ICSE BOARD SAMPLE PAPER - 1

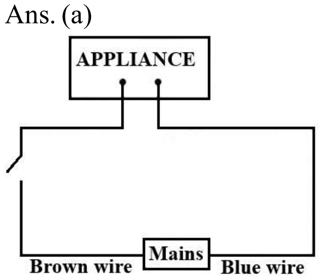
SUBJECT: PHYSICS

Hint & Solutions

SECTION - A

Question 1

1. Ans. (b) (1), (2) and (3)
   (1) Moon revolving around the earth
   (2) A pebble fixed at the end of a string whirling in a circular path
   (3) An aeroplane moving at a constant height
2. Ans. (a) 40 J
3. Ans. (c) $\text{chemical} \rightarrow \text{heat} + \text{light}$
4. Ans. (a) 5 N
5. Ans. (a) Move away from the slab
6. Ans. (c) bends at both the surfaces of the prism towards its base
7. Ans. (a) is less than one
8. Ans. (a) $\delta_I > \delta_G > \delta_Y > \delta_R$
9. Ans. (a) $V = \sqrt{\frac{T}{m}}$
10. Ans. (a)



11. Ans. (d) We know that,
    equivalent resistance is given by,
    $R = R_1 + R_2 + R_3 + R_4 + R_5$
    $r = \frac{1}{5} + \frac{1}{5} + \frac{1}{5} + \frac{1}{5} + \frac{1}{5}$
    $r = \frac{5}{5}$ $\therefore R = 1\Omega$
    Maximum resistance is 1Ω
12. Ans. (b) $e = e_0 \sin 2\pi nt$
13. Ans. (a) 1
14. Ans. (c) isobars
15. Ans. (d) The SI unit of specific heat is J/kg°C .

Question-2

(i) (a) load
(b) Microwaves rays
(c) Specific latent heat of fusion of ice is high
(d) conductance
(e) neutron

(ii) **(a)** Work input = Effort × displacement of effort.
= E × dE

$$\text{Efficiency } \eta = \frac{work\ output}{work\ input}$$

$$\eta = \frac{L \times dL}{E \times dE} = \frac{L}{E} \times \frac{1}{dE/dL}$$

$$\text{But } \frac{L}{E} = M.A$$

$$\frac{dE}{dL} = V.R$$

$$\eta = \frac{M.A}{V.R}$$

M.A = n × V.R
Thus, mechanical advantage of a machine is equal to the product of its efficiency and velocity ratio.

(b) Velocity Ratio

(iii) **(a)** The sound heard after reflection from a distant obstacle (such as a cliff, a hillside, the wall of a building, edge of a forest, etc.) after the original sound has ceased, is called an echo.

(b) 1. The minimum distance between the source of sound (or observer) and the reflector in the air must be 17 m.
2. The size of the reflector must be large enough as compared to the wavelength of the sound wave

Question-3

(i) (a) In vacuum, both have the same speed.
(b) As speed of light increases with increase in wavelength of light. When we observe the given values, we find that the wavelength of red colour (7.8×10^{-7} m) is more than that of blue colour (4.8×10^{-7} m). Hence, in glass, red light has greater speed.

(ii) We are given:
- Power of the motor (P) = 3 kW = 3000 W
- Voltage (V) = 220 V
The relationship between power (P), current (I), and voltage (V) is given by the formula:
P = I × V
From this, we can rearrange the formula to find the current (I): I = P/V
Now, we can substitute the values of power and voltage into the formula: I = 3000 W/220 V
Now we perform the calculation:
I = 3000/220
≈ 13.6363 A
⇒ 14 Ampere fuse.

(iii) (a) Rectangular lamina: The center of gravity is located at the point where the two diagonals intersect.
(b) Cylinder : The center of gravity is at the midpoint of the cylinder's axis.

(iv) (i) "The heat capacity of a body is 50 J K^{-1}" means 50 J of heat energy is required to raise the temperature of that body by 1 K.

