CBSE : SCIENCE PAPER (HINTS & SOLUTIONS)

SECTION - A (BIOLOGY)

1. Answer: B – Algae, Grass, Mango, Rose

2. Answer: B – Carbon dioxide + Water + Energy

3. Answer: C – Medulla oblongata

4. Answer: B – Thyroid gland

5. Answer: B – Law of Dominance

6. Answer: D – Ozone increases global warming

7. Answer: C – Reusing plastic bottles

8. Answer: A – Both A and R true, R is the correct explanation of A

9. Answer: C – A true but R false

10. Plants lack an excretory system because they produce fewer toxic wastes. Metabolic by-products such as CO_2, O_2, and water are released by diffusion through stomata or lenticels. Many wastes are stored in vacuoles or fallen leaves.

11. Attempt either option A or B: **(2)**

A. Double Circulation:

Blood passes through the heart twice in one complete cycle.

Pathway: Right atrium → Right ventricle → Lungs → Left atrium → Left ventricle → Body.

Ensures separation of oxygenated and deoxygenated blood for efficient respirations

OR

B. Oxygen binds with haemoglobin to form oxyhaemoglobin in lungs → transported to tissues → released by diffusion.

CO_2 forms bicarbonates in plasma → carried to lungs → expelled during exhalation.

12. Third Trophic leve ,Curd is made from milk which is obtained from COW. Cow is a primary consumer that feeds on producer (grass) and occupies the second trophic level Consuming the produce obtained from an organism at second trophic level makes Ravi belong to the third trophic level.

13. The three major regions of the human brain are:

1. Cerebrum:

Largest part of the brain.Function: Controls intelligence, reasoning, memory, learning, and voluntary actions (like writing or walking).

2. Cerebellum:

Located at the back of the brain below the cerebrum.

Function: Maintains body balance and coordinates muscular activities.

3. Medulla oblongata (Brain stem):

Found at the base of the brain, connecting it to the spinal cord.

Function: Controls involuntary activities such as heartbeat, breathing, and blood pressure.

14.

(i) Each F_1 receives one allele from each parent for each gene:

From TTRR parent → gamete = TR

From ttrr parent → gamete = tr

(ii) 256 ÷ 16 = 16. (So 1/16 of 256 is 16.)

Tall, Red (9/16): 9 × 16 = 144

Tall, White (3/16): 3 × 16 = 48

Dwarf, Red (3/16): 3 × 16 = 48

Dwarf, White (1/16): 1 × 16 = 16

Therefore,144:48:48:16

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

(A) Rice = carbohydrates; Paneer = proteins and fats.

Carbohydrates: Broken to maltose by salivary amylase, to glucose by intestinal enzymes; absorbed through villi.

Proteins: Pepsin in stomach → peptides; trypsin and peptidases → amino acids.

Fats: Bile emulsifies → lipase → fatty acids and glycerol.

(B) Photosynthesis is a vital biological process used by green plants, algae, and some bacteria to convert light energy into chemical energy.

Photosynthesis is considered crucial for several reasons:

It forms the base of most food webs, serving as the primary source of food for nearly all life.

It is the primary source of atmospheric oxygen, necessary for the survival of aerobic organisms.

It helps regulate the climate by removing carbon dioxide from the atmosphere.

It provides the energy captured in fossil fuels and raw materials like wood and cotton.

16. Attempt either option A or B: (5)

(A) (i)

Asexual Reproduction	Sexual Reproduction
Involves only one parent; no gamete formation.	Involves two parents; male and female gametes fuse.
Offspring are genetically identical (clones) to the parent.	Offspring show genetic variation.

(ii) Advantage: Rapid method of reproduction — a large number of offspring can be produced quickly without needing a mate.

Disadvantage: No genetic variation; if conditions change or disease spreads, all offspring may be affected equally.

OR

B. (i) Greenhouse 1 will yield more fruits.

Reason: In Greenhouse 1, the farmer dusted pollen grains from male to female flowers — ensuring pollination and fertilization, which leads to fruit formation. In Greenhouse 2, no pollination occurs, so no fertilization and hence no fruit development.

(ii) Three changes that occur in a flower after fertilization:

1. Ovary develops into a fruit.
2. Ovules develop into seeds.
3. Petals, sepals, stamens, and style wither and fall off.

SECTION - B (CHEMISTRY)

17. (A) (a) and (b)

18. (B) I and III

(I and III are true: PbO and ZnO are amphoteric; CaO reacts with acids but not with aqueous NaOH; SO_2 reacts with NaOH.)

19. (D) Sodium > Magnesium > Zinc > Iron

(Interpreting the option as the activity series ordered most → least; this corresponds to Iron < Zinc < Magnesium < Sodium in ascending order.)

20. Colour of methyl orange: (B) Red (in dilute HCl) ; Yellow (in aqueous NaOH).

21. (B) HCl - low PH

22. (B) insoluble calcium carbonate converts to water soluble calcium bicarbonate.

Insoluble $CaCO_3$ converts to soluble calcium bicarbonate.

23. (D) NaCl

24. (D) A is false but R is true.

(C_4H_{12} is not a valid member; R correctly states unsaturated examples.)

