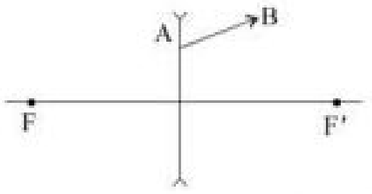
Under what condition can it happen?

REFRACTION OF LIGHT AT CURVED SURFACES

Continued from December 17th

5. Following figure shows ray AB that has passed through a divergent lens. Construct the path of the ray up to the lens if the position of its foci is known. (AS-5)(T.Q)



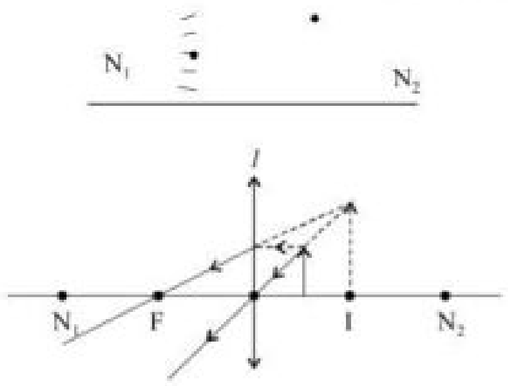
A. The path of the ray up to the lens is as shown in fig.

OA is the incident ray on the concave lens.

AB is divergent ray, appears to diverge from the focus 'F' as show in figure.

Here OA is parallel to the principal axis.

6. Following figure shows a point light source and its image produced by a lens with an optical axis N_1, N_2. Find the position of the lens and its foci using a ray diagram. (AS-5)(T.Q)

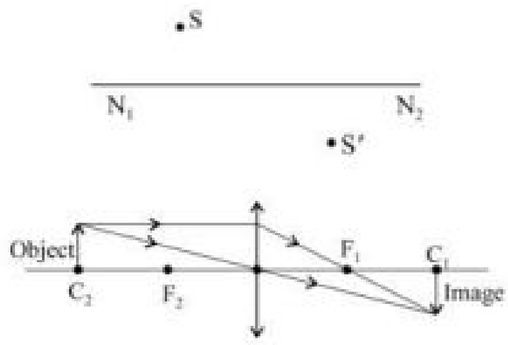


A. (1) The object is in between focus and optic centre.

(2) The image is virtual, erect and magnified.

(3) I is the lens, 'O' is the object and 'I' is the image.

7. Find the focus by drawing a ray diagram using the position of source 'S' and the image 'S'' given in the fig: (AS-5)(T.Q)

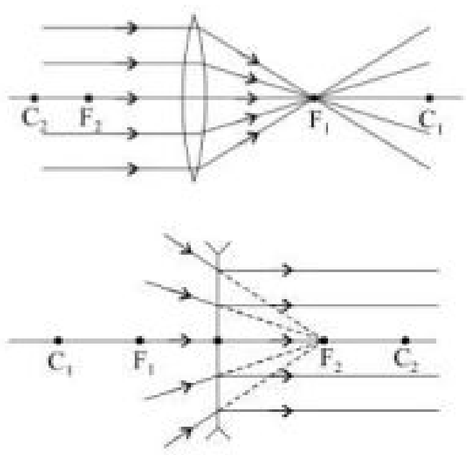


A. (1) When the object is between curvature (C) and focus (F), the image will be formed beyond centre of curvature.

(2) The image will be real, inverted and magnified.

8. A parallel beam of rays is incident on a convergent lens with a focal length of 40 cm. Where a divergent lens with a focal length of 15 cm should be placed for the beam of rays to remain parallel after passing through the two lenses? Draw a ray diagram. (AS-5)(T.Q)

A.



Focal length of convex lens, $f_1 = 40$ cm (+ve)

Focal length of concave lens, $f_2 = 15$ cm (-ve)

For the emergent rays to be parallel to principal axis, the effective focal length of the combination should be zero.

Effective focal length of two lenses separated by some distance is given by

$$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}-\frac{d}{f_1 f_2}$$

Where $f_1 \rightarrow$ focal length of first lens

$f_2 \rightarrow$ focal length of second lens

$d \rightarrow$ separation between lenses

$F \rightarrow$ effective focal length

$$\frac{1}{F}=\frac{1}{40}-\frac{1}{15}-\frac{d}{40(-15)}$$

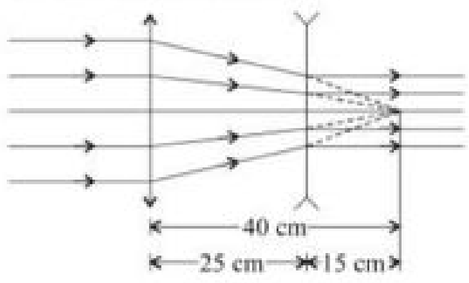
$$\frac{1}{F}=\frac{1}{40}-\frac{1}{15}+\frac{d}{40\times 15}$$

$$\frac{1}{F}=\frac{15-40+d}{40\times 15}$$

$$\frac{1}{F}=\frac{d-25}{40\times 15}$$

$$0=\frac{d-25}{40\times 15}$$ (For parallel beam of emergent rays)

