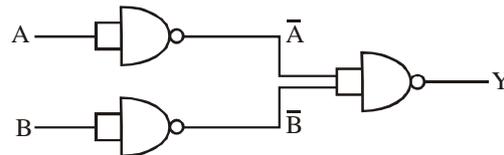


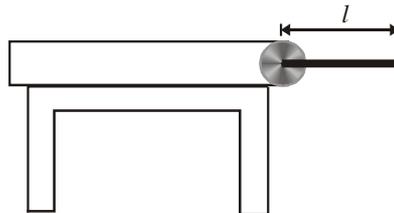
# CBSE PMT – 2007 MAINS

## PHYSICS

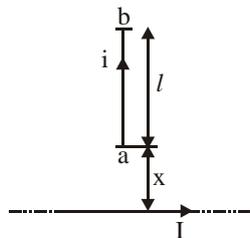
1. (a) How many photons of wavelength 439 nm should strike on a perfectly reflecting surface in 1 second so that it may exert a force of 10N?  
 (b) Can water be boiled without heating?
2. (a) Equation for two waves is given as  $y_1 = a \sin(\omega t + \phi_1)$ ,  $y_2 = a \sin(\omega t + \phi_2)$ . If amplitude and time period of resultant wave does not change then calculate  $(\phi_1 - \phi_2)$ .  
 (b) A solid sphere of radius  $a$  having charge  $q$  is placed inside spherical shell of inner radius  $r$ , outer radius  $R$ .  
 Find potential at distance  $x$ , where  $r < x < R$ .
3. (a) Prove that for a monoatomic gas ratio of specific heat  $\gamma = 5/3$   
 (b) Give the truth table of the following



4. (a) Write the difference between nuclear force and coulombic force.  
 (b) An airplane is moving horizontally with speed of 100 m/sec at height of 2000 m from ground. A small object is detached from it and strikes the ground. Calculate the angle from vertical with which it strikes the ground.  
 (c) Which of the following quantities have same dimensional formula?  
 Angular momentum, impulse, energy, torque, force and moment of inertia.
5. (a) From a table, a rod is hinged as shown in the figure. When the support is withdrawn calculate the acceleration of center of mass.



- (b) There are two wires each produces frequency of 500Hz. By what percentage tension in one wire is increased so that 5 beats per second can be heard?
6. (a) Find the force on conductor carrying current  $i$  as shown the figure.



- (b) A conducting cone is given charge  $q$ . How will the charge density and electric potential varies at different points of cone?

7. (a) When 4 amp current flows through battery from positive to negative terminal potential difference is 12V obtained, when 2 amp current passes from negative to positive terminal of the battery potential difference 9V is obtained, calculate emf and internal resistance of the battery.
- (b) A small pulley of radius 20 cm and moment of inertia  $0.32 \text{ kg m}^2$  is used to hang a 2kg mass with the help of a massless string. If this load is released then calculate acceleration of the block.



8. (a) Capacitance of  $6\mu\text{F}$  is charged by 6V battery. Now it is connected with inductor of 5mH. Find current in inductor when 1/3rd of total energy is magnetic.
- (b) An object is thrown vertically upward with some speed. It crosses two points  $p$ ,  $q$  which are separated by  $h$  metre. If  $t_p$  is the time between  $p$  and highest point and coming back and  $t_q$  is the time between  $q$  and highest point and coming back, relate acceleration due to gravity  $t_p$ ,  $t_q$  and  $h$ .
9. (a) Two coils  $m$  &  $n$  having 10 turns and 15 turns respectively are placed close to each other. When 2A current is passing through coil  $m$ , then flux linked in coil  $n$  is  $1.8 \times 10^{-4}$  Weber per turn. If 3A current is passed through coil  $n$  then, calculate the flux linked per turn of coil  $m$ .
- (b) A string having tension 360N and mass /length =  $4 \times 10^{-3} \text{ kg/m}$ . It produces two consecutive resonant frequencies with a tuning fork, which are 375 Hz and 450 Hz. Find mass of string.
10. (a) In photoelectric effect a photon of wavelength  $3300\text{\AA}$  is incident on metal surface of work function 2.5eV. Now emitted electrons enter in a transverse magnetic field  $6.7 \times 10^{-6} \text{ T}$  and turn in a circular path of radius 50 cm. Calculate charge of electron from the given data?
- (b) If temperature and magnetic field applied across paramagnetic substance are tripled, how many times intensity of magnetization of substance will change?

## CHEMISTRY

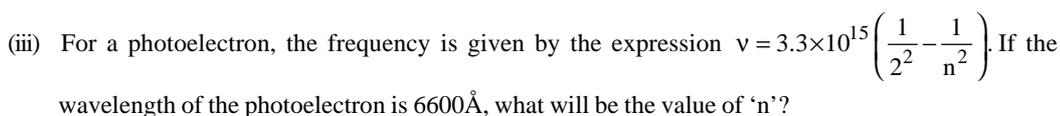
11. (i) Two silver rods are dipped in 1M HCl and 1M  $\text{HNO}_3$ . In which of the two acids will the silver rods dissolve under standard conditions? Given:  $E_{\text{Ag}/\text{Ag}^+}^0 = -0.79 \text{ volt}$ ,  $E_{\text{NO}_3^-/\text{NO}}^0 = +0.96 \text{ volt}$ .
- (ii) A 0.1M acetic acid solution ionizes to 1.2%. What is its  $K_a$  ?
12. (i) Why  $\text{NH}_3$  is more soluble in water than  $\text{PH}_3$  ?
- (ii) Why  $\text{BH}_3$  dimerizes but  $\text{BF}_3$  does not?
- (iii) The complex  $\text{K}[\text{PtCl}_3\text{C}_2\text{H}_4]$  has 3 chlorine atoms bonded to platinum. Why is the chlorine atom lying opposite to ethene have higher bond length?
13. (i) An electron in which orbit of lithium will have same energy as an electron in the second orbit of hydrogen?



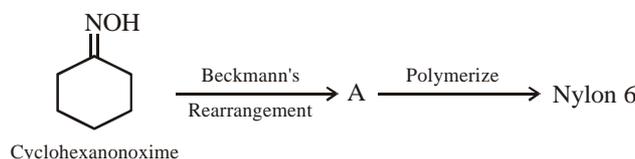
What is the order of the reaction with respect to  $I_2$ ? Also give the total order.

$[I_2]$ Mol/ltr	$[CH_3COCH_3]$ Mol/ltr	$[H^+]$ Mol/ltr	Rate Mol/ltr sec
$3 \times 10^{-3}$	$2.5 \times 10^{-2}$	$1.5 \times 10^{-3}$	$2 \times 10^{-2}$

Also find the value and unit of the rate constant from the data given above.



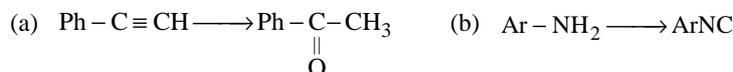
14. (i) Complete the reaction given below



- (ii) Identify which of the following given compounds is optically active?

- (a) 2-chloro 3-methyl pent -1, 4-diene      (b) 3-methyl 3-hydroxy pentanol  
(c) 2-chloro 2-methyl butane

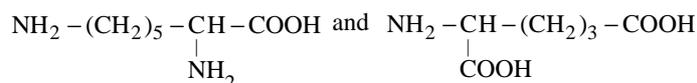
- (iii) Convert:



- (iv) An alkene  $C_4H_8$  reacts with HBr both in the presence and absence of peroxides to give the same product. Identify the alkene.

15. (i)  $C_4H_{10}O$  is produced on reaction of an alkane with  $H_2O/H_2SO_4$ , which is not resolvable into optical isomers. Identify the compound?

- (ii) Make two possible dipeptides from the amino acids given below:



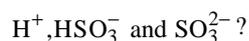
- (iii) The amino acid alanine when kept in a solution with pH less than its isoelectric point it coagulates at the cathode and if pH is greater than isoelectric point it coagulates at anode. Explain this phenomenon.

- (iv) Which out of 1-Butene and 2-Butene react easily with  $Br_2$  in  $CS_2$  and why?

16. (i) Why 1-Butyne gives sodium salt with  $NaNH_2$  but 2-butyne does not?

- (ii) Draw the structures for DNA purines?

17. (i) For 0.5 M  $H_2SO_3$  solution  $K_{a_1} = 1.8 \times 10^{-2}$  and  $K_{a_2} = 8.3 \times 10^{-5}$ . Find the concentrations of



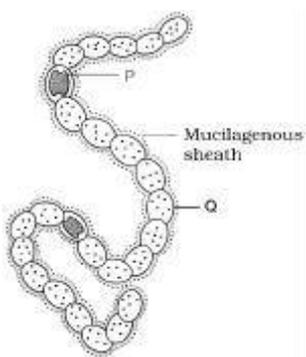
- (ii)  $N_2O_4$  dissociates with a degree of dissociation as 0.4. Establish  $K_\chi$ . Relation between  $K_\chi$  and  $K_p$  and the value of  $K_p$ . Given total pressure = 1 atm and  $T = 315 \text{ K}$ .

- (iii) 1 Mole of nitrogen and 4 mole of hydrogen react to form ammonia in a 20 litre vessel. 10 litres of water are added and the vessel properly shaken. What will be the pressure of the residual gases?

