CBSE : SCIENCE PAPER (HINTS & SOLUTIONS)

SECTION - A (BIOLOGY)

1. (B) 2

2. (A) Absorbing light energy

3. (C) Only deoxygenated blood flows through the heart.

Fishes, on the other hand, have only two chambers to their hearts, and the blood is pumped to the gills, is oxygenated there, and passes directly to the rest of the body. Thus, blood goes only once through the heart in the fish during one cycle of passage through the body. Only deoxygenated blood flows through the heart.

4. (D) Sphygmomanometer

5. (A) Cytoplasm

6. (C) I and III

7. (B) Veins

8. (D) Both A & R are false

9. (C) If Assertion is True but the Reason is False.

10. Necessary conditions for autotrophic nutrition –

(1) Sunlight

(2) Photosynthetic pigment

(3) Carbon dioxide

(4) water

Its by products –

(1) Glucose

(2) Water

(3) Oxygen

11. **Attempt either option A or B:**

A. **Explain Question:**

The question asks is nutrition necessary for an organism.

Concept:

The concept is Nutrition.

Solution:

Yes, nutrition is necessary for an organism because all organisms need energy to carry out various functions in the body and we get energy by taking in food and utilizing it for various purposes.

OR

B. **Question Explanation:** Advantages of sexual reproduction.

Concept: Sexual vs. Asexual Reproduction.

Solution: Sexual reproduction creates genetic variation by combining genes from two parents. This variation is crucial for adaptation to changing environments and for the long-term survival and evolution of the species. Asexual reproduction produces genetically identical offspring.

(i) Sexual reproduction is better than asexual reproduction because it brings variation which is necessary to have in a population so in case of adversity of environment all the members do not die but members with suitable variation survive to save the population from getting extinct.

In asexual reproduction variations are very less.

(ii) These variations collected over a period of time leads to formation of new species.

12. **Question Explanation :** Benefits of tissue culture.

Concept: Micropropagation.

Solution: Advantages of tissue culture are –

(i) Genetically identical plants are produced.

(ii) Disease free plants can be produced.
(iii) It is a quick method to produce large number of plants in a short period and limited space.
(iv) New plant varieties can be produced using this technique.

13. (i) Allen Module Page No. 9
(ii) Allen Module Page No. 10

14. **Explain Question:**
Question asks to explain excretion in plants.
Concept:
Excretion in plants
Solution:
The main waste products produced by plants are carbon dioxide, water vapour and oxygen.
CO_2 and water are produced as wastes during respiration by plants.
CO_2 produced during respiration in day time is all used by the plant itself in photosynthesis. Plants excrete oxygen as a waste only during day time.
The gaseous wastes of respiration and photosynthesis in plants are removed through the stomata in leaves and lenticels in woody stem and released in to the air. Oxygen is produced as a waste during photosynthesis.
Plants get rid of excess water by transpiration.
Many plant waste products are stored in cellular vacuole.
Plants also store some of the waste products in their body parts (leaves, bark and fruits). e.g. Tannins, essential oils, latex, gums, resins.

15. **Attempt either subpart A or B:** **(4)**

A. Pairs of allelic characters found in garden pea plant.

Properties		Dominant	Recessive
1	Height	Tall	Dwarf
2	Colour of seed	Yellow	Green
3	Colour of pod	Green	Yellow
4	Colour of flower	Violet	White
5	Shape of seed	Round	Wrinkled
6	Shape of pod	Inflated	Constricted
7	Position of flower	Axial	Terminal

OR

B. Genetically organisms are of two types :
(i) Haploid : They have single set of chromosomes, where each chromosome is represented singly. As the chromosomes are the bearer of genes so haploids have single set of genes. A single gene determines the expression of character.
(ii) Diploid : They have two set of homologous chromosomes, where the chromosome occurs in pair, one maternal contributed by the mother through her ovum and the second chromosome of the pair is contributed by the male parent through his sperm.
The resultant cell zygote produces by the fusion of male and female gametes have two sets of chromosomes, each set contributed by each parent. In diploids a character is controlled by two genes factors. Both the father and mother contribute practically equal amount of genetic material to the child. It means that each trait can be influenced by both paternal and maternal DNA.

16. **Attempt either option A or B:**

A. (i) Three major regions of the brain are : Cerebrum, Cerebellum and Brainstem
Function :
Cerebrum: Controls voluntary activities such as movement, speech, thought, and memory.

Cerebellum: Manages posture, coordination, and fine motor skills.

Brainstem: Regulates essential automatic bodily functions, such as breathing, heart rate, and digestion.

(ii) The growth of a plant part due to chemical stimulus is known as chemotropism. For example the growth of pollen tube towards the ovule induced by a sugary substance as stimulus. This is an example of positive chemotropism.

(iii) (a) The hormone secreted by the thyroid gland is thyroxine. It regulates carbohydrate protein and fat metabolism in the body so as to provide the best balance for growth.

(b) Pituitary gland secretes growth hormone. It regulates growth and development of the body.

(c) Pancreas secretes hormone insulin. It helps in regulating the blood sugar level.

OR

B. Vegetative Propagation is an asexual method of reproduction in plants where vegetative parts namely root, stem and leaves give rise to new plants in appropriate conditions.

It is used when either plants do not produce seeds, or their seeds are not viable.

Their qualities are good, and we want to preserve those qualities.

Only male or female plant is available. Fast, rapid, cheap growth method.

Three methods of vegetative propagation are natural vegetative propagation, artificial vegetative propagation, tissue culture.

Natural vegetative propagation by leaves: Leaves of some plants produce adventitious buds with adventitious roots on their margin, which get detached and develop into new plants.

e.g. *Bryophyllum*, *Kalanchoe*.

Leaf of Bryophyllum with buds

SECTION - B (CHEMISTRY)

17. **(C)** Only in reaction (C), one of the products is insoluble solid ($BaSO_4$)
18. **(D)** Decomposition of calcium carbonate to form quick lime and carbon dioxide
19. **(B)** CO_2 reacts with lime water, $Ca(OH)_2$ to form $CaCO_3$ which gives milkiness. On passing CO_2 further, $CaCO_3$ is converted to $Ca(HCO_3)_2$ which is soluble and hence solution become colourless.
20. **(C)** absorb moisture from the gas
21. **(B)** Amphoteric oxides are those which react with acids as well as bases.
22. (A) Impure copper is made the anode and cathode is of pure copper
23. **(C)**

$$\underset{\text{Ethane}}{CH_2 = CH_2} + Br_2 \xrightarrow{CCl_4} \underset{1,2-\text{Dibromoethane}}{Br - CH_2 - CH_2 - Br}$$

24. (B) Both A and R are true, and R is not the correct explanation of A.
25. Hydrogenation is the process of converting vegetable oil to vegetable ghee.

