Grade 10 UP 2021 Science

Time : 2 Hours 15 Mins. **Total Marks : 70**

Part - A

Instructions for Part - A:

(i) Answer any two of Multiple-choice type questions from (a), (b), (c), (d) of Question No. 1. Each question carries 2 marks. $2 \times 2 = 4$ Marks

(ii) Answer any two from (a), (b), (c) of Question No. 2. Each question carries 3 marks. $2 \times 3 - 6$ Marks

(iii) Answer any one of Question No. 3 and Question No. 4. Each question carries 15 marks. [Question No. 3(a) $= 7\frac{1}{2}$ and Question No. 3(b) $= 7\frac{1}{2}$ OR Question No. 4 = 15 marks]

Q1. (a) When white light is incident on a prism which of the following colours is deviated most?

(i) Red (ii) Green

(iii) Yellow (iv) Violet

Solution:

(iv) Violet colour is deviated the most.

Violet light is the most deviated colour in the visible spectrum because it has the shortest wavelength and bends more than other colours.

(b) The radius of curvature of a mirror is 40 cm. Its focal length will be

(i) 20 cm (ii) 40 cm

(iii) 80 cm (iv) 160 cm

Solution:

(i) 20 cm

Given: Radius of curvature = 40 cm

Focal length = Radius of curvature/2.

F = 40/2 = 20 cm

(c) The filament of an electric bulb is made up of _____.

(i) Copper (ii) Tungsten

(iii) Nichrome (iv) Aluminium

Solution:

(ii) Tungsten

The filament of an electric bulb is made up of tungsten. It has a very high melting point, which allows it to glow without melting.

(d) The law for finding the direction of force acting on a current carrying conductor in magnetic field is

(i) Ohm's law (ii) Lenz's law

(iii) Fleming's right hand rule (iv) Fleming's left hand rule

Solution:

(iv) Fleming's Left-Hand Rule

Fleming's Left-Hand Rule is used to determine the direction of force acting on a current-carrying conductor placed in a magnetic field.

Q2. (a) Explain refraction through a prism.

(b) Differentiate between near point and far point of a human eye.

(c) Represent image formation by a convex lens when the object is placed between its focus and optical centre.

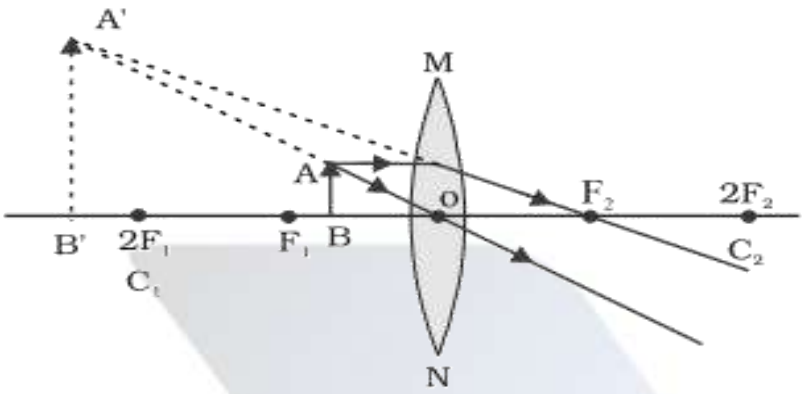
Solution:

(a) When light passes through a prism, it undergoes refraction twice—once at the air-prism boundary and once at the prism-air boundary. The light bends towards the normal while entering the prism and away from the normal while exiting. This bending causes the light to disperse into its constituent colours, forming a spectrum. The deviation is different for different colours, with violet deviating the most and red the least.

(b) The difference between near point and far point of a human eye is given below:

Feature	**Near Point**	**Far Point**
Definition	The closest distance at which the eye can focus clearly.	The farthest distance at which the eye can focus clearly.
Normal Value	25 cm (for a normal eye)	Infinity (for a normal eye)
Defect Related	Affected in hypermetropia (farsightedness)	Affected in myopia (nearsightedness)

