

# Biology

Academic Year: 2012-2013

Marks: 70

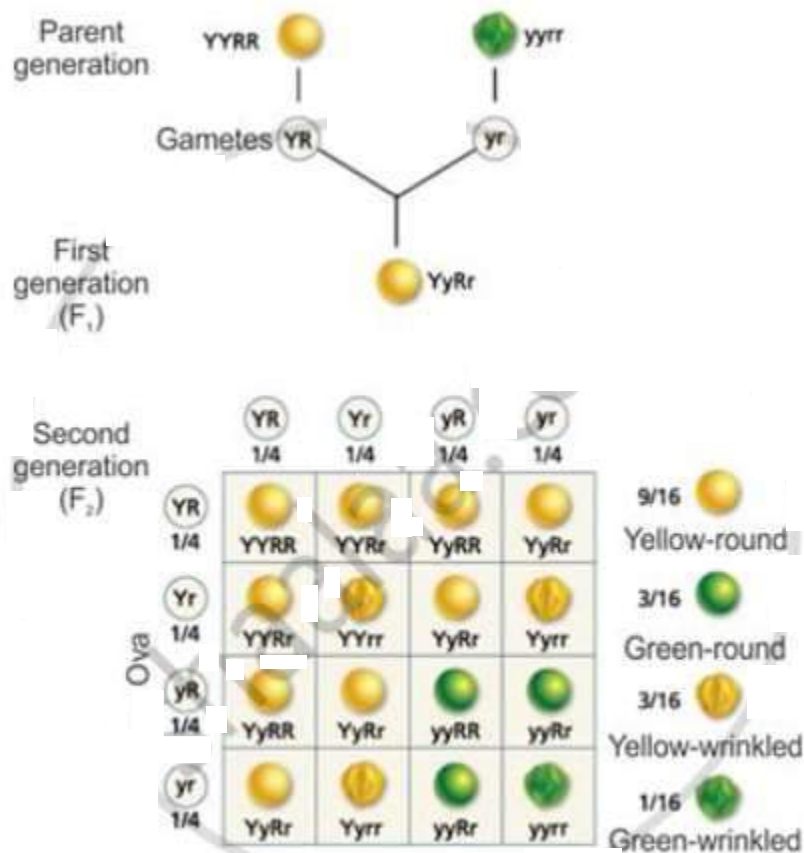
Date: October 2012

## Question 1: Attempt any one

[7]

**Question 1.1:** Work out a typical Mendelian dihybrid cross and state the law that he derived from it. [7]

**Solution:** Mendel derived 'the law of independent assortment' from a dihybrid cross. This law states that the two factors of each character assort or separate independently of the factors of the other characters at the time of gamete formation and get randomly rearranged in the offspring producing both parental and new combinations of traits.



Y = dominant allele for seed colour (yellow)  
y = recessive allele for seed colour (green)  
R = dominant allele for seed shape (round)  
r = recessive allele for seed shape (wrinkled)

**Question 1.2:** What is Bacteriophage? [7]

**Solution:** Bacteriophage is virus that infects the bacteria.

**Question 2: Select and write the most appropriate answer from the given alternatives for each sub-question:** [7]

**Question 2.1:** Which one of the following is an example of multiple alleles? [1]

- (a) Height in pea plant
- (b) Hair colour in cattle
- (c) Petal colour in four o'clock plant
- (d) Wing-size in Drosophila

**Solution:** (d) Wing-size in Drosophila

**Question 2.2:** The harmful radiations absorbed by the ozone layer are\_\_\_\_\_ [1]

- (a) X-rays
- (b) visible light
- (c) Ultraviolet (UV) rays
- (d) gamma rays

**Solution:** Ultraviolet (UV) rays

**Question 2.3:** The micro-organism used in the production of acetic acid is\_\_\_\_\_ [1]

- (a) Aspergillus niger
- (b) Rhizopus arrhizus
- (c) Neurospora gossypii
- (d) Acetobacter aceti

**Solution:** Acetobacter aceti

**Question 2.4:** The adenosine triphosphate (ATP) gain during glycolysis, connecting link and Krebs' cycle respectively are \_\_\_\_ [1]