Vegetable oils have long unsaturated carbon chains and hence are liquids at room temperature but on hydrogenation with H_2 in presence of Ni, they get converted into saturated carbon chains which are generally solids at room temperature

$$\underset{\text{(Liquid)}}{\text{Vegetable oil}} + H_2 \xrightarrow{\text{Ni, 473K}} \underset{\text{(Solid)}}{\text{Vegetable ghee}}$$

26. **Attempt either option A or B.**

(A) The metal used in galvanization of iron articles is zinc. Therefore, the metal M is zinc (Zn) and its carbonate ore, MCO_3 is $ZnCO_3$ which is called **calamine.**

The carbonate ore after concentration is calcined to form zinc oxide which is then reduced with carbon to form zinc metal.

$$\underset{\text{Calamine}}{ZnCO_3(s)} \xrightarrow{\Delta} \underset{\text{Zinc oxide}}{ZnO(s)} + CO_2(g)$$

$$ZnO\ (s) + C\ (s) \xrightarrow{\text{Smelting}} Zn\ (s) + CO\ (g)$$

OR

(B) The gas which smells like that of rotten eggs is H_2S. Hence, the ore is a sulphide ore. It is concentrated by froth floatation process. The metal is obtained from the concentrated ore in the following two steps:

(i) **Roasting,** i.e., heating the ore strongly in the presence of air. The metal sulphide is converted into metal oxide along with evolution of sulphur dioxide gas.

$$\text{Metal sulphide} + O_2 \xrightarrow{\text{Roasting}} \text{Metal oxide} + SO_2$$

(ii) **Reduction with carbon.** On heating the metal oxide with carbon, it is reduced to free metal

$$\text{Metal oxide} + \text{Carbon} \longrightarrow \text{Metal} + \text{Carbon monoxide}$$

27. (a) Plaster of Paris, $CaSO_4 \cdot \frac{1}{2}H_2O$

(b) It is obtained by heating gypsum to a temperature of 100°C (313 K)

$$\underset{\text{Gypsum}}{CaSO_4 \cdot 2H_2O} \xrightarrow{100°C} \underset{\text{Plaster of Paris}}{CaSO_4 \cdot \frac{1}{2}H_2O} + 1\frac{1}{2}H_2O$$

(c) $$\underset{\text{Plaster of Paris}}{CaSO_4 \cdot \frac{1}{2}H_2O} + \underset{\text{Water}}{1\frac{1}{2}H_2O} \longrightarrow \underset{\text{Gypsum (hard mass)}}{CaSO_4.2H_2O}$$

(d) In making toys, casts for statues, jewellery etc. and chalks for writing on the blackboard.

28.

(A) (i) $$\underset{\text{Aluminium}}{2Al(s)} + \underset{\substack{\text{Ferrous sulphate} \\ \text{(Green)}}}{3FeSO_4(aq)} \longrightarrow \underset{\substack{\text{Aluminium sulphate} \\ \text{(Colourless)}}}{Al_2(SO_4)_3(aq)} + \underset{\text{Iron}}{3Fe(s)}$$

Green colour of ferrous sulphate solution will fade till it may ultimately become colourless and iron particles settle down.

(ii) $Cu(s) + FeSO_4(aq) \longrightarrow$ No reaction.

(iii) $Fe(s) + FeSO_4(aq) \longrightarrow$ No reaction.

(iv) $$\underset{\text{Zinc}}{Zn\ (s)} + \underset{\substack{\text{Ferrous sulphate} \\ \text{(Green)}}}{FeSO_4(aq)} \longrightarrow \underset{\substack{\text{Zinc sulphate} \\ \text{(Colourless)}}}{ZnSO_4(aq)} + \underset{\text{Iron}}{Fe(s)}$$

OR

(B) (a) (i) Characteristic smell of burning sulphur is obtained.

(ii) Green colour first fades and finally a reddish brown residue is left behind.

(b) It is a decomposition reaction.

(c) **1st Step :**

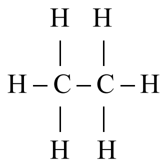
$$\underset{\substack{\text{Ferrous sulphate} \\ \text{crystals}}}{FeSO_4.7H_2O} \xrightarrow{\text{Heat}} \underset{\substack{\text{Anhydrous} \\ \text{ferrous sulphate}}}{FeSO_4(s)} + 7H_2O\ (\ell)$$

2nd step :

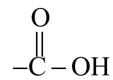
$$\underset{\text{Ferrous sulphate}}{2FeSO_4(s)} \xrightarrow[\text{heating}]{\text{Further}} \underset{\substack{\text{Ferric oxide} \\ \text{(Reddish brown)}}}{Fe_2O_3(s)} + \underset{\text{Sulphur dioxide}}{SO_2(g)\uparrow} + \underset{\text{Sulphur trioxide}}{SO_3(g)\uparrow}$$

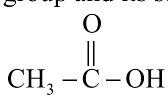
29. ***Attempt either option A or B.***

(A) (i) **Compound D,** i.e. C_2H_6 (ethane). It is a saturated hydrocarbon since it contains a single bond between its two carbon atoms as shown below :



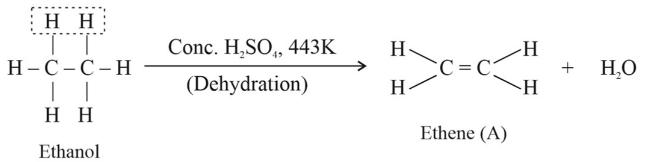
Saturated hydrocarbon

(ii) Compound B is a carboxylic acid since it contains carboxyl group, i.e.,

as the functional group and its structure is as given below :



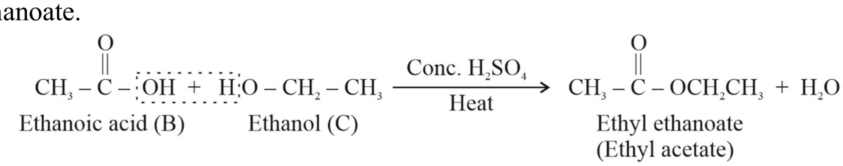
Carboxylic acid

(iii) Compound C is ethanol since when it is heated to 443K in presence of conc. H_2SO_4, it undergoes dehydration (i.e., loss of a molecule of H_2O) to form ethene (A) which is an unsaturated compound.
The chemical equation for the above reaction is



Since H_2SO_4 removes one molecule of H_2O from ethanol, this reaction is called dehydration and H_2SO_4 acts as a **dehydration agent.**

(iv) When B and C react together in presence of conc. H_2SO_4, they lose a molecule of H_2O to form an **ester,** ethyl ethanoate.

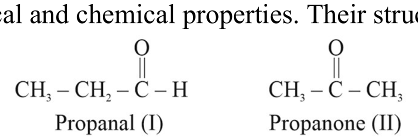


Esters are sweet-smelling substances. So they are widely used in making perfumes and flavouring agents.

(B) (a) Compounds having same molecular formula but different properties are called isomers. They differ in arrangement of atoms.

