Term I - Full Syllabus Test

Subject: Science

Time: 01:30 hrs

Instructions:

- The question paper contains three sections.
- Section A (**1 - 24**) has 24 questions. Attempt any 20 questions.
- Section B (**25 - 48**) has 24 questions. Attempt any 20 questions.
- Section C (**49 - 60**) has 12 questions based on three case studies. Attempt any 10 questions.
- All questions carry equal marks.
- There is no negative marking.

1. Which of the following represent a double displacement reaction?

   ✗ **A.** $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

   ✗ **B.** $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

   ✓ **C.** $AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

   ✗ **D.** $2H_2(g) + Cl_2(g) \rightarrow 2HCl\ (g)$

   The reaction in which exchange of ions takes place between the compounds of the reactants is called a double displacement reaction.

   The reaction between silver nitrate and sodium chloride involves exchange of their ionic counter parts to form the product. Hence, it is a double displacement reaction.

   All the other three reactions given are combination reactions. Combination reaction is a reaction in which two or more elements or compounds combine to form a new product.

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2. The absolute refractive index of a medium with respect to air is given by :

[c = speed of light in air, v = speed of light in the medium]

- ✗ **A.** $n_m = \frac{c^2}{v}$
- ✗ **B.** $n_m = \frac{v}{c}$
- ✓ **C.** $n_m = \frac{c}{v}$
- ✗ **D.** None of above

The absolute refractive index of a medium with respect to air is given by the ratio of speed of light in the air to the speed of light in the medium, which can be written as:

$n_m = \frac{c}{v}$

3. The number of water of crystallization molecules present in one molecule of plaster of Paris is:

- ✗ **A.** 4.0
- ✓ **B.** 0.5
- ✗ **C.** 0.2
- ✗ **D.** 1.0

Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt. Chemical formula of plaster of Paris is $CaSO_4.\frac{1}{2}H_2O$.

Therefore, water of crystallization in one molecule of plaster of Paris is 0.5. Hence, it is also called calcium sulphate hemihydrate.

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4. What will be the values of the coefficients x, y and z if the given reaction is balanced?

$\mathrm{xFeCl_3 + yMgO \rightarrow Fe_2O_3 + zMgCl_2}$

✔ **A.** x = 2, y = 3, z = 3

✘ **B.** x = 2, y = 4, z = 3

✘ **C.** x = 3, y = 2, z = 2

✘ **D.** x = 3, y = 2, z = 3

To find the value of x, y and z, we need to balance the given equation.
Number of Fe atoms on the reactant side: 1
Number of Fe atoms on the product side: 2
So we will multiply 2 on the left side to $FeCl_3$. Hence it will become;
$2FeCl_3 + MgO \rightarrow Fe_2O_3 + MgCl_2$

Number of Cl atoms on the reactant side: 6 (i.e. 2x3)
Number of Cl atoms on the product side: 2

So we will multiply 3 on the right side to $MgCl_2$. Hence it will become;

$2FeCl_3 + MgO \rightarrow Fe_2O_3 + 3MgCl_2$

Now, the number of Mg atoms are not balanced. In order to balance it, we will multiply 3 to MgO.

$2FeCl_3 + 3MgO \rightarrow Fe_2O_3 + 3MgCl_2$

From the above balanced equation the value of x, y and z, w are 2, 3, and 3 respectively.

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5. Determine which substance is oxidized and which substance is reduced in the following reaction:
$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$

A. CO_2 is oxidized and H_2 is reduced.

B. CO_2 is reduced and H_2 is oxidized.

C. Both CO_2 and H_2 are reduced.

D. Both CO_2 and H_2 are oxidized.

A substance is said to be oxidised if it either gains oxygen atom or loses hydrogen atom.

A substance is said to be reduced if it either loses oxygen atom or gains hydrogen atom.

In the given chemical reaction, CO_2 is reduced since it is losing oxygen atom and H_2 is oxidized since it is gaining oxygen atom.

6. To form a virtual image twice the size of the object, using a convex lens of focal length, (f) $20\ cm$, the object distance (u) must be _____.

A. $u < 20\ cm$

B. $u > 40\ cm$

C. $20\ cm \leq u \leq 40\ cm$

D. $u = 20\ cm$

Given:
Focal length $(f) = 20\ cm$.
Image size h_i is twice the object size h_o
$\therefore h_i = 2(h_o)$
or, magnification, $m = \frac{h_i}{h_o} = \frac{v}{u} = 2$
$\Rightarrow v = 2u$, where u is the object distance and v is the image distance.
According to lens formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$
or $\frac{1}{2u} - \frac{1}{u} = \frac{1}{20}$
or $u = -10\ cm$
Therefore object lies in between focus and optical centre.
That is, inorder to form a virtual image twice the size of the object,
$u < 20\ cm$

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7. _____ is a phenomenon in which the fats and oils present in food get oxidised causing spoilage of food.

- ✗ **A.** Corrosion
- ✓ **B.** Rancidity
- ✗ **C.** Rusting
- ✗ **D.** Decomposition

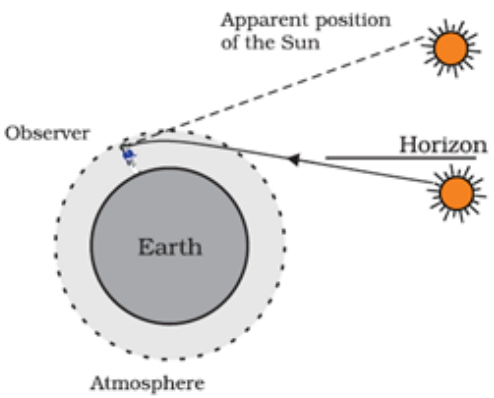
The phenomenon which leads to the spoilage of food due to oxidation of oils and fats is called rancidity. It makes food undesirable and unsafe for consumption.

8. Sun appears to be risen before the actual sunrise because of:

- ✗ **A.** Scattering of light
- ✗ **B.** Dispersion of light
- ✓ **C.** Atmospheric refraction
- ✗ **D.** Atmospheric reflection

The sun seems to rise two minutes before the actual sunrise due to the phenomenon of atmospheric refraction.

When the sun is just below the horizon, the light from the sun, while coming towards the earth, suffers refraction from a rarer to a denser layer and so it bends towards the normal at each refraction. Due to the continuous bending of light at different successive layers, the sun can be seen even when its actual position is just below the horizon.



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9. Which of the following are examples of chemical reactions?

i. Burning of wood

ii. Cutting of wood

iii. Conversion of steam to water

iv. Rusting of almirah

✔ **A.** i, iv

✘ **B.** i, iii

✘ **C.** ii, iv

✘ **D.** ii, iii

Burning of wood - Chemical change - The chemical composition of wood changes.
Cutting of wood - Physical change - The chemical composition remains the same, only the size of the wood changes.

Conversion of steam to water- Physical change - No change in chemical nature of the substance.

Rusting of almirah- Chemical change - Iron present in almirah converts into iron oxide (new compound) due to the presence of air and moisture.

