

Part II

Section A

Question # 2

Part (a)

Structure of the Universe according to Big Bang Theory

Introduction

The universe came into existence around 13.8 billion years ago with an event known as the Big Bang as described by "Isaac Asimov" in his book. According to Big Bang

Theory, all the existent matter rose from a single primordial atom and eventually led to the formation of the universe of which we are a part today. The structure of the universe is scientifically and logically described on the basis of this theory.

What is the Big Bang Theory?

It is a physical theory given by a Belgian Priest "George Lemaitre" in 1920's and suggests that the universe began from an initial state of high temperature and pressure when "time and space

were non-existent"

Hypothesis of the theory

1. Universe began from a single primordial atom
2. All the four fundamental forces (gravity, electromagnetism, strong and weak nuclear forces) were forged into a single force

Structure of the Universe based on Big Bang Theory

1. Vast and Infinite

The universe is vast and infinite deemed by the presence

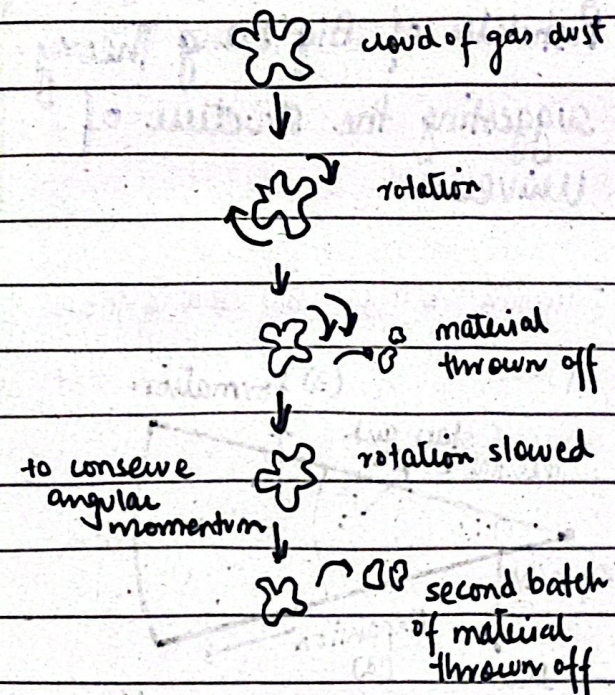
of homogenous stars and heavenly bodies with vast distances between them.

2. Olber's paradox of darkness of universe

Olber's paradox suggests that the universe is not static, because if it was, all the light from faraway stars would have reached by now and the universe would have been brighter. Thus, universe is dark with suspended celestial bodies.

3. Laplace's Nebular hypothesis

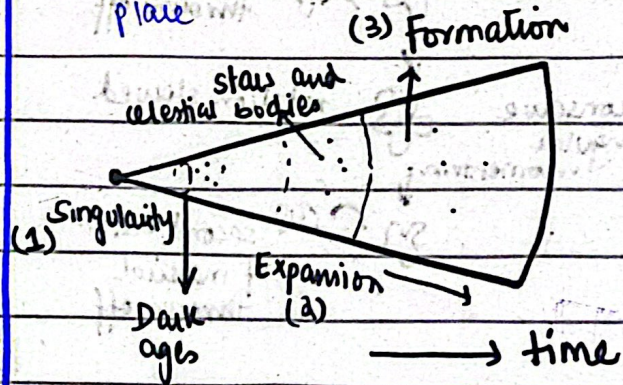
Our solar system which is a part of the universe formed by a process explained by Laplace



This led to formation of planetary bodies and their moons. Therefore, structure of universe is composed of celestial bodies that coagulated over time.

