

Question #3

(a)

Mitochondria

→ **Structure:** 1. Double membrane

→ Outer membrane: smooth and protective

→ Inner membrane: highly folded into cristae (this increases surface area)

2. Inner space (matrix) contains enzymes, mitochondrial DNA, and ribosomes.

3. Have their own DNA, so they can make some of their own protein.

→ **Function:** 1. Site of cellular respiration

2. Produces ATP (adenosine triphosphate) - the cell's main energy currency

3. Helps regulate cell death (apoptosis) and heat production

→ **Why it is called 'powerhouse' of cell?**

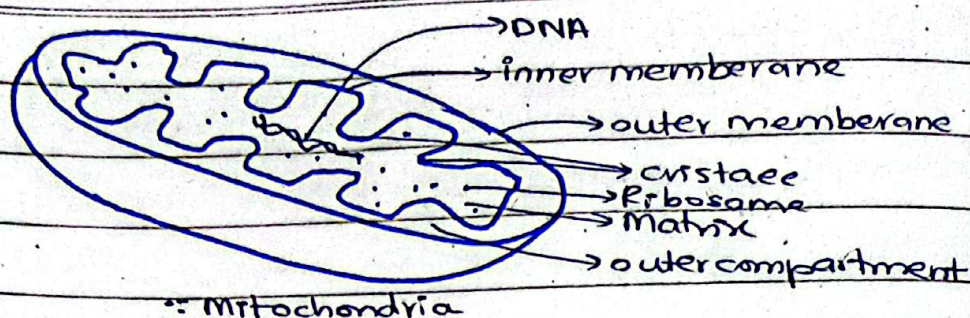
Because it produces most of the energy the cell needs to function. Through cellular respiration, it converts energy from food (like glucose) into ATP, which powers:

- muscle contraction
- Active transport
- cell division
- every energy demanding process

No mitochondria = no ATP = cells shut down. So, its powerhouse.

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Ribosomes

- Structure:**
1. Small, non-membrane-bound organelles
 2. Made of ribosomal RNA (rRNA) and proteins
 3. Found: Floating freely in cytoplasm or attached to the rough endoplasmic reticulum (RER)

- Function:**
1. Site of protein synthesis
 2. They 'read' messenger RNA (mRNA) and assemble amino acids into proteins.
 3. Free ribosomes make proteins used inside cell.
 4. Attached ribosomes make proteins that are exported or inserted into membranes.

Conclusion:

Hence, mitochondria helps in energy production and ribosomes help in protein synthesis.

———— (b) ————

Enzymes:

Enzymes are biological catalysts (usually proteins) that speed up chemical reactions in living cells without being used up in the process. They are :

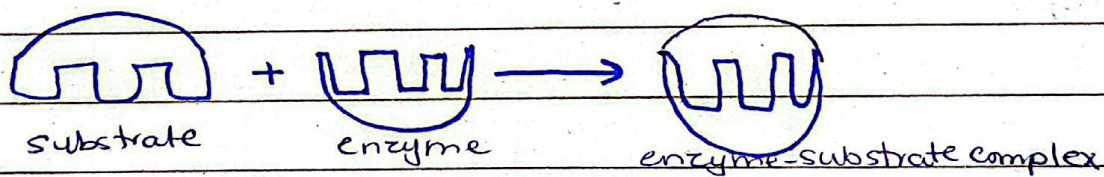
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- Highly specific in action.
- Required only in small amounts
- Control metabolic reactions like digestion, respiration and synthesis.

Lock & Key Model:

It is a theory explaining enzyme specificity, proposed by Emil Fischer in 1898, which suggests an enzyme's active site (the lock) is a rigid structure with a specific shape that precisely fits only one substrate (the key). This is like a key fitting into a lock. The enzyme-substrate complex is formed. The reaction occurs and products are released. The enzyme remains unchanged and can be reused. This model explains enzyme specificity. Only the correct substrate can bind to a particular ^{enzyme}.



∴ lock & key model

Factors affecting Enzyme Activity:

1. Temperature:

- Activity increases as temperature rises (more kinetic energy)

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- Works best at an optimum temperature ($\approx 37^{\circ}\text{C}$ in humans)
- High temperature denature enzymes, changing the active site shape.

2. pH:

- Each enzyme has an optimum pH.
- Extreme pH values can denature enzymes.
- Example: Pepsin (stomach): works best in acidic pH
Trypsin (intestine): works best in alkaline pH

Conclusion:

Enzymes are protein catalysts that speed up reaction. Lock and key model explains enzyme specificity.

