



03



متعلقہ سوال کا جواب صرف مختص کردہ جگہ پر اور بیرونی نشان کے اندر دیا جائے۔



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Q. No. 2 (i)

Uric acid is a purine even less toxic than urea. It precipitates from solution, allowing four nitrogen atoms per uric acid molecule to be excreted. One gram of nitrogen in the form of uric acid required only 1 ml of water to excrete it. So, it is very less toxic so it does not need to be converted to non-toxic level. It can be easily excreted so, it does not cause damage to the extent of ammonia or urea. Terrestrial invertebrates and egg-laying vertebrates used uric acid as their major nitrogenous waste product so they are called uricotelic.

Q. No. 2 (ii)

It is advantageous so that  $O_2$  coming from air can be transported from internal surface to all body cells and  $CO_2$  from all body cells can be removed from body.

Respiratory surface has following properties:

- It must be moist and permeable so that gases can easily pass through.
- It must be thin because diffusion is efficient over a distance of 1mm or less.
- It must have good blood supply.
- It must have large surface area so that sufficient



Q. No. 2 (iii)

1. Myofibril

2. Myosin

3. F. actin

4. Actin

5. Tropomyosin

6. Troponin

Q. No. 2 (iv)

It is nearly impossible to stop a reflex action from taking place because it is an involuntary, automatic and immediate response to stimulus. Most of the reflex actions are coordinated by interneurons in spinal cord, they do not even involve brain. Due to these reasons, we cannot control a reflex action.

Fundamental parts of a typical reflex arc are:

Receptors, sensory neurons, interneurons, motor neurons, effectors.

Stimulus reaches the receptors and effectors (muscles,





Q. No. 2 (v)

Color blind son:  $X^c Y$ Daughter:  $X^C X^c$ 

• Color blindness is an X-linked recessive trait so father cannot pass it to his son but affected father can pass it to daughter. On the other hand, if mother is affected she can pass it equally to son or daughter or if she is carrier then in both cases son will be affected but daughter is carrier. Daughter will be affected if she has carrier mother and affected father.

• Father

Genotype:  $X^c Y$ 

Phenotype: normal

• Mother:

Genotype:  $X^C X^c$ 

Phenotype: carrier but not affected

♂	♀	$X^c$	$X^c$
$X^c$	$X^C X^c$	$X^c X^c$	
Y	$X^c Y$	$X^c Y$	

Q. No. 2 (vi)

The act of spontaneously giving birth before 28<sup>th</sup> week of pregnancy is called miscarriage.

**Causes:** The embryo may implant near the cervix

In this case, placenta is formed such that it partially and completely covers the opening of cervix. As the fetus grows and uterus expands, placenta may be removed from uterus and haemorrhage. Also, already formed placenta may be torn or haemorrhage due to many reasons resulting in miscarriage. Keep in view the live birth that takes place before expected date of



Q. No. 2 (vii)

- Neural crest cells have been proposed as fourth germ layer due to wide variety of structures they form.
- After neural tube closure, these neural crest cells migrate to lateral sides of neural tube forming cranial, spinal nerves, sympathetic ganglia and associated neurons.
- They also migrate to various parts of embryo forming teeth, medulla of adrenal gland, skull bones, peripheral nerves.

Q. No. 2 (viii)

<b>Intron</b> These are non-coding sequences present in DNA or RNA.	<b>Exon</b> These are coding sequences present in DNA or RNA.
<b>Heterochromatin</b> This is condensed and non-expressed region of chromatin fibre	<b>Euchromatin</b> This is uncondensed region of chromatin and genes are expressed in this region.
<b>Nucleosome</b> Complex formed when DNA	<b>Primosome</b> The enzymes primase and







Q. No. 2 (xi)

Cystic fibrosis is a disease that affects mucus and sweat glands. People with severe disease show lung and digestive problems.

Gene for this disease is cystic fibrosis trans membrane conductance regulator (CFTR). This disease is caused due to defect in this gene. As a result, mucus becomes thick and sticky, which causes obstruction in airways and dryness. Normally mucus lining organs is liquid like so it prevent from infections and drying out.