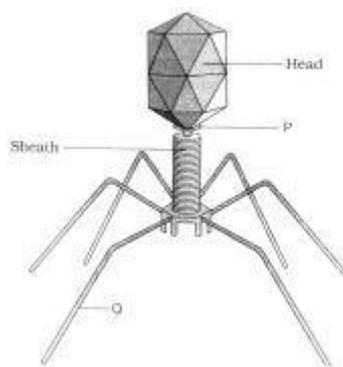
18. (i) Why is  $F_2$  more reactive than  $Cl_2$ ?
- (ii) Why is  $CrO_4^{2-}$  more oxidizing than  $MoO_4^{2-}$ ?
- (iii) Out of  $(SiH_3)_2O$  and  $(CH_3)_2O$  which is more basic and why?
19. (i) The empirical formula of an insoluble compound is  $PtCl_2 \cdot (NH_3)_2$ . On churning this compound with  $AgNO_3$  we get  $[Pt(NH_3)_4]Cl_2$  and  $Ag_2[PtCl_4]$ . What will be the molecular formula of the compound will be?
- (ii) Out of trimethyl amine and triethyl phosphine, which one has higher dipole moment?
20. (i) Why  $PO_4^{3-}$  ions exist but  $NO_4^{3-}$  ions don't?
- (ii) Why  $B_2$  is paramagnetic but  $C_2$  is not?
- (iii) For a octahedral fields splitting  $\Delta_0 > P$  when the pairing energy is less and  $\Delta_0 < P$  when pairing energy is higher. Explain the spin magnetic moments acquired by  $d^5$  and  $d^6$  configurations of metal ions in this field.

## BIOLOGY

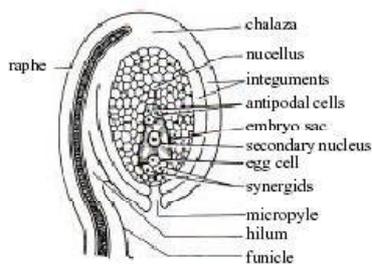
21. Write the location and function of the following
- (a) Cytoskeleton (b) Phytol chain  
 (c) Synergid (d) Sieve tube element  
 (e) Centromere
22. Refer the following diagrams (a) to (e) :



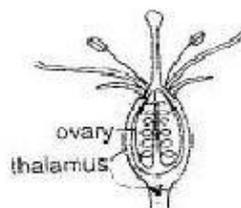
(a)



(b)



(c)



(d)



(e)

- (a) What is shown in diagram (a)? What are (P) and (Q)?  
 (b) Tell whether the diagram (b) is T<sub>1</sub>-phage or T<sub>2</sub>-phage? What are (P) and (Q)?  
 (c) Which type of ovule is shown in diagram (c)? Give one reason.  
 (d) What is the type of flower called given in diagram (d)? Give examples of such flower.  
 (e) Which type of aestivation is shown in (e)? Give examples?
23. Write down the types of placentation, inflorescence and fruit of the following  
 (a) Pea (b) Coriander  
 (c) Wheat (d) Sunflower (e) Mustard
24. Differentiate between the following [Give one important difference]  
 (a) Culm and Caudex (b) Slime moulds and Fungi  
 (c) Cyathium and Hypanthodium (d) Biological magnification and eutrophication  
 (e) White rust and Brown rust.
25. Match the column-I and Column-II :
- |                                    |                             |
|------------------------------------|-----------------------------|
| <b>Column-I</b>                    | <b>Column-II</b>            |
| (a) Jacob and Monod                | (i) Neurospora              |
| (b) One gene one enzyme hypothesis | (ii) Operon                 |
| (c) Griffith                       | (iii) Reverse Transcriptase |
| (d) Temin and Baltimore            | (iv) Okazaki fragments      |
| (e) DNA polymerase                 | (v) Transformation          |
|                                    | (vi) Transduction           |
|                                    | (vii) Conjugation           |
26. Fill in the blanks with suitable words given in boxes:

Marsilea	Coralloid root	Usnea		Eichhomia
Monoecious		Pneumatophores	Geitonogamy	Cycas
Pinus	Dioecious	Vivipary	Xenogamy	Oscillatoria

- (a) Rhizophora has both \_\_\_\_\_ and \_\_\_\_\_  
 (b) Aquatic plants are \_\_\_\_\_ (Pteridophyte) and \_\_\_\_\_ (Angiosperm)  
 (c) Plant bearing both male and female flowers is called \_\_\_\_\_ and the pollination between different flowers of the same plant is called \_\_\_\_\_.  
 (d) \_\_\_\_\_ has \_\_\_\_\_.
27. (a) Give any two conditions for seed habit.  
 (b) Among the pairs which one shows the tendency of seed habit?  
 (i) Lycopodium and Equisetum  
 (ii) Selaginella and Pteris.  
 (iii) Dryopteris and Pteridium.  
 (c) Suggest three ways to break seed dormancy.
28. Fill in the blanks  
 (a) Mutation can be defined as \_\_\_\_\_ variation.  
 (b) Mutation leads to evolution of \_\_\_\_\_ of a gene.  
 (c) Genes expressed only in homozygous state are \_\_\_\_\_.  
 (d) When both alleles of a gene are expressed it is \_\_\_\_\_.  
 (e) Gene, which is most frequent is \_\_\_\_\_ type.
29. (a) Who discovered photoperiodism?  
 (b) Select one SDP and one LDP from following plants  
 Chrysanthemum , Rice, Spinach, Barley, Radish  
 (c) Who gave the term 'Phytochrome'? Give one specific feature of phytochrome.

30. Match the Column-I and Column-II

**Column-I**

- (a) Indian Rhinoceros
- (b) Acid rain
- (c) Somaclonal variations
- (d) Protoplasm fusion
- (e) Biopiracy

**Column-II**

- (i) Extinct
- (ii) Endangered
- (iii) Gir forest
- (iv) Corbett National Park
- (v) CFC
- (vi) Nitrogen oxide
- (vii) Sulphur oxide
- (viii) PEG
- (ix) Mutation
- (x) Tumeric

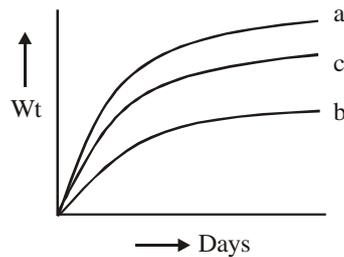
31. Differentiate between

- (a) Habitat and Niche
- (b) Flora and Vegetation

32. Answer the following question:

- (a) Apart from  $\text{CO}_2$ , name other green house gases
- (b) What is the type of movement of twiner and opening of flower?

33. Three groups of baby mice



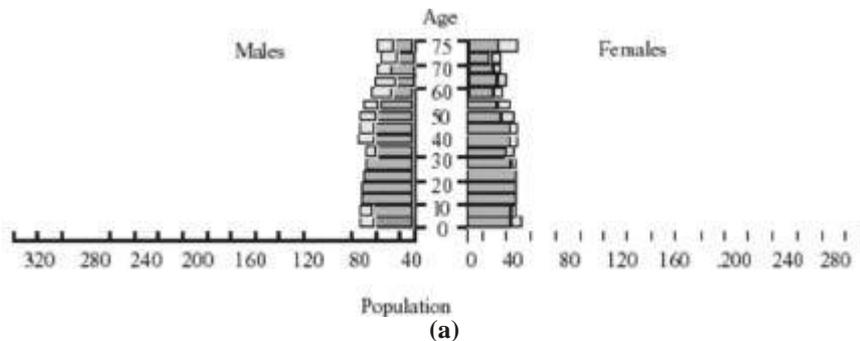
- (a) kept on complete diet
- (b) fed basal diet without nutrient to be tested
- (c) basal diet + carotene by feeding carrots

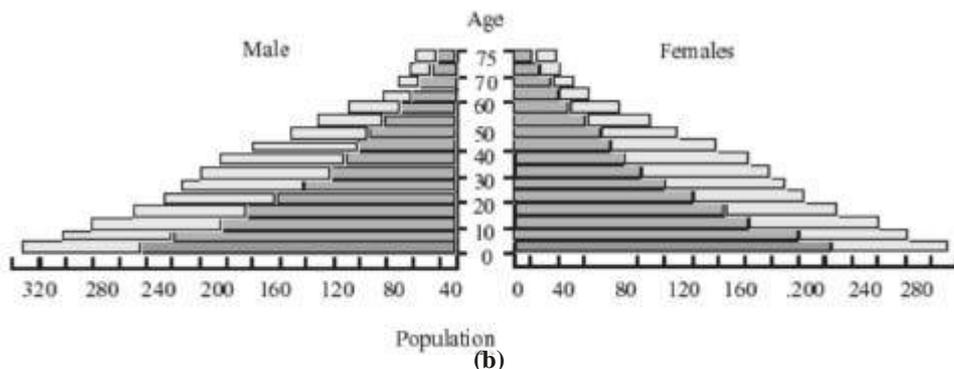
34. Out of following animals – answer the questions.

Whale, Earthworm, Bat, Starfish, Scorpion, Honey bee, Peafowl.