- (a) 8, 6, 24
- (b) 8, 24, 6
- (c) 24, 8, 6
- (d) 6, 8 24

**Solution:** 8, 6, 24

**Question 2.5:** Guano deposits are rich in \_\_\_\_\_ [1]

- (a) sulphur
- (b) phosphorus

- (c) calcium
- (d) magnesium

**Solution:** phosphorous

**Question 2.6:** How many meiotic divisions are required for the formation of 100 seeds?  
[1]

- (a) 25
- (b) 50
- (c) 100
- (d) 125

**Solution:** 125

**Question 2.7:** During fertilisation male gamete are carried by pollen tube. This is called  
[1]

- (a) syngamy
- (b) siphonogamy
- (c) mesogamy
- (d) polygamy

**Solution:** siphonogamy

**Question 3.1: Answer in 'ONE' sentence each :** [6]

**Question 3.1.1:** Define 'microsporogenesis'. [1]

**Solution:** The process of formation of microspores from microspore mother cell through meiotic cell division is called as 'microsporogenesis'.

**Question 3.1.2:** Define 'Greenhouse effect'. [1]

**Solution:** The heating-up of earth's atmosphere due to trapped infrared rays reflected from earth surface by atmospheric gases is called greenhouse effect.

**Question 3.1.3:** Name any two edible mushrooms. [1]

**Solution:** Edible mushroom are:

- a. White button mushroom (*Agaricus bisporus*)
- b. Paddy straw mushroom (*Volvariella volvacea*)
- c. Oyster mushroom (*Pleurotus florida*)

**Question 3.1.4:** Name the reactions when  $\alpha$ -ketoglutarate is converted to succinyl Co-A in Krebs' cycle [1]

**Solution:** Oxidative decarboxylation.

**Question 3.1.5:** What is amphimixis? [1]

**Solution:** Amphimixis (amphi=both; mixis=mixing):

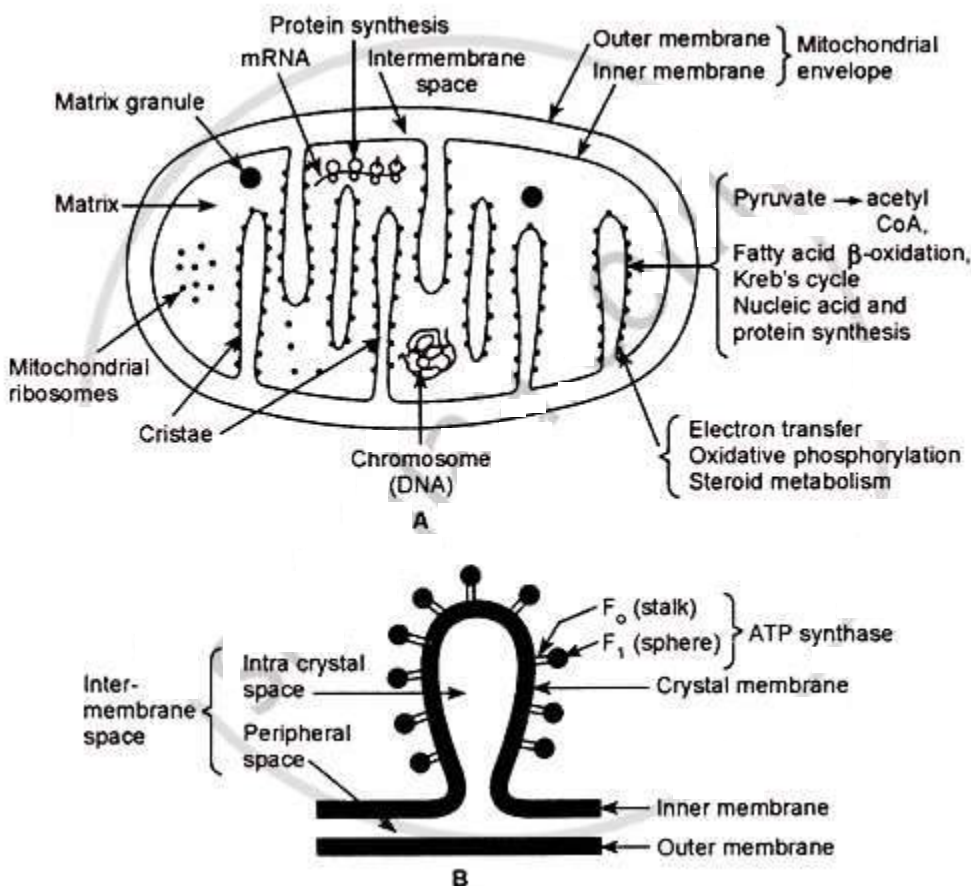
It involves mixing or fusion of genetic material of male and female gametes. The offsprings produced are not identical to parents. They show genetic variation.