(ii) "The specific heat capacity of copper is 0.4 J g^{-1} K^{-1}" means that the heat energy required to raise the temperature of 1 g of copper by 1 K is 0.4 J.

(v) (a) A- South, B- North.

(b) The polarity gets switched.

(vi) Two differences between the radioactive decay and nuclear fission.

Radioactive decay	Nuclear fission
It is a spontaneous process.	It does not occur by itself. It is initiated when, neutrons are bombarded on a heavy nucleus.
The rate of radioactive decay cannot be controlled.	The rate of nuclear fission can be controlled.

(vii) a : The phenomenon is called dispersion.

b : The color seen at X is red, and the color seen at Y is violet.

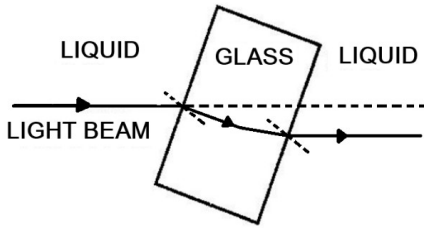
c : Different colors of white light bend at different angles through a prism because each color has a different wavelength and thus a different refractive index in the glass.

SECTION - B

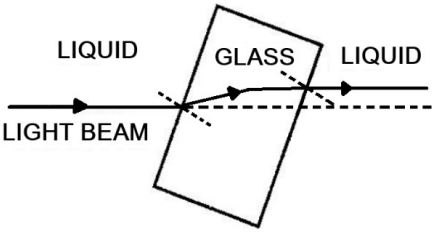
Question-4

(i)

(a) (i) If light shows down in going from liquid to glass, it means that $\mu_{glass} > \mu_{liquid}$, so it will bend towards the normal at the point of incidence in passing from liquid to glass at the first surface, while it will bend away from the normal at the second surface in passing from glass to liquid. the ray diagram is shown in figure. the light beam suffers lateral displacement.



(ii) If light speeds up in going from liquid to glass, it means that $\mu_{glass} < \mu_{liquid}$, so it will bend away from the normal at the point of incidence on the first surface in passing from liquid to glass, while it will bend towards the normal at the second surface in passing from glass to liquid. the ray diagram is shown in figure. the light beam suffers lateral displacement in a direction opposite to that in case (i).



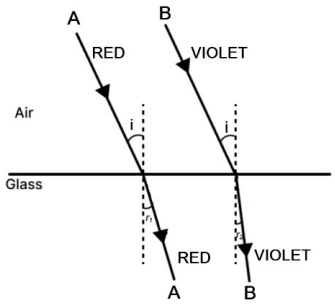
(b) A light ray passing from liquid to glass travels straight without bending under the following two conditions:

(1) when the light ray falls normally on glass from liquid (i.e., if $\angle i = 0°, \angle r = 0°$)

(2) When refractive index of liquid is same as that of glass (or speed of light in glass is same as in liquid).

In both the above conditions, the glass block will not be visible inside the liquid.

(ii) The completed ray diagram is shown below in figure.

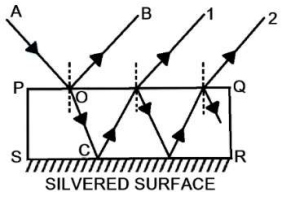


(i) In glass, the speed of violet light is less than that of the red light.

(ii) The two refracted rays inside glass are not parallel. The reason is that the speed of red light in glass is more, while it is less for the violet light, so the red ray bends less, while the violet ray bends more (i.e., the angle of refraction r_1 for red ray is more than the angle of refraction r_2 for the violet ray).

(iii) Since $\mu = c/V$, so the refractive index of glass is more for the violet light than for the red light (i.e., $\mu V > \mu R$).

(iii) (a) The completed diagram is shown in figure in which OB is the reflected ray and OC is the refracted ray for the incident ray AO.



(b) Two rays emerging from the surface PQ after reflections from the surface RS are labelled as 1 and 2.