(b) Propanol (I) and propanone (II) are isomers since they have the same molecular formula, C_3H_6O but have different physical and chemical properties. Their structures and names are given below :

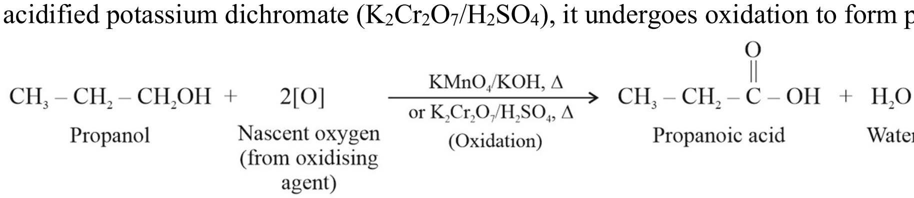
IUPAC name :



Common name : Propionaldehyde   Acetone

(c) (i) $C_2H_5OH \xrightarrow[\text{(Dehydration)}]{\text{Conc. } H_2SO_4\text{, 443K}} C_2H_4 + H_2O$

(ii) Propanol is an alcohol. On heating with alkaline potassium permanganate ($KMnO_4/KOH$) or with acidified potassium dichromate ($K_2Cr_2O_7/H_2SO_4$), it undergoes oxidation to form propanoic acid.



SECTION - C (PHYSICS)

30. (A) i and ii

(i) Current through a wire is inversely proportional to its resistance. This statement is correct. According to Ohm's Law (I = V/R), the current (I) flowing through a conductor is inversely proportional to its resistance (R) for a constant voltage (V).

(ii) Resistance of a wire is directly proportional to its length and inversely proportional to its area of cross-section. This statement is correct. The formula for the resistance of a uniform conductor is $R=\rho L/A$ where ρ (rho) is the resistivity, L is the length, and A is the area of the cross-section.

(iii) Resistance of a wire is directly proportional to resistivity of its material which depends on shape and size of the wire. This statement is partially incorrect. Resistivity ρ(rho) is an intrinsic material property that depends on factors like the material's nature and temperature, but it is largely independent of the shape and size of the specific wire sample. The resistance (R) depends on the shape and size (length and area), not the resistivity itself.

31. (C) Focus

To produce a strong, parallel beam of light, the light bulb is placed at the principal focus of the concave mirror. Light rays diverging from the focus strike the concave reflecting surface and, by the laws of reflection, emerge as rays parallel to the principal axis, creating a powerful, concentrated beam.

32. (C) A is true but R is false.

Assertion (A): True. The blue color of the sky is indeed caused by Rayleigh scattering, where tiny atmospheric particles (like nitrogen and oxygen molecules) scatter sunlight, especially shorter wavelengths, making the sky appear blue.

Reason (R): False. The reason incorrectly states longer wavelengths scatter more. Blue light has a shorter wavelength than red light, and Rayleigh scattering is inversely proportional to the fourth power of the wavelength, meaning shorter wavelengths scatter much more effectively. This is why blue light dominates the sky's appearance.

33. (A) Convex lens

The diagram shows light rays converging after passing through a lens, which is characteristic of a convex (converging) lens.

(B) Real and inverted image

The image A'B' is formed by the actual intersection of light rays on the opposite side of the lens from the object, making it a real image. It is also oriented downwards relative to the object AB, meaning it is inverted.

(C) The object distance is u =–25 cm (negative as it is to the left of the optical center).

The image distance is v = +15 cm (positive as it is to the right of the optical center).

The lens formula is given by:

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

$$\frac{1}{15}-\frac{1}{-25}=\frac{1}{f}$$

$$\frac{1}{15}+\frac{1}{25}=\frac{1}{f}$$

Find a common denominator (which is 75):

$$\frac{5}{75}+\frac{3}{75}=\frac{1}{f};\ \frac{8}{75}=\frac{1}{f}$$

$$f=\frac{75}{8}$$

$$f = 9.375\text{ cm}$$

34. Attempt either A or B

(A) (i) The two 10Ω resistors are connected in parallel.

$$R_p = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$\mathbf{R_{eff}} = \frac{10\Omega \times 10\Omega}{10\Omega + 10\Omega} = \frac{100\Omega^2}{20\Omega} = \mathbf{5\Omega}$$

(ii) The effective resistance of the two parallel 10Ω resistors is 5Ω. This effective resistance is in series with the third 5Ω resistor.

$$R_{total} = R_{eff} + R_{series} = 5\Omega + 5\Omega = 10\Omega$$

$$I_{total} = \frac{V}{R_{total}} = \frac{5V}{10\Omega} = 0.5A$$

$$I_{5\Omega} = I_{total} = 0.5A$$

OR

(B) The resistors are $R_{CD} = 3\Omega, R_{DE} = 2\Omega \ \& \ R_{CE} = 5\Omega$

The total resistance of the Delta is $R_{total\Delta} = R_{CD} + R_{DE} + R_{CE} = 3 + 2 + 5 = 10\Omega$

$$R_C = \frac{R_{CD} \times R_{CE}}{R_{total\Delta}} = \frac{3 \times 5}{10} = \frac{15}{10} = 1.5\Omega$$

$$R_D = \frac{R_{DE} \times R_{CD}}{R_{total\Delta}} = \frac{2 \times 3}{10} = \frac{6}{10} = 0.6\Omega$$

$$R_E = \frac{R_{CE} \times R_{DE}}{R_{total\Delta}} = \frac{5 \times 2}{10} = \frac{10}{10} = 1\Omega$$

Resistance of the top branch: $R_{top} = 4\Omega + R_C = 4 + 1.5 = 5.5\Omega$

Resistance of the bottom branch: $R_{bottom} = 1.5\Omega + R_D = 1.5 + 0.6 = 2.1\Omega$

The parallel combination of the top and bottom branches is

$$R_{parallel} = \frac{R_{top} \times R_{bottom}}{R_{top} + R_{bottom}} = \frac{5.5 \times 2.1}{5.5 + 2.1} = \frac{11.55}{7.6} \approx 1.5197\Omega$$

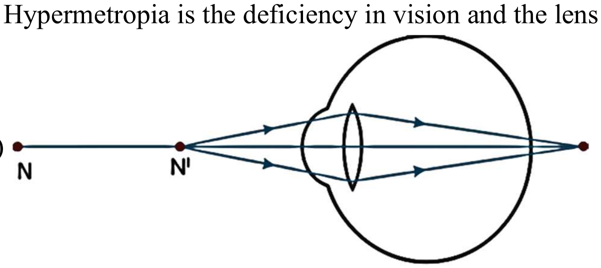
The total resistance across A and B is

$$R_{AB} = R_{parallel} + R_E = 1.5197 + 1 = 2.5197\Omega$$

The total resistance of the given circuit across the ends A and B is approximately 2.52Ω.

35. (i) Hypermetropia is the deficiency in vision and the lens is convex lens.

(ii)



36. (i) A is North Pole, B is South Pole

When the circuit is closed, current flows from the positive terminal of the battery. Applying the right-hand thumb rule to the solenoid, if the current direction on the front face (end A) is observed to be anti-clockwise, that end behaves as a North Pole. Conversely, the other end (B) where the current is clockwise, behaves as a South Pole.

