

Grade 10 Science and Technology Maharashtra 2015

SECTION A

Q1. (A) (a) Rewrite the following statements with suitable words in the blanks:

(i) The device used for producing electric current is called a _____.

Solution: Generator

An electric generator generates electric current by converting mechanical energy into electrical energy.

(ii) _____, the second layer of the atmosphere reaches 48 km above the earth's surface.

Solution: Stratosphere

(b) Rewrite the following table to match the second column with the first column:

Column A	Column B
eosin	losing hydrogen
oxidation	synthetic indicator
	losing oxygen
	neutral indicator

Solution:

Column A	Column B
eosin	synthetic indicator
oxidation	Losing hydrogen

(c) Give the molecular formula of bleaching powder.

Solution:

The chemical formula of bleaching powder is CaOCl_2 .

(B) Rewrite the following statements by selecting the correct options:

(i) When phenolphthalein is added to NaOH , the colour of the solution will become:

- (A) colourless
- (B) red
- (C) pink
- (D) yellow

Solution: (C) pink

In an alkaline solution, phenolphthalein appears pink because it acts as an indicator, signaling the endpoint by reacting with hydroxide ions. In an acidic solution, it turns colorless.

(ii) If the potential difference across the ends of a conductor is 220 V and the resistance of the conductor is 44Ω (ohm), then the current flowing through is:

- (A) 0.2 A
- (B) 0.5 A
- (C) 2 A
- (D) 5 A

Solution: (D) 5A

Using Ohm's law, we can find the current

$$I = V/R.$$

Here, supposedly $V = 220$ volts and $R = 44\Omega$

$$\text{Hence, } I = 220/44 = 5 \text{ A}$$

(iii) $1 \text{ A} = \underline{\hspace{2cm}} \text{ mA}$

- (A) 10^2
- (B) 10^3
- (C) 10^{-3}
- (D) 1^{-6}

Solution: (B) 10^3A

Given that $1 \text{ A} = 1\text{C}/1 \text{ s}$

$$1 \text{ A} = 10^3 \text{ mA}$$

(iv) The distance between principal focus and optical centre of the lens is:

- (A) diameter
- (B) focal length
- (C) principal axis
- (D) optical centre

Solution: (B) focal length

The focal length is the distance between the optical center of the lens and its principal focus.

(v) When rays of light are incident on a glass slab, then the incident ray and emergent ray are to _____ each other.

- (A) perpendicular
- (B) parallel
- (C) opposite
- (D) concurrent

Solution: (B) parallel

Q2. Answer any five of the following:

(i) Give scientific reason: Danger signals are red in colour.

Solution:

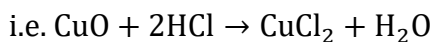
The color red experiences the least scattering by air molecules, making it ideal for use in warning signals. This is because the scattering effect is inversely proportional to the fourth power of a color's wavelength. Since red light has the longest wavelength among all colors, it scatters the least. As a result, red light is chosen for danger signals, as it can travel the farthest through conditions like fog and rain.

(ii) Complete the following reaction, balance it and write the name of the products:



Solution:

Copper oxide reacts with hydrochloric acid to form cupric chloride (copper chloride) and water.



(iii) State Newlands' Law of Octaves.

Solution:

The law of octaves states that when elements are arranged in order of increasing atomic mass, every eighth element exhibits similar properties.

(iv) The velocity of light in a medium is $1.5 \times 10^8 \text{ m/s}$. What is the refractive index of the medium with respect to air, if the velocity in air is $3 \times 10^8 \text{ m/s}$?

Solution:

The velocity of light (v_2) in a medium is $1.5 \times 10^8 \text{ m/s}$, But the velocity in air (v_1) is $3 \times 10^8 \text{ m/s}$. Let's find the refractive index of the given medium with respect to air.

$$\text{Hence, } n = \frac{v_1}{v_2}$$

$$\text{That is } n = \frac{(3 \times 10^8)}{1.5 \times 10^8} = \frac{3}{1.5} = 2$$

$$\text{So, } n = 2$$

Hence, the refractive index of the medium relative to air is 2.

(v) Differentiate between resistances in series and parallel.