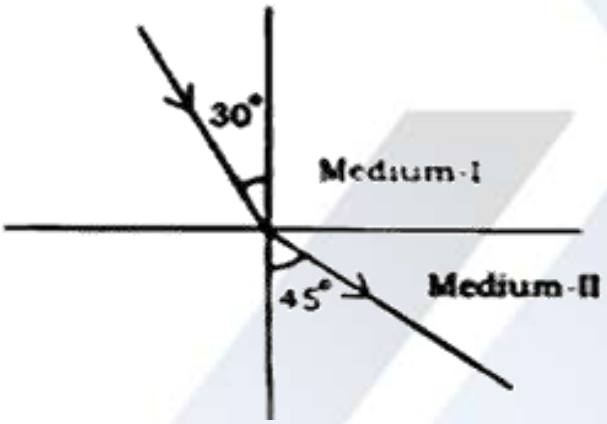
(c) Image formation is shown below:



Q3. (a) A person cannot see objects beyond 30 cm from his eyes. What is the defect of vision? Find the nature and focal length of the lens to correct this defect.

OR

A ray of light moving from Medium-I enters into Medium-II as shown in figure.



(i) Which of the two is denser medium?

(ii) Calculate the refractive index of Medium-II with respect to Medium-I.

(b) On what factors does the resistance of any conducting wire depend?

OR

Current of 5 A is moving through a wire. How much charge will flow through this wire in 10 minutes? Calculate the number of electrons flowing per second through the wire.

Solution:

(a) The given person is suffering from myopia (nearsightedness) because they cannot see far objects clearly. This occurs when the eyeball is too long or the lens is too curved, causing the image to form before the retina.

The corrective lens used is a concave lens that diverges light before it enters the eye.

The focal length (f) is calculated using the lens formula:

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

Here, **v** (image distance for a normal eye) is infinity, and **u** (the farthest point the person can see) is –30 cm.

$$\begin{aligned} \frac{1}{f} &= 0 - \frac{1}{-30} \\ f &= -30 \text{ cm} \end{aligned}$$

The focal length of the correcting lens should be –30 cm, and it should be a concave lens.

OR

(i) The given figure shows that the light ray bends away from the normal when entering Medium-II. This means that Medium-II is optically rarer than Medium-I. Therefore, Medium-I is denser than Medium-II.

(ii) Refractive index can be calculated using Snell's law:

$$n_1 \sin i = n_2 \sin r$$

where,

n_1 = Refractive index of Medium-I

n_2 = Refractive index of Medium-II

$i = 30°$ (Angle of incidence)

$r = 45°$ (Angle of refraction)

Since we need the refractive index of Medium-II with respect to Medium-I:

$$\begin{aligned} n_{21} = \frac{n_2}{n_1} &= \frac{\sin i}{\sin r} \\ n_{21} &= \frac{\sin 30°}{\sin 45°} \\ &= \frac{0.5}{0.707} \\ &= 0.707 \end{aligned}$$

(b) The resistance R of a wire depends on the following factors:

- Length of the Wire (L) → Resistance increases with length. $R \propto L$
- Cross-Sectional Area (A) → Resistance decreases with a larger area. $R \propto \frac{1}{A}$
- Resistivity (ρ) → Different materials have different resistivities. $R \propto \rho$
- Temperature → For most metals, resistance increases with temperature.

Mathematically,

$$R = \rho \frac{L}{A}$$

OR

Charge Flow and Number of Electrons Calculation:

Given:

- Current, $I = 5A$
- Time, $t = 10$ minutes $= 10 \times 60 = 600$ seconds
- Charge formula: $Q = I \times t$

$$Q = 5 \times 600 = 3000C$$

So, 3000 Coulombs of charge will flow through the wire.

Number of Electrons per Second

We use the formula:

$$Q = n \times e$$

where,

- $e = 1.6 \times 10^{-19}C$ (Charge of one electron)
- $n =$ Number of electrons

$$n = \frac{Q}{e} = \frac{3000}{1.6 \times 10^{-19}}$$
$$n = 1.875 \times 10^{22} \text{ electrons}$$

Since this is over 600 seconds, the number of electrons per second:

$$\frac{1.875 \times 10^{22}}{600} = 3.125 \times 10^{19} \text{ electrons per second}$$

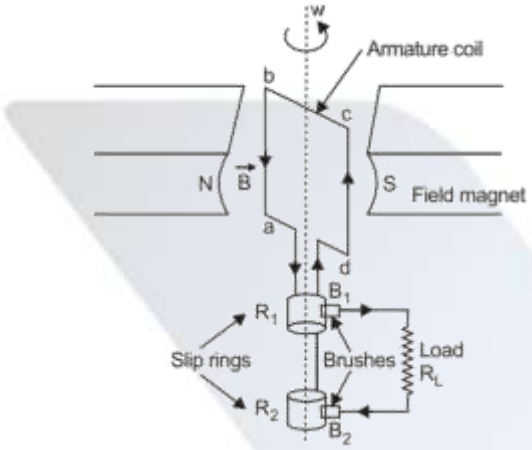
Q4. Explain the principle, construction and working of an A.C. dynamo with the help of a labelled diagram.

