen atom, then the frequency of emitted radiation in the hertz will be

(Take Rydberg's constant, $R = 10^5\ \text{cm}^{-1}$)

(a) $\frac{3}{4}\times 10^{15}$ (b) $\frac{3}{16}\times 10^5$
(c) $\frac{3}{16}\times 10^{15}$ (d) $\frac{9}{16}\times 10^{15}$

46. If the ratio of radii of nuclei $^{27}_{13}Al$ and $^{A}_{52}X$ is 3 : 5, then the number of neutrons in the nuclei of X will be
(a) 13 (b) 52
(c) 100 (d) 73

47. Number of nuclei of a radioactive substance at time $t = 0$ are 1000 and 900 at time $t = 2$ s. What will be the number of nuclei at time $t = 4$ s?
(a) 810 (b) 800
(c) 790 (d) 700

48. A bar magnet has coercivity 4×10^3 Am^{-1}. It is desired to demagnetise it by inserting it inside a solenoid 12 cm long and having 60 turns. The current that should be sent through the solenoid is
(a) 8 A (b) 10 A
(c) 12 A (d) 14 A

49. A potentiometer is an ideal device of measuring potential difference because
(a) it uses a sensitive galvanometer
(b) it is an elaborate arrangement
(c) it has a long wire hence heat developed is quickly radiated
(d) it does not disturb the potential difference it measures

50. If the momentum of a body is increased by n times, then its kinetic energy increases
(a) n times
(b) n^2 times
(c) $2n$ times
(d) $\sqrt{n}$ times

Chemistry

1. When 1 mole gas is heated at constant volume, temperature is raised from 298 K to 308K. Heat supplied to the gas is 500 J. Then which statement is correct?
(a) $q = W = 500$ J, $\Delta U = 0$
(b) $q = \Delta U = 500$ J, $W = 0$
(c) $q = W = 500$ J, $\Delta U = 0$
(d) $\Delta U = 0$, $q = W = -500$ J

2. For the reaction, $2N_2O_5 \rightarrow 4NO_2 + O_2$ rate and rate constant are 1.02×10^{-4} and $3.4 \times 10^{-5}\ s^{-1}$ respectively, then concentration of N_2O_5 at that time will be
(a) 1.732 (b) 3
(c) 1.02×10^{-4} (d) 3.4×10^5

3. A human body required the 0.01 M activity of radioactive substance after 24 h. Half-life of radioactive substanu is 6 h. Then injection of maximum activity of radioactive substance that can be injected
(a) 0.08 (b) 0.04
(c) 0.16 (d) 0.32

4. Molarity of liquid HCl if density of solution is 1.17 g/cc
(a) 36.5 (b) 18.25
(c) 32.05 (d) 42.10

5. Which one of the following is not paramagnetic?
(a) NO (b) N_2^+ (c) CO (d) O_2^-

6. Among the following ions the $p\pi - d\pi$ overlap could be present in
(a) NO_2^- (b) NO_3^-
(c) PO_4^{3-} (d) CO_3^{2-}

7. A compound formed by elements A and B crystallises in the cubic structure where A atoms are at the corners of a cube and B atoms are at the face centres. The formula of the compound is
(a) A_2B_2 (b) AB_3
(c) AB (d) A_3B

8. Assuming fully decomposed, the volume of CO_2 released at STP on heating 9.85 g of $BaCO_3$ (atomic mass, Ba = 137) will be
(a) 1.12 L (b) 0.84 L
(c) 2.24 L (d) 4.06 L

9. The correct structure of $Fe(CO)_5$ is
(a) trigonal bipyramidal
(b) octahedral
(c) tetrahedral
(d) square pyramidal

10. Which one of the following forms a colourless solution in aqueous medium?
(a) V^{3+} (b) Cr^{3+} (c) Ti^{3+} (d) Sc^{3+}
(Atomic number Sc = 21, Ti = 22, V = 23, Cr = 24)

11. $_{92}U^{235}$ nucleus absorbs a neutron and disintegrate in $_{54}Xe^{139}$, $_{38}Sr^{94}$ and X so, what will be product X?
(a) 3-neutrons (b) 2-neutrons
(c) α-particle (d) β-particle

12. In hydrogen atom, energy of first excited state is –3.4 eV. Then KE of same orbit of hydrogen atom
(a) + 3.4 eV (b) + 6.8 eV
(c) – 13.6 eV (d) + 13.6 eV

13. Reaction,
$BaO_2(s) \rightleftharpoons BaO(s) + O_2(g); \Delta H = +$ ve.
In equilibrium condition, pressure of O_2 depends on
(a) increased mass of BaO_2
(b) increased mass of BaO
(c) increased temperature of equilibrium
(d) increased mass of BaO_2 and BaO both

14. Solution of 0.1 N NH_4OH and 0.1 N NH_4Cl has pH 9.25, then find out pK_b of NH_4OH.
(a) 9.25 (b) 4.75
(c) 3.75 (d) 8.25

15. van der Waals' real gas, acts as an ideal gas at which condition?
(a) High temperature, low pressure
(b) Low temperature, high pressure
(c) High temperature, high pressure
(d) Low temperature, low pressure

16. Unit of entropy is
(a) $JK^{-1}mol^{-1}$ (b) $J\ mol^{-1}$
(c) $J^{-1}K^{-1}mol^{-1}$ (d) $JK\ mol^{-1}$

17. $3A \longrightarrow B + C$
It would be a zero order reaction when
(a) the rate of reaction is proportional to square of concentration of A
(b) the rate of reaction remains the same at any concentration of A
(c) the rate remains unchanged at any concentration of B and C
(d) the rate of reaction doubles if concentration of B is increased to double

18. In electrolysis of NaCl when Pt electrode is taken then H_2 is liberated at cathode while with Hg cathode it forms sodium amalgam because
(a) Hg is more inert than Pt
(b) more voltage is required to reduce H^+ at Hg than at Pt
(c) Na is dissolved in Hg while it does not dissolved in Pt
(d) concentration of H^+ ions is larger when Pt electrode is taken

19. Which of the following statement is true?
(a) Silicon exhibits 4 coordination number in its compounds
(b) Bond energy of F_2 is less than Cl_2
(c) Mn(III) oxidation state is more stable than Mn(II) in aqueous state
(d) Elements of 15th group shows only +3 and +5 oxidation states

20. An atom has electronic configuration $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3, 4s^2$. You will place it in
(a) fifth group (b) fifteenth group
(c) second group (d) third group

21. The hypothetical complex chloro diaquatriammine cobalt (III) chloride can be represented as
(a) $[CoCl(NH_3)_3(H_2O)_2]Cl_2$
(b) $[Co(NH_3)_3(H_2O)Cl_3]$
(c) $[Co(NH_3)_3(H_2O)_2Cl]$
(d) $[Co(NH_3)_3(H_2O)_3]\,Cl_3$

22. In the silver plating of copper, $K[Ag(CN)_2]$ is used instead of $AgNO_3$. The reason is
(a) a thin layer of Ag is formed on Cu
(b) more voltage is required
(c) Ag^+ ions are completely removed from solution
(d) less availability of Ag^+ ions, as Cu cannot displace Ag from $[Ag(CN)_2]^-$ ion

23. $CuSO_4$ when reacts with KCN forms CuCN which is insoluble in water. It is soluble in excess of KCN due to the formation of the following complex

(a) $K_2[Cu(CN)_4]$ (b) $K_3[Cu(CN)_4]$
(c) $CuCN_2$ (d) $Cu[KCu(CN)_4]$

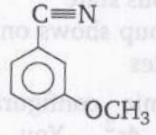
24. Zn gives H_2 gas with H_2SO_4 and HCl but not with HNO_3

(a) Zn act as oxidising agent when react with HNO_3
(b) HNO_3 is weaker acid than H_2SO_4 and HCl
(c) in electrochemical series Zn is above hydrogen
(d) NO_3^- is reduced in preference to hydronium ion

25. IUPAC name of the following is

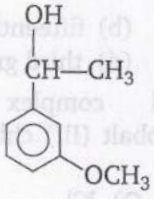
$CH_2=CH-CH_2-CH_2-C\equiv CH$

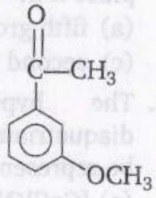
(a) 1, 5-hexenyne (b) 1-hexene-5-yne
(c) 1-hexyne-5-ene (d) 1, 5-hexynene

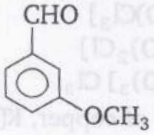
26. 

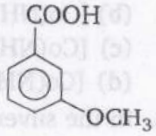
$+ CH_3MgBr \longrightarrow P$

Product '*P*' in the above reaction is

(a) 

(b) 

(c) 

(d) 

27. *n*-propyl alcohol and isopropyl alcohol can be chemically distinguished by which reagent?

(a) PCl_5
(b) Reduction
(c) Oxidation with potassium dichromate
(d) Ozonolysis

28. In the following reaction, product '*P*' is

$$R-\underset{\underset{O}{\|}}{C}-Cl \xrightarrow[Pd\text{-}BaSO_4]{H_2} P$$

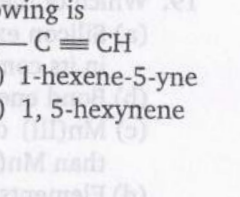
(a) RCH_2OH (b) $RCOOH$
(c) $RCHO$ (d) RCH_3

29. Enzymes are made up of

(a) edible proteins
(b) proteins with specific structure
(c) nitrogen containing carbohydrates
(d) carbohydrates

30. Geometrical isomers differ in

(a) position of functional group
(b) position of atoms
(c) spatial arrangement of atoms
(d) length of carbon chain

31. Monomer of 

is

(a) 2-methylpropene
(b) styrene
(c) propylene
(d) ethene

32. Which one of the following will have largest number of atoms?

(a) 1 g Au
(b) 1 g Na
(c) 1 g Li
(d) 1 g Cl_2

33. The size of isoelectronic species ; F^-, Ne, Na^+ is affected by

(a) nuclear charge (Z)
(b) valence principal quantum number (n)
(c) electron-electron interaction in the outer orbitals
(d) None of the factors because their size is the same

34. $\Delta U°$ of combustion of methane is $-X$ kJ mol^{-1}. The value of $\Delta H°$ is

(a) $= \Delta U°$ (b) $> \Delta U°$
(c) $< \Delta U°$ (d) $= 0$

35. In the sample of soft drink, the concentration of H^+ ion is 3.8×10^{-3} M. Its pH is

(a) 2 (b) 2.42

(c) 3 (d) 3.42

36. Which one of the following alkali metals gives hydrated salts?

(a) Li (b) Na (c) K (d) Cs

37. Boric acid is polymeric due to

(a) its acidic nature

(b) the presence of hydrogen bonds

(c) its monobasic nature

(d) its geometry

38. Which one of the following carbocation is most stable?

(a) $(CH_3)_3C\overset{+}{C}H_2$ (b) $(CH_3)_3\overset{+}{C}$

(c) $CH_3CH_2\overset{+}{C}H_2$ (d) $CH_3\overset{+}{C}HCH_2CH_3$

39. The best and latest technique for isolation, purification and separation of organic compounds is

(a) crystallisation (b) distillation

(c) sublimation (d) chromatography

40. Which one of the following vitamins is water soluble?

(a) Vitamin B (b) Vitamin E

(c) Vitamin K (d) Vitamin A

41. Which one of the following on reduction with lithium aluminium hydride yield a secondary amine?

(a) Nitroethane (b) Methyl isocyanide

(c) Acetamide (d) Methyl cyanide

42. Which one of the following ionic species has the greatest proton affinity to form stable compound?

(a) HS^- (b) NH_2^-

(c) F^- (d) I^-

43. The reaction,

$$CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-O-CH_2CH_3 + HI \xrightarrow{\Delta} ?$$

Which of the following compound will be formed?

