CBSE-MAINS

MEDICAL ENTRANCE

SOLVED PAPER 2006

Physics & Chemistry

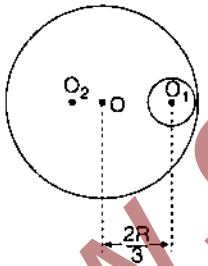
1. (a) Find dimensional formula of $\frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{hc}$.

(b) A body is dropped from height 8 m. After striking the surface it rises to 6 m, what is fractional loss in kinetic energy during impact? Assuming air resistance to be negligible.

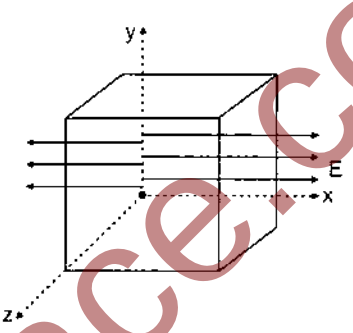
(c) A ring of mass 0.8 kg and radius 0.1 m makes $\frac{5}{\pi}$ rotations per second about axis perpendicular to its plane through centre. Calculate angular momentum and kinetic energy of ring.

2. (a) Plot the graph of g w.r.t. distance from centre of earth.

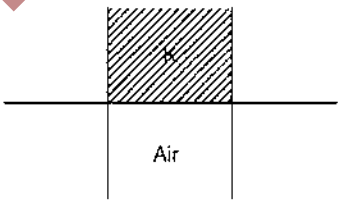
(b) There is a disc of radius R. Circular portion centered at O_1, can be assumed as separate portion. Centre of mass of remaining portion is at O_2. Find OO_2 and also find moment of inertia of system about O_2.



3. (a) Electric field at $x = 10$ cm is 100 V/m and at $x = -10$ cm is -100 V/m. Find the sign and magnitude of charge enclosed by the cube of side 20 m.



(b) A capacitor of plate area A and separation between plates d is half filled with dielectric of dielectric constant K. What is equivalent capacitance?



4. (a) A particle is rotating with constant angular acceleration on a circular track. If its angular velocity changes from 20 π rad/sec to 40 π rad/sec in 10 seconds, find the number of revolutions that the particle has completed during this time.

(b) Body of mass 0.8 kg has initial velocity $\vec{v}_i = (4\hat{i} + 3\hat{j})$ m/s and final velocity $\vec{v}_f = (-6\hat{j} + 2\hat{k})$ m/s. Find change in kinetic energy of the body.

5. Assuming Newton's law of cooling to be valid, the temperature of body changes from 60° C to 40° C in 7 minute. Temperature of surrounding being 10°C . Find its temperature after next 7 minutes.

6. (a) Why the given decay process is not spontaneous?

$$_{92}U^{238} \rightarrow {}_{91}U^{237} + {}_{1}H^{1}$$

given M ($_{92}U^{238}$) = 238.050431 amu

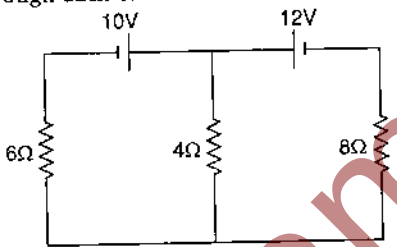
M ($_{91}U^{237}$) = 237.062312 amu

M ($_{1}H^{1}$) = 1.007825 amu

(b) Find mass of photon.

7. (a) There is magnetic material of coercivity 2×10^3 A/m. What current should flow through solenoid of length 15 cm having turns 150 to demagnetise the substance completely?

(b) Write down equations for getting current through each element of circuit.



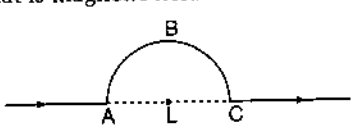
8. (a) Two tuning forks when sounded together give 8 beats/sec. When *A* is sounded with air column of length 37.5 cm closed at one end resonance occurs in its fundamental mode. *B* gives resonance with air column of length 38.5 cm and closed at one end in its fundamental mode. Find the frequencies of tuning forks.

(b) If frequency of oscillation in SHM is *n*, what is frequency of kinetic energy of the particle ?

9. (a) According to Faraday's law, does induced emf depend upon resistance ?

(b) What is power factor of *LCR* series circuit at resonance ?

(c) A wire, bent in form of a semicircle and two long straight portions, is carrying current *I*. What is magnetic field at *L* if $AL = LC = R$?



(d) In a series *LCR* circuit, what is the potential drop across resistance when operating voltage is 220 V, at resonance ?

10. (a) Activity of Po sample is 5 millicuries. Half-life of Po is 138 days, what amount of Po was initially taken. (Avogadro's no. = 6.02×10^{26} per k mole)

(b) Semiconductor Ge has forbidden gap of 1.43 eV. Calculate maximum wavelength which results from electron hole combination.

(c) Why do we keep low gas pressure in discharge tube?

11. (a) $(SiH_3)_3$ N is planar while $(CH_3)_3$ N is pyramidal, explain.

(b) Explain the difference in dipole moment of NH_3 and NF_3 drawing the diagram and giving the direction of dipole moment.

(c) Why $HClO_4$ is more acidic than HClO ?

12. (a) In a hydrogen atom an electron jumps from 5th orbital to 2nd orbital, find the wavelength of the radiation emitted. ($h = 6.626 \times 10^{-34}$, $c = 3 \times 10^8$, $R = 2.18 \times 10^{-18}$)

(b) Using VSEPR theory draw the structures of

(i) $POCl_3$

(ii) XeF_4

13. (a) The energy release in freezing of a substance is 500 J at temperature 100 K and pressure 1 atm, find out the following using the data given

(i) What is the change in Gibbs free energy ?

(ii) What is the change in entropy ?

(b) $2Hg + 2Cr^+ \longrightarrow 2Cr + Hg_2^{2+}$

Determine whether the reaction will proceed in backward direction or forward direction.

(i) $Hg_2^{2+}\,[10^{-1}]\,Cr^+\,[10^{-4}]$

(ii) $Cr^+\,[10^{-1}]\,Hg_2^{2+}\,[10^{-4}]$

$E^{\circ}_{Hg_2^{2+}/Hg} = 0.79\,V$

$E^{\circ}_{Cr^+/Cr} = 0.80\,V$

14. (a) $A + B \longrightarrow$ product

$$R = k[A][B]^3$$

if the volume of the container is reduce to 1/3, find the change in rate of the reaction.