(c)

	<u>Renewable Energy</u>	<u>Non-Renewable Energy</u>
Definition	Sources that are naturally replenished in a short time.	Sources that take millions of years to form.
Availability	Inexhaustible on a human scale.	Limited & can run out.
Environmental Impact	Generally eco-friendly and low pollution.	Cause pollution & greenhouse gas emissions.
Example	Wind, solar, hydro, biomass, geothermal	Coal, petroleum, natural gas, nuclear fuels.

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Sustain-
ability

Sustainable for long
term use.

Unsustainable for future
generations

Why Wind Energy has huge potential?

1. Renewable & Abundant:

- Wind is naturally occurring & will never be depleted.
- Available in many regions, especially coastal & high-altitude areas.

2. Environment-friendly:

- Produces no air pollution or greenhouse gases during operation
- Helps reduce dependence on fossil fuels & combat climate change.

3. Cost-effective in long run:

- High initial setup cost, but very low running cost
- Electricity from wind is becoming cheaper with advancing technology

4. Scalable & Flexible:

- Wind farms can set up onshore or offshore.
- Suitable for both large-scale power generation and small rural systems.

5. Energy security and jobs:

- Reduces dependence on imported fuels
- Creates employment in manufacturing, installation and maintenance.

Limitations:

1. Wind doesn't blow all the time.
2. Requires large land areas
3. Noise and visual impact concerns

Conclusion:

Wind energy is a clean, renewable & sustainable energy resource that can significantly reduce our reliance on non-renewable energy resource.

_____(d)____

Dengue Fever:

It is a viral disease caused by dengue virus & transmitted to humans through bite of an infected female mosquito. It is common in tropical & subtropical regions, especially during rainy seasons.

Vector responsible for transmission:

- The vector is female *Aedes aegypti* mosquito.
- Identified by white stripes on legs & body.
- Bites mainly during the daytime (early morning & late afternoon)
- Breeds in clean stagnant waters (coolers, flower pots, tanks, tyres)

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Symptoms:

Symptoms usually appear 3-14 days after the mosquito bite:

- Sudden high fever
- Pain behind eyes
- Skin rash
- Muscle & joint pain (breakbone fever)
- Severe Headache
- Nausea & vomiting
- Fatigue and weakness

In severe cases, dengue may lead to bleedings, low platelet count, or dengue hemorrhagic fever, which can be life-threatening.

Preventive Measure:

- Don't allow water to stagnate
- Clean water coolers & tanks regularly
- Cover water storage containers
- Use mosquito repellents
- Wear full sleeved clothes
- Use mosquito net and screens
- Proper waste disposal
- Spraying of insecticides

Question#5

_____ (a) _____

Balanced Diet:

It is a diet that provides all essential

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nutrients in right proportions needed to maintain good health, growth and energy. It should include:

- carbohydrates — energy giving food
- Proteins — body building food
- Fats — concentrated energy and insulation
- Vitamins — protective and regulatory nutrients
- Minerals — essential for body functions
- Water — transport and temperature regulation
- Dietary fibre (roughage) — helps digestion

Functions of Carbohydrates:

- Primary source of energy for the body
- Broken down into glucose, which fuels brain and muscles
- Excess carbohydrates are stored as glycogen in liver and muscles
- Help in proper functioning of central nervous system
- Spare proteins from being used as an energy ^{source}

Functions of Proteins:

- Growth & repair of body tissues
- Formation of enzymes, hormones and antibodies
- Essential for muscle development
- Help maintain fluid balance in the body
- Can provide energy when carbohydrates & fats

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are insufficient.

Conclusion:

Balanced diet includes all nutrients in correct amounts. Carbohydrates are main energy source and proteins are required for body building & repair.

———— (b) ————

Food Preservation:

It is process of treating and handling food to prevent or slow down spoilage, thereby maintaining its quality, safety and nutritional value for a longer period. It mainly works by controlling microorganisms, enzyme activity, and chemical reactions that cause food deterioration.

Pasteurization:

Principle: It works on principle of killing harmful microorganisms by heating food to a specific temperature for a specific time, followed by rapid cooling, without significantly affecting taste or nutrition.

Explanation:

- Commonly used for milk, fruit juices and liquid foods.
- Example (milk) : Heated to about 72°C for 15 seconds

then quickly cooled.

- Destroys disease-causing bacteria like *Mycobacterium* and *Salmonella*.
- Doesn't kill all microorganisms, so pasteurized food needs refrigeration.

Effect:

Increases shelf life & safety of food

Canning:

Principle: It works on principle of destroying microorganisms by heat and preventing recontamination by airtight sealing.

Explanation:

- Food is placed in clean cans or jars
- Heated at high temperature to kill microorganisms and spores
- Containers are sealed air-tight
- Absence of air prevents growth of microorganisms

Effect: Food can be stored for months or years without spoilage.

Conclusion:

Hence, pasteurization and canning are effective ways of food preservation to prevent spoilage.