Postulates of Big Bang Theory suggesting the structure of universe

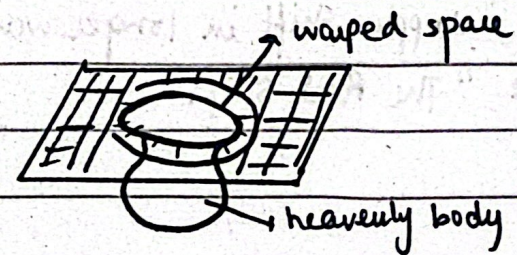
Following is how Big Bang took place



These events ultimately led to the creation of universe and creation of space and time.

How space gets warped with heavenly bodies

Einstein suggested that space is like a sheet and when a heavy body is placed on it, the space gets distorted around it, leading to gravity.



Abundance of light elements

Upon research, it was found that our universe is composed of lighter elements such as hydrogen.

Red shift observed

Hubble explained that galaxies are moving away and expanding at a rate proportional to their distance, hence showing a doppler shift in longer wavelengths i.e. "The Red shift"

Conclusion

On the basis of Big Bang Theory, structure of the universe is ever stretching, vast, composed of lighter elements, dark matter, dark energy and celestial bodies.

Part (b)

Urinary System

Definition

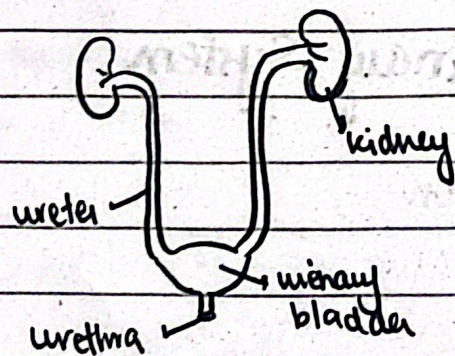
Urinary system of the body deals with the excretion of wastes from the body fluids and is

composed of

- a pair of kidneys
- ureters
- urinary bladder
- urethra

Structure of urinary system

Urinary system has:

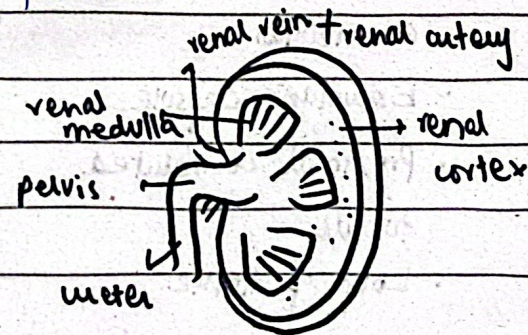


All these parts play an effective

role in the removal of wastes from the body.

Kidney

Kidneys are bean shaped organs placed on either side of the vertebral column.

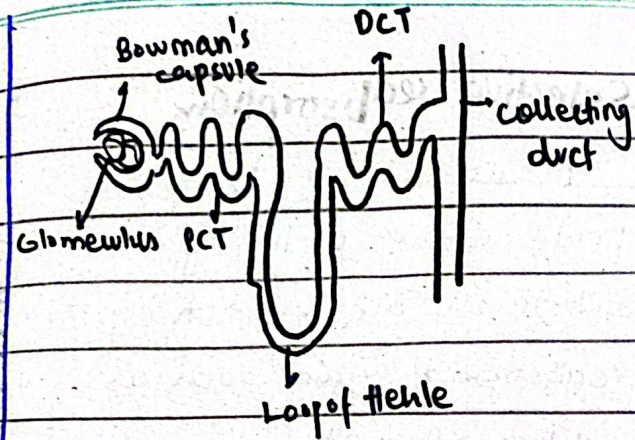


Kidneys have millions of nephrons which serve as being their structural & functional unit.

Nephron - structural and functional unit of urinary system

Nephrons carry out the process of urinary formation. Structurally, a nephron is composed of

- Glomerulus
- Bowman's capsule
- Proximal convoluted tubule
- Loop of Henle
- Distal convoluted tubule
- Collecting duct



The process of urine formation takes place within this structure.

Process of urine formation

Pressure filtration

Also called ultrafiltration, high pressure of blood in the glomerulus, expels out amino acids and water molecules.