(b) A solution containing 46 g of H_2O and 66 g of acetone. The density of the resulting is 0.926 g/cc. Find the molarity of water in the solution.

15. (a) Density was given 7.2 g/cm^3 chromium 53 in *bcc* structure. Edge length of unit cell is 288.4 pm, calculate Avogadro's constant.

(b) Given $E^\circ_{Cr^{3+}/Cr^{2+}} = -0.41$ V

$E^\circ_{Mn^{3+}/Mn^{2+}} = +1.51$ V

$E^\circ_{Cr^{2+}/Cr} = -0.91$ V

$E^\circ_{Mn^{2+}/Mn} = -1.18$ V

(i) Which is having more stable +2 oxidation state ?

(ii) Which having more stable +3 oxidation state ?

16. $3H_2 + N_2 \rightleftharpoons 2NH_3$, $K_c = 61$

$N_2 = 1 \times 10^{-3}$

$H_2 = 3 \times 10^{-3}$

$NH_3 = 3 \times 10^{-3}$

State whether the concentration of NH_3 will increase or decrease.

17. (a) Two complex compounds of Ni are (NiB_4) and $(Ni\,A_2X_2)$ where *A* and *B* are neutral monodentate ligand and *X* is halogen.

(i) Give hybridisation of Ni in both the cases.

(ii) Explain for such a selection.

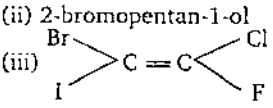
(iii) Give the magnetic behaviour in both the cases.

(b) Give the IUPAC name of $K[Co(en)Cl_4]$ and shape of the complex.

18. (a) Which of the following are optically active, give reasons ?

(i) 3, 4-dibromo-3, 4-dimethylhexane

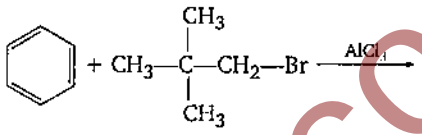
(ii) 2-bromopentan-1-ol

(iii) 

(b) (i) Draw the Fischer projection of enantiomer of 3, 4 dibromo-3, 4-dimethyl, which is optically inactive.

(ii) Draw E isomer of 1-bromo, 3-iodo but-2-ene

19. (a) Find the major product in the following reaction

(i) 

(ii) $CH_2 = CHBr + AgCN \longrightarrow$

(iii) $CH_3 - C \equiv C - CH_3 \xrightarrow{Na - NH_3} ?$

(b) Carry out following conversion

(i) $Ph - C \equiv CH \xrightarrow{?} Ph - \overset{O}{\overset{\|}{C}} - CH_3$

(ii) Convert 1-butyne into 1, 2-dibromobutane

20. (a) On denaturation how the activity of the protein changes ?

(b) Give the structural difference between glycogen and starch.

Zoology

1. Give reasons :

(i) If neural connection of heart is severed then heart would continue beating or not ?

(ii) If sympathetic control is re-established in such case what will happen.

(iii) If parasympathetic control is re-established in such a case what will happen.

2. Match the following :

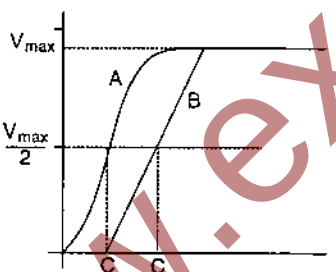
Column-I	**Column-II**
A. Oparin	(i) Cell Theory
B. Darwin	(ii) Origin of Life
C. Biogenesis	(iii) HMS Beagle
D. Miller	(iv) Natural Selection
E. Schleiden and Schwann	(v) Urey as Teacher
	(vi) Concept of Survival of Fittest
	(vii) Acquired Inheritance
	(viii) All animals and plans are composed of cells
	(ix) Life originates from pre-existing life
	(x) Mutation
	(xi) Concept that life originated spontaneously from chemicals in reducing atmosphere

3. Differentiate between with reference to :
   (i) Number of occipital condyles in skull of birds/humans.
   (ii) Shark and whale with number and position of respiratory structures.
   (iii) Sea anemone and Ctenoplana on the basis of symmetry.
   (iv) Toad and Crocodile on the basis of number of chambers in heart.

4. Define the following :
   (i) Carrying capacity
   (ii) Programmed senescence theory
   (iii) Amniocentesis
   (iv) Pheromones

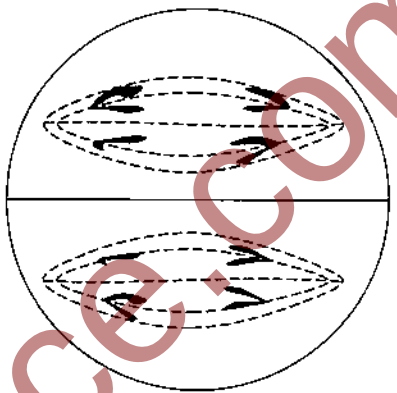
5. Write the functions of :
   (i) Microtubules
   (ii) Sphaerosomes
   (iii) Endodermis
   (iv) Lenticels

6. (a) (i) Name the fluid filling the knee joint.
   (ii) On the basis of type of movement classify the knee joint.
   (iii) Name the bones involved in the knee joint.
   (b) Describe the function of tectorial membrane and its location.

7. 

   (i) Infer the plot of A
   (ii) Infer the plot of B
   (iii) What is C. How C differs from A and B ? Give reason.
   (iv) Describe Allosteric modulation.

8. Fill in the blanks :
   (i) Enzymes are globular..... The site on which enzyme binds is .....
   (ii) Anthrax is caused by ..... and vaccine for it was developed by .....
   (iii) Causative agent of diphtheria is ..... and its incubation period is ..... and its mode of transmission is .....



9. (i) In the above diagram which stage (mitosis/meiosis) is exhibited ?
   (ii) Define acrocentric chromosome. How many acrocentric chromosomes can be seen in above diagram ?
   (iii) How can you say that the above karyotype is not of human ?
   (iv) What is the abnormality in Klinefelter syndrome and Turner syndrome ?

10. Fill in the blanks ;
   (i) Parathyroid mobilises ..... from blood to .....
   (ii) Interstitial cells stimulating hormone stimulates interstitial cells of ..... to secrete .....
   (iii) In human type of cleavage is ..... and the 16 cell stage is called.....
   (iv) Cuboidal ..... present in the renal collecting tubule is permeable to ..... but not to water.
   (v) Insulin and ..... both involved in glucose metabolism are secreted from ..... which are scattered in patches in pancreas.