(c) Multiple (or infinite) images are formed. the second image formed due to first reflection at C at the silvered surface RS, is the brightest. it is seen in the direction of ray 1.

Question-5

(i) Given : u = 10 cm (negative), f = 10 cm (negative)

(a) Form relation $\frac{1}{\upsilon}-\frac{1}{u}=\frac{1}{f}, \frac{1}{\upsilon}=\frac{1}{u}+\frac{1}{f}$ or $\frac{1}{\upsilon}=\frac{1}{-10}+\frac{1}{-10}$ or $\frac{1}{\upsilon}=-\frac{1}{5}$ or $\upsilon=-5\text{cm}$

Thus the image is formed at a distance 5 cm in front of the lens.

(b) From relation $\frac{I}{O}=\frac{\upsilon}{u}, \frac{I}{O}=\frac{-5}{-10}=\frac{1}{2}$

Thus the size of the image is half the size of the object.

(ii) Step 1: Analyze the Graph

From the graph, we identify the following key points:

- From point A to B, the temperature increases from 0°C to 80°C.
- From point B to C, the temperature remains constant while the substance changes from solid to liquid (phase change).
- From point C to D, the temperature of the liquid increases.

Step 2: Calculate the Heat Absorbed from A to B

We know that the heat absorbed (Q) during the temperature increase can be calculated using the formula:

$Q = m \cdot c \cdot \Delta T$

Where

-Q = heat absorbed (in joules)

-m = mass of the substance (in kg)

-c = specific heat capacity (in J/kg°C)

-ΔT = change in temperature (in °C)

Given:

- $c = 500\,\text{J/kg}^\circ\text{C}$

- $\Delta T = 80^\circ C - 0^\circ C = 80^\circ C$

- From the graph, the heat absorbed from A to B is Q = 800J.

Step 3: Substitute Values to Find Mass

Using the formula:

$800 = \text{m} \cdot 500 \cdot 80$

Now, rearranging to find m: $\text{m} = \dfrac{800}{500 \cdot 80}$

Calculating : $\text{m} = \dfrac{800}{40000} = 0.02\text{kg}$

Step 4: Convert Mass to Grams

To convert kg to grams:

M = 0.02kg = 20grams

Step 5: Calculate the Specific Latent Heat of Fusion from B to C

During the phase change from solid to liquid (B to C), the heat absorbed is also given by:

Q = m.L

Where

-L = specific latent heat of fusion (in J/kg)

From the graph, the heat absorbed from B to C is: Q= 1600J − 800J = 800J

Step 6: Substitute Values to Find Latent Heat

Using the formula:

800 = 0.02.L

Rearranging to find L: L = $\text{L} = \dfrac{800}{0.02}$

Calculating: L = 40000 J/kg

Final Answers

(i) The mass of the substance is 20 grams (or 0.02 kg).

(ii) The specific latent heat of fusion of the substance is 40,000 J/kg.

(iii) Given data :

- Mass of water, mw = 5.0kg

- Initial temperature of water, $\text{T}_{\text{w}_\text{i}} = 50°\text{C}$

- Mass of ice, mi = 5.0 kg

- Initial temperature of ice, $\text{T}_{\text{i}_\text{i}} = 0°\text{C}$

- Specific heat capacity of water, $\text{c}_\text{w} = 4200\,\text{J Kg}^{-1}\text{K}^{-1}$

- Specific latent heat of ice, $\text{L} = 336\,\text{kJ kg}^{-1} = 336000\ \text{J kg}^{-1}$

(i) Heat energy imparted by water in fall of its temperature from 50°C to 0°C

The heat energy Q lost by the water can be calculated using the formula:

$Q = m_w \cdot c_w \cdot \Delta T$

Where:

- $\Delta T = T_{w_i} - T_{w_f} = 50^\circ C - 0^\circ C = 50\,\text{K}$

Substituting the values:

$Q = 5.0\,\text{kg} \cdot 4200\,\text{J kg}^{-1}\text{K}^{-1} \cdot 50\,\text{K}$

$Q = 5.0 \cdot 4200 \cdot 50 = 1050000\,\text{J}$

(ii) Mass of ice melted

The heat energy lost by the water is used to melt the ice. The energy required to melt the ice can be expressed as: $Q = m_i \cdot L$

Where m_i is the mass of ice melted.