Selective reabsorption

occurs in the loop of Henle where a lot of substances are selectively reabsorbed again such as water, NH_3 etc.

Secretion

In the filtrate, salts are secreted to maintain the pH of the urine and then it is collected in the collecting duct.

part (c)

Unbalanced diet

Definition

An unbalanced diet refers to "disproportionate components of food in a diet" which are not in coherence to the proportions that should be taken in a balanced diet.

Component of a normal balanced diet

Normally, a balanced diet as per United Nations Diet Report (2022), must have

the following components

- Carbohydrates
- Fats
- Proteins
- Fibres
- Vitamins

Given that, proteins should be in greater number second to carbs. Similarly, fats should be a proportionate part as well.

What happens when diet is "unbalanced"?

According to World Health

Organization "Every human should consume a balanced diet to stay healthy or else it will cause deficiencies."

Therefore, these deficiencies will lead to diseases.

Effect on Health

Deficiency of proteins

- Hormonal imbalance
- Weaker muscles
- Enzymal Snaction
- Digestive problems

Deficiency of carbohydrates

- Loss of energy levels
- Lethargy
- Concentration problems
- Low blood sugar

Deficiency of Fats

- Loss of body fat
- Lower BMI
- No energy storage

Deficiency of Vitamin

Vitamin A poor eyesight

Vitamin D bone problems

Vitamin C scurvy.

Thus, this shows that an unbalanced diet can have a myriad of negative impact on overall health.

part (d)

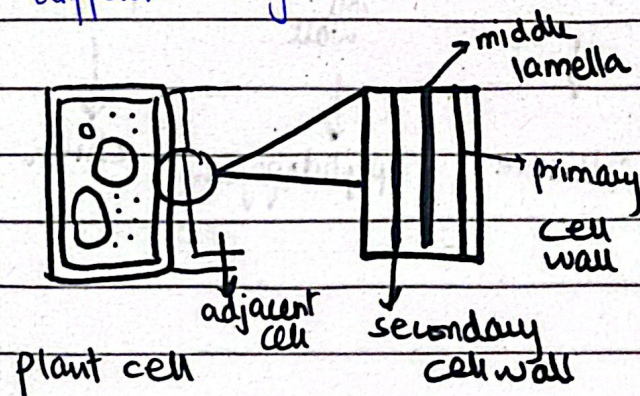
Cell Wall

Definition

Cell wall is the outermost layer in the plant cells which provides support. It is absent in animal cells.