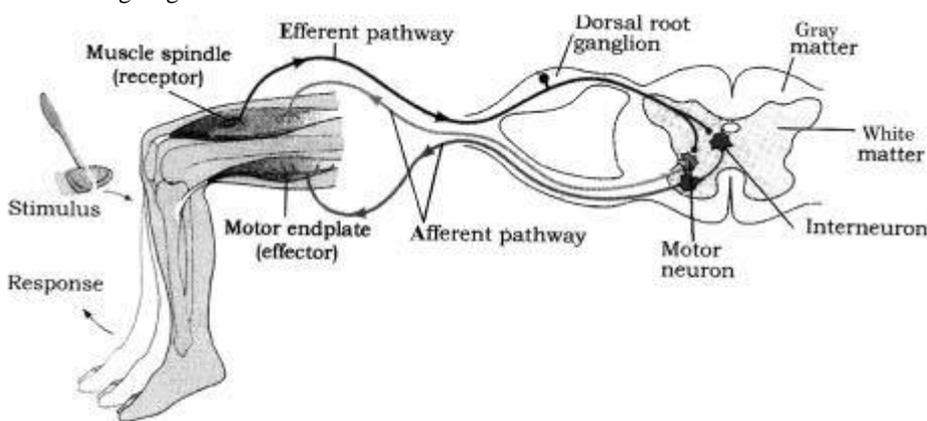
- (a) Which animal is different from rest of animals?
- (b) How many of these are poisonous, which class they belong to?
- (c) Which animals belong to same class?
- (d) Which animals are only representatives of their phylum?
- (e) Which of the following have 3 ear ossicles. Name the ossicles in the order of sound transmission.

35. The following diagrams represent Age-Sex pyramid of (a) developed (b) developing nation.

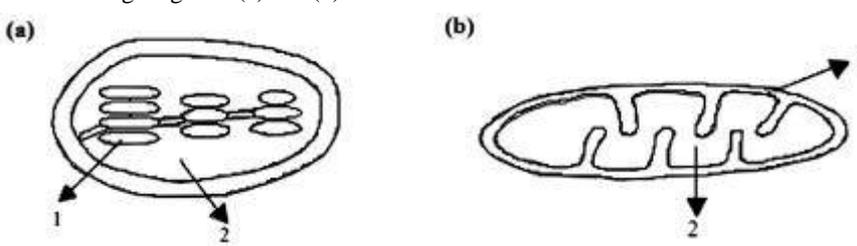




36. Refer the following diagram :



- (a) What kind of reflex is it?
  - (b) Where is it striking?
  - (c) List the errors in the above diagram?
37. (a) Nictitating membrane and Vermiform appendix are examples of which type of organs.
- (b) Define vestigial organs
- (c) Which of the following four can be categorised in the same category?  
 Out of coccyx, mammary glands muscles of external ear and opacity of eye due to cataract are these 4 in same categories.
38. Refer the following diagrams (a) and (b)



- Write the functions of (1) and (2) in each diagram.
39. In photorespiration, RuBP is oxidized to form glycolate and glycerate. Glycolate enters the PCO cycle to regenerate glycerate. Draw a flow diagram of photorespiration to show different intermediates and the cell organelles involved.

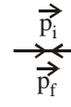
## HINTS & SOLUTIONS

1. (a) Let  $n$  photons strike on the surface per second. Then the force exerted by the photons,

$$F = n (\Delta p)$$

Where  $\Delta p =$  change in momentum per second

$$\Delta \vec{p} = \vec{p}_i - (-\vec{p}_f) = \vec{p}_i + \vec{p}_f$$



$$|\Delta \vec{p}| = 2p_i = 2 \times \frac{h}{\lambda} \quad (\because |\vec{p}_i| = |\vec{p}_f|)$$

$$\therefore F = n \times \frac{2h}{\lambda} \text{ or, } n = \frac{F\lambda}{2h}$$

Here,  $F = 10 \text{ N}$ ,  $\lambda = 439 \text{ nm} = 439 \times 10^{-9} \text{ m}$ ,  $h = 6.625 \times 10^{-34} \text{ Js}$

$$\text{Putting all these values, we get } n = \frac{10 \times 439 \times 10^{-9}}{2 \times 6.625 \times 10^{-34}} = 3.313 \times 10^{27}.$$

- (b) Water can be boiled without supplying heat if it is kept inside a closed vessel and increasing the pressure on its surface such as water in a pressure cooker and also it can be boiled if pressure is reduced in a vessel containing water.

2. (a) Here,  $A_1 = a$ ,  $A_2 = a$  and  $A = a$

We have,

$$A = A_1^2 + A_2^2 + 2A_1A_2 \cos(\phi_1 - \phi_2)$$

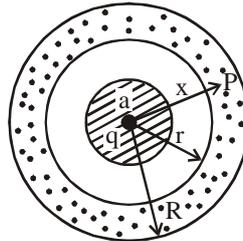
$$\text{or, } a^2 = a^2 + a^2 + 2a \cdot a \cos(\phi_1 - \phi_2)$$

$$\text{or, } a^2 = 2a^2 + 2a^2 \cos(\phi_1 - \phi_2)$$

$$\text{or, } a^2 = 2a^2 [1 + \cos(\phi_1 - \phi_2)]$$

$$\text{or, } \frac{1}{2} = 1 + \cos(\phi_1 - \phi_2) \text{ or, } \cos(\phi_1 - \phi_2) = -\frac{1}{2} \Rightarrow \phi_1 - \phi_2 = 120^\circ$$

- (b) Let the point at a distance  $x$  be P.



Then the potential at P is given by  $V = V_1 + V_2 + V_3$

where,  $V_1 =$  potential at P due to the solid sphere =  $\frac{Kq}{x}$

$V_2 =$  potential at P due to the inner surface of the shell =  $\frac{K(-q)}{x}$

$V_3 =$  potential at P due to the outer surface of the shell =  $\frac{Kq}{R}$

$$\therefore V = \frac{Kq}{x} + \frac{K(-q)}{x} + \frac{Kq}{R} = \frac{Kq}{R}$$

3. (a) The ratio of specific heats,  $\gamma$  is given by

$\gamma = 1 + \frac{2}{n}$ , where  $n$  is the degree of freedom. We know that the degree of freedom of a molecule is the number of independent ways in which it can have energy. Also, a monoatomic molecule can move linearly but can't rotate, so it can have energy along three directions viz.  $x$ ,  $y$  and  $z$  axes only.  
 $\therefore$  For a monoatomic gas,  $n = 3$ .

Hence,  $\gamma = 1 + \frac{2}{n} = 1 + \frac{2}{3}$  or,  $\gamma = \frac{5}{3}$  (proved)

(b) From the figure the Boolean expression is  $Y = \overline{\overline{A.B}}$

After simplification, we get

$Y = \overline{\overline{A} + \overline{B}}$  ( $\because \overline{\overline{A.B}} = \overline{\overline{A} + \overline{B}}$  by absorptive law of Boolean algebra)  
 $= A + B$

$\therefore$  The truth table is as given below:

In puts		Out put
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

4. (a) The differences between nuclear force and coulombic force are tabulated below:

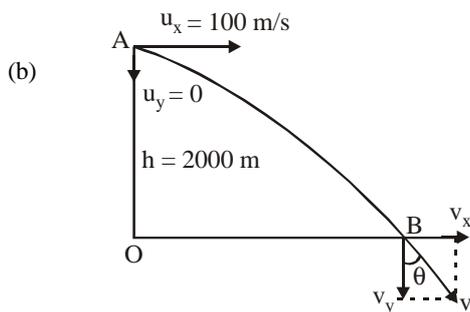
**Nuclear Force**

1. The force acting between the constituent particles of an atom is called nuclear force.
2. It is charge independent.
3. It is a short-range force.
4. It does not obey the inverse square law but it obeys inverse law of  $r^n$  where  $n$  is a very large number.
5. It is stronger than coulombic force

**Coulombic Force**

- The force acting between two charged particles is called coulombic force.  
 It is charge dependent.  
 It is a short as well as a long range force.  
 It obeys the inverse square law of distance.

It is weaker than nuclear force.



Let  $\theta$  be the required angle. Then  $\tan \theta = \frac{v_x}{v_y}$

Where,  $v_x =$  horizontal component of velocity when the object strikes the ground at B  
 $= u_x + a_x t = u_x$  ( $\because a_x = 0$ )  
 $= 100 \text{ m/s}$

$v_y =$  vertical component of velocity at B  $= u_y + a_y t = gt$  ( $\because u_y = 0, a_y = +g$ )

$$\text{But } h = u_y t + \frac{1}{2} a_y t^2 = \frac{1}{2} g t^2 \Rightarrow t = \sqrt{\frac{2h}{g}}$$

$$\therefore v_y = g \times \sqrt{\frac{2h}{g}} = \sqrt{2gh} = \sqrt{2 \times 10 \times 2000} = 200 \text{ ms}^{-1}.$$

$$\therefore \tan \theta = \frac{v_x}{v_y} = \frac{100}{200} = \frac{1}{2}$$

$$\therefore \theta = \tan^{-1}\left(\frac{1}{2}\right)$$

(c) Clearly,

$$[\text{Angular momentum}] = [\text{ML}^2\text{T}^{-1}]$$

$$[\text{Impulse}] = [\text{MLT}^{-1}]$$

$$[\text{Energy}] = [\text{ML}^2\text{T}^{-2}]$$

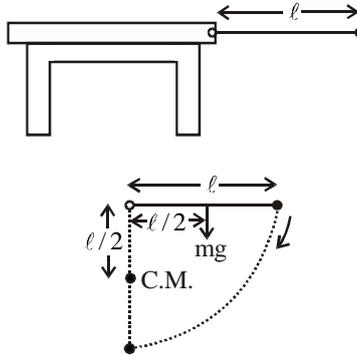
$$[\text{Torque}] = [\text{ML}^2\text{T}^{-2}]$$

$$[\text{Force}] = [\text{MLT}^{-2}]$$

$$[\text{Moment of Inertia}] = [\text{ML}^2]$$

Hence, the dimensional formulae of energy and torque are same.