(a) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-I + CH_3CH_2OH$

(b) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3 + CH_3CH_2OH$

(c) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2OH + CH_3CH_3$

(d) $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2OH + CH_3CH_2I$

44. Predict the product '*C*' obtained in the following reaction of butyne –1

$$CH_3CH_2-C\equiv CH + HCl \longrightarrow B \xrightarrow{HI} C$$

(a) $CH_3-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_2-CH_2I$

(b) $CH_3CH_2CH_2-\underset{\displaystyle Cl}{\underset{|}{\overset{\displaystyle I}{\overset{|}{C}}}}-H$

(c) $CH_3-\underset{\displaystyle I}{\underset{|}{CH_2CH}}-CH_2Cl$

(d) $CH_3CH_2-\underset{\displaystyle Cl}{\underset{|}{\overset{\displaystyle I}{\overset{|}{C}}}}-CH_3$

45. Sulphide ores of metals are usually concentrated by froth floatation process. Which one of the following sulphide ores offers an exception and is concentrated by chemical leaching?

(a) Argentite (b) Galena

(c) Copper pyrite (d) Sphalerite

46. The equilibrium constant of the reaction;

$Cu(s) + 2Ag^+(aq) \longrightarrow Cu^{2+}(aq) + 2\,Ag(s)$

$E° = 0.46$ V at 298 K

(a) 2.4×10^{10} (b) 2.0×10^{10}

(c) 4.0×10^{10} (d) 4.0×10^{15}

47. In the preparation of alkene from alcohol using Al_2O_3 which is effective factor?
(a) Porosity of Al_2O_3
(b) Temperature
(c) Concentration
(d) Surface area of Al_2O_3

48. Which one of the following is correct?
(a) On reduction any aldehyde gives secondary alcohol
(b) Reaction of vegetable oil with H_2SO_4 gives glycerine
(c) Alcoholic iodine with NaOH gives iodoform
(d) Sucrose on reaction with NaCl gives invert sugar

49. Which one of the following is correct about H-bonding in nucleotide?
(a) A-T, G-C
(b) A-G, T-C
(c) G-T, A-C
(d) A-A, T-T

50. Change in enthalpy for the reaction,
$2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$
if heat of formation of $H_2O_2(l)$ and $H_2O(l)$ are -188 and -286 kJ/mol respectively is
(a) -196 kJ/mol
(b) $+196$ kJ/mol
(c) $+948$ kJ/mol
(d) -948 kJ/mol

Mathematics

1. The complex numbers $\sin x + i\cos 2x$ and $\cos x - i\sin 2x$ are conjugate to each other for
(a) $x = n\pi$ (b) $x = \left(n + \frac{1}{2}\right)\pi$
(c) $x = 0$ (d) No value of x

2. The sum of the integers from 1 to 100 which are divisible by 3 and 5, is
(a) 2317 (b) 2632
(c) 315 (d) 2489

3. If $1 + \sin x + \sin^2 x + \ldots$ upto ∞
$= 4 + 2\sqrt{3}$, $0 < x < \pi$ and $x \neq \frac{\pi}{2}$, then x is equal to
(a) $\frac{\pi}{3}, \frac{5\pi}{6}$ (b) $\frac{2\pi}{3}, \frac{\pi}{6}$
(c) $\frac{\pi}{3}, \frac{2\pi}{3}$ (d) $\frac{\pi}{6}, \frac{\pi}{3}$

4. If $\alpha + \beta = -2$ and $\alpha^3 + \beta^3 = -56$, then the quadratic equation whose roots are α and β is
(a) $x^2 + 2x - 16 = 0$
(b) $x^2 + 2x + 15 = 0$
(c) $x^2 + 2x - 12 = 0$
(d) $x^2 + 2x - 8 = 0$

5. If one root of equation $x^2 + ax + 12 = 0$ is 4 while the equation $x^2 + ax + b = 0$ has equal roots, then the value of b is
(a) $\frac{4}{49}$ (b) $\frac{49}{4}$ (c) $\frac{7}{4}$ (d) $\frac{4}{7}$

6. If ${}^{2n+1}P_{n-1} : {}^{2n-1}P_n = 3 : 5$, then the value of n is equal to
(a) 4 (b) 3 (c) 2 (d) 1

7. The number of ways in which 5 boys and 5 girls can be seated for a photograph, so that no two girls sit next to each other is
(a) $6!\,5!$ (b) $(5!)^2$
(c) $\frac{10!}{(5!)}$ (d) $\frac{10!}{(5!)^2}$

8. The coefficient of x^{20} in the expansion of $(1 + 3x + 3x^2 + x^3)^{20}$ is
(a) ${}^{60}C_{40}$ (b) ${}^{30}C_{20}$
(c) ${}^{15}C_2$ (d) None of these

9. If $A = [a_{ij}]_{2\times 2}$, where $a_{ij} = i + j$, then A is equal to
(a) $\begin{bmatrix} 1 & 1 \\ 2 & 2 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}$
(c) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ (d) $\begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix}$

10. If $C = 2\cos\theta$, then the value of the determinant $\Delta = \begin{vmatrix} C & 1 & 0 \\ 1 & C & 1 \\ 6 & 1 & C \end{vmatrix}$ is

(a) $\frac{\sin 4\theta}{\sin\theta}$

(b) $\frac{2\sin^2 2\theta}{\sin\theta}$

(c) $4\cos^2\theta(2\cos\theta - 1)$

(d) None of the above

11. $\sin\left(2\sin^{-1}\sqrt{\frac{63}{65}}\right)$ is equal to

(a) $\frac{2\sqrt{126}}{65}$ (b) $\frac{4\sqrt{65}}{65}$

(c) $\frac{8\sqrt{63}}{65}$ (d) $\frac{\sqrt{63}}{65}$

12. If $\sec^{-1}\sqrt{1+x^2} + \text{cosec}^{-1}\frac{\sqrt{1+y^2}}{y} + \cot^{-1}\frac{1}{z} = \pi$, then $x + y + z$ is equal to

(a) xyz (b) $2xyz$ (c) xyz^2 (d) x^2yz

13. The value of x in $\left(0, \frac{\pi}{2}\right)$ satifying the equation $\sin x \cos x = \frac{1}{4}$ is

(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{12}$

(c) $\frac{\pi}{8}$ (d) $\frac{\pi}{4}$

14. The equation $\sqrt{3}\sin x + \cos x = 4$ has

(a) infinitely many solutions

(b) no solution

(c) two solutions

(d) only one solution

15. In a ΔABC, $2ac\sin\frac{A-B+C}{2}$ is equal to

(a) $a^2 + b^2 - c^2$

(b) $c^2 + a^2 - b^2$

(c) $b^2 - a^2 - c^2$

(d) $c^2 - a^2 - b^2$

16. From the top of a tower, the angle of depression of a point on the ground is 60°. If the distance of this point from the tower is $\frac{1}{\sqrt{3}+1}$ m, then the height of the tower is

(a) $\frac{4\sqrt{3}}{2}$ m (b) $\frac{\sqrt{3}+3}{2}$ m

(c) $\frac{3-\sqrt{3}}{2}$ m (d) $\frac{\sqrt{3}}{2}$ m

17. If the three points (0, 1), (0, – 1) and (x, 0) are vertices of an equilateral triangle, then the value of x are

(a) $\sqrt{3}, \sqrt{2}$ (b) $\sqrt{3}, -\sqrt{3}$

(c) $-\sqrt{5}, \sqrt{3}$ (d) $\sqrt{2}, -\sqrt{2}$

18. The equation of the straight line passing through the point (4, 3) and making intercepts on the coordinate axes whose sum is – 1, is

(a) $\frac{x}{2} + \frac{y}{3} = -1$ and $\frac{x}{-2} + \frac{y}{1} = -1$

(b) $\frac{x}{2} - \frac{y}{3} = -1$ and $\frac{x}{-2} + \frac{y}{1} = -1$

(c) $\frac{x}{2} + \frac{y}{3} = 1$ and $\frac{x}{-2} + \frac{y}{1} = 1$

(d) $\frac{x}{2} - \frac{y}{3} = 1$ and $\frac{x}{-2} + \frac{y}{1} = 1$

19. The angle between the lines represented by the equation $2x^2 + 3xy - 5y^2 = 0$ is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{2}$

(c) $\tan^{-1}\left|\frac{12}{5}\right|$ (d) $\tan^{-1}\left|\frac{7}{3}\right|$

20. The other end of the diameter through the point (–1, 1) on the circle $x^2 + y^2 - 6x + 4y - 12 = 0$ is

(a) (–7, 5) (b) (–7, – 5)

(c) (7, – 5) (d) (7, 5)

21. The number of common tangents to the circles $x^2 + y^2 = 4$ and $x^2 + y^2 - 6x - 8y + 24 = 0$ is

(a) 3 (b) 4

(c) 2 (d) 1

22. The distance between the foci of the conic $7x^2 - 9y^2 = 63$ is equal to
(a) 8 (b) 4
(c) 3 (d) 7

23. The two parabolas $x^2 = 4y$ and $y^2 = 4x$ meet in two distinct points. One of these is the origin and the other is
(a) (2, 2)
(b) (4, – 4)
(c) (4, 4)
(d) (–2, 2)

24. The sum of the series $1 + \frac{1}{3}\cdot\frac{1}{4} + \frac{1}{5}\cdot\frac{1}{4^2} + \frac{1}{7}\cdot\frac{1}{4^3} + \ldots\infty$ is
(a) $\log_e 1$ (b) $\log_e 2$
(c) $\log_e 3$ (d) $\log_e 4$

25. The coefficient of x^n in the series
$1 + \frac{a+bx}{1!} + \frac{(a+bx)^2}{2!} + \frac{(a+bx)^3}{3!} \ldots\infty$
(a) $\frac{(ab)^n}{n!}$ (b) $e^b \cdot \frac{a^n}{n!}$
(c) $e^a \cdot \frac{b^n}{n!}$ (d) $e^{a+b}\frac{(ab)^n}{n!}$

26. The angle between the lines whose direction cosines are $\left(\frac{\sqrt{3}}{4}, \frac{1}{4}, \frac{\sqrt{3}}{2}\right)$ and $\left(\frac{\sqrt{3}}{4}, \frac{1}{4}, -\frac{\sqrt{3}}{2}\right)$ is
(a) π (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{3}$ (d) $\frac{\pi}{4}$

27. A straight line which makes an angle of 60° with each of y and z-axes, this line makes with x-axis at an angle
(a) 30° (b) 60°
(c) 75° (d) 45°

28. If $\mathbf{a}$ and $\mathbf{b}$ are unit vectors and $|\mathbf{a} + \mathbf{b}| = 1$, then $|\mathbf{a} - \mathbf{b}|$ is equal to
(a) $\sqrt{2}$ (b) 1
(c) $\sqrt{5}$ (d) $\sqrt{3}$

29. If $ABCDEF$ is a regular hexagon with $\mathbf{AB} = \mathbf{a}$ and $\mathbf{BC} = \mathbf{b}$, then $\mathbf{CE}$ equals
(a) $\mathbf{b} - \mathbf{a}$ (b) $-\mathbf{b}$
(c) $\mathbf{b} - 2\mathbf{a}$ (d) None of these

30. If $\mathbf{a} = \mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$ and $\mathbf{b} = \mathbf{i} \times (\mathbf{a} \times \mathbf{i}) + \mathbf{j} \times (\mathbf{a} \times \mathbf{j}) + \mathbf{k} \times (\mathbf{a} \times \mathbf{k})$ then length of $\mathbf{b}$ is equal to
(a) $\sqrt{12}$ (b) $2\sqrt{12}$
(c) $3\sqrt{14}$ (d) $2\sqrt{14}$

31. Range of the function $f(x) = \frac{x}{1+x^2}$ is
(a) $(-\infty, \infty)$ (b) $[-1, 1]$
(c) $\left[-\frac{1}{2}, \frac{1}{2}\right]$ (d) $[-\sqrt{2}, \sqrt{2}]$