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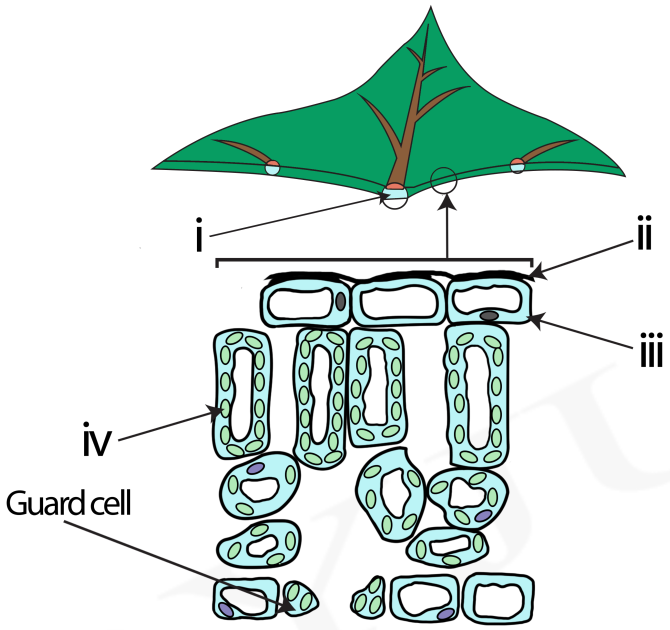
10. The image given below shows the cross section of a leaf with labels (i) to (iv). Identify the option that correctly identifies the structure and corresponding function.



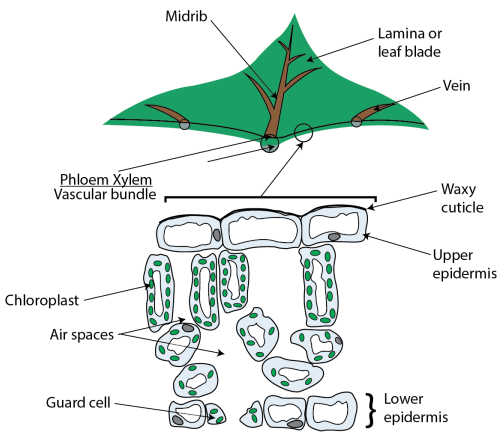
A. (i) Midrib: Attracts insects for pollination

B. (ii) Lower epidermis: Protects from mechanical damage

C. (iii) Waxy cuticle: Prevents loss of water

D. (iv) Chloroplasts: A cell organelle that conducts photosynthesis

The dot-like structures shown in the image are chloroplasts. These are the cell organelles that contain chlorophyll and help in photosynthesis.



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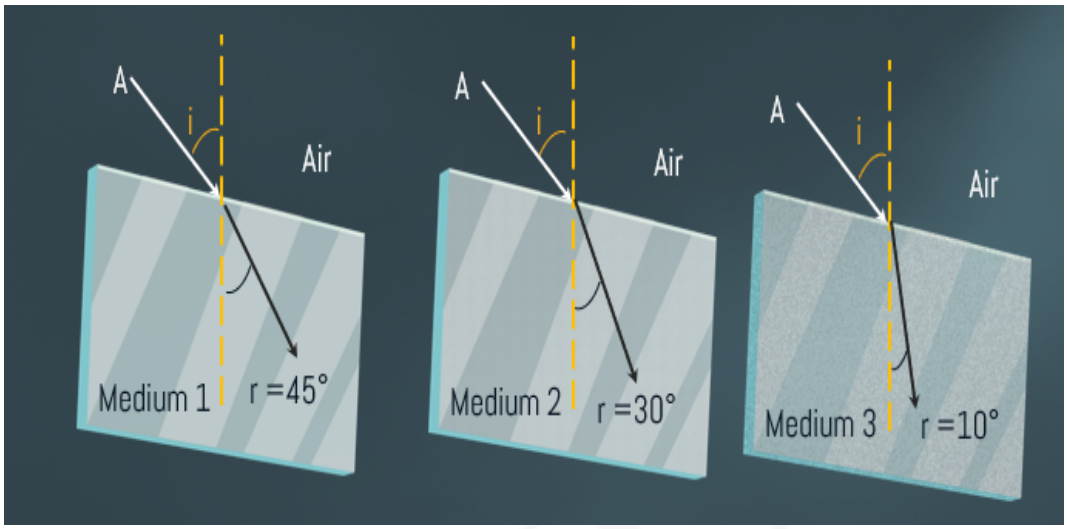
11. A ray of light is incident on a set of media at an angle 60°. The angle of refraction is different for different media as shown.
In which medium the speed of light is slowest?



A. Medium 1

B. Medium 2

C. Medium 3

D. Light will have same speed in all medium

Let refrative index of medium 1, medium 2 and medium 3 with respect to air is denoted by n_{1a}, n_{2a}, n_{3a} and let angle of incidence in all case be i and angle of refraction in medium 1, medium 2 and medium 3 be r_1, r_2, r_3

Then, according to snell's law,

$$n_{1a} = \frac{sin_i}{sin_{r_1}}$$

From the given figure,

$r_1 > r_2 > r_3$

Putting this in snell's law we will get,

$n_{1a} < n_{2a} < n_{3a}$

This mean that out of the given three medium, medium 3 is most optically dense and by the defintion of refractive index (ratio of speed of light in air/vacuum to the speed of light in that medium) we can say that the one which has maximum refractive index will allow light to travel slow.
Thus, speed of light in medium 3 will be minimum

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12. The danger signals installed at the top of tall buildings are red in colour. These can be easily seen from a distance because among all other colours, the red light:

- ✗ **A.** is scattered the most by smoke or fog.
- ✓ **B.** is scattered the least by smoke or fog.
- ✗ **C.** is absorbed the most by smoke or fog.
- ✗ **D.** Reflection of light from the earth.

The red light has relatively longer wavelength than the other colours of the spectrum. Hence, it suffers the least scattering.

13. The instrument used for measuring blood pressure is:

- ✗ **A.** Manometer
- ✓ **B.** Sphygmomanometer
- ✗ **C.** Thermometer
- ✗ **D.** Barometer

A sphygmomanometer is an instrument used for measuring blood pressure. It consists of an inflatable rubber cuff that is applied to the arm and connected to a column of mercury next to a graduated scale. It measures the systolic and diastolic blood pressure by increasing and gradually releasing the pressure in the cuff.

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14. The phloem tissue in plants is responsible for the transport of:

- ✗ **A.** Water
- ✗ **B.** Minerals
- ✓ **C.** Food
- ✗ **D.** All of the above

Xylem and phloem are the two vascular tissues that are responsible for the transport of substances in plants. Phloem helps the bidirectional transport of food whereas xylem helps in the unidirectional transport of water.

15. Which among the following is not a part of the alimentary canal?

- ✗ **A.** Stomach
- ✓ **B.** Liver
- ✗ **C.** Oesophagus
- ✗ **D.** Rectum

The alimentary canal is a long tube that carries the food we eat. It begins at the mouth (buccal or oral cavity), passes through the pharynx, oesophagus or food pipe, stomach, small intestine, large intestine, rectum and finally ends at the anus. The liver is an accessory gland that helps in the digestion of food by producing bile, which helps in the digestion of fat in the small intestine but the food does not pass through it, therefore the liver is not a part of the alimentary canal. The stomach, oesophagus and rectum are the parts of the alimentary canal.

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16. Select the correct events that occur during inspiration.