5. (a) When the support is withdrawn, the rod will rotate about the axis passing through the hinged point.



$$\text{Torque acting on the rod about the axis of rotation} = mg\left(\frac{\ell}{2}\right)$$

$$\text{Also, Torque} = I\alpha, \text{ where } I = \text{moment of inertia of the rod about the axis of rotation} = \frac{m\ell^2}{3}$$

$$\text{If } a_{\text{cm}} \text{ be the acceleration of the centre of mass, then } \alpha = \frac{a_{\text{cm}}}{(\ell/2)}$$

$$\therefore mg\left(\frac{\ell}{2}\right) = I\alpha \text{ or, } \frac{mg\ell}{2} = \frac{m\ell^2}{3} \times \frac{a_{\text{cm}}}{\ell/2} \text{ or } \frac{mg\ell}{2} = \frac{2m\ell^2 \cdot a_{\text{cm}}}{3\ell}$$

$$\Rightarrow a_{\text{cm}} = \frac{3g\ell^2}{4m\ell^2} = \frac{3g}{4m} \text{ms}^{-2} = \frac{3 \times 10}{4m} \text{ms}^{-2} \quad \therefore a_{\text{cm}} = \frac{15}{2m} \text{ms}^{-2},$$

where  $m$  is the mass of the rod.

(b) We know that

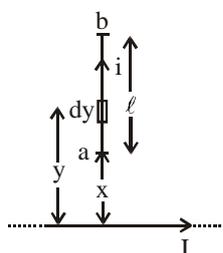
$n \propto \sqrt{T}$ , where  $n$  = frequency and  $T$  = tension in the wire.

or,  $n = KT^{1/2}$ , where  $K$  is the constant of proportionality.

or,  $\frac{\Delta T}{T} = 2\left(\frac{\Delta n}{n}\right)$ , where  $\Delta T$  is change in tension and  $\Delta n$  change in frequency.

or, % change in tension =  $\frac{\Delta T}{T} \times 100 = 2\left(\frac{\Delta n}{n}\right) \times 100 = \frac{2 \times 5}{500} \times 100 = 2$

6. (a)



Let us consider a current element  $dy$  at a distance  $y$  from the wire carrying current  $I$ .  
The magnetic field acting on the current element due to infinitely long conductor,

$$B = \frac{\mu_0}{2\pi y}$$

$\therefore$  Force acting on  $dy$  length,  $dF = idyB$

Now, total force acting on the conductor of length ( $\ell$ ),

$$F = \int_x^{(x+\ell)} idyB = \int_x^{(x+\ell)} \frac{\mu_0 I}{2\pi y} idy = \frac{\mu_0 Ii}{2\pi} = \int_x^{(x+\ell)} \left(\frac{1}{y}\right) dy = \frac{\mu_0 Ii}{2\pi} = [\ell n y]_x^{(x+\ell)}$$

$$= \frac{\mu_0 Ii}{2\pi} = [\ell n(x+\ell) - \ell n(x)] = \frac{\mu_0 Ii}{2\pi} = \left[ \ell n \frac{(x+\ell)}{x} \right]$$

$$\text{or, } F = \frac{\mu_0 Ii}{2\pi} = \ell n \left( 1 + \frac{\ell}{x} \right)$$

(b) We know that, Charge density  $\sigma = \frac{q}{4\pi r^2}$  or,  $q = (4\pi r^2) \cdot \sigma$ .

Also, the potential on the surface of a conductor of any configuration is constant,

$$\text{i.e. } \frac{q}{4\pi\epsilon_0 r} = \text{constant or, } \frac{1}{4\pi\epsilon_0} \cdot \frac{(4\pi r^2) \cdot \sigma}{r} = \text{constant or, } r \cdot \sigma = \text{constant}$$

$$\text{or, } \sigma = \frac{\text{constant}}{r} \Rightarrow \sigma \propto \frac{1}{r}$$

Hence, the charge density varies inversely with distance but potential remains constant.

7. (a) **First case**

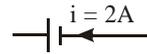
In this case, the battery is being charged.



$\therefore V = E + ir$ , where  $E$  = emf of battery and  $r$  = internal resistance of the battery  
 or,  $12 = E + 4r$  ..... (1)

**Second case**

In this case, the battery is being discharged.



$\therefore V = E - ir$  or,  $9 = E - 2r$  ..... (2)  
 Subtracting (2) from (1), we get

$$3 = 6r \Rightarrow r = \frac{3}{6} = \frac{1}{2} = 0.5\Omega$$

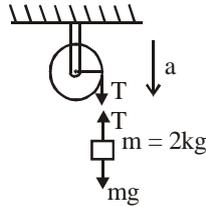
Putting this value of  $r$  in (1), we get  $12 = E + (0.5 \times 4)$  or,  $E = 10\text{ V}$

$\therefore E = 10\text{V}$  and  $r = 0.5\Omega$ .

(b) Considering the rotational motion of the pulley,

we get  $T \cdot r = I\alpha$  or,  $T \cdot r = I \left( \frac{a}{r} \right)$

Where,  $a$  is the linear acceleration of the pulley in downward direction.



$$\therefore T = \frac{Ia}{r^2} \text{ ..... (1)}$$

Now, considering the motion of the mass  $m (= 2\text{kg})$ , we get  $mg - T = ma$

or,  $mg - \frac{Ia}{r^2} = ma$ ; from (1)

or,  $ma + \frac{Ia}{r^2} = mg$  or,  $a \left( m + \frac{I}{r^2} \right) = mg \Rightarrow a = \frac{mg}{\left( m + \frac{I}{r^2} \right)}$

Putting the values of  $m, g, I$  and  $r$ , we get

$$a = \frac{2 \times 10}{\left[ 2 + \frac{0.32}{(0.2)^2} \right]} = \frac{20}{2+8} \text{ms}^{-2} = \frac{20}{10} \text{ms}^{-2} \therefore 2 \text{ms}^{-2}$$

8. (a) Energy of capacitor,  $E_C = \frac{1}{2} \times CV^2 = \frac{1}{2} \times (6 \times 10^{-6}) \times (6)^2 = 108 \times 10^{-6} \text{ J}$

When the capacitor is connected to the inductor, the magnetic energy,  $E_B = \frac{1}{2} Li^2$

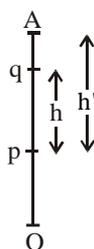
or,  $E_B = \frac{1}{2} \times (5 \times 10^{-3}) \times i^2 = (2.5 \times 10^{-3}) i^2$

According to question,  $E_B = \frac{1}{2} \times E_C$  or,  $(2.5 \times 10^{-3})^2 = \frac{1}{3} \times 108 \times 10^{-6}$

$$\text{or, } i^2 = \frac{108 \times 10^{-6}}{3 \times 2.5 \times 10^{-3}} = \frac{43.2 \times 10^{-3}}{3} = 14.40 \times 10^{-3} = 144 \times 10^{-4}$$

$$\therefore i = \sqrt{144 \times 10^{-4}} \text{ A or, } i = 12 \times 10^{-2} \text{ A.}$$

- (b) Let A be the highest point and h' the distance between the point p and A. Here,  $t_p$  = time taken in going from p to A and again from A to p



$$\text{Similarly, time taken in falling from A to q} = \frac{t_q}{2}.$$

$$\text{Now, } h' = \frac{1}{2}g\left(\frac{t_p}{2}\right)^2 = \frac{gt_p^2}{8} \quad \dots(i)$$

$$\text{and } h' - h = \frac{1}{2}g\left(\frac{t_q}{2}\right)^2 = \frac{gt_q^2}{8} \quad \dots(ii)$$

$$\text{Subtracting (ii) from (i), we get } h = \frac{gt_p^2}{8} - \frac{gt_q^2}{8} = \frac{g}{8}(t_p^2 - t_q^2) \text{ or, } g = \frac{8h}{t_p^2 - t_q^2}$$

which is the required relation.

