

**Maharashtra State Board  
Class X Science and Technology  
Board Paper – 2014 Solution**

**SECTION A**

**1.**

(A)

(a)

- i. blue
- ii. germanium
- iii. soap

(b)

- i. False. It is an example of a displacement reaction.
- ii. True.

(B)

- i. (b) Cu. When iron nails are kept in a copper sulphate solution, the more reactive element iron displaces the less reactive element copper from copper sulphate and forms ferrous sulphate.  
$$\text{Fe}_{(s)} + \text{CuSO}_{4(aq)} \rightarrow \text{FeSO}_{4(aq)} + \text{Cu}_{(s)}$$
- ii. (c) It will become one-fourth. According to Ohm's law, the product of current and resistance should remain constant if the potential applied is the same. Hence, if resistance is made four times, then current should be one-fourth.
- iii. (c)  $40^\circ$ . The ray of light strikes at an angle of  $50^\circ$  with the horizontal. The angle of incidence is with respect to the normal, so the angle of incidence is  $90 - 50 = 40^\circ$ .
- iv. (d) Lichen. Litmus is a water soluble mixture of different dyes extracted from lichens, especially *Roccella tinctoria*.
- v. (a) Series. The effective resistance in series is the sum of individual resistances. So, the resistances should be connected in series in order to increase the effective resistance.

***[Please note that the explanation provided is to help you in learning. You may not be required to write an explanation in your answer to this question.]***

2.

i.

- (a) The number of valence electrons in the outermost shell of an atom of an element is equal to the valency of an element.
- (b) The number of valence electrons for all the elements in a group is the same. Therefore, the elements in the same group have the same valency.
- (c) For example, the elements of Group I such as sodium (Na) and potassium (K) contain only one valence electron, and so, the valency of elements of Group I is one. Similarly, for Group II, the valency is two.

ii.

Data :  $I = 0.24 \text{ A}$ ,  $V = 24 \text{ V}$

To find:  $R = ?$

Solution:  $V = IR$

$$R = \frac{V}{I}$$

$$R = \frac{24}{0.24}$$

$$R = 100 \Omega$$

The resistance of the conductor is  $100 \Omega$ .

iii. Differences between primary pollutants and secondary pollutants:

| <b>Primary pollutants</b>  | <b>Secondary pollutants</b>   |
|--|---|
| 1. They are emitted directly from the source.  | 1. They are not emitted directly from the source but are formed due to chemical reactions.                          |
| 2. They are found in the atmosphere in the form in which they are emitted.                                 | 2. They are formed in the atmosphere by chemical reactions between primary pollutants and atmospheric constituents. |
| 3. Ash, smoke, dust, radioactive compounds, oxides of sulphur, carbon and nitrogen are primary pollutants. | 3. $\text{SO}_3$ , $\text{O}_3$ , hydrogen cyanide, peroxyacetyl nitrate, ketones etc. are secondary pollutants.    |

iv.

| <b>Element</b> | <b>Electronic configuration</b> |
|----------------|---------------------------------|
| K              | 2,8,8,1                         |
| Ne             | 2,8                             |

v. Fleming's right-hand rule

Stretch the thumb, forefinger and middle finger of the right hand so that they are perpendicular to each other. If the forefinger indicates the direction of the magnetic field and the thumb shows the direction of motion of the conductor, then the middle finger will show the direction of the induced current.

vi. Dispersion of light

The phenomenon of splitting of light into its component colours is called dispersion of light. When white light passes through a glass prism, it spreads out into a band of different colours which constitute the spectrum of light. The colours in the spectrum of white light are violet, indigo, blue, green, yellow, orange and red. Dispersion takes place because the refractive index of a material such as glass or water is different for different colours. It is maximum for violet colour and minimum for red colour. Hence, in the spectrum of white light obtained with a prism, violet light is deviated the most, while red light is deviated the least. The deviation of light corresponding to other colours lies in between these two colours.

3.

i. Differences between direct current and alternating current:

| Direct current  | Alternating current  |
|---|--|
| 1. Direct current flows only in one direction.  | 1. Alternating current reverses its direction periodically with time.                                      |
| 2. It cannot be used in large-scale generation of electricity for household purposes. | 2. It is used in household electrical appliances such as electric heater, electric iron, refrigerator etc. |
| 3. The frequency of direct current is zero.   | 3. The frequency of alternating current in India is 50 Hz.   |

ii.

