1.   (a)   Some persons say, there are no flowers in Banyan tree. comment on it.

     (b)   Write two characteristics of hot spot. Name any two hot spots of india.

     (c)   Write one difference between pathogen and parasites.

     (d)   Define phyllode and phylloclade. Give one example of each.

     (e)   *Yeast* is a prokaryote or eukaryote. Give evidence in favour of your answer.

Sol.   (a)   In Banyan tree hypanthodium type of inflorescence is found and in hypanthodium type of inflorescence, flowers are enclosed inside the modified peduncle.

     (b)   Characteristics of hot sopt

        (1) Number of endemic species

        (2) Degree of threat

        Two hot spot of India = (1) Western Ghat   (2) The Eastern Himalay as

     (c)   Parasites live on or in side the host to obtain their nutrition. while pathogens are disease causing living organisms.

     (d)   Phyllode → It is petiolate modification. In it petiole is modified into leaf like structure or flat structure and functions as normal leaf. e.g. → *Australian acacia.*

        Phylloclade → It is stem modification. In it stem is modified into a flat, fleshy and green leaf like structure and it carries out photosynthesis. e.g. → *Opuntia*

     (e)   Yeast is a eukaryote. because in Yeast cellular organelles are present. nucleus is covered by membrane and histone associated with DNA.
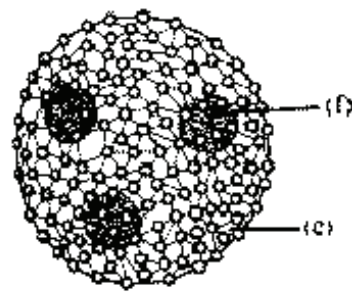
2.   (i)   Identify the given diagram and label (a) or (b)
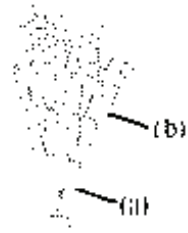
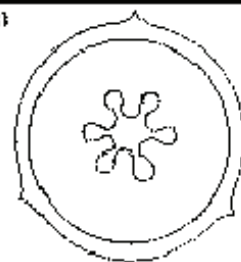   (ii)   Identify the given diagram and label (c) or (d)
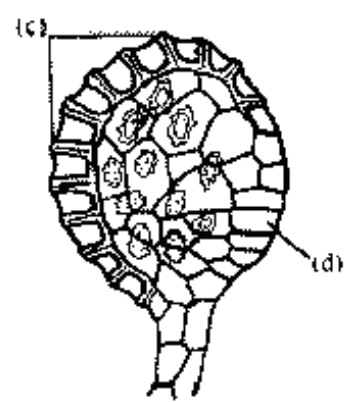
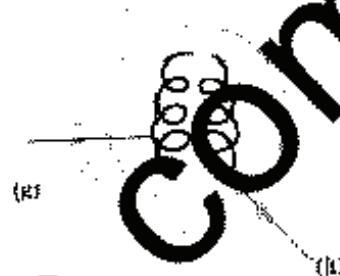   (iii)   Identify the given diagram and label (e) or (f)

(iv) Identify the given diagram and select suitable example for this diagram out of the given below examples.
Priomrose, *Dianthus*, *Hollyhock*, Sunflower, Lemon, Gram.

(v) Identify the given diagram and also write down its two method of transmission and label (g) or (h) also.

(g)

(h)

Sol. (i) – *Penicillium* / Conidiophore of *Penicillium*
   (a) - Ramus
   (b) - Phialides / Sterigmeta

(ii) - V.S. of *Pteridium* sporangium / V.S. of fern sporangium
   (c) - Annulus
   (d) - Stomium

(iii) **Volvox** colony
   (e) - Parent colony
   (f) - Daughter colony

(iv) Free central placentation
   Examples - Primrose, *Dianthus*

(v) Human immunodeficiency virus / HIV
   Two methods of transmission - (1) sexual contact (2) blood transfusion
   (g) - single - stranded RNA (RNA)
   (h) - Reverse transcriptase

3. Define the following terms :
   (a) Point mutation
   (b) Transcription unit
   (c) Germplasm
   (d) Biofortification
   (e) Adaptation

Sol. (a) **Point mutation** :- Change in a single base pair of DNA is called as a point mutation.

or

Replacement of one nitrogenous base by another nitrogenous base in genetic material.

(b) **Transcription unit** :- A transcription unit in DNA is defined primarily by the these regions in DNA. A promoter, structural gene and a terminator.

Germplasm :-

Germplasm is the sum total of all the alleles of the genes, present in a crop and its related species.

(d) **Biofortification** :- Enhancement of higher levels of vitamins, minerals, higher protein and healthier fats in breeding crops.

(e) **Adaptation** :- Any attribute of the organism (morphological, physiological and behavioural) that enables the organism to survive and reproduce in its habitat.

4. Fill in the blanks with the suitable word out of the followings :-

> Primary, Apical, Intercalary, Lateral, Pond, Tree, Sedge, Xylem, Secondary, phloem, Forest, Desert, Xenogamy, Geitonogamy, Proteins, Mulberry, Castor, Papaya, Phytoplanktons, *Rhodospirillum*, *Chlorella*, *Agrobacterium*, *Gliocladium*, Vacuole, Chloroplast, Cambium, Monoecious, *Anabaena*

(a) In primary succession, in a .... the pioneer plants are ....

(b) The increase in girth of plants is called .... growth. Which is caused by the activity of .... meristem.

(c) Transport .... of endodermal cells are control points, where a plant adjust the quality and quantity of solutes reaching the ....

(d) Both maize and .... are monoecious plants. They can prevent autogamy, but not ....

(e) Microrganism like species of .... are used as biopesticides, while those of .... are used as biofertilizers.

Sol. (a) Pond, phytoplanktons   (b) Secondary, lateral   (c) Proteins, xylem

(d) Castor, Geitonogamy   (e) *Gliocladium, Anabaena*

5. Write placentation, inflorescence and type of fruit of the following :

(a) *Poinsettia*   (b) Merigold   (c) Onion

(d) Brinjal   (e) Radish

Sol.