9. (a) For the coil n, we have  $15 \times \phi_n = MI_m$  or,  $15 \times 1.8 \times 10^{-4} = M \times 2$

$$\therefore M = 13.5 \times 10^{-4} \text{ H}$$

$$\text{For the coil m, we have } 10 \times \phi_m = MI_n \text{ or, } \phi_m = \frac{MI_n}{10} = \frac{13.5 \times 10^{-4} \times 3}{10} = 40.5 \times 10^{-5} \text{ Wb.}$$

- (b) We know that the velocity of transverse wave in a string of mass per unit length  $\mu$  and tension T is given by

$$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{360}{4 \times 10^{-3}}} = 3 \times 10^2 \text{ m/s} = 300 \text{ m/s}$$

$\therefore$  The string produces two consecutive resonant frequencies 375 Hz and 450 Hz with a tuning fork.

$$\text{We have } n \frac{v}{2\ell} = 375 \quad \dots(i)$$

$$\text{and } (n+1) \frac{v}{2\ell} = 450 \quad \dots(ii)$$

where  $n$  is an integer

$$\text{Subtracting (i) from (ii), we get } (n+1-n) \cdot \frac{v}{2\ell} = 75 \quad \text{or, } \frac{v}{2\ell} = 75 \quad \text{or, } \frac{300}{2\ell} = 75$$

$$\Rightarrow \ell = 2 \quad \therefore \text{Mass per unit length } (\mu) = 4 \times 10^{-3}$$

$$\text{or, } \frac{m}{\ell} = 4 \times 10^{-3} \quad \text{or, } m = 4 \times 10^{-3} \times \ell = 4 \times 10^{-3} \times 2$$

$$\therefore m = 8 \times 10^{-3} \text{ kg.}$$

10. (a) Here, wavelength ( $\lambda$ ) of photon =  $3300 \text{ \AA} = 3300 \times 10^{-10} = 3.3 \times 10^{-7} \text{ m.}$

$$\text{work function } (\phi) \text{ of the surface} = 2.5 \text{ eV} = 2.5 \times 1.6 \times 10^{-19} \text{ J} = 4.0 \times 10^{-19} \text{ J}$$

$$\text{Energy of incident photon} = \frac{hc}{\lambda} = \frac{6.625 \times 10^{-34} \times 3 \times 10^8}{3.3 \times 10^{-7}} \text{ J} = 6.02 \times 10^{-19} \text{ J}$$

By Einstein's equation of photoelectric effect, we have  $E = \phi + T_{\max}$

$$\text{or, } T_{\max} = E - \phi = 6.02 \times 10^{-19} - 4.0 \times 10^{-19} \text{ J} = 2.02 \times 10^{-19} \text{ J}$$

Now, as the emitted electrons enter a magnetic field and turn in a circular path, the radius of the path is given by

$$R = \frac{\sqrt{2m(T_{\max})}}{qB} \Rightarrow q = \frac{\sqrt{2m(T_{\max})}}{RB}$$

Putting the values of  $m$ ,  $R$ ,  $B$  and  $T_{\max}$ , we get

$$q = \frac{\sqrt{2 \times 9.1 \times 10^{-31} \times 2.02 \times 10^{-19}}}{50 \times 10^{-2} \times 6.7 \times 10^{-6}} \text{ coulomb} = \frac{6.04 \times 10^{-25}}{3.35 \times 10^{-6}} \text{ coulomb} = 1.8 \times 10^{-19} \text{ C (approx.)}$$

- (b) We have, from Curie's law,  $I \propto \frac{B}{T}$

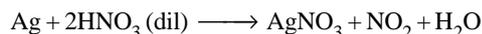
where,  $I$  = intensity of magnetization,  $B$  = magnetic field,  $T$  = absolute temperature

when  $B$  and  $T$  are tripled, the new intensity of magnetization,  $I' \propto \frac{3B}{3T} \propto \frac{B}{T}$

So, intensity of magnetization will not change.

## Chemistry

11. (i) Less reactive metals like Ag oxidise more readily in  $\text{HNO}_3$  than  $\text{HCl}$  because  $\text{HNO}_3$  behaves as an oxidising acid while  $\text{HCl}$  as non-oxidising acid.



Further if we calculate  $E_{\text{cell}}^\circ$  for the reaction. we get

$$E_{\text{cell}}^\circ = E_{\text{cathode}}^\circ - E_{\text{anode}}^\circ = +0.96 - (-0.79) = +1.75 \text{ volt.}$$

From the relation  $\Delta G = -nFE^\circ$ , we found  $\Delta G$  to be negative.

Since the  $E_{\text{cell}}^\circ$  is +ve, thus the reaction would be spontaneous under standard condition.

$$(\Delta G = -nFE)$$

$$(ii) \text{ Given } \alpha = \frac{1.2}{100} = 0.012 \text{ and } C = 0.1 \text{ M}$$

12. (i) Intermolecular hydrogen bonding is found in  $\text{NH}_3$  which increases its solubility whereas as hydrogen bonding does not found in  $\text{PH}_3$  which make it less soluble.
- (ii)  $\text{BF}_3$  is a monomeric covalent species. They do not dimerize like  $\text{BH}_3$  because the lone pairs on the halogens can interact with the vacant p orbital on boron due to which the electron deficiency of the central boron is satisfied whereas this property is not seen in  $\text{BH}_3$ .
- (iii) The carbon atoms are approximately equidistant from the platinum atom and the distance from the midpoint of the C – C bond to the platinum atom is 2.022 Å. The C – C distance, 1.375 (4) Å, is 0.038 Å longer than the value found in free ethylene, indicating some  $d\pi - p\pi^*$  back-bonding from the platinum atom to  $\text{C}_2\text{H}_4$ . Back-bonding is also indicated by a bending of the four hydrogen atoms away from the platinum atom. The carbon atoms are at an average distance of 0.164 Å from the plane of the four hydrogen atoms, and the angle between the normals to the methylene planes (the  $\alpha$  angle) is  $32.5^\circ$ . Both the magnitude of  $\alpha$  and the C – C bond lengthening are considerably smaller in Zeise's salt.
13. (i) For H-like particles energy of electron in nth shell.

$$E_n = -\frac{1312Z^2}{n^2} \text{ kJ mol}^{-1}$$

$$\therefore \text{ Energy in IIInd orbit of hydrogen} = -\frac{1312 \times 1^2}{2^2} \text{ kJ mol}^{-1} = -\frac{1312}{4} \text{ kJ mol}^{-1}$$

$$\text{and for Li}^{++}, E_n = -\frac{1312 \times 3^2}{6^2} = -\frac{1312}{4} \text{ kJ mol}^{-1}$$

Therefore if the electron is in sixth orbit of  $\text{Li}^{++}$ , energy would be same.

- (ii) As the rate law expression does not involve the concentration of  $\text{I}_2$  therefore order of reaction w.r.t  $\text{I}_2$  is 0.  
As given in the expression that  $\text{Rate} = k[\text{CH}_3\text{COCH}_3][\text{H}^+]$   
Now substitute the values in the expression.  
 $2 \times 10^{-2} = k[2.5 \times 10^{-2}][1.5 \times 10^{-3}]$

$$\therefore k = \frac{2 \times 10^{-2} \text{ mol lit}^{-1}}{2.5 \times 10^{-2} \times 1.5 \times 10^{-3} \text{ mol}^2 \text{ lit}^{-2}} = 0.535 \times 10^{-3} = 5.33 \times 10^{-4} \text{ mol}^{-2} \text{ lit sec}^{-1}$$

$$(iii) \text{ Given } v = 3.3 \times 10^{15} \left( \frac{1}{2^2} - \frac{1}{n^2} \right)$$

$$\lambda = 6600 \text{ \AA} = 6600 \times 10^{-10} \text{ meter and } v = \frac{c}{\lambda}$$

$$\therefore \frac{c}{\lambda} = 3.3 \times 10^{15} \left( \frac{1}{2^2} - \frac{1}{n^2} \right) \Rightarrow \frac{3 \times 10^8}{6.6 \times 10^{-7}} = 3.3 \times 10^{15} \left( \frac{1}{4} - \frac{1}{n^2} \right) \Rightarrow 0.138 = \frac{1}{4} - \frac{1}{n^2}$$

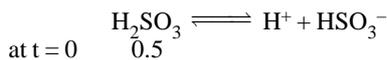
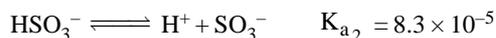
$$\Rightarrow \frac{1}{n^2} = \frac{1}{4} - \frac{138}{1000} = \frac{1000 - 552}{4000} = \frac{448}{4000}$$

$$\Rightarrow n^2 = \frac{4000}{448} \Rightarrow n = \frac{63.24}{21.16} = 2.988 \approx 3$$





17. (i) Given,  $\text{H}_2\text{SO}_3 \rightleftharpoons \text{H}^+ + \text{HSO}_3^-$   $K_{a_1} = 1.8 \times 10^{-2}$



at  $t = 0$

at  $t_{\text{eq}}$   $0.5 - \alpha$   $\alpha$   $\alpha$

where  $\alpha$  = degree of dissociation

$$\text{Now } K_{a_1} = \frac{[\text{H}^+][\text{HSO}_3^-]}{[\text{H}_2\text{SO}_3]}$$

$$\therefore K_{a_1} = \frac{\alpha^2}{(0.5 - \alpha)} = 1.8 \times 10^{-2} \text{ or } \alpha^2 = 0.9 \times 10^{-2} - 1.8 \times 10^{-2} \alpha \text{ or } \alpha^2 + 1.8 \times 10^{-2} \alpha - 0.9 \times 10^{-2} = 0$$