(ii) By reversing the direction of the current

The polarity of the ends of the solenoid can be reversed by changing the direction of current flow in the coil. This is achieved by reversing the terminals of the battery.

(iii) Uniform and parallel

The magnetic field lines within the solenoid are parallel to each other and to the axis of the solenoid, indicating a uniform magnetic field inside. This is similar to the field lines within a bar magnet, where the field is strong and uniform.

37. The initial resistance is given by $R_1 = \rho\frac{L_1}{A_1}$, where ρ is the material resistivity, L_1 is the original length, and A_1 is the original cross-sectional area [1].

Since the new length $L_2 = 2L_1$ and volume $V = A \times L$ is constant $(A_1L_1 = A_2L_2)$, the new area is $A_2 = \frac{A_1L_1}{L_2} = \frac{A_1L_1}{2L_1} = \frac{A_1}{2}$

The new resistance R_2 is calculated as $R_2 = \rho\frac{L_2}{A_2} = \rho\frac{2L_1}{A_1/2} = 4\rho\frac{L_1}{A_1} = 4R_1$ [1].

With $R_1 = 10\Omega$ the new resistance is $R_2 = 4 \times 10\Omega = 40\Omega$.

In a separate scenario, if the original wire's diameter d_1 is doubled to $d_2 = 2d_1$, the cross-sectional area $A = \pi(\frac{d}{2})^2$ changes significantly. The new area $A_2 = \pi(\frac{d_2}{2})^2 = \pi(\frac{2d_1}{2})^2 = \pi d_1^2$

The original area $A_1 = \pi(\frac{d_1}{2})^2$. Thus $A_2 = 4\pi(\frac{d_1}{2})^2 = 4A_1$

Assuming the length remains the original L_1, the new resistance R_2 is

$R_2 = \rho\frac{L_1}{A_2} = \rho\frac{L_1}{4A_1} = \frac{1}{4}R_1$. With $R_1 = 10\Omega$ the new resistance is $R_2 = \frac{1}{4} \times 10\Omega = 2.5\Omega$

The resistance of the new wire after stretching is 40Ω. If the diameter of the original wire is doubled, the resistance changes to 2.5Ω (a decrease of 7.5 Ω).

38. No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be

(a) only convex (b) only plane

(c) either plane or convex (d) only concave

Sol. (c) either plane or convex

A plane mirror always forms an erect, virtual image of the same size as the object. A convex mirror always forms an erect, virtual, and diminished image for any position of the object. A concave mirror forms an inverted image in most cases, except when the object is placed between the pole and the principal focus, in which case it forms an erect, virtual, and magnified image. Therefore, a mirror that always produces an erect image, regardless of the distance, is either plane or convex.

(B) Concave mirror

A concave mirror is used by dentists. This is because when the tooth (object) is placed between the pole and the principal focus of the concave mirror, it produces a magnified, erect, and virtual image of the tooth. This magnified image allows the dentist to clearly view any defects in the tooth.

Attempt either subpart C or D

(C) The focal length of the concave mirror is f = –2 cm (negative for a concave mirror).

The magnification m = +3 (positive as the image is erect and virtual).

The magnification formula is $m = -\frac{\upsilon}{u}$

Using the magnification formula:

$m = -\frac{\upsilon}{u}$

$3 = -\frac{\upsilon}{u}$

$\upsilon = -3u$

The mirror formula is $\frac{1}{f} = \frac{1}{\upsilon} + \frac{1}{u}$

$\frac{1}{-2} = \frac{1}{-3u} + \frac{1}{u}$

$\frac{1}{-2} = \frac{1+(-3)}{-3u}$

$\frac{1}{-2} = \frac{-2}{-3u}$

$\frac{1}{-2} = \frac{2}{3u}$

$1 \times 3u = -2 \times 2$

$3u = -4$

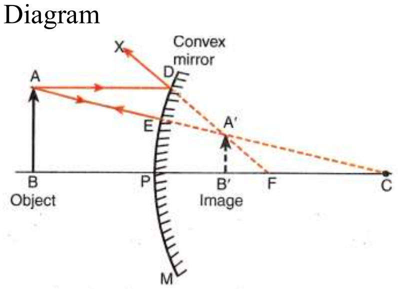
$u = -\frac{4}{3}\,\text{cm}$

The object (tooth) distance from the mirror is $-\frac{4}{3}$cm or approximately – 1.33 cm.

The negative sign indicates that the object is placed in front of the mirror.

OR

(D) Diagram



39. ***Attempt either option A or B***

(A) (i) Using Ohm's law, $I = \frac{V}{R}$·

$I_1 = \frac{20\,V}{4\,\Omega}$

The current in the first resistance is 5A.

(ii) Using the power formula P = V × I

$P_1 = 20\,V \times 5\,A$

The power dissipated across the first resistance is 100 W

(iii) An ammeter is always connected in series to measure the total current flowing from the source. Location 4 is in the main circuit loop, in series with the voltage source, allowing it to measure the total current.

A voltmeter is always connected in parallel across the component or source to measure voltage. Location 1 is connected in parallel across the voltage source, allowing it to measure the total voltage correctly.

The ammeter should be placed at location 4 (in series with the source) to measure the total current. The voltmeter should be placed at location 1 (in parallel across the source terminals) to measure the total voltage.

(B)

(i) A) Live wire, (B) Neutral wire, (C) Earth wire

(ii) Fuse and Earthing

A fuse (D) is a safety device that prevents the circuit from overloading and short-circuiting by melting and breaking the circuit when a current exceeds a safe limit.

Earthing (C) connects the appliance's metal body to the ground, providing a low-resistance path for current and preventing electric shock if the live wire touches the body.

(iii) Total power of bulbs: $P_{bulbs} = 5 \times 10\,W = 50\,W$

Total power of fans: $P_{fans} = 3 \times 60\,W = 180\,W$

Total power of AC: $P_{AC} = 1.2\,kW = 1200\,W$

Total power consumed: $P_{total} = P_{bulbs} + P_{fans} + P_{AC} = 50\,W + 180\,W + 1200\,W = 1430\,W$

$$P_{total} = \frac{1430\,W}{1000} = 1.43\,kW$$

Total energy consumed in 30 days:

$$E_{total} = E_{day} \times 30\,days = 14.3\,kWh/day \times 30\,days = 429\,kWh$$

Cost per unit (kWh): $Rate = Rs.3.00\ per\ kWh$

Total cost : $Cost = E_{total} \times Rate = 429\,kWh \times Rs.3.00\ per\ kWh = Rs.1287$

CBSE : MATHEMATICS PAPER (HINTS & SOLUTIONS)

SECTION - A

Section A consists of 20 questions of 1 mark each.

1. (b) (0, 3)

The centroid of a triangle is the point where the three medians intersect. It can be found by taking the average of the x-coordinates and the average of the y-coordinates of the vertices of the triangle.