32. The domain of the real function $f(x) = \frac{1}{\sqrt{4-x^2}}$ is
(a) the set of all real numbers
(b) the set of all positive real numbers
(c) (–2, 2)
(d) [–2, 2]

33. $\lim_{x\to\infty}\left(\frac{x+a}{x+b}\right)^{x+b}$ is
(a) 1 (b) e^{b-a}
(c) e^{a-b} (d) e^b

34. The function $f(x) = |x| + \frac{|x|}{x}$ is
(a) continuous at the origin
(b) discontinuous at the origin because $|x|$ is discontinuous there
(c) discontinuous at the origin because $\frac{|x|}{x}$ is discontinuous there
(d) discontinuous at the origin because $|x|$ and $\frac{|x|}{x}$ are discontinuous there

35. If $f(x) = \frac{x}{1+|x|}$ for $x \in R$, then $f'(0)$ is
(a) 0 (b) 1
(c) 2 (d) does not exist

36. If $y = \sqrt{\frac{1+e^x}{1-e^x}}$, then $\frac{dy}{dx}$ is

(a) $\frac{e^x}{(1-e^x)\sqrt{1-e^{2x}}}$

(b) $\frac{e^x}{(1-e^x)\sqrt{1-e^x}}$

(c) $\frac{e^x}{(1-e^x)\sqrt{1+e^{2x}}}$

(d) $\frac{e^x}{(1-e^x)\sqrt{1+e^x}}$

37. If $f'(x) = \sin(\log x)$ and $y = f\left(\frac{2x+3}{3-2x}\right)$, then $\frac{dy}{dx}$ is

(a) $\frac{9\cos(\log x)}{x(3-2x)^2}$

(b) $\frac{9\cos\left(\log\frac{2x+3}{3-2x}\right)}{x(3-2x)^2}$

(c) $\frac{9\sin\left(\log\frac{2x+3}{3-2x^2}\right)}{(3-2x)^2}$

(d) None of the above

38. If $x = e^t \sin t$, $y = e^t \cos t$, t is a parameter, then $\frac{d^2y}{dx^2}$ at (1, 1) is equal to

(a) $-\frac{1}{2}$ (b) $-\frac{1}{4}$

(c) 0 (d) $\frac{1}{2}$

39. The slope of tangent to the curve $x = t^2 + 3t - 8$, $y = 2t^2 - 2t - 5$ at the point $(2, -1)$ is

(a) $\frac{22}{7}$ (b) $\frac{6}{7}$

(c) -6 (d) None of these

40. $\int \frac{1}{x\sqrt{x^2-1}}dx$ is equal to

(a) $\cos^{-1}x + C$

(b) $\sec^{-1}x + C$

(c) $\cot^{-1}x + C$

(d) $\tan^{-1}x + C$

41. $\int \frac{2x\tan^{-1}x^2}{1+x^4}dx$ is equal to

(a) $[\tan^{-1}x^2]^2 + C$

(b) $\frac{1}{2}[\tan^{-1}x^2]^2 + C$

(c) $2[\tan^{-1}x^2]^2 + C$

(d) None of the above

42. $\int_0^{\pi/2} \frac{d\theta}{1+\tan\theta}$ is equal to

(a) π (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{4}$

43. $\int_{-4}^{4} |x+2|dx$ is equal to

(a) 50 (b) 24

(c) 20 (d) None of these

44. The area bounded by the curve $y = x$, x-axis and ordinates $x = -1$ to $x = 2$ is

(a) 0 (b) $\frac{1}{2}$

(c) $\frac{3}{2}$ (d) $\frac{5}{2}$

45. The area enclosed between the curve $y = \log_e(x+e)$ and the coordinate axes is

(a) 3 (b) 4

(c) 1 (d) 2

46. The solution of $\frac{dy}{dx} + \sqrt{\left(\frac{1-y^2}{1-x^2}\right)} = 0$ is

(a) $\tan^{-1}x + \cot^{-1}x = C$

(b) $\sin^{-1}x + \sin^{-1}y = C$

(c) $\sec^{-1}x + \operatorname{cosec}^{-1}x = C$

(d) None of the above

47. The dice are thrown. The probability that the sum of the points on two dice will be 7, is
(a) $\frac{5}{36}$ (b) $\frac{6}{36}$ (c) $\frac{7}{36}$ (d) $\frac{8}{36}$

48. A horizontal force F is applied to a small object P of mass m on a smooth plane inclined to the horizontal at an angle θ. If F is just enough to keep P in equilibrium, then F is equal to
(a) $mg\cos^2\theta$ (b) $mg\sin^2\theta$
(c) $mg\cos\theta$ (d) $mg\tan\theta$

49. Let R be the relation on the set R, of all real numbers defined by aRb iff $|a-b| \leq 1$. Then, R is
(a) reflexive and symmetric
(b) symmetric only
(c) transitive only
(d) anti-symmetric only

50. The converse of the contrapositive of the conditional $p \rightarrow \sim q$ is
(a) $p \rightarrow q$ (b) $\sim p \rightarrow \sim q$
(c) $\sim q \rightarrow p$ (d) $\sim p \rightarrow q$

Answers

Physics

1. (b)	2. (a)	3. (c)	4. (c)	5. (c)	6. (a)	7. (c)	8. (b)	9. (d)	10. (a)
11. (d)	12. (b)	13. (c)	14. (a)	15. (b)	16. (b)	17. (d)	18. (c)	19. (a)	20. (c)
21. (a)	22. (d)	23. (a)	24. (b)	25. (b)	26. (b)	27. (b)	28. (a)	29. (a)	30. (b)
31. (b)	32. (c)	33. (d)	34. (b)	35. (d)	36. (a)	37. (b)	38. (d)	39. (b)	40. (a)
41. (c)	42. (c)	43. (a)	44. (b)	45. (d)	46. (d)	47. (a)	48. (a)	49. (d)	50. (b)

Chemistry

1. (b)	2. (b)	3. (c)	4. (c)	5. (c)	6. (c)	7. (b)	8. (a)	9. (a)	10. (d)
11. (a)	12. (a)	13. (c)	14. (b)	15. (a)	16. (a)	17. (b)	18. (b)	19. (b)	20. (a)
21. (a)	22. (d)	23. (b)	24. (d)	25. (b)	26. (b)	27. (c)	28. (c)	29. (b)	30. (c)
31. (a)	32. (c)	33. (a)	34. (c)	35. (b)	36. (a)	37. (b)	38. (b)	39. (d)	40. (a)
41. (b)	42. (c)	43. (d)	44. (d)	45. (d)	46. (d)	47. (b)	48. (c)	49. (a)	50. (a)

Mathematics

1. (d)	2. (c)	3. (c)	4. (d)	5. (b)	6. (a)	7. (a)	8. (a)	9. (d)	10. (d)
11. (a)	12. (a)	13. (b)	14. (b)	15. (b)	16. (c)	17. (b)	18. (d)	19. (d)	20. (c)
21. (b)	22. (a)	23. (c)	24. (c)	25. (c)	26. (c)	27. (d)	28. (d)	29. (c)	30. (d)
31. (c)	32. (c)	33. (c)	34. (c)	35. (b)	36. (a)	37. (d)	38. (a)	39. (b)	40. (b)
41. (b)	42. (d)	43. (c)	44. (d)	45. (c)	46. (b)	47. (b)	48. (d)	49. (a)	50. (d)

Hints & Solutions

Physics

1. Wave number $= \frac{1}{\lambda}$

   $\therefore$ Dimensions of wave number

   $= [M^0L^{-1}T^0]$

2. Work done by centripetal force is always zero. As the force is acting towards the centre so, the work done by this force in moving the body over half the circumference of the circle is zero.

3. Here, $\mathbf{r}_1 = 3\mathbf{i} + 2\mathbf{j} - 6\mathbf{k}$ and $\mathbf{r}_2 = 14\mathbf{i} + 13\mathbf{j} + 9\mathbf{k}$

   So, displacement, $(\mathbf{r}_2 - \mathbf{r}_1) = (14\mathbf{i} + 13\mathbf{j} + 9\mathbf{k}) - (3\mathbf{i} + 2\mathbf{j} - 6\mathbf{k})$

   $= 11\mathbf{i} + 11\mathbf{j} + 15\mathbf{k}$

   Hence, work done

   $= \mathbf{F} \cdot \mathbf{s}$

   $= (4\mathbf{i} + \mathbf{j} + 3\mathbf{k}) . (11\mathbf{i} + 11\mathbf{j} + 15\mathbf{k})$

   $= 44 + 11 + 45 = 100\ \text{J}$

4. In elastic one dimensional collision particle rebounds with same speed in opposite direction.

   So, change in momentum = $2\,mu$

   But, impulse = $F \times T$ = Change in momentum

   $\Rightarrow \quad F_0 \times T = 2\,mu$

   or $\quad F_0 = \frac{2mu}{T}$

5. According to Kepler's law of planetary motion

   $T^2 \propto R^3$

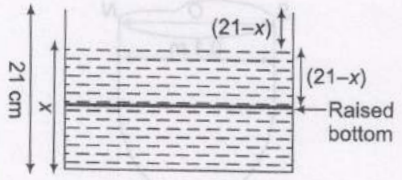
   If N is the frequency then

   $N^2 \propto (R)^{-3}$

   or $\quad \frac{N_2}{N_1} = \left(\frac{R_2}{R_1}\right)^{-3/2}$

   $\Rightarrow \quad \frac{R_1}{R_2} = \left(\frac{N_2}{N_1}\right)^{2/3}$

6. Let the water should be filled up to height x, so that bottom of the container should appear to be raised up to height $(21 - x)$.



   Apparent depth (from figure) $h' = (21 - x)$

   Real depth, $h = x$

   $\therefore \quad \mu = \frac{h}{h'}$

   $\frac{4}{3} = \frac{x}{21 - x}$

   $x = 12\ \text{cm}$

   Apparent depth (from figure) $h' = (21 - x)$

   Real depth, $h = x$

   $\therefore \quad \mu = \frac{h}{h'}$

   $\frac{4}{3} = \frac{x}{21 - x}$

   $x = 12\ \text{cm}$

7. On comparing the given equation with

   $y = a\cos(\omega t + kx - \phi)$

   we get, $\quad k = \frac{2\pi}{\lambda} = 0.02$

   and $\quad \lambda = 100\ \text{cm}$

   It is given that phase difference between particles, $\Delta\phi = \frac{\pi}{2}$

   So, the path difference between them,

   $\Delta p = \frac{\lambda}{2\pi} \times \Delta\phi$

   $= \frac{\lambda}{2\pi} \times \frac{\pi}{2} = \frac{\lambda}{4} = \frac{100}{4} = 25\ \text{cm}$

8. If the temperature increases, then the speed of sound increases.

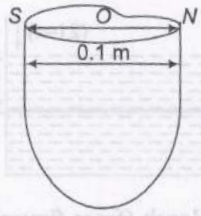
   Since, $f = \frac{v}{\lambda}$ and λ remains unchanged.

   Hence, frequency increases.

9. Net magnetic field at mid point O

$$B_{net} = B_N + B_S$$

where, B_N = magnitude of magnetic field due to N-pole



and B_S = magnitude of magnetic field due to S-pole

But, $$B_N = B_S = \frac{\mu_0}{4\pi}\frac{m}{r^2}$$

$$= \frac{4\pi \times 10^{-7} \times 0.01}{4\pi \times \left(\frac{0.1}{2}\right)^2} = 4 \times 10^{-7}\ \text{T}$$

$\therefore$ $$B_{net} = 8 \times 10^{-7}\ \text{T}$$

10. The truth table can be written as

Inputs		Output		
A_1	B_1	$\bar{A}_1$	$\bar{B}_1$	Y
0	0	1	1	0
0	1	1	0	1
1	0	0	1	1
1	1	0	0	1

The output Y is that of OR gate.