$d-25=0 \Rightarrow d=25\,cm$

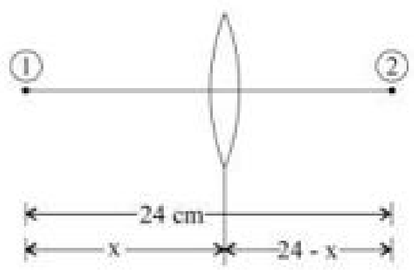


9. The distance between two point sources of light is 24cm. Where should a convergent lens with a focal length of f = 9 cm be placed between them to obtain the images of both sources at the same point ? (AS-7)(T.Q)

A. Distance between the point sources, d = 24 cm

Focal length of the lens, f = 9 cm.

Let the lens be at a distance x from the first object, as shown in fig.



For the first source: $\frac{1}{f}=\frac{1}{u_1}+\frac{1}{v_1}$

$$\frac{1}{9}=\frac{1}{x}+\frac{1}{v} \quad \ldots\ldots\ldots(1)$$

For the second source: $\frac{1}{f}=\frac{1}{u_2}+\frac{1}{v_2}$

$$\frac{1}{9}=\frac{1}{24-x}-\frac{1}{v} \quad \ldots\ldots\ldots(2)$$

(1) + (2) gives

$$\frac{2}{9}=\frac{1}{x}+\frac{1}{24-x};\ \frac{2}{9}=\frac{24-x+x}{x(24-x)};$$

$$\frac{1}{9}=\frac{12}{24x-x^2} \Rightarrow 24x-x^2=108$$

$$x^2-24x+108=0$$

$$(x-18)(x-6)=0$$

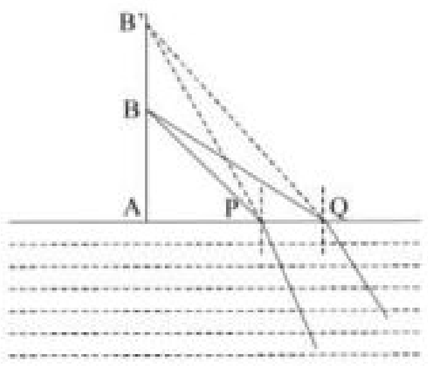
$x = 6$ or 18

So, the lens should be placed either at 6 cm or at 18 cm.

10th Class Special

10. Suppose you are inside the water in a swimming pool near an edge. A friend is standing on the edge. Do you find your friend taller or shorter than his usual height? Why ? (AS-7)(T.Q)

A. The friend looks taller than what he actually is. Friend AB is standing on the bank of the lake.



The rays of light BP and BQ from the head (B) of the friend, on refraction at the water air interface, bend towards the normals at points P and Q and appear to come from point B'. Therefore, to me, my friend will appear as AB' i.e., taller than what his actual height, AB is.

ONE MARK QUESTIONS:

1. A convex lens is held in water. Will the focal length increase or decrease? (As 2)

A. The focal length of the convex lens will increase because the refractive index of glass with respect to water is less than the refractive index of glass with respect to air.

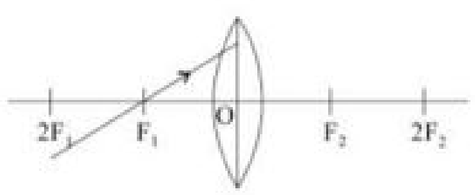
2. A ray of light after refraction through a concave lens, emerges parallel to the principal axis. Under what condition does it happen? (As 1)

A. This happen when the incident ray is directed towards the principal focus of the concave lens.

3. A lens immersed in transparent liquid is not Visible. Under what condition can it happen ? (As 1)

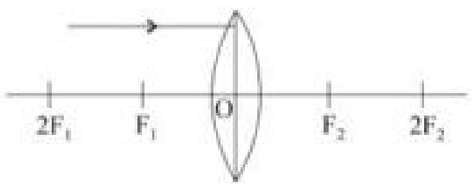
A. This happen when the refractive index of the liquid is same as that of the lens material. Under such conditions, no light is reflected by the lens and hence it is not visible.