25. Onion juice is a natural indicator.

Liquid X turns blue litmus red ⇒ X is acidic (e.g., HCl).

Observations & equations:

(a) With zinc granules — effervescence (H_2 evolved):

$Zn + 2HCl \rightarrow ZnCl_2 + H_2\uparrow$

(b) With solid sodium carbonate — CO_2 evolved (turns lime water milky):

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2\uparrow$

26. Attempt either option A or B.

(Option A chosen)

(i) No, Z cannot be stored in water — it reacts violently with water (produces H_2 and heat).

(ii) Element Z: Sodium (stored under kerosene). Extraction: electrolysis of molten sodium chloride (Downs cell).

Reaction: $2\ NaCl(l) \rightarrow 2\ Na(s) + Cl_2(g)$

27. (A) Gases expected: Anode → O_2, Cathode → H_2.

(B) Bulb did not glow because distilled water is a poor conductor (lacks ions).

(C) Substance added: a small amount of dilute H_2SO_4 (or a soluble electrolyte such as Na_2SO_4) to provide ions and allow electrolysis.

28. (A)

(a)(i) Highest $[H^+]$: pH = 0.

(a)(ii) Lowest $[H^+]$: pH = 5.

(b) Diluting conc. H_2SO_4: Always add acid to water slowly with stirring (never add water to acid); dilute in small portions while cooling to control heat evolution.

29. Attempt either option A or B.

(Option A)

(a) From $2\ C_xH_y + 9\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O \Rightarrow 2x = 6$ so $x = 3$; $2y = 12$ so $y = 6$. Formula C_3H_6.

(b) IUPAC name: propene.

(c) Electron-dot (Lewis) structure (skeletal shown):

$H_2C{=}CH{-}CH_3$ with each C having appropriate dots/bonds (double bond between C1 and C2).

(d) Alcohol that yields propene on dehydration: propan-2-ol (isopropyl alcohol) (or propan-1-ol also gives propene).

(e) Hydrogenation: $C_3H_6 + H_2 \rightarrow C_3H_8$ (Ni catalyst).

SECTION - C (PHYSICS)

30. (D) All statements are incorrect.

31. (A) 0.75

32. (B) Both A and R are true, and R is not the correct explanation of A.

33. (A) u = -20 cm

v = +40 cm ; $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$; $\frac{1}{40}-\left(\frac{-1}{20}\right)=\frac{1}{f}$; $\frac{1}{40}+\frac{1}{20}=\frac{1}{f}$

$\frac{1+2}{40}=\frac{1}{f}$; $f=\frac{40}{3}$cm

(B) Magnification $=\frac{v}{u}=\frac{+40}{+40/3}=+3$

34. Attempt either A or B. **(2)**

(A) For net resistance

$\frac{1}{R_1}=\frac{1}{4}+\frac{1}{4}=\frac{2}{4}$; $R_1=2\Omega$; $R_{net}=2+2=4\Omega$

$I=\frac{V}{R_{net}}=\frac{10}{4}=2.5A$

(i) Reading of ammeter = 1.5A

(ii) Reading of voltmeter

$V_1=I_1R_1$

$I_1=\frac{1}{2}=\frac{2.5}{2}=1.25A$; $V_1 = 1.25 \times 4 = 5V$

Reading of voltmeter = 5V

(B) $\frac{1}{R_p}=\frac{1}{4}+\frac{1}{4}$

$R_p = 2\Omega$; $R_{Net} = 2 + 4 = 6\ \Omega$

(i) 6 Ω

(ii) $I=\frac{V}{R_{Net}}=\frac{10}{6}=1.66A$

Reading of voltmeter = 1.66 A

35. (i) Myopia is called as near sightedness which means student is not able to see the for objects clearly. Concave lens will be used to correct the defect because in this image is formed before retina defect.

(ii) $u=-\infty$

v = -100 cm

$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$; $\frac{-1}{100}-\left(\frac{1}{-\infty}\right)=\frac{1}{f}$

$\frac{1}{f}=\frac{-1}{\omega}$

F = -100 cm concave lens

36. (i) $R = \frac{3L}{A} = 10\Omega$

$R^1 = (\Omega^2)R$

$= (3)^2 \times 10$

$= 9 \times 10 = 90\Omega$

(i) Length after stretching = 3L

After compressing = $\frac{3L}{2}$

Area after stretching = $\frac{A}{3}$

After compressing = $\frac{2A}{3}$

$R^1 = \frac{3L^1}{A^1} = \frac{3 \times 3L \times 3}{2 \times IA}$

$= \frac{9}{4} \times \frac{2L}{A} = \frac{9}{4} \times 10 \;\; = \frac{45}{2} = 22.5\Omega$

37. (i) Some I represents direct current (DC) whereas source II represents alternating current (AC).

(ii) Source I may be a dry cell or a Voltaic cell and Source II is an AC Generator.

(iii) The period (T) of AC (Source II) is 0.03s–0.01s = 0.02s. Thus, the frequency of AC, i.e.,

$\nu = \frac{1}{T} = \frac{0}{0.02s} = 50Hz$

(iv) (a) The magnetude of DC remains the constant whereas that of AC keeps on changing.