Setting the heat lost by water equal to the heat gained by ice:

$1050000\ J = m_i \cdot 336000\ J\ kg^{-1}$

Now solving for m_i

$m_1 = \frac{1050000}{336000} \approx 3.125\ kg$

(iii) Final temperature of mixture

Since all the heat lost by the water is used to melt the ice and the final temperature of the mixture is 0°C (as the water and melted ice are at the same temperature), we conclude:

$T_f = 0°C$

(iv) Mass of water at 0°C in mixture

The total mass of water in the mixture will be the mass of the original water plus the mass of the melted ice:

Total mass of water $= m_w + m_i = 5.0\ kg + 3.125$

$kg = 8.125\ kg$

Question-6

(i) Given $F_1 = F_2 = 10N$

Perpendicular distance of point of rotation X from the force F_1 is $d_1 = 0.4m$

While that of force F_2 is $d_2 = \frac{1}{2} \times 0.4m = 0.2m$

$$\frac{\text{Torque pr oduced by force } F_1}{\text{Torque pr oduced by force } F_2} = \frac{F_1 \times d_1}{F_2 \times d_2} = \frac{10N \times 0.4m}{10N \times 0.2m} = \frac{2}{1}$$

(ii) Force acting on the body = 10 kgf = 10 × 10 N = 100 N

Displacement, S = 0.5 m

Work done = force x displacement in the direction of force

W= 100 × 0.5 = 50 J

(ii) Work = force x displacement in the direction of force

$W = F \times S \cos\ \theta$

$W = 100 \times 0.5 \cos 60°$

w = 100 × 0.5 x 0.5 (cos 60° = 0.5)

(iii) Normal to the force:

Work = force x displacement in the direction of force

$W = F \times S \cos\ \theta$

$W = 100 \times 0.5 \cos 90°$

(iii) Given $= 10g = \frac{10}{1000} kg = 0.01\ kg,\ h = 5m, g = 9.8\ ms^{-1}.h. = 4m$

(a) Initial potential energy of the ball =mgh=0.01 × 9.8 × 5 = 0.49 J

(b)Kinetic energy of the ball just before striking the ground = Initial potential energy of the ball =0.49 J.

(c)Kinetic energy of the ball after striking the ground =Potential energy of ball at the highest point after rebound.

= mgh. = 0.01 × 9.8 × 4 = 0.392 J

(d) Loss in kinetic energy on striking the ground =Initial kinetic energy -Final kinetic energy

= 0.49 J-0.392 J = 0.098 J

Note: This energy appears in the form of heat energy and sound energy when the ball strikes the ground .

Question-7

(i) Load = 75 kgf

Effort = 25 kgf

$\therefore n = 3$

$$M.A. = \frac{\text{Load}}{\text{Effort}}$$

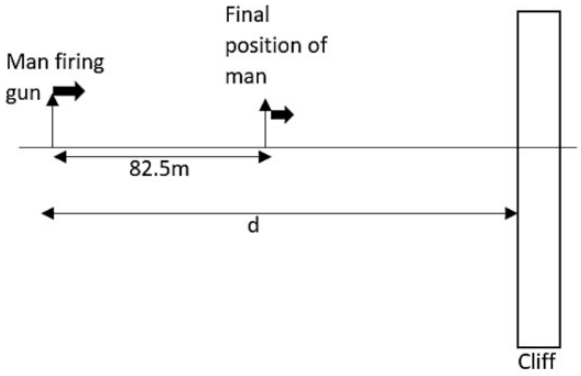
$$M.A. = \frac{75}{25}$$

$M.A. = 3$ or $MA = n = 3$

Velocity ratio $VR = n = 3$

$$\text{Efficiency } \eta = \frac{M.A.}{V.R.} = \frac{3}{3} = 1 \text{ or } 100\%$$

