

# Nutrition

## Nutrition

Nutrition is a process of intake as well as utilization of nutrients by an organism. It is the process of breakdown of nutrients into smaller molecules and their absorption. Food provides us nutrition and energy. It contains different types of nutrients in varying amounts according to the need of our body.

- (a) Nutrients: These are the substances required by our body for its growth, repair, work and maintenance of the body. Different types of nutrients are carbohydrates, fats, proteins, vitamins, minerals etc. Our daily energy need may vary according to our occupation, age, sex and under some specific conditions.

## Modes of nutrition

There are several modes of nutrition on the basis of which organisms are classified as follows:

### Nutrition

#### Autotrophic

They are able to synthesize their own food.

#### Heterotrophic

They are not able to synthesize their own food.

#### Autotrophic:

(Auto = self, trophic = food) It is a mode of nutrition in which organisms prepare their own food. Inorganic molecules like  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are converted into organic molecules like carbohydrates in the presence of sunlight and chlorophyll. E.g. Green plants. Autotrophs are further categorized as:

- (i) Photoautotrophs: Those which utilize sunlight for preparing their food
- (ii) Chemoautotrophs: Those which utilized chemical energy for preparing their food.

#### (a) Heterotrophic:

(Hetero = different; trophic = food) It is a mode of nutrition in which organisms derive their food from some other animals or plants. They cannot prepare their own food e.g. human being. Heterotrophs are further categorized depending on the nature of food they consume:

- (i) Herbivores: Animals which eat only plants, e.g. Cow, goat etc.
- (ii) Carnivores: They feed on flesh of other animals, e.g. Lion, vulture etc.

- (iii) Omnivores: They feed on plants and animals both, e.g. Dog, human etc.
- (i) Detritivores: Feed on detritus or dead organic remains, e.g. Earthworm etc.
- (ii) Sanguivorous: Feed on blood e.g. Leech, female mosquito etc.
- (iii) Frugivorous: Feed on fruits, e.g. Parrot etc.
- (iv) Insectivores: Feed on insects, e.g. Bats etc.
- (b) On the basis of mode of feeding organisms are Categorized As:
  - (i) Holozoic: They ingest mostly solid but sometimes liquid food e.g. Amoeba, human etc.
  - (ii) Saprotrophic: They absorb organic matter from dead and decaying organisms with the help of their enzymes. E.g. Bacteria, fungi etc.
  - (iii) Parasitic: They derive their nutrition from other living plants or animals. E.g. Plasmodium, round worms etc.

Nutrition can be divided into two Categories on the basis of occurrence

Nutrition in plants

Nutrition in animals

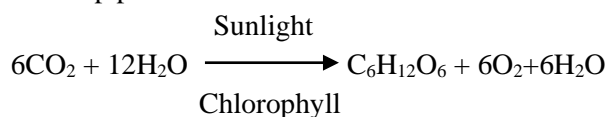
## Nutrition in plants

- Plants are autotrophic in nature. They prepare their own food hence they are called as producers.
- They contain a green pigment called chlorophyll which can entrap solar energy which is then converted into chemical energy in the form of food and the process is called as "photosynthesis".

#### (a) Photosynthesis:

(i) Definition: The synthesis of organic compounds like glucose from simple inorganic molecules like  $\text{CO}_2$  and  $\text{H}_2\text{O}$  by the cells of green plants having chlorophyll in the presence of sunlight is called as photosynthesis.

(ii) Equation of photosynthesis: Photosynthesis is a two step process.



(A) Light reaction: ATP, NADPH<sub>2</sub> and O<sub>2</sub> are produced.

(B) Dark reaction: CO<sub>2</sub> & H<sub>2</sub>O are converted into glucose.

- Photosynthesis essentially requires two things:
  - (i) Sunlight:
- For Plants sun is the basic source of radiant energy.
- Visible part of electromagnetic radiations of sun ranges from 390 nm to 760 nm.
- Maximum photosynthesis occurs in red region.
- There is minimum photosynthesis in green region because green parts of plants reflect whole of the green light.

(ii) Chlorophyll: These are the green pigments present in chloroplast. They are found in green leaves in a maximum amount as well in other green aerial parts of plant. There are six different types of chlorophyll, they are chlorophyll a, b, c, d, e, and bacteriochlorophyll, amongst them chlorophyll a and chlorophyll b are the most commonly occurring chlorophylls.