4. Redraw the diagram and show the path of the refracted ray. (As 5)

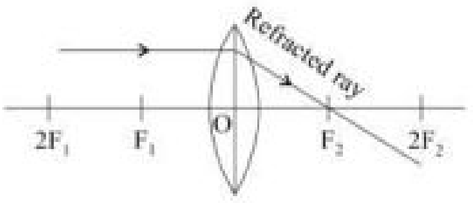


A. The refracted ray becomes parallel to the principal axis.

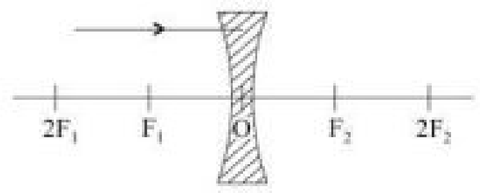
5. Redraw the given diagram and show the path of the refracted ray. (As 5)



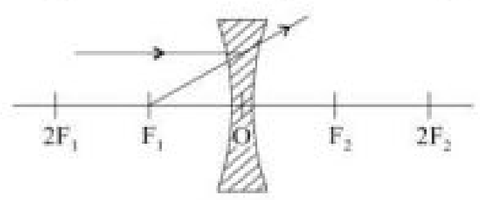
A. The refracted ray passes through F_2 as shown in fig.



6. Draw this diagram in your answer book and complete the path of the ray. (As 5)

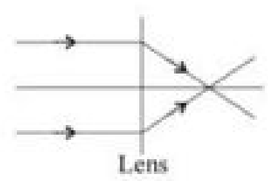


A. The path of the refracted ray is shown in fig.



7. The rays incident on a lens refracted as shown in the fig. Name the lens and the converging point. (As 5)

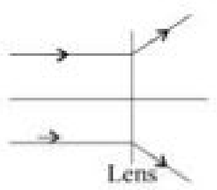
A.



The lens is convex lens and the converging point is called focus.

8. The rays incident in a lens refracted as shown in the fig. Name the lens. (As 5)

A. The lens is concave lens.



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Which is called a peptide bond?

BIOMOLECULES

Continued from 17th December..

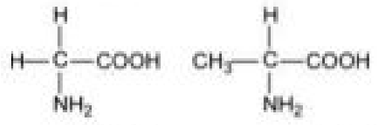
Amino acids and Proteins: Amino acids are organic compounds containing both amino group ($-NH_2$) and carboxylic acid (-COOH) i.e. they are bi functional.

Classification of Amino acids: Depending on the location of the amino group on carbon chain, that contains the carboxylic acid functional group, amino acids are classified as α, β, γ and δ etc.

- Though there are more than 700 different amino acids that occur naturally, only 20 of them are important.
- When proteins are hydrolysed only α – amino acids are obtained.
- The general formula of α -amino acids is

$$R-CH(NH_2)-COOH$$

Examples of α – amino acids are:



Glycine **Alanine**

Examples of β – amino acids are:

$H_2N-\overset{\beta}{C}H_2-\overset{\alpha}{C}H_2-COOH$

β -amino propionic acid

$H_2N-\underset{\beta}{CH}(CH_3)-\overset{\alpha}{C}H_2-COOH$

β -amino butyric acid

Examples for γ -amino acids are

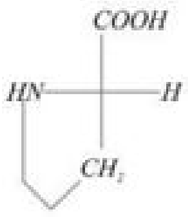
$H_2N-\overset{\gamma}{C}H_2-\overset{\beta}{C}H_2-\overset{\alpha}{C}H_2-COOH$

γ -amino butyric acid

$H_2N-\underset{\gamma}{CH}(CH_3)-\overset{\beta}{C}H_2-\overset{\alpha}{C}H_2-COOH$

γ -amino pentanoic acid

Out of numerous amino acids, α – amino acids contain primary amino group except proline which contains secondary amino group.



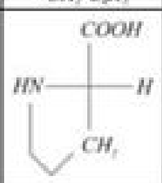
II. Based on the relative number of NH_2 and $COOH$ groups.

- The amino acids containing equal number of $-NH_2$ and $-COOH$ are called **neutral amino acids**.
  ex: Glycine
- If amino groups are more it is basic
  ex: Lysine, Arginine
- If carboxylic groups are more it is acidic in nature.
  ex: Asparticacid, Glutamic acid.