- ✔ **A.** Diaphragm contracts
- ✘ **B.** Diaphragm relaxes
- ✘ **C.** Thoracic cavity volume decreases
- ✘ **D.** Ribs and sternum return to the original position

When we inhale: the internal intercostal muscles relax and the external intercostal muscles contract, pulling the ribcage upwards and outwards and the diaphragm contracts, pulling downwards. As a result lung volume increases and the air pressure inside decreases, this leads to movement of the air from outside to inside the body.

17. The exit of food from the stomach to the _____ is controlled by _____.

- ✘ **A.** oesophagus, epiglottis
- ✔ **B.** small intestine, sphincter muscle
- ✘ **C.** large intestine, sphincter muscle
- ✘ **D.** colon, anal sphincter

The alimentary canal in the human digestive system continues from the stomach into the small intestine. Food stays in the stomach for around 3 hours where it is slowly churned into a more slimy mix called chyme. The chyme is slowly released into the duodenum of the small intestine at regular intervals for further digestion by the action of pancreatic and bile juices. The release of chyme is controlled by a set of circular ring-like muscles known as sphincter muscles. Such circular muscles are present at multiple places in the alimentary canal and control the movement of the digesting food mass.

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18. Match the chambers of the human heart in Column A to its function in Column B.

Column A	*Column B*
(i) *Right atrium*	(a) *Pumps deoxygenated blood to lungs*
(ii) *Left atrium*	(b) *Receives oxygenated blood from lungs*
(iii) *Right ventricle*	(c) *Pumps oxygenated blood to the body*
(iv) *Left ventricle*	(d) *Receives deoxygenated blood from the body*

✗ **A.** (i) - (b), (ii) - (d), (iii) - (c), (iv) - (a)

✗ **B.** (i) - (b), (ii) - (d), (iii) - (a), (iv) - (c)

✗ **C.** (i) - (d), (ii) - (b), (iii) - (c), (iv) - (a)

✓ **D.** (i) - (d), (ii) - (b), (iii) - (a), (iv) - (c)

The right atrium receives deoxygenated blood from the body and pours into the right ventricle. The right ventricle pumps out the deoxygenated blood to the lungs for oxygenation. After oxygenation in the lungs, the oxygenated blood is received by the left atrium which pours it into the left ventricle. The left ventricle then pumps out the oxygenated blood to the different body parts.

19. Which of the following compounds cannot be used as an antacid during acid indigestion?

✗ **A.** $Mg(OH)_2$

✗ **B.** $Al(OH)_3$

✗ **C.** $NaHCO_3$

✓ **D.** $NaOH$

Our stomach produces hydrochloric acid for digestion of food without harming the stomach. During indigestion, excess of acid is produced and this causes pain and irritation.

To get rid of this pain, people use mild bases called antacids. Antacids are basic in nature and they neutralise the effect of excess acid.

$Mg(OH)_2$, $Al(OH)_3$, and $NaHCO_3$ being mild bases can be used as an antacid during acid indigestion but $NaOH$ (a strong base) is unfit for consumption.

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20. Arrange the given compounds in the decreasing order of their pH.
$NaCl$, $NaOH$, CH_3COOH, H_2SO_4

A. $NaCl > NaOH > CH_3COOH > H_2SO_4$

B. $H_2SO_4 > CH_3COOH > NaCl > NaOH$

C. $NaOH > CH_3COOH > H_2SO_4 > NaCl$

D. $NaOH > NaCl > CH_3COOH > H_2SO_4$

The basic and acidic nature of a solution is determined by measuring the hydrogen ion concentration present in it. This concentration can be measured by a pH scale. The table given below shows the approximate pH range of the acidic, basic and neutral solutions.

Type of solution	Approx. pH range
Acidic	0 - 7
Neutral	7
Basic	7 - 14

- H_2SO_4 and CH_3COOH will have pH in the range of 0 to 7 while H_2SO_4 being strong acid will have less pH than CH_3COOH.
- Since $NaCl$ is a neutral salt, it will have pH equivalent to 7.
- $NaOH$ being a strong base will have pH in the range of 7 - 14.

Hence, arranging above compounds based on pH in descending order:
$NaOH > NaCl > CH_3COOH > H_2SO_4$

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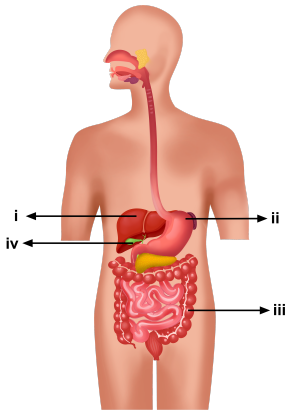
21. Observe the diagram of the human digestive system. The labels (i) to (iv) represent the different parts of the digestive system. Match the correct part of the digestive system in column I to its corresponding function in column II.



Column I	Column II
i	a) Increases the efficiency of lipase enzyme action
ii	b) Responsible for absorption of more water from undigested food
iii	c) Stores bile
iv	d) Digestion of food is taken care of by gastric glands present here

✗ **A.** i - c) ; ii – b) ; iii – d) ; iv- a)

✓ **B.** i - a) ; ii – d) ; iii – b) ; iv- c)

✗ **C.** i - c) ; ii – a) ; iii – d) ; iv- a)

✗ **D.** i - d) ; ii – a) ; iii – c) ; iv- b)

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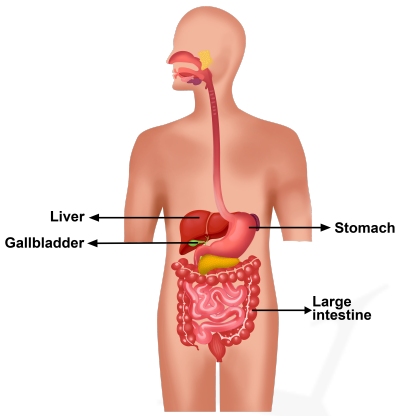
i) Liver: It produces bile juice. Bile is responsible for the emulsification of fats. Bile salts break the larger fat globules into smaller globules, increasing the efficiency of lipase enzyme action.

ii) Stomach: The digestion in the stomach is taken care of by the gastric glands present in the walls of the stomach. These release hydrochloric acid, a protein digesting enzyme called pepsin, and mucus.

iii) Large intestine: It helps in absorption of excess water from the undigested waste, hence solidifying the undigested waste.

iv) Gallbladder: Bile juice produced by the liver is stored in the gallbladder.



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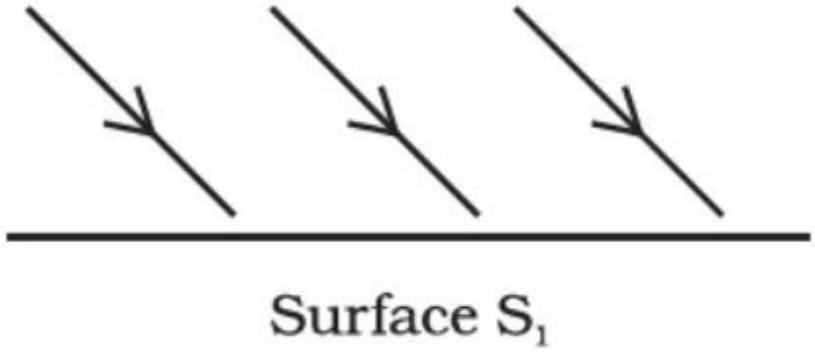
22. The light rays are falling on surfaces S_1, S_2, S_3 as shown in the figures.