(a) When we wash our dinner plate with soap/detergent, the yellow oily leftover stains will turn red/orange due to its reaction with soap/detergent.

(b) It is a neutralisation reaction. The reaction between an acid and a base to form salt and water is called a neutralisation reaction.

iii.

| Indicator     | Colour change | Inference                |
|---------------|---------------|--------------------------|
| Methyl orange | No change     | <u>Neutral substance</u> |
|               | <u>Red</u>    | Acid                     |
|               | Yellow        | <u>Base</u>              |

iv.

(a) The eye defect shown in the diagram is hypermetropia or long-sightedness. Hypermetropia is the defect of vision in which the human eye can see distant objects clearly but is unable to see nearby objects clearly.

(b) Possible reasons for hypermetropia:

- i. Weak action of ciliary muscles cause low converging power of the eye lens.
- ii. The distance between the eye lens and the retina decreases due to either shortening of the eyeball or flattening of the lens.

(c) Hypermetropia can be corrected by using a suitable convex lens. The rays coming from nearby object are first converged by the convex lens and then converged by the eye lens to the retina.

v. Effects of radioactive pollution:

Radioactive substances have disastrous effects on the entire ecosystem. The damage caused by radiations may be transmitted to several generations.

- i. Radioactive substances present in the soil get transferred to growing plants.
- ii. This affects the plant DNA, resulting in the death of some plants, while some plants produce weak seeds.
- iii. Effect of radioactive pollution on human beings is mild to severe depending on the level and the duration of exposure of radiations.
- iv. Radiations react with the human biological molecules forming ions. These ions have the capacity to destroy cells, proteins, nucleic acids and enzymes.

vi. The phenomenon of change in the direction of propagation of light when it passes obliquely from one transparent medium to another is called refraction of light.

Laws of refraction:

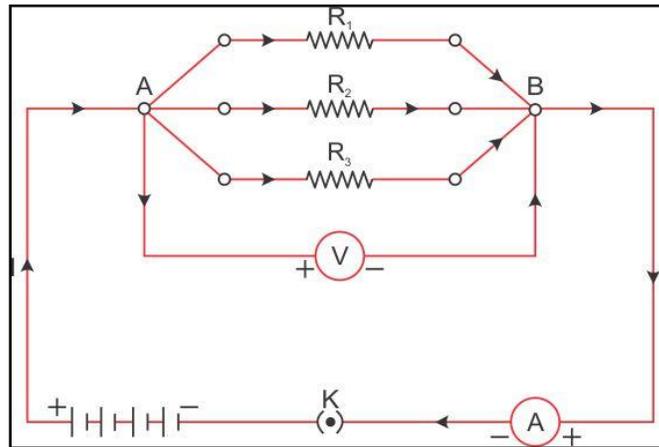
- i. The incident ray and the refracted ray are on the opposite sides of the normal at the point of incidence, and all three lie in the same plane.
- ii. For a given pair of media, the ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant.

$$\frac{\sin i}{\sin r} = \mu$$

This constant is called the refractive index of the second medium with respect to the first medium.

4.

- i. When two or more resistors are joined at the same end, the resistances are connected in parallel.



The potential difference in parallel remains the same across all the resistors.

The current is the sum of the currents across all the individual resistors.

$$I = I_1 + I_2 + I_3 \quad \dots (1)$$

Let  $R_p$  be the resultant resistance of the circuit.