They are cured with help of gene therapy. Liposomes microscopic vesicles that are spontaneously produced in solution containing lipoproteins coated with gene for treating this disease. It is given to patient in the form of nasal spray.

Q. No. 2 (xii)





Q. No. 2 (xiii)

Effective control of a particular disastrous diseases or all disease of population is possible by using all appropriate methods of disease control. This is called integrated disease management.

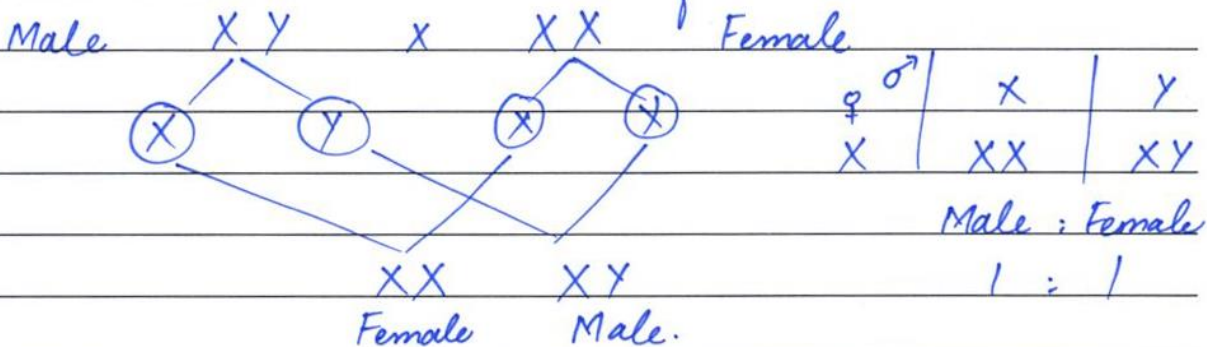
**Procedure:** Combating disease by utilizing all possible methods as and when required, ensuring the participation of community in this program is an effective method. People should be made aware of severity of problem, its causes & remedies. It can be through print and electronic media, arranging seminars in colleges & schools and person to person communication. We utilize all methods like drug treatment, preventive measures, vaccines, different therapies.

**Objective:** Real objective is to prevent spread of disease and its new onset. Many diseases have been eliminated by this method of disease control.

Q. No. 2 (xiv)

Human male has two different chromosomes, one long rod-shaped X-chromosomes and other smaller, Y-chromosome.

Thus, it is referred to as heterogametic. The nature of sperm decides gender of offspring as half of sperms contain X-chromosomes and half contain Y.







Q. No. 2 (xv)

Hormones are small soluble organic molecules which are effective in low concentration. They are chemical messengers as they carry signal from one place to another.

### Classification on Basis of Chemical Nature

1. **Steroid hormones:** Estrogen (ovaries), progesterone (ovaries, placenta), testosterone (testes), adrenal cortex hormones
2. **Proteinous:** Somatotrophic, thyrotropic and gonadotrophic hormones from pituitary, insulin and glucagon from pancreas
3. **Peptide hormone:** Melanocyte stimulating hormone (MSH), calcitonin and parathormone. ACTH, oxytocin and vasopressin
4. **Catecholamine:** Adrenaline and nor-adrenaline from adrenal medulla.
5. **Amino acid derivative:** Thyroxin (Thyroid gland)

Q. No. 2 (xvi)

Biological rhythms are cyclic patterns of physiological changes or changes in activity of living organisms due to periodic environmental changes. The exact mechanism by which these biological rhythms are maintained even in absence of particular stimulus is called biological clock.

These rhythms help to regulate our activities as some activities are synchronized in 24-hour cycle, some are regulated monthly and others are annual





Q. No. 2 (xvii)

1. **Failure to Ovulate**: Infertility may be due to decreased secretion of hormones of either hypothalamus or pituitary gland as a result female either fails to develop follicles (lack of FSH) or fails to ovulate (lack of LH).

2. **Uterus damage**: Fibroids are benign tumors that are produced in uterus and result in infertility.

3. **Cervical mucus defect**: Mucus in cervix is thick and sticky but rising levels of estrogen make it thin and crystalline to facilitate passage of sperm into the uterus. But if there is a problem with mucus, fertilization cannot occur.