Surface S_1

Surface S_2

Surface S_3

The surfaces on which the angle of incidence will be equal to the angle of reflection is/are:

- ✗ **A.** Only S_1
- ✗ **B.** S_1 and S_2 only
- ✗ **C.** S_2 and S_3 only
- ✓ **D.** All the three surfaces

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When a light ray falls on a surface, laws of reflection are always followed whatever be the surface.
Therefore, the angle of incidence will be equal to the angle of reflection on all the three surfaces.

23. Light is incident on a transparent plastic block at an angle of 45° from air. The speed of light in the plastic is $\frac{c}{\sqrt{2}}$, where c is the speed of light in the vacuum. Find the angle of refraction.

- ✔ **A.** 30°
- ✘ **B.** 60°
- ✘ **C.** 75°
- ✘ **D.** 45°

We know that, refractive index,

$$\mu_{21} = \frac{\mu_2}{\mu_1} = \frac{v_1}{v_2} = \frac{\sin i}{\sin r}$$

$$\Rightarrow \frac{c}{c/\sqrt{2}} = \frac{\sin 45^\circ}{\sin r}$$

$$\Rightarrow \sin r = \frac{1}{2}$$

$$\Rightarrow r = 30^\circ$$

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24. Concave mirror is used in which of the following case(s)?

1. Dentist mirror
2. Rearview mirror
3. Solar heater
4. Torch reflector

✗ **A.** Only 1

✗ **B.** 1 and 2

✗ **C.** 1 and 3

✓ **D.** 1, 3 and 4

A concave mirror can produce an enlarged, reduced, or the same size image of an object. Hence it is widely used as a dentist mirror, solar heat collector, and torch reflector.

Whereas a convex mirror is used as a rearview mirror.

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25. An object of size $50\ \text{cm}$ is placed $20\ \text{cm}$ in front of a spherical mirror and its image of size $25\ \text{cm}$ is formed above the principal axis. Find the focal length as per sign convention and the type of spherical mirror used here?

A. $-25\ \text{cm}$, concave mirror

B. $-20\ \text{cm}$, concave mirror

C. $+25\ \text{cm}$, convex mirror

D. $+20\ \text{cm}$, convex mirror

Given,
Height of the image $h' = +25\ \text{cm}$ (positive since image is formed above principal axis)
Height of the object $(h) = 50\ \text{cm}$
Object distance $(u) = -20\ \text{cm}$
Let M be the magnification produced, v be the image distance and f be the focal length of the mirror.

We know that,

$$M = \frac{-v}{u} = \frac{h'}{h}$$

$$\implies \frac{-v}{u} = \frac{25}{50} = \frac{1}{2}$$

$$\implies \frac{-v}{-20} = \frac{1}{2}$$

$\therefore$ Image distance $(v) = +10\ \text{cm}$
Positive sign indicates that image is formed right of the mirror.

Now applying mirror formula,

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

$$\frac{1}{10} - \frac{1}{20} = \frac{1}{f}$$

$$\frac{1}{f} = \frac{1}{20}$$

$\therefore$ focal length, $f = +20\ \text{cm}$
Since focal length is positive and the image is virtual and erect, the mirror must be convex.

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26. If the power of a lens is + 0.1 D and if an object of size 2 cm is placed 5 cm before the lens. Find the size and position of the image formed?

- **A.** Image size = 4 cm, image distance = – 10 cm
- **B.** Image size = 10 cm, image distance = – 4 cm
- **C.** Image size = 5 cm, image distance = 4 cm
- **D.** Image size = 4 cm, image distance = 5 cm

Given, power, $P = 0.1\ D$

Object distance, $u = -5\ cm$

Let v be the image distance and f be the focal length.

P = $\frac{1}{f} \Rightarrow$ f = 10 cm

Using lens formula,

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

$\frac{1}{v} - \frac{1}{(-5)} = \frac{1}{(10)} \Rightarrow \frac{1}{v} = \frac{1}{10} = \frac{-1}{10}$

v = - 10 cm

Height of object, $h = 2\ cm$

Let h' be height of object.

We know,

$\frac{v}{u} = \frac{h'}{h} \Rightarrow \frac{-10}{(-5)} = \frac{h'}{2}$

h' = 4 cm

Image height = 4 cm

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27. To get her house whitewashed, an officer bought 10 kg of quicklime from the market and dissolved in 30 litres of water.
She noticed that the water started boiling even when it was not being heated.
Choose the corresponding product formed and the type of reaction involved.

- ✗ **A.** Product formed:- Limestone
  Type of reaction:- Endothermic
- ✗ **B.** Product formed:- Limewater
  Type of reaction:- Endothermic
- ✓ **C.** Product formed:- Slaked lime
  Type of reaction:- Exothermic
- ✗ **D.** Product formed:- Limestone
  Type of reaction:- Exothermic

The reaction of quicklime with water is highly exothermic. Hence, the solution started boiling although it was not being heated.

Calcium oxide commonly known as quicklime dissolves in water to form slaked lime $\mathrm{Ca(OH)_2}$. The reaction occurs as follows:
$\mathrm{CaO(s) + H_2O(g) \rightarrow Ca(OH)_2(aq) + heat}$

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28. Which of the given metals exhibits both reactions (a) as well as (b)?

(a) Metal + Oxygen $\rightarrow$ Metal oxide

(b) Metal + Cold water or hot water or steam $\rightarrow$ Metal hydroxide + Hydrogen

✗ **A.** Magnesium (Mg), iron (Fe), sodium (Na), and copper (Cu)

✗ **B.** Magnesium (Mg), zinc (Zn), platinum (Pt), and gold (Au)

✓ **C.** Sodium (Na), potassium (K), magnesium (Mg) and calcium (Ca)

✗ **D.** Copper (Cu), magnesium (Mg), gold (Au), and sodium (Na)

Sodium (Na), potassium (K), calcium (Ca), and magnesium (Mg) react with oxygen to form their respective metal oxides. Sodium, potassium and calcium being very reactive, react with cold water, hot water and steam. However, magnesium is less reactive than these three and reacts with only hot water and steam.

Iron (Fe) reacts with both oxygen and steam. Copper (Cu) reacts with oxygen but is unreactive with any form of water.

Platinum (Pt) and gold (Au) are unreactive towards both water and oxygen.

Hence, the elements showing both reactions are sodium (Na), potassium (K), magnesium (Mg) and calcium (Ca).

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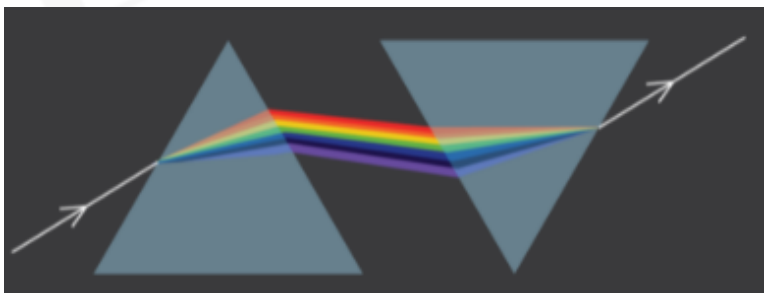
29. A beam of white light passes through two inverted prisms as shown.