On applying Ohm's law to the entire circuit, we get

$$I = \frac{V}{R_p} \quad \dots (2)$$

Now, applying Ohm's law to individual resistances, we get

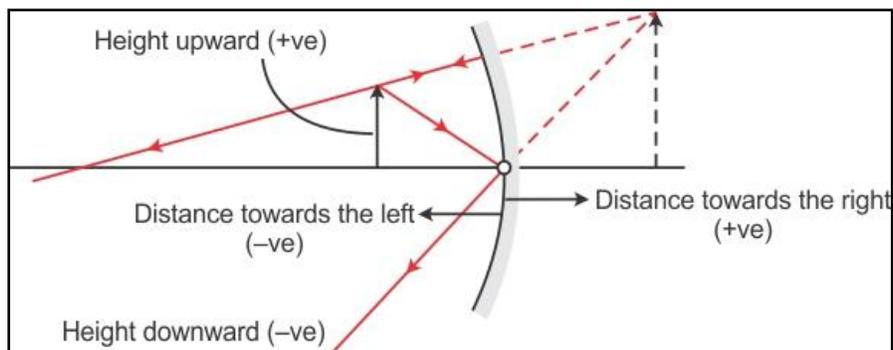
$$I_1 = \frac{V}{R_1}$$
$$I_2 = \frac{V}{R_2} \quad \dots (3)$$
$$I_3 = \frac{V}{R_3}$$

From equations (1), (2) and (3), we get

$$\frac{V}{R_p} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$
$$\therefore \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

Here,  $R_p$  is the resultant resistance. Thus, the reciprocal of the resultant resistance of a parallel combination of resistors is the sum of the reciprocals of individual resistances. The resultant resistance is lesser than all the resistances.

ii. The sign convention for reflection by spherical mirrors is as follows:



1. The object is always placed to the left of the mirror.
2. All distances parallel to the principal axis are measured from the pole of the mirror.
3. All the distances measured to the right of the origin are taken as positive, while those measured to the left of the origin are taken as negative.
4. Distances measured perpendicular to and above the principal axis are taken as positive.
5. Distances measured perpendicular to and below the principal axis are taken as negative.
6. The focal length of a convex mirror is positive, while that of a concave mirror is negative.

## SECTION B

5.

(A)

(a)

- i. Glomerulus. It is a part of the excretory system, while the rest are a part of the digestive system.
- ii. C<sub>2</sub>H<sub>4</sub>. It is an alkene, while the rest are all alkanes.

(b)

| Column A       | Column B    |
|----------------|-------------|
| i. Stigma      | (b) Carpel  |
| ii. Pepsin     | (c) Protein |
| iii. Dendrites | (a) Neuron  |

(B)

- i. (d) Less reactive than aluminium. The reactivity of metals decreases from top to bottom in the reactivity series. Iron is placed below aluminium in the reactivity series, and hence, iron is less reactive than aluminium.
- ii. (b) Budding. Cloning is a process by which an entire organism is reproduced in a genetically identical manner from a single cell taken from the parent organism. Pollination and germination are associated with sexual reproduction in plants.
- iii. (b) Increased weight.

$$\begin{aligned}\text{The percentage of water absorbed by the raisins} &= \frac{\text{Final weight} - \text{Initial weight}}{\text{Initial weight}} \times 100 \\ &= \frac{\text{Increased weight}}{\text{Initial weight}} \times 100\end{aligned}$$

- iv. (c) Mitochondria. Cellular respiration is a biochemical process in which simple nutrients such as glucose are oxidised within the cells to release energy. This process takes place in the mitochondria of the cells.
- v. (a) Oxygen. Sunlight, carbon dioxide and chlorophyll are the raw materials required for photosynthesis.

***[Please note that the explanation provided is to help you in learning. You may not be required to write an explanation in your answer to this question.]***

6.

i. Differences between alkanes and alkenes:

| <b>Alkanes</b>  | <b>Alkenes</b>   |
|---|--|
| 1. Alkanes are saturated hydrocarbons in which the carbon atoms are linked to each other only by single covalent bonds. | 1. Alkenes are unsaturated hydrocarbons in which the valencies of carbon atoms are not fully satisfied by single covalent bonds. |
| 2. They contain only a single bond.   | 2. They contain triple bonds.  |
| 3. They are chemically less reactive.   | 3. They are chemically more reactive.  |
| 4. The substitution reaction is a characteristic property of alkanes.   | 4. The addition reaction is a characteristic property of alkenes.  |
| 5. Their general formula is $C_nH_{2n+2}$ .   | 5. Their general formula is $C_nH_{2n-2}$ .  |

(Write any 2 points of differences)

ii. Methods of preventing the rusting of iron:

(a) The rusting of iron can be prevented by painting, oiling, greasing or varnishing its surface.