11. We have, $$i_b = \frac{5 - 0.7}{8.6} = 0.5\ \text{mA}$$

$\therefore$ $$i_c = \beta_{ib} = 100 \times 0.5\ \text{mA}$$
$$= 50\ \text{mA}$$

By using

$$V_{CE} = V_{CC} - i_C R_L$$
$$= 18 - 50 \times 10^{-3} \times 100$$
$$= 18 - 5 = 13\ \text{V}$$

12. By the relation,

$$t = \frac{1}{\sin\theta}\sqrt{\frac{2h}{g}\left(1 + \frac{K^2}{R^2}\right)}$$

We have

$$\frac{t_s}{t_D} = \frac{\sqrt{\left(1 + \frac{K^2}{R^2}\right)_S}}{\sqrt{\left(1 + \frac{K^2}{R^2}\right)_D}}$$

$$= \sqrt{\frac{1 + \frac{2}{5}}{1 + \frac{1}{2}}} = \sqrt{\frac{\frac{7}{5}}{\frac{3}{2}}} = \sqrt{\frac{14}{15}}$$

Hence $t_S : t_D = \sqrt{14} : \sqrt{15}$

13. Total time of flight

$$= \frac{2u\sin\theta}{g} = \frac{2 \times 50 \times 1}{2 \times 10} = 5\ \text{s}$$

Time to cross the wall = 3 s

$\therefore$ Time in air after crossing the wall

$$= (5 - 3) = 2\ \text{s}$$

So, distance travelled beyond the wall

$$= (u\cos\theta)t = 50 \times \frac{\sqrt{3}}{2} \times 2 = 86.6\ \text{m}$$

14. Using the relation $S_n = u + \frac{a}{2}(2n - 1)$

As the body starts from rest,

$\therefore$ $$u = 0$$

So, $$S_n = \frac{a}{2}(2n - 1)$$

$\therefore$ $$\frac{S_4}{S_3} = \frac{(2 \times 4 - 1)}{(2 \times 3 - 1)} = \frac{7}{5}$$

15. We have, compressibility

$$= \frac{\Delta V / V}{p} \Rightarrow \sigma = \frac{\Delta V}{pV}$$

or $$\Delta V = \sigma p V$$

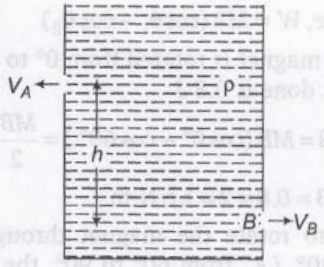
16. The weight of straw will be balanced by the force of surface tension.

Let the mass of straw is m, then

$$mg = 2Tl \text{ or } m = \frac{2Tl}{g}$$

$$= \frac{2 \times 3 \times 10^{-2} \times 10 \times 10^{-2}}{9.8}\ \text{kg}$$
$$= 0.6\ \text{g}$$

17.



Net force (reaction)

$$F = F_B - F_A = \frac{dp_B}{dt} - \frac{dp_A}{dt}$$

$$= av_B \rho \times v_B - av_A \rho \times v_A$$

$$\therefore \quad F = a\rho (v_B^2 - v_A^2) \qquad ...(i)$$

According to Bernaulli's theorem

$$p_A + \frac{1}{2}\rho v_A^2 + \rho gh = p_B + \frac{1}{2}\rho v_B^2 + 0$$

$$\Rightarrow \quad \frac{1}{2}\rho (v_B^2 - v_A^2) = \rho gh$$

$$\Rightarrow \quad v_B^2 - v_A^2 = 2gh \qquad ...(ii)$$

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

$$F = a\rho (2gh) = 2a\rho gh$$

18. If m is the total mass of the gas then its kinetic energy $= \frac{1}{2}mv^2$ when the vessel is suddenly stopped, then the total kinetic energy will increase the temperature of the gas. Hence

$$\frac{1}{2}mv^2 = \mu C_V \Delta T$$

or $$\frac{1}{2}mv^2 = \frac{m}{M} C_V \Delta T$$

But $$C_V = \frac{R}{\gamma - 1}$$

$$\therefore \quad \frac{1}{2}mv^2 = \frac{m}{M} \times \frac{R}{\gamma - 1} \times \Delta T$$

$$\Delta T = \frac{Mv^2}{2R}(\gamma - 1)$$

19. We know that,

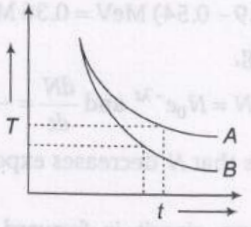
$$\text{Rate of cooling} \propto \frac{1}{C(\text{specific heat})}$$

Since $C_{oil} < C_{water}$ (given)

∴ Rate of cooling of water < Rate of cooling of oil.

It is clear that at a particular time after start cooling, temperature of oil will be less than that of water.

So, graph A represents the cooling curve of water and graph B represents the cooling curve of oil.



20. The force constant of the spring,

$$k = \frac{F}{x} = \frac{0.5 \times 10}{0.2} = 25 \text{ N/m}$$

Now, if the mass of 0.25 kg is suspended by the spring, then the period of oscillation,

$$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{0.25}{25}} = 0.628 \text{ s}$$

21. for a nearest satellite, the period of revolution is

$$T = 2\pi\sqrt{\frac{R^3}{GM}} = 2\pi\sqrt{\frac{R^3}{G\frac{4}{3}\pi R^3 \rho}}$$

$$T \propto \sqrt{\frac{1}{\rho}}$$

i.e., the period of revolution depends upon the density of the planet. Here, the density of the planets is same, therefore time period will be same.

22. For looping the loop minimum velocity at the lowest point should be $\sqrt{5gl}$.

23. Rest mass energy of electron = 0.54 MeV

i.e., $$m_0 c^2 = 0.54 \text{ MeV} \qquad ...(i)$$

But the kinetic energy of electron

$$= mc^2 - m_0 c^2 \qquad ...(ii)$$

Also,

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{m_0}{\sqrt{1 - (0.8)^2}} = \frac{m_0}{0.6}$$

So, $mc^2 = \frac{m_0c^2}{0.6} = \frac{0.54}{0.6}$ MeV (From Eq (i))

$mc^2 = 0.9$ MeV ...(ii)

Substituting values of Eq (ii) and (i) in Eq (ii) we get

KE = (0.9 – 0.54) MeV = 0.36 MeV

24. By using,

$$N = N_0e^{-\lambda t} \text{ and } \frac{dN}{dt} = -\lambda N$$

It shows that N decreases exponentially with time.

25. The given circuit is forward biased hence current flow is possible.

Current $i = \frac{V}{R} = \frac{(4-1)}{300} = 10^{-2}$ A

26. For better demodulation

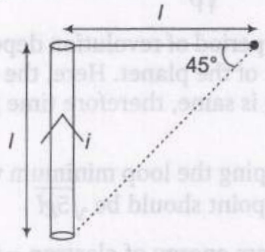
$$\frac{1}{f_c} << RC$$

Here, $\frac{1}{f_c} = \frac{1}{100 \times 10^3} = 10^{-5}$ s

and $RC = 10^3 \times 10 \times 10^{-12} = 10^{-8}$ s

So, $\frac{1}{f_c}$ is not less than RC. Hence, it is not good.

27. The magnetic field due to a finite length wire



$$B = \frac{\mu_0}{4\pi} \cdot \frac{i}{r} (\sin\phi_1 + \sin\phi_2)$$

Here, $\phi_1 = 0°$ and $\phi_2 = 45°$

$$\therefore \quad B = \frac{\mu_0}{4\pi}\frac{i}{r}(\sin 0° + \sin 45°)$$

$$= \frac{\mu_0}{4\pi}\frac{i}{l}\frac{1}{\sqrt{2}}$$

$$= \frac{\sqrt{2}\mu_0 i}{8\pi l}$$

28. Work done, $W = MB(\cos\theta_1 - \cos\theta_2)$

When the magnet is rotated from 0° to 60°, then work done is 0.8 J

$$0.8 = MB(\cos 0° - \cos 60°) = \frac{MB}{2}$$

$$MB = 0.8 \times 2 = 1.6 \text{ N-m}$$

In order to rotate the magnet through an angle of 30°, *i.e.,* from 60° to 90°, the work done is

$$W' = MB(\cos 60° - \cos 90°)$$

$$= MB\left(\frac{1}{2} - 0\right) = \frac{MB}{2}$$

$$W' = \frac{1.6}{2} = 0.8 \text{ J}$$

$$= 0.8 \times 10^7 \text{ erg}$$

29. Intensity of magnetisation,

$$I = \frac{M}{V} = \frac{M}{\text{mass / density}}$$

Given, mass = 1 g = 10^{-3} kg

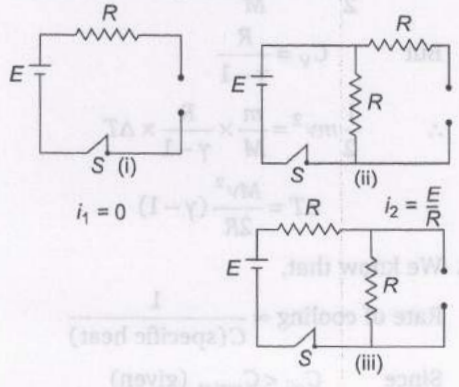
and density

$$= 5 \text{ g/cm}^3$$

$$= \frac{5 \times 10^{-3} \text{ kg}}{(10^{-2})^3 \text{ m}^3} = 5 \times 10^3 \text{ kg/m}^3$$

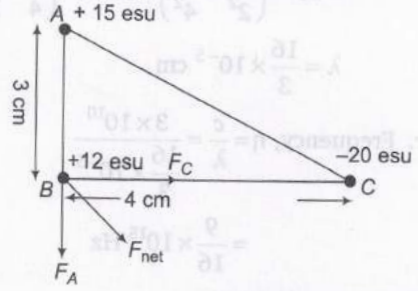
Hence, $I = \frac{6 \times 10^{-7} \times 5 \times 10^3}{10^{-3}} = 3$ A/m

30. The inductor (L) will not work on DC so as the switch S is closed current through L is zero and it acts as open circuit.



So, $i_2 > i_3 > i_1$ $\quad i_3^0 = \frac{E}{2R}$

31. The given condition can be shown as



Net force on B, $F_{net} = \sqrt{F_A^2 + F_C^2}$

$\therefore \quad F_A = \dfrac{5 \times 12}{(3)^2} = 20$ dyne

and $\quad F_C = \dfrac{12 \times 20}{(4)^2} = 15$ dyne

So, $F_{net} = \sqrt{(20)^2 + (15)^2} = 25$ dyne.