Structure

Cell wall is composed of different layers

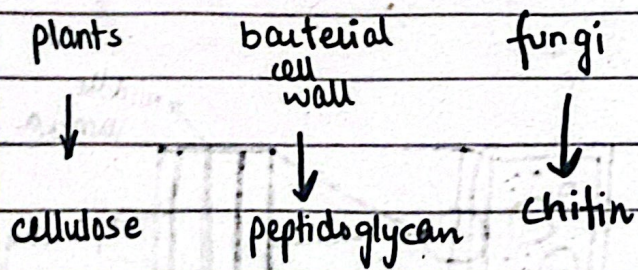


A plant cell wall is composed of a

- Primary cell wall
- Secondary cell wall
- Middle lamella

Composition of a cell wall

It varies between different organisms



Functions of a cell wall

These are the functions

- Provides mechanical support
- transfer of materials

Cell Membrane

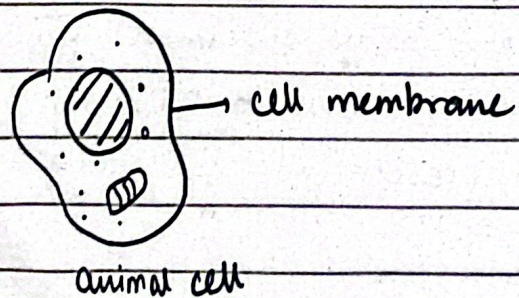
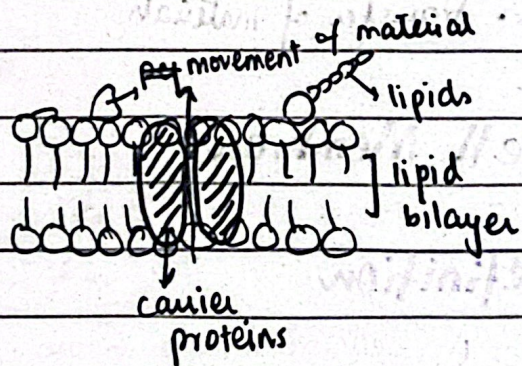
Definition

A cell membrane encloses cytoplasm and organelles within a cell. It is outermost layer in animal cells. But in plants it is present under cell wall.

Structure of a cell membrane

cell membrane's structure is best described by the

Fluid Mosaic Model



According to this model, cell membrane is a lipid bilayer which allows movement of material via carrier proteins.

Function of a cell membrane

Functions are

- Semipermeable membrane
- provides support to inner content of cell
- attachment site for ER
- carries out endocytosis and exocytosis

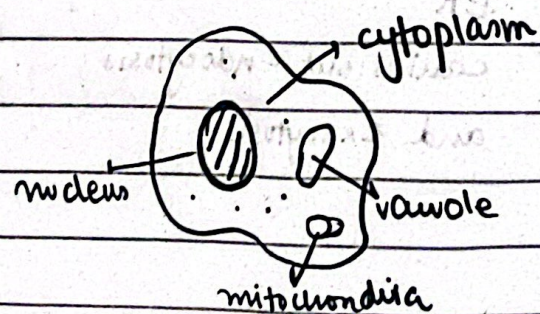
Cytoplasm

Definition

Cytoplasm is a jelly-like substance encapsulated by the cell membrane. Within cytoplasm, all the organelles are suspended and carry out their functions.

A host for organelles

Cytoplasm suspends in itself all organelles of a cell.



Function of cytoplasm

- suspension medium for organelles
- protects a cell from losing turgidity.
- site for major cellular processes.

Mitochondria

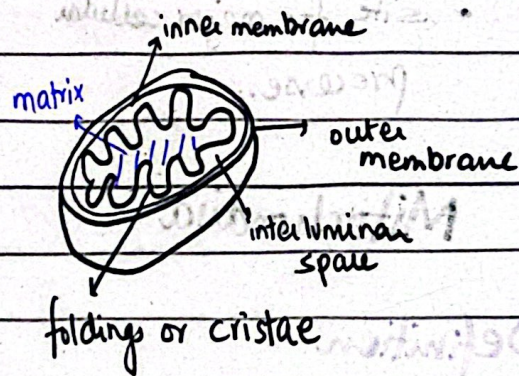
Definition

A double membrane bounded organelle present in a cell which is also called "the powerhouse of a cell" because responsible for

energy generation.

Structure of a mitochondria

Mitochondria is double membrane bounded.



Outer membrane

smooth

Inner membrane

has foldings called cristae

Function of a mitochondria

- Powerhouse of cell
- Breaks down ATP to generate energy
- Energy hub
- Facilitates anaerobic respiration by self replication.

Question 4 part 'A'

Heart

Definition

An organ responsible for pumping of blood

Location

In the thoracic cavity between lungs, slightly tilted to left side.