(b) The direction of DC remains the same whereas that of AC keeps on changing.

38.

(A) (a) The lens is a convex lens.

(b) The image is virtual.

Attempt either subpart C or D.

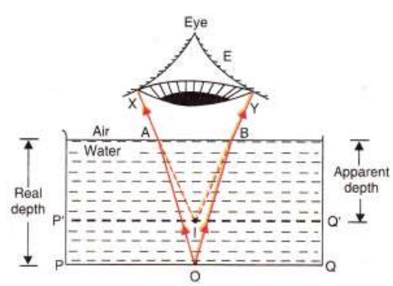
(c) Magnification for lens $= \frac{\upsilon}{u} = \frac{h_i}{h_o} = 2$

$\frac{-30cm}{u} = 2$

Hence $u = -15$ cm.

OR

(d) A swimming pool appears shallower than its actual depth due to a physical phenomenon called refraction, which is the bending of light as it passes from one transparent medium to another



OR

(B) (i) The refractive index of a medium with respect to air is given by $\frac{\text{speed of light in the air}}{\text{speed of light in the medium}}$. Since the speed of light in the medium is always less than the speed of light in air, hence the above ratio is always greater than I.

(ii) The ray of light is undergoing normal incidence at the air-plastic block interface. And for normal incidence, there is no deviation.

39. Attempt any one A or B. **(5)**

(A)

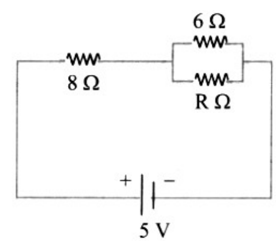
(i) Total current flowing through the circuit.

$$I = \frac{V}{R_s} = \frac{5}{8+6} = \frac{5}{14} = 0.36A$$

Potential difference across $8\Omega(V_1) = 0.36 \times 8 = 2.88$ V

(ii) Potential difference across 8 Ω resistor will be larger.

Reason : As per question, the new circuit diagram will be



When any resistor is connected parallel to 6 Ω resistance. Then the resistance across that branch (6 Ω and R Ω) will become less than 6 Ω. i.e., equivalent resistance of the entire circuit will decrease and hence current will increase. Since, V = IR, the potential difference across 8 Ω resistor will be larger.

OR

(B) (a) Total resistance between the points B and E.

BC , CD , & DE are in series

Hence 1 + 2 + 3 = 6 Ω

BE through 3 Ω and through C & D 6 Ω are in parallel

Hence Total resistance between the points B and E.

= 1/(1/3 + 1/6) = 6/(2 + 1) = 6/3 = 2 Ω

Total resistance between the points B and E.= 2 Ω

(b) Total resistance between the points A and F.

= AB + BE + EF (in series)

= 3 + 2 + 3 = 8 Ω

Total resistance between the points A and F. = 8 Ω

(ii) For mathematical expression of Joule's law of heating, see point Number 29 under the heading "Chapter At a Glance"

As Per Question length of wire L=12m, radius 2×10^{-4} m and specific resistivity 3.14×10^{-8} Ω m

∴ Resistance of given wire

$$R = \frac{\rho L}{A} = \frac{\rho L}{\pi r^2} = \frac{3.14 \times 10^{-8} \times 12}{3.14 \times \left(2 \times 10^{-4}\right)^2} = 3\Omega$$

CBSE : MATHEMATICS PAPER (HINTS & SOLUTIONS)

SECTION - A

Section A consists of 20 questions of 1 mark each.

1. (d)

The quadratic will have real root only when its discriminant will be greater than or equal to zero.

D > 0

$b^2 - 4ac > 0$

$(-8)^2 - 4 \times 1 \times k > 0$

64 – 4k > 0

4k < 64

k < 64/4

k < 16

2. (d)

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

$$AB = \sqrt{(3-0)^2 + (\sqrt{3}-0)^2} = \sqrt{3^3 + (\sqrt{3})^2} = \sqrt{9+3} = \sqrt{12}$$

$$BC = \sqrt{(3-3)^2 + (\lambda - \sqrt{3})^2} = \sqrt{0^2 + (\lambda - \sqrt{3})^2} = \sqrt{(\lambda - \sqrt{3})^2} = |\lambda - \sqrt{3}|$$

$BC^2 = AB^2$: $(\lambda - \sqrt{3})^2 = 12$

$$\lambda - \sqrt{3} = \pm\sqrt{12}$$

$$\lambda - \sqrt{3} = \pm 2\sqrt{3}$$

This gives two possible values for λ:

$$\lambda = \sqrt{3} + 2\sqrt{3} = 3\sqrt{3}$$

$$\lambda = \sqrt{3} - 2\sqrt{3} = -\sqrt{3}$$

$$\lambda = -\sqrt{3}$$

3. (b)

For infinitely many solutions

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

$$\Rightarrow \frac{3}{6} = \frac{-1}{-k} \Rightarrow \frac{1}{2} = \frac{1}{k}$$

$$\Rightarrow k = 2$$

4. (b)