S. No.	Placentation	Inflorescence	Fruit
(a)	Axile	Cyathium	Regma
(b)	Basal	Capitulum	Cypsela
(c)	Axile	Scapigerous umbel or cymose umbel	Capsule
(d)	Axile	Cymose	Berry
(e)	Parietal	Raceme / Racemose	*Lomentum / Siliqua*

6. Match the contents of column-I with column-II

|	Column-I		Column-II
(A)	*Usnea*	(i)	Zoospore
(B)	*Mucor*	(ii)	Zygospore
(C)	*Zea mays*	(iii)	Velamen
(D)	*Equisetum*	(iv)	Naked seed
(E)	*Ginkgo biloba*	(v)	Mutualism
		(vi)	Predation
		(vii)	Living fossil
		(viii)	G.M. crop
		(ix)	Rust
		(x)	Horse tail
		(xi)	Urediniospore
		(xii)	Mycobiont
		(xiii)	Club moss
		(xiv)	Runner
		(xv)	Indehiscent fruit
		(xvi)	Scutellum

Sol. (A) — (v), (xii) (B) — (ii)   (C) — (xvi),(xvi)   (D) — (x)   (E) — (iv) (vii)

7. (i) Write three main reasons for maximum bio-diversity in tropical rain forests.

(ii) Expand IUCN.

(iii) What do you mean by sacred grooves. ? name such grooves in Meghalaya., Rajasthan and Madhya Pradesh.

(iv) When. where and in which country earth summit /world summit was held ?

Sol. (i) Three main reasons for maximum bio diversity in tropical rain forests are -

(1) Tropical latitudes are relatively remained undisturbed for millions of years

(2) Tropical environments are less seasonal. relatively more constant and predictable.

(3) More solar energy is available in these areas.

(ii) International Union of Conservation of nature and Natural resources.

(iii) These are forest areas protected by tribal communities due to religious Sanctity.

Meghalaya → Khasi and Jaintia

Rajasthan → Aravalli hills

MP → Chanda. Bastar. Sarguja

(iv) (1) 2002

(2) Johanasburg

(3) South Africa

8. (a) Draw the floral diagram. and write floral formula of mustard.

(b) Write down three properties of genetic code

(c) Write one difference between El-nino and La-nino effect

Sol. (a)

Ebr ⊕ ☿ K₂ C₄ A₆ G₂
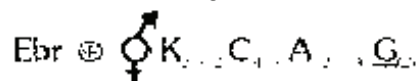
(Any three)

(b) (1) Triplet in nature

(2) Nearly universal

(3) Unambiguous

(4) degenerative

(c) Water of pacific ocean get warm due to hot water current is called El nino effect and water of pacific ocean get cold due to cold water current is called La nino effect.

9. **Fill in the blanks with the help of following given words.**

> Extinct, North-western, Tropical, *Fig*, *Ficus*, *Glomus*, Northern, Southern, *Pinus*, Diversity, *Ustilago*, Rust, Smut, *staphylococcus*, Flemming, *Azospirillum*, Pastuer, *Selaginella*, Chara

(a) In ....**(1)**...... areas ....**(2)**........ acts as keystone species.

(b) The species those are........**(3)**........ in .. ..**(4)**........ parts of India are due to Jhoom cultivation.

(c) Loose ....**(5)**........ in wheat is caused by ....**(6)**........

(d) ....**(7)**........ could not grow on penicillum containing culture, it was first observed by ....**(8)**........

(e) Beside *Polytrichum* and ....**(9)**........, female sex organ archaegonia are also present in ....**(10)**......

Sol. (1) – Tropical

(2) – *Fig*

(3) – Extinct

(4) – North - Eastern

(5) – Smut

(6) – *Ustilago*

(7) – Staphylococcus

(8) – Flemming

(9) – *Selaginella*

(10) – *Pinus*

10. How do the following help in transfer, storage and expression of genetic information ?

(a) Nucleolus

(b) Ribosome

(c) Centriole

(d) Centromere

(e) Chromatin

Sol. (a) Nucleolus helps in ribosome formation, which helps in translation.

(b) Ribosome is the site of expression or translation

(c) Centriole helps in spindle arrangement/cell division

(d) Centromere helps in division of chromosome and attachment of spindle fibre

(e) Genetic informations are mainly stored in chromatin/Storage of genetic informations

11. Find out the false statements out of the given and correct them by changing only underlined words.

(a) In garden pea **dwarf** plants are hybrid and when they are crossed with each other, they produce **50%** dwarf plants

(b) Earthworm is **hermaphrodite** and has **true** coelome

(c) Enzymes similar in structure and activity are called **coenzymes**

(d) Nitrogenous waste product in human is **uric acid**, while **urea** is in cockroach

(e) At the time of splicing process **exons** are removed and **introns** join together.

Sol. (a) In garden pea **tall** plants are hybrid and when they crossed with each other they produce **25%** dwarf plants

(c) Enzymes similar in structure and activity are called **isoenzyme**

(d) Nitrogenous waste product in human is urea, while **uric acid** is in cockroach

(e) At the time of splicing process **introns** are removed and **exons** join together.

12. **(a)** Identify the given diagram with its location in human body
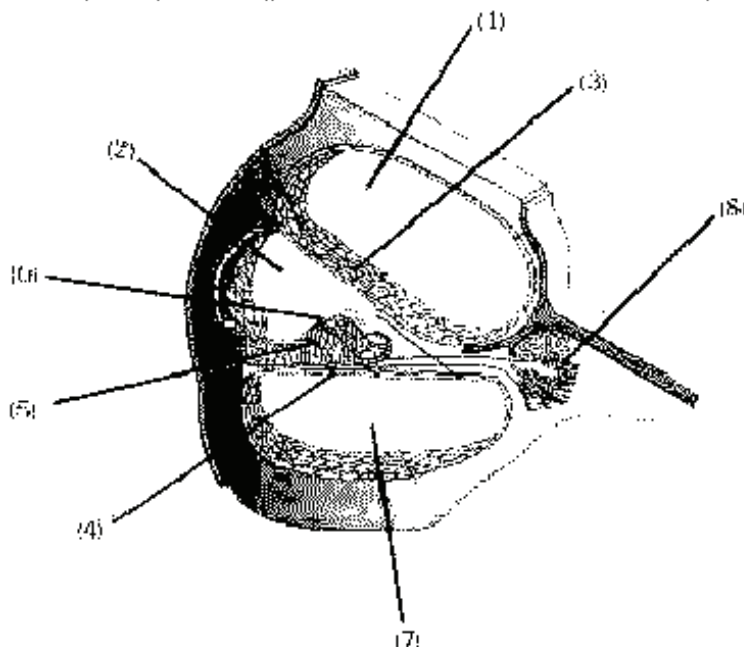
(b) Label no. (2) and write down name of fluid present in it.

(c) Label (4), (5) and (6) and how do they help in the functioning of above diagram ?