**Question 3.1.6:** What is heterocyst? [1]

**Solution:** The Blue Green Algae (BGA) have some specialized colourless cells called heterocysts which are the sites of nitrogen fixation.

**Question 3.2:** Sketch and label the 'Ultrastructure of Mitochondrion'. [6]

**Solution:** Mitochondrion



**Question 3.3:** Attempt Any TWO of the following: [4]

**Question 3.3.1:** Give advantages of single cell protein (SCP). [2]

**Solution:** Advantages:

1. Spirulina serves as a good source of proteins (SCP).
2. These can be produced throughout the year.
3. Large quantities of SCP from very small land area can be obtained due to rapid growth of microbes.
4. Substrates used may be cheaper or even wastes.
5. Some SCPs are good sources of B-complex vitamins.
6. So SCP is expected to solve the problem of protein deficiency in the children of developing countries. (But SCP may contain toxic compounds produced by some microbes and may lead to indigestion and allergic reactions.)

**Question 3.3.2:** Explain the concept of primary productivity [2]

**Solution:** a. Primary productivity:

It can be defined as the rate at which solar energy is captured by producer for synthesis of energy rich organic molecules through photosynthesis.

It is again of two types:

1. Gross primary productivity (GPP)

It refers to total amount of organic matter (Biomass) produced during photosynthesis by producer. It is estimated in terms of either chlorophyll content as chl/g dry wt/unit area or photosynthetic numbers as CO<sub>2</sub> fixed/g chl/hour.

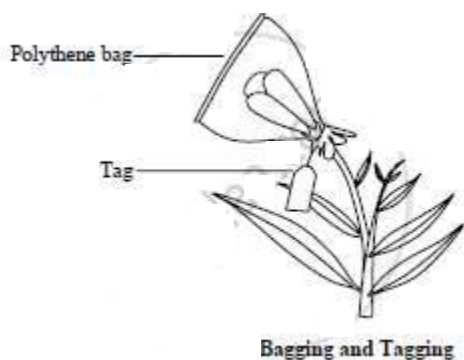
2. Net primary productivity (NPP)

It refers to the amount of organic matter stored by producer after meeting the loss by way of respiration. Net primary productivity= Gross primary productivity-Respiration rate.

**Question 3.3.3:** With the help of suitable diagram define 'bagging' and 'tagging' of flower. [2]

**Solution: Bagging:** During Hybridization, emasculated flowers are covered with butter paper or polythene bag of suitable size to prevent pollination by pollengrains of unwanted source. This is known as bagging.

**Tagging:** After dusting the pollen grains on stigma of emasculated flower, it is retagged and tag with relevant information such as date of emasculation, date of pollination, details of male and female parents, etc is attached with plants. This is known as tagging.



**Question 3.3.4:** Give advantages of self-pollination. [2]

**Solution:** Advantages of self-pollination:

- It is a sure method.
- Plants produced are genetically pure.
- No wastage of pollen grains, hence economical process.
- No expenditure of energy to develop devices for pollination.

**Question 4.1:** Attempt Any TWO of the following: [6]

**Question 4.1.1:** A heterozygous tall plant of pea is crossed with a dwarf plant of pea. [3]

Calculate the phenotypic ratio of the progeny.

**Solution:** When a heterozygous tall plant of pea (Tt) is crossed with a dwarf plant of pea (tt), it can be represented as follows;

Phenotype of Parents	→	Heterozygous Tall	×	Dwarf												
Genotype	→	Tt		tt												
Gametes	→	<table border="1"><tr><td>T</td><td>t</td></tr></table>	T	t	×	<table border="1"><tr><td>t</td></tr></table>	t									
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♀ \ ♂	T	t														
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t	tT Heterozygous tall	tt Homozygous dwarf														

In this cross, 50% offsprings are tall and 50% are dwarf.

Thus, phenotypic ratio of the progeny = 1 (Tall) : 1 (Dwarf)

**Question 4.1.2:** Distinguish between photosynthesis and aerobic respiration [3]

**Solution:**

No.	Photosynthesis	Aerobic respiration
1	It takes place in the cells containing chloroplasts.	It takes place in all living cells of higher organisms.
2	It occurs in chloroplast.	It occurs in cytoplasm and mitochondria.
3	It is an energy trapping process.	It is an energy releasing process.