The line segment AB is a diagonal of the square PAOB. The length of the diagonal of a square with side length s can be found using the Pythagorean theorem:

$$AB^2 = PA^2 + PB^2$$

$$AB^2 = 5^2 + 5^2$$

$$AB^2 = 50$$

$$AB = 5\sqrt{2} \text{ cm}$$

5. (a)

Sum of 5 numbers = 15 × 5 = 75

Sum of 6 numbers = 17 × 6 = 102

Included number = 102 – 75 = 27

6. (d)

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

$4 = a + (7-1)(-4)$

$4 = a - 24$

$a = 24 + 4 = 28$

7. (a)

$AB + CD = BC + AD$

$6cm + 4cm = 7cm + AD$

$AD = 3cm$

8. (b)

The highest frequency is 20, which corresponds to the class interval 15 – 20

The lower limit of the modal class is 15

The median position is $\frac{N}{2} = \frac{66}{2} = 33.$

The cumulative frequencies are:

- $0 - 5: 10$
- $5 - 10: 10 + 15 = 25$
- $10 - 15: 25 + 12 = 37$
- $15 - 20: 37 + 20 = 57$
- $20 - 25: 57 + 9 = 66$

The median class is the class where the cumulative frequency first exceeds the median position (33), which is the class interval 10 – 15.

The lower limit of the median class is 10.

The sum of the lower limit of the median class and the lower limit of the modal class is: 10 + 15 =25

9. (b)

$\alpha + \beta = -\frac{B}{A}$; $\alpha\beta = \frac{C}{A}$

$a + b = -\frac{a}{1} \Rightarrow a + b = -a$

$-2a = b \quad \ldots(1)$

$ab = \frac{b}{1} \Rightarrow ab = b$

$a = 1 \quad \ldots(2)$

$b = -2 \times 1$

$b = -2$

10. (d) $\frac{4}{3}\pi\left(R^3 - r^3\right)$

11. (a) $\frac{5}{11}$

12. (d)

The probability of any event must be a value between 0 and 1.

13. (b)

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

$\frac{x+3}{3x+19} = \frac{x}{3x+4}$

$x = 2$

14. (a)

$\sin\theta + \cos\theta = \sqrt{2}\cos\theta$ ...(1)

Let $\cos\theta - \sin\theta = p$ ...(2)

$(1)^2 + (2)^2 \Rightarrow \sin^2\theta + \cos^2\theta + 2\sin\theta\cos\theta + \cos^2\theta + \sin^2\theta$

$-2\sin\theta\cos\theta = 2\cos^2\theta + p^2$

$\Rightarrow 2 = 2\cos^2\theta + p^2$

$\Rightarrow p^2 = 2(1 - \cos^2\theta) = 2\sin^2\theta$

$\Rightarrow p = \sqrt{2}\sin\theta$

15. (a)

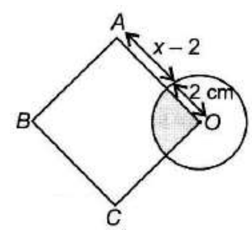
Let the length of side of square = x cm

Then area of square = x^2 cm^2

Area of sector of circle

$= \frac{\theta}{360°} \times \pi r^2$

$= \frac{90°}{360°} \times \pi 2^2 [\because \text{angle fo a square} = \theta = 90°]$



Shaded area = π

Area of square = 3 × shaded area

side = $\sqrt{3\pi}$cm

16. (a)

$\frac{x}{3} = 2\sin A \Rightarrow x = 6\sin A$

$\frac{y}{3} = 2\cos A \Rightarrow y = 6\cos A$

$x^2 + y^2 = (6\sin A)^2 + (6\cos A)^2$

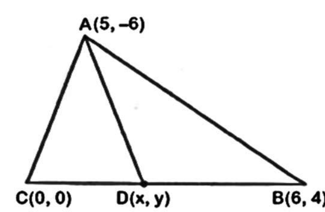
$x^2 + y^2 = 36(\sin^2 A + \cos^2 A)$

$x^2 + y^2 = 36$

17. (a)

Coordinates of D(x, y).

Using the mid-point formula, the coordinates of the midpoint of BC are



Co-ordinates of D(x, y) = $\left(\frac{6+0}{2}, \frac{4+0}{2}\right)$

= (3, 2)

Now, length of AD = $\sqrt{(x_4 - x_1)^2 + (y_4 - y_1)^2}$

$= \sqrt{(3-5)^2 + (2+6)^2}$

$= \sqrt{4 + 64}$

$= \sqrt{68}$ units

18. (b)

The modal class is the class interval with the highest frequency. In the given table, the highest frequency is 16, which corresponds to the class interval 150-155. The lower limit of the modal class is 150.

Looking at the cumulative frequency column, the 30th observation falls into the class interval 160-165, as its cumulative frequency (37) is the first to be greater than or equal to 30. The upper limit of the median class is 165.

Sum = 150 + 165

Sum = 315

19. (C) Assertion (A) is true but reason (R) is false.