Sol. **(a)** Transverse section of cochlea and it is located in coiled part of bony labyrinth

(b) Scala media. it contains endolymph

(c) (4) → basilar membrane

(5) → organ of Corti/hair cells

(6) → Tectorial membrane

They receive waves from lymph and induce a ripple in the basilar membrane. These movements of basilar membrane bend the hair cells of organ of Corti, pressing Them against the tectorial membrane. As a result, nerve impulses are generated in the associated afferent neurons. these impulses are transmitted by afferent neurons via auditory nerve to auditory cortex of the brain where impulses are analysed and sound is recognised.

13 **(A)** What is the genetic basis of each of the given genetic disorders. also give the informations as ask against each of them

(1) Down's syndrome – specific feature on palm

(2) Turner's syndrome – Abnormalities in gonads

(3) Klinefelter syndrome – Appearance of opposite sex character

(B) How do dolphin and panguin show convergent evolution ?

(C) Ramapithecus were more ape like, while Dryopithecus were more man like.

Is this statement incorrect then correct it, and rewrite ?

Sol. **(A)**

(1) Genetic basis – Presence of an additional copy of the chromosome number 21 (trisomy of 21)
Palm is broader

(2) Genetic basis – absence of one of the X chromosomes i.e. 44 + XO
Sterile females with rudimentary ovaries.

(3) Genetic basis – due to presence of an additional copy of X–chromosome resulting into a karyotype of 44 + XXY.
Feminine development (development of breast i.e Gynaecomastia)

(B) Penguins and Dolphins live in similar habitat. that has resulted in selection of similar adaptive features in different groups of organisms/Flippers of panguin and dolphin adapted for the similar function

(C) Ramapithecus were more man like.. while Dryopithecus were more ape like.

14. Fill in the blanks by using following words given in bracket. :-

[CNG, LPG, Butane, Cotton boll worm, Corn borer, Citric acid, Acetic acid, DNA sequences, Nucleotide sequence, Protein, **Agrobacterium**, Restriction endonuclease, Aphid, Cloning **Bacillus**, methane, Bacteria.]

(a) **Aspergillus niger** is used to produce ....

(b) Biofertilizer are obtained from .... species and biopesticides are obtained from .... species.

(c) .... are the enzyme used to cut the DNA from specific site.

(d) The process of making identical copies of DNA segments is known as ....

(e) The protein encoded by the genes CryIAc and CryIIAb control .... and Cry I Ab controls. ....

(f) Bio gas mainly contains .... and used for cooking.

Sol.
(a) Citric acid

(b) Bacteria, **Bacillus**

(c) Restriction endonuclease

(d) Cloning

(e) Cotton boll worm, corn borer

(f) Methane

15. Match the Contents of column-I with those of Column-II

	Column-I			Column-II
(a)	Mutualism		(i)	One species get benefited other neither benefited nor harmed
(b)	ESP (Electrostatic precipitator)		(ii)	Ozone depletion
(c)	Sewage waste		(iii)	Methane
(d)	Montreal protocol		(iv)	SO₂
(e)	J. Shaped curve		(v)	Phytoplankton growth in river water
			(vi)	Saturated
			(vii)	Both species get benifited
			(viii)	Zoo
			(ix)	Particulate matter
			(x)	Exponential growth
			(xi)	CFC
			(xii)	orchid branch with mango
			(xiii)	Fish mortality
			(xiv)	Industrial exhaust

Sol.
(a) = vii

(b) = ix, xiv

(c) = v, xiii

(d) = ii, iii, xi

(e) = vi, x

16. Read the statement (i) to (v) carefully

(a) Find out the correct statements.

(b) Find out the wrong statements and correct them by changing underlined word

(i) Skull, **Ribs**, **Sternum** and **Vertebral** column form axial skeleton

(ii) Conduction of impulse along axon membrane takes place due to **repolarization** and **depolarization** waves.

(iii) Myoglobin present in some muscle gives **redish** colour.

(iv) Common hepatic duct is formed by **bile duct** and **pancreatic duct**.

(v) Amniotic fluid diagnosis is misused in **termination** of **pregnancy**.

Sol. (i) Correct

(ii) Wrong

Correct–conduction of impulses along with axon membrane take place due to depolarization and repolarization waves.

(iii) Correct

(iv) Wrong

Correct–Common heptic duct is formed by **right hepatic duct** and **left hepatic duct**.

(v) Wrong

Correct–Amniotic fluid diagnosis is misused in determination of sex of child.

17. Match the column and answer the questions given below

Column-I	Column-II	Column-III
(i) **Nereis**, Earthworm, **Pila**, Leech	Bilateral, Metamerism	Phylum
(ii) Shark ; Whale ; Dolphin ; Bat	Bony endoskeleton, vivipary	Chambers of heart
(iii) Ostrich : Lizard : Peacock : Duck billed Platypus	homeothermy oviparous	Nourishment to young ones
(iv) Starfish : Sea anemone : Sea Cucumber : Sea urchin	Radial symmetry, Dorsal hollow nervous system	Level of organisation

(a) Which characters of column-II are common among the animals of column-I ?

(b) Which characters of column-II are mismatched in column-I and how these characters are mismatched.

Sol. (a)
- (1) Bilateral
- (2) Vivipary
- (3) Ovipary
- (4) Radial symmetry

(b)
- (i) **Pila** → Because, it belongs to mollusca phylum
- (ii) **Shark** → Because, it contains two chambered heart
- (iii) Duck billed platypus → Because, it is breast feed (Mammals)
- (vi) **Sea anemone** → Because, it has tissue grade level of organisation.

18.

(A)
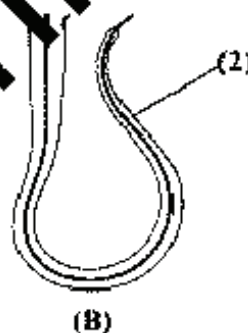
(B)
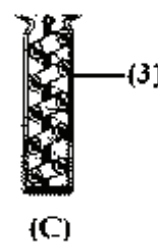
(C)

(a) Write the correct sequence of above diagrams (A), (B) and (C).

(b) Label part (1) in diagram A and write the function of part (1).

(c) Label part (2) in diagram B and write the function of part (2)

(d) Label part (3) in diagram C and write the function of part (3).

(ii) What is the correct place of fertilisation in female reproductive system ?

(iii) At which stage implantation takes place ?

Sol. Correct sequence is A – C – B

(1) Acrosome of sperm.

It's main function :- The enzymes present in the acrosome helps in fertilization by helping in dissolution/penetration of egg membranes.

(c) (2) Tail of sperm, it helps in the swimming of sperm/facilitates the motility of sperm

(d) (i) (3) Middle piece of sperm containing mitochondria. These mitochondria produce energy for the movement of tail.