(b) Galvanisation is another method of protecting iron from rusting by coating it with a thin layer of zinc.

iii.

(a) Functions of ovaries:

a. They produce eggs.

b. The eggs are released from the ovaries by the process of ovulation.

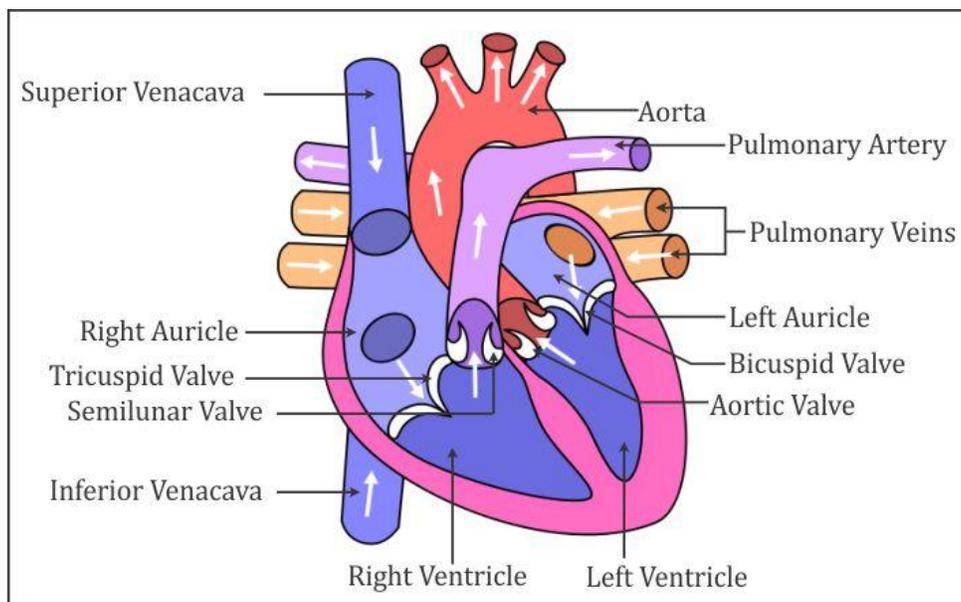
c. The ovaries also secrete the female sex hormone oestrogen, which brings about changes in girls at the time of puberty.

(b) Functions of seminal vesicle and prostate glands:

a. They produce the ejaculatory fluid.

b. This fluid helps in the transport of sperms and provides nutrition to the sperms.

iv. Vertical section of the human heart



v. Pressure cooker

- (1) The pressure cooker is a common example of the use of eco-friendly technology.
- (2) It works on the principle of pressure of steam used during cooking. During cooking, steam and heat are produced in the cooking vessel.
- (3) In an ordinary vessel, most of this steam and heat escape into the atmosphere. Therefore, it takes a longer time for the food to cook. However, in a pressure cooker, the steam produced is trapped due to the presence of a tightly fitting lid. This results in increased vapour pressure and production of more heat. The steam and heat help in cooking food faster.
- (4) It also saves fuel and is eco-friendly.

vi. Haemodialysis

- (1) Haemodialysis is a technique used to clean blood.
- (2) When the kidneys are affected due to injury, infections or restricted blood flow, they are unable to filter out nitrogenous wastes from the blood. This results in the accumulation of wastes, a condition called kidney failure.
- (3) A dialyser or dialysing machine is used to remove nitrogenous wastes from the blood.
- (4) At one time, about 500 ml blood is passed through the dialyser. The purified blood is pumped back into the patient's body.

7.

i.

| Compound   | IUPAC name     |
|--|----------------|
| (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ | Propan-1-ol    |
| (b) $\text{HCOOH}$                               | Methanoic acid |
| (c) $\text{CH}_3\text{-CH=CH-CH}_3$              | 2-butene       |

ii.

| Voluntary actions | Involuntary actions   |
|-------------------|-----------------------|
| Moving a table    | Coughing              |
| Kicking a ball    | Food getting digested |
| Flying a kite     | Beating of heart      |

iii. Reduce, reuse and recycle is the three 'R' mantra. It is an effective measure to eliminate waste and conserve resources.