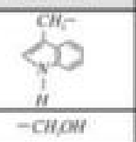
III. Based on the source

- The amino acids, which can not be synthesized, in the body but can only be supplied to the body. through diet, are called **"essential amino acids"**.
  They are valine, Leucine, Isoleucine, Arginine, Lysine, Threonine, Methionine, Phenylalanine, Tyrptophan and Histidine.
- The amino acids, which are synthesized in the body, are known as **"non – essential amino acids".**
- Nearly all the naturally occurring amino acids are α -amino acids containing amino group on the -carbon bonded to the carboxylic group.
- **NOMENCLATURE:** Amino acids are known by their common names and abbreviated by first three letters or one letter symbol of their common names.

Amino acids with non polar side chain are

Amino Acids	Characteristic of side chain	General symbol	One letter code
1.Glycine	H	Gly	G
2.Alanine	$-CH_3$	Ala	A
3.Valine	$-CH(CH_3)_2$	Val	V
4.Leucine	$-CH_2-CH(CH_3)_2$	Leu	L
5.Iso Leucine	$-CH(CH_3)-CH_2-CH_3$	Ile	I
6.Phenylalanine	$-CH_2-C_6H_5$	Phe	F
7.Proline		Pro	P

Amino acids with polar but neutral side chain are

Amino Acids	Characteristic of side chain	General symbol	One letter code
1.Tyrptophan		Trp	W
2.Serine	$-CH_2OH$	Ser	S
3.Threonine	$-CH(OH)-CH_3$	Thr	T
4.Glutamine	$-CH_2CH_2\overset{O}{\overset{\|}{C}}-NH_2$	Gln	Q
5.Aspargine	$-CH_2\overset{O}{\overset{\|}{C}}-NH_2$	Asn	N
6.Cysteine	CH_2SH	Cys	C
7.Methionine	$-CH_2-CH_2-SCH_3$	Met	M
8.Tyrosine	$-CH_2-C_6H_4-OH$(Para)	Tyr	Y

Amino acids with basic side chain are

Amino Acids	Characteristic of side chain	General symbol	One letter code
1.Histidine		His	H
2.Arginine	$-(CH_2)_3-NH-\overset{}{\underset{\|}{C}}=NH$ NH_2	Arg	R
3.Lysine	$-(CH_2)_4-NH_2$	Lys	K

Amino acids with acidic side chain are

Amino Acids	Characteristic of side chain	General symbol	One letter code
2. Glautamic acid	$-CH_2-CH_2-COOH$	Glu	E
3. Aspartic acid	$-CH_2-COOH$	Asp	D

Physical Properties of α – amino acids

The simplest amino acid is glycine. Its IUPAC name is "2-amino ethanoic acid".

They are generally colourless crystalline solids.

These are water soluble, high melting solids and behave like salts rather than carboxylic acids or simple amines.

Except glycine, all other naturally occurring α amino acids are optically active due to asymmetry at α – Carbon.

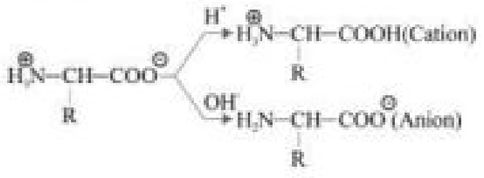
Most of the naturally occurring amino acids are with L –Configuration

They are highly polar and in aqueous solution they form zwitter ions.

$$H_2N-CH(R)-COOH \xrightarrow{H_2O} \overset{\oplus}{H_3}N-CH(R)-COO^{\ominus}$$

(zwitter ion)

d) In acidic solution, they form +ve ion and in basic solution they form –ve ion.



e) At a particular P^H, the dipolar ion acts as neutral ion (iso electric point)

- At a particular P^H, the dipolar ion of amino acid (zwitterion) acts as neutral ion and does not migrate to cathode 'or' anode in electric field. This p^H is known as iso electric point of the amino acid"

The isoelectric point of neutral amino acid is calclated by $P_I = \frac{PK_{a_1} + PK_{a_2}}{2}$

All amino acids do not have same isoelectric point.

An amino acid having more COOH groups will have $P_I < 7$.

An amino acid having more NH_2 groups will have $P_I > 7$.

Ex: alanine $\overset{\oplus}{H_3}N-CH(CH_3)-COO$

COOH $p^{K_a} = 2.34$

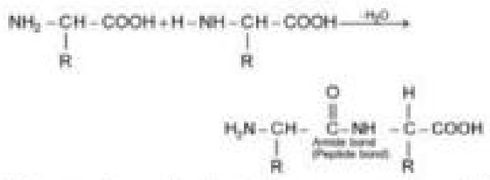
NH_3^+ $p^{K_a} = 9.69$

then $P_I = \frac{2.34 + 9.69}{2} = 6.02$

JEE MAIN Special

- The iso electric point depends on different groups present in the molecule of the amino acid.
- In neutral amino acids the P^H range is 5.5 to 6.3
- At iso electric point, amino acids have least solubility. So it is used in the separation of different amino acids obtained from the hydrolysis of proteins.