(ii) Ampullary isthmic junction/Ampulla of fallopian tube.

(iii) Blastula stage / Blastocyst

19. (1) Match the contents of column-I with those of column-II :

	Column-I		Column-II
(a)	Erythropoietin	(i)	Collaterial glands
(b)	Smooth muscle fibres	(ii)	Typhlosole
(c)	Cockroach	(iii)	Involuntary
(d)	**Petromyzon**	(iv)	Gizzard
		(v)	Hormone
		(vi)	Radulla
		(vii)	Juxtaglomerular cells
		(viii)	Circular mouth
		(ix)	Fusiform
		(x)	Wall of blood vessels
		(xi)	Choanocytes

(2) For column I, in column II some terms are not matching. Write the name of any one with its phylum.

Sol. (1) (a) – v, vii (b) iii, ix, x (c) i, iv (d) viii •

(2) Typhlosole – Annelida

Radulla – Mollusca

Choanocytes – Porifera

20. Match the contents of column-I with column-II :-

	Column-I		Column-II
(a)	Bacterial disease in cattles	(i)	Rinderpest
(b)	Fresh water fishes	(ii)	Rohu
(c)	Water born disease in huma	(iii)	Catla
(d)	Parasitic protozoan	(iv)	**Plasmodium**
(e)	Important toxicant i wa r	(v)	**Paramecium**
		(vi)	Cholera
		(vii)	Anthrax
		(viii)	Cowpox
		(ix)	Sardine
		(x)	Malaria
		(xi)	Arsenic
		(xii)	Copper

(a) → (vii) (b) → (ii), (iii) (c) → (vi) (d) → (iv) (e) → (xi)

1. **(a)** Three identical rings of mass 'M' and radius 'R' are placed shown in figure. Find moment of inertia about axis xx' ?
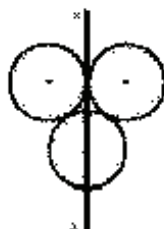
(b) ϕ represents momentum and q represents position. Find dimension of plank's constant (h) in terms of q and ϕ

(c) Spring of spring constant 1200 Nm^{-1} is mounted on a smooth frictionless surface and attached to a block of mass 3 kg. Block is pulled 2 cm to the right and released. Find angular frequency of oscillation?
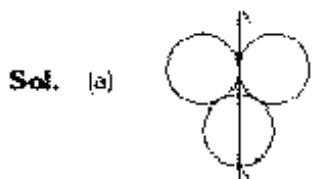
Sol. **(a)**

$$I_{xx} = 3I_{CM} + 2MR^2 = 3 \times \frac{MR^2}{2} + 2MR^2 = \frac{7}{2}MR^2$$

(b) **Method- I** From dimensional analysis method $[h] = [\phi]^a[q]^b$ $\Rightarrow [M^1L^2T^{-1}] = [M^1L^1T^{-1}]^a[L^1]^b$

Comparing dimension on both sides

$a = 1, -a + b = 2$ or $b = 1$ $\therefore [h] = [\phi^1q^1]$

Method : II Momentum of photon $= \frac{h}{\lambda} \Rightarrow h = p\lambda$

$\therefore$ dimension of planck constant $= [\phi^1q^1]$

(c) Angular frequency $\sqrt{\frac{K}{m}} = \sqrt{\frac{1200}{3}} = 20 \text{ rad / sec}$

2. A disc is rotating with angular velocity (ω) about its axis (without any translation push) on a smooth surface :

(a) Find direction and magnitude of velocity at points B and A

(b) Why is friction necessary for rolling ?

(c) What is direction of friction at point B ?

(d) What is condition of friction during perfect rolling ?
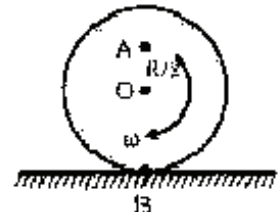
Sol. **(a)**

$v_A = + \frac{\omega R}{2}$ (i.e. Towards right)

$v_B = -\omega R$ (i.e. Towards left)
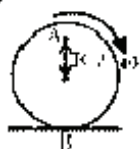
(b) Friction produce tangential force and torque as per requirement of starting of translation motion and retarding of rotational motion respectively.

(c) No friction is acting.

(d) Frictional force = 0 in case of pure rolling on horizontal surface.

3. (a) A 70 kg. man jumps to a height of 0.8 m. Find impulse provided by ground to man.

(b) 2 moles of an ideal monoatomic gas occupying volume V is adiabatically expanded from temperature 300K. to a volume of $2\sqrt{2}$ V. Find :

(i) Final temperature.

(ii) Change in internal energy (R = 8.3)

Sol. (a) Velocity of jumping $v_1 = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.8} = \sqrt{15.68} = 3.96$ ms^{-1} ($\uparrow$) upwards

Impulse from ground = change in momentum of person.

$$I = \Delta p = m |v_i - v_j| = 70 [3.96 - 0] = 277.2 \text{ kg-m/s}$$

(b) (i) In adiabatic process. $TV^{\gamma-1}$ = constant

$$T_2 = \left(\frac{V_1}{V_2}\right)^{\gamma-1} \times T_1 = \left(\frac{V}{2\sqrt{2}V}\right)^{\frac{5}{3}-1} \times 300 = 150 \text{ K or } -123°C$$

(ii) Change in internal energy $\Delta U = \mu C_v dt$

$$\Delta U = 2 \times \frac{3}{2}R \times (150 - 300) = 3 \times 8.3 \times (-150) = -3735 \text{ joule}$$

4. (a) A policemen buzz a whistle of frequency 400 Hz. A car driver approaching the policemen. The speed of car is 54 kmh^{-1}. Find out the change in frequency experienced by the driver, when driver approaches the policemen and after he crosses the policemen. Velocity of sound is 350 ms^{-1}]

(b) Is $y = a \sin\omega t \cos\omega t$ a S.H.M. ? Explain your answer.

(c) $y_1 = y_0\sin[\omega t - kx]$. $y_2 = y_0\sin[\omega t + kx]$. These waves when they are superimposed. we get progressive or standing wave ? In terms of given data state the velocity of y_1 and y_2.