If the vertices of the triangle are $(x_1, y_1), (x_2, y_2), (x_3, y_3)$, then the centroid (x_c, y_c) is given by:

$$x_c = \frac{x_1 + x_2 + x_3}{3}, \quad y_c = \frac{y_1 + y_2 + y_3}{3}$$

$$x_c = \frac{3 + (-8) + 5}{3} = \frac{3 - 8 + 5}{3} = \frac{0}{3} = 0$$

$$y_c = \frac{-7 + 6 + 10}{3} = \frac{9}{3} = 3$$

2. (b) 0

The expression can be simplified using the trigonometric identity that

$\csc(90° - \mathbf{x}) = \sec(\mathbf{x})$ and $\cot(90° - \mathbf{x}) = \tan(\mathbf{x})$

For the first two terms: $\csc(75° + \theta) = \csc(90° - (15° - \theta)) = \sec(15° - \theta)$

So, $\csc(75° + \theta) - \sec(15° - \theta) = \sec(15° - \theta) - \sec(15° - \theta) = 0$

For the last two terms: $\cot(35° - \theta) = \cot(90° - (55° + \theta)) = \tan(55° + \theta)$

So, $-\tan(55° + \theta) + \cot(35° - \theta) = -\tan(55° + \theta) + \tan(55° + \theta) = 0$

The entire expression simplifies to 0 + 0 = 0

3. (c) ± 4

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$5 = \sqrt{(1-4)^2 + (0-p)^2}$$

$$5 = \sqrt{(-3)^2 + (-p)^2}$$

$$5 = \sqrt{9 + p^2}$$

$$5^2 = (\sqrt{9 + p^2})^2$$

$$25 = 9 + p^2$$

$$p^2 = 16$$

$$p = \pm 4$$

4. (d) $-\frac{2}{3}$

The problem states that the sum of the zeroes is equal to their product: $\alpha + \beta = \alpha\beta$

$$-\frac{b}{a} = \frac{c}{a},$$

$-\frac{2}{k}=\frac{3k}{k}$

$-\frac{2}{k}=3$

$-2=3k$

$k=-\frac{2}{3}$

5. (b) –10

$P(2)=(2)^2+3(2)+K=0$

$4+6+K=0$

$10+K=0$

$K=-10$

6. (a) 10.5 cm^2

$A_{square}=s^2$

$A_{square}=7^2=49cm^2$

$A_{quadrant}=\frac{1}{4}\times\frac{22}{7}\times 7^2=\frac{1}{4}\times 22\times 7=\frac{154}{4}=38.5cm^2$

$ant: A_{shaded}=A_{square}-A_{quadrant}=49-38.5=10.5\ cm^2$

7. (c) $75\sqrt{3}$ m

Let h be the height of the tower, d be the distance of the object from the tower, and θ be the angle of depression.

The angle of depression from the top of the tower is equal to the angle of elevation from the object to the top of the tower, so $\theta=30^\circ$.

The relationship between the height, distance, and angle is given by the tangent function:

$\tan(\theta)=\frac{h}{d}$

Given $h=75m$ & $\theta=30°$

$\tan(30^\circ)=\frac{75}{d}$; $\frac{1}{\sqrt{3}}=\frac{75}{d}$

$d=75\sqrt{3}m$

8. (b) 3.5

$a_{101}=3.5+(101-1)\times 0$

$a_{101}=3.5+100\times 0$

$a_{101}=3.5+0$

$a_{101}=3.5$

9. (c) 2 cm

$\frac{AD}{DB} = \frac{AE}{EC}$

$\frac{1.5}{3} = \frac{1}{EC}$; $\frac{1}{2} = \frac{1}{EC}$

$EC = 2cm$

10. (c) 700%

Let the original radius of the sphere be r_1

The original volume is $V_1 = \frac{4}{3}\pi r_1^3$

The radius is increased by 100%, meaning the new radius is $r_2 = r_1 + 100\%$ or $r_1 = r_1 + r_1 = 2r_1$

The new volume is $V_2 = \frac{4}{3}\pi r_2^3 = \frac{4}{3}\pi(2r_1)^3 = \frac{4}{3}\pi\left(8r_1^3\right) = 8\times\left(\frac{4}{3}\pi r_1^3\right) = 8V_1$

The increase in volume is $V_2 - V_1 = 8V_1 - V_1 = 7V_1$

The percentage increase in volume is calculated as: $\text{Percentage Increase} = \left(\frac{\text{Increase in Volume}}{\text{Original Volume}}\right)\times 100\%$

$\text{Percentage Increase} = \left(\frac{7V_1}{V_1}\right)\times 100\% = 7\times 100\% = 700\%$

11. (a) 27.5

Mode = 3 × median – 2 × mean

⇒ 2 × mean = 3 × median – mode

⇒ 2 × mean = 3 × 26 – 29

⇒ 2 × mean = 49

⇒ Mean = 49/2 ∴ Mean = 24.5

12. (a) 0.0001

Probability values range from 0 to 1, where a probability of **0** means the event is impossible, and a probability of **1** means the event is certain to happen. Events that are "very unlikely" have probabilities very close to 0. Among the given options, 0.0001 is the smallest value and is closest to zero.

13. (b) 54

$10y + x = \frac{5}{6}(10x + y)$

$|x - y| = 1 \Rightarrow x - y = 1 or y - x = 1$

Expand and rearrange the first equation to find the relationship between x and y

$6(10y + x) = 5(10x + y)$

$60y + 6x = 50x + 5y$

$60y - 5y = 50x - 6x$

$55y = 44x$

Divide both sides by 11:

$5y = 4x \Rightarrow x = \frac{5y}{4}$

The digits x and y must be integers between 1-9 and 0-9 respectively. From $x = \frac{5y}{4}$, y must be a multiple of 4. Possible values for y are 4 or 8.

If y = 4, then $x = \frac{5 \times 4}{4} = 5$. The number is 54.

If y = 8, then $x = \frac{5 \times 8}{4} = 10$, which is not a single digit.

So the only possible number is 54.

Now check the difference condition: $|x - y| = |5 - 4| = 1$ This condition is satisfied.

The number is 54. The reversed number is 45.

Is 45 equal to $\frac{5}{6}$ of 54?

$\frac{5}{6} \times 54 = 5 \times 9 = 45$

Correction Answer is 54

14. (b) (2n – 1)a

Identify the first term (a): $a_1 = a$

Find the common difference (d): $d = a_2 - a_1 = 3a - a = 2a$

Apply the nth term formula: $a_n = a + (n-1)d$

Substitute and simplify:

$a_n = a + (n-1)(2a)$

$a_n = a + 2an - 2a$

$a_n = 2an - a$

$a_n = (2n-1)a$

15. (a) All real value except 10

$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

$\frac{3}{6} = \frac{-1}{-2} \neq \frac{-5}{-p}$

$\frac{1}{2} = \frac{1}{2}; \frac{1}{2} \neq \frac{5}{p}$

$1 \times p \neq 2 \times 5$

$p \neq 10$

16. (c) No real roots

Expanding the square gives: $(x^4 + 2x^2 + 1) - x^2 = 0$

Combining the x^2 terms: $x^4 + x^2 + 1 = 0$

Let $u = x^2$. Since x must be a real number for real roots, u must be non-negative $(u \geq 0)$. The equation in terms of u is $u^2+u+1=0$

To determine if the quadratic equation in u has real roots, the discriminant $\left(\Delta=b^2-4ac\right)$ is calculated. For $u^2+u+1=0,$ we have a = 1, b = 1, and c = 1.