On solving the value of  $\alpha$ , we get  $\alpha = 0.08625$  mol/l

$$\therefore [\text{H}^+] = [\text{HSO}_3^-] = 0.08625 \text{ mol/l and } K_{a_2} = \frac{[\text{SO}_3^{--}][\text{H}^+]}{[\text{HSO}_3^-]}$$

now substitute of the value of  $[\text{H}^+]$  and  $[\text{HSO}_3^-]$

$$\text{in above equation, we get } 8.3 \times 10^{-5} = \frac{[\text{SO}_3^{--}][0.08625]}{[0.08625]}$$

$$[\text{SO}_3^{--}] = 8.3 \times 10^{-5} \text{ mol/l}$$

- (ii)  $\text{N}_2\text{O}_4 \rightleftharpoons 2 \text{NO}_2$
- |                 |         |               |
|-----------------|---------|---------------|
| t = 0           | 1       | 0             |
| t <sub>eq</sub> | 1 - 0.4 | 0.4 × 2 = 0.8 |
- Total no of moles = 1 - 0.4 + 0.8 = 1.4

$$\text{Now } K_x = \frac{[x_{\text{NO}_2}]}{[x_{\text{N}_2\text{O}_4}]} \quad \text{where } x_{\text{NO}_2} = \frac{0.8}{1.4} \text{ and } x_{\text{N}_2\text{O}_4} = \frac{0.6}{1.4}$$

$$\therefore K_x = \left( \frac{0.8}{1.4} \right)^2 \bigg/ \frac{0.6}{1.4} = 0.76$$

$$\text{As } K_p = K_x (P_{\text{total}})^{\Delta n_g} = 0.76 \times (1) = 0.76 \text{ atm} \quad \therefore (\Delta n_g = 2 - 1 = 1)$$

- (iii)  $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$
- |        |        |        |
|--------|--------|--------|
| 1 mole | 3-mole | 2 mole |
|--------|--------|--------|

i.e. 1 mole of  $\text{N}_2$  react with 3 mole of  $\text{H}_2$  to form 2 mole of  $\text{NH}_3$ , but the amount of  $\text{H}_2$  taken is 4 moles thus the  $\text{H}_2$  will be the residual gas and hence

$$P_{\text{H}_2} \times V = nRT$$

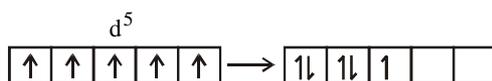
$$P_{\text{H}_2} \times 10 = 1 \times 0.0821 \times 298$$

$$P_{\text{H}_2} = 2.45 \text{ atm.}$$

Now the effective volume of the vessel occupied by  $\text{H}_2$  gas is  $20 - 10 = 10$  litre

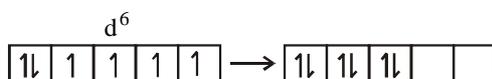
18. (i)  $\text{F}_2$  is more reactive than  $\text{Cl}_2$  because bond dissociation energy of  $\text{Cl}_2$  is more than  $\text{F}_2$ , because of interionic repulsions present in the small atom of fluorine.

- (ii) The most stable oxidation state of Cr is +3 and +6, whereas the stable oxidation states of Mo are +3, +4, +5 and +6, Chromium will try to pass from +6, O No to +3 oxidation state when it form  $\text{Cr}^{+++}$  from  $\text{CrO}_4^-$  thus it is less stable and hence more oxidizing. Whereas Mo is much more stable and hence is less oxidizing.
- (iii) In  $(\text{SiH}_3)_2\text{O}$ , the Si – O bond show  $\text{P}\pi - \text{d}\pi$  bonding due to which  $\text{p}\pi$  electrons of O are loosely bound and ease of these electrons are much easier and hence is more basic. Whereas in  $(\text{CH}_3)_2\text{O} - \text{P}\pi - \text{d}\pi$  bonding is not possible and therefore, the availability of  $\text{p}\pi$  electrons is very less, hence is less basic.
19. (i) As on churning the compound with  $\text{AgNO}_3$  we get  $\text{Pt}(\text{NH}_3)_4 \text{Cl}_2$  and  $\text{Ag}_2 [\text{PtCl}_4]$ . Thus we can expect that the complex must be a higher derivative of the compound given i.e.  $\text{PtCl}_2 \cdot (\text{NH}_3)_2$ . Thus the molecular formula of the compound would be
- $$[\text{Pt}(\text{NH}_3)_4]^{2+} \quad [\text{PtCl}_4]^{2-}$$
- tetra ammineplatinum (II) tetrachloro platinum (II)
- (ii) As N is more electronegative than P therefore the electronegativity difference between C & N in  $(\text{CH}_3)_3\text{N}$  is more than the electronegativity difference between C & P in  $(\text{C}_2\text{H}_5)_3\text{P}$  thus the dipole moment of  $(\text{CH}_3)_3\text{N}$  is higher than  $(\text{C}_2\text{H}_5)_3\text{P}$ . Further, both the molecules are pyramidal due to the repulsion arises between the ethyl groups in  $(\text{C}_2\text{H}_5)_3\text{P}$  the bond angle is larger and hence lower is the dipole moment.
20. (i)  $\text{P}(15) = 1s^2 2s^2 2p^6 3s^2 3p^3 3d^0$ ,  $\text{N}(7) = 1s^2 2s^2 2p^3$   
As P contains vacant d orbit, thus it can exceed its octet and utilize d-orbitals for multiple bonding. whereas N can not exceed its octet due to the absence of d-orbital and hence can not form  $\text{NO}_4^{3-}$  ion.
- (ii) The Molecular orbital configuration of  $\text{B}_2$  is  $\text{B}_2 - \text{KK } \sigma(2s)^2 \sigma^*(2s)^2 \pi(2p_x)^1 \pi(2p_y)^1$   
As it contains two unpaired  $e^-$  therefore it is paramagnetic and the molecular orbital configuration of  $\text{C}_2$  is  $\text{C}_2 = \text{KK } \sigma(2s)^2 \sigma^*(2s)^2 \pi(2p_x)^2 \pi(2p_y)^2$   
As it does not contains any unpaired  $e^-$  thus this is diamagnetic.
- (iii) When  $\Delta_o < P$  i.e. when the pairing energy is higher, then



No. of unpaired electron remain = 1 (Paramagnetic)

$$\therefore \text{Spin magnetic moment } \mu = \sqrt{n(n+2)} = \sqrt{1(1+2)} = \sqrt{3} = 1.732 \text{ B.M.}$$

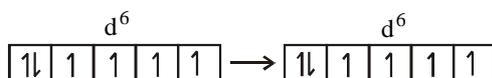


No. of unpaired  $e^- = 0$  (Diamagnetic)

$$\therefore \mu = 0 \text{ when } \Delta_o > P \text{ i.e. when the pairing energy is less then}$$



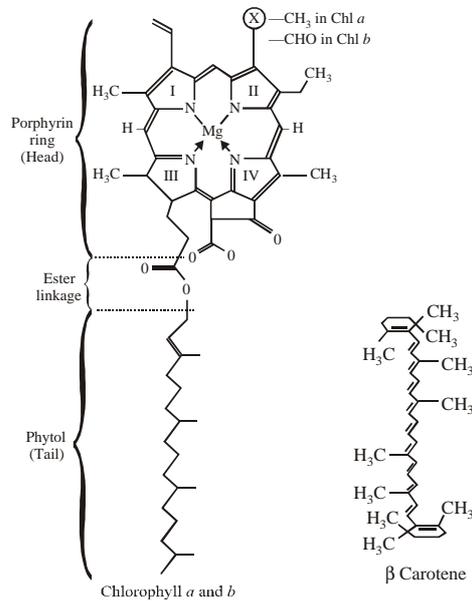
No. of unpaired  $e^- = 5$ ,  $\mu = \sqrt{5(5+2)} = \sqrt{35} = 5.91 \text{ B.M.}$



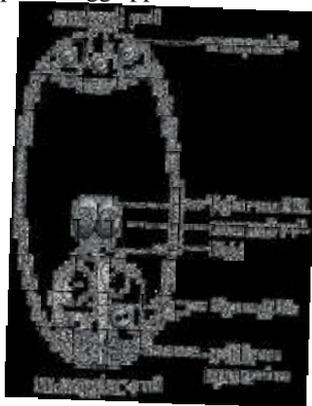
No. of unpaired  $e^- = 4$ ,  $\mu = \sqrt{4(4+2)} = \sqrt{24} = 4.89 \text{ B.M.}$

## Biology

21. (a) **Cytoskeleton** : They are extremely minute, fibrous and tubular structures which form the structural frame work inside the cell. Cytoskeletal structures occur only in eukaryotic cells. They were discovered with the help of fluorescence microscopy. Cytoskeletal structures maintain shape of the cell and its extensions, regulate orientation and distribution of cell organelles, intracellular transport and movement of cells. They are of three types – microfilaments, intermediate filaments and microtubules.
- (b) **Phytol chain** - phytol chain tail in association with porphyrin (ring head) through ester linkage forms a chlorophyll molecule.



- (c) **Synergids** - synergids are the part of egg apparatus which is located inside the embryo sac.



- (d) **Sieve tube elements**: Sieve tubes are elongated tubular conducting channels of phloem. Each sieve tube is formed of several cells called sieve tube elements or members, sieve tube cells or sieve elements. Sieve tube members are placed end to end. The endwalls are generally bulged out. They may be transverse or oblique. They have many small pores or sieve pits. Each sieve pore is lined by a layer of callose. Its function is translocation of solute.