Size and Weight

Approximately size of a closed fist and nearly 280 - 300(grams)

Layers of Heart Wall

Epicardium

Myocardium

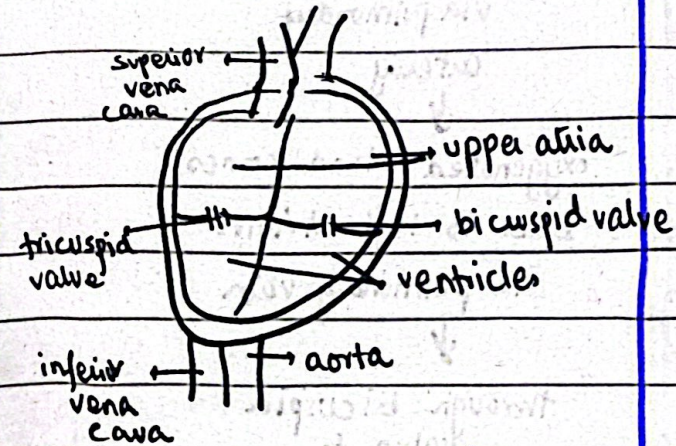
Endocardium

Septa of Heart

Interatrial septum

Interventricular septum

Structure of Heart



Role of Heart in Blood circulation

Blood flows in following direction

deoxygenated blood via
vena cava to left
atrium right
↓

through tricuspid valve
to right ventricle



pumped to lungs
via pulmonary
artery



oxygenated blood comes
back to left atrium

via pulmonary vein



through bicuspid
valve to
left ventricle



pumped to body
via aorta

Therefore heart is involved
in pulmonary as well as
systemic circulation.

Role of blood vessels in circulation

Arteries

carry oxygenated blood
to body except pulmonary
artery

Veins

carry deoxygenated blood
to heart except pulmonary vein.

Capillaries

facilitate exchange and
absorption of gases & substances
in blood.

part (B)

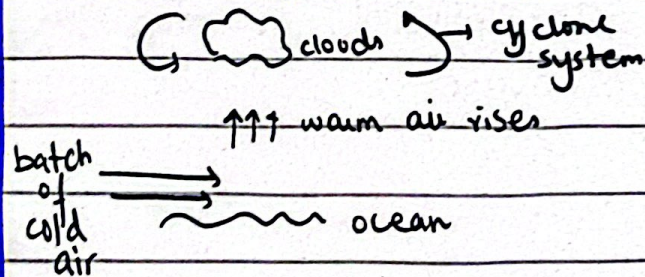
Cyclone

Definition

A cyclone is a system of winds formed when warm air above oceans rises up and forms clouds.

Formation of a cyclone

Cyclone is characterized by presence of low pressure



Warm air rises up



leads to formation of clouds



creates a storm system



new batch of cold air replaces warm air
↓
cycle continues

Part (C)

Functions of Carbohydrates

- Energy source
- Maintenance of blood sugar
- Smoother digestion

Function of Proteins

- Muscle building
- Hormonal balance
- Enzymatic action
- Digestion
- hair and nails

Functions of Fats

- Maintain BMI
- Insulation
- Energy storage

Calcium

- stronger bones
- health of teeth
- muscle functioning

Iron

- oxygenation
- Hb level

(d)

Remote Sensing

Remote sensing is a way of collecting data from the earth without physical contact.

Environmental Applications

- Forest cover mapping
- Urbanization assessment
- Location of disaster vulnerable areas
- Water body assessments
- Road maps.
- Pollution control

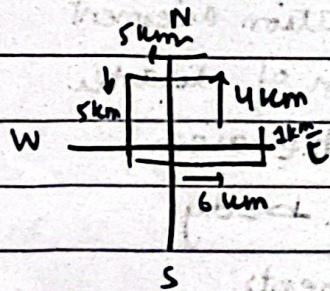
Ability portion

Question 8

part (a)

D B (A) E C
↓
middle

part (b)



(2) Towards north direction

(3) Towards west

(4) Towards west

part (c)

C is the odd one out

rest of them are clothing items

shirt, coat, sweater

part (d)

26 triangles

Question 7

part (a)

Let number be 100

$$40\% \text{ of } 100 = 40$$

$$40 = \frac{2}{3} (x)$$

$$x = 40 \times \frac{3}{2}$$

$$x = 60$$

Ratio

$$40 : 60$$

$$2 : 3 \quad \text{Answer}$$