32. The given arrangement is equivalent to the parallel combination of three identical capacitors.

Hence, equivalent capacitance $= 3C = \dfrac{3\varepsilon_0 A}{d}$

33. Total current through the circuit

$$i = \frac{10}{\frac{1000}{3} + 500} = \frac{3}{250}\text{ A}$$

$\therefore$ Voltmeter reading

$$= i_V \times R_V = \frac{2}{3} \times \frac{3}{250} \times 500 = 4\text{ V}$$

34. We know that,

$$A = \frac{\mu R_L}{r_P + R_L} = \frac{14 \times 12}{10 + 12} = \frac{84}{11}$$

Peak value of output signal,

$$V_0 = \frac{84}{11} \times 2\sqrt{2}\text{ V}$$

$$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{84}{11 \times \sqrt{2}} \times 2\sqrt{2} = \frac{84 \times 2}{11}\text{ V}$$

So, the rms value of current through

$R_L = 12\text{ k}\Omega$

$$i_{rms} = \frac{84 \times 2}{11 \times 12 \times 10^3}\text{ A}$$

$$= 1.27\text{ mA}$$

35. MI of body about centre of mass

$$I_{cm} = mk^2$$

MI of body about new parallel axis

$$I_{new} = I_{cm} + ma^2 = mk^2 + ma^2 = m(K^2 + a^2)$$

$\therefore$ Kinetic energy, $K = \dfrac{1}{2} I_{new} \omega^2$

$$= \frac{1}{2} m(K^2 + a^2)\omega^2$$

36. Rise in capillary,

$$h = \frac{2T\cos\theta}{rdg}$$

$$\therefore \quad \frac{h_2}{h_1} = \frac{T_2}{T_1} \times \frac{\cos\theta_2}{\cos\theta_1} \times \frac{d_1}{d_2} \times \frac{r_1}{r_2}$$

$$\frac{h_2}{h_1} = \frac{140}{70} \times \frac{\cos 60^\circ}{\cos 0^\circ} \times \frac{1}{2} \times 1$$

$$h_2 = \frac{h_1}{2} = 3\text{ cm}$$

37. Pressure differences between sea level and the top of hill

$$\Delta p = (h_1 - h_2) \times \rho_{Hg} \times g$$

$$= (75 - 50) \times 10^{-2} \times \rho_{Hg} \times g \quad \ldots(i)$$

and pressure difference due to h metre of air

$$\Delta p = h \times \rho_{air} \times g \quad \ldots(ii)$$

By equating Eqs. (i) and (ii)

$$h \times \rho_{air} \times g$$

$$= (75 - 50) \times 10^{-2} \times \rho_{Hg} \times \rho$$

$$h = 25 \times 10^{-2}\left(\frac{\rho_{Hg}}{\rho_{air}}\right)$$

$$= 25 \times 10^{-2} \times 10^4 = 2500\text{ m}$$

$\therefore$ Height of hill $= 2.5$ km

38. Given,

$$y = 0.2 \sin(10\pi t + 1.5\pi)\cos(10\pi t + 1.5\pi)$$

$$= 0.1 \sin 2(10\pi t + 1.5\pi)$$

$[\because \sin 2A = 2 \sin A \cos A]$

$$= 0.1 \sin(20\pi t + 3.0\pi)$$

So, the motion of particle is SHM

Time period,

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{20\pi} = \frac{1}{10} = 0.1\text{ s}$$

39. For total internal reflection, at PQ

$$\theta < C$$

From geometry of figure,

$$\theta = 60 \text{ i.e., } 60 > C$$

$$= \sin 60 > \sin C$$

$$= \frac{\sqrt{3}}{2} > \frac{\mu_{\text{liquid}}}{\mu_{\text{prism}}} = \mu_{\text{liquid}} < \frac{\sqrt{3}}{2} \times \mu_{\text{prism}}$$

$$= \mu_{\text{liquid}} < \frac{\sqrt{3}}{2} \times 1.5 = \mu_{\text{liquid}} < 1.3$$

40. According to corpuscular theory of light, different colours of light are due to different size of corpuscules.

41. An antenna is a metallic structure used to radiate or receive eletromagnetic waves.

42. The current will lag behind the voltage when reactance of inductor is more than the reactance of capacitor *i.e.*,

$$\omega L > \frac{1}{\omega c}$$

or $$\omega > \frac{1}{\sqrt{LC}} \text{ or } 2\pi\nu > \frac{1}{\sqrt{LC}}$$

$$\nu > \frac{1}{2\pi\sqrt{LC}} \text{ or } \nu > \nu_r$$

where ν_r is the resonant frequency.

43. We have, $V_0 = i_0 Z$

$$\Rightarrow \quad 200 = 100 Z$$

$$Z = 2\,\Omega$$

So, the impedance of the circuit

$$Z^2 = R^2 + X_L^2$$

$$\Rightarrow \quad (2)^2 = (1)^2 + X_L^2$$

$$X_L = \sqrt{3}\,\Omega$$

44. Wavelength of green light is threshold wave length. For emission of electron, wavelength of incident light should be smaller than wavelength of green light. Hence, in the given lights indigo can produce emission of photo electrons.

45. Using the relation,

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$= 10^{-5}\left(\frac{1}{2^2} - \frac{1}{4^2}\right) = 10^{-5} \times \left(\frac{1}{4} - \frac{1}{16}\right)$$

$$\lambda = \frac{16}{3} \times 10^{-5} \text{ cm}$$

$$\therefore \text{ Frequency, } \eta = \frac{c}{\lambda} = \frac{3 \times 10^{10}}{\frac{16}{3} \times 10^{-5}}$$

$$= \frac{9}{16} \times 10^{15} \text{ Hz}$$

46. By using the relation,

$$r \propto A^{1/3}$$

$$\frac{r_1}{r_2} = \left(\frac{A_1}{A_2}\right)^{1/3}$$

$$\frac{3}{5} = \left(\frac{27}{A}\right)^{1/3}$$

$$\frac{27}{125} = \frac{27}{A} \Rightarrow A = 125$$

So, number of nuclei in atom

$$X = A - 52 = 125 - 52 = 73$$

47. In 2 s only 90% nuclei are left behind. Thus in next two seconds 90% of 900 *i.e.*, 810 nuclei will be left behind.

48. The coercivity of bar magnet is 4×10^3 Am^{-1} *i.e.*, it requires a magnetic intensity $H = 4 \times 10^3$ Am^{-1} to get demagentised.

Let i be the current carried by solenoid having n number of turns per metre length, then

$$H = ni$$

Here $H = 4 \times 10^3$ Am^{-1}

and $$n = \frac{N}{l} = \frac{60}{0.12} = 500 \text{ turn/m}$$

$$\therefore \quad i = \frac{H}{n} = \frac{4 \times 10^3}{500} = 8.0 \text{ A}$$

49. In balance condition, potentiometer does not take the current from secondary circuit.

50. We know that, $\text{KE} = \frac{p^2}{2m}$

i.e., $$\text{KE} \propto p^2$$

If p is increased n times, then KE will increased by n^2 times.

Chemistry

1. As we know that $\Delta H = \Delta E + p\Delta V$

When $\Delta V = 0 \therefore \Delta H = \Delta E$

From first law of thermodynamics

$$\Delta U = q + W$$

In the given problem, $\Delta H = 500$ J

$$-W = -p\Delta V, \Delta V = 0$$

So, $\Delta U = q = 500$ J

2. $2N_2O_5 \longrightarrow 4NO_2 + O_2$

$$\frac{-d[N_2O_5]}{dt} = k[N_2O_5]$$

$$1.02 \times 10^{-4} = 3.4 \times 10^{-5} s^{-1} \times [N_2O_5]$$

$$\therefore \quad [N_2O_5] = \frac{1.02 \times 10^{-4}}{3.4 \times 10^{-5}} = 3$$

3. Remaining activity = 0.01 M after 24 h

$$\text{Remaining activity} = \text{Initial activity} \times \left(\frac{1}{2}\right)^n$$

Used half- life time (n)

$$= \frac{\text{Total time}}{T_{1/2}} = \frac{24}{6} = 4$$

So, $0.01 = \text{Initial activity} \times \left(\frac{1}{2}\right)^4$

Initial activity $= 0.01 \times 16 = 0.16$

4. Density = 1.17 g/cc = 1170 g/L

$$\text{Molarity of solution} = \frac{\text{Strength in g/L}}{\text{mol. wt.}}$$

$$= \frac{1170}{36.5} \text{M} = 32.05 \text{ M}$$

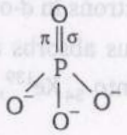
5. Paramagnetic character is shown by those atoms or molecules which have unpaired electrons.

In the given molecules CO is not paramagnetic, since, it does not have unpaired electrons. The configuration of CO molecule is

$CO(14) = \sigma 1s^2, \overset{*}{\sigma}\ 1s^2, \sigma 2s^2, \overset{*}{\sigma}\ 2s^2, \pi 2p_x^2 \approx \pi 2p_y^2, \sigma 2p_z^2$

6. In P-O bond, π-bond is formed by the sidewise overlapping of d-orbital of P and p-orbital of oxygen. Hence, it is formed by $p\pi$ and $d\pi$ overlapping.

In nitrogen and carbon no vacant d-orbital is present. So, they do not form $p\pi$—$d\pi$ bond.



7. A atoms are at the corners of a cube.

So, the number of A atoms per unit cell

$$= 8 \times \frac{1}{8} = 1.$$

Similarly, B atoms are present at face centres of a cube.

So, the number of B atoms per unit cell

$$= 6 \times \frac{1}{2} = 3$$

Hence, the compound is AB_3.

8. On decomposition $BaCO_3$ liberates CO_2 as

$$\underset{197\text{ g}}{BaCO_3} \longrightarrow BaO + \underset{22.4\text{ L at STP}}{CO_2 \uparrow}$$

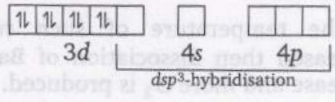
$\because$ 197 g $BaCO_3$ gives 22.4 L of CO_2 at STP

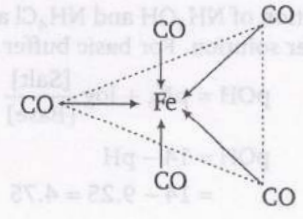
$\therefore$ 9.85 g $BaCO_3$ will give CO_2

$$= \frac{22.4 \times 9.85}{197} = 1.12 \text{ L}$$

9. In $Fe(CO)_5$, the Fe atom is in dsp^3 hybridised state. Therefore, the shape of molecule is trigonal bipyramidal. The hybridisation is as $_{26}Fe = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^2 4p^0$

In $Fe(CO)_5$ the 'Fe' atom is





10. The electronic configuration of Sc is

$$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^1, 4s^2$$

and configuration of Sc^{3+} is

$$1s^2, 2s^2 2p^6, 3s^2 3p^6$$

So, Sc^{3+} is colourless due to the absence of unpaired electrons in *d*-orbital.

11. $_{92}U^{235}$ nucleus absorbs a neutron and then disintegrate into $_{54}Xe^{139}$, $_{38}Sr^{94}$ and X.

Thus,

$$_{92}U^{235} + {}_0n^1 \longrightarrow {}_{54}Xe^{139} + {}_{38}Sr^{94} + 3{}_0n^1$$

12. $\because$ Total energy (E_n) = KE + PE

$$\text{In first excited state} = \frac{1}{2}mv^2 + \left[-\frac{Ze^2}{r}\right]$$

$$= +\frac{1}{2}\frac{Ze^2}{r} - \frac{Ze^2}{r} - 3.4 \text{ eV}$$

$$= -\frac{1}{2}\frac{Ze^2}{r}$$

$$\therefore \quad \text{KE} = \frac{1}{2}\frac{Ze^2}{r} = +3.4 \text{ eV}$$

13. $BaO_2(s) \rightleftharpoons BaO(s) + O_2(g)$; ΔH = + ve

$\text{Rate}_1 = k_1[BaO_2]$ (forward reaction)

$\text{Rate}_1 = k_1 \quad (\because [BaO_2] = 1)$

Similarly (for backward reaction)

$$r_2 = k_2[BaO] \cdot [O_2]$$

$$r_2 = k_2[O_2]$$

At equilibrium, $r_1 = r_2$

$$k_1 = k_2[O_2]$$

$$\frac{k_1}{k_2} = p_{o_2} \text{ or } K = p_{o_2}$$

If the temperature of such reaction is increased then dissociation of BaO_2 would increase and more O_2 is produced.

14. Solution of NH_4OH and NH_4Cl acts as a basic buffer solution. For basic buffer solution,

$$\text{pOH} = pK_b + \log\frac{[\text{Salt}]}{[\text{Base}]}$$

$$\text{pOH} = 14 - \text{pH}$$

$$= 14 - 9.25 = 4.75$$

$$4.75 = pK_b + \log\frac{0.1}{0.1}$$

$$pK_b = 4.75$$

15. At higher temperature and low pressure real gas acts as an ideal gas and obey $pV = nRT$ relation.

16. $\Delta S = \frac{q}{T}$

q = required heat per mol

T = constant absolute temperature.