(ii)



The time taken to travel this distance is given as, t = 3s

Therefore, the speed of travel can be found by the equation, $S = \frac{d}{t}$

Substituting the values in it, $S = \frac{2d}{3}$

When the man moves towards the cliff by a distance, $d' = 82.5\,m$

Therefore the resultant distance between the cliff and the man is given as, $d - d' = d - 82.5$

The total distance will be twice of this. That is, $d_f = 2 \times (d - 82.5)$

The time taken will be, $t_f = 2.5s$

Therefore the speed will be given as, $S = \frac{2(d - 82.5)}{2.5}$

These two speeds will be equivalent. That is, $S = \frac{2(d - 82.5)}{2.5} = \frac{2d}{3}$

Simplifying this equation, 5s = 6d – 495

Therefore the distance between the cliff and the initial position of man will be, d = 495m

Therefore the answer has been obtained.

(iii) (i) The vibration with the largest amplitude is (b) because it has the most pronounced peaks and troughs.

(ii) The vibration with the least frequency is (c) because it has the longest wavelength, which corresponds to a lower frequency.

(iii) The ratio of frequency between (a) and (c) can be determined by the number of nodes. Mode (a) has 2 nodes and mode (c) has 1 node. The frequency ratio is inversely proportional to the number of nodes, so the ratio is 2:1.

(iv) The ratio of wavelength between (b) and (a) can be determined by the wavelengths of the modes. Mode (a) has a wavelength of $\lambda_a = \frac{2\ell}{2} = \ell$ and mode (b) has a wavelength of $\lambda_b = \frac{2\ell}{3}$.

Therefore, the ratio of wavelengths is $\frac{\lambda_b}{\lambda_a} = \frac{\frac{2\ell}{3}}{\ell} = \frac{2}{3}$

Question-8

(i) (a) $R = \frac{V}{I} = \frac{2V}{1A} = \frac{2V}{1A} = 2\Omega$. Resistance/unit length $= \frac{2\Omega}{5m} = 0.4\Omega/m$

(b) Resistance of 2m length of the wire = 0.4 × 2= 0.8 Ω

(c) When the wire is doubled on itself, it will be equivalent to two resistances (each of value 1Ω) parallel to each other. The resultant resistance across the $= \frac{1\Omega}{2} = 0.5\Omega$

(ii) (i) P.D. across 6 Ω = P.d. cross 3 Ω or $6 \times 0.5 = 3 \times i_c$

or i_c i.e., current passing through the ammeter C is $\frac{6 \times 0.5}{3} = 0.1$ ampere

(ii) Here, $\frac{1}{R} = \frac{1}{6} + \frac{1}{3} = \frac{3}{6} = \frac{1}{2}$ or R = 2 Ω

$\therefore$ Total resistance of the circuit $= 2\Omega + R = 2\Omega + 2\Omega = 4\Omega$

$\therefore$ Current through A = Current passing through B + current passing through C

= 0.5 + 1.0 = 1.5 ampere

(iii) (a) When same current flows in each resistor, then the two resistors are joined in series

(b) When potential difference is same across each resistor, then the two resistors are joined in parallel

(c) When equivalent resistance is less than either of the two resistances, then the two resistors are joined in parallel

(d) When equivalent resistance is more than either of the two resistances, then the two resistors are joined in series

Question-9

(i) Step 1: Identify the Given Values

- Voltage across the lamp, V=6V
- Power of the lamp, P=12W
- Source voltage, E=12V

Step 2: Calculate the Current through the Lamp

Using the formula for power: $P = V \cdot I$

We can rearrange this to find the current I :

$I = \frac{P}{W} = \frac{12W}{6V} = 2A$

Step 3: Calculate the Resistance of the Lamp

Using Ohm's Law, we can find the resistance Rlamp of the lamp:

$R_{lamp} = \frac{V}{I} = \frac{6V}{2V} = 3\Omega$

Step 4: Set Up the Equation for the Total Voltage

In a series circuit, the total voltage supplied by the source is equal to the sum of the voltage drops across the l amp and the resistor R: $E = I \cdot R_{lamp} + I \cdot R$

Substituting the known values:

$12V = 2A \cdot 3\Omega + 2A \cdot R$

Step 5: Simplify the Equation

$12 = 6 + 2R$

Step 6: Solve for the Resistor R

Rearranging the equation to solve for R

$12 - 6 = 2R$

$6 = 2R$

$R = \frac{6}{2} = 3\Omega$

(ii) (a) D; (b) A; (c) B

(iii) (a) $x + {}^{a}_{1}Q$

(b) ${}^{4}_{2}He$

(c) ${}^{234}_{90}Q, {}^{234}_{91}R, {}^{234}_{92}S$

(d) ${}^{A-4}_{Z-2}X_1, {}^{A-4}_{Z-2}X_2, {}^{A-4}_{Z}X_3$

SUBJECT: CHEMISTRY

Hint & Solutions

SECTION - A

Question 1

(i) Ans: (a) 1

(ii) Ans: (c) Basic

(iii) Ans: (c) Nickel atoms

(iv) Ans: (a) H_2O

(v) Ans: (b) Q

(vi) Ans: (c) SO_2

(vii) Ans: (c) 44.8 L

(viii) Ans: (b) Lead oxide

(ix) Ans: (a) Addition reaction

(x) Ans: (d) Br

(xi) Ans: (d) CH_3COOH

(xii) Ans: (d) sodium hydroxide

(xiii) Ans: (a) C_3H_4

(xiv) Ans: (b) 30

(xv) Ans: (a) A

Question 2

(i) (a) Oxygen gas

(b) Sodium argentocyanide

(c) Thick block of impure copper as anode and pure thin sheet of copper as cathode

(d) Bromine gas

(e) Oxygen gas

(ii) (a) $NaHSO_4$

(b) AgCl

(c) $CuSO_4.5H_2O$

(d) $CuCO_3$

(e) $Pb(NO_3)_2$

(iii) (a) reducing agents

(b) bad

(c) alkaline

(d) Silver chloride

(e) dehydration

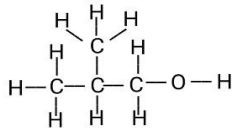
(iv) Column A with column B

Column A	Answer
(a) Acid Salt	4. Sodium bicarbonate
(b) Copper oxide	1. Black in colour
(c) Zinc hydroxide	5. Soluble in excess sodium hydroxide
(d) Copper metal	2. Reddish brown
(e) Polar compound	3. Hydrogen chloride

(v)

(a) 1. $CH_3–CH = CH–CH_3$

2. $CH_3–CH_2–COOH$

3. 

2-methyl-1-propanol

(b) 1. $CH \equiv CH$

2. $CH_3–COOH$

SECTION - B

Question 3

(i) (a) $Percentage of Nitrogen = \frac{Mass of Nitrogen}{Total Mass of compound} \times 100$

$Percentage of Nitrogen = \frac{28}{80} \times 100$

Percentage of Nitrogen=35%

(b) Nitrogen and hydrogen combine at about 200 to 400 atm pressure and 400-600 0C

(ii) (a) Ammonia is highly soluble in water and hence it is not collected over water.

(b) Quick lime being basic in nature will react with dry hydrogen chloride gas and hence it is not used to dry hydrogen chloride gas.