—— (C) ——

Internet of Things (IoT):

It refers to network of physical objects embedded with sensors, software and internet connectivity that allows them to collect, share and act on data without direct human intervention. These things can sense their environment, communicate with other devices, and make smart decisions.

In Daily Life:

- Smart homes: lights, fans, ACs and appliances controlled via smart phones or voice
- Health monitoring: wearables track heart rate, steps, sleep, and oxygen levels
- Energy efficiency: smart meters reduce electricity and water wastage
- Convenience & automation: routine tasks happen automatically (alarms, reminders)

In Business:

- Real-time monitoring of machines & systems
- Predictive maintenance reduces breakdowns & downtime
- Supply chain optimization through tracking goods in transit.

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- Data-driven decision-making improves productivity & profits.

Real-world Examples:

1. Smart Home Systems:

- Smart thermostats, lights, and security cameras
- Controlled remotely using apps or voice assistants
- Improve comfort, safety & energy efficiency.

2. Industrial IoT:

- Sensors attached to factory machines
- Monitor temperature, vibration & performance
- Helps detect problems early & prevent costly failures

(d)

RAM (Random Access Memory) ROM (Read only Memory)

Nature	Volatile	• Non-volatile
Data retention	Loses data when power is off.	• Retains data even without power
Usage	Stores data and programs currently in use	• stores permanent instructions
Speed	Faster	• Slower than RAM
Modifiability	Read & Write	• mostly read-only
Example use	Running applications	• Booting the computer

Basic Architecture of Computer:

A computer system mainly consists of:

- Input Unit
 - Memory Unit
 - Central Processing Unit
 - Output Unit
- CPU is brain of Computer

CPU:

It performs all processing & control operations.

It consists of:

1. Control Unit (CU):

- Directs & coordinates all activities of computer.
- Fetches instructions from memory.
- Decodes instructions & controls execution
- Controls data flow between CPU, memory and input/output devices
- It doesn't process data, it only control operations.

2. Arithmetic Logic Unit (ALU):

- Performs arithmetic operations: addition, subtraction, multiplication, division.
- Performs logical operations: comparisons ($>$, $<$, $=$), AND, OR, NOT
- Makes decisions during program execution.
- ALU is where actual calculations and logic happen.

Question #8(a)

If ROAD is read as UQDG

R	O	A	D
+	+	+	+
3	3	3	3
U	Q	D	G

So,

LAKE is read as ODNH

L	A	K	E
+	+	+	+
3	3	3	3
O	D	N	H

(b)

She is wife of man's nephew.

(c)

(i) $4, \overset{\times 3}{12}, \underset{\div 2}{6}, \overset{\times 3}{18}, \underset{\div 2}{9}, \overset{\times 3}{27}, \underset{\div 2}{13.5}$

(ii) $1, \overset{\times 2}{2}, \overset{\times 3}{6}, \overset{\times 4}{24}, \overset{\times 5}{120}, \overset{\times 6}{720}$

(d)

T $\rightarrow$ S $\rightarrow$ Q $\rightarrow$ P $\rightarrow$ R

↓ ↓

(180cm) (150cm)

So, Q is the third tallest.

Maximum range = tallest - shortest

$$= 480 - 150$$

$$= 330 \text{ cm}$$

Question #7

—— (a) ——

Let x be the no. of people who watch both cricket & hockey.

Total = Cricket + Hockey + both + neither

$$100 = 65 + 40 - x + 20$$

$$x = 65 + 40 + 20 - 100$$

$$x = 25$$

—— (b) ——

Let width = w , then length = $w + 4$

Perimeter is

$$2(\text{Length} + \text{width}) = 72$$

$$2(w + 4 + w) = 72$$

$$4w + 8 = 72$$

$$w = 16$$

So, Length = 20, Volume for depth 2.5 m is

Volume = length $\times$ width $\times$ depth

$$= 20 \times 16 \times 2.5$$

$$= 800 \text{ m}^3$$

—— (c) ——

Relative speed of two trains is:

$$60 + 40 = 100 \text{ km/hr}$$

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Time to meet is =

$$\text{Time} = \frac{\text{Distance}}{\text{speed}}$$

$$= \frac{400}{100} = 4 \text{ hours}$$

meeting time is 8:00 AM + 4 hours = 12:00 PM

— (d) —

Let's father age = F, son's age = S, then

$$F + S = 75$$

$$F - 10 = 4(S - 10)$$

Simplifying second equation,

$$F = 4S - 40 + 10$$

$$= 4S - 30$$

Substitute into first equation,

$$4S - 30 + S = 75$$

$$5S = 105$$

$$S = 21$$

$$\text{Then, } F = 75 - S$$

$$= 75 - 21$$

$$= 54$$

So, father is 54 years & son is 21 years.