Unit of entropy is $JK^{-1}mol^{-1}$

17. For reaction, $3A \longrightarrow B + C$

If it is zero order reaction, therefore the rate remains same at any concentration of '*A*' or $\frac{dx}{dt} = k[A^0]$. It means that rate is independent from the concentration of reactants.

18. Sodium chloride in water dissociates as

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

$$H_2O \rightleftharpoons H^+ + OH^-$$

When electric current is passed through this solution using platinum electrode, Na^+ and H^+ move towards cathode, whereas Cl^- and OH^- ions move towards anode.

At cathode $H^+ + e^- \longrightarrow H$

$$H + H \longrightarrow H_2$$

At anode $Cl^- - e^- \longrightarrow Cl$

$$Cl + Cl \longrightarrow Cl_2$$

If mercury is used as cathode, H^+ ions are not discharged at mercury cathode because mercury has a high hydrogen over voltage. Na^+ ions are discharged at cathode in preference of H^+ ions yielding sodium, which dissolves in mercury to form sodium amalgam.

19. Bond energy of F_2 is less than Cl_2 because in F_2 molecule, electron-electron repulsion of 2*p*-orbital of two fluorine atoms is maximum in comparison to the repulsion of 3*p*-orbitals of two chlorine atoms. So, less amount of energy is required to break the bond of F_2 in comparison to Cl_2.

20. An atom has electronic configuration

$$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3, 4s^2$$

It is a member of *d*-block element because the last electron is filled in *d*-subshell as $3d^3$ and the following electronic configuration is possible for *d*-subshell as $(n-1)d$-subshell

Group No.	III B	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
	$ns^2(n-1)s^2p^6d^1$	d^2	d^3	d^4	d^5	d^6	d^7	d^8	d^9	d^{10}

Hence, it is a member of fifth group.

21. Chloro diaquatriammine cobalt (III) chloride is $[CoCl(NH_3)_3(H_2O)_2]Cl_2$

22. In the silver plating of copper, $K[Ag(CN)_2]$ is used instead of $AgNO_3$. The reason is less availability of Ag^+ ions, as Cu cannot displace Ag from $[Ag(CN)_2]^-$ ion.

23. $CuSO_4$ reacts with KCN and gives a white precipitate of cuprous cyanide and cyanogen gas. The cuprous cyanide dissolves in excess of KCN forming $K_3[Cu(CN)_4]$.

$$CuSO_4 + 2KCN \longrightarrow K_2SO_4 + Cu(CN)_2$$

$$2Cu(CN)_2 \longrightarrow \underset{\text{insoluble}}{2CuCN} + \underset{\text{cyanogen}}{CN{-}CN}$$

$$CuCN + 3KCN \longrightarrow \underset{\text{soluble}}{K_3[Cu(CN)_4]}$$

24. Zn is present above H_2 in electrochemical series. So, it liberates hydrogen gas from dilute HCl/H_2SO_4. But HNO_3 is a strong oxidising agent so it oxidises the hydrogen obtained into H_2O. In HNO_3, NO_3^- ion is reduced and give NH_4NO_3, N_2O, NO and NO_2 (based upon the concentration of HNO_3).

$$4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + NH_4NO_3 + 3H_2O$$

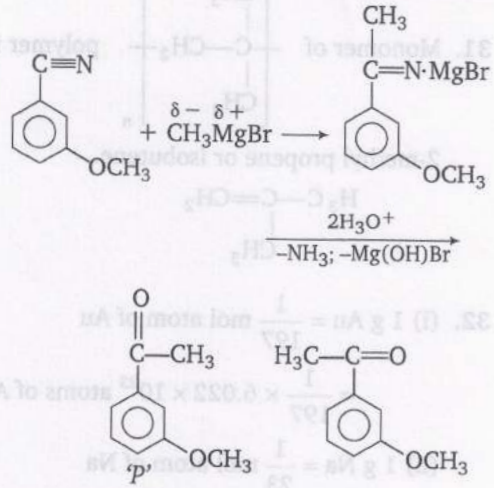
25. The double bond gets priority over triple bond.

So, the IUPAC name of

$$\overset{1}{C}H_2 = \overset{2}{C}H - \overset{3}{C}H_2 - \overset{4}{C}H_2 - \overset{5}{C} \equiv \overset{6}{C}H$$

is hex-1-en-5-yne or 1-hexene-5-yne

26.



27. *n*-propyl alcohol and isopropyl alcohol give different product on oxidation with $K_2Cr_2O_7$.

$$\underset{\substack{n\text{-propyl}\\ \text{alcohol}}}{CH_3{-}CH_2{-}CH_2OH} \xrightarrow[K_2Cr_2O_7/H_2SO_4]{[O]} \underset{\text{Propionaldehyde}}{CH_3{-}CH_2{-}CHO}$$

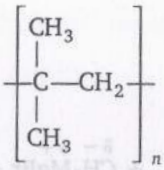
$$\underset{\substack{\text{isopropyl alcohol}}}{CH_3{-}\underset{\displaystyle OH}{\underset{|}{CH}}{-}CH_3} \xrightarrow[K_2Cr_2O_7/H_2SO_4]{[O]} \underset{\text{acetone}}{CH_3{-}\overset{\displaystyle O}{\overset{\|}{C}}{-}CH_3}$$

28. Rosenmunds reaction

$$R{-}\overset{\displaystyle O}{\overset{\|}{C}}{-}Cl \xrightarrow[Pd-BaSO_4]{H_2} \underset{\text{'P'}}{R{-}\overset{\displaystyle O}{\overset{\|}{C}}{-}H} + HCl$$

29. Enzymes are made up of protein with specific structure and acts as a catalyst for biochemical reactions.

30. Geometrical isomers differ in spatial arrangement of atoms.

31. Monomer of  polymer is

2-methyl propene or isobutene.

$$H_3C-\underset{\displaystyle CH_3}{\overset{}{C}}=CH_2$$

32. (i) 1 g Au $= \frac{1}{197}$ mol atom of Au

$= \frac{1}{197} \times 6.022 \times 10^{23}$ atoms of Au

(ii) 1 g Na $= \frac{1}{23}$ mol atom of Na

$= \frac{1}{23} \times 6.022 \times 10^{23}$ atom of Na

(iii) 1 g Li $= \frac{1}{7}$ mol atom of Li

$= \frac{1}{7} \times 6.022 \times 10^{23}$ atom of Li

(iv) 1 g $Cl_2 = \frac{1}{71}$ mol molecules of Cl_2

$= \frac{1}{71} \times 6.022 \times 10^{23}$ molecules of Cl_2

$= \frac{2}{71} \times 6.022 \times 10^{23}$ atoms of Cl_2

Hence, 1 g lithium has the largest number of atoms.

33. The size of isoelectronic species F^-, Ne and Na^+affected by nuclear charge (Z_{iff}). With increase in nuclear charge (atomic number), the size of the isoelectronic species decreases.

34. $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

$\Delta n_g = (n_p - n_r) = 1 - 3 = -2$

$\Delta H^\circ = \Delta U^\circ + \Delta n_g RT$

$\Delta H^\circ = -X - 2RT$ or $\Delta H^\circ < \Delta U^\circ$

35. $pH = -\log[H^+]$

$pH = -\log[3.8 \times 10^{-3}]$

$pH = -(-3\log 10 + \log 3.8)$

$= +3 - 0.5798 = 2.4202 \approx 2.42$

36. Among alkali metal ions, Li^+ is the smallest. Therefore, it has the maximum degree of hydration than any other alkali metal cation.

37. Boric acid is polymeric due to the presence of H—bonding (as it has polar O—H bonds).

38. The order of stability of carbocation is $3^\circ > 2^\circ > 1^\circ$

(a) $(CH_3)_3C-\overset{+}{C}H_2$ (1° carbocation) (b) $(CH_3)_3C^+$ (3° carbocation)

(c) $CH_3CH_2\overset{+}{C}H_2$ (1° carbocation) (d) $CH_3\overset{+}{C}HCH_2CH_3$ (2° carbocation)

3° carbocation *i. e.*, $(CH_3)_3C^+$ is the most stable carbocation.

39. Chromatography is the best and latest technique for the isolation, purification and separation of organic compounds.

40. Fat soluble vitamin — A, D, E, K

Water soluble vitamin — Vitamin B complex and C

so, vitamin B is water soluble.

41. $CH_3-NC + 4[H] \longrightarrow CH_3-NH-CH_3$

methyl isocyanide

42. Proton affinity *i.e.*, basicity depends upon the strength of $H-A$ bond (where, A = S, N, F, I). F^- forms the strongest bond. So, it has the greatest proton affinity to form hydride.

43. $CH_3-\underset{\displaystyle CH_3}{\overset{}{CH}}-CH_2-O-CH_2-CH_3 + HI$

$\xrightarrow{\Delta} CH_3-\underset{\displaystyle CH_3}{\overset{}{CH}}-CH_2OH + CH_3CH_2I$

44. $CH_3-CH_2-C \equiv CH + HCl \longrightarrow$

$CH_3CH_2-\underset{\displaystyle Cl}{\overset{}{C}}=CH_2 \xrightarrow{HI}$

$CH_3-CH_2-\underset{\displaystyle Cl}{\overset{\displaystyle I}{C}}-CH_3$

2-chloro - 2 - iodobutane

45. Sphalerite is concentrated by chemical leaching.

46. $Cu(s) + 2Ag^{2+}(aq) \longrightarrow Cu^{2+}(aq) + 2Ag(s)$;

$$E^\circ = 0.46\ V \text{ at } 298\ K$$

$$\log K_C = \frac{nFE^\circ}{RT}$$

$$= \frac{2 \times 0.46}{0.059}$$

$$K_C = 4 \times 10^{15}$$

47. Temperature is the effective factor for dehydration of alcohols by Al_2O_3.

$$R{-}CH_2{-}CH_2{-}OH \xrightarrow[350^\circ - 380^\circ C]{Al_2O_3} R{-}CH{=}CH_2 + H_2O$$

At 220° – 250° it forms ether.

48. $C_2H_5OH + 4I_2 + 6NaOH \longrightarrow \underset{\text{iodoform}}{CHI_3\downarrow} + HCOONa + 5NaI + 5H_2O$

Iodoform is a pale yellow solid.

49. The structure of DNA molecule is a double helicle structure. In this structure double helix are made up of polynucleotide chains which are held together by H-bonds. In these helixes the adenine (A) base is linked with thymine (T) by two H-bonds and guanine (G) is linked with cytocine (C) by three H-bonds as A = T, and G ≡ C.

50. $2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$; $\Delta H = ?$

$$\Delta H = [(2 \times \Delta H_f \text{ of } H_2O(l) + (\Delta H_f \text{ of } O_2)] - (2 \times \Delta H_f \text{ of } H_2O_2(l))]$$

$$= [(2 \times -286) + (0) - (2 \times -188)]$$

$$= [-572 + 376] = -196\ kJ/mol$$

Mathematics

1. Given, numbers are conjugate to each other,

$\therefore \quad \sin x + i \cos 2x = \cos x - i \sin 2x$

Equating real and imaginary parts, we get

$\sin x = \cos x$ and $\cos 2x = \sin 2x$

$\therefore \quad \tan x = 1$

$\Rightarrow \quad x = \frac{\pi}{4}, \frac{5\pi}{4}, \frac{9\pi}{4}, \ldots$ ...(i)

and $\tan 2x = 1$

$\Rightarrow \quad 2x = \frac{\pi}{4}, \frac{5\pi}{4}, \frac{9\pi}{4}, \ldots$ ...(ii)

$\Rightarrow \quad x = \frac{\pi}{8}, \frac{5\pi}{8}, \frac{9\pi}{8}, \ldots$

There exists no value of x common in Eqs. (i) and (ii).