The emergent beam of light from the second prism will be:

[0.8 mark]

- ✔ **A.** White in colour
- ✘ **B.** Red in colour
- ✘ **C.** Yellow in colour
- ✘ **D.** A patch of seven different colours

First glass prism disperses the light into its constituent colours but the second inverted prism recombines all the colours back to the white beam of light.



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30. Which phenomena do we observe on Earth that is not caused due the Earth's atmosphere?

- ✗ **A.** Red sun
- ✗ **B.** Blue sky
- ✗ **C.** Early sunrise
- ✓ **D.** Day & night

Earth's atmosphere is responisble for scattering and refracting the sunlight. The phenomenon in the first three options happen due to the scattering and atmospheric refraction of the sunlight. However, only option d does not happen due to the earth's atmosphere.

31. Why is it necessary for the food to be broken down and digested?

- ✗ **A.** Large molecules in intact food pass through the digestive epithelium and enter the cell through the membrane, damaging the nuclear membrane. Hence, it must be broken down.
- ✗ **B.** Fats present in intact food contain very large molecules that cannot pass through cell membranes. Fats need to be passed through the digestive epithelium to be utilised.
- ✓ **C.** Large molecules present in intact food cannot pass through cell membranes. Nutrients need to be separated from food to be passed through the digestive epithelium to be utilised.
- ✗ **D.** If not broken down, large molecules produce toxic substances that pass through the epithelium of the digestive tract and are utilised by the cells. This can be lethal to the cells.

Food that we consume contains complex organic molecules like carbohydrates, proteins and fats that cannot pass through the cell membranes of the small intestine where absorption takes place. In order to be absorbed by the body, these large and complex molecules have to be broken down into simple nutrients like glucose, amino acids, fatty acids and glycerols respectively.

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32. There is an increase in blood urea when there is insufficient filtration in _____.

- ✗ **A.** loop of Henle
- ✗ **B.** distal tubule
- ✓ **C.** Bowman's capsule
- ✗ **D.** collecting tubule

The process of filtration occurs in the glomerular capsule also known as Bowman's capsule.
The Bowman's capsule contains a dense capillary network called the glomerulus. Blood flows into these capillaries. The blood that enters into the glomerulus contains urea, glucose, various salts and proteins of plasma and large quantities of water.
The filtration occurs across the membrane made up of the glomerular capillary wall and the inner membrane of the Bowman's capsule. The pores of this filtering membrane are impermeable to large molecules like blood cells and proteins.
But smaller molecules like glucose, urea, creatinine, amino acids, and mineral salts are filtered into the Bowman's capsule. The insufficient filtration in Bowman's capsule results in an increased concentration of urea in the blood.

33. **Assertion:** Intensive exercise leads to muscle cramps.
Reason: Ethanol is produced as a result of anaerobic respiration.

- ✗ **A.** Both A and R are true and R is the correct explanation of A
- ✓ **B.** Both A and R are true but R is not a correct explanation of A
- ✗ **C.** A is true but R is false
- ✗ **D.** A and R are false

Anaerobic respiration occurs during high-intensity exercises. When our body works so hard there is a shortage of oxygen for energy consumption. Due to the shortage of oxygen, our body breaks down glucose stored in our muscles for energy. As a byproduct of the breakdown, lactic acid is formed. The buildup of lactic acid can cause muscle pain, cramps and muscle fatigue.
Ethanol is a product of anaerobic respiration in yeasts and this process is known as fermentation.

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34. Assertion(A) - Waste products are stored in different parts of plants.
Reason(R) - Plants do not have excretory system.

✔ **A.** Both A and R are true and R is the correct explanation of A.

✘ **B.** Both A and R are true but R is not the correct explanation of A.

✘ **C.** A is true but R is false.

✘ **D.** A is false but R is true.

• Plants do not have specific excretory organs like animals. Hence waste products are stored in different parts of plants.
• Gaseous waste products in plants are excreted through stomatal pores.
• Excess water is excreted out by the process called transpiration.
• Nitrogenous waste products are stored in different parts of plants like leaves, bark, seeds, roots and fruits.
• These waste products are then removed during abscission of these parts.

35. Which of the following is correct?

✘ **A.** Acids are always kept in metallic vessels.

✔ **B.** Some metals catch fire easily when they come in contact with air.

✘ **C.** All metals are solid at room temperature.

✘ **D.** Copper reacts with dil.H_2SO_4 and evolves H_2 gas.

Acids react with most of the metals therefore they must not be kept in metallic vessels.

Metals such as sodium and potassium burn easily when they come in contact with air. Hence, (b) is correct.

Mercury, a metal, is found to be in the form of liquid at room temperature.

Copper does not react with dilute sulphuric acid therefore no evolution of hydrogen gas will occur.

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36. Assertion (A): Aluminium oxide is an example of amphoteric oxide.
Reason (R): Aluminium oxide reacts with both acids and bases.

- ✔ **A.** Both A and R are true and R is the correct explanation of A
- ✘ **B.** Both A and R are true but R is not the correct explanation of A
- ✘ **C.** A is true but R is false
- ✘ **D.** A is false but R is true

Aluminium on reaction with oxygen forms alumina which shows both acidic as well as basic behaviours. Such metal oxides which react with both acids as well as bases to produce salts and water are known as amphoteric oxides.

Reactions of aluminium oxide are as following:

$\mathrm{Al_2}O_3(s) + 6\mathrm{HCl}(aq) \rightarrow 2\mathrm{AlCl_3}(aq) + 3\mathrm{H_2O}(l)$
[Acidic nature]

$\mathrm{Al_2}O_3(s) + 2\mathrm{NaOH}(aq) \rightarrow 2\mathrm{NaAlO_2}(aq) + \mathrm{H_2O}(l)$
[Basic nature]

Therefore, Both A and R are true and R is the correct explanation of A

37. Which of the following types of nutrition can be observed in amoeba?

- ✘ **A.** Autotrophic
- ✘ **B.** Parasitic
- ✘ **C.** Saprophytic
- ✔ **D.** Holozoic

Amoeba spreads its false feet or pseudopodia and engulfs its food by trapping it inside food vacuoles. This type of nutrition where the food is taken wholly inside the body and digested is known as holozoic nutrition. Most larger animals and birds follow a holozoic mode of nutrition.

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38. **Assertion:** Carnivores have shorter small intestine while herbivores have longer small intestine.
Reason: Meat is more difficult to digest than cellulose.

- ✗ **A.** Both A and R are true and R is the correct explanation of A.
- ✗ **B.** Both A and R are true but R is not a correct explanation of A.
- ✓ **C.** A is true but R is false.
- ✗ **D.** A and R are false.

The length of the alimentary canal in the organisms depends upon the type of food they eat. Herbivores have a longer small intestine as compared to the carnivores as grass and other plant based food is rich in cellulose which is difficult to digest compared to meat. Thus the correct answer is option C.

39. **Assertion:** Mammals and birds are warm blooded organisms which maintain a uniform internal body temperature.
Reason: Mammals and birds have a four-chambered heart.

- ✓ **A.** Both A and R are true and R is the correct explanation of A.
- ✗ **B.** Both A and R are true but R is not a correct explanation of A.
- ✗ **C.** A is true but R is false.
- ✗ **D.** A and R are false.