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

SECTION - B

21. $$\frac{5\tan 60^\circ}{(\sin^2 60^\circ + \cos^2 60^\circ)\tan 30^\circ} = \frac{5\times\sqrt{3}}{(1)\times\frac{1}{\sqrt{3}}} = 15$$

22. The distance formula between two points $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

The length of side AB is:

$$AB = \sqrt{(-5-1)^2 + (0-0)^2} = \sqrt{(-6)^2 + 0^2} = \sqrt{36} = 6$$

The length of side BC is:

$$BC = \sqrt{(-2-(-5))^2 + (5-0)^2} = \sqrt{(3)^2 + 5^2} = \sqrt{9+25} = \sqrt{34}$$

The length of side AC is:

$$AC = \sqrt{(-2-1)^2 + (5-0)^2} = \sqrt{(-3)^2 + 5^2} = \sqrt{9+25} = \sqrt{34}$$

$BC = AC = \sqrt{34}$

Since two sides of the triangle (BC and AC) are equal in length, the triangle is an isosceles triangle.

23. The distance between the points (4, p) and (l, 0) = 5

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

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

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

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

On squaring both the sides, we get

$9 + p^2 = 25$

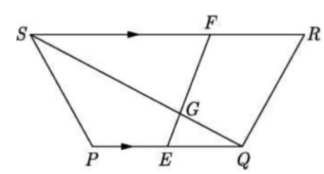
$\Rightarrow p^2 = 16$

$\Rightarrow p = \pm 4$

Hence, the required value of p is ± 4.

24. PQRS is a trapezium PQ || RS

E and F are points on PQ and RS which intersects diagonal SQ at G



Now, considering ΔGEQ and ΔGFS, we have

∠EGQ = ∠FGS [vertically opposite angles]

∠EQG = ∠FSG [alternate angles]

∠GEQ = ∠GFS [alternate angles]

∴ By AAA similarity,

ΔGEQ ~ ΔGFS

Since the corresponding sides of two similar triangles are proportional to each other.

$\therefore \frac{EQ}{FS} = \frac{GQ}{GS}$

$\Rightarrow EQ \times GS = GQ \times FS$

OR

Sol. In ΔCAB,

∠A = ∠B (Given)

AC = CB (By isosceles triangle property)

But, AD = BE (Given)....(i)

or AC – AD = CB – BE

CD = CE ....(ii)

Dividing equation (ii) by (i),

CD /AD = CE / BE

By converse of BPT,

DE ||AB

25.

(i) When tossing two different coins simultaneously, there are four possible equally likely outcomes in the sample space E = {HH, HT, TH, TT}

The total number of outcomes is E = 4

The favourable outcomes are $E_1 = \{HH, HT, TH\}$

$E_1 = 3$

$$P(E_1) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}} = \frac{3}{4}$$

(ii) The favorable outcomes are {HT, TH}.

The number of favorable outcomes is E = 2

$$P(E_2) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}} = \frac{2}{4} = \frac{1}{2}$$

SECTION - C

26. The midpoint of each class is the average of its lower and upper limits. The total frequency is the sum of all frequencies.

Class	Frequency (f_i)	Midpoint (x_i)	$f_i x_i$
4-6	5	5	25
7-9	4	8	32
10-12	9	11	99
13-15	10	14	140
Total	**N = 28**	–	$\sum f_i x_i = 296$

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i} = \frac{296}{28} = 10.5714$$

27.

(a) $S_n = \frac{n}{2}\left[2a + (n-1)d\right]$

$S_{14} = 1050, n = 14, \& \ a = 10$

$$1050 = \frac{14}{2}\left[2(10) + (14-1)d\right]$$

$$1050 = 7[20 + 13d]$$

150 = 20 + 13d

130 = 13d

d = 10

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

$a_{20} = 10 + (20 - 1)10$

$a_{20} = 10 + 19(10)$

$a_{20} = 10 + 190$

$a_{20} = 200$

$a_n = 10 + (n - 1)10$

$a_n = 10 + 10n - 10$

$a_n = 10n$

OR

(b) Here, a is the first term, d is a common difference, and n is the number of terms.

Given,

First term, a = 5

Last term, l = 45

Sum of n terms, $S_n = 400$

We know that sum of n terms of AP is given by the formula $S_n = n/2\ [a + l]$

$400 = n/2\ (5 + 45)$

$400 = n/2 \times 50$

$n = 16$

$a_n = a + (n - 1)\ d$, we will find the common difference where $a_n = 45$.

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

$45 = 5 + (16 - 1)\ d$

$40 = 15d$

$d = 40/15$

$d = 8/3$

28. $$\text{LHS} = \frac{\tan\theta - \cot\theta}{\sin\theta\cos\theta} = \frac{\frac{\sin\theta}{\cos\theta} - \frac{\cos\theta}{\sin\theta}}{\sin\theta\cos\theta}$$

$$\text{LHS} = \frac{\frac{\sin^2\theta - \cos\theta^2}{\cos\theta\sin\theta}}{\sin\theta\cos\theta}$$

$$= \frac{\sin^2\theta - \cos^2\theta}{\sin^2\theta\cos^2\theta}$$

$$= \frac{\sin^2\theta}{\sin^2\theta\cos^2\theta} - \frac{\cos^2\theta}{\sin^2\theta\cos^2\theta}$$

$$= \frac{1}{\cos^2\theta} - \frac{1}{\sin^2\theta}\left(\frac{1}{\cos\theta} = \sec\theta, \frac{1}{\sin\theta} = \operatorname{cosec}\theta\right)$$

$$= \sec^2\theta - \operatorname{cosec}^2\theta$$

Hence LHS = RHS

29. In ΔPAO and Δ QBO

∠A = ∠B = 90°

∠POA = ∠QOB (Vertically Opposite Angle)