Solution:

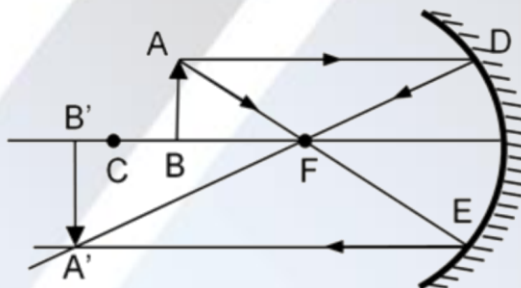
Resistance in series	Resistance in parallel
In an electrical circuit, components are arranged in a line	In an electrical circuit, components are arranged parallel to each other.
The same amount of current flows through all the components	The current flowing through each component is different
The voltage across each resistor is different.	The voltage across each of the resistors is the same.
$R_{eq} = R_1 + R_2 + R_3 + \dots$	$R_{eq} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \dots}$

If one component breaks down, the other components in the whole circuit will stop working.	Even If one component breaks down, the other components remain functioning effectively.
If V is the total voltage, then $V=V_1 + V_2 +V_3$	If V is the total voltage, then $V= V_1 = V_2 = V_3$

(vi) Draw a ray diagram for a concave mirror when the object is between the centre of curvature and focus.

Solution:

When an object is positioned between C and F in front of a concave mirror, two specific rays are considered: one that travels parallel to the principal axis and another that passes through the principal focus. As a result, a magnified image is formed beyond C . This image is real and inverted.



Q3. Answer any five of the following:

(i) Explain the role of citizens in pollution control.

Solution:

Citizens play a crucial role in pollution control through individual actions and collective efforts to reduce environmental harm.

- Minimize waste by recycling and reusing items to reduce landfill pollution.
- Choose public transport, carpool, or walk to reduce air pollution from vehicles. Air pollution can be controlled by replacing traditional fuels with alternatives like CNG, instead of diesel or petroleum.

- Industrial emissions are a major contributor to pollution, controlling or treating these pollutants at their source can help reduce their impact. Using less polluting raw materials can also be a solution.
- Ensure that your vehicle undergoes regular emission testing.
- Avoid dumping waste in water bodies or public spaces to prevent pollution.
- Increasing the number of trees, particularly in highly populated regions, can help absorb pollutants and enhance air quality.
- Save water, energy, and other resources to decrease environmental impact.

(ii) What is a spectrum? Why do we get a spectrum of seven colours when white light is dispersed by a prism?

Solution:

When white light passes through a prism, it splits into a spectrum of seven colors, demonstrating that white light is a combination of these different colors.

Additionally, explore the concept of dispersion in a prism with a diagram illustrating the dispersion of light, as well as the refraction and dispersion of light through a prism.

(iii) State four most common electrical appliances based on the heating effect of electric current. Why do we use finely heated platinum wire in surgery?

Solution:

The four most common electrical appliances based on the heating effect of electric current are

- Electric iron
- Electric heater
- Electric oven
- Electric toaster.

A finely heated platinum wire was used for the surgery instead of a knife because it heats quickly and evenly without harming surrounding tissue. Platinum is preferred as it has a high melting point (1768°C), is durable, and does not react

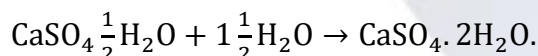
with body tissues during the surgery.

(iv) Name the product obtained when Plaster of Paris is mixed with water. State the use of the product. Give two uses of POP.

Solution:

The chemical formula of Plaster of Paris (POP) is $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$.

When the POP mixed with water, it gives Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) as the product.



Uses of Plaster of Paris (POP):

- In hospitals, Plaster of Paris (POP) is used as a cast to hold fractured bones in the correct position.
- It is used for creating decorative items and for smoothing wall surfaces.
- POP serves as a fire-resistant material.

(v) Classify the following elements into metals, nonmetals and metalloids:

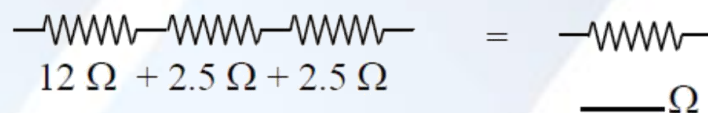
C, Mg, Si, S, Hg, As.