Botany

1. Define the following terminologies :
   (i) Polyploidy
   (ii) Allogamy
   (iii) Apomixis
   (iv) Plasmodesmata
   (v) Capsomeres

2. Define the following terminologies :
   (i) Double fertilization
   (ii) Cladode
   (iii) Pneumotophores
   (iv) Transgenic
   (v) Biological species

3. Differentiate between monera and Protista on the basis of the following :
   (a) Chemical nature of cell wall
   (b) Genetic material
   (c) Cytoplasmic ribosome
   (d) Location of respiratory organ
   (e) Location of extra-chromosomal DNA

4. (A) Use the fruits name from the table given below :

Aggregate, composite, drupe, pome, pepo, berry, cypsela, schizocarp, follicle, hesperidium.

   Write name of fruit of following and other information asked :
   (i) Coconut, edible part
   (ii) Coriander, inflorescence
   (iii) Orange, placentation
   (B) Use the name of the inflorescence given in the table below :

Umbel, raceme, spadix, cyathium corymb, verticillaster, spikelet, capitulum

   Write inflorescence of the following and given other informations :
   (i) Marigold, fruit
   (ii) Euphorbia, fruit

5. Differentiate between the following :
   (i) B.O.D vs C.O.D (Give full form also)
   (ii) Genetic vs Species diversity
   (iii) Keystone species vs Endangered species
   (iv) Primary succession vs Secondary succession
   (v) Montreal protocol vs Kyoto protocol

6. Fill in the blanks :
   CO_2 reacts with .....1..... carbon compound to give .....2..... molecules of phosphoglyceric acid. RuBP carboxylase is known as .....3..... It is also known as .....4..... because it .....5..... RuBP to .....6..... glycolate. In C_4 plants .....7..... anatomy is present. The acceptor molecule is .....8..... which forms four carbon molecule .....9..... that either reduces to .....10..... or changes to aspartate.

7. In *Antirrhinum majus* :
   RR is phenotypically red, rr is white and Rr is pink. Mention the phenotype and the ratio in F_1 generation of the following crosses :

   RR × Rr
   rr × RR
   Rr × Rr
   rr × Rr

   Name the other plant which shows similar type of inheritance. Give the scientific name.

8. Given below are the sources of pollution and their effects. Using this information fill the spaces in the given box. Each pollutant may have more than one source and may show more than one effect.

Automobile exhaust, burning of fossils, refrigerant, agricultural field, fire extinguisher, paint solvents, deforestation, plastic foam

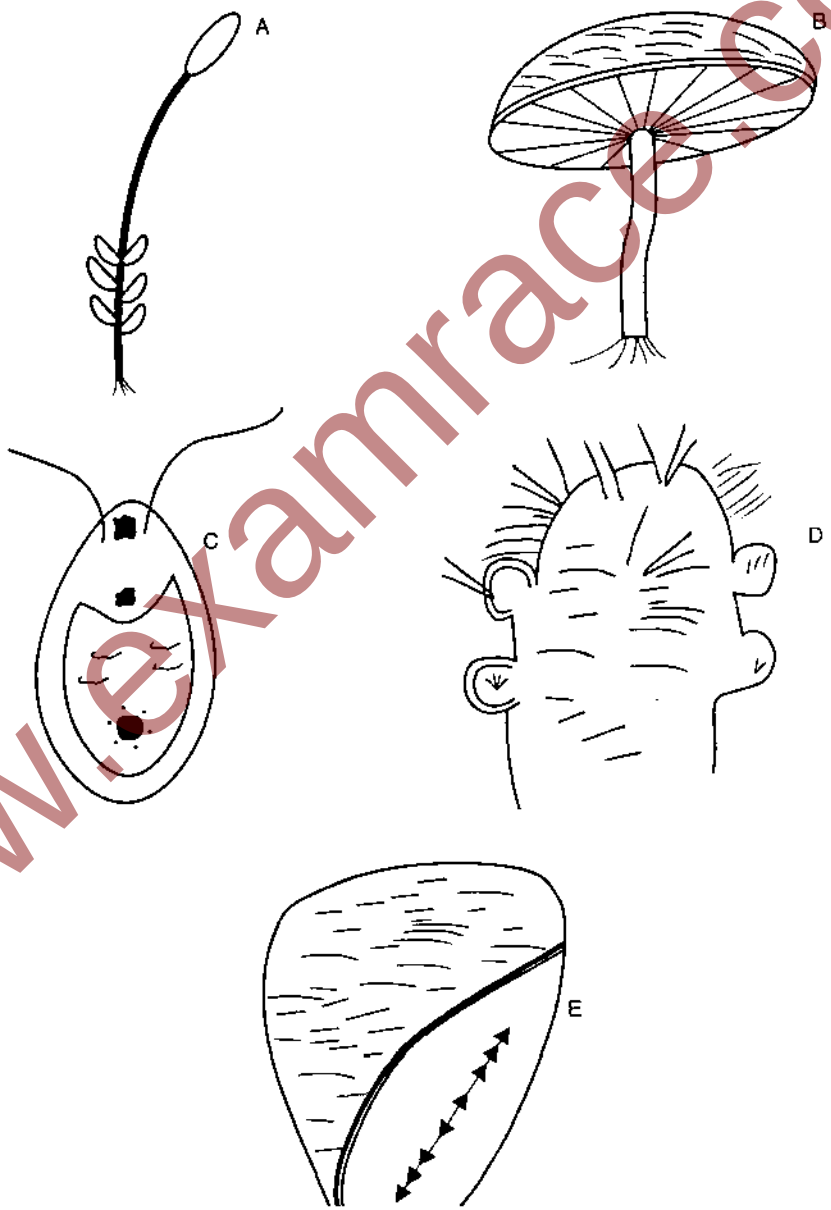
Photochemical smog, acid deposition, global warming, depletion of ozone.