- (e) **Centromere** - The two chromatids of chromosomes are attached to each other by a narrow area which is also known as primary constriction. It is the site at which the spindle attaches during cell division which is also concerned with anaphasic movement of chromosome. On the basis of position of centromere chromosome shape is also determined like telocentric acrocentric, submetacentric, metacentric.
22. (a) Nostoc which is a filamentous blue - green alga. The region marked as (P), in the figure is Heterocyst which is large - sized, pale coloured thick-walled cell which occurs in terminal intercalary or lateral position. It is specialised to perform nitrogen fixation. The region marked (Q) is Akinete which helps in asexual reproduction.
- (b) It is  $T_2$ -phase of bacteriophage which comes under T-even phage and is also known as coliphage. The region marked as (a) in the figure is collar and the region marked as (b) is tail fibre.
- (c) This ovule is anatropous because the ovule is inverted at  $180^\circ$  angle which is also called resupination. In this case, micropyle and funicle are closer.
- (d) Epigynous flower (inferior ovary) - The thalamus grows further upwards thus enclosing the ovary and finally fusing with it.
- (e) This is vexillary aestivation which is seen in the whorl of five petals where the posterior one is the largest and almost covers the two lateral petals and the latter in turn nearly overlap two anterior petals, e.g., papilionaceae soybean, gram, etc.
23. (a) Pea - In this case, placenta develops along the junction of the two margins of the carpels in one-chambered ovary which is known as marginal placentation. Inflorescence may be solitary axillary or terminal, raceme. Fruit type is pod or legume, where fruit is formed from superior unilocular ovary of a monocarpellary pistil.
- (b) Coriander - In this case, the ovary is multi-chambered and placenta bearing ovules develop from the central axis which is known as axile.  
Inflorescence is compound umbel because peduncle or main axis gives branches repeatedly once or twice in umbel or racemose manner. And fruit is of cremocarp type where fruit develops from anterior, bilocular ovary of a bicarpellary syncarpous pistil with persistent stylopod or stylopodium.
- (c) Wheat - Since the ovary is unilocular and placenta develops directly on the thalamus and bears a single ovule at the base of the ovary. So, the placentation is of basal type. The inflorescence is spikelet which bears two empty glumes (bracts) and also bears IIIrd bract (flowering glumes) or lemma or lower palea. The fruit is of caryopsis type.
- (d) Sunflower - In this case, placentation is again of basal type because the ovary is unilocular and placenta develops directly on the thalamus and bears single ovule at the base of ovary.  
The inflorescence is capitulum or head because its receptacle is flattened, bears sessile flowers and florets in a centripetal manner.  
Fruit type is of cypsela - in this case fruit develops from a monocarpellary pistil with superior, unilocular and uniovuled ovary.
- (e) Mustard : Parietal placentation is present in mustard where ovary is one-chambered and placenta bears the ovules which develop on the inner - wall of the ovary and their position corresponds to the confluent margins of the carpels and the number of placenta is equal to the number of carpel. The fruit is of siliqua type.
24. (a) **Culm** : The stem or stalk of a grass or sedge. Usually has a seed head at the top.  
The erect stem of a grass. The stem with solid nodes and hollow internodes is called culm. e.g., Bambusa is branched cylindrical,  
**Caudex** : The caudex is an enlarged, woody base of the stem or trunk (located just below the ground) on some plants - it is used for water storage. Many desert plants have a caudex, an adaptation to dry conditions. Some palms, cycads, and succulents have a caudex. e.g., Date palm.
- (b) **Slime molds** : They are vegetative cells without cell wall while spores are with cellulosic cell wall. Protists that may represent a transition between protists and fungi are called slime molds.

Phylum of fungus like organisms within the kingdom Protista, commonly known as true slime molds. They exhibit characteristics of both protozoans (one-celled microorganisms) and fungi. Distributed worldwide, they usually occur in decaying plant material. About 500 species have been described. Also, myxomycetes, mycetozoa.

**Fungi :** They are vegetative cell with cell wall which is made up of either fungal cellulose chitin or both. Saprophytic and parasitic organisms that lack chlorophyll and include molds, rusts, mildews, smuts, mushrooms and yeast; singular, fungus.

They are aerobic, multicellular, nonphotosynthetic, heterotrophic microorganisms. The fungi include mushrooms, yeast, molds, and smuts. Fungi have two ecological advantages over bacteria: (1) they can grow in low moisture areas, and (2) they can grow in low pH environments.

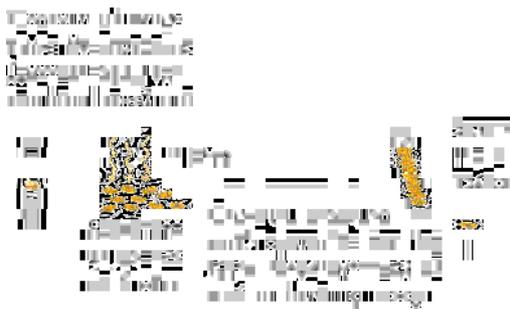
- (d) **Biological Magnification :** Refers to the process whereby certain substances such as pesticides or heavy metals move up the food chain, work their way into rivers or lakes, and are eaten by aquatic organisms such as fish, which in turn are eaten by large birds, animals or humans. The substances become concentrated in tissues or internal organs as they move up the chain.

**Eutrophication :** Over-enrichment of a water body with nutrients, resulting in excessive growth of organisms and depletion of oxygen concentration. The process by which a body of water becomes either naturally or by pollution rich in dissolved nutrients (as phosphates) and often shallow with a seasonal deficiency in dissolved oxygen.e.g., Disease of crucifers caused by Albuginaceae (Peronosporales: Oomycota). Zinc oxide; the powdery product of corrosion of zinc or zinc-coated surfaces. Fungus causing a disease characterized by a white powdery mass of conidia.

- (e) **White rust :** It is a fungal disease caused by *Cystopus candidus* or *Albugo candida* on vegetative parts of crucifers.

**Brown rust :** It is a fungal disease caused by *Puccinia recondita* on vegetative parts of wheat plant.

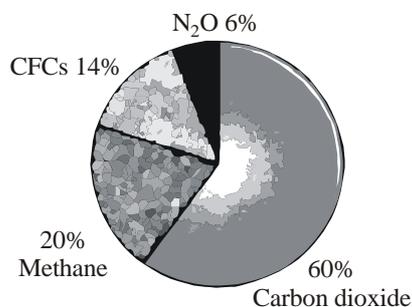
25. (a) Jacob and monod gave the 'operon' model to explain the regulation of gene expression in the bacterium E. Coli in 1961.
- (b) Beadle and Tatum proposed the "one gene one enzyme" theory. One gene codes for the production of one protein. "One gene one enzyme" has since been modified to "one gene one polypeptide" since many proteins (such as hemoglobin) are made of more than one polypeptide.



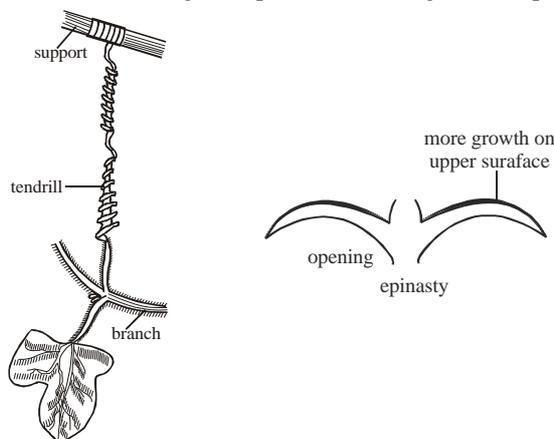
- (c) An Okazaki fragment is a relatively short fragment of DNA (with an RNA primer at the 5' terminus) created on the lagging strand during DNA replication. These fragments are processed by the replication machinery to produce a continuous strand of DNA and hence a complete daughter DNA helix. It was given by Griffith.
- (d) Reverse transcriptase is the replication enzyme of retroviruses which was discovered by Temin and Baltimore.
26. (a) **Pneumatophores :** Vivipary pneumatophore - an air-filled root (submerged or exposed) that can function as a respiratory organ of a marsh or swamp plant
- Vivipary :** A phenomenon that occurs when the embryo breaks through the seed coat (and defies natural growth inhibitors, such as are present in tomato and other fruit seeds) to begin growing, sometimes while the fruit is still attached to the parent plant.