Solution:

Among the given elements, metals are Mg and Hg, while non-metals include C and S, whereas metalloids, are Si, As.

(vi) Complete the following:

a.

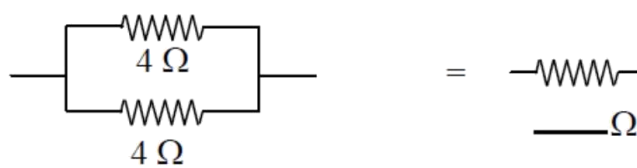


Solution: 17 Ohm

From the given figure, the resistors are connected in series.

$$\text{Here, } R = R_1 + R_2 + R_3 = 12 + 2.5 + 2.5 = 12 + 5 = 17\Omega$$

b.



Solution:

In the given figure, the resistors are connected in parallel.

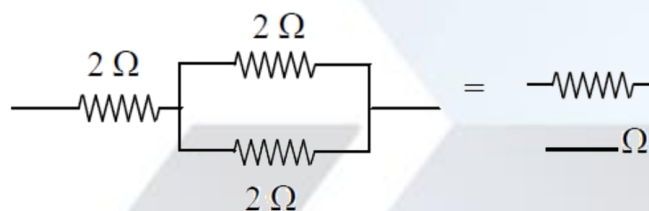
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

Now, on applying values you will get $\frac{1}{R} = \frac{1}{4} + \frac{1}{4} = 1/2$

Therefore, $\frac{1}{R} = \frac{1}{2}$

$R = 2$ Ohms

c.



Solution:

First, let us find the total resistance for the parallel connection

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

So, $\frac{1}{R_2} = \frac{1}{2} + \frac{1}{2} = 1$

Therefore, $\frac{1}{R_2} = 1$

With $R_2 = \frac{1}{1} = 1$ ohm

Now, R_1 has already been given as 2 ohms, and you have observed that R_1 and R_2 are connected in series

So, $R = R_1 + R_2 = 2 + 1 = 3$ Ohms

Q4. Attempt any one of the following:

(A) Often when electricity is used we come across electrical fires. Answer the following questions related to the following terms:

- a. When does short circuiting take place?
- b. What happens to the resistance of the circuit during a short circuit?
- c. What happens to the flow of electric current during a short circuit?
- d. What is overloading?
- e. How can the effects of overloading be avoided?

Solution:

(a) A short circuit occurs when faulty wire insulation or a malfunctioning appliance causes the live and neutral wires to touch, allowing excessive current to flow through the circuit. A short circuit happens when the live wire touches the neutral wire.

(b) During a short circuit, the resistance decreases because the current bypasses its normal path, resulting in a large flow of current through the wire.

(c) During a short circuit, the flow of electric current increases rapidly because the resistance in the circuit becomes very low. This can cause overheating, damage to appliances, or even a fire.

(d) Overloading occurs when too many electrical appliances are connected to a single circuit, or when appliances draw higher current than the circuit can handle. This excessive current lead to overheating of wires, damage to appliances, or even a fire hazard.

(e) Here are some simple precautions to avoid overloading:

(i) Do not use more power than the fuse can handle.

(ii) Use good-quality materials like fuses, MCBs, wires, and plugs.

(iii) Always connect a fuse in series with the circuit.

(iv) Ensure the wiring in your home is of the correct capacity to handle the required load.

(v) Do not connect multiple high-power appliances to a single circuit.

(B) In a Std X class, out of 40 students, 10 students use spectacles, 2 students have positive power and 8 students have negative power of lenses in their spectacles.

Answer the following questions:

- a. What does the negative power indicate?

- b. What does the positive power indicate?
- c. Generally which type of spectacles do most of the students use?
- d. What defect of eyesight do most of the students suffer from?
- e. Give two possible reasons for the above defect.