Pollutant	Source	Effect
CH_4		
Oxides of nitrogen		
SO_2		
SPM		
CFCs		

9. Match the following :

Column-I	**Column-II**
A. Biopesticide	(i) *Ricinus communis*
B. Biofertiliser	(ii) *Bacillus megatherium*
C. Antibiotic	(iii) *Attacus attacus*
D. Oil seeds	(iv) *Bacillus thuringiensis*
E. Mulberry silk	(v) *Bombyx mori*
	(vi) *Arachis hypogea*
	(vii) NPV
	(viii) *Streptomyces griseus*
	(ix) *Morus alba*
	(x) *Azotobacter*

10. Lable the parts (A, B, C, D, E)



Physics & Chemistry

1. (a) We know that

$$E = \frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{r}$$

$$\therefore \quad \frac{Er}{hc} = \frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{hc}$$

$$\Rightarrow \quad \frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{hc} = \frac{Er}{hc}$$

$$\Rightarrow \quad \frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{hc} = \frac{r}{\lambda} \qquad \left(\text{as } E = \frac{hc}{\lambda}\right)$$

Hence, dimensional formula of

$$\frac{1}{4\pi\varepsilon_0}\cdot\frac{e^2}{hc} = \frac{[L]}{[L]} = [M^0L^0T^0]$$

(b) Initial energy of the ball

$$= mg \times 8$$

Final energy of the ball

$$= mg \times 6$$

Loss in energy during impact

$$= 8mg - 6mg = 2mg$$

$\therefore$ Fractional loss $= \frac{2mg}{8mg} = \frac{1}{4}$

(c) Angular momentum

$$L = I\omega = mr^2\omega \qquad (\text{as } I = mr^2)$$

$$= 0.8 \times (0.1)^2 \times (2\pi \times 5/\pi)$$

$$= 0.08 \text{ kg-m}^2/\text{s}$$

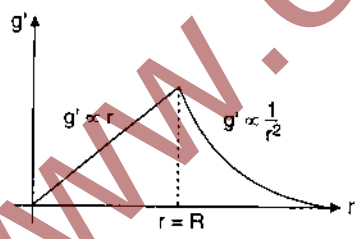
Kinetic energy of ring

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

$$= \frac{1}{2} \times 0.8 \times (0.1)^2 \times (2\pi \times 5/\pi)^2$$

$$= 0.4 \text{ J}$$

2. (a) The variation in the value of g with r (the distance from the centre of earth) is as follows :



For $r \le R$,

$$g' = g\left(1 - \frac{h}{R}\right) = \frac{gr}{R}$$

as $\quad R - h = r$

or $\quad g' \propto r$

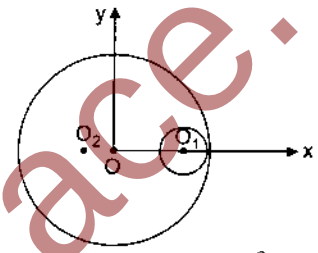
For $r > R$,

$$g' = \frac{g}{\left(1 + \frac{h}{R}\right)^2} = \frac{gR^2}{r^2}$$

as $\quad R + h = r$

or $\quad g' \propto \frac{1}{r^2}$

(b) The distance of centre of mass 'O_2' of the remaining part from the initial centre of mass 'O' is given by



$$X = OO_2 = \frac{-\sigma \times \pi\left(\frac{R}{3}\right)^2 \cdot \frac{2R}{3}}{\sigma\pi R^2 - \sigma\pi\left(\frac{R}{3}\right)^2}$$

$$= -\frac{2\pi R^3}{27} \times \frac{9}{8\pi R^2}$$

$$= -\frac{R}{12}$$

Moment of inertia of system about O_2 is given by

$$I_{O_2} = \left[\frac{(\sigma\pi R^2)R^2}{2} + (\sigma\pi R^2)\left(\frac{R}{12}\right)^2\right] - \left[\frac{\sigma\pi (R/3)^2}{2}\left(\frac{R}{3}\right)^2 + \left(\sigma R\left(\frac{R}{3}\right)^2\left(\frac{3R}{4}\right)^2\right)\right]$$

$$= \sigma\pi R^4\left[\frac{1}{2} + \frac{1}{144} - \frac{1}{2\times 81} - \frac{1}{16}\right]$$

$$= (0.44)\,\sigma\pi R^4$$

3. (a) From Gauss's law, "the net electric flux through any closed surface is equal to the net charge inside the surface divided by ε_0." Then,

$$\oint \vec{\mathbf{E}} . \vec{\mathbf{dS}} = \frac{q_{in}}{\varepsilon_0}$$

$$\therefore\ 100 \times (0.2)^2 - (-100)\,(0.2)^2 + 0 + 0 = \frac{q_{in}}{\varepsilon_0}$$

$$\Rightarrow \qquad 4 - (-4) = \frac{q_{in}}{\varepsilon_0}$$

$$\therefore \qquad q_{in} = 8\varepsilon_0$$

(b) The two capacitors are in parallel.

$$\therefore \qquad C = C_1 + C_2$$

$$= \frac{\varepsilon_0 K\,(A/2)}{d} + \frac{\varepsilon_0\,(A/2)}{d}$$

$$= \frac{\varepsilon_0 A}{2d}\,(K + 1)$$

4. (a) From equation of rotational motion

$$\omega = \omega_0 + \alpha t$$

Here, $\omega = 40\pi$ rad/sec, $\omega_0 = 20\pi$ rad/sec, $t = 10$ sec

$$\therefore \qquad 40\pi = 20\pi + \alpha \times 10$$

$$\Rightarrow \qquad \alpha = \frac{20\pi}{10} = 2\pi \text{ rad/sec}^2$$

Again, $\qquad \theta = \omega_0 t + \frac{1}{2}\alpha t^2$

$$= 20\pi \times 10 + \frac{1}{2} \times 2\pi \times (10)^2$$

$$= 200\pi + 100\pi$$

$$= 300\pi$$

$\therefore$ Number of revolutions

$$n = \frac{\theta}{2\pi} = \frac{300\pi}{2\pi} = 150$$

(b) Initial kinetic energy of the body

$$(\text{KE})_i = \frac{1}{2} m v_i^2$$

$$= \frac{1}{2} \times 0.8\,(16 + 9)$$

$$= 0.4 \times 25$$

$$= 10 \text{ J}$$

Final kinetic energy of the body

$$(\text{KE})_f = \frac{1}{4} m v_f^2$$

$$= \frac{1}{2} \times 0.8 \times (36 + 4)$$

$$= 0.4 \times 40$$

$$= 16 \text{ J}$$

Hence, change in kinetic energy is given by

$$\Delta \text{ KE} = (\text{KE})_f - (\text{KE})_i$$

$$= 16 - 10 = 6 \text{ J}$$

5. Let after next 7 minutes, its temperature be θ. From Newton's law of cooling,

$$\frac{\theta_1 - \theta_2}{t} \propto \left(\frac{\theta_1 + \theta_2}{2} - \theta_0\right)$$

where θ_0 = temperature of surrounding.