(iii) (a) Q (b) R

(c) P

(iv) (a) $NH_3 + 3Cl_2(excess) \longrightarrow NCl_3 + 3HCl$

(b) $S + 6HNO_3 \longrightarrow H_2SO_4 + 2H_2O + 6NO_2$

(c) $C + 2H_2SO_4 \longrightarrow CO_2 + 2H_2O + 2SO_2$

Question 4

(i) (a) Bauxite $(Al_2O_3.2H_2O)$

(b) Zinc blende (ZnS) and Zinc calamine ($ZnCO_3$)

(ii) (a) $NaCl + H_2SO_4 \overset{<200^0C}{\rightarrow} NaHSO_4 + HCl$

(b) $CH_3 - CH_2 - Br + KOH \longrightarrow CH_2 = CH_2 + KBr + H_2O$

(iii) (a) Nitrate (NO_3^-)

(b) Sulphide (S_2^-)

(c) Sulphate (SO_4^{2-})

(iv) (a) Due to the presence of carbon-carbon double bond, it undergoes addition reaction.

(b) Due to deliquescent nature of sodium hydroxide, soda lime is preferred over it.

(c) Hydrocarbons have a high amount of calorific value and hence can be used as fuels.

Question 5

(i) To the sodium chloride and sodium nitrate solutions, add the silver nitrate solution. A white curry precipitate is produced when sodium chloride is present. The reaction mixture stays colourless while dealing with sodium nitrate solution.

$NaCl + AgNO_3 \longrightarrow AgCl \downarrow + NaNO_3$

$NaNO_3 + AgNO_3 \longrightarrow$no ppt.

(ii) Molecular mass = 2 vapour density= 2(8) = 16

$Volumeatstp = \frac{mass}{molecularmass} \times 22.4$

$Volumeatstp = \frac{24}{16} \times 22.4 = 33.6L$

(iii) (a) dehydrating property

(b) Non-volatile acid

(c) Oxidizing agent

(iv) (a) $2CH_3 - CH_3 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$

(b) $CaC_2 + 2H_2O \longrightarrow C_2H_2 + Ca(OH)_2$

(c) $NH_4NO_3 \longrightarrow N_2O + 2H_2O$

Question 6

(i) (a) pale blue precipitate of $Cu(OH)_2$ is formed, which becomes deep blue when excess of ammonium hydroxide is added.

$CuSO_4 + 2NH_4OH \longrightarrow (NH_4)_2SO_4 + Cu(OH)_2 \downarrow$

$Cu(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH(excess) \longrightarrow 4H_2O + [Cu(NH_3)_4]SO_4$

(b) gelatinous white precipitate of zinc hydroxide is formed which becomes colourless solution on adding excess of ammonium hydroxide

$ZnSO_4 + 2NH_4OH \longrightarrow (NH_4)_2SO_4 + Zn(OH)_2 \downarrow$

$Zn(OH)_2 + (NH_4)_2SO_4 + 2NH_4OH(excess) \longrightarrow 4H_2O + [Zn(NH_3)_4]SO_4$

(ii) (a) acid salt

(b) lead sulphate

(iii) (a) $2Ca(NO_3)_2 \longrightarrow 2CaO + 4NO_2 + O_2$

$2 \times 164g \longrightarrow 2 \times 56g + 4 \times 22.4L$

Moles of calcium nitrate undergoing decomposition=$\frac{82}{164} = 0.5mole$

(b) from the chemical equation we observe 2 moles of $Ca(NO_3)_2$ decomposes to give 2 moles of CaO

Thus 0.5 moles $Ca(NO_3)_2$ will give 0.5 moles of CaO mass of CaO formed = 0.5 x 56 g = 28 g

(c) 2 moles of $Ca(NO_3)_2$ decomposes to give 4 moles of NO_2

Thus, 0.5 moles of $Ca(NO_3)_2$ will give 1 mole of NO_2

Thus, volume of NO_2 produced=22.4 L at STP

(iv) (a) galvanization (b) solder

(c) Copper oxide (CuO)

Question 7

(i) (a) Inert gases have completely filled octet which makes them extremely stable. They neither lose, nor gain electrons. Hence, they do not form ions.

(b) Because they are formed from neutral atoms by sharing of electrons and hence the bonds are relatively weaker than ionic compounds.

(ii) (a) Lowers the fusion temperature from 2050°C to 950°C. and enhances conductivity.