Solution:

- (a) The negative power of lenses indicates that the student has myopia (short-sightedness), meaning they can see things that are close clearly, but things far away look blurry.
- (b) The positive power of lenses indicates that the student has hypermetropia (long-sightedness), meaning they can see distant things clearly, but things that are nearby look blurry.
- (c) Most students use spectacles with negative power lenses (8 out of 10 students). They use diverging or concave lens spectacles.
- (d) Majority of the students suffer from myopia / near-sightedness.
- (e) Major reasons for myopia:
 - When the ciliary muscles do not relax sufficiently, the converging power of the eye lens is high
 - Due to the elongation of eyeball, the distance between the eye lens and retina increase which results in focusing the light in front of retina.

SECTION B

Q5. (A)

(a) Find the correlation in the given pair and rewrite the

(i) Tinning : Tin :: Galvanizing : _____

Solution: Zinc

Galvanizing is the process of applying a thin layer of zinc to iron or steel to protect it from rusting, whereas tinning refers to coating steel with a thin layer of tin to prevent corrosion.

(ii) Mammals: _____ :: Amphibia : Fishes.

Solution: Reptiles

(b) State True or False:

(i) Solar water-heater work on renewable energy systems.

Solution: True.

Solar energy is a renewable source of energy.

(ii) In human beings, the blood goes to the heart in one cycle once.

Solution: False.

In humans, blood circulates through two pathways: systemic and pulmonary circulation. Systemic circulation involves the flow of blood from the heart to various body parts and back to the heart, while pulmonary circulation refers to the movement of blood from the heart to the lungs and back.

(iii) In frogs, thyroid secretion stimulates the metamorphosis from tadpole to adult frog.

Solution: True

(B) Rewrite the following statements by selecting the correct options:

(i) The molecular formula of acetic acid is .

(A) CH_3COOH

(B) $\text{CH}_3 - \text{CH}_3$

(C) C_6H_8

(D) C_2H_4

Solution: (A) CH_3COOH

(ii) Carbon dioxide enters into the leaves through tiny pores present on the surface of the leaf called _____.

(A) chlorophyll

(B) chloroplast

(C) stomata

(D) epidermis

Solution: (C) stomata

(iii) _____ solution is blue in colour.

(A) CuSO_4

(B) FeSO_4

(C) ZnSO_4

(D) $\text{Al}_2(\text{SO}_4)_3$

Solution: (A) CuSO_4

(iv) Yeast reproduces by _____

(A) spore formation

(B) multiple fission

(C) fragmentation

(D) budding

Solution: (D) budding

(v) Raisins put in water absorb water by the process of _____

(A) diffusion

(B) osmosis

(C) transpiration

(D) excretion

Solution: (B) osmosis

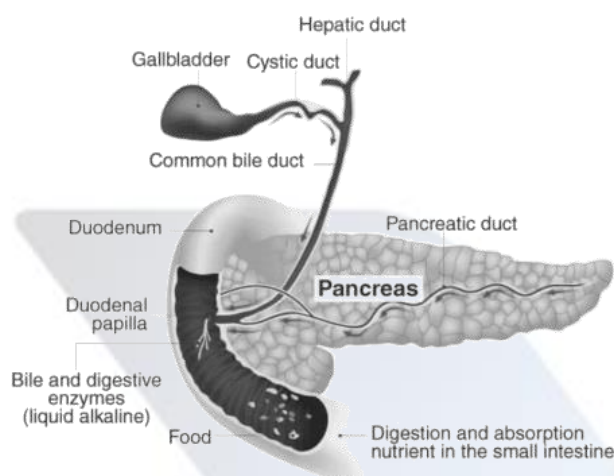
Q6. **Solve any five of the following:**

(i) Give scientific reason: Common salt has a high melting point and boiling point.

Solution: Common salt (sodium chloride) has a high melting and boiling point because it consists of ionic bonds. The positively charged sodium ions (Na^+) and negatively charged chloride ions (Cl^-) are strongly attracted to each other by electrostatic forces. To break these strong bonds and change the state, a significant amount of energy is required, resulting in high melting and boiling points.

(ii) Draw a neat, labelled diagram of the Pancreas with their associated structures.

Solution:



(iii) State the connecting links between Peripatus with Annelida and Arthropoda.