$$\therefore \qquad \frac{60 - 40}{7} \propto \left(\frac{60 + 40}{2} - 10\right) \qquad \ldots(\text{i})$$

and $\qquad \frac{40 - \theta}{7} \propto \left(\frac{40 + \theta}{2} - 10\right) \qquad \ldots(\text{ii})$

Dividing Eq. (i) by (ii), we obtain

$$\frac{20}{7} \times \frac{7}{(40 - \theta)} = \frac{40}{(20 + \theta)/2}$$

$$\Rightarrow \qquad \frac{20}{40 - \theta} = \frac{40 \times 2}{20 + \theta}$$

$$\Rightarrow \qquad 20 + \theta = 160 - 4\theta$$

$$\Rightarrow \qquad 5\theta = 160 - 20 = 140$$

$$\therefore \qquad \theta = \frac{140}{5} = 28°\text{C}$$

6. (a) From the given reaction, there is an increase in mass as given below :

Mass increase

$= M\,(_{91}\text{U}^{237}) + M\,(_1\text{H}^1) - M\,(_{92}\text{U}^{238})$

$= 237.062312 + 1.007825 - 238.050431$

$= 238.070137 - 238.050431$

$= 0.019706$ amu

Thus, due to mass increase this reaction becomes endothermic reaction not spontaneous.

(b) Rest mass of photon is zero, but it has dynamic (relativistic) mass.

According to mass-energy equivalence, every body possesses energy due to its mass. Thus,

$$E = mc^2$$

where m is relativistic mass of photon. Also energy of photon is

$$E = h\nu$$

where h is Planck's constant.

$$\therefore \qquad h\nu = mc^2$$

Hence, $m = \frac{h\nu}{c^2}$

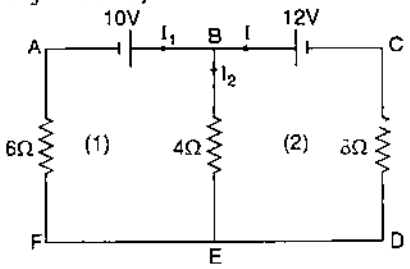
7. (a) Coercivity $= ni$

where n is number of turns per metre length of solenoid.

$$\therefore \qquad 2 \times 10^3 = \frac{150}{0.15} i$$

$$\therefore \quad i = \frac{2\times10^3\times0.15}{150} = 2\,A$$

(b) Applying Kirchhoff's first law (junction law) at junction B,



$$I = I_1 + I_2 \qquad ...(i)$$

Applying Kirchhoff's second law in loop 1 *(ABEFA)*

$$-10 - 6I_1 + 4I_2 = 0 \qquad ...(ii)$$

Applying Kirchhoff's second law in loop 2 *(BCDEB)*

$$12 - 4I_2 - 8I = 0 \qquad ...(iii)$$

Eqs. (i), (ii) and (iii) are required equations for getting current through each element.

8. (a) Given,

$$f_A - f_B = 8 \qquad ...(i)$$

$$f_A = \frac{v}{4l} = \frac{v}{4\times37.5\times10^{-2}}$$

and $$f_B = \frac{v}{4\times38.5\times10^{-2}}$$

So, $$\frac{f_A}{f_B} = \frac{38.5}{37.5}$$

$$\Rightarrow \quad f_A = \frac{385\,f_B}{375} \qquad ...(ii)$$

Putting value of f_A in Eq. (i), we get

$$\frac{385\,f_B}{375} - f_B = 8$$

$$\Rightarrow \quad 10 f_B = 8\times375$$

$$\therefore \quad f_B = \frac{8\times375}{10} = 300\ Hz$$

Hence, from Eq. (i), we get

$$f_A = 300 + 8 = 308\ Hz$$

(b) The displacement equation in SHM, is

$$y = a\sin\omega t = a\sin 2\pi nt$$

$$\therefore \text{ Kinetic energy} = \frac{1}{2}m\left(\frac{dy}{dt}\right)^2$$

$$= \frac{1}{2}m\{(2\pi na)^2\cos^2 2\pi nt\}$$

$$\propto \cos^2 2\pi nt \propto [1-\cos 4\pi nt]$$

$\cos 4\pi nt$ changes periodically by a frequency $2n$.

9. (a) Faraday's law states that, "the induced emf in a closed loop equals the negative of the time rate of change of magnetic flux through the loop."

$$\therefore \quad e = -\frac{d\phi_B}{dt}$$

Hence, it is obvious that induced emf does not depend upon resistance.

(b) Average power of an AC circuit is given by

$$P = V_{rms}\,I_{rms}\cos\phi$$

Here, the term $\cos\phi$ is known as power factor.

For a series *LCR* circuit,

$$\cos\phi = \frac{R}{Z}$$

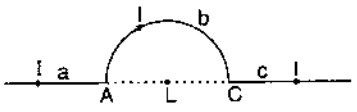
$$= \frac{R}{\sqrt{R^2 + (X_L - X_C)^2}}$$

For series *LCR* circuit at resonance, inductive reactance is equal to capacitive reactance *i.e.*, $X_L = X_C$.

Hence, $$\cos\phi = \frac{R}{\sqrt{R^2 + 0}}$$

$$= \frac{R}{R} = 1$$

(c) Keeping in mind that the field due to a straight wire of infinite length for a point at a distance d from one of its ends is zero if the point is along its length and $\frac{\mu_0}{4\pi d}$ if the point is on a line perpendicular to its length while at the centre of semicircular coil is $\frac{\mu_0\,\pi\,I}{4\pi\,R}$ and here,



$$\vec{\mathbf{B}} = \vec{\mathbf{B}}_a + \vec{\mathbf{B}}_b + \vec{\mathbf{B}}_c$$

$$= 0 + \frac{\mu_0\pi I}{4\pi R}\otimes + 0$$

$$= \frac{\mu_0 I}{4R} \text{ into the page}$$

(d) At resonance in series *LCR* circuit,

$$X_L = X_C$$

i.e., circuit is purely resistive.