ΔPAO ~ ΔQBO

$$\frac{OA}{OB} = \frac{PA}{QB}$$

$$\frac{6}{4.5} = \frac{4}{QB}$$

QB = 3 cm

30. TSA of hemisphere = $3\pi r^2$

$3\pi r^2 = 462$

$3\times\frac{22}{7}\times r^2 = 462$

$r^2 = \frac{462\times 7}{3\times 22}$

$r^2 = 49$

$r = 7$

Volume of hemisphere = $\frac{2}{3}\pi r^3$

$= \frac{2}{3}\times\frac{22}{7}\times 7\times 7\times 7 = 718.67\ cm^3$

OR

Sol. Radius (r) of cylindrical part Radius (r) of hemispherical part 3.5 cm
Height of cylindrical part (h) 10 cm
Surface area of article CSA of cylindrical part + 2 × CSA of hemispherical part

$= 2\pi rh + 2\times 2\pi r^2$

$= 2\pi\times 3.5\times 10 + 2\times 2\pi\times 3.5\times 3.5$

$= 70\pi + 49\pi$

$= 119\pi$

$= 119\times\frac{22}{7}$

$= 374\ cm^2$

31. The given data is in the form of a cumulative frequency table (less than type). The class intervals and their corresponding frequencies can be derived as follows:

Height (in cm)	Number of students (Frequency, f)	Cumulative Frequency (cf)
Less than 120 (0-120)	12	12
120-140	$26 - 12 = 14$	26
140-160	$34 - 26 = 8$	34
160-180	$40 - 34 = 6$	40
180-200	$50 - 40 = 10$	50

The median position is $\frac{N}{2} = \frac{50}{2} = 25$

The cumulative frequency just greater than 25 is 26, which corresponds to the class interval 120-140.
Therefore, the median class is 120-140.

$$\text{Median} = L + \frac{\frac{N}{2} - cf}{f}\times h$$

L is the lower limit of the median class (120)
N is the total frequency (50)
cf is the cumulative frequency of the class preceding the median class (12)
f is the frequency of the median class (14)
h is the class size (20, i.e., 140-120)

$$\text{Median} = 120 + \frac{25-12}{14} \times 20$$

$$\text{Median} = 120 + \frac{13}{14} \times 20$$

$$\text{Median} = 120 + \frac{260}{14}$$

$$\text{Median} = 120 + 18.57$$

$$\text{Median} = 138.57$$

OR

Sol. The given data is a cumulative frequency distribution (less than type).

Height (in cm)	No. of students (cf)	Class Interval	Frequency (f_i)	Class Mark (x_i)	$f_i x_i$
Less than 75	5	50 - 75	5	62.5	312.5
Less than 100	11	75 - 100	$11-5=6$	87.5	525.0
Less than 125	14	100 - 125	$14-11=3$	112.5	337.5
Less than 150	18	125 - 150	$18-14=4$	137.5	550.0
Less than 175	21	150 - 175	$21-18=3$	162.5	487.5
Less than 200	28	175 - 200	$28-21=7$	187.5	1312.5
Less than 225	33	200 - 225	$33-28=5$	212.5	1062.5
Less than 250	37	225 - 250	$37-33=4$	237.5	950.0
Less than 275	45	250 - 275	$45-37=8$	262.5	2100.0
Less than 300	50	275 - 300	$50-45=5$	287.5	1437.5
Total	—	—	$\sum f_i = 50$	—	$\sum f_i x_i = 9075$

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$\bar{x} = \frac{9075}{50} = 181.5$$

SECTION - D

32. For a quadratic equation $ax^2 + bx + c = 0$ have real and equal roots, its discriminant must be equal to zero,
$D = b^2 - 4ac = 0$

$D = k^2 - 4(1)(64)$

$= k^2 - 256 = 0$

$k^2 = 256$

$k = \pm 16$

$D = (-8)^2 - 4(1)(k)$

$= 64 - 4k = 0$

$64 = 4k$

$k = 16$

Hence value of k is 16.