Mammals and birds have a four-chambered heart which prevents mixing of oxygenated and deoxygenated blood and makes the oxygen supply to the different parts of the body more efficient as compared to fishes or amphibians which have a 2-chambered and 3-chambered heart respectively. This separation allows the mammals and birds to maintain a high rate of energy production which also helps them in maintaining a uniform body temperature irrespective of the surroundings' temperature, thus classifying them as warm blooded organisms.

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40. **Assertion:** Aquatic animals have a faster breathing rate as compared to terrestrial animals.
Reason: Dissolved oxygen concentration is lesser than the atmospheric oxygen.

✔ **A.** Both A and R are true and R is the correct explanation of A.

✘ **B.** Both A and R are true but R is not a correct explanation of A.

✘ **C.** A is true but R is false.

✘ **D.** A and R are false.

Terrestrial animals can breathe the oxygen in the atmosphere, but animals that live in water need to use the oxygen dissolved in water. Since the amount of dissolved oxygen is fairly low compared to the amount of oxygen in the air, the rate of breathing in aquatic organisms is much faster than that seen in terrestrial organisms.

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41. Three test tubes, labelled A, B, and C, contain different solutions. The results of dipping red and blue litmus papers in these test tubes are shown in the table below.

Analyse the table below and select the incorrect option from the following.

	Test tube A	Test tube B	Test tube C
Red Litmus	No change	No change	No change
Blue Litmus	Red	No change	Red

A. The sample in test tube A is acidic

B. The sample in test tube A is neutral

C. The sample in test tube C is acidic

D. The sample in test tube B is neutral

Litmus paper is used to identify the nature of a solution. They are available in two colours- red and blue.
The following table shows the colour of each litmus in different medium:

	Acidic	Neutral	Basic
Red Litmus	Red	Red	Blue
Blue Litmus	Red	Blue	Blue

When a blue litmus paper was put in all these test tubes, it turned red in test tubes A and C. So, we can confirm that the samples in test tubes A and C are acidic.
No change in the colour of red litmus is observed when it is added to any of the test tubes. This marks the absence of a basic sample. Both litmus papers didn't change their colour when kept in test tube B. This means that the solution in test tube B is neutral.

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42. Which of the following options is incorrect for electrolysis of brine solution?

A. Sodium hydroxide can be produced by this process.

B. Gas given out at cathode burns with a pop sound.

C. Gas given out at anode is used for making bleaching powder.

D. Gas given out at cathode is used for making bleaching powder.

Aqueous solution of sodium chloride is called brine. When electricity is passed through brine solution, the following reaction takes place:

$$2\,NaCl(aq) + 2H_2O(l) \rightarrow 2\,NaOH(aq) + Cl_2(g) + H_2(g)$$

Chlorine gas is given out at anode and hydrogen gas given out at the cathode. Sodium hydroxide is also produced by this process.

The chlorine produced is used for the manufacture of bleaching powder. ($CaOCl_2$)

$$Ca(OH)_2(aq) + Cl_2(aq) \rightarrow CaOCl_2(aq) + H_2O(l)$$

The hydrogen gas burns a matchstick with a pop sound.

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43. Assertion (A): Silver chloride is always kept in a dark coloured bottle.
Reason (R): Photolytic decomposition of silver chloride occurs in the presence of light.

✔ **A.** Both A and R are true and R is the correct explanation of A

✘ **B.** Both A and R are true and R is not the correct explanation of A

✘ **C.** A is true but R is false

✘ **D.** A is false but R is true

Silver chloride decomposes to two different products i.e. silver and chlorine gas on exposure to light. Therefore, it is always kept in dark coloured bottles which restricts the light inside the bottle.
The balanced chemical equation for decomposition of silver chloride is:

$$2AgCl(s) \rightarrow 2Ag(s) + Cl_2(g)$$

Such chemical reaction in which two or more products are formed from a single reactant is called a decomposition reaction. It is a decomposition reaction that occurs in the presence of light and hence it is a photochemical/photolytic decomposition reaction.

44. Choose the correct option regarding the following statements:

Statement 1: Sodium hydroxide is water soluble.
Statement 2: Copper oxide is an alkali.

✔ **A.** Only statement 1 is correct.

✘ **B.** Only statement 2 is correct.

✘ **C.** Both statements are incorrect.

✘ **D.** Both statements are correct.

A water-soluble base is known as an alkali. Sodium hydroxide is a base because it can neutralise the acids reacting with it. It is also an alkali because it gets dissolved in water.

Copper oxide is a base because it has the ability to neutralise acids. However, it is not an alkali because it does not dissolve in water.

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45. A $3\ \text{cm}$ long object is placed at $12\ \text{cm}$ from a concave lens, perpendicular to its principal axis. The lens forms a virtual image whose size is $1.5\ \text{cm}$. Find the power of the lens.

- ✔ **A.** $-\frac{25}{3}\text{D}$
- ✘ **B.** $-8\ \text{D}$
- ✘ **C.** $-\frac{7}{36}\text{D}$
- ✘ **D.** $-\frac{25}{9}\text{D}$

Given:

$u = -12\ \text{cm}$
$h_0 = 3\ \text{cm}$

Since the lens forms a virtual image, so the image is erect.

$\therefore h_i = 1.5\ \text{cm}$

Now,

$$m = \frac{v}{u} = \frac{h_i}{h_0}$$

$$\Rightarrow \frac{v}{-12} = \frac{1.5}{3}$$

$$\Rightarrow v = -6\ \text{cm}$$

Using lens formula,

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

$$\Rightarrow \frac{1}{(-6)} - \frac{1}{(-12)} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{f} = \frac{1}{12} - \frac{1}{6} = \frac{-1}{12}$$

$$\Rightarrow f = -12\ \text{cm} = -\frac{12}{100}\text{m}$$

Now, power,

$$P = \frac{1}{f}$$
$$\Rightarrow P = -\frac{100}{12} = -\frac{25}{3}\text{D}$$

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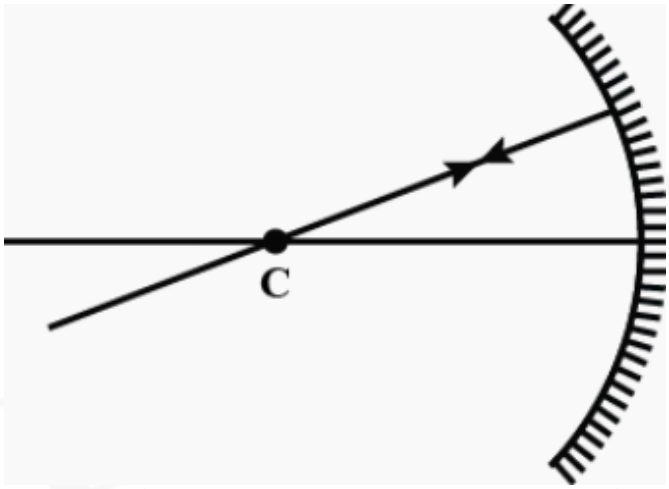
46. Assertion (A) : A ray passing through the centre of curvature of a concave mirror after reflection, is reflected back along the same path.
Reason (R) : The ray passing through the centre of curvature is incident normally to the mirror.