- Besides chlorophyll certain other pigments are also present in plants like.

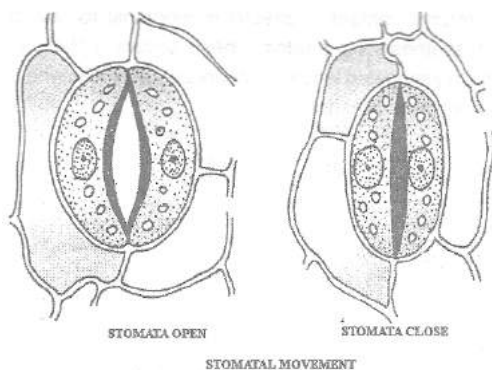
(i) Carotenes: Orange in colour e.g. Carrot.

(ii) Xanthophylls: Orange yellow in colour e.g. Maize.

(i) Phycobilins: Different colours like red, violet e.g. Blue-green algae, brown algae etc.

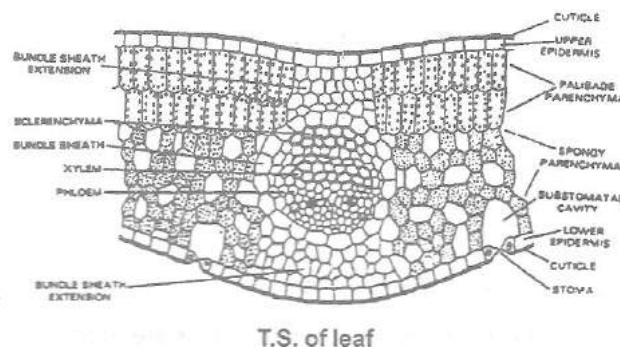
#### **Raw Materials of Photosynthesis:**

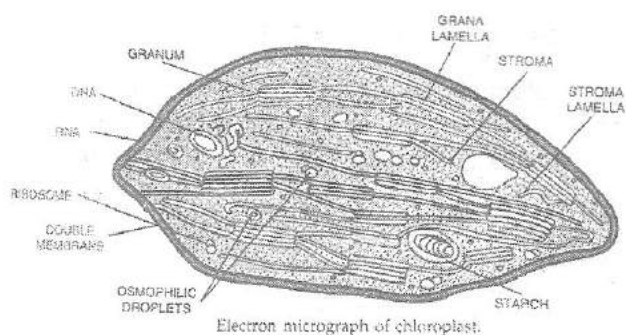
(i) **Carbondioxide:** Terrestrial plants obtain carbon dioxide from the atmosphere through the small openings present on leaves called as stomata. Aquatic Plants obtain CO<sub>2</sub> dissolved in water through their general body surface so they perform more photosynthesis than terrestrial plants.



(ii) **Water:** Plants absorb water from the soil by the process of osmosis. This water is transported to leaves by a special type of tissue called as xylem.

- Plants utilize carbon dioxide during photosynthesis, the intensity of light at which amount of CO<sub>2</sub> used during photosynthesis becomes equal to the amount of CO<sub>2</sub> released during respiration by plants is called as Compensation point.
- Compensation point occurs at low light intensity that is during morning and during evening hours.
- Site of photosynthesis: Site of photosynthesis is different in prokaryotes and eukaryotes.
- In prokaryotes: Photosynthesis occurs in lamellar chromatophores:
- In eukaryotes: Photosynthesis occurs in chloroplast
- Exception: Fungi (It lacks chlorophyll so no photosynthesis occurs).
- In higher plants chloroplast is the main site of photosynthesis.
- Chloroplast is also called as green plastid.
- Plastids are of three types on the basis of pigments present in them.
  - (i) Leucoplast: white in colour, found in underground parts, lacks any coloured pigment. Helps in storage of protein (Aleuroplast), oil (Elaioplast), starch (Amyloplast)
  - (ii) Chromoplast: colour other than green, found in aerial parts of the plants.
    - (i) Chloroplast: Contain green pigment, called as chlorophyll.
- Chloroplast was discovered by Schimper.
- Chloroplast also have variable shapes, for example cup shaped, ribbon shaped etc. in algae while it is discoidal in higher plants.





- A typical structure of chloroplast is a double membranous structure having two parts.