Sol. (a) When driver approaches to the policeman then observed frequency $n' = n\left(\frac{v + v_0}{v}\right)$

after crossing $n'' = n\left(\frac{v - v_0}{v}\right)$ where n = 400 Hz. v_0 = 54 km/hr = 15 m/s

difference $\Delta n = n' - n'' = n\left(\frac{v + v_0}{v}\right) - n\left(\frac{v - v_0}{v}\right) = \frac{2nv_0}{v} = \frac{2 \times 400 \times 15}{350} = 34.2$ Hz

(b) $y = A \sin\omega t \cos\omega t = \left(\frac{A}{2}\right) 2\sin\omega t \cos\omega t = \left(\frac{A}{2}\right) \sin 2\omega t$.

$$\frac{dy}{dt} = 2\left(\frac{A}{2}\right)\omega \cos 2\omega t = A \omega \cos 2\omega t$$

$$\frac{d^2y}{dt^2} = \frac{-4\omega^2 A}{2}\sin 2\omega t = -4\omega^2 y \Rightarrow \frac{d^2y}{dt^2} + 4\omega^2 y = 0 \Rightarrow \text{ it is S.H.M.}$$

(c) It is standing wave because given waves are super imposition of two waves prapogating in opposite direction

Velocity of $y_1 = v = \dfrac{\omega}{k}$ in +ve x direction.

Velocity of $y_2 = v = \dfrac{\omega}{k}$ in −ve x direction

5. (a) A heat engine is having a source at temperature 527°C and sink at temperature 127°C. If the useful work is required to be done by the engine at the rate of 750 watt. then find out the amount of heat absorbed by the sink per second from the source in calories. Also find the efficiency of heat engine.

(b) An electron microscope is operated at 40 kV. What is the ratio of resolving power of this microscope and another one which uses yellow light of wavelength 6×10^{-7} m.

Sol. (a) Given $T_1 = 800$ K and $T_2 = 400$ K. $W = Q_1 - Q_2 = 750$ W

Amount of heat absorbed is given by

$$\dfrac{W}{Q_1} = \dfrac{T_1 - T_2}{T_1} = \dfrac{800 - 400}{800} = \dfrac{1}{2} \Rightarrow \dfrac{750}{Q_1} = \dfrac{1}{2} \Rightarrow Q_1 = 1500 \text{ Watt. or J/sec}$$

$$Q_1 = \dfrac{1500}{4.2} = 357.14 \text{ cal/sec}$$

Efficiency $\eta = \dfrac{T_1 - T_2}{T_1} = \dfrac{800 - 400}{800} = \dfrac{1}{2}$ or 50%

(b) $\lambda = \dfrac{12.27}{\sqrt{V}} \text{Å} = \dfrac{12.27}{\sqrt{40 \times 10^3}} \times 10^{-10} = 6.13 \times 10^{-12} \text{ m}$

Resolving power $R \propto \dfrac{1}{\lambda} \Rightarrow \dfrac{R_1}{R_2} = \dfrac{\lambda_2}{\lambda_1} = \dfrac{6 \times 10^{-7}}{6.13 \times 10^{-12}} = 9.78 \times 10^4$

6. For given circuit find out :

(a) V (b) I_1, I_2, I_3 (c) Power drawn by circuit.

Sol. (a) Apply Kirchhoff's current law at juction $I_1 = I_2 + I_3$

$$\Rightarrow \dfrac{50 - V_s}{5} = \dfrac{V_s - 0}{3} + \dfrac{V_s - 30}{15} \Rightarrow V_s = 20 \text{ V}$$

(b) $I_1 = \dfrac{50 - 20}{5} = 6\text{A}.$ $I_2 = \dfrac{20 - 0}{3} = \dfrac{20}{3}\text{A}.$ $I_3 = \dfrac{20 - 30}{15} = \dfrac{-2}{3}\text{A}$

(c) Total Power $= I_1^2 R_1 + I_2^2 R_2 + I_3^2 R_3 = 36 \times 5 + \dfrac{400}{9} \times 3 + \dfrac{4}{9} \times 15 = 320 \text{ W}$

7. (a) Two identical conducting spheres M and N has charges q_m and q_n respectively. A third identical neutral sphere P is brought in contact with M and then seperated. Now sphere P is brought in contact with N then find out final charge on sphere P.

(b) When a 2Ω resistance is connected to a cell then 2A current flow in it and when 9Ω resistance is connected to cell then 0.5 A current flow in it. Find out internal resistance of cell.

(c) Efficiency of a transformer is 80% and primary and secondary coil has 30 and 120 turns respectively. Current in secondary coil is 0.25A. Find out current in primary.

Sol. (a) When P and M are come in contact then charge of sphere P = $\dfrac{q_m + 0}{2} = \dfrac{q_m}{2}$

When P and N are come in contact then charge of sphere P = $\dfrac{\dfrac{q_m}{2} + q_N}{2} = \dfrac{q_m + 2q_N}{4}$

(b)

here $I = \dfrac{E}{R + r}$
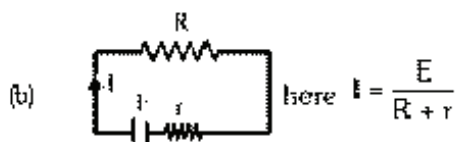
According to question $2 = \dfrac{E}{2 + r}$ ...... (i) and $0.5 = \dfrac{E}{9 + r}$ ...... (ii)

From (i) and (ii) $r = \dfrac{1}{3}\,\Omega$

(c) % Efficiency = $\dfrac{\text{Output power}}{\text{Input power}} \times 100$ $\Rightarrow$ $0.8 = \dfrac{V_s \cdot I_s}{V_p \cdot I_p}$

$\because$ $\dfrac{V_s}{V_p} = \dfrac{N_s}{N_p}$ $\therefore 0.8 = \dfrac{120}{30} \times \dfrac{0.25}{I_p} \Rightarrow I_p = 1.25$ A

8. (a) Current changes in time interval 5 sec. from 4A to 2A in a coil of self inductance 0.1 H. Find value of induced emf and direction of induced current in coil.

(b) Figure show an infinite long wire which carrying current I_1 and another wire of finite length carrying current I_2 is placed perpendicular and coplaner. Then find out :

(i) What is direction of magnetic force on finite length wire due to long wire.

(ii) Magnetic force per unit length on finite length wire is constant or variable.
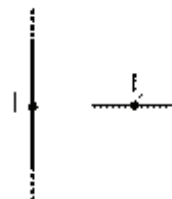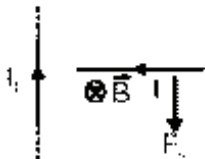
Graph shows variation of current in a coil with respect to time :

Draw the variation between induced emf and time qualitatively and quantitatively.
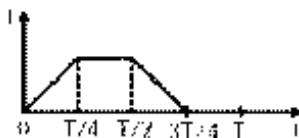
Sol. (a) $e = -L\dfrac{\Delta I}{\Delta t} = \dfrac{-L(I_2 - I_1)}{t} = -\dfrac{0.1(2-4)}{5} = +\,0.04$ volt

here induced emf is positive so direction of induced current is in the direction of main current

(b)

(i)   Direction of magnetic field due to infinite long wire is as shown in fig.