OR

Sol. Let the speed of fast train is x km/hr
Speed of slow train is x – 10 km/hr

$\text{Time} = \frac{\text{distance}}{\text{speed}}$

$\frac{60}{x-10} - \frac{60}{x} = 3$

$\frac{60x - 60x + 600}{x^2 - 10x} = 3$

$\frac{600}{x^2 - 10x} = 3$

$x^2 - 10x = 200$

$x^2 - 10x - 200 = 0$

$x^2 - 20x + 10x - 20 = 0$

$x(x-20) + 10(x-20) = 0$

$(x-20)(x+10) = 0$

$x = 20 \text{ or } -10$

Hence speed of fast train is 20 km/hr
And speed of slow train is 20 – 10 = 10 km/hr

33. The given dimensions are:

- Height of the cylindrical part (h) = 3.5 m
- Diameter of the cylindrical part (d) = 6 m
- Radius of the cylindrical part (r) = $\frac{d}{2} = \frac{6}{2} = 3$ m
- Slant height of the conical top (l) = 4.2 m

The radius of the conical top is the same as the cylindrical part, so r = 3 m.
Total Area (A) = $CSA_{cylinder} + CSA_{cone}$

$A = 2\pi rh + \pi rl = \pi r(2h + l)$

$A = \pi \times 3 \times (2 \times 3.5 + 4.2)$

$A = 3\pi \times (7 + 4.2)$

$A = 3\pi \times 11.2$

$A = 33.6\pi \text{ m}^2$

$A = 33.6 \times \frac{22}{7}$

$A = 4.8 \times 22$

$A = 105.6\ m^2$

The rate of the canvas is 500 per m^2.

Cost= Total area × Rate

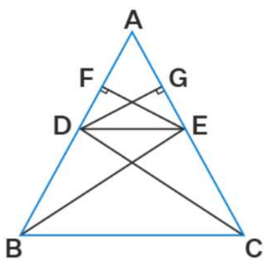
$= 105.6 \times 500 = 52800$

The area of canvas used for making the tent is 105.6 m^2

and the cost of the canvas is ₹52,800

34.

(a)



Given: triangle ABC, D and E are the points that intersect AB and AC.

DE is parallel to BC.

Construction: join BE and CD, draw EF and DG perpendicular to AB and AC.

We know that, area of triangle = 1/2 × base × height

Now, area of △ADE = 1/2 × AD × EF

Area of △BDE = 1/2 × BD × EF

So, area of △ADE/area of △BDE = (1/2 × AD × EF)/(1/2 × BD × EF) = AD/BD ….(1)

Area of △ADE = 1/2 × AE × DG

Area of △DEC = 1/2 × EC × DG

So, area of △ADE/area of △DEC = (1/2 × AE × DG)/(1/2 × EC × DG) = AE/EC ….(2)

△BDE and △DEC lie on the same base DE, also △BDE and △DEC lie between the same parallel DE and BC.

So, area of △BDE = area of △DEC

Since area of the triangles are same, then AD/BD = AE/EC

Therefore, the two sides are divided in the same ratio.

OR

(b) In $\triangle CAP$ and $\triangle CBQ$

$\Delta CAP \angle CAP = \angle CBQ = 90^\circ$ (Given that PA and QB are perpendicular to AC)

$\angle PCA = \angle QCB$ (Common angle)

Therefore, $\Delta CAP \sim \Delta CBQ$ by the Angle-Angle (AA) similarity criterion.

the ratio of corresponding sides is equal:

$\frac{BQ}{AP} = \frac{BC}{AC}$

Substituting the given lengths AP = x, BQ = y

$$\frac{y}{x}=\frac{BC}{AC}$$

Rearranging the equation to express $\frac{1}{x}$

$$\frac{1}{x}=\frac{BC}{AC\cdot y} \quad \cdots(1)$$

Now, in ΔACR and ΔABQ

$\angle ACR = \angle ABQ = 90°$

$\angle QAB = \angle RAC$ ...(common angle)

So, ΔACR ~ ΔABQ (By AA similarity Rule)

Hence, $\frac{BQ}{CR}=\frac{AB}{AC} \Rightarrow \frac{y}{z}=\frac{AB}{AC}$ ...(ii)

$$\frac{y}{x}+\frac{y}{z}=\frac{BC}{AC}+\frac{AB}{AC}$$

$$y\left(\frac{1}{x}+\frac{1}{z}\right)=\frac{BC+AB}{AC}$$

$$y\left(\frac{1}{x}+\frac{1}{z}\right)=\frac{AC}{AC}$$

$$\Rightarrow y\left(\frac{1}{x}+\frac{1}{z}\right)=1$$

$$\frac{1}{x}+\frac{1}{z}=\frac{1}{y}$$

Hence Proved

SECTION - E

35. $x_i=\frac{\text{Upper class limit + Lower class limit}}{2}$

Taking as assumed mean (a) = 30

Age (in years)	Number of patients f_i	Class mark x_i	$d_i = x_i - 30$	$f_i d_i$
5 − 15	6	10	−20	−120
15 − 25	11	20	−10	−110
25 − 35	21	30	0	0
35 − 45	23	40	10	230
45 − 55	14	50	20	280
55 − 65	5	60	30	150
Total	**80**			**430**

Mean $\overline{x} = a + \left(\frac{\sum f_i u_i}{\sum f_i}\right) xh$

$= 30 + \left(\frac{430}{80}\right)$

$= 30 + 5.375$

$= 35.375$

$= 35.38$

The maximum class frequency is 23 belonging to class interval 35 – 45.