(i) Grana: It is a lamellar system consisting of stacks of granum lamella each bounded by a membranous box called as thylakoid. They are 40-60 per cell. Number of thylakoids per grana is 50 or more. Chlorophyll molecules are found inside the thylakoid membrane where they trap solar energy in the form of small energy packets called 'photons' or 'quanta'. Grana are interconnected to each other by a channel called as stroma lamellae or Fret's channel.

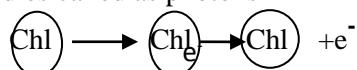
(ii) Stroma: It is a non pigmented proteinaceous matrix in which grana remain embedded. It contains enzymes for dark reaction.

- Mechanism of photosynthesis:

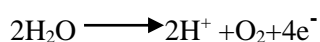
(i) Light reaction:

- It is also called as photochemical process.
- It was discovered by → 'Robert Hill' therefore it is also called as Hill's reaction.
- Site: Grana of Chloroplast.
- Raw materials: Light and water.
- Regulation: This process is regulated by chlorophyll molecule.
- It consists of three steps:

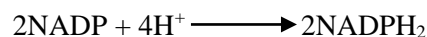
(A) Photo excitation of chlorophyll II Molecule: During this process chlorophyll molecule receives sunlight in the form of small energy bundles called as photons



(B) Photolysis: It is also called as photooxidation of water, this takes place in presence of  $\text{Mn}^{+2}$  and  $\text{Cl}^-$  ions.



$\text{O}_2$  is liberated as by product and  $\text{H}^+$  ions are used for reduction of NADP



(C) Photophosphorylation: During this process ATP are produced. It takes place in quantasomes.  $\text{Mg}^{+2}$  ions and inorganic phosphate is required to convert



(i) Dark reaction:

- It is also called as thermo chemical reaction.
  - It was discovered by Melvin calvin and benson therefore it is also called as Calvin cycle.
- Site = Stroma of chloroplast.

- Raw materials: They require  $\text{CO}_2$ ,  $\text{NADPH}_2$ , ATP and Enzymes.
- Regulated by: Light reaction and enzymes.
- It involves three basic steps:

(A) Carboxylation: In this step  $\text{CO}_2$  is captured by  $\text{CO}_2$  acceptors like RUBP ( $\text{C}_3$ Plants) PEP ( $\text{C}_4$ Plants) with the help of carboxylase enzyme i.e. RUBISCO & PEPCO respectively.

(B) Synthesis: In this phase captured  $\text{CO}_2$  is assimilated into glucose in the presence of phosphated into glucose in the presence of phosphatase and isomerase enzymes and RUBP is regenerated back.

(C) Regeneration of RUBP

### Factors Affecting photosynthesis

(a) Light:

Normally plants utilize sunlight but marine algae can perform photosynthesis even in the moon light. Plants can also perform photosynthesis in the artificial lights.

- Highest rate of photosynthesis: Red light
- Minimum photosynthesis: Green light

(b) Temperature:

Optimum range =  $25^\circ\text{C}$  to  $30^\circ\text{C}$  It ranges from  $10^\circ - 40^\circ\text{C}$

In some forms like algae of hot spring →  $60^\circ - 70^\circ\text{C}$  is normal.

(c) Carbon dioxide:

In the atmosphere concentration of  $\text{CO}_2 \propto$  rate of photosynthesis.

(d) Oxygen:  $\text{O}_2$  acts as competitive inhibitor of  $\text{CO}_2$ . Over concentration of  $\text{O}_2$  stops photosynthesis.

(e) Chlorophyll:

Chlorophyll content is directly proportional to rate of photosynthesis. No photosynthesis occurs in etiolated cells, In variegated leaves it occurs only at places where chlorophyll is present.

### Significance of photosynthesis:

- (i) Production of food material
- (ii) Atmospheric control and purification of air.

### Nutrition in Animals

- In unicellular organisms a single cell is responsible for carrying out all the vital activities.
- In multi cellular organisms a well develop digestive systems present.
- Animals have highly evolved digestive mechanism that includes two basic components:
- Alimentary canal: Long, hollow, tubular structure consisting of various organs for digestion.
- Digestive glands: They secrete enzymes/ hormones which help in digestion.
- Digestion in animals consists of following steps
- Ingestion: The process of intake of food.
- Digestion: It is the breakdown of large and complex molecules into simpler, smaller and soluble forms.
- Absorption: Taking up of the digested through intestinal wall to blood.
- Assimilation: In this process absorbed food is used by body cells.
- Egestion: The process by which undigested matter is expelled out.
- Digestive system is regulated by various hormones secreted by some endocrine glands.
- Alimentary canal was first of all developed in the phylum platyhelminthes but only mouth was present in them.
- Coiled and well developed alimentary canal was developed in annelida till mammals.