OR

What is meant by electromagnetic induction? Explain Faraday's experiment related with electromagnetic induction. Write the law for finding the direction of induced current.

Solution:

Principle: An A.C. dynamo works on the principle of electromagnetic induction. When a coil rotates in a magnetic field, the flux linked with the coil changes, inducing an alternating current (A.C.) in the coil.



Construction: An A.C. dynamo consists of:

- Armature Coil (ABCD): A rectangular coil that rotates in the magnetic field.
- Magnetic Field: Provided by a permanent magnet or an electromagnet.
- Slip Rings (R1, R2): Connected to the ends of the coil, they rotate along with the coil.
- Brushes (B1, B2): Stationary carbon contacts that transfer current from the slip rings to the external circuit.

Working: The coil is rotated between the North and South poles of a magnet. As the coil rotates, the magnetic flux changes, inducing a current in the coil (as per Faraday's Law). The direction of the current changes every half cycle, producing alternating current (A.C.). The slip rings ensure that the polarity of the output keeps changing, making the current alternating.

OR

Electromagnetic Induction: It is the production of electric current in a conductor due to a changing magnetic field.

Faraday's Experiment:

Setup:

- A coil is connected to a galvanometer.
- A bar magnet is used to create a changing magnetic field.

Observations:

- When the magnet is moved towards the coil, the galvanometer needle deflects, indicating an induced current.
- When the magnet is held stationary, no current flows.
- When the magnet is moved away, the current is induced in the opposite direction.
- Faster movement of the magnet induces a stronger current.

Part – B

Instructions for Part-B:

(i) Answer any two of Multiple choice type questions from (a), (b), (c) of Question No. 5. Each question carries 2 marks. $2 \times 2 = 4$ Marks

(ii) Answer any two from (a), (b), (c) of Question No. 6. Each question carries 3 marks. $2 \times 3 = 6$ Marks

(iii) Answer any one of Question No. 7 and Question No. 8. Each question carries 10 marks. $1 \times 10 = 10$ Marks

Q5. (a) On moving from left to right in a period in periodic table, the atomic number

(i) increases (ii) decreases

(in) remains constant (iv) first increases then decreases.

Solution:

(i) increases

On moving from left to right in a period, the atomic number increases as each successive element has one more proton.

(b) Which one of the following compounds is acidic in nature?

(i) CH_3CHO (ii) CH_3-CH_3

(iii) CH_3COOH (iv) CH_3

Solution:

(iii) CH_3COOH

CH_3COOH (Acetic Acid) is acidic in nature due to the presence of the –COOH (carboxyl) group.

(c) The chemical formula of bleaching powder is

(i) $Na_2CO_3.10H_2O$ (ii) $CaOCl_2$

(iii) NaOH (iv) K_2CO_3

Solution:

(ii) $CaOCl_2$

Bleaching powder is chemically known as Calcium Oxychloride.

Q6. (a) Write down the structural formulae of the following compounds:

(i) Butanone

(ii) 2-Methyl propanol-1

(b) What is modern periodic law? How many periods are there in the periodic table?

(c) Write two uses of each of the following compounds.

(i) Baking soda

(ii) Sodium hydroxide

Solution:

(a) Structural Formulae:

(i) Butanone (C_4H_8O) :

- Structural formula: $\mathbf{CH_3 - CO - CH_2 - CH_3}$
- Also called methyl ethyl ketone (MEK).

(ii) 2-Methylpropanol-1 ($C_4H_{10}O$) :

- Structural formula: $CH_3 - CH(CH_3) - CH_2 - OH$
- Also called Isobutanol.

(b) Modern Periodic Law: "The physical and chemical properties of elements are periodic functions of their atomic number."

Number of Periods: There are 7 periods in the modern periodic table.

(c) (i) Uses of Baking Soda ($NaHCO_3$):

- Used in baking as a leavening agent to make cakes and bread fluffy.
- Used as an antacid to relieve acidity and indigestion.