4	It is an anabolic process.	It is a catabolic process.
5	This process requires CO <sub>2</sub> and H <sub>2</sub> O.	This process requires sugar and O <sub>2</sub> .
6	Light is necessary for photosynthesis.	Light is not necessary for aerobic respiration.
7	End products are carbohydrates and oxygen.	End products are CO <sub>2</sub> , H <sub>2</sub> O and energy.
8	Overall equation: $6\text{CO}_2 + 12\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2 \uparrow$	Overall equation: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{H}_2\text{O} + 6\text{CO}_2 + \text{Energy}$

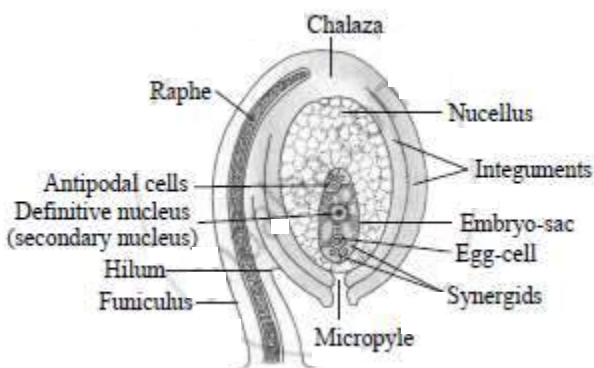
**Question 4.1.3:** What is photorespiration? [3]

**Solution:** Photorespiration:

Extra uptake of O<sub>2</sub> and extra release of CO<sub>2</sub> by green plants in presence of light is known as photorespiration. It is the respiration initiated in presence of light. The process takes place in chloroplast, peroxisome (micro body having single membrane) and mitochondrion.

**Question 4.2:** Sketch and label V. S. of mature anatropous ovule. [3]

**Solution: V. S. of mature anatropous ovule :**



**Question 5: Attempt any one** [7]

**Question 5.1:** Explain the process of formation of urine with suitable diagram [7]

**Solution:** This complex process is completed in 3 steps namely.

- Ultrafiltration
- Selective Reabsorption
- Tubular Secretion

a. Ultrafiltration:

Filtration of blood under pressure is called Ultrafiltration.

It takes place in Malpighian bodies.

It is physical process and occurs through the glomerulus under high osmotic pressure.

Ultra-pressure is developed in glomerulus due to difference in diameters of afferent and efferent renal arterioles.

Blood enters the glomerulus at a fast rate through afferent arteriole with greater diameter and drains away by efferent arteriole with smaller diameter at slower rate. This creates hydrostatic pressure within glomerulus. This is called effective filtration pressure (EFP).

The filtration takes place through semipermeable membrane or filtration membrane under pressure.

The ultra-filtrate enters the urinary space of Bowman's capsule. This filtrate is blood plasma without proteins (deproteinized plasma). About 125 ml of ultra-filtrate is produced per minute.

b. Selective reabsorption:

In this process 99% of the filtrate is reabsorbed.

There are two processes involved in this step: Passive transport or osmosis and active transport. Active transport is transport against the concentration gradient by using ATP molecules.

When the filtrate passes through the renal tubule there is exchange of substances between the blood in peritubular capillary network.

High threshold substances e.g. glucose, amino acids, potassium and calcium ions etc. are completely reabsorbed.

Urea and uric acid are low threshold substances. They are reabsorbed negligibly. Water is reabsorbed everywhere except in the ascending loop of Henle. This absorption occurs by osmosis and is known as obligatory absorption of water. Amino acids and ions are pumped out from PCT. Glucose is maximally reabsorbed in healthy persons so that no glucose molecules remain in the urine.

Urea is reabsorbed because urea molecule is very small and tubules are partially permeable to it.

**Question 5.2:** Describe the changes involved during gastrulation. [7]

**Solution:** Gastrulation: Formation of gastrula from blastula is known as gastrulation.

During gastrulation, three primary germinal layers ectoderm, mesoderm and endoderm are formed by morphogenetic movements and rearrangement of the cells.

Gastrulation and implantation take place simultaneously.



Gastrulation involves following changes:

a. Formation of endoderm:

Some cells covering the free surface of the embryonic knob (exposed to the cavity of blastocyst) become flat and form first endodermal cells.

Ectodermal cell multiply, spread out in all directions and form a complete lining inside the trophoblast of blastodermic vesicle is called the endoderm.

The endoderm located under the embryonic knob is embryonic endoderm. The remaining endoderm along with trophoblast forms the primary yolk sac.