2. Sum of the integers which are divided both 3 and 5

$$= 15 + 30 + 45 + \ldots + 90$$

$$= \frac{6}{2}(15 + 90)$$

$$= 315$$

3. Given, $1 + \sin x + \sin^2 x + \ldots \infty = 4 + 2\sqrt{3}$

$$\Rightarrow \quad \frac{1}{1 - \sin x} = 4 + 2\sqrt{3}$$

$$\Rightarrow \quad 1 - \sin x = \frac{1}{4 + 2\sqrt{3}} \times \frac{4 - 2\sqrt{3}}{4 - 2\sqrt{3}}$$

$$= \frac{4 - 2\sqrt{3}}{4}$$

$$\Rightarrow \quad \sin x = \frac{2\sqrt{3}}{4} = \frac{\sqrt{3}}{2}$$

$$\Rightarrow \quad x = \frac{\pi}{3}, \frac{2\pi}{3}$$

4. Given that, $\alpha + \beta = -2$ and $\alpha^3 + \beta^3 = -56$

$$\Rightarrow \quad (\alpha + \beta)(\alpha^2 + \beta^2 - \alpha\beta) = -56$$

$$\Rightarrow \quad \alpha^2 + \beta^2 - \alpha\beta = 28$$

Also, $\quad (\alpha + \beta)^2 = (-2)^2$

$$\Rightarrow \quad \alpha^2 + \beta^2 + 2\alpha\beta = 4$$

$$\Rightarrow \quad 28 + 3\alpha\beta = 4$$

$$\Rightarrow \quad \alpha\beta = -8$$

$\therefore$ Required equation is $x^2 + 2x - 8 = 0$

5. Since, 4 is a root of $x^2 + ax + 12 = 0$

$$\therefore \quad 16 + 4a + 12 = 0$$

$$\Rightarrow \quad a = -7$$

Let the roots of the equation $x^2 + ax + b = 0$ be α and α.

$\therefore \quad 2\alpha = -a$

$\Rightarrow \quad \alpha = \frac{7}{2}$

and $\quad \alpha \cdot \alpha = b$

$\Rightarrow \quad \left(\frac{7}{2}\right)^2 = b \Rightarrow b = \frac{49}{4}$

6. Given, ${}^{2n+1}P_{n-1} : 2x-1\ P_n = 3:5$

$\Rightarrow \quad \frac{(2n+1)!}{(n+2)!} \times \frac{(n-1)!}{(2n-1)!} = \frac{3}{5}$

$\Rightarrow \quad \frac{(2n+1)(2n)}{(n+2)(n+1)n} = \frac{3}{5}$

$\Rightarrow \quad 10(2n+1) = 3(n^2+3n+2)$

$\Rightarrow \quad 3n^2 - 11n - 4 = 0$

$\Rightarrow \quad (3n+1)(n-4) = 0$

$\Rightarrow \quad n = 4$

7. Required number of ways $= 5! \times 6!$

8. $(1+3x+3x^2+x^3)^{20} = (1+x)^{60}$

$\therefore$ Coefficient of x^{20} in $(1+x)^{60}$ is ${}^{60}C_{20}$ or ${}^{60}C_{40}$.

9. $A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} 1+1 & 1+2 \\ 2+1 & 2+2 \end{bmatrix} = \begin{bmatrix} 2 & 3 \\ 3 & 4 \end{bmatrix}$

10. Let $\Delta = \begin{vmatrix} C & 1 & 0 \\ 1 & C & 1 \\ 6 & 1 & C \end{vmatrix} = C(C^2-1) - 1(C-6)$

$= C^3 - 2C + 6$

Put $C = 2\cos\theta$, we get

$\Delta = (2\cos\theta)^3 - 2(2\cos\theta) + 6$

$= 8\cos^3\theta - 4\cos\theta + 6$

11. $\sin\left(2\sin^{-1}\sqrt{\frac{63}{65}}\right)$

$= \sin\left(\sin^{-1} 2\sqrt{\frac{63}{65}}\sqrt{1-\frac{63}{65}}\right)$

$= \sin\left(\sin^{-1}\frac{2\sqrt{126}}{65}\right)$

$= \frac{2\sqrt{126}}{65}$

12. Given, $\sec^{-1}\sqrt{1+x^2} + \operatorname{cosec}^{-1}\frac{\sqrt{1+y^2}}{y} + \cot^{-1}\frac{1}{z} = \pi$

$\therefore \quad \tan^{-1}x + \tan^{-1}y + \tan^{-1}z = \pi$

$\Rightarrow \quad \tan^{-1}\left(\frac{x+y+z-xyz}{1-xy-yz-zx}\right) = \pi$

$\Rightarrow \quad x+y+z = xyz$

13. $2\sin x\cos x = \frac{1}{2}$

$\Rightarrow \quad \sin 2x = \frac{1}{2} = \sin\frac{\pi}{6}$

$\Rightarrow \quad 2x = n\pi + (-1)^n\frac{\pi}{6}$

$\Rightarrow \quad x = \frac{n\pi}{2} + (-1)^n\frac{\pi}{12}$

For $x \in \left(0, \frac{\pi}{2}\right)$

$x = \frac{\pi}{12}$

14. We know that,

$-\sqrt{a^2+b^2} \le a\cos\theta + b\sin\theta \le \sqrt{a^2+b^2}$

$\therefore \quad -\sqrt{3+1} \le \sqrt{3}\sin x + \cos x \le \sqrt{3+1}$

$\Rightarrow -2 \le \sqrt{3}\sin x + \cos x \le \sqrt{2}$

But $\sqrt{3}\sin x + \cos x = 4$.

Hence, given equation has no solution.

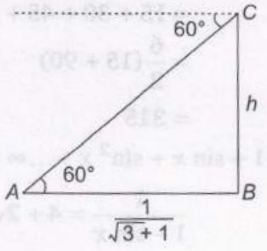
15. $2ac\sin\left(\frac{A-B+C}{2}\right) = 2ac\sin\left(\frac{180-2B}{2}\right)$

$= 2ac\sin(90^\circ - B) = 2ac\cos B$

$= a^2 + c^2 - b^2$

16. Let h be the height of the tower.

In ΔABC,



$$\tan 60° = \frac{h}{\left(\frac{1}{\sqrt{3}+1}\right)}$$

$$\Rightarrow \quad \frac{\sqrt{3}}{\sqrt{3}+1} = \frac{h}{1}$$

$$\Rightarrow \quad h = \frac{\sqrt{3}(\sqrt{3}-1)}{3-1} = \frac{3-\sqrt{3}}{2}$$

17. Since, $A(0, 1), B(0, -1)$ and $C(x, 0)$ are the vertices of an equilateral ΔABC.

$$\therefore \quad AB = BC$$

$$\Rightarrow \quad \sqrt{0+4} = \sqrt{x^2+1}$$

$$\Rightarrow \quad x^2 = 3$$

$$\Rightarrow \quad x = \pm\sqrt{3}$$

18. Let a and b intercepts on the coordinate axes.

$$\therefore \quad a + b = -1 \Rightarrow b = -(a+1)$$

Equation of line is $\frac{x}{a} + \frac{y}{b} = 1$

$$\Rightarrow \quad \frac{x}{a} - \frac{y}{a+1} = 1 \qquad \ldots(i)$$

Since, this line passes through (4, 3).

$$\therefore \quad \frac{4}{a} - \frac{3}{a+1} = 1 \Rightarrow a + 4 = a^2 + a$$

$$\Rightarrow \quad a^2 = 4 \Rightarrow a = \pm 2$$

$\therefore$ Equation of line is $\frac{x}{2} - \frac{y}{3} = 1$ or $\frac{x}{-2} + \frac{y}{1} = 1$ [From Eq. (i)]

19. Here, $a = 2, h = \frac{3}{2}, b = -5$

$$\therefore \quad \tan\theta = \left|\frac{2\sqrt{\left(\frac{3}{2}\right)^2 + 10}}{2-5}\right| = \left|\frac{\sqrt{49}}{-3}\right|$$

$$\Rightarrow \quad \theta = \tan^{-1}\left|\frac{7}{3}\right|$$

20. Given, circle is $x^2 + y^2 - 6x + 4y - 12 = 0$

Centre of this circle is $(3, -2)$

Let other end of the diameter is (α, β).

$$\therefore \quad \frac{\alpha-1}{2} = 3, \frac{\beta+1}{2} = -2$$

$$\Rightarrow \quad \alpha = 7, \beta = -5$$

$\therefore$ Other end of the diameter is $(7, -5)$.

21. The centres and radii of circles are $C_1(0, 0), C_2(3, 4)$ and

$$r_1 = 2, r_2 = \sqrt{9+16-24} = 1$$

Now, $C_1C_2 = \sqrt{(3-0)^2 + (4-0)^2} = 5$

$$r_1 + r_2 = 2 + 1 = 3$$

Since, $C_1C_2 > r_1 + r_2$

$\therefore$ Number of common tangents = 4.

22. Given, equation of hyperbola is

$$\frac{x^2}{9} - \frac{y^2}{7} = 1$$

Distance between foci

$$2ae = 2\sqrt{2a^2 + b^2} = 2\sqrt{9+7} = 8$$

23. Given, equations of parabola are $x^2 = 4y$ and

$$y^2 = 4x \qquad \ldots(i)$$

$$\therefore \quad \left(\frac{x^2}{4}\right)^2 = 4x$$

$$\Rightarrow \quad x^4 - 64x = 0$$

$$\Rightarrow \quad x = 0, x = 4$$

On putting the value of x in Eq. (i), we get $y = 0$ and $y = 4, -4$

($\because y = -4$ does not satisfy the equation $x^2 = 4y$)

Hence, points of intersection are (0, 0) and (4, 4).

24. Since, $\log(1+x) - \log(1-x)$

$$= 2\left[x + \frac{x^3}{3} + \frac{x^5}{5} + \ldots\infty\right]$$

Put $x = \frac{1}{2}$ on both sides, we get

$$\log\left(\frac{3}{2}\right) - \log\left(\frac{1}{2}\right) = 2\left(\frac{1}{2} + \frac{1}{3}\cdot\frac{1}{2^3} + \frac{1}{5}\cdot\frac{1}{2^5} + \ldots\infty\right)$$

$$\Rightarrow \quad \log 3 = 1 + \frac{1}{3}\cdot\frac{1}{4} + \frac{1}{5}\cdot\frac{1}{4^2} + \ldots$$

25. $1+\frac{(a+bx)}{1!}+\frac{(a+bx)^2}{2!}+\frac{(a+bx)^3}{3!}+\ldots\infty=e^{a+bx}$

$\therefore$ Coefficient of x^n in $e^a e^{bx}=e^a\cdot\frac{(b)^n}{n!}$

26. $\cos\theta=|l_1l_2+m_1m_2+n_1n_2|$

$$=\left|\frac{\sqrt{3}}{4}\times\frac{\sqrt{3}}{4}+\frac{1}{4}\times\frac{1}{4}+\frac{\sqrt{3}}{2}\times\left(\frac{-\sqrt{3}}{2}\right)\right|$$

$$=\left|\frac{3}{16}+\frac{1}{16}-\frac{3}{4}\right|=\left|\frac{-2}{4}\right|=\frac{1}{2}$$

$\Rightarrow\quad\theta=\frac{\pi}{3}$

27. Clearly, $\cos^2\alpha+\cos^2 60^\circ+\cos^2 60^\circ=1$, where α is the angle which the straight line makes with x-axis,