### Nutrition in Humans

- Humans have highly evolved any complicated digestive system consisting of an alimentary canal and different types of digestive glands.
- Alimentary canal consists of following organs:
- (a) Mouth:

It is a small slit through which food is ingested.

#### (b) Buccal Cavity:

Mouth opens into a chamber called as buccal cavity. Roof of buccal cavity is called hard palate. At the floor of this cavity thick. Muscular structure is present called tongue. It helps in chewing, swallowing, tasting and speaking. Tongue has various types of papilla having taste buds.

- Jaws present in buccal cavity are provided with four different types of teeth:

- |                 |   |              |
|-----------------|---|--------------|
| (i) Incisors    | : | For cutting  |
| (ii) Canines    | : | For tearing  |
| (iii) Premolars | : | For grinding |
| (iv) Molars     | : | For grinding |

- Dental formula of humans:

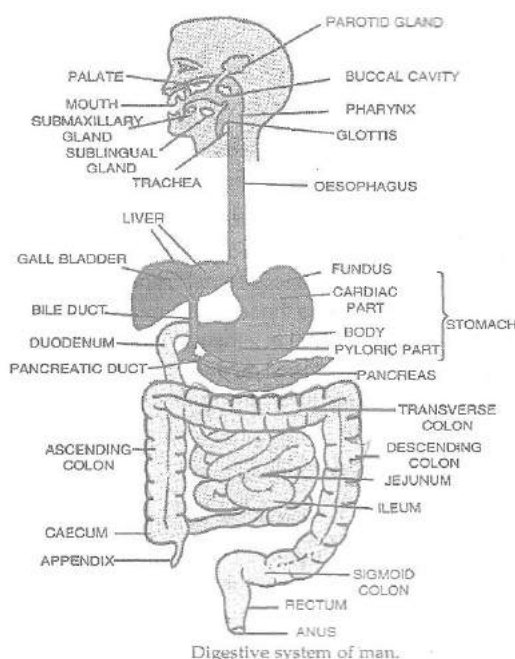
- (a) Milk teeth These are temporary, arise at 6-11 month age, 20 in number

$$\frac{\text{Each half of upper jaw}}{\text{Each half of lower jaw}} = \frac{2102}{2102}$$

- (b) Permanent teeth → arise at 6-12 years, 32 in number

$$\frac{\text{Each half of upper jaw}}{\text{Each half of lower jaw}} = \frac{2123}{2123}$$

- Three pairs of salivary glands are found in mouth which release their secretions into the buccal cavity. They secrete salivary amylase for starch digestion. So digestion of starch starts from mouth.



**(c) Oesophagus:**

Also called as food pipe. It leads the food from mouth to stomach. Oesophagus has highly muscular walls, no digestion occurs here.

**(d) Stomach:**

It is a 'J' shaped bag present on left side of abdomen. It contains several branched and tubular glands present on the inner surface of its wall, which secrete gastric juice.

**(e) Small Intestine:**

It is a coiled and narrow tube having 3 regions: duodenum jejunum ileum.

- On the inner wall of small intestine numerous finger like projections are found which are called as villi, they increase the surface area of absorption.

**(f) Large Intestine:**

Small intestine opens into large intestine from where the undigested food material is passed to anus through rectum. It is divided into three parts:

**(i) Caecum**

**(ii) Colon**

**(iii) rectum**

**(g) Digestive Glands:**

(i) Salivary glands: 3 pairs of salivary glands are found in mouth cavity. It helps in chemical digestion. They secrete an enzyme called salivary amylase or ptyalin. It helps in digestion of starch.

(ii) gastric glands: present in stomach. They secrete hydrochloric acid, protein digesting enzymes and mucus.

- (ii) Liver: It is the largest gland, secretes bile into the small intestine. Bile contains bile juice and bile pigments. Bile is alkaline in nature and it is temporarily stored in gall bladder and helps in digestion of fats, it also helps in absorption of fats.