It encloses a fluid and not yolk.

b. Formation of embryonic disc:

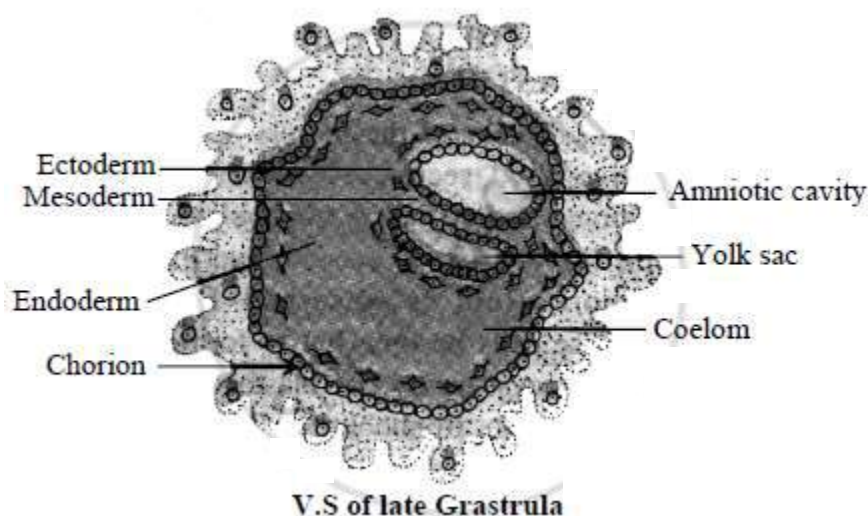
The blastocyst continues to grow in size.

With the growth of blastocyst, after the formation of endoderm, the embryonic knob becomes columnar to form embryonic disc.

c. Formation of amniotic cavity:

A space appears between embryonic disc and the trophoblast is called amniotic cavity.

It is filled with amniotic fluid. The roof of this cavity is formed by amniogenic cells derived from trophoblast and its floor is made up of embryonic disc.



d. Formation of ectoderm:

The remaining cells of embryonic disc get arranged in a layer called ectoderm.

e. Formation of mesoderm:

At the hind end of the embryonic disc, cells start proliferating at an increased rate. The new layer of cells so formed, is mesoderm, which separates the yolk sac and the amniotic cavity from the trophoblast.

f. Formation of extra embryonic coelom:

A large cavity called extra embryonic coelom is formed in the extra embryonic mesoderm.

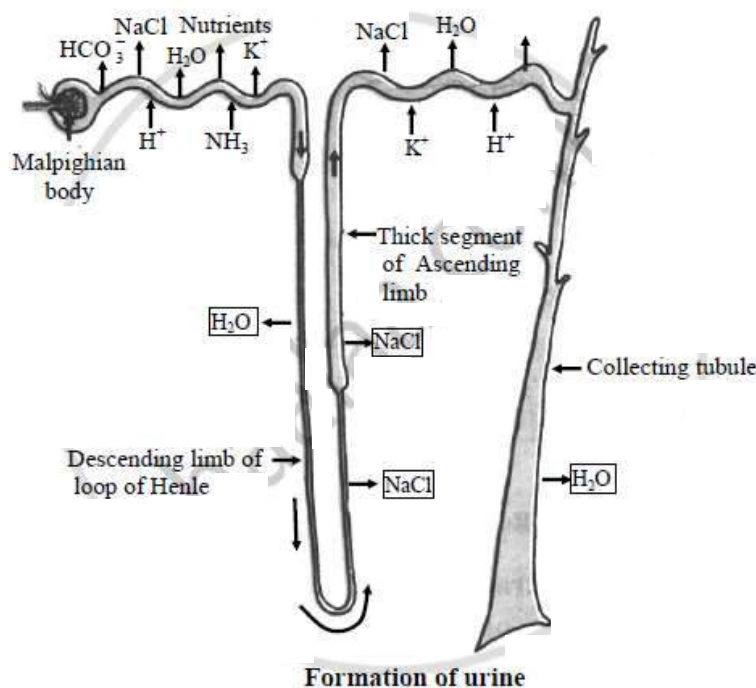
Extra embryonic mesoderm splits this cavity into two layers:

1. Outer mesoderm lining the trophoblast is called parietal extra embryonic mesoderm.
2. Inner mesoderm covering primary yolk sac and wall of amniotic cavity is termed as visceral extra embryonic mesoderm.

g. Formation of chorion and amnion:

Chorion consists of trophoblast lined by parietal extra embryonic mesoderm.

Amnion consists of amniogenic cells covered by visceral extra embryonic mesoderm.



c. Tubular Secretion (Renal Secretion):

It is also called active secretion or renal secretion.

The separation and secretion of unwanted substances from peritubular capillary network into tubular fluid is called tubular secretion. During ultrafiltration some of the unwanted substances escape into the efferent arteriole.