Q. No. 2 (xviii)

• Soon after fertilization, zygote undergoes mitotic divisions which is called cleavage.

• There are two patterns of cleavage:

1- **Holoblastic cleavage:** In cells with evenly distributed yolk, entire cell divides producing cells of roughly the same size. e.g. bony fishes and amphibians.

2- **Meroblastic cleavage:** In case of birds, reptiles, mammals and some fishes, there is a large amount of yolk and a very small amount of cytoplasm concentrated at animal pole. In such cells, cleavage occurs in a small disc of cytoplasm located in animal pole called blastodisc. It is called meroblastic cleavage.







Q. No. 2 (xx)

1. Microbes can be used in food industry to produce different food varieties e.g. bread, soy sauce, etc.
2. Microbes are used to manufacture hormones, enzymes and such isotopes (e.g. L-amino acids) which cannot be prepared by conventional techniques.
3. Microbes are used to clean wastewater and sewage and also generate electricity.





Q. No. 3 (Page 1/6)

a.

(i)

A: DNA helicase

B: Primase

C: DNA polymerase-III

D: DNA polymerase-I

E: Lagging strand

F: Leading strand

(ii)

A: It is used to break bonds between base pairs of DNA so it results in unwinding of DNA duplex.

B: It is used to attach primers to start activity of DNA polymerase-III.

C: It is enzyme which polymerizes DNA by adding DNA nucleotides to 3' end of primer.

D: It replaces primer RNA by DNA nucleotides which are then joined together by DNA ligase.

(iii)

DNA remains stable during DNA replication as there is no change in DNA nucleotide sequence. DNA strands are replication by help of specific enzymes so there is no chance of error or damage to DNA. It is highly directional as it always takes place from 5' to 3' end.



Q. No. 3 (Page 2/6)

b.

### ABO blood group system

ABO blood group system is a well-known <sup>example</sup> of multiple alleles. Karl Landsteiner discovered it in 1901.

#### Antigens

It is characterized by presence of specific molecules called antigens on RBC surfaces which are glycoprotein in nature. It is controlled by two antigens A and B. If antigen A is present on RBC, blood group is A. If antigen B is present, blood group is B. If both antigens are present, blood group is AB. If no antigen is present, it is O.

#### Genetic Basis

It is expressed by a single autosomal polymorphic gene I (isohaemagglutinin). It has three alleles which are located on the same locus,  $I^A$ ,  $I^B$  and  $i$ .  $I^A$  and  $I^B$  are completely dominant over  $i$  while they are codominant to each other. Blood groups genotypes are represented in table.

Phenotype (Blood group)	Genotype	Antigen	Antibody	Transfusion
A	$I^A I^A, I^A i$	A	B	A, O
B	$I^B I^B, I^B i$	B	A	B, O
AB	$I^A I^B$	A, B	-	all
O	$ii$	-	A, B	O





Q. No. 3 (Page 3/6)

till death. So, person has single blood group.

### Antibodies

If wrong antigen enters, antigen-antibody reaction occurs called agglutination. Antibodies of this system do not require any stimulus. They are produced for absence of respective antigen.

Blood group A will have B antibody. Blood group B will have A antibody. Blood group AB has no antibody while blood group O has both antibodies.

### Transfusion Principle

Transfusion is always done on the basis of donor's antigen and recipient's antibodies, otherwise clumping of RBC occurs. Therefore blood group A has receive blood from A and O because it has B antibody so it cannot receive any blood group containing B antigen. Similarly B

~~and~~ can receive from B and O. Blood group AB is called universal recipient because it has no antibodies so it can receive any antigen

Blood group O is called universal donor because it has no antigen so it can donate blood

to any blood group but it can receive blood only from O.