- ✔ **A.** Both A and R are true and R is the correct explanation of A.
- ✘ **B.** Both A and R are true but R is not the correct explanation of A.
- ✘ **C.** A is true but R is false.
- ✘ **D.** A is false but R is true.



The ray of light passes through the centre of curvature of a concave mirror it strikes the mirror along the normal ray, it incidences on to the mirror at an angle of 90 degrees. Hence, the incident ray coincides with the normal.
Therefore, angle of incidence = 0
So, as we know according to the law of reflection:
angle of reflection = 0,
Hence, the angle of reflection tends to zero degree, thus the ray of light retraces its path.

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47. In an experiment, students need to get an upright image of an object using a lens of focal length 25 cm. The experiment was set up by putting the lens and the object at a distance of 10 cm. Students of group A used a convex lens and group B used a concave lens for their experiment. The ratio of magnification obtained by group A and group B is:

- A. $\frac{3}{7}$
- B. $\frac{7}{3}$
- C. 3
- D. 1

Using sign convention,
$u = -10\ cm, f_A = +25\ cm\ (convex\ lens), f_B = -25\ cm\ (concave\ lens)$

Using lens formula,
$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

For group A,
$$\frac{1}{25} = \frac{1}{v_A} - \frac{1}{-10}$$

$v_A = -50/3\ cm$

For group B,
$$\frac{1}{-25} = \frac{1}{v_B} - \frac{1}{-10}$$

$v_B = -50/7\ cm$

Magnification, $m = \frac{v}{u} = \frac{Height\ of\ image\ (I)}{Height\ of\ object\ (O)}$

Therefore, $m_A = \frac{v_A}{u_A} = \frac{(-50/3)}{(-10)} = 5/3$

Similarly, $m_B = \frac{v_B}{u_B} = \frac{(-50/7)}{(-10)} = 5/7$

Hence,
$$\frac{m_A}{m_B} = \frac{(5/3)}{(5/7)} = 7/3$$

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48. Assertion (A): Stars twinkle, while planets shine steadily.
Reason (R): Stars have their own light where as planet do not.

- ✗ **A.** Both A and R are true and R is the correct explanation of A
- ✓ **B.** Both A and R are true but R is not the correct explanation of A
- ✗ **C.** A is true but R is false
- ✗ **D.** A is false but R is true

As the stars have their own light, and are very much far away from us, the light coming from the stars has to travel a very long distance. So, stars seems like a point source where as planets are closer to Earth and so appear as tiny disks in our sky.
Light from the stars bent many times and in random directions due to Earth's atmosphere. This random refraction results in the star winking out - twinkling.
Planets are closer to Earth and so appear as tiny disks in our sky. The light from these little disks is also refracted by Earth's atmosphere, as it travels toward our eyes. Due to the planets' apparent closeness to Earth, the light coming from these celestial bodies does not bend much due to Earth's atmosphere. Also not beinga point source but appearing as disks, they comprise of several point sources- lights of which are coming at the same time. So a deviation in light path of one point source can cancel with deviations of other and would average out to give rise to a steady shine. Therefore, the light coming from our solar system's planets does not appear to twinkle like stars.

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49. Ingredients used in kitchens always amazes us through their magic. One of them is baking powder which has a compound X as its major constituent. The compound X sometimes also helps in getting relief from acid indigestion or even in ant bite. In the laboratory, when we heat compound X, it gets converted into Y which is anhydrous but absorbs water to become a hydrated salt Z, one of the raw materials of soaps and detergents.

(ii) Identify the compound Y and Z from the following:

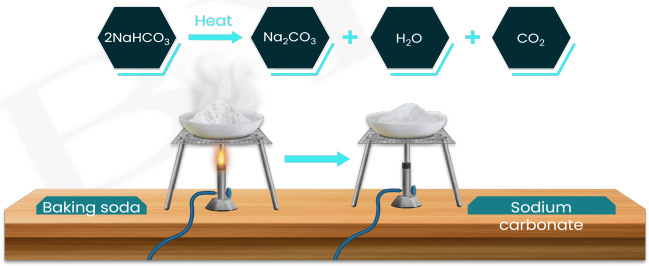
✗ **A.** Y: $NaHCO_3$, Z: $Na_2CO_3.10H_2O$

✓ **B.** Y: Na_2CO_3, Z: $Na_2CO_3.10H_2O$

✗ **C.** Y: $NaOH$, Z: $NaCl$

✗ **D.** Y: $NaHCO_3$, Z: Na_2CO_3

Heating of baking soda $(NaHCO_3)$ results in the formation of sodium carbonate (Na_2CO_3) and carbon dioxide gas along with water vapours.



Hence, Y is sodium carbonate (Na_2CO_3) which is anhydrous in nature i.e. no water molecule attached to the molecule of sodium carbonate.
Sodium carbonate when comes in contact with moisture, it get hydrated with 10 molecules of water to form sodium carbonate decahydrate $(Na_2CO_3.10H_2O)$.
Thus, Z is sodium carbonate decahydrate $(Na_2CO_3.10H_2O)$ which is commonly known as washing soda, a raw material used in soap and detergent manufacturing.

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50. Ingredients used in kitchens always amazes us through their magic. One of them is baking powder which has a compound X as its major constituent. The compound X sometimes also helps in getting relief from acid indigestion or even in ant bite. In the laboratory, when we heat compound X, it gets converted into Y which is anhydrous but absorbs water to become a hydrated salt Z, one of the raw materials of soaps and detergents.

(iv) Compound X is a basic compound because it is a salt of a _____.

✗ **A.** strong acid and strong base

✗ **B.** weak acid and weak base

✗ **C.** strong acid and weak base

✓ **D.** weak acid and strong base

The nature of the salt obtained from neutralisation reaction depends upon the strength of the acid and the base.

Case 1: A strong base is required to react with strong acid in order to obtain a neutral salt, whose pH value will be equal to 7.
Case 2: A strong acid is required to react with weak base in order to obtain an acidic salt whose pH value will be less than 7.
Case 3: A weak acid is required to react with strong base in order to obtain a basic salt whose pH value will be greater than 7.

Compound X i.e. baking soda $(NaHCO_3)$, which is an example of basic salt obtained from the neutralisation reaction of sodium hydroxide (strong base) and carbonic acid (weak acid).

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51. Ingredients used in kitchens always amazes us through their magic. One of them is baking powder which has a compound X as its major constituent. The compound X sometimes also helps in getting relief from acid indigestion or even in ant bite. In the laboratory, when we heat compound X, it gets converted into Y which is anhydrous but absorbs water to become a hydrated salt Z, one of the raw materials of soaps and detergents.

(iii) The aqueous solution of Y changes _____.

✔ **A.** red litmus to blue

✘ **B.** blue litmus to red

✘ **C.** red litmus to colourless

✘ **D.** blue litmus to colourless

The pH of distilled water is 7. So, the water is neutral before adding sodium carbonate. The pH value for sodium carbonate is around 11, hence it is basic in nature.

When a small amount of sodium carbonate is added to water, the pH of the water increases above 7. Therefore, the solution becomes basic and changes red litmus blue.

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52. Ingredients used in kitchens always amazes us through their magic. One of them is baking powder which has a compound X as its major constituent. The compound X sometimes also helps in getting relief from acid indigestion or even in ant bite. In the laboratory, when we heat compound X, it gets converted into Y which is anhydrous but absorbs water to become a hydrated salt Z, one of the raw materials of soaps and detergents.