- (iii) Pancreas: It lies parallel to and below the stomach. It secretes pancreatic juice into small intestine. Pancreatic juice contains trypsin and pancreatic amylase. Besides these 2 enzymes pancreas secretes 2 hormones also i.e:- insulin and glucagon so it has both exocrine as well as endocrine functions. Both bile and pancreatic

juice are released into the duodenum by a common duct.

**(a) Digestion process:**

This system involves following processes:

(i) Ingestion: Intake of food is done through mouth, food is then chewed and masticated and sent to oesophagus through pharynx by swallowing.

(ii) Digestion: Saliva secreted in buccal cavity starts digestion of starch into maltose. This partly digested food is then passed to stomach by oesophagus through peristaltic movement. Food is churned in stomach for about three hours and broken down into smaller pieces. Due to presence of hydrochloric acid, medium of stomach becomes acidic. In acidic medium protein digestive enzyme pepsin breaks down proteins into peptones, Gastric lipases is also secreted here which partially breaks down lipids.

- Now the partly digested food moves to small intestine i.e. in the duodenum. Duodenum receives the secretion from liver and pancreas through a common duct they are bile and pancreatic juice, and alkaline in nature. So the digestion and emulsification of fats occurs at this place.
- Here in the duodenum fats are emulsified by bile, remaining proteins are digested by trypsin and starch by pancreatic amylase.
- Note: Duodenal wall secretes bicarbonate ions which make the medium alkaline.
- This partially digested food now enters in the ileum where intestinal juice i.e. "Succus entericus" is secreted.
- At this place digestion is completed.

Carbohydrates → Glucose.

Proteins → Amino.

Fats → Fatty acids and glycerol.

(iii) Absorption: After digestion molecules are broken down into simple water soluble forms now they are to be utilized, So they pass through the wall of small intestine which contains blood capillaries and enters into the blood. For absorption of fat lymph capillaries are present called as lacteals. Here wall of small intestine

have tiny finger like projections called villi, they increase the surface area for absorption.

(iv) Assimilation: The process of utilization of food is called assimilation, the nutrients dissolved in blood are carried to all of the body where they are utilized.

(a) For building up and replacement of cells.

(b) For obtaining energy. This energy is released by the process of oxidation during respiration.

(iv) Egestion: The undigested food is then collected in large intestine where water is absorbed and remaining waste is expelled out or egested through anus.

### EXERCISE

- Trypsin digests protein in-
  - Stomach in acidic medium
  - Stomach in alkaline medium
  - Duodenum in acidic medium
  - Duodenum in alkaline medium
- Holophytic nutrition means-
  - Autotrophism
  - heterotrophism
  - symbiotism
  - parasitism
- Which of the following has no digestive enzyme?
  - Saliva
  - Bile
  - Gastric juice
  - Intestinal juice
- The main organ for digestion and absorption of food is-
  - Large intestine
  - Small intestine
  - Stomach
  - liver
- Liver helps in-
  - Digestion of food
  - Detoxification
  - Secretion
  - All of these
- Food pipe is the another name of-
  - Oesophagus
  - (b) Bile duct
  - Salivary Gland
  - Pancreatic duct
- Total number of canines in permanent dental set of human is-
  - 4
  - 6
  - 2
  - 12

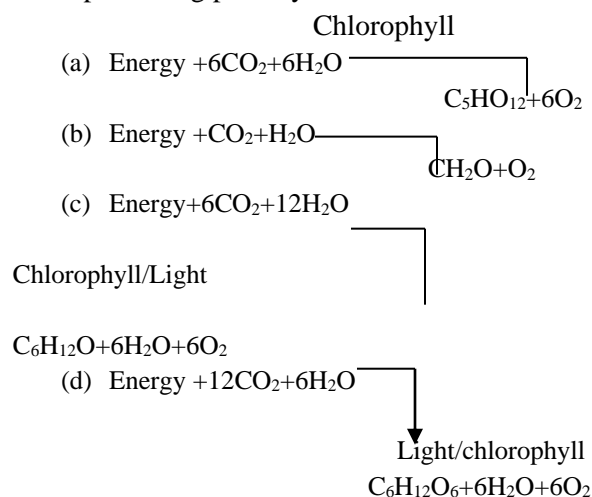
8. Starch is digested by-

- Peptidase
- Amylase
- Lipase
- proteinase

9. Chlorophyll in chloroplasts is located in-

- Grana
- pyrenoid
- Stroma
- none of these

10. Which of the following is the best equation representing photosynthesis?



11. The pigments found in plants are-

- Carotenes
- xanthophylls
- Chlorophyll
- All of the above

12. In which part of chloroplast light reaction of photosynthesis occurs?

- Grana
- Stroma
- Matrix
- All of the above

13. The oxygen evolved in photosynthesis comes from-

- $\text{CO}_2$
- Water
- temperature
- all of the above

14. The raw materials for photosynthesis are-

- $\text{CO}_2$  &  $\text{O}_2$
- Sunlight and  $\text{CO}_2$
- Water and chlorophyll
- $\text{CO}_2$  and water

15. Plants are green in colour because-

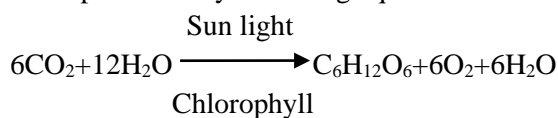
- They absorb green light only
- They reflect green light
- They absorb green light but reflect all other lights
- None of the above are correct

16. Bile is produced by- (NTSE Stage-I/Raj./2007)

- (a) Stomach (b) Liver  
(c) Gall bladder (d) pancreas

Note:-

17 to 21 Read the passage given below and answer the questions no. 17 to 21. Animals can't produce their food themselves, They obtain their food from green plants. Where as green plants are capable to convert solar energy into chemical energy for the production of food. This process is represented by following equation.



17. The process represented by above equation is-

(NTSE Stage-I/Raj./2007)

- (a) Photosynthesis  
(b) Reduction of Carbohydrate  
(c) Respiration  
(d) Protein synthesis

18. The gas produced in above process are-

(NTSE Stage-I/Raj./2007)

- (a) Oxygen (b) Carbon di oxide  
(c) Water vapour (d) All above

19. The essential factors for above process are-

(NTSE Stage-I/Raj./2007)

- (a) Temperature and Cytoplasm  
(b) Sunlight and chlorophyll  
(c) Chlorophyll and Humidity  
(d) Sunlight and Air

20. This process is stopped at night because-

(NTSE Stage-I/Raj./2007)

- (a) CO<sub>2</sub> increases  
(b) O<sub>2</sub> decreases  
(c) Water is not transported

(d) Sunlight is not available

21. In which substance the chemical energy is stored by the above process?

(NTSE Stage-I/Raj./2007)

- (a) O<sub>2</sub> (b) CO<sub>2</sub>  
(c) C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> (d) H<sub>2</sub>O

22. The Process of photosynthesis in green plants involves- (NTSE Stage-I/Raj./2008)

- (a) Intake of nitrogen and release of oxygen  
(b) Intake of oxygen and release of nitrogen  
(c) Intake of carbon dioxide and release of oxygen  
(d) Intake of oxygen and release of carbon dioxide

23. Some body system and the related part of system are given in column P & Q

(NTSE Stage-I/Raj./2008)

P	Q
(1) Digestive system	(i) Kidney
(2) Circulatory system	(ii) Stomach
(3) Excretory system	(iii) Arteries
(4) Reproductive system	(iv) Fallopian tube

The correct option is-

- (a) 1 (i) 2 (ii) 3 (iii) 4 (iv)  
(b) 1 (ii) 2 (iv) 3 (i) 4 (iii)  
(c) 1 (iii) 2 (i) 3 (ii) 4 (iv)  
(d) 1 (ii) 2 (iii) 3 (i) 4 (iv)

24. The complex substances of food in humans are broken down into simple ones with the help of digestive juices secreted by-

(NTSE Stage-II/2008)

- (a) Rectum, Pancreas and small Intestine  
(b) Salivary gland, Liver and pancreas  
(c) Liver, Oesophagus and Large Intestine.  
(d) Salivary gland, Appendix and Duodenum

## ANSWER - KEY

### NUTRITION

Q.	1	2	3	4	5	6	7	8	9	10
A.	D	A	B	B	D	A	A	B	A	C
Q.	11	12	13	14	15	16	17	18	19	20
A.	D	A	B	D	B	B	A	A	B	D
Q.	21	22	23	24						
A.	C	C	D	B						