$\Rightarrow$ direction of F_m will be in plane of paper downwords

(ii)   Magnetic field due to long wire is not uniform so magnetic force per unit length is also not constant

(c)

as $e = -L\dfrac{dI}{dt}$ Let $\left|\dfrac{dI}{dt}\right| = K$
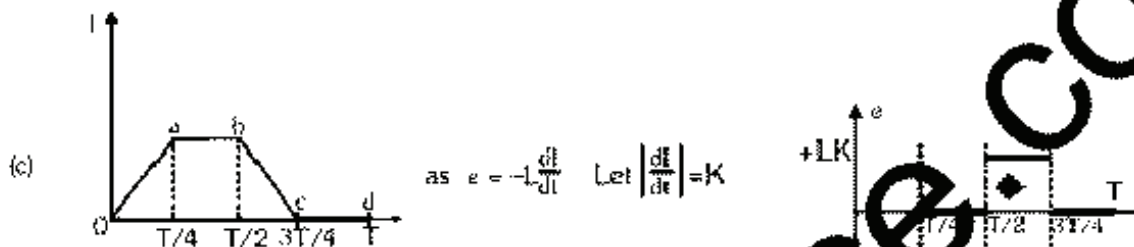
oa – part rate of change of current is positive so induced emf is negative (–LK)

ab – part current is consant so induced emf is zero

bc – part rate of change of current is negative so induced emf is positive (+LK)

cd – part current is zero so induced emf is zero

9. (a) A sodium lamp emits $3.14 \times 10^{?}$ photons per second. Calculate the distance from sodium lamp where flux of photon is one photon per second per cm^2.

(b) Alpha particle, electron and photon have equal kinetic energies then which particle has more ionization power in same gas medium. Explain it.

(c) A radioactive nuclei X converts into stable nuclei Y. Half life of X is 50 years. Calculate the age of radioactive sample when the ratio of X and Y is 1 : 15.

Sol. (a) Flux of photon at distance d from sodium lamp $\phi = \dfrac{\text{number of photon per second}}{\text{Area}}$

$= \dfrac{3.14 \times 10^{20}}{4 \times 3.14 \times d^2} \Rightarrow d^2 = \dfrac{10^{20}}{4} \Rightarrow d = 5 \times 10^{9}$ cm

(b) Alpha particle, because ionization power depends on momentum as $p = \sqrt{2mE}$ and E = constant so

ionization power $\propto \sqrt{m}$

(c) Active fraction $\dfrac{N}{N_0} = \dfrac{1}{1+15} = \dfrac{1}{16}$

$\Rightarrow \dfrac{1}{2^{t/t_{1/2}}} = \dfrac{1}{2^4} \Rightarrow$ age of sample $= 4 \times T_{1/2} = 200$ years.

10. (a) In a hydrogen atom, electron moves from second excited state of first excited state and then from first excited state to ground state. Find ratio of wavelength obtained.

(b) Draw the circuit diagram of reversed bias P-N junction.

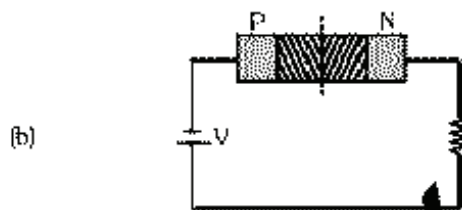(c) Draw the output waveform across diode in given circuit.
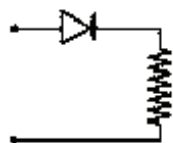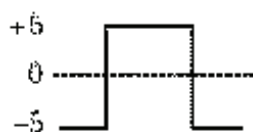
(d) Draw the truth table for the given logic gate.
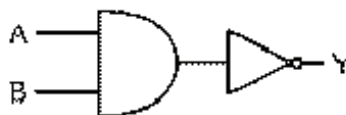
Sol. (a) From Bohr model $\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$$\frac{1}{\lambda_1} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = \frac{5}{36}R \quad \ldots\ldots (i) \quad \text{and} \quad \frac{1}{\lambda_2} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = \frac{3}{4}R \quad \ldots (ii)$$

Dividing eq. (i) and (ii), we get $\frac{\lambda_1}{\lambda_2} = \frac{27}{5}$

(b)

(c)

(d)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

11. (a) 0.534 g of solute is dissolved in 15 g of water then freezing point temp Changes 0°C to − 1.57°C. Molal depression constant of water K_f = 1.85 K kg mol⁻¹. Find out –

    (i)   Molal concentration

    (ii)   Molecular wt. of solute.

(b) For the following Rxⁿ.

$$H_2 + I_2 \rightleftharpoons 2HI$$

If initially 25 ml of H_2 and 20 ml of I_2 are present in a container and at equilibrium 30 ml of HI is formed then calculate equilibrium const.

Sol. (a) $\Delta T_f = 0°C - (-1.57°C)$

        $\Delta T_f = 1.57°C$

        $\Delta T_f = \text{molality} \times K_f$

    (i) $\text{Molality} = \dfrac{1.57}{1.85} = 0.848 \text{ m.}$

    (ii) $\text{Molality} = \dfrac{\text{wt. of solute}}{\text{Molecular wt. of solute } (M_w) \times \text{wt. of solvent (kg)}}$

        $0.848 = \dfrac{0.534 \times 1000}{M_w \times 15}$

        $M_w = 41.949 \text{ g/mol.}$

(b) $H_2 + I_2 \rightleftharpoons 2HI$
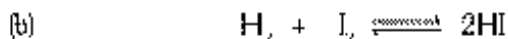
Initial   25   20   0

At Eqⁿ   25−x   20−x   2x

        Given at eqⁿ 2x = 30 ml.

               x = 15 mL.

A/c to L.M.A.

$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{(30)^2}{(10)(5)} = \frac{900}{5 \times 10} = 18$$

12. (a) Two gases A and B of mass 70.6 g and 167.5 g (M_w of A = 32 and M_w of B = 20) are mixed. Then total pressure of mixture is 25 bar. Calculate partial pressure of A & B.

(b) 1.02% solution of glycerine and 2% solution of glucose are isotonic molecular wt of glucose is 180 then find molecular wt of glycerine.