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The relevant question should be answered only in the allotted space and inside the outer mark

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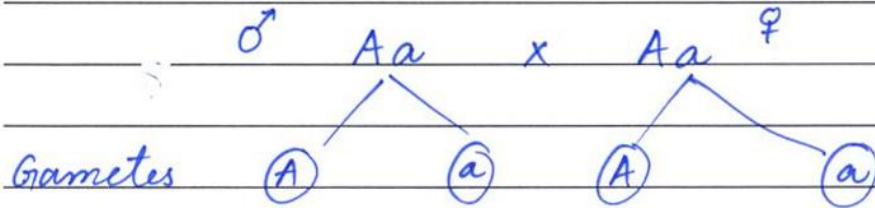
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**Q. No. 3 (Page 6/6)**





Q. No. 4 (Page 1/6)

**b.**Genotype of parents :  $Aa$  (normal)Genotype of child :  $aa$  (albino)

♀ ♂	A	a
A	AA	Aa
a	Aa	aa

AA : Aa : aa

1 : 2 : 1

Normal : Albino

3 : 1

Thus probability for normal child is  $\frac{3}{4}$  or 75%.



Q. No. 4 (Page 2/6)

a.

i.

A : Meninges

B : Cerebrum (cerebral cortex)

C : Hypothalamus

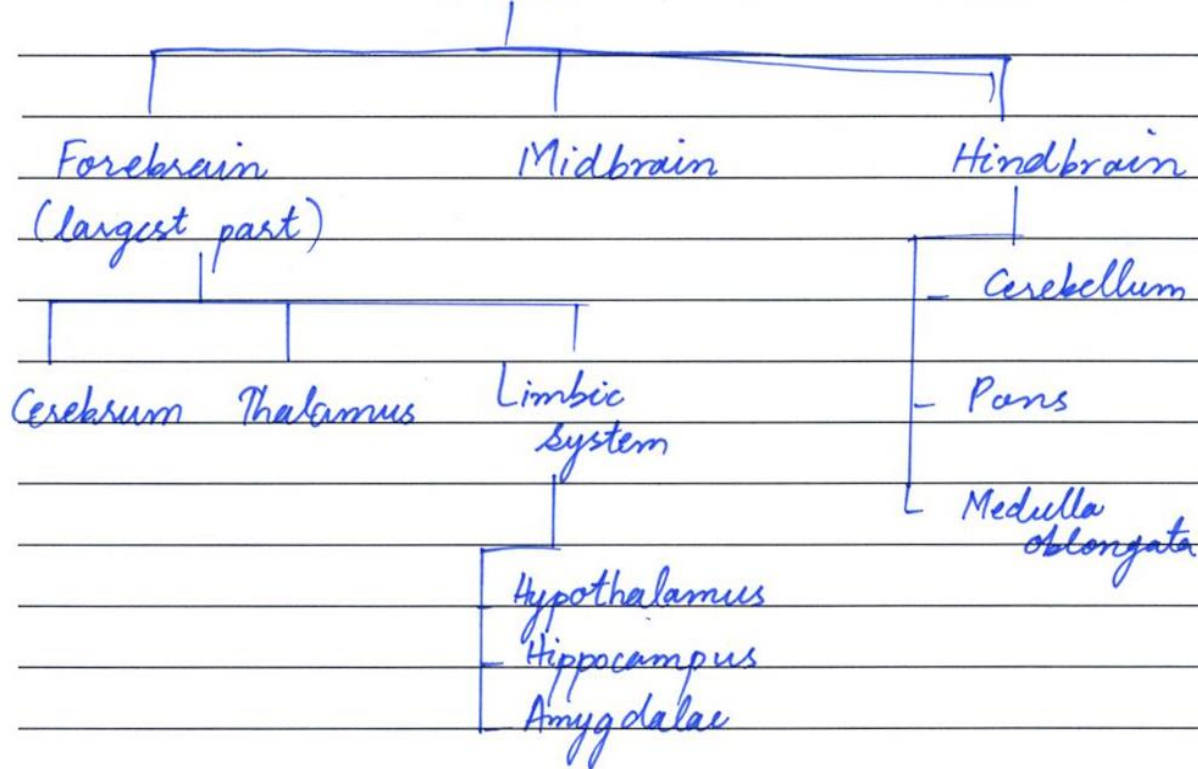
D : Cerebellum

E : Midbrain

F : Pons

ii.

The three main parts of brain are



iii.