These substances are actively separated and secreted inside renal tubule such as K<sup>+</sup> ion, H<sup>+</sup> ion, creatinine, uric acid, penicillin, urea, ammonia etc. This process is important for homeostasis.

Finally fluid become hypertonic which is excreted as urine.

Absorption of water is controlled by ADH and absorption of salt is controlled by aldosterone.

**Question 6: Select and write the most appropriate answer from the given alternatives for each sub-question :** [6]

**Question 6.1:** The phenomenon of industrial melanism demonstrates\_\_\_\_\_ [1]

- (a) natural selection
- (b) induced mutations
- (c) reproductive isolation
- (d) geographical isolation

**Solution:** natural selection

**Question 6.2:** α<sub>1</sub> antitrypsin is used in the treatment of\_\_\_\_\_ [1]

- (a) Phenylketonuria
- (b) Cystic fibrosis
- (c) Emphysema
- (d) Haemophilia

**Solution:** Emphysema

**Question 6.3:** Charas, hashish, ganja are obtained from \_\_\_\_\_ [1]

- (a) Papaver somniferum
- (b) Erythroxylum coca
- (c) Atropa belladonna
- (d) Cannabis sativa

**Solution:** Cannabis sativa

**Question 6.4:** The catecholamines are secreted by\_\_\_\_\_. [1]

- (a) adrenal cortex
- (b) adrenal medulla
- (c) thymus
- (d) pancreas

**Solution:** adrenal medulla

**Question 6.5:** Which of the following are 'scavenger cells'? [1]

- (a) Lymphocytes
- (b) Erythrocytes
- (c) Basophils
- (d) Macrophages

**Solution:** Macrophages

**Question 6.6:** The pairing of homologous chromosomes is called\_\_\_\_\_ [1]

- (a) crossing over
- (b) terminalization
- (c) synapsis
- (d) bivalent

**Solution:** synapsis

**Question 6.7:** Hot spot method of in situ conservation protects\_\_\_\_\_ species in its own habitat. [1]

- (a) vulnerable
- (b) rare
- (c) indeterminate
- (d) endangered

**Solution:** endangered

**Question 7.1: Answer in 'ONE' sentence each :** [6]

**Question 7.1.1:** Name the radioactive probe used in India for DNA fingerprinting. [1]

**Solution:** In India, the unique segment obtained from the Y chromosome of the female banded krait snake i.e. Banded Krait minisatellite is used as a radioactive probe for DNA fingerprinting.

**Question 7.1.2:** Name the viral diseases in poultry animals [1]

**Solution:** Viral diseases in poultry animals include Ranikhet, Bronchitis, Avian influenza etc.

**Question 7.1.3:** Give examples of unconditional reflexes [1]

**Solution:** Examples of uncondition reflexes are blinking of eyes with strong light, withdrawal of hand when pricked, breast feeding, swallowing, knee jerk, sneezing, coughing etc.

**Question 7.1.4:** What is vaccine? [1]

**Solution:** Vaccine is an antigenic preparation used to stimulate the production of antibodies and induce immunity against several diseases.

**Question 7.1.5:** Name the disorder caused by under secretion of thyroxine in children [1]

**Solution:** Hyposecretion of thyroxine in children causes cretinism

**Question 7.2:** Give the graphical representation of Hardy-Weinberg's principle in the form of Punnet Square. [1]

**Solution:**

		Hybrid	Aa
		A(p)	a(q)
Hybrid Aa	A(p)	AA (p <sup>2</sup> )	Aa (pq)
	a(q)	Aa (pq)	aa (q <sup>2</sup> )

**Question 7.3: Attempt Any TWO of the following :** [4]

**Question 7.3.1:** Explain the technique of multiple ovulation embryo transfer (MOET) in animal breeding. [2]

**Solution:** a. It is one method for herd improvement.

b. In this method the cow is administered with hormones to induce follicular maturation and super ovulation.

c. In this method instead of one egg per cycle, they produce 6-8 eggs. Female is either mated with elite bull or artificially inseminated.

d. Blastocyst at 8-32 cell stage are recovered non-surgically and transferred to surrogate mothers.

**Question 7.3.2:** Illustrate any 'three' genes which can be used in gene therapy. [2]

**Solution:** Some examples of genes which can be used in gene therapy:

1) Tissue growth factor-beta (TGF-β): It promotes new blood vessels and epidermal growth. It is useful in wound healing and treatment of burns.