Sol. (a)   Moles of gas A. $n_A = \dfrac{70.6}{32} = 2.20$

        Moles of gas B. $n_B = \dfrac{167.5}{20} = 8.375$

        Partial pressure of gas A. $P'_A = \dfrac{n_A}{n_A + n_B} P_{total}$

$$P'_A = \left(\frac{2.20}{2.20 + 8.375} \right) \times 25 = 5.20 \text{ bar}$$

Partial pressure of gas B. $P'_B = \dfrac{n_B}{n_A + n_B} P_{Tot}$

$$P'_B = \left(\dfrac{8.375}{2.20 + 8.375}\right) \times 25 = 19.799 = 19.8 \text{ bar}$$

or $P'_A + P'_B = P_{Tot}$

∴ $P'_B = 25 - 5.20 = 19.8$ bar

(b) $\pi_{serum} = \pi_{serum}$

or $C_{serum} = C_{serum}$ (mol/L)

$$\dfrac{1.02 \times 1000}{M_W \times 100} = \dfrac{2 \times 1000}{180 \times 100}$$

$M_W = 91.8$ g/mol.

13. (a) For which order reaction unit of rate is equals to unit of rate const.

(b) What is the relation between half life $(t_{1/2})$ and initial conc. for zero & first order reaction.

(c) Find out internal energy change for the reaction :

A $(l) \longrightarrow$ A(g) at 373K. Heat of vaporisation is 40.66 kJ/mol, R = 8.3 J mol^{-1} K^{-1}.

Sol. (a) Zero order reaction.

(b) For zero order reaction $t_{1/2} = \dfrac{a}{2K}$

For first order reaction $t_{1/2} = \dfrac{0.693}{K}$

(c)   A $(l) \longrightarrow$ A(g)
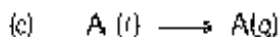
$\Delta n_g = 1$

$\Delta H = \Delta E + \Delta n_g RT$

40.66 kJ mol$^{-1} = \Delta E + 1 \times \dfrac{8.3}{1000} \times 373$

$40.66 = \Delta E + 3.0$

$\Delta E = 37.57$ kJ/mol.

14. (a) r_{Na^+} and r_{Cl^-} represent radius of Na$^+$ and Cl$^-$. If n is the no. of NaCl units per unit cell then gives equation you will use to obtain molar volume.
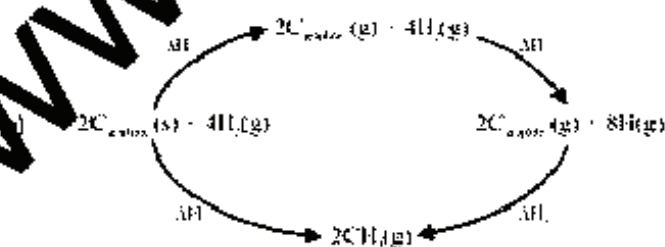
Find out –

(i) Heat of formation of CH$_4$ in terms of ΔH_1, ΔH_2 and etc.

(ii) Heat of sublimation of C$_{graphite}$ in terms of ΔH_1, ΔH_2 etc.

(iii) Heat of dissociation of H$_2$ in term of ΔH_1, ΔH_2 etc.

Sol. (a) For NaCl crystal shortest distance between atoms $= (r^+ + r^-) = \dfrac{a}{2}$

$r^+ = r_{Na}$

$r^- = r_{Cl}$

Vol. of unit cell $= a^3 = (2r^+ + 2r^-)^3 = 8(r^+ + r^-)^3$

so vol. occupied by one molecule $= \dfrac{8(r^+ + r^-)^3}{n}$

therefore vol. of 1 mole molecules $= \dfrac{8(r^+ + r^-)^3}{n} \times N_A = \dfrac{8(r^+ + r^-)^3}{n} \times 6.02 \times 10^{23}$

(b) (i) $\dfrac{\Delta H_1}{2}$

(ii) $\dfrac{\Delta H_1}{2}$

(iii) $\dfrac{\Delta H_2}{4}$

15. (a) Explain why ?
(i) AgBr is insoluble in water but soluble in hypo solution ? Explain by writing equation.
(ii) In solution of H_2SO_4 when SO_3 is doubled, a compound 'A' is formed, which further reacts with H_2O to give H_2SO_4. Explain process with equation ?
(iii) Why bond order of BF_3 is more than one ?
(b) Draw the structure of –
(i) XeF_4
(ii) B_2H_6

Sol. (a) (i) Due to formation of water soluble complex $Na_3[Ag(S_2O_3)_2]$
$AgBr + 2Na_2S_2O_3 \longrightarrow Na_3[Ag(S_2O_3)_2] + NaBr$
Hypo solution

(ii) $H_2SO_4 + SO_3 \longrightarrow H_2S_2O_7 \xrightarrow{H_2O} 2H_2SO_4$
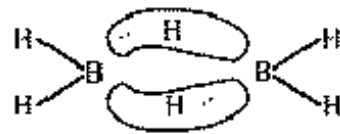(A)
Oleum
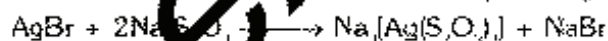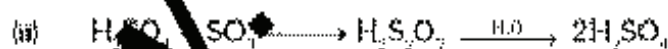
(iii) Due to $p\pi$-$p\pi$ back bonding.

(i) XeF_4
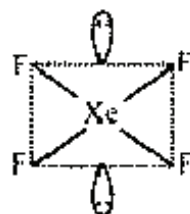
Square planar.

(ii) B_2H_6

Banana bond (2e – 3C bond)

16. (a) (i) Why nitrogen is less reactive than elemental phosphorous ?

      (ii) Why $N(CH_3)_3$ is more basic than $N(SiMe_3)_3$?

      (iii) Why Boric acid acts as an acid though it does not give H^+ ion ?

  (b) (i) Properties of Be resembles with Al. Why ?

      (ii) IF_7 exist but BrF_7 does not. Why ?

Sol. (a) (i) Bond order of N_2 molecule is three resulting in high bond dissociation energy while in P_4 molecule bond order is one therefore bond dissociation energy is less.

      (ii) Due to $p\pi$–$d\pi$ back donation lp of N is delocalised in vacant d-orbital of Si in $N(SiMe_3)$ but not in $N(CH_3)_3$.

      (iii) Boric acid is electron deficient compound therefore acts as Lewis acid.
$$B(OH)_3 + H_2O \longrightarrow B(OH)_4^- + H^+$$

  (b) (i) Due to same value of ionic potential, Be and Al are diagonally related.

      (ii) Sterric hindrance in BrF_7 as maximum covalency of Br is six and atomic size of Br is smaller than that of iodine.

17. (a) (i) Give the electronic configuration of d-orbitals in the complex ion $[MnF_6]^{3-}$ according to CFT. through diagram ?