(ii) Uses of Sodium hydroxide (NaOH):

- Used in the manufacture of soap and detergents.
- Used in paper and textile industries for processing materials.

Q7. (a) The electronic configuration of the element A is 2,8,8,1. What will be the period number and group number of element A?

(b) Balance the following reactions:

(i) $Cu_2S + O_2 \xrightarrow{\Delta} Cu_2O + SO_2$

(ii) $CO_2 + H_2O \underset{chlotophyll}{\overset{Sunlight}{\rightarrow}} C_6H_{12}O_6 + O_2$

Solution:

(a) The period number is determined by the number of electron shells. Since element A has 4 shells (2, 8, 8, 1), it belongs to Period 4 and the group number is determined by the valence electrons. The outermost shell has 1 electron, meaning it belongs to Group 1 (alkali metals).

(b) Balanced equations are as follows:

(i) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

(ii) $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Q8. What happens when (write only reaction)-

(i) Sodium carbonate reacts with acetic acid?

(ii) Sodium hydraxide reacts with acetic acid?

(iii) Sodium reacts with ethyl alcohol?

(iv) Acetic acıd reacts with ethyl alcohol?

(v) Ethyl alcohol is heated at 443 K with conc. sulphuric acid?

OR

Write short notes on the following:

(i) Substitution reaction

(ii) Addition reaction

(iii) Esterification

(iv) Homologous series.

Solution:

(i) When sodium carbonate (Na_2CO_3) reacts with acetic acid (CH_3COOH), it produces sodium acetate (CH_3COONa), carbon dioxide (CO_2), and water (H_2O). This reaction is characterized by the effervescence (bubbling) due to the release of carbon dioxide gas.

$$Na_2CO_3 + 2CH_3COOH \rightarrow 2CH_3COONa + CO_2 + H_2O$$

(ii) When sodium hydroxide (NaOH) reacts with acetic acid (CH_3COOH), it forms sodium acetate (CH_3COONa) and water (H_2O). This is a neutralization reaction, where a strong base (NaOH) neutralizes a weak acid (CH_3COOH) to form a salt and water. The reaction is:

$$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$$

(iii) When sodium (Na) reacts with ethyl alcohol (C_2H_5OH), it forms sodium ethoxide (C_2H_5ONa) and hydrogen gas (H_2). This reaction is similar to the reaction of sodium with water but occurs at a slower rate. The release of hydrogen gas can be observed as effervescence (bubbling).

$$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2 \uparrow$$

(iv) When acetic acid (CH_3COOH) reacts with ethyl alcohol (C_2H_5OH) in the presence of concentrated sulfuric acid (H_2SO_4) as a catalyst, it forms ethyl acetate ($CH_3COOC_2H_5$) and water (H_2O). This is an esterification reaction, where an acid and an alcohol react to form an ester, which has a fruity smell.

$$CH_3COOH + C_2H_5OH \overset{Conc.H_2SO_4}{\rightarrow} CH_3COOC_2H_5 + H_2O$$

(v) When ethyl alcohol (C_2H_5OH) is heated to 443 K in the presence of concentrated sulfuric acid (H_2SO_4), it undergoes dehydration to form ethylene (C_2H_4) (an alkene) and water (H_2O).

$$C_2H_5OH \overset{443K, Conc.H_2SO_4}{\rightarrow} C_2H_4 + H_2O$$

OR

(i) Substitution Reaction:

- A chemical reaction in which one atom or a group of atoms in a molecule is replaced by another atom or group.
- Common in alkanes and aromatic compounds.
- Example:

  $$CH_4 + Cl_2 \overset{UV}{\rightarrow} CH_3Cl + HCl$$

  (Methane reacts with chlorine in the presence of UV light, replacing hydrogen with chlorine.)

(ii) Addition Reaction:

- A reaction in which two or more reactants combine to form a single product.
- Typical in alkenes and alkynes due to their double or triple bonds.
- Example:

  $$C_2H_4 + H_2 \overset{Ni}{\rightarrow} C_2H_6$$

(iii) Esterification:

- A reaction between a carboxylic acid and an alcohol to form an ester and water.
- Catalyzed by concentrated sulphuric acid (H_2SO_4).