Hence, all the potential drops across resistance only. So, the potential drop across resistance is 220 V.

10. (a) The decay rate or activity *(R)* of a radioactive substance is the number of decays per second.

$$R = \lambda N$$

$$\therefore\ 5\times10^{-3}\times3.7\times10^{10} = \frac{0.693}{138\times24\times60\times60}N$$

($\because$ 1 Ci $= 3.7\times10^{10}$ decays/sec)

$$\Rightarrow N = \frac{138\times24\times60\times60\times3.7\times5\times10^{7}}{0.693}$$

$$= 3.18\times10^{15} \text{ atoms}$$

(b) Energy,

$$E_{min} = \frac{hc}{\lambda_{max}}$$

$$\therefore\quad \lambda_{max} = \frac{hc}{E_{min}}$$

$$= \frac{6.6\times10^{-34}\times3\times10^{8}}{1.43\times1.6\times10^{-19}} \text{ m}$$

$$= 8.654\times10^{-7} \text{ m}$$

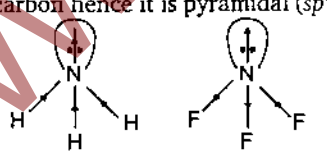
$$= 8654\times10^{-10} \text{ m}$$

$$= 8654 \text{ Å}$$

(c) By reducing gas pressure in discharge tube, the mean free path (which is average distance travelled between successive collisions) increases. Hence, the electrons strike the surface of the tube, producing fluorescence.

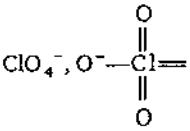
11. (a) Due to presence of vacant *d*-orbitals in surrounding silicon, there is $p\pi - d\pi$ backbonding in case of $(SiH_3)_3\ddot{N}$ hence, planar (sp^2) while in case of $(CH_3)_3$ N, there is absence of vacant orbital in surrounding carbon hence it is pyramidal (sp^3).

(b)



Dipole moment of NF_3 is less than NH_3 because in NF_3 bond moments oppose the polarity of lone pair

(c) Due to resonance stabilisation of conjugate base of $HClO_4$ *i.e.*,



ClO_4^-, $HClO_4$ is more acidic than HClO.

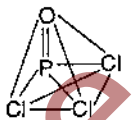
12. (a) $\Delta E = E_5 - E_2$

$$\frac{hc}{\lambda} = R_H\left[\frac{1}{n_2^2} - \frac{1}{n_5^2}\right]$$

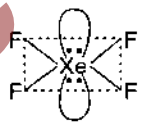
$$6.626\times10^{-34}\times3\times10^{8} = 2.18\times10^{-18}\left[\frac{1}{4} - \frac{1}{25}\right]$$

$$\lambda = 4342 \text{ Å}$$

(b) (i)



(ii)



13. (a) (i) At freezing in equilibrium process,

$$\Delta G = 0$$

(ii) At equilibrium

$$\Delta S = \frac{\Delta H}{T} = \frac{-500}{100} = -5 \text{ J mol}^{-1} \text{ K}^{-1}$$

(b) (i) $E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{[Hg_2^{2+}]}{[Cr^+]^2}$

$$= 0.01 - \frac{0.059}{2}\log\left(\frac{10^{-1}}{10^{-4}}\right)$$

$$= 0.01 - \frac{0.059}{2}\times3$$

$$= -0.0785 \text{ V}$$

As E_{cell} is negative, reaction proceeds in backward direction.

(ii) $E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log\frac{[Hg_2^{2+}]}{[Cr^+]^2}$

$$= 0.01 - \frac{0.59}{2}\log\left(\frac{10^{-4}}{10^{-1}}\right)$$

$$= 0.01 + \frac{0.059}{2}\times3$$

$$= 0.0985 \text{ V}$$

As E_{cell} is positive, reaction proceeds in forward direction.

14. (a) $R_1 = k[A][B]^2$

$R_2 = k[3A][3B]^2 = k\cdot27[A][B]^2 = 27R$

Reaction rate increases by 27 times.

(b) Total mass = 46 + 66 = 112 g

Volume of solution = 112×0.926 cc

Molarity = $\frac{46/18}{112\times0.926}\times1000 = 24.64$

15. (a) $\rho = \dfrac{ZM}{a^3 N_0}$

$$N_0 = \frac{ZM}{a^3 \rho} = \frac{2 \times 53}{(288.4 \times 10^{-10})^3 \, 7.2}$$

$$= 6.015 \times 10^{23}$$

(b) (i) Mn^{2+} is more stable, because reduction potential Mn^{3+}, Mn^{2+} is positive and Mn^{2+}, Mn is negative.

(ii) Cr^{3+} is more stable because reduction potential for both Cr^{3+}, Cr^{2+} and Cr^{2+}, Cr are negative.

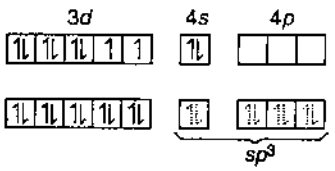
16. $Q_c = \dfrac{[NH_3]^2}{[N_2][H_2]^3} = \dfrac{(3 \times 10^{-3})^2}{(1 \times 10^{-3})(3 \times 10^{-3})^3}$

$$= \frac{1}{3} \times 10^6$$

As Q_c is greater than K_c, reaction proceeds in backward direction thus, concentration of NH_3 decreases.

17. (a) **NiB_4**

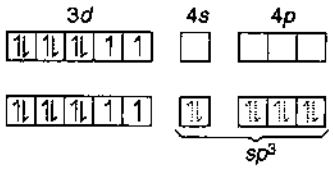
Ni (28) ..... $3d^8 4s^2$



Complex is diamagnetic

(NiA_2X_2)

Ni^{2+} (28) ..... $3d^8$



Complex is paramagnetic due to presence of 2 unpaired electrons

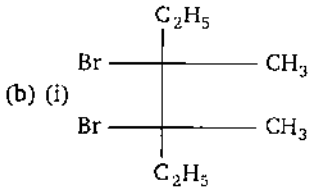
(b) Potassium tetrachloroethylenediamine cobaltate (III), shape is octahedral

18. (a) (i) Two optically active and one optically inactive form *i.e.*, meso, having two asymmetric C atoms and symmetric structure.

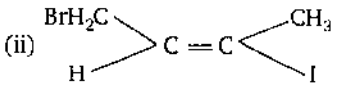
(ii) Two optically active forms, having one asymmetric carbon.