2) Tissue plasminogen activator (TPA): It is used to prevent or reverse blood clots.

3) Human blood clotting factor VIII: It is used to aid in the clotting of blood and to treat patients suffering from haemophilia.

**Question 7.3.3: Answer the following question.** [2]

Describe the structure of blastula.

**Solution:** Blastulation is the process of formation of the hollow and multicellular blastocyst. The process of blastulation can be summarized as follows:

1. The embryo (blastocyst) that enters the uterus remains floating in uterine cavity for 2-4 days after its entry i.e. till the end of 7th day after fertilization.
2. The outer layer of cells seen in the morula now forms the layer called the trophoblast.
3. Cells from the trophoblast begin to absorb the glycogen rich uterine milk
4. The blastocyst doubles in size from 0.15 mm to 0.30 mm.
5. With more fluid entering inside the blastocyst cavity is formed.
6. These outer cells become flat and are called trophoblast cells (since they help only in absorbing nutrition for the developing embryo).
7. The larger inner cells form inner cell mass or embryoblast (the embryo proper develops from the embryoblasts).
8. These remain attached to the trophoblasts on only one side.
9. The trophoblast cells in contact with the embryonal knob are called cells of Rauber.
10. At this stage, the blastocyst shows polarity i.e. the side with inner cell mass is called the embryonal end and the side opposite to it is the abembryonic end.
11. By the end of the 7th day the blastocyst is fully formed and ready for implantation and gastrulation.
12. The function of zona pellucida is to prevent the implantation of the embryo at an abnormal site. It does not expose the sticky and phagocytic trophoblast cells till it reaches the implantation site i.e. within the uterus, after which the zona pellucida ruptures.

**Question 7.3.4:** Give the importance of fossil in support of organic evolution [2]

**Solution:**

- a. Fossils are defined as the dead remains of plants and animals that lived in the past in various geological layers.
- b. Unlike the evidences from other branches of biology, evidence from fossils are sound, direct and reliable.
- c. Fossils are described as the true witnesses or documents of evolution.
- d. The development in the field of Geology reveals that the primitive forms of organisms occupy the lower layers and the advanced forms occupy the upper layers of the earth during fossilization.

**Question 8.1: Attempt Any TWO of the following :** [6]

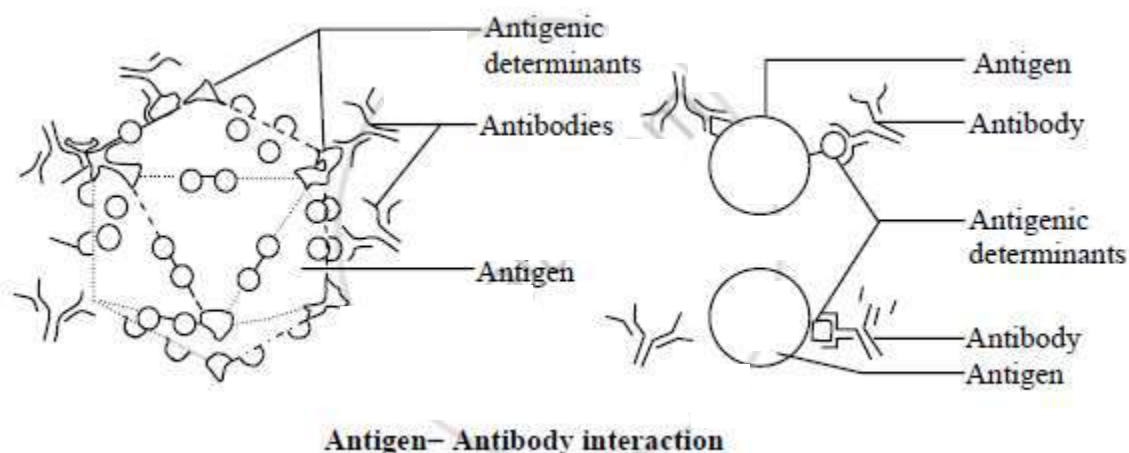
**Question 8.1.1:** Describe the antigen-antibody complex [3]

- Solution:**
- a. Antibodies are always antigen specific. Combining sites of antigen, called antigenic determinants or epitopes react with corresponding antigen binding sites of antibodies called paratopes.
  - b. Specificity of an antibody for an antigen lies in its sequence of amino acids within variable regions of two chains. These are active sites of antibody where the

molecules bind to specific antigens.

c. Both the arms have same amino acid sequence and therefore bind the same kind of antigen.

d. Thus each antibody can join two antigen like Lock and Key manner called antigen – antibody complex.