- Example:

$$CH_3COOH + C_2H_5OH \xrightarrow{Conc.H_2SO_4} CH_3COOC_2H_5 + H_2O$$

(Acetic acid reacts with ethanol to form ethyl acetate, a sweet-smelling ester.)

(iv) Homologous Series:

- A series of organic compounds with the same functional group and a general formula, differing by a $-CH_2$ - unit.
- Members have similar chemical properties but show a gradual change in physical properties.
- Example (Alkane Series): $CH_4, C_2H_6, C_3H_8, C_4H_{10}, \ldots$
  (Methane, Ethane, Propane, Butane-each differs by a CH_2 unit.)

Part – C

Instructions for Part-C:

(i) Answer any two of Multiple choice type questions from (a), (b), (c), (d) of Question No. 9. Each question carries 2 marks. $2 \times 2 = 4$ Marks

(ii) Answer any two from (a), (b), (c) of Question No. 10. Each question carries 3 marks. $2 \times 3 = 6$ Marks

Q9. (a) Water soluble vitamin is

(i) Vitamin D (ii) Vitamin C

(iii) Vitamin A (iv) Vitamin K

Solution:

(ii) Vitamin C

Vitamin C is water soluble. Rest of the given vitamins are fats soluble.

(b) Bowman's capsule is the part of

(i) abdomen (ii) liver

(iii) pancreas (iv) kidney

Solution:

(iv) Kidney

Bowman's capsule is a cup-shaped structure in the kidney that surrounds the glomerulus. It helps in the formation of urine by filtering waste and excess substances from the blood.

(c) Male reproductive organ in an angiospermic plant is

(i) gynoecium (ii) androecium

(iii) ovule (iv) pollen tube

Solution:

(ii) Androecium

The androecium is the male reproductive organ in angiospermic plants (flowering plants).

(d) Which one of the following is not the principle of theory of natural selection of Darwin?

(i) Struggle for existence (ii) Survival of the fittest

(iii) Use and disuse of organs (iv) Origin of new species.

Solution:

(iii) Use and disuse of organs

Darwin's theory of natural selection is based on principles such as struggle for existence, survival of the fittest, and the origin of new species. However, the concept of "use and disuse of organs" was proposed by Jean-Baptiste Lamarck, not Darwin. Lamarck's theory suggested that organisms develop or lose traits based on their usage, which is not a part of Darwin's natural selection mechanism.

Q10. (a) Differentiate between homozygous and heterozygous.

(b) Mention the number and types of chromosomes found in male and female humans.

(c) Mendel conducted his experiment on pea plants having seven pairs of contrasting traits. Mention the dominant and recessive traits in length of stem and types of pod.

Solution:

(a) The difference between homozygous and heterozygous is given below:

Homozygous	Heterozygous
An organism has two identical alleles for a trait (e.g., TT or tt).	An organism has two different alleles for a trait (e.g., Tt).
Produces only one type of gamete.	Produces two types of gametes.
True-breeding for a trait.	Hybrid for a trait.
Example: TT (tall pea plant) or tt (dwarf pea plant).	Example: Tt (hybrid tall pea plant).

(b) Humans have 46 chromosomes (23 pairs) in each cell, which carry genetic information. Types of chromosomes:

- **Autosomes (22 pairs)**: These chromosomes control general body characteristics and are the same in both males and females.
- **Sex Chromosomes (1 pair)**: These determine the sex of an individual:
- **Male: XY** → Males inherit an X chromosome from the mother and a Y chromosome from the father.
- **Female: XX** → Females inherit one X chromosome from each parent.

(c) Gregor Mendel conducted experiments on pea plants and observed seven pairs of contrasting traits. For stem length and pod type, he found:

Stem Length:

- Dominant Trait: Tall (T) → When a pea plant carries at least one T allele, it grows tall.
- Recessive Trait: Dwarf (t) → A plant is dwarf only if it has two recessive tt alleles.

Pod Type:

- Dominant Trait: Inflated pod (I) → Pea plants with at least one I allele have full, swollen pods.
- Recessive Trait: Constricted pod (i) → The pod is pinched or narrow only if both alleles are ii.

Q11. (a) Describe any two sex-linked diseases in man.

OR

Explain the hypothesis of biochemical origin of life propounded by Oparin.

(b) Describe Lamarckism.

OR

Comment upon the following:

(i) Functions of liver

(ii) Fat soluble vitamins.