(iii) Optically inactive

(b) (i)

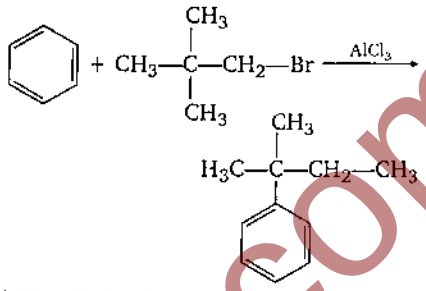


(ii)



E-isomer

19. (a) (i)

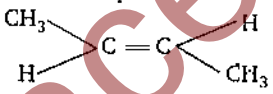


Electrophilic substitution reaction.

(ii) $CH_2 = CHBr + AgCN \rightarrow CH_2 = CH - CN$

Substitution reaction.

(iii) It is electrophilic addition reaction



Anti addition of hydrogen atoms to triple bond takes place in Na metal in NH_3 producing a *trans* alkene.

(b) (i) $Ph - C \equiv CH \xrightarrow[1\%\, HgSO_4 / H_2O]{20\%\, H_2SO_4}$

$$Ph - \overset{\overset{O}{\|}}{C} - CH_3$$

(ii) $\underset{\text{1-butyne}}{CH \equiv C - CH_2 - CH_3} \xrightarrow[[H_2]]{Pd/C}$

$$CH_2 = CH - CH_2 - CH_3 \xrightarrow[\text{in } CCl_4]{Br_2}$$

$$\underset{Br}{\overset{|}{CH_2}} - \underset{Br}{\overset{|}{CH}} - CH_2 - CH_3$$

1, 2 dibromobutane

20. Secondary and tertiary structures are affected primary remains unaffected.

(a) Tertiary structure is affected thus the activity of protien stops.

(b) Glycogen — α-1-6-glucose — polymer

Starch — α-1-4-glucose — polymer.

1. (i) The heart will beat but the heart beat will become irregular called arrhythmia. The cardiac centre lies in medulla oblongata of the brain. The cardiac centre is formed of cardio-inhibitor and cardio accelerator. The cardio inhibitor decreases the heart beat whereas cardio accelerator increase the heart beat.
   (ii) When the sympathetic control is re-established tachycardia will cause. Tachycardia is defined as faster heart rate usually faster than 100 beats per minute.
   (iii) If parasympathetic control is re-established **bradycardia** will cause. Bradycardia means a slow heart rate usually fewer than 60 beats per minute.
2. A-ii, xii. B-iii, iv, vi. C-ix, D-v. E-i, ix-viii.
3. (i) The skull is mono-condylic in reptiles and birds whereas dicondylic in frog, rabbit and human.
   (ii) The sharks have 5-7 pairs of gills behind the eye whereas the whale, have lungs for respiration.
   (iii) Sea anemone has radial symmetry whereas Ctenoplana has biradial symmetry.
   (iv) In toad (amphibia) the heart is three chambered whereas in crocodile the heart is four-chambered.
4. (i) Carrying capacity is the maximum number of individuals of a population which can be provided with all the necessary resources for their healthy living.
   (ii) Programmed senescence theory state that aging is a result of switching on of certain genes and switching off of other genes.
   (iii) **Amniocentesis** is a technique of drawing amniotic fluid through a needle inserted in the abdomen and testing it to find out the sex and disorders of the foetus.
   (iv) Pheromones or ectohormones are secreted by exocrine glands of skin to the surface. The smell of these chemicals affect the mutual behaviour of members of species. Certain insects secrete pheromones to attract their mating partner.
5. (i) Microtubules are formed of tubulin protein. The microtubules involved in the formation of spindle fibres, movement of flagella and cillia and formation of endoskelton of cell.
   (ii) Spherosomes are small spherical organelles which synthesize and store lipid and contains
   (iii) Endodermis is the innermost layer of cortex which contains casparian strips on their radial walls. Casparian strips are made of suberin mainly (a waxy substance) which prevent water from flowing back to soil.
   (iv) Lenticels are corky pores or narrow lines on the surface of stems of woody plants that allow the interchange of gases between the interior tissue and surrounding air.
6. (a) (i) Synovial fluid (ii) Hinge joint
   (iii) Tibia fibula
   (b) A membrane having a jelly-like appearance present above the organ of Corti and is involved in sensory reception.
7. (i) In A the rate of reaction is rapid and go to stationary phase slowly whereas in B, the rate of reaction is slow and go to stationary phase suddenly.
   (ii) The rate of reaction in B is slow as compare to A.
   (iii) C represents the substrate concentration at which half of the maximum velocity of enzyme has reached where as A and B represents reaction velocity. As the graph shows relationship between substrate concentration and reaction velocity in which substrate concentration is plotted on X-axis and reaction velocity on Y-axis.
   (iv) Allosteric modulation or feed back inhibition is an enzyme regulatory machanism where a product of a reaction can function as temporary allosteric inhibitor if its concentration crosses a threshold value.
8. (i) Proteins, active sites,
   (ii) *Bacillus anthracis*, Louis Pasteur
   (iii) *Corynebacterium diptheriae*, 5 to 7 days, air borne
9. (i) Meiosis.
   (ii) A chromosme with the centromere located very close to one end so that the shorter arm is very small. In the given diagram two acrocentric chromosomes can be seen.
   (iii) Because it lacks telocentric chromosome.
   (iv) In Klinefelter syndrome (XXY) male has one extra X chromosome whereas in Turner syndrome (XO) there is one less X chromosome in it.
   Male with Tuner's syndroms does not survive.

10. (i) calcium, bone
(ii) testes, testosterone
(iii) holoblastic equal, morula
(iv) epithelium, ions Na^+, K^+, Ca^{2+} amino acids vitamin C
(v) glucagon, islets of Langerhans

Botany

1. (i) Increase of the number of chromosome sets as a result of endoreduplication.
(ii) The transfer of pollen grains from the anther of one flower to the stigma of a genetically different flower is called allogamy.
(iii) Asexual reproduction which includes agamospermy (parthenogenesis, adventive embrony) and vegetative propagation. The organism that reproduce by apomixis is called apomict.
(iv) These are cytoplasmic strands which connect the cytoplasm of adjacent plant cells.
(v) Capsomeres are sub-unit of capsid (protein coat) of virus. These possess antigenic properties.