Modal class 35 – 45

Lower limit (l) of modal class = 35

Frequency (f_l) of modal class = 23

Class size (h) = 10

Frequency (f_0) of class preceding the modal class = 21

Frequency (f_2) of class succeeding the modal class = 14

$Mode = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} xh\right)$

$= 35 + \left(\frac{23 - 21}{2(23) - 21 - 14}\right) \times 10$

$=35 + \left[\frac{2}{46 - 35}\right] \times 10$

$= 35 + \frac{20}{11}$

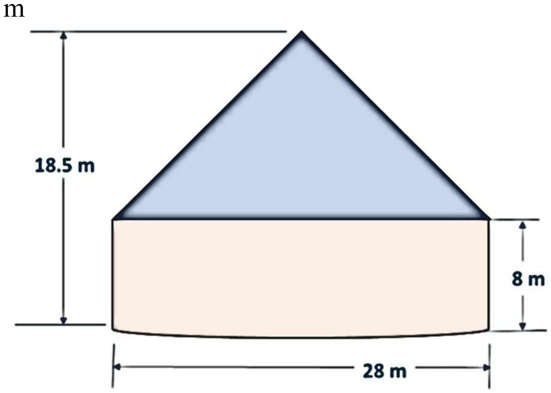
$= 36.8$

36.

(a) Height of total shape = 18.5 m, height of cylindrical shape = 8 m,

Therefore, height of the canonical top = 18.5 – 8 = 10.5 m

∴ Radius of the base = 14 m



(i) Slant height of the canonical top:

Slant height of the canonical top = √ [(14)2 + (10.5)2] = √ (306.25) = 17.5 m

Therefore, the slant height of the conical part is 17.5 m.

(ii) Floor Area of tent:

Floor area of tent = area of circle at the bottom = πR^2

Since radius of the base circle = 14 m

∴ Floor area of tent = πR^2

$= \frac{22}{7} \times (14)^2 = 22 \times 14 \text{ x } 2 = 308 \times 2 = 616 \text{ m}^2$

Therefore, the floor area of the tent. is 616 m^2

(iii) (a) Cloth are used for making tent:

Cloth required to make the tent = Curved surface area of conical part + curved surface area of cylindrical part

$= \pi R L + 2 \pi R H = \pi R (L + 2 H)$

Here, radius, R = 14 m, slant height L = 17.5 m, Height of cylinder, H = 8 m

Cloth required to make the tent = $\pi R (L + 2 H)$

$= \frac{22}{7} (14) (17.5 + 2 \times 8) = 22 \times 2 \times (33.5) = 22 \times 67 = 1474 \text{ m}^2$

Therefore, 1474 m^2 cloth will be required to make the tent

(iii)(b) volume of air inside empty tent:

Volume of air inside the tent = volume of conical part + volume of cylindrical part

$= \frac{1}{3}\pi R^2 H_{cone} + \pi R^2 H_{cylinder}$

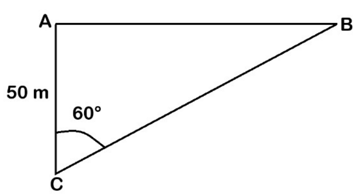
$= \pi R^2 (\frac{1}{3} H_{cone} + H_{cylinder})$

Volume of air = $\frac{22}{7}(14)^2(\frac{1}{3}(10.5) + 8)$

$= \frac{22}{7}(14)^2(11.5)$ = 7,084 m^3

Therefore, volume of air inside the empty tent is 7,084 m^3.

37. $\tan 60° = \frac{AB}{AC}$



$\sqrt{3} = \frac{AB}{50}$

$AB = 50\sqrt{3}$ m

distance $= 50\sqrt{3}$ m

(i) Speed $= \frac{\text{Distacne}}{\text{Time}}$

Speed $= \frac{50\sqrt{3}}{8}$ m/sec $= \frac{50\sqrt{3}}{8} \times \frac{18}{5} = 22.5\sqrt{3}$ km/hr

(ii) Speed $= \frac{50\sqrt{3}}{6}$ m/sec $= \frac{50\sqrt{3}}{6} \times \frac{18}{5} = 30\sqrt{3}$ km/hr

(iii) Speed $= \frac{50\sqrt{3}}{4}$ m/sec $= \frac{50\sqrt{3}}{4} \times \frac{18}{5} = 45\sqrt{3}$ km/hr

38.

(i) The number on the first spot by substituting n=1 into the formula:

$20 + 4(1) = 24$.

(ii) (a) The formula equal to 112:

$20 + 4n = 112.$

$4n = 112 - 20$

$4n = 92,$

$n = 23.$

Therefore, the 23rd spot is numbered as 112.

(b) $20 + 4n$ put $n = 1$

$a_1 = 24$

Put $n = 2$

$a_2 = 20 + 4 \times 2 = 28$

$d = a_2 - a_1 = 28 - 24 = 4$

$$S_n = \frac{n}{2}(2a + (n-1)d)$$

$a = 24$, $d = 4$, and $n = 10$.

$$S_{10} = \frac{10}{2}(2(24) + (10-1)(4)) = (48 + 36) = 5(84) = 420.$$

So, the sum of all the numbers on the first 10 spots is 420.

(iii) $(n - 2)^{th}$ spot, substitute n-2 into the formula:

$20 + 4(n - 2) = 20 + 4n - 8 = 4n + 12.$

Therefore, the number on the $(n - 2)^{th}$ spot is $4n + 12$.