Q. No. 4 (Page 3/6)

in coordinating action of muscles to produce complex activities such as walking, running, doing some work with hand, etc. It also controls learning memory storage for behaviours.

E: Midbrain is reduced in humans. It contains reticular infornation. It acts as a relay centre between cerebrum and hindbrain or cerebellum. It is used to link forebrain with hindbrain.

F: Pons are used to control rate and depth of heartbeast and respiration.









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The relevant question should be answered only in the allotted space and inside the outer mark

**Space for diagram/rough work**



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**Q. No. 4 (Page 6/6)**





Q. No. 5 (Page 1/6)

a.

## Joints

### Definition :

A joint or articulation is a place where two bones or a bone and a cartilage meet. Study of joints is called arthrology.

### Classification

#### 1. Fibrous Joints

These are immovable joints. In these joints, two bones are joined together by means of fibrous connective tissue. They lack a joint cavity between them. The gap between the bones may be narrow or wide.

#### Examples

These joints are found between:

- 1- Most bones of skull called suture.
- 2- Shaft regions of long bones in forearm and legs.
- 3- Between root of tooth or socket of maxilla or mandible.

#### 2. Cartilaginous Joints

These are slightly movable joints. In these joints, adjacent bones are joined together by means of hyaline cartilage or fibrocartilage. They also lack a joint cavity between them.

#### Examples

- 1- Costal cartilages between ribs
- 2- Intervertebral disc.



Q. No. 5 (Page 2/6)

### 3 - Synovial Joints

These are freely moveable joints. The ends of bones are covered with hyaline cartilage and has a joint cavity between them that is filled with synovial fluid. It consists of an inner layer of synovial membrane and an outer layer of ligaments.

#### Examples

1. Ball and socket joint (Shoulder joint, hip joint)
2. Hinge joint (knee joint, elbow joint)
3. Gliding joint
4. Pivot joint (in neck)

### Disorder of Skeleton

#### Slipped Disc

Each intervertebral disc is a cushion like pad consisting of annulus fibrosus and nucleus pulposus.

- Annulus fibrosus is a strong outer ring that joins adjacent vertebrae together.
- Nucleus pulposus is an inner semifluid that provides elasticity and compressibility to the disc. It also acts as a shock absorber.

#### Cause:

- Severe or sudden trauma to the spinal cord or spinal nerves can result in herniation of one or more discs. As it involves rupture of annulus fibrosus followed by protrusion of spongy nucleus pulposus. If this protrusion touches spinal cord or spinal nerve. It can result in severe pain. Slipped disc is misleading as it is not the whole





Q. No. 5 (Page 3/6)

**b.**

## **Gel Electrophoresis**

Gel electrophoresis is a technique used in molecular biology to separate different sized fragments of charge bearing polymers (DNA, RNA, proteins) under the influence of electric field in a semi solid gel containing medium like agarose or polyacrylamide. The molecules being sorted are dispensed into a gel medium. The gel containing medium is placed in an electrophoresis chamber and connected to power source. As the electric current flows different sized fragments move to the opposite pole of gel.

### **Principle of Movement**

The movement of different sized fragments is based on their length because smaller fragments can move faster and cover greater distance on gel as compared to larger fragments as distance moved by DNA is inversely proportional to its length. Also, it depends on other factors like charge, number of strands (single or double), shape (linear or circular) and concentration of gel (pore size). After sometime, different sized fragment form distinctive bands within gel.

### **Visualization**

In order to visualize DNA or RNA, the gel is placed on an ultraviolet transilluminator, we can see



Q. No. 5 (Page 4/6)

fragment while thin bands represent lower concentration

ii.

This technique is used in biology to separate different sized fragments of charge bearing polymers (RNA, DNA, protein.) When these fragments are moved on gel by applying current, they produce distinct bands on gel. This method is used in processes of DNA sequencing while sequence of DNA can be deduced from the gel pattern. It is used in DNA fingerprinting techniques as well.

The DNA in a band can be analyzed further by cutting piece of gel and purifying DNA.

The DNA can also be transferred to nitrocellulose membrane for autoradiography (X-ray imaging)









Q. No. 5 (Page 6/6)