- (b) Marsilea; Eichhornia  
**Marsilea** which is a water clover: water fern of Europe and Asia and the eastern United States distinguished by four leaflets resembling clover leaves  
**Eichhornia** : Eichhornia Azurea is one of those plants used frequently in the so called 'Dutch aquariums'. It is a very unusual plant with long bright green leaves spreading widely sideways, which makes it look very flat. It loves bright lighting, CO<sub>2</sub> and rich bottom.
- (c) Monoecious, Geitonogamy  
 Monoecious term is used to denote bisexual condition means presence of both reproductive organs in the same organism. Geitonogamy is the transfer of pollen grains from the another to the stigma of another flower of the same plant. Although geitonogamy is functionally cross-pollination involving a pollinating agent, genetically it is similar to autogamy since the pollen grains come from the same plant.
- (d) Cycas and coralloid root (which has the form of coral; branching like coral )
27. (a) Heterospory (which is a condition in which an organism produces two different types and sizes of spores, viz. microspores and megaspores) and formation of female gametophyte inside megasporangium.  
 (b) Selaginella : The advent of reproduction by seeds was one of the most essential evolutionary steps in plant history: the vast majority of living plants are seed plants (spermatophytes). The seed habit includes the following set of defining characteristics: (1) heterospory, (2) occurrence of a single megaspore that germinates within an indehiscent megasporangium (nucellus) retained on the sporophyte, (3) enclosure of the megasporangium in an integument, and (4) capture of pollen before seed dispersal. Contrasting hypotheses about the single / multiple, saltational / gradual origin of the seed habit. Pteris and Dryopteris possess the seed habit.  
 (c) Mechanical Scarification, Stratification, Impaction.  
 Seeds of almost all plants growing in areas with marked seasonal temperature variations require a period of cold treatment prior to germination, just as buds do. This requirement is usually satisfied by our winter temperatures. There are several ways to break the dormancy of seeds. For example, for some species, if moist seed is exposed to a low temperature for many days, dormancy may be broken and the seed germinated. The average temperature and time are 5°C for 100 days). This horticultural procedure is called STRATIFICATION.  
 Dormancy may be caused by the embryo being immature or though mature, germination will not occur because of the external seed coat or dormancy may be controlled by the internal physiology of the seed or a combination of internal and external dormancies may be responsible.  
 Mechanical abrasion or breaking the seed coat, which is termed SCARIFICATION with a knife, file or sandpaper may allow the hard seed condition or inhibitor to be removed or metabolic activity requisite to germination to be initiated. Impaction or the third condition is to keep the seed under certain condition which breaks the seed dormancy.
28. (a) Sudden or inheritable – It arises due to change in base pair of the genetic materials.  
 (b) New Alleles – It is the term used by Mendel to define genes which is also known as factor. It is the particular form of gene.  
 (c) Recessive – If the gene is in homozygous state then both alleles are expressed, If it is in heterozygous then one is expressed (dominant)  
 (d) Codominance – Both genes of allelo morphic pair express themselves equally in F<sub>1</sub> - hybrids.  
 (e) Wild type gene : Wild type, sometimes written wild type or wild-type, is the typical form of an organism, strain, gene, or characteristic as it occurs in nature. Wild type refers to the most common phenotype in the natural population. The phenotype can be dominant or recessive.  
 In biology it relates specifically to the difference between a naturally occurring organism and one that has been deliberately mutated.  
 Mutant is an antonym of wild type.

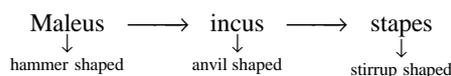
29. (a) Photoperiodism. was first studied by Garner and Allard in 1920.  
 (b) SDP (short day plants ) or long night plants-Chrysanthemum LDP ( long day plants - spinach  
 (c) Borthwick and Hendricks in 1952 reported phytochrome pigment. Induction of flowering.
30. (a) Indian Rhinoceros are now in the list of endangered species because its populations have decreased or habits have been reduced to the levels that pose immediate danger of extinction.  
 (b) Acid rain refers to precipitation with a pH of less than 5. It is, in fact, a mixture of  $H_2SO_4$  and  $HNO_3$ .  
 (c) Somaclonal variations is a type of mutation which is spontaneous in origin. The variations observed among plants regenerated from tissue culture is termed as somaclonal variation.  
 (d) protoplasm fusion – PEG  
 (e) Biopiracy – turmeric
31. (a) **Habitat and Niche:** Habitat means to dwell. It is a specific place where a species or population normally lives in nature, which is a physical area, some particular part of earth's surface, air, soil or water. It includes both living and non-living objects.  
**Niche** - The word niche literally means a specific place. How-ever , The ecologists use it for the habitat along with the role a species or population plays in its ecosystem. In other words, niche means the total interaction of a species with its environment or its functional position or status in an ecosystem. Xerophytic vegetation is found in desert.  
 (b) **Flora :** All species of plants that are found in a particular region, period, or special environment. Six floral kingdoms are commonly distinguished: Boreal (Holarctic), Paleotropical, Neotropical, South African (Capensic), Australian, and Antarctic. These kingdoms are further broken down into subkingdoms and regions, over which there is some dispute.  
**Vegetation :** Types of plant species found in an area constitute the vegetation of the area. It is also the process of growth in plants. An abnormal growth or excrescence (especially a warty excrescence on the valves of the heart) is also known as vegetation.
32. (a)  $CFC_s = 14\%$ ,  $CH_4 = 20\%$ ,  $N_2O = 6\%$  and the rest  $60\%$  are  $CO_2$



- (b) Type of movement of twiner is thigmotropic movement e.g cucurbit plant .



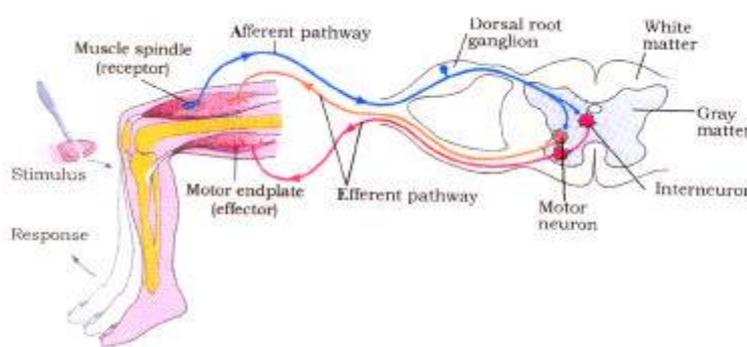
33. (a) According to the given conditions and graph a shows complete growth, b shows retarded growth and c shows moderate growth.  
 (b) Vitamin i.e Retinol  
 (c) Hyper-concentration of retinol leads to hypervitaminosis A which is characterised by anorexia, headach, irritabilily, hepatosplenomegaly, dermatitis, bone pain, loss of hair in patch etc. Overdoses of phyridoxine can cause peripheral neuropathy. Overdose of ascorbie acid is less likely to cause any problem because it can be rapidly cleared from the body.
34. (a) Earthworm is different from rest of animals because earthworm is monoecious (or) hermaphrodite while rest are dioecious.  
 (b) Scorpion and Honey bee carry poison to defend themselves from the enemy. Scorpion belongs to class - Arachnida of phylum - Arthropoda. Honey bee belongs class insecta of phylum - Arthropoda.  
 (c) Bat and whale belong to class Mammalia . The bats are the only mammals which have wings and can really fly. Whale is the largest animal in existence and is the unhabitants of the open ocean, strandings and offshore sightings are rare.  
 (d) Earthworm which is also known as pheretima is the representative of phylum - Annelida. Starfish is found in rocky area floor which is carnivorous, which possess greater power of regeneration and shows autotomy represents the phylum echinodermata.  
 (e) Bat and whales which are the members of class mammalia, like human have 3 ear oscicles in the order



3 ear ascicles are the characteristics of mammalia.

35. (a) In the graph (A) population remains stable that means it will be statronary phase or plateaus phase. While in the graph (B) it will the lag phase or exponential phase when the population will increase tremendously.  
 (b) Graph (A) shows the stable growth so the resources available will be more like getting jobs ultimately more professional job opportunity will be in the developed nation which will force to migrate the population from developing nation to the developed nation.

36.



**Diagram: Diagrammatic presentation of reflex action (showing knee jerk reflex)**

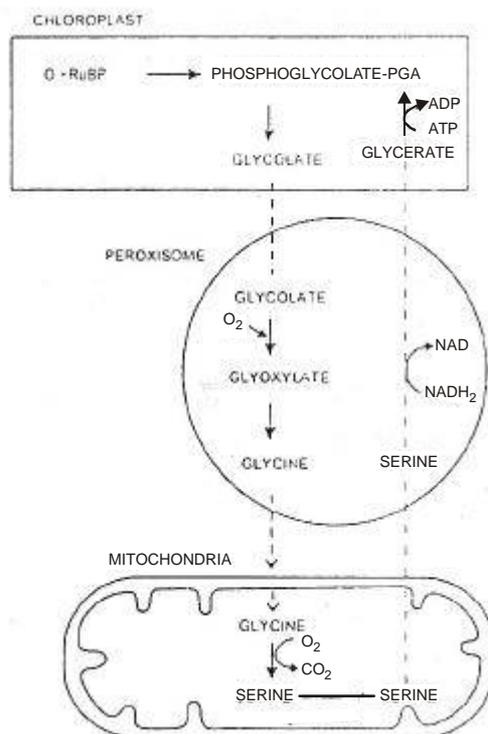
- (a) It is knee jerk reflex.  
 (b) In case of knee jerk reflex tendon of patella is tapped.  
 (c) Gray matter is replaced by white matter. Efferent pathway should be afferent pathway and afferent pathway should be efferent pathway because afferent end transmits the impulse via a dorsal nerve root in the CNS (at the level of spinal cord) and the efferent neuron then carries signals from CNS to the effector.

37. (a) These two are the examples of vestigial organs which were functional in ancestors but functionless in modern humans.
- (b) The organs which occur in reduced form and are useless to the possessor, but are homologous to the fully developed, functional organs of related animals are called vestigial organs. The existence of vestigial or useless organs is satisfactorily explained by the doctrine of organic evolution. These organs were fully developed, functional and necessary in the ancestral forms, due to change in their mode of life.
- (c) Coccyx, mammary glands in males, muscles of external ear in human (both male and female) belong to the same category of vestigial organs.
38. The given figures (a) and (b) are chloroplast and mitochondria respectively. Function of thylakoids which is marked as (1) figure (a):-

In thylakoids the primary process of energy transduction occurs i.e. light energy is converted into chemical energy. The reaction centers photosystem I and II are present in thylakoids. It also increases the surface area of inner membrane for photosynthesis.

Function of stroma which is marked as (2) in figure (a) : It has ATP synthetase and  $e^-$  carriers. It has enzymes for amino acid synthesis, calvin cycle, fatty acid synthetase, nucleic acid and protein synthesis sulphate reduction.

39.



**Photorespiratory Pathway**