- Reduce: Using of fewer resources helps to reduce their consumption.
- Reuse: Using things again and again rather than throwing them after using only once helps to conserve resources. This is called reuse.
- Recycle: The substances which are used before are put back into process to make new items. This is called recycling.

Significance of three 'R' mantra:

- All the three processes—reducing, reusing and recycling—cut down the amount of energy used while producing new items.
- It also curtails the amount of pollution created during the process.
- It helps to conserve valuable natural resources.

iv. DNA is an acronym for deoxyribonucleic acid. It is present in the chromosomes which are present in the nucleus of every cell.

DNA is a double helical structure which consists of nucleotides made of deoxyribose sugar, phosphoric acid and nitrogenous bases such as adenine, thymine, cytosine and guanine. The nucleotide sequence of the DNA molecule is called a gene. A particular type of gene is responsible for the synthesis of a particular protein.

James Watson and Francis Crick proposed the double helix or spiral staircase structure of the DNA molecule in 1953. They were awarded the Nobel Prize for this discovery in 1962.

v.

| Characteristics            | Asexual Reproduction  | Sexual Reproduction |
|----------------------------|-----------------------|---------------------|
| Number of parents involved | <b><u>One</u></b>     | <b><u>Two</u></b>   |
| Type of cells involved     | Somatic cells         | Germ cells          |
| Type of cell division      | <b><u>Mitosis</u></b> | Meiosis and mitosis |

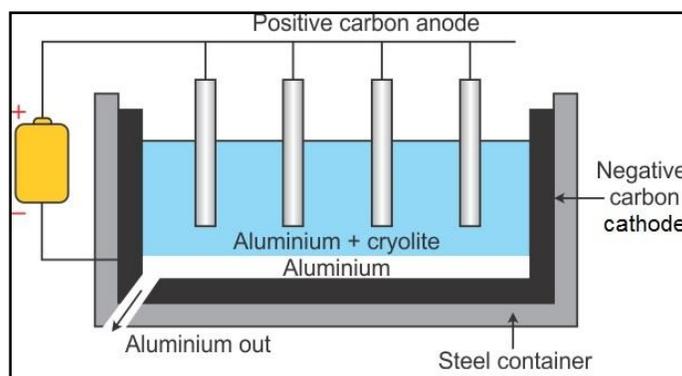
- vi. Neurons are of three types—sensory neuron, motor neuron and association neuron.
  - a. Sensory neurons conduct nerve impulses from the sense organs to the brain and spinal cord.
  - b. Motor neurons carry impulses from the brain and spinal cord to the effector organs such as muscles or glands.
  - c. Association neurons integrate the functions of sensory and motor neurons.

**8.**

**(A)**

- i. The process of concentration of bauxite is known as Bayer's process.
- ii. In the electrolytic reduction of alumina, the reaction at the cathode is as follows:  

$$\text{Al}^{3+} + 3\text{e}^{-} \rightarrow \text{Al}$$
- iii. Cryolite is added to the molten mixture of alumina to reduce the melting point. The formula of cryolite is  $\text{Na}_3\text{AlF}_6$ .
- iv. Extraction of aluminium:



**(B)**

- i. The sex chromosome is a chromosome involved in sex determination.
- ii. 23 pairs of chromosomes are present in human beings. Of these, 22 pairs are of the autosomes and 1 pair is of the sex chromosomes.
- iii. Determination of sex in human offspring:
  - a. In human beings, the male possess 44 autosomes and a pair of heteromorphic sex chromosomes, XY, while the female possess 44 autosomes and a pair of homomorphic sex chromosomes, XX.
  - b. At the time of gamete formation, meiosis occurs.
  - c. The male parent produces X-bearing and Y-bearing gametes or sperms. The female parent produces only X-bearing gametes or eggs.
  - d. During reproduction, the combination of one X-bearing gamete from the male with one X-bearing gamete from the female results in offspring with the genetic constitution XX. The child produced is a female or a daughter.
  - e. The combination of a Y chromosome from the male with one X chromosome from the female results in an offspring with genetic constitution XY. The child produced is a male or a son.
  - f. The offspring produced are always in equal proportion, and hence, the chance of having a daughter or a son is 50%.

iv. Sex determination in man:

