

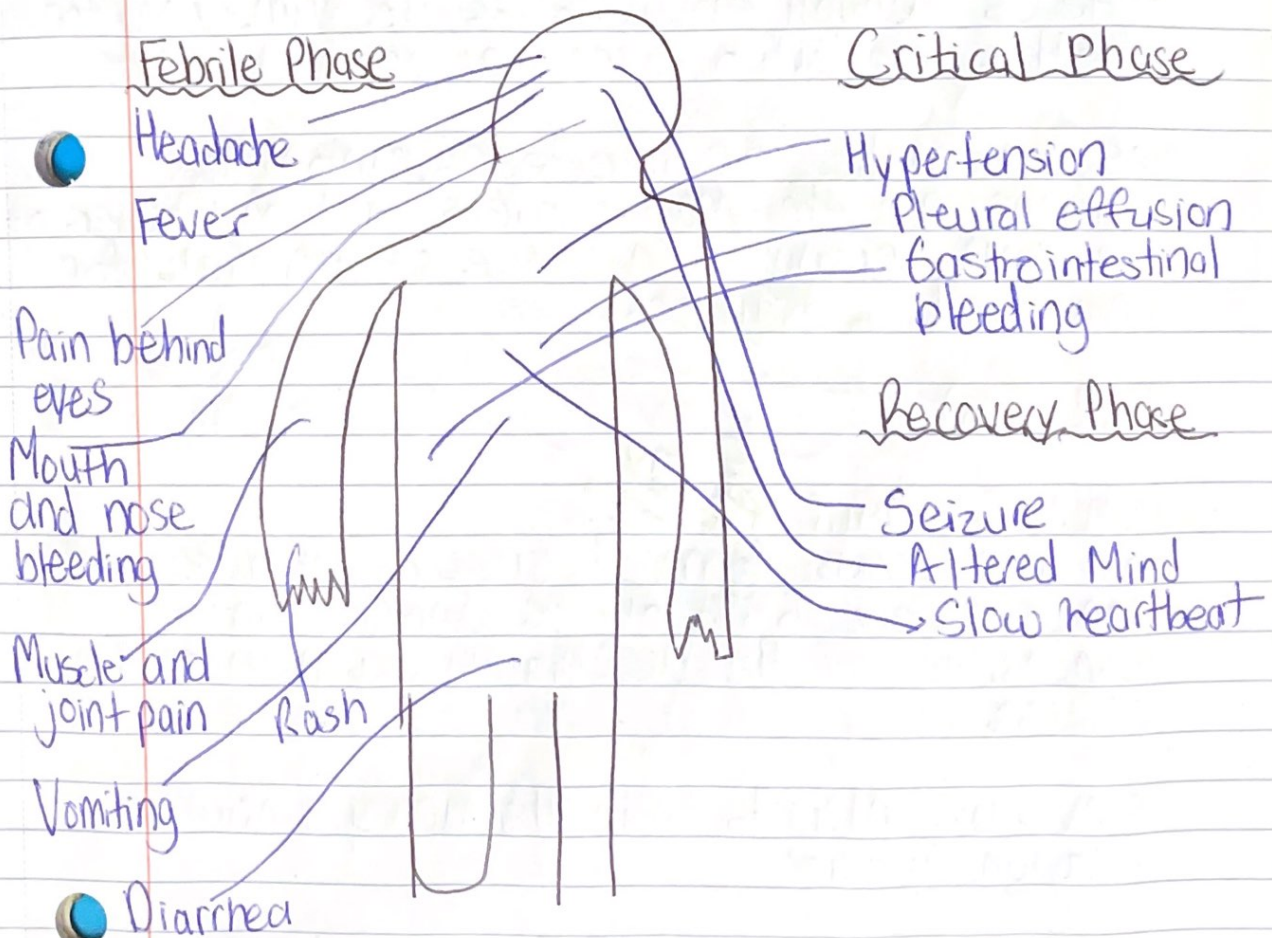
# General Science

Q.2 (a)

What is dengue?

- viral infection transmitted primarily by Aedes mosquitoes, especially Aedes aegypti and Aedes albopictus
- mosquito borne viral disease
- widespread throughout the tropics
- transmitted by female mosquitoes

Symptoms of Dengue:



→ symptoms usually appear 4-10 days after being bitten by an infected mosquito, and can vary in severity  
→ usually last for 2-7 days

Causative Agents of Dengue:

→ caused by the dengue virus (DENV)  
↳ has four distinct serotypes:

→ DENV-1

→ DENV-2

→ DENV-3

→ DENV-4

→ *Aedes aegypti* mosquito is the primary vector  
↳ this mosquito lives in urban habitats

→ asymptomatic or infected symptomatic humans are the main carriers and multipliers of the virus, serving as a source of the virus for uninfected mosquitoes

Q.2. (b)

What is Dark <sup>Energy</sup> ~~Matter~~?

→ a mysterious form of energy that makes up approximately 68% of the universe and is responsible for the accelerating expansion of the universe

→ invisible, interacts with the universe primarily through gravity

→ is believed to counteract the gravitational pull that should be slowing the expansion of the universe

## Unknown Nature

→ dark energy remains one of the biggest mysteries in cosmology, as it is neither detectable directly through light nor through conventional forces of nature

Dark ~~Matter~~  
Energy  
Explained

## Role in Cosmic Expansion

→ dark energy is believed to exert a negative pressure, causing the universe's expansion to speed up over time rather than slow down

## Cosmological Constant

→ one possible dark energy explanation is the cosmological constant, a term introduced by Einstein, representing a constant energy density filling space

## What is Dark Matter?

→ a form of matter that does not emit, absorb, or reflect light, making it invisible to current instruments

→ it interacts gravitationally with visible matter, influencing the structure and behaviour of galaxies and clusters of galaxies

→ thought to make up about 27% of the universe's mass

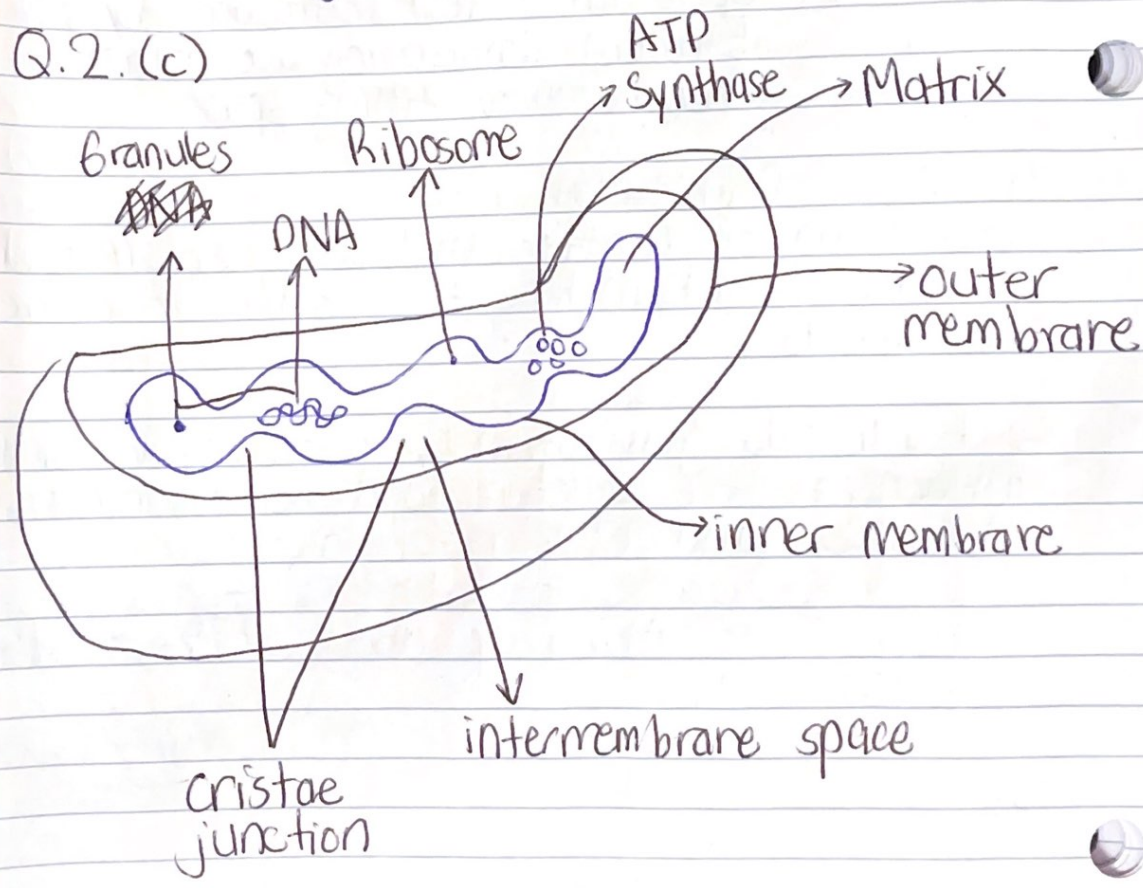
Role in Structure Formation  
→ dark matter's gravitational pull helped clump matter together in the early universe, acting as the "scaffolding" for the formation of galaxies

### Dark Matter Explained

Composition  
→ thought to be composed of yet-undiscovered particles, such as axions

Gravitational Effects  
→ dark matter's presence is inferred from its gravitational effect on galaxies and galaxy clusters

Q.2. (c)



## Structure of Mitochondria:

### ① Outer Membrane

→ smooth

→ contains proteins called porins, which allow ions and small molecules to pass freely in and out of the mitochondrion

### ② Inner Membrane

→ highly folded into structures called cristae, which increase the surface area and are integral for ATP Production

### ③ Intermembrane Space

→ space between the outer and inner membranes where protons accumulate during electron transport

### ④ Matrix

→ innermost compartment, which contains enzymes for the krebs cycle, mitochondrial DNA, and ribosomes

## Regulation of Cell Metabolism

→ mitochondria regulate metabolites involved in amino acid synthesis and oxidation, lipid metabolism

## Functions of Mitochondria

### Apoptosis

→ release signaling molecules to trigger programmed cell death, important for cell health

## ATP Production

→ through cellular respiration, mitochondria convert energy stored in food molecules into ATP via three main stages:

→ Glycolysis

→ krebs Cycle

→ Electron Transport Chain and Oxidative Phosphorylation

How Mitochondria are the "Powerhouse"

→ mitochondria generate ATP through the electron transport chain and oxidative phosphorylation.

→ when electrons from NADH and  $FADH_2$  move through the ETC, they create an electrochemical gradient by pumping protons into the intermembrane space.

→ this proton gradient powers ATP synthase, which phosphorylates ADP to produce ATP, the cell's main energy currency.

→ thus, mitochondria provide the energy required for various cellular activities, earning them the title of "powerhouse of the cell".

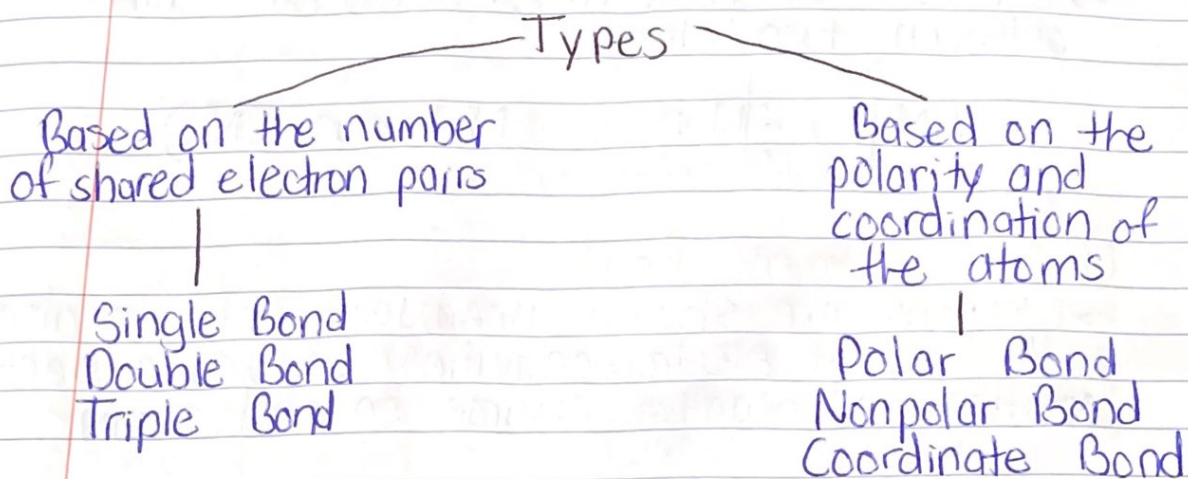
Q.2.(d)

What Are Covalent Bonds?

→ chemical bonds formed when atoms share pairs of electrons to achieve a stable electron configuration, typically filling their outer electron shells.

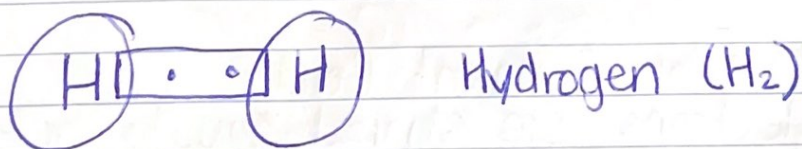
→ this sharing of electrons occurs primarily between non-metal atoms with similar electronegativities and results in the formation of molecules with strong bonds.

## Types of Covalent Bonds:



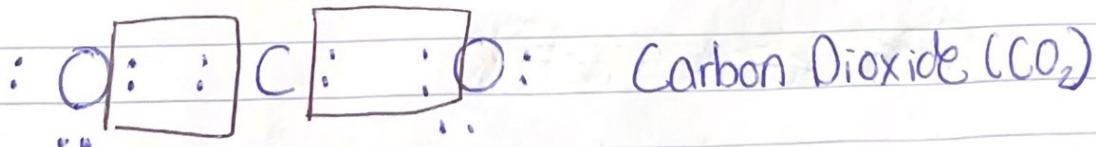
### ① Single Covalent Bond

→ one pair of electrons (2 electrons) is shared between two atoms

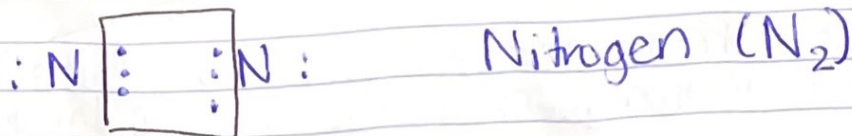


### ② Double Covalent Bond

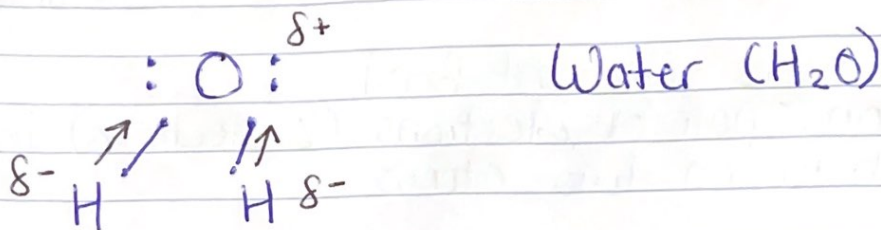
→ 2 pairs of electrons (4 electrons) are shared between 2 atoms



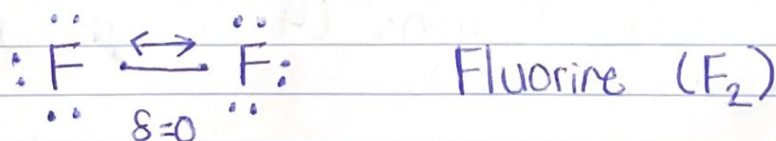
③ Triple Covalent Bond  
→ 3 pairs of electrons (6 electrons) are shared between two atoms



④ Polar Covalent Bond  
→ electrons are shared unequally between atoms with different electronegativities, causing a partial positive and negative charge on each atom



⑤ Nonpolar Covalent Bond  
→ electrons are shared equally between atoms with similar or identical electronegativities



~~Coordinate bond~~

Covalent Bonding Structures

- Linear Structure (e.g. CO<sub>2</sub>)
- Bent Structure (e.g. H<sub>2</sub>O)
- Trigonal Planar Structure (e.g. BF<sub>3</sub>)
- Tetrahedral Structure (e.g. CH<sub>4</sub>)



## General Ability

Q.6. (a)

$$\frac{9+8+10+12+k}{5} = 15$$

$$\begin{aligned} \rightarrow 39+k &= (15 \times 5) \\ 39+k &= 75 \\ k &= 75-39 \\ k &= 36 \end{aligned}$$

$\therefore$  The value of  
k is 36

Q.6 (b)

~~In a solution of 7 litres  
 $\hookrightarrow$  3 litres = colored water  
4 litres = sugar solution~~

~~In a solution of 17 litres  
 $\hookrightarrow$  4 litres = sugar solution  
5 litres = colored water~~

$$\text{initial sugar} = 4x \quad \text{initial water} = 3x$$

After adding 10 L to the mixture:

$$\begin{aligned} \frac{4x}{3x+10} &= \frac{4}{5} \rightarrow 20x = 12x + 40 \\ 8x &= 40 \\ x &= 5 \end{aligned}$$

$$\begin{aligned} \text{Initial quantity} &= (4x+3x) \\ &= (4 \times 5 + 3 \times 5) \\ &= 35 \text{ L} \end{aligned}$$

$\therefore$  initial quantity of sugar is 20 L

Q.6. (c)

$$\begin{aligned}\text{Volume} &= \frac{4}{3} \pi r^3 \\ &= \frac{4}{3} \cdot (3.1416) \cdot 12^3 \\ &= 7,238 \text{ cubic centimetres}\end{aligned}$$

Q.6 (d)

$$\begin{array}{ccccccc} -10 & , & -8 & , & 6 & , & 40 & , & 102 & & (200) \\ \underbrace{\hspace{1.5cm}} & & \underbrace{\hspace{1.5cm}} & & \underbrace{\hspace{1.5cm}} & & \underbrace{\hspace{1.5cm}} & & \underbrace{\hspace{1.5cm}} & & \\ +2^2-2 & & +4^2-2 & & +6^2-2 & & +8^2-2 & & +10^2-2 & & \end{array}$$

Q.8 (a)

$$n=7$$

$$\begin{aligned}\text{Brian charges} &\rightarrow 20 + (4 \times 7) \\ &= 20 + 28 \\ &= 48\end{aligned}$$

$\therefore$  He will charge 48 pounds

Q.8 (b)

- (i) replica
- (ii) humanity
- (iii)
- (iv)
- (v) teraph

Q.8 (d)



22 triangles