$\Delta=(1)^2-4(1)(1)$

$\Delta=1-4$

$\Delta=-3$

Since the discriminant Δ is negative $(\Delta<0),$ the quadratic equation $u^2+u+1=0$ has no real roots for u.

Because there are no real values for u that satisfy the equation, and $u=x^2,$ there are no real values for x that satisfy the original equation. Therefore, the original equation has no real roots.

17. (c) 32 cm

$PO=\sqrt{24^2+7^2}=25\text{ cm}$

$PR=25+7=32\text{ cm}$

18. (a) b = 6, c = 9

The resulting equation is $x^2-2x+1=0$

Factoring the equation gives: $(x-1)^2=0$

The roots of this equation are x = 1 and x = 1

Each root of the original equation was decreased by 2 to get the roots of the new equation. Therefore, the original roots are: 1 + 2 = 3

The roots of the original equation are 3 and 3

For a general quadratic equation $ax^2+bx+c=0,$ the sum of roots is $-\frac{b}{a}$ and the product of roots is $\frac{c}{a}$.

For the original equation $x^2-bx+c=0$ (where a = 1), the sum of roots is b and the product of roots is c.

Sum of roots $=3+3=6$

Product of roots $=3\times3=9$

b = 6, c = 9

19. (A) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A)

20. (D) Assertion (A) is false but reason (R) is true.

Distance between two points $A\left(x_1,y_1\right)$ & $B\left(x_2,y_2\right)$ is given $AB=\sqrt{\left(x_2-x_1\right)^2+\left(y_2-y_1\right)^2}$ The formula provided in the reason is correct.

To check if the value of y = 6 is correct, use the distance formula with p(2, –3) and Q(10, y) is 10.

$\sqrt{(10-2)^2+(y-(-3))^2}=10$

$\sqrt{(8)^2+(y+3)^2}=10$

Square both sides:

$64+(y+3)^2=100$

$(y+3)^2=100-64$

$(y+3)^2=36$

Take the square root of both sides:

$y+3=\pm\sqrt{36}$

$y+3=\pm 6$

This gives two possible values for y :

$y+3=6 \Rightarrow y=3$

$y+3=-6 \Rightarrow y=-9$

The assertion states that the value of y is 6, but the correct values are 3 and –9.

Therefore, assertion (A) is false.

SECTION - B

Section B consists of 5 questions of 2 marks each.

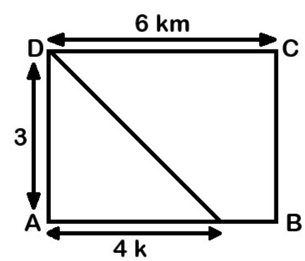
21. sin 30° cos 60° + cos 30° sin 60°

$$=\frac{1}{2}\times\frac{1}{2}+\frac{\sqrt{3}}{2}\times\frac{\sqrt{3}}{2}=\frac{1}{4}+\frac{3}{4}=\frac{1+3}{4}=\frac{4}{4}=1$$

It is equal to sin 90° = 1 but not equal to cos 90° as cos 90° = 0.

22. As per given condition we have drawn the figure below

$$AE=\frac{2}{3}AB=\frac{2}{3}\times 6=4\text{ km}$$



In ΔADE

$DE^2=AD^2+AE^2$

$=3^2+4^2$

$DE^2=25$

$\therefore DE=5\text{ km}$

23.

Class	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 7
Frequency	8	10	10	16	12	6	7

Class 30-40 has the maximum frequency 16

Therefore this is model class

ℓ = 30, f_0 = 10, f_1 = 16, f_2 = 12, h = 10

$$\text{Mode }=\ell+\left(\frac{f_1-f_0}{2f_1-f_0-f_2}\right)\times h$$

$$=30+\left(\frac{16-10}{2\times16-10-12}\right)\times 10=30+\left(\frac{6}{32-22}\right)\times 10=30+\frac{6}{10}\times 10=30+6=36$$

OR

Class 30-35 has the maximum frequency 25

Therefore, this is model class.

ℓ = 30, f_1 = 25, f_0 = 10, f_2 = 7, h = 5

$$\text{Mode }M_0=\ell+\left(\frac{f_1-f_0}{2f_1+f_0-f_2}\right)\times h$$

$= 30 + \left(\frac{25-10}{2\times 25-10-7}\right)\times 5 = 30 + \left(\frac{25-10}{50-17}\right)\times 5 = 30 + \frac{15}{33}\times 5 = 30 + 2.27 = 32.27$ approx

24. Let x = 571

$\sqrt{x} = \sqrt{571}$

Now 571 lies between the perfect squares of $(23)^2 = 529$ and $(24)^2 = 576$

Prime number less than 24 are 2,3,5,7,11,13,17,19,23.

Here 571 is not divisible by any of the above numbers thus 571 is a prime number.

OR

$p = a^2b^3 = a\times a\times b\times b\times b$

$q = a^3b = a\times a\times a\times b$

Now LCM (p, q) = a × a × a × b × b × b = a^3b^3

and HCF (p, q) = a × a × b = a^2b

LCM (p, q) × HCF (p, q) = $a^3b^3 \times a^2b = a^5b^4$

= p × q = $a^2b^3 \times a^3b = a^5b^4$

$\therefore LCM(p,q)\times HCF(p,q) = pq$

25. PQ = 6cm

OP = OQ = 6cm

$\because PQ = PO = QP$

$\therefore \Delta POQ$ is an equilateral triangle

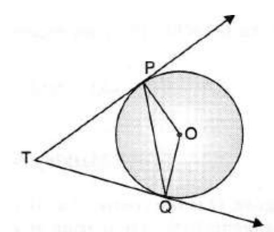
$\therefore \angle POQ = 60°$

We know that $\angle POQ$ and $\angle PTQ$ are supplementary angle.

$\therefore \angle POQ + \angle PTQ = 180°$

$\angle PTQ = 180 - 60 = 120°$

$\therefore \angle PTQ = 120°$



SECTION - C

Section C consists of 6 questions of 3 marks each.