(i) Identify the compound X from the following:

✔ **A.** $NaHCO_3$

✘ **B.** Na_2CO_3

✘ **C.** $NaOH$

✘ **D.** $NaCl$

In kitchen, baking powder is used as ingredient for making tasty pakodas, fluffy cakes and more.
Baking powder has baking soda $(NaHCO_3)$ as a major consituent along with some edible acids into it.
Therefore, compound X is $NaHCO_3$: a mild base.
In acid indigestion, $NaHCO_3$ neutralises excess hydrochloric acid in the stomach and in case of ant bite, it neutralises formic acid injected through the ant sting.

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53. **Case:** Transpiration is the evaporative loss of water by plants. It occurs mainly through the stomata in the leaves. Besides the loss of water vapour in transpiration, exchange of oxygen and carbon dioxide in the leaf also occurs through pores called stomata. Normally stomata remain open during the day and close at night.

Based on the above case answer the following question:

Which of the following will not directly affect the rate of transpiration?

✗ **A.** Temperature

✗ **B.** Wind speed

✗ **C.** Light intensity

✓ **D.** Chlorophyll content of leaves

Environmental factors like light, humidity, temperature, pressure and wind velocity affect the rate of transpiration. The rate of transpiration is directly proportional to the presence of light, high temperature, and high wind velocity while it is inversely proportional to the relative humidity.
The chlorophyll content has no role in the process of transpiration but holds a significance in the process of photosynthesis.

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54. **Case:** Transpiration is the evaporative loss of water by plants. It occurs mainly through the stomata in the leaves. Besides the loss of water vapour in transpiration, exchange of oxygen and carbon dioxide in the leaf also occurs through pores called stomata. Normally stomata remain open during the day and close at night.

Based on the above case answer the following question:

Water vapour comes out from the plant leaf through the stomatal opening. Through the same stomatal opening, carbon dioxide diffuses into the plant during photosynthesis. Reason out the above statements using one of the following options.

✗ **A.** The above processes happen only during night time.

✗ **B.** One process occurs during the day time and the other during night.

✗ **C.** Both processes cannot happen at the same time.

✓ **D.** Both processes can happen together at daytime.

The loss of water in the process of transpiration and the exchange of gases during photosynthesis take place through the stomatal pores. The rate of transpiration is higher in day in comparison to night. Photosynthesis on the contrary takes place during the day only. Hence, both transpiration and photosynthesis can happen at daytime.

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Based on the above case answer the following question:

Which of the following statements is not true for stomatal apparatus?

✗ **A.** Guard cells regulate the closing and opening of the stomatal pore.

✗ **B.** Guard cells enclose the stomatal pores.

✗ **C.** Stomata are involved in gaseous exchange.

✓ **D.** The guard cells shrink to open the stomatal pore.

The opening and closing of the stomatal pores are regulated by the guard cells. The guard cells swell when water flows into them making the stomatal pore open. This leads to the exchange of gases via the stomata.

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56. **Case:** Transpiration is the evaporative loss of water by plants. It occurs mainly through the stomata in the leaves. Besides the loss of water vapour in transpiration, exchange of oxygen and carbon dioxide in the leaf also occurs through pores called stomata. Normally stomata remain open during the day and close at night.

Based on the above case answer the following question:

Which of the following is not a purpose of transpiration?

✗ **A.** Helps in absorption and transport in plants.

✓ **B.** Prevents loss of water.

✗ **C.** Maintains shape and structure of plants by keeping the cells turgid.

✗ **D.** Supplies water for photosynthesis.

Loss of water is a defining feature of transpiration. This loss of water vapour through evaporation creates a suctional pull which helps in transport of water from roots to the aerial parts of the plant. The water transported is absorbed by the cells for photosynthesis and also helps maintain the turgidity inside the cell.

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57. **Case:** Pooja did an experiment with an equilateral glass prism in which she projected a narrow beam of white light source from one side of the surface of the prism and placed a screen on the other side of the prism. She observed certain patches of different colours on the screen. Later, she repeated the same experiment with a red-light source, however, she could only observe a red coloured patch on the screen. Again, she repeated the experiment with blue and green light sources, respectively, and could only see one colour patch on both the occasions.

The reason why she could not see any other colour when the red light was used as source because:

✗ **A.** The prism was defective

✓ **B.** Red light source is monochromatic

✗ **C.** Red colour does not refract in prism

✗ **D.** The prism is opaque to red colour

She could not see any other colour on the screen when red light source was used because the source has only one light of single wavelength, i.e, the source (red light) is monochromatic.

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58. **Case:** Pooja did an experiment with an equilateral glass prism in which she projected a narrow beam of white light source from one side of the surface of the prism and placed a screen on the other side of the prism. She observed certain patches of different colours on the screen. Later, she repeated the same experiment with a red-light source, however, she could only observe a red coloured patch on the screen. Again, she repeated the experiment with blue and green light sources, respectively, and could only see one colour patch on both the occasions.

What can be the correct explaination of the phenomenon observed by Pooja?

✔ **A.** Different wavelengths travel at different speeds in glass

✘ **B.** Different lights travel faster in glass at different rates

✘ **C.** Any light would disperse in the prism

✘ **D.** Enough data is not available to make a scientific explaination in this case

Lights with different colours have different wavelengths and light with different wavelengths travel travel at different speeds in a particular medium.
Since white light is a combination of seven different colours and each colour travels at different speeds inside the glass prism, hence, each colour undergoes different amount of bending (refraction) after passing through the glass prism and we obtain a spectrum of these seven colours on the screen.

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59. **Case:** Pooja did an experiment with an equilateral glass prism in which she projected a narrow beam of white light source from one side of the surface of the prism and placed a screen on the other side of the prism. She observed certain patches of different colours on the screen. Later, she repeated the same experiment with a red-light source, however, she could only observe a red coloured patch on the screen. Again, she repeated the experiment with blue and green light sources, respectively, and could only see one colour patch on both the occasions.

Which of the following natural phenomena could she also relate to which is similar to the one she observed in the experiment?

✗ **A.** Blue colour of the sky

✗ **B.** Early sunrise or delayed sunset

✓ **C.** Formation of rainbow

✗ **D.** Reddish colour of the sky during sunset

Formation of rainbow is the natural phenomena that is also based on dispersion of white light. It can be observed on a rainy humid day when the sun is out. Here, the water droplets present in the stmosphere acts as tiny prisms and they disperse the white sunlight into its constituent seven different colours, which we see as the rainbow.

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60. **Case:** Pooja did an experiment with an equilateral glass prism in which she projected a narrow beam of white light source from one side of the surface of the prism and placed a screen on the other side of the prism. She observed certain patches of different colours on the screen. Later, she repeated the same experiment with a red-light source, however, she could only observe a red coloured patch on the screen. Again, she repeated the experiment with blue and green light sources, respectively, and could only see one colour patch on both the occasions.

The phenomenon that she was trying to demonstrate was:

✗ **A.** Scattering

✗ **B.** Refraction

✓ **C.** Dispersion

✗ **D.** Reflection

The phenomenon that she was trying to demonstrate is dispersion. Dispersion is the splitiing of white light into its constituent colours after passing through a prism.

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