Solution:

(a) The connecting links between Peripatus and Annelida are:

Segmental Nephridia: Excretory structures similar to those found in annelids.

Thin Cuticle: A soft outer covering, like in annelids.

Parapodia-like Appendages: Appendages resembling parapodia, which are found in annelids.

(b) The connecting links between Peripatus and Arthropoda are:

Trachea: A respiratory system similar to that of arthropods.

Open Circulation: Circulatory system in which blood flows freely into body cavities, similar to arthropods.

(iv) Name the two plant hormones and state their functions.

Solution:

Plant hormones regulate various growth and developmental processes, including cell division, cell enlargement, flowering, seed formation, dormancy, and abscission.

(a) Auxins promote cell elongation, regulate growth, and help in the formation of roots. They are involved in phototropism (growth towards light) and gravitropism (growth in response to gravity).

(b) Gibberellins promote stem elongation, seed germination, and flowering. They are also responsible for breaking seed dormancy and promoting fruit development.

(v) Differentiate between Toilet soap and Laundry soap.

Solution:

Toilet soap	Laundry soap
Toilet soap is made with high-quality fats, oils as raw materials	Laundry soap is made with cheap quality fats, oils as raw materials
Expensive perfumes and colors are added to make them more attractive.	Cheap perfumes and colors are added.
It also doesn't contain any fillers.	It contains fillers like sodium rosinate, sodium silicate, borax, and sodium carbonate.
Care is taken to ensure that there is no free alkali to avoid skin irritation.	No such care is taken.

(vi) State any four objectives of sustainable development.

Solution:

Here are four key objectives of sustainable development:

- Reduce pollution by using eco-friendly methods.
- Use natural resources wisely to ensure they last for future generations.
- Take care of the environment.
- Support steady economic growth.

Q7. Answer any five of the following:

(i) What is an alloy? Give two examples with their chemical composition.

Solution:

An alloy is a combination of two or more metals, or a metal and a non-metal.

Metals are mixed in fixed proportions by weight while they are in a molten state to create an alloy. Over 90% of the metals we use are actually alloys.

Two examples of alloys are:

Magnalium: An alloy of aluminium and magnesium (Al, Mg), with 95% aluminium (Al) and 5% magnesium (Mg).

Brass: An alloy of copper and zinc (Cu, Zn), with 80% copper (Cu) and 20% zinc (Zn).

(ii) Name the following:

- a. Cells that assist the neuron in their function.
- b. The small gap between the consecutive neurons.
- c. Part of the brain that coordinates the voluntary functions.

Solution:

- (a) Schwann cells
- (b) Synapse or synaptic cleft
- (c) Cerebellum

(iii) Explain the process of fertilization, development and birth in human beings.

Solution:

Fertilization, Development, and Birth in Humans

Fertilization:

Fertilization happens when the male sperm joins with the female egg. The sperm is released from the male reproductive organ (penis) and enters the female body through the vagina. It travels to the fallopian tubes where it meets the egg. This is where fertilization occurs, forming a fertilized egg (zygote).

Development:

The zygote starts dividing and forms a ball of cells, eventually becoming a blastocyst, which attaches to the uterus lining. Over time, it grows into an embryo, which develops into a fetus with all major organs forming.

Birth:

After about 9 months of growth, the baby is ready to be born. In labor, the uterus contracts to push the baby out through the birth canal. After the baby is born, the placenta, which supported the baby, is also delivered. The baby starts breathing and its organs begin functioning on their own.

This process helps create a new human life, starting with fertilization, growing in the womb, and ending with birth.

(iv) What are vestigial organs? Give two examples each in human beings and plants

Solution:

Vestigial organs are body parts, tissues, or cells that no longer function as they did in their ancestors. These organs provide evidence of evolution and help explain how species adapt over time.

Examples in Humans:

Appendix: A small organ with no important function today.

Tailbone: The small bone at the end of the spine, a leftover from when humans had tails.

Examples in Plants:

Seedless Fruits: Fruits like bananas have tiny, unused seeds.

Stipules: Small leaf-like parts at the base of some plant stems that no longer serve a purpose.

(v) What is recycling waste? Explain with one example. State two advantages of recycling.