Solution:

(a) Two Sex-Linked Diseases in Humans:

1) **(Haemophilia:** A genetic disorder where the blood does not clot properly due to the absence of clotting factors. It is caused by a recessive gene on the X chromosome. More common in males, as they have only one X chromosome. A small injury can lead to excessive bleeding.

2) **Colour Blindness:** A condition where a person cannot distinguish certain colours, especially red and green. Caused by a recessive gene on the X chromosome. More common in males, as they inherit only one X chromosome from their mother. Affected individuals may have trouble identifying traffic signals or coloured objects.

OR

Oparin's Hypothesis on the Biochemical Origin of Life: A.I. Oparin (1924) proposed that life originated through gradual chemical evolution. In the primitive Earth, the atmosphere contained ammonia (NH_3), methane (CH_4), hydrogen (H_2), and water vapour (H_2O). Due to lightning and UV radiation, these gases combined to form simple organic molecules like amino acids. Over time, these molecules combined to form complex compounds like proteins and nucleic acids, eventually leading to the formation of primitive cells.
This idea was later supported by the Miller-Urey experiment (1953), where scientists created amino acids in a laboratory by simulating early Earth conditions.

(b) Jean-Baptiste Lamarck proposed the theory of **Lamarckism**, which explains how organisms evolve based on use and disuse of body parts. His main ideas:

- Use and Disuse: Body parts that are frequently used develop better, while unused parts become weak or disappear.
- Example: Giraffes developed long necks because they stretched them to reach higher leaves.
- Inheritance of Acquired Traits: Changes an organism acquires during its lifetime are passed to its offspring.
- Example: If a blacksmith develops strong arms due to work, his children would also be born with strong arms (this idea was later proven incorrect).

OR

(i) **Functions of the Liver:**
The liver is the largest internal organ in the human body.
Main functions are:

- Detoxification: Removes harmful substances from the blood.
- Bile Production: Helps in the digestion of fats.
- Storage of Nutrients: Stores glycogen (energy), vitamins, and minerals.

- Blood Clotting: Produces proteins essential for blood clotting.

(ii) **Fat-Soluble Vitamins:**

Fat-soluble vitamins are stored in body fat and do not dissolve in water.

Types and Functions:

- Vitamin A: Important for vision and immune system. Found in carrots, eggs, and dairy products.
- Vitamin D: Helps in calcium absorption and bone health. Found in sunlight, fish, and dairy products.
- Vitamin E: Acts as an antioxidant and protects cells. Found in nuts, seeds, and spinach.
- Vitamin K: Helps in blood clotting. Found in leafy green vegetables and soybeans.

Q12. Describe the functions of different enzymes secreted by pancreas. Add a note on diabetes mellitus also.

OR

Differentiate between breathing and respiration. Describe the mechanism of inspiration and expiration in detail.

Solution:

Functions of different enzymes secreted by pancreas are:

Amylase:

- Breaks down starch into simple sugars (maltose).
- Helps in digesting carbohydrates.

Trypsin:

- Breaks down proteins into smaller peptides.
- Helps in protein digestion.

Lipase:

- Breaks down fats into fatty acids and glycerol.
- Helps in fat digestion.

Diabetes mellitus is a condition caused by a lack of insulin or the body's inability to use it properly, leading to high blood sugar levels. It has two types: **Type 1**, where the body does not produce insulin, and **Type 2**, where the body does not respond to insulin effectively.

OR

The difference between breathing and respiration is given below:

Breathing	**Respiration**
It is a physical process of taking in oxygen and removing carbon dioxide.	It is a chemical process in which food is broken down to release energy.
Involves lungs and the muscles of the respiratory system.	Takes place in cells using oxygen to produce ATP (energy).
No energy is produced.	Energy is released in the form of ATP.
Example: Inhaling and exhaling air.	Example: Glucose breaking down to release energy.

The process of breathing involves two main phases:

Inspiration (Inhalation) – Taking in Air

- The diaphragm contracts and moves downward.
- The ribcage moves upward and outward.
- The chest cavity increases, reducing air pressure inside the lungs.
- As a result, air rushes into the lungs.

Expiration (Exhalation) – Breathing Out

- The diaphragm relaxes and moves upward.
- The ribcage moves downward and inward.
- The chest cavity decreases, increasing pressure in the lungs.
- As a result, air is pushed out of the lungs.