2. (i) It is the fusion of one male gamete with egg (syngamy) and the other male gamete with polar nuclei (triple fusion). It is common in angiosperms.
(ii) It is modified stem with one or two internodes *e.g., Ruscus.*
(iii) These are negatively geotropic respiratory roots found in the halophytes (mangrove plants). Their function is exchange of gases through lenticels *e.g., Rhizophora, Sonnertia, Avicennia.*
(iv) These are genetically modified crops which are raised by introducing desirable genes in one plant from another plant through genetic engineering.
(v) Accroding to Mayr–It is a group of interbreeding individuals which resemble each other in morphological, physiological biochemical and behavioural characters. These are reproductively isolated to other groups.

3. (a) In Monera (bacteria) the cell wall is made of peptidoglycan whereas in protista the cell wall is either absent or cellulosic in nature.
(b) In Monera the genetic material is naked circular RNA which is not enclosed by nuclear envelope and lack histone proteins whereas in protista the genetic material is linear DNA enclosed by nuclear envelop complexed with histone proteins and organised into chromosomes.
(c) In Monera the cytoplasmic ribosomes are 70S type whereas in protista these are 80S type.
(d) In Monera the respiratory enzymes are present on plasma membrane **or** mesosome whereas in protista the respiratory enzymes are located in mitochondria.
(e) In Monera the extra chromosomal DNA (plasmid) is located in cytoplasm while in protista the extra chromosomal DNA (circular DNA) is found in mitochondria and chloroplast.

4. (A) (i) Coconut - Drupe (fruit) endosperm (edible port)
(ii) Coriander - Schizocarp (fruit) compound Umbels (inflorescence)
(iii) Orange - Hespiridium (fruit) Central (Placentation)
(B) (i) Marigold - Capitulum (inflorescence) Cypsela (fruit)
(ii) Euphorbia - Cyathium (inflorescence) capsule (fruit)

5. (i) B.O.D (Biological Oxygen Demand) is the amount of O_2 in miligrams required for five days in one litre of water for oxidation of organic wastes by micro-organism at 20°C. Whereas C.O.D (Chemical Oxygen Demand) is the amount of oxyen required to oxidise all the reducing substances present in water.
(ii) Genetic diversity is the variation in number and types of genes as well as chromosomes present in different species or the variation in gene and their alleles in same species. On the other hand species diversity is the variety in the number and richness of the species of a region.
(iii) **Keystone species** is a species which has large influence on community structure and characteristic *i.e.,* removal or decrease in keystone species cause serious disruption in community structure and function. Whereas the **species facing** a high risk of extinction in wild in near future due to decrease in its habitate, excessive predation or poaching is known as **endangered species**.

(iv) The succession which starts from the primitive substratum where there was no previously any sort of living matter is called **primary succession**. The first group of organisms establishing there are known as pioneer, primary community or primary colonisers. On the other hand the succession which starts from previously built up substrata with already existing living matter is called **secondary succession**.

(v) In Montreal protocol (16 September, 1987). 27 industrialised countries agreed to limit production of chlorofluoro carbons to half the level of 1986. Whereas in Kyoto protocol (December, 1997) international conference held in Kyoto Japan obtained commitments from different countries for reducing overall green-house gas emissions at a level 5% below 1990 level by 2008-2012.

6. 1. Five
2. Two
3. Rubisco
4. RuBP oxidase
5. Oxidises
6. Phosphoglycolate
7. Kranz
8. Phospho enol pyruvate
9. Oxaloacetate
10. Malate

7. This cross follows the law of incomplete dominance.

RR × Rr	Red and Pink	1:1
rr × RR	Pink	All pink
Rr × Rr	Red, Pink and White	1:2:1
rr × Rr	Pink and white	1:1

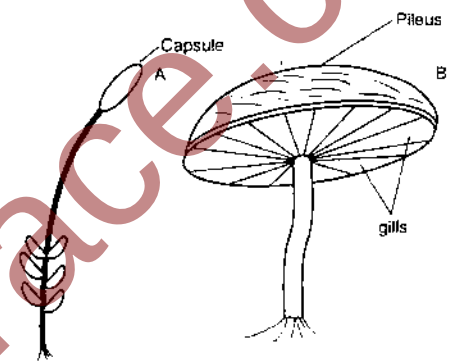
The 4 O'clock plant also show incomplete dominance.
Scientific name :
Mirabilis jalapa (4 O'clock plant).

8.

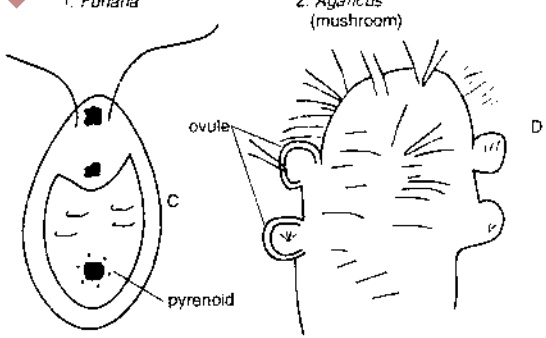
Pollutant	Source	Effect
CH_4	Agricultural field	Global warming
Oxides of nitrogen	Automobile exhaust, burning of fossils	Photochemical smog, acid deposition, global warming, depletion of ozone
SO_2	Automobile exhaust, burning of fossils	Acid deposition, depletion of ozone
SPM	Automobile exhaust, burning of fossils	Photochemical smog, global warming
CFCs	Refrigerant, fire extinguisher, paint solvents, plastic foam	Global warming, depletion of ozone

9. A — i,
(iv) *Bacillus thruingenesis* bacterium produces protein toxin called thurioside which when ingested by insects, flies inhibit ion transport in mid gut and kill them.
vii
B — x C — viii
D — vi E — v, ix

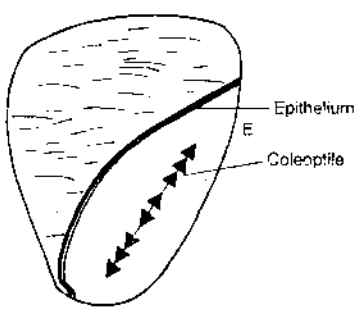
10.



1. *Funaria* 2. *Agaricus* (mushroom)



3. *Chlamydomonas* 4. Megasporophyll of *Cycas*



5. L.S. of grain of Monocots