Solution:

Recycling is the process of turning waste materials into new products. It helps prevent waste, reduces the need for fresh raw materials, saves energy, and cuts down on air and water pollution. It also lowers greenhouse gas emissions compared to making new plastic.

Plastic Recycling: This involves collecting waste plastic and turning it into new products. For example, soft drink bottles can be melted down and turned into plastic chairs and tables.

Two Advantages of Recycling:

(1) Reduces Landfill Waste: Recycling helps to keep trash out of landfills, which not only look bad but also smell and can harm nearby communities. Instead of filling landfills, we can recycle materials like food for compost or cans to make new ones.

(2) Helps the Environment: Recycling benefits the environment in several ways: It cuts down on pollution by preventing waste from being burned, and manufacturers can reuse materials, saving energy. Recycling hazardous waste stops it from leaking into the ground and damaging ecosystems or water supplies.

(vi) Which mode of reproduction gives rise to variation? Give the importance of variation in survival of species.

Solution:

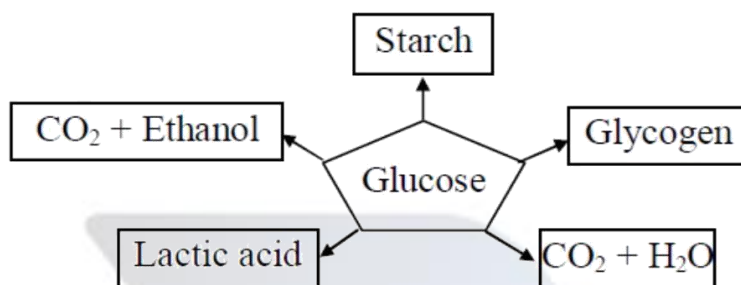
Sexual reproduction leads to more variation than asexual reproduction because of DNA copying errors and the involvement of two parents. In sexual reproduction, the offspring inherits a mix of traits from both parents, creating variation. In asexual reproduction, the offspring are exact copies of the parent, with no mixing of genes, so variation accumulates slowly over generations.

Genetic variation is essential for evolution. Without it, a species cannot adapt to changes and may become extinct. If genetic variation is low, there will be little diversity in traits, making it hard for the species to survive. Therefore, genetic diversity is crucial for a species' survival.

Q8. Attempt any one of the following:

(A) Given below are the end products of different reactions involving glucose.

Write the appropriate end product in front of the following:



- i. Anaerobic reaction =
- ii. Reaction in human muscles =
- iii. Aerobic respiration =
- iv. Reaction in plant cells =
- v. Reaction in liver =

Solution:

(A)

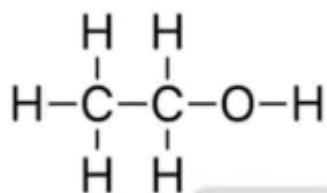
- (i) Anaerobic reaction is $\text{CO}_2 + \text{Ethanol}$
- (ii) Reaction in human muscles = Lactic acid
- (iii) Aerobic respiration = $\text{CO}_2 + \text{H}_2\text{O}$
- (iv) Reaction in plant cells = Starch
- (v) Reaction in liver = Glycogen

(B) Answer the following questions:

- i. Give other two names of ethanol.
- ii. Give the structural formula of ethanol.
- iii. Give two properties of ethanol.
- iv. Explain the action of phosphorus trichloride with ethanol. Write the balanced chemical equation of the above reaction.

Solution:

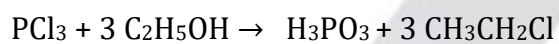
- (i) Other two names of Ethanol are Ethyl alcohol / Alcohol or Grain Alcohol and Cologne Spirit
- (ii) The structural formula of ethanol is as follows:



(iii)

- (a) It is a flammable liquid that can easily evaporate.
- (b) It dissolves in both water and organic solvents.
- (c) Ethanol is a colourless liquid.
- (d) It has a pleasant odour.
- (e) It has low melting and boiling points.

(iv) PCl_3 reacts with ethanol and produces orthophosphorous acid and ethyl chloride. The balanced chemical equation for the above reaction:



Hence proved.