      (ii) Explain the geometry of $[Ni(CO)_4]$

      (iii) Deduce the formulae of Cr^{3+} complex having ligands H_2O and Cl, molar conductivity equivalent of $MgCl_2$?

  (b) Edge length of BCC structure of tungeston (W) is 351.6 pm. Find out radius of atom ?

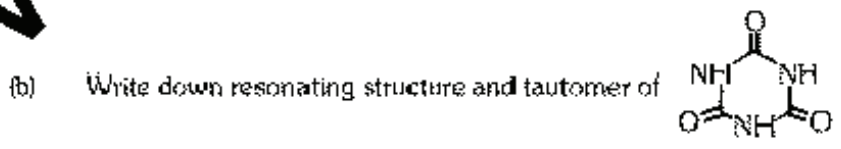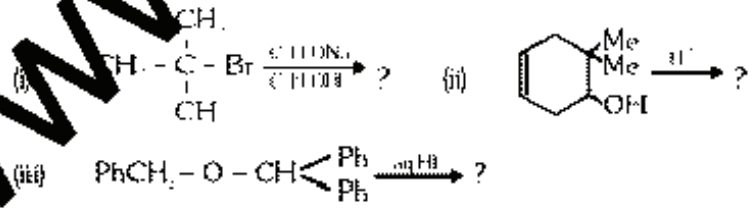**Sol.** (a) (i) $[MnF_6]^{3-}$ Mn^{3+}

Electronic configuration of d-orbital is $t_{2g}^3\,eg^1$.

      (ii) Oxidation state of Ni in $[Ni(CO)_4]$ is zero, therefore electron of 4s subshell are rearranged in lower energy 3d subshell hence hybridisation is sp^3 and geometry is tetrahedral.
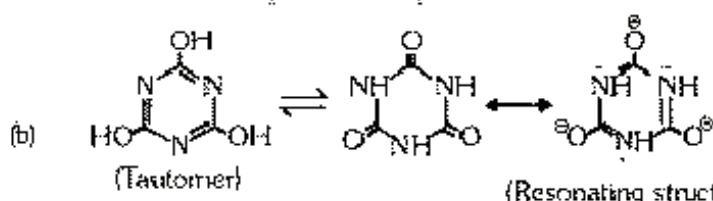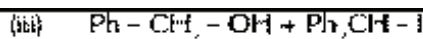
      (iii) $[Cr(H_2O)_5Cl]Cl_2$

  (b) For BCC structure
$$4r = \sqrt{3}\,a$$
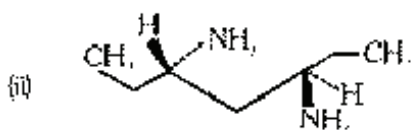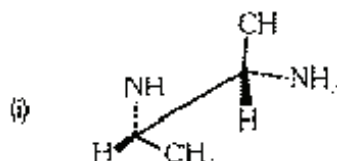$$r = \frac{\sqrt{3}}{4}a = \frac{\sqrt{3}}{4} \times 351.6 \text{ pm.} = 152.24 \text{ pm.}$$

18. (a) Write down structures of product of the following reactions :

(i)

(ii)

(iii) $PhCH_2 - O - CH \big\langle{}^{Ph}_{Ph} \xrightarrow{\text{aq HI}} ?$

  (b) Write down resonating structure and tautomer of

Sol. (a) (i)

(ii)

(iii) $Ph - CH_2 - OH + Ph_2CH - I$

(b)

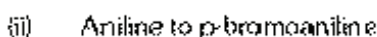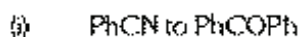(Tautomer)   (Resonating structure)

19. (a) Identify the chiral or achiral among the following and give the reason :-

(i)

(ii)

(iii) 3-Methyl pentane

(b) Convert the following compounds :-

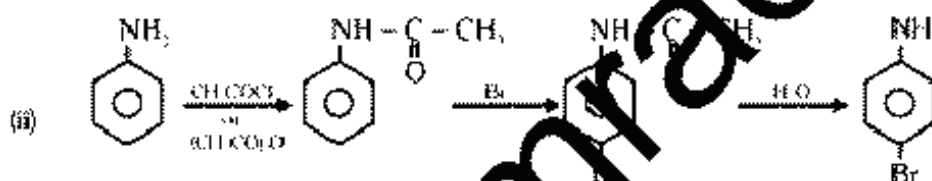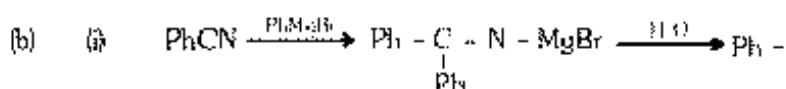(i) PhCN to PhCOPh   (ii) Aniline to p-bromoaniline

Sol. (a) (i) Chiral molecule due to absence of symmetrical plane.

(ii) Achiral molecule due to presence of symmetrical plane or internal compensation (Meso compound)

(iii) Chiral molecule due to presence of chiral – C atom.

(b) (i) $PhCN \xrightarrow{PhMgBr} Ph - C = N - MgBr \xrightarrow{H_2O} Ph - C = O$
       $\qquad\qquad\qquad\qquad\;\; |$
       $\qquad\qquad\qquad\qquad\; Ph$

(ii)

20. (a) (i) Write down structure of that dicarboxylic acid which on reaction with alk. $KMnO_4$ gives meso-tartaric acid.
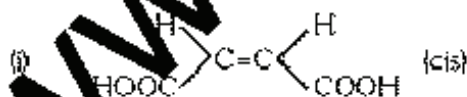
(b) Identify major product of the following reactions.

(i)

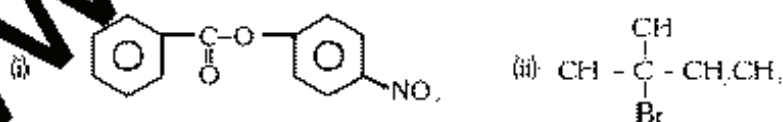

? (ii) 3–Methyl-1–butene $\xrightarrow{HBr}$?

(c) (i) $CH_2 = \overset{\ominus}{C}H$ is more basic than $CH \equiv \overset{\ominus}{C}$, explain why ?

(ii) Alkyne less reactive than alkene towards electrophile, explain why ?

Sol. (a) (i)

 (cis)

(b) (i)

(ii) $CH_3 - \underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2CH_3$

(c) (i) $CH_2 = \overset{\ominus}{C}H$ is less stable than $CH \equiv \overset{\ominus}{C}$ due to negative charge on less EN so $CH_2 = \overset{\ominus}{C}H$ is more basic than $CH \equiv \overset{\ominus}{C}$

(ii)