Peptide bond: The amide bond formed between the amino group of one amino acid and the carboxylic group of another amino acid by the loss of water is called a peptide bond.



- The product obtained from two amino acid molecule through peptide bond is called dipeptide.
- Based on number of amino acid molecule in peptide they are called tri, tetra and polypeptides.
- No of peptide linkages =
  [(no of aminoacid residues) -1]
- Shorter peptides (2 - 20 amino acids) are called oligopeptides, longer peptides (more than 20 amino acids) are polypeptides.
- Proteins are polypeptides containing many amino acids molecular mass is more than 10,000. (Polypeptides contains more than 100 amino acids)
- Polypeptides are amphoteric.
  Ex: Silk, hair, skin, enzymes, hormone etc
- In a polypeptide structure free amino group (NH_2) i.e. N- terminal residue is written on the left hand side and the free carboxyl group on the right hand side of the chain.

$$H_2N-\underset{CH_3}{CH}-\overset{O}{\overset{\|}{C}}-NH-CH_2-\overset{O}{\overset{\|}{C}}-NH-\underset{CH_3}{CH}-COOH$$

alanine glycine alanine

The above structure has the name **alanylglycylalanine.**

In the above structure -COOH group is C- terminal residue and $-NH_2$ group is N-terminal residue.

Most of the toxins in animal and plant venoms are proteins. A dipeptide called aspartame being 100 times sweeter to sucrose is used as substitute for sugar.

Aspartame
(aspartyl phenylalanine methyl ester)

- **The number of peptides possible for using different amino acids $= n^m$.**
  Here n is the no.of amino acids, m is 2 for dipeptide, 3 for tri peptide, 4 for tetra peptide, etc.

Ex: The number of tripeptides possible with three amino acids is $3^3 = 27$.

Ex: If there are 100 aminoacid units in a small protein, the given 20 different amino acid units can combine at one time in $(20)^{100}$ different ways.

Proteins: Proteins are the most abundant biomolecules of the living system. Main sources are milk, fish,, meat, peanuts, cheese, pulses etc..

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- Proteins are occur in every part of the body and form the fundamental basis of structure and functions of life.
- Proteins are required for growth and maintenance of body.
- Proteins are biopolymers having a large number of amino acids bonded to each other by Peptide bonds and disulphide bonds and have three dimensional structures.
- Generally Proteins can be classified into two types on the basis of their molecular shape

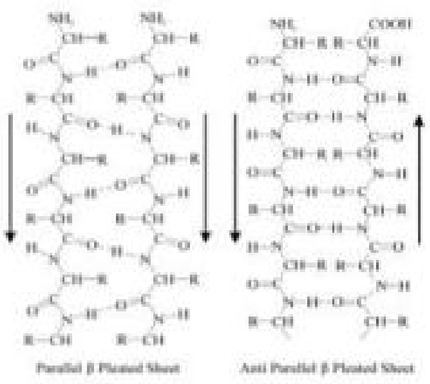
1. **Fibrous proteins:** In this proteins polyeptide chains run paralally and are held together by disulphide and H – bonds produce fibre like structure. These are insoluble in water
   Ex:- Keratin (present in Skin, Hair, Silk, Tissues etc..), myosin (present in muscles).
2. **Globular proteins:** In this proteins polypeptide chains coil around give spherical shape. These are soluble in water
   Ex:- Insulin, albumin and haemoglobin.

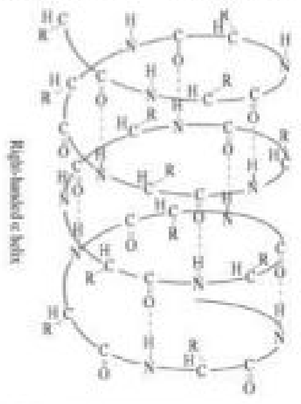
Structure of Proteins: Based on structure and shape proteins are studied into four different levels

1. Primary 2. Secondary
3. Tertiary and 4.Quarternary structures

Primary structures: For a given polypeptide, amino acids are linked with each other in a specific sequence. This is considered as primary structure of that poly peptide.

- Any change in this sequence produces a different protein.
- Primary structure indicates the location of disulphide bridges if present.





Secondary structure: The secondary structure of protein explains the shape of polypeptide change.

- Two different secondary structure of protiens are α – helix and β – pleated sheet structure.