$\therefore\quad\cos^2\alpha=1-\frac{1}{4}-\frac{1}{4}=\frac{1}{2}$

$\Rightarrow\quad\cos\alpha=\frac{1}{\sqrt{2}}\Rightarrow\alpha=45^\circ$

28. Given, $|\mathbf{a}+\mathbf{b}|=1, |\mathbf{a}|=|\mathbf{b}|=1$

$\Rightarrow\quad|\mathbf{a}|^2+|\mathbf{b}|^2+2|\mathbf{a}||\mathbf{b}|=1$

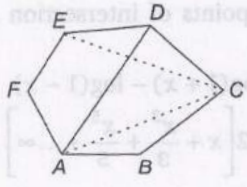
$\Rightarrow\quad2|\mathbf{a}||\mathbf{b}|=-1\quad\ldots(i)$

Now, $|\mathbf{a}-\mathbf{b}|^2=|\mathbf{a}|^2+|\mathbf{b}|^2-2|\mathbf{a}||\mathbf{b}|$

$=1^2+1^2-(-1)=3\quad$ [From Eq. (1)]

$\Rightarrow\quad|\mathbf{a}-\mathbf{b}|=\sqrt{3}$

29. In ΔABC, $\mathbf{AB}+\mathbf{BC}=\mathbf{AC}$



$\Rightarrow\quad\mathbf{AC}=\mathbf{a}+\mathbf{b}$

AD is parallel to BC and $AD=2BC$

$\therefore\quad\mathbf{AD}=2\mathbf{b}$

In ΔACD, $\mathbf{AC}+\mathbf{CD}=\mathbf{AD}$

$\Rightarrow\quad\mathbf{CD}=2\mathbf{b}-(\mathbf{a}+\mathbf{b})=\mathbf{b}-\mathbf{a}$

Now, $\mathbf{CE}=\mathbf{CD}+\mathbf{DE}=\mathbf{b}-2\mathbf{a}$

30. We have, $\mathbf{a}=\mathbf{i}+2\mathbf{j}+3\mathbf{k}$

$\therefore\mathbf{b}=\mathbf{i}\times(\mathbf{a}\times\mathbf{i})+\mathbf{j}\times(\mathbf{a}\times\mathbf{j})+\mathbf{k}\times(\mathbf{a}\times\mathbf{k})\quad\ldots(i)$

Now, $\mathbf{i}\times(\mathbf{a}\times\mathbf{i})=(\mathbf{i}\cdot\mathbf{i})\mathbf{a}-(\mathbf{i}\cdot\mathbf{a})\mathbf{i}$

$=1(\mathbf{i}+2\mathbf{j}+3\mathbf{k})-(1)\mathbf{i}$

$=2\mathbf{j}+3\mathbf{k}$

Similarly, $\mathbf{j}\times(\mathbf{a}\times\mathbf{j})=\mathbf{i}+3\mathbf{k}$

and $\quad\mathbf{k}\times(\mathbf{a}\times\mathbf{k})=\mathbf{i}+2\mathbf{j}$

$\therefore$ From Eq. (i),

$\mathbf{b}=2\mathbf{j}+3\mathbf{k}+\mathbf{i}+3\mathbf{k}+\mathbf{i}+2\mathbf{j}$

$=2\mathbf{i}+4\mathbf{j}+6\mathbf{k}$

$\Rightarrow\quad|\mathbf{b}|=\sqrt{4+16+36}=2\sqrt{14}$

31. Let $y=\frac{x}{1+x^2}$

$\Rightarrow\quad x^2y-x+y=0$

For x to be real, $1-4y^2\geq0$

$\Rightarrow\quad(1-2y)(1+2y)\geq0$

$\Rightarrow\quad\left(\frac{1}{2}-y\right)\left(\frac{1}{2}+y\right)\geq0$

$\Rightarrow\quad-\frac{1}{2}\leq y\leq\frac{1}{2}$

$\therefore\quad y=f(x)\in\left[-\frac{1}{2},\frac{1}{2}\right]$

32. Given, $f(x)=\frac{1}{\sqrt{4-x^2}}$

For domain of $f(x)$,

$4-x^2>0$

$\Rightarrow\quad x^2<4$

$\Rightarrow\quad-2<x<2$

$\therefore$ Domain $=(-2, 2)$

33. $\lim_{x\to\infty}\left(\frac{x+a}{x+b}\right)^{x+b}=\lim_{x\to\infty}\left(1+\frac{a-b}{x+b}\right)^{x+b}$

$$=\lim_{x\to\infty}\left\{\left(1+\frac{a-b}{x+b}\right)^{\frac{x+b}{a-b}}\right\}^{a-b}$$

$=e^{a-b}$

34. $|x|$ is continuous at $x = 0$ and $\frac{|x|}{x}$ is, also discontinuous at $x = 0$.

$\therefore f(x) = |x| + \frac{|x|}{x}$ is discontinuous at $x = 0$.

35. Let $x < 0 \Rightarrow |x| = -x$

$$\Rightarrow \quad f(x) = \frac{d}{dx}\left(\frac{x}{1-x}\right) = \frac{1}{(1-x)^2}$$

$$\Rightarrow \quad [f'(x)]_{x=0} = 1$$

Again $x > 0 \Rightarrow |x| = x$

$$f(x) = \frac{d}{dx}\left(\frac{x}{1+x}\right)$$

$$= \frac{1}{(1+x)^2}$$

$$\Rightarrow \quad [f'(x)]_{x=0} = 1$$

$$\Rightarrow \quad f'(0) = 1$$

36. $y = \sqrt{\frac{1+e^x}{1-e^x}}$ or $y^2 = \frac{1+e^x}{1-e^x}$

$$2y\frac{dy}{dx} = \frac{(1-e^x)e^x + (1+e^x)e^x}{(1-e^x)^2}$$

$$= \frac{2e^x}{(1-e^x)^2}$$

$$\therefore \quad \frac{dy}{dx} = \frac{e^x}{(1-e^x)^2}\sqrt{\left(\frac{1-e^x}{1+e^x}\right)\left(\frac{1-e^x}{1-e^x}\right)}$$

$$= \frac{e^x}{(1-e^x)\sqrt{1-e^{2x}}}$$

37. (d) $y = f(t)$, where $t = \frac{2x+3}{3-2x}$

$$\Rightarrow \quad \frac{dy}{dx} = f'(t) \times \frac{dt}{dx}$$

$$= \sin\left(\log\frac{2x+3}{3-2x}\right) \times \frac{12}{(3-2x)^2}$$

38. At point $(1, 1)$, $1 = e^t \sin t$, $1 = e^t \cos t$

$$\Rightarrow \quad \tan t = 1 \Rightarrow t = \frac{\pi}{4}$$

Now, $\quad \frac{dy}{dt} = e^t(\cos t - \sin t)$

and $\quad \frac{dx}{dt} = e^t(\sin t + \cos t)$

$$\Rightarrow \quad \frac{dy}{dx} = \frac{\cos t - \sin t}{\cos t + \sin t}.$$

Now, $\quad \frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{\cos t - \sin t}{\cos t + \sin t}\right)\frac{dt}{dx}$

$$= \left[\frac{(\cos t + \sin t)(-\sin t - \cos t) - (\cos t - \sin t)(-\sin t + \cos t)}{(\cos t + \sin t)^2}\right]\frac{dt}{dx}$$

$$= \frac{-2}{(\cos t + \sin t)^2} \cdot \frac{1}{e^t(\sin t + \cos t)}$$

$$= \frac{-2}{(e^t \cos t + e^t \sin t)} \cdot \frac{1}{(\cos t + \sin t)^2}$$

$$= \frac{-2}{x+y} \cdot \frac{1}{(\cos t + \sin t)^2}$$

$$= \frac{-2}{1+1} \cdot \frac{1}{\left(\cos\frac{\pi}{4} + \sin\frac{\pi}{4}\right)} = -\frac{1}{2}$$

39. $t = 2$ for the point $(2, -1)$

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{4t-2}{2t+3} = \frac{6}{7} \text{ for } t = 2$$

40. $\int \frac{1}{x\sqrt{x^2-1}}dx = \sec^{-1}x + C$

41. Put $t = \tan^{-1}x^2$

$$\Rightarrow \quad dt = \frac{1}{1+x^4}2x\,dx, \text{ then}$$

$$\int \frac{2x\tan^{-1}x^2}{1+x^4}dx = \int t\,dt = \frac{t^2}{2} + C$$

$$= \frac{1}{2}(\tan^{-1}x^2)^2 + C$$

42. Let $I = \int_0^{\pi/2} \frac{d\theta}{1+\tan\theta} = \int_0^{\pi/2} \frac{d\theta}{1+\tan\left(\frac{\pi}{2}-\theta\right)}$

$$= \int_0^{\pi/2} \frac{d\theta}{1+\cot\theta}$$

On adding, we get

$$2I = \int_0^{\pi/2}\left(\frac{1}{1+\tan\theta} + \frac{1}{1+\cot\theta}\right)d\theta$$

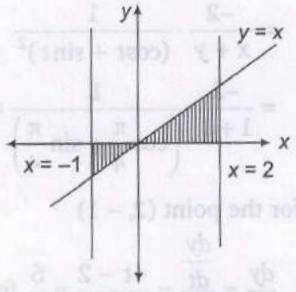
$$= \int_0^{\pi/2} d\theta = [\theta]_0^{\pi/2} = \frac{\pi}{2}$$

$$\Rightarrow \quad I = \frac{\pi}{4}$$

43. $\int_{-4}^{4} |x+2|\,dx = \int_{-4}^{-2} -(x+2)\,dx + \int_{-2}^{4}(x+2)\,dx$

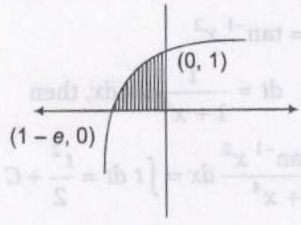
$$= \left|\frac{-x^2}{2} - 2x\right|_{-4}^{-2} + \left|\frac{x^2}{2} + 2x\right|_{-2}^{4} = 20$$

44. Bounded area $= \left|\int_{-1}^{0} x\,dx\right| + \left|\int_0^2 x\,dx\right|$



$$= \left|-\frac{1}{2}\right| + |2| = 2 + \frac{1}{2} = \frac{5}{2}$$

45. Required area $= \int_{1-e}^{0} \log_e(x+e)\,dx$



$$= \int_1^e \log t\,dx = [t\log t - t]_1^e$$

$$= 1 \text{ sq unit}$$

46. Given, equation is $\int \frac{dy}{\sqrt{1-y^2}} + \int \frac{dx}{\sqrt{1-x^2}} = 0$

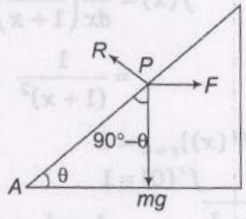
On integration, we get $\sin^{-1} y + \sin^{-1} x = C$

47. Since, favourable ways are 6. Total ways are 36.

Hence, probability $= \frac{6}{36}$

48. By applying Lami's theorem at P, we have

$$\frac{R}{\sin 90^\circ} = \frac{F}{\sin(180^\circ - \theta)} = \frac{mg}{\sin(90^\circ + \theta)}$$



$$\Rightarrow \quad \frac{R}{1} = \frac{F}{\sin\theta} = \frac{mg}{\cos\theta}$$

$$\Rightarrow \quad F = mg\tan\theta$$

49. $|a-a| = 0 < 1 \ \therefore aRa\ \forall\ a \in R$

$\therefore R$ is reflexive.

Again, $aRb \Rightarrow |a-b| \le 1 \Rightarrow |b-a| \le 1 \Rightarrow bRa$

$\therefore R$ is symmetric, Again $|R\,\frac{1}{2}$ and $\frac{1}{2}R|$

but $\frac{1}{2} \neq 1$

$\therefore R$ is not anti-symmetric

Further, $1\,R\,2$ and $2\,R\,3$ but $1\,r\,3$

$[\because |1-3| = 2 > 1]$

$\therefore R$ is not transitive.

50. The contra positive $p \to \sim q$ is

$$\sim(\sim q) \to \sim p \text{ or } q \to \sim p$$

Also, converse of $q \to \sim p$ is $\sim p \to q$.