26. The mean marks of the students.

Marks	f_i	x_i	$u_i = \frac{x_i - a}{h}$	f_iu_i
30-35	14	32.5	-3	-42
35-40	16	37.5	-2	-32
40-45	28	42.5	-1	-28
45-50	23	47.5	0	0
50-55	18	52.5	1	18
55-60	8	57.5	2	16
60-55	3	62.5	3	9
	$\sum f_i = 110$			$\sum f_iu_i = -59$

Let a be assumed mean

a = 47.5

Mean $M = a + \frac{\sum f_i u_i}{N} \times h$ $\therefore$ Mean = 44.818

$= 47.5 + \left(\frac{-59}{110}\right) \times 5 = 47.5 - 2.682 = 44.818 = 44.818$

27. AP : 7, 13, 19, …..247

A = 7

d = 13 – 7 = 6

$a_n = a + (n-1)d$

247 = 7 + (n – 1) × 6

247 – 7 = (n – 1) × 6

$\frac{240}{6} = n - 1$

40 = n – 1

n = 41

$\therefore$ Middle term $= \frac{n+1}{2} = \frac{41+1}{2} = 21$

$a_{21} = a + (n-1)d$

$= 7 + (21-1) \times 6$

$= 127$

28. Let radius of the circle be r

As per questions

Circumference = Diameter + 16.8 cm

$2\pi r = 2r + 16.8$

$\Rightarrow 2 \times \frac{22r}{7} = 2r + 16.8$ $\Rightarrow \frac{44r}{7} = 2r + 16.8$ $\Rightarrow 44r = 14r + 16.8 \times 7$

$\Rightarrow r = \frac{117.6}{30}$

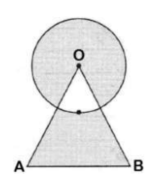
$\therefore r = 3.92$ cm

OR

Since OAB is an equilateral triangle, we have ∠AOB = 60°

Area of shaded region = area of major sector + area of ΔAOB – area of minor sector

$= \frac{300}{360} \times \frac{22}{7} \times (6)^2 + \frac{\sqrt{3}}{4} \times (12)^2 - \frac{60}{360} \times \frac{22}{7} \times (6)^2$



$= \frac{660}{7} + 36\sqrt{3} - \frac{132}{7}$

$= \left(36\sqrt{3} + \frac{528}{7}\right) cm^2$

29. $\text{LHS} = (\sin\theta + \text{cosec}\,\theta)^2 + (\cos\theta + \sec\theta)^2$

$= \sin^2\theta + \text{cosec}^2\theta + 2\sin\theta.\text{cosec}\,\theta + \cos^2\theta + \sec^2\theta + 2\sec\theta.\cos\theta$

$= \sin^2\theta + \cos^2\theta + \text{cosec}^2\theta + \sec^2\theta + 2\sin\theta.\text{cosec}\,\theta + 2\sec\theta\cos\theta$

$= 1 + \cot^2\theta + 1 + 1 + \tan^2\theta + 2\times 1 + 2\times 1$

$= 1 + \cot^2\theta + 1 + \tan^2\theta + 1 + 2 + 2$ $\quad \begin{bmatrix} \sec^2\theta = 1 + \tan^2\theta \\ \text{cosec}^2\theta = 1 + \cot^2\theta \end{bmatrix}$

$= 7 + \tan^2\theta + \cot^2\theta = \text{RHS}$

30. We have $\dfrac{AC}{BC} = \dfrac{3}{4}$

$x = \dfrac{mx_2 + nx_1}{m+n}$

$-1 = \dfrac{3\times x + 4\times 2}{3+4}$

$-7 = 3x + 8$

$x = -5$

$y = \dfrac{my_2 + ny_1}{m+y}$

$2 = \dfrac{3\times y + 4\times 5}{3+4}$

$14 = 3y + 20$

$y = -2$

Thus $(x, y) = (-5, 2)$

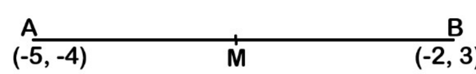
$x^2 + y^2 = (-5)^2 + 2^2 = 29$

OR

Let M(–3, p) divides the line joining of A(–5, 4) and B(–2, 3) in the ratio K : 1.

The coordinate of M are $\left(\dfrac{-2K-5}{K+1}, \dfrac{3K-4}{K+1}\right]$

But co-ordinate of M are (–3, p) therefore we get



$\dfrac{-2K-5}{K+1} = -3$

$K = 2$

And $\dfrac{3K-4}{K+1} = p$ $\qquad$ put K = 2

$\dfrac{3\times 2 - 4}{2+1} = p$

$\dfrac{2}{3} = p$ $\qquad$ [$\therefore$ Hence ratio of division is 2 : 1 and $p = \dfrac{2}{3}$]

31. The required answer will be HCF of 144 and 90

$144 = 2^4 \times 3^2$

$90 = 2 \times 3^2 \times 5$

HCF (144, 90) $= 2 \times 3^2 = 2 \times 9 = 18$

Thus each stack would have 18 cartons.

SECTION - D

Section D consists of 4 questions of 5 marks each.

32. Let the circle touches CB at M, CA at N and AB at p

Now $OM \perp BC$ and $ON \perp AC$

$\therefore OM = ON$ radius of circle CM and CN are tangent from C

$\therefore CM = CN$

$\therefore \square OMCN$ is a square

OM = CM = CN = ON =r (let)

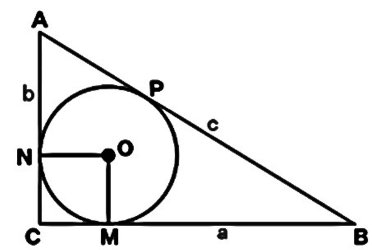
Since length of tangent from an external point to circle are equal.

AN = AP, CN = CM, and BP = BM

Now taking

AN = AP

$AC - CN = AB - BP$



$b - r = c - BM$

$b - r = c - (a - r)$

$b - r = c - a + r$

$b - c + a = r + r$

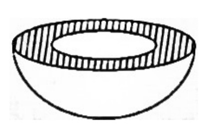
$b - c + a = r + r$

$b + a - c = 2r$

$2r = a + b - c$

$\therefore r = \dfrac{a + b - c}{2}$ Hence proved

33. R = 8 cm, r = 6 cm



Surface area $= 2\pi R^2 + 2\pi r^2 + \pi\left(R^2 - r^2\right)$

$= \pi\left[2R^2 + 2r^2 + \left(R^2 - r^2\right)\right]$

$= \pi\left[2 \times 8^2 + 2 \times 6^2 + \left(8^2 - 6^2\right)\right] = \pi[128 + 72 + 28]$

$= 3.14 \times 228 = 715.92 \text{ cm}^2$

$\therefore$ Total cost $= 715.92 \times 5 = 3579.60$

34. $3x - y = 7$

$3x - y - 7 = 0 \qquad \ldots(1)$

$a_1 = 3, b_1 = -1, c_1 = -7$

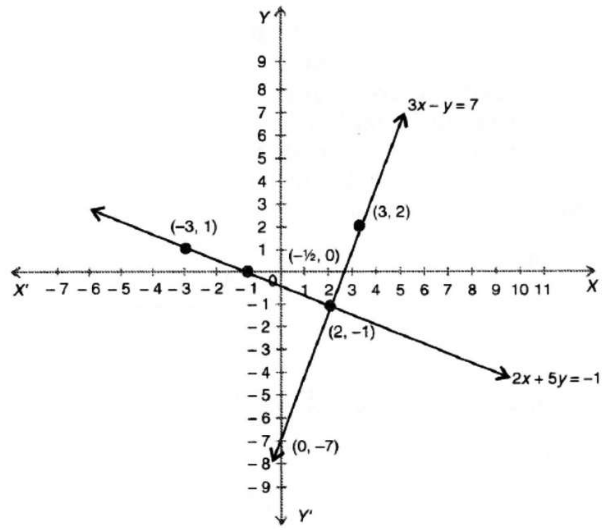
$2x + 5y + 1 = 0$

$a_2 = 2, b_2 = 5, c_2 = 1$

$\frac{a_1}{a_2} = \frac{3}{2} \quad \frac{b_1}{b_2} = \frac{-1}{5}$

$\because \frac{a_1}{a_2} \neq \frac{b_1}{b_1}$

Given pair of linear equations has a unique solution



Now line (1)

$y = 3x - 7$

x	0	2	3
y	–7	–1	2

Line (2)

$2x + 5y + 1 = 0$

x	2	–3	–0.5
y	–7	–1	0

Clearly two lines intersect at point (2, –1)

Hence x = 2 and y = –1.