**Question 8.1.2:** Distinguish between ape and man. [3]

**Solution:**

	Ape		Man
1	Apes possess a prognathous face, slanting forehead and snout protruded with a flat nose.	1	Humans possess an orthognathous face, high forehead, dome shaped skull and elevated nose.
2	They have a cranial capacity of 400–600 c.c.	2	They have a cranial capacity of approximately 1450 c.c.
3	The chin is absent.	3	A prominently developed chin.
4	Locomotion is quadrupedal.	4	Locomotion is bipedal.

**Question 8.1.3:** Give the effects of water pollution on human health [3]

**Solution:** Effects of water pollution are as follows:

- Several water borne infectious diseases are directly related to polluted water.
- The heavy metal water pollutants causing health hazards in human beings are mercury, lead, arsenic, cadmium, selenium etc.
- Mercury causes abdominal pain, headache, diarrhoea, haemolysis, and chest pain.
- Lead causes anaemia, vomiting, loss of appetite, convulsions, damage of brain, liver and kidney.

- e. Arsenic causes disturbed peripheral circulation, mental disturbance, liver cirrhosis, hyperkeratosis, lung cancer, ulcers in gastro-intestinal tract and kidney damage.
- f. Cadmium causes diarrhoea, growth retardation, bone deformation, kidney damage, testicular atrophy, anaemia, hypertension, injury of central nervous system and liver.
- g. Selenium causes damage of liver, kidney and spleen, fever, nervousness, vomiting, low blood pressure, blindness and even death.

**Question 8.2:** Draw labelled diagrams of the following: Eye [3]

**Solution 1:**

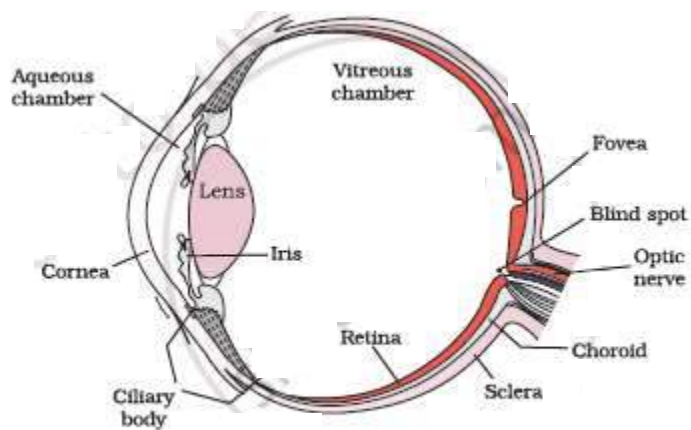
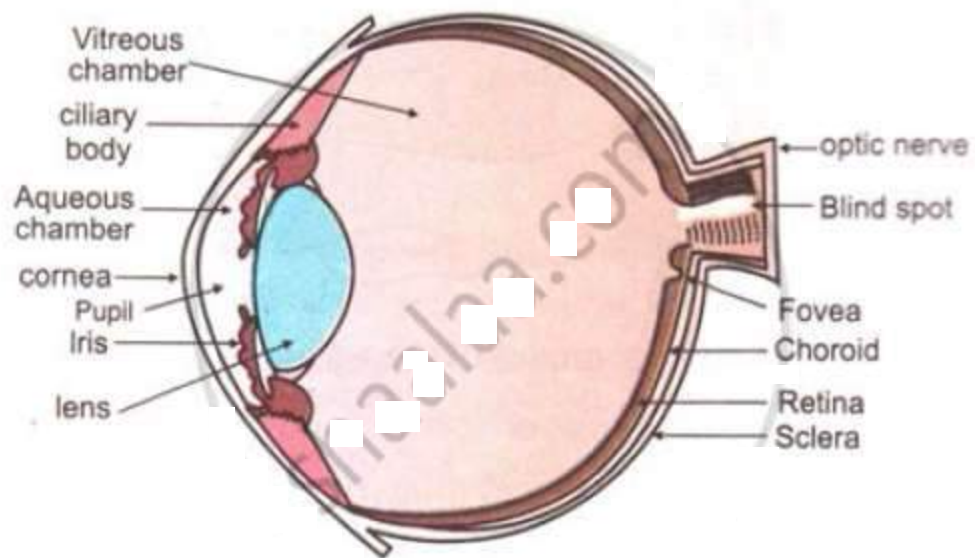


Diagram showing parts of an eye

**Solution 2:**





**Anatomy of Human Eye**