OR

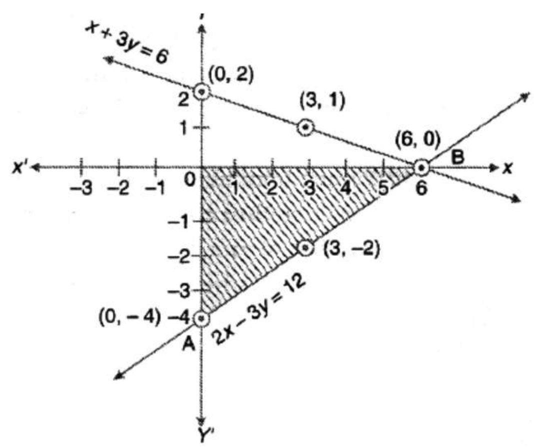
$x + 3y = 6$

$y = \frac{6 - x}{3}$

x	3	6	0
y	1	0	2

$2x - 3y = 12$

$y = \frac{2x - 12}{3}$



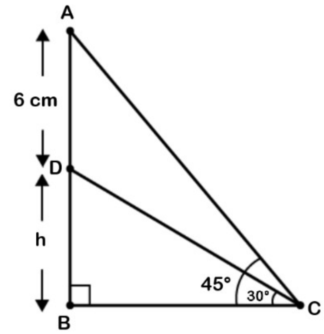
x	0	6	3
y	–4	0	–2

The two lines intersect each other at point B(6, 0).

Hence x = 6 and y = 0

Again ΔAOB is the region bounded by the line $3x - 3y = 12$ and both the co-ordinate axes.

35. In ΔABC



$$\tan 45° = \frac{AB}{BC}$$

$$1 = \frac{h+6}{BC}$$

$BC = h + 6 \quad \ldots(1)$

In ΔDBC

$$\tan 30° = \frac{BD}{BC}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{h+6}$$

$$\sqrt{3}h = h + 6$$

$$\sqrt{3}h - h = 6$$

$$h\left(\sqrt{3}-1\right) = 6$$

$$h = \frac{6}{\sqrt{3}-1}$$

$$= \frac{6 \times \left(\sqrt{3}+1\right)}{\left(\sqrt{3}-1\right)\left(\sqrt{3}+1\right)} = \frac{6\left(\sqrt{3}+1\right)}{2}$$

$$= 3\left(\sqrt{3}+1\right) = 3\left(1.73+1\right) = 3 \times 2.73 = 8.19 \text{ m}$$

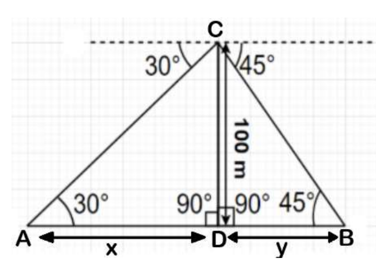
$\therefore$ Thus height of tower is 8.19 m

OR

Let DC be tower of height 100 m

A and B be two car on the opposite side of tower.

In ΔADC



$$\tan 30 = \frac{CD}{AD}$$

$$\frac{1}{\sqrt{3}} = \frac{100}{x}$$

$\therefore x = 100\sqrt{3} \quad \ldots(1)$

In ΔBDC

$$\tan 45 = \frac{CD}{DB}$$

$$1 = \frac{100}{y}$$

$y = 100 \text{ m} \quad \ldots.(2)$

Distance between two car.

AB = AD + DB

$= x + y = 100\sqrt{3} + 100 \quad = 100 \times 1.73 + 100 \quad = 273 \text{ m}$

Distance between two car is 273 m.

SECTION - E

Section E consists of 3 case study based questions of 4 marks each.

36. n(s) = 100

Children	Frequency
No children	51
One child	20
Two child	19
Three child	7
Four or More child	3
Total	100

(i) let E_1 be the event that the family has two or three children

$n(E_1) = 19 + 7 = 26$

$p(E_1) = \frac{n(E_1)}{n(s)}$

$= \frac{26}{100} = 0.26$

(ii) let E_2 be the event that the family has more than one child

$n(E_2) = 19 + 7 + 3 = 29$

$p(E_2) = \frac{29}{100} = 0.29$

(iii) Let E_3 be the event that the family has less than three children

$n(E_3) = 51 + 20 + 19 = 90$

$p(E_3) = \frac{n(E_3)}{n(s)} = \frac{90}{100} = 0.90$

OR

Let E_4 be the event that the family has 3 or more than three children

$n(E_4) = 7 + 3 = 10$

$p(E_4) = \frac{n(E_4)}{n(s)} = \frac{10}{100} = 0.1$

37. (i) It is Isosceles Triangle

(ii) Let common ratio be x

Width = 2x

height = 3s

Now width of single curtain will be x and length of single curtain is equal the eight of window.

Thus Ratio $= \frac{x}{3x} = \frac{1}{3}$

(iii) Area = 9600

$2x \times 3x = 9600$

$x^2 = \frac{9600}{6} = 1600$

$x = \sqrt{1600}$

$x = 40$

Width = 2x = 2 × 40 = 80 cm

Length 3x = 3 × 40 = 120 cm

OR

Area of both curtain

$= 2 \times \left(\frac{1}{2} \times 40 \times 120\right)$

$= 40 \times 120 = 4800$

Window Area

$= \frac{4800}{9600} \times 100 = 50\%$

38. (i) The length of the grassland is 3 m more than twice the length of the flowerbed

Thus it will be 2x + 3.

The total length of the field is = 2x + 3 + x = 3x + 3

Perimeter $= 2(3x + 3 + x) = 2(4x + 3) = 8x + 6$

(ii) $A = (3x + 3)x$

$1260 = 3x^2 + 3x$

$x^2 + x - 420 = 0$

Thus x = 20 is only possible value

(iii) Area of grassland $= (Ag) = (2x + 3)x = (2 \times 20 + 3) \times 20 \ = 860\text{ m}^2$

OR

Area of flowerbed

$A_f = x^2 = (20)^2 = 400\,m^2$

Ratio $= \frac{400}{860} = \frac{20}{43}$