(b) Thick Graphite rods attached to copper clamps dipping into fused electrolyte are used as anode.

(iii) (a) $Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + H_2O + CO_2$

(b) $NaNO_3 + H_2SO_4 \xrightarrow{<200^0C} NaHSO_4 + HNO_3$

(c) $CH_2 = CH_2 + H_2 \xrightarrow{Ni} CH_3 - CH_3$

(iv) (a) C (b) B (c) A

Question 8

(i) (a) Lead Oxide (PbO)

$PbO + 2NaOH \longrightarrow Na_2PbO_2 + H_2O$

(b) Zinc oxide (ZnO)

(ii) 

(iii) (a) Concentrated Nitric Acid
(b) Steel
(c) Magnetic separation method

(iv) (a) higher
(b) higher
(c) smaller

SUBJECT: BIOLOGY

Hint & Solutions

SECTION - A

Question 1

(i) Ans. (d) First sound, closing of atrio-ventricular valve
(ii) Ans. (a) Gibberellin
(iii) Ans. (a) Both A and R are true, and R is the correct explanation of A.
(iv) Ans. (b) Pancreas
(v) Ans. (b) Vein
(vi) Ans. (c) A is false, but R is false.
(vii) Ans. (b) Cone cells.
(viii) Ans. (c) Cerebrum
(ix) Ans. (a) Population explosion
(x) Ans. (b) Identical twins develop from one ovum which splits, fraternal twins from two fertilised ova.
(xi) Ans. (d) Endocrine system
(xii) Ans. (a) 23 pairs
(xiii) Ans. (a) Tool making, Agricultural, Scientific and Industrial
(xiv) Ans. (d) 1-b , 2-d, 3-c, 4-a
(xv) Ans. (c) Eustachian tube

Question 2

(i) (a) Green house effect (b) Acrosome
(c) Active (d) Smooth ER
(e) PNS

(ii) (a) SAN (sino atrial nose) (b) Superior vena cava
(c) AVN (atrio-ventricular node) (d) Ventricle
(e) Purkinjee fibre

(iii) (a) Odd- oxygen
Category of other - air pollutants

(b) Odd- cochlea
Category of other - Central nervous system
(c) Odd - uterus
Category of other - primary sex orgns/gonads
(d) Odd- Transpiration
Category of other - molecular mechanisms of absorption
(e) Odd- liver
Category of other - organ of urinary system.

(iv) (a) Cochlea (b) Dynamic equilibrium
(c) Equalizing pressure (d) Transfer message to brain
(e) Malleus, incus , stapes

(v) (a) Graafian follicle (mature follicle). (b) diploid (2n)
(c) corpus luteum (d) oviduct (fallopian tube)
(e) fertilisation

SECTION - B

Question 3

(i) No, he will not be able to produce sperms.
Justification: Sperm formation (spermatogenesis) requires a temperature about 2–3°C lower than body temperature.

(ii) 1. Increase in temperature – raises the rate of evaporation of water from leaf surfaces.
2. Increase in wind speed – removes the humid layer around stomata, enhancing water loss.
(Other acceptable answers: low humidity, high light intensity.)

(iii) (a)cerebrum (part of the forebrain).
(b) Cerebrum: Controls voluntary actions, reasoning, memory, and intelligence.
Medulla oblongata: Controls involuntary activities such as heartbeat, breathing, and digestion

(iv) Carry out cellular respiration to release energy (ATP) from glucose,
Provide energy for all cell activities, including at night or in non-photosynthetic tissues (roots, flowers, seeds).

(v)

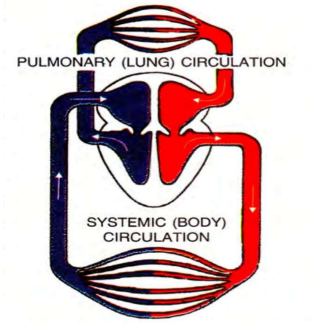


Fig. 7.13 : General plan of double ıtion of blood in the human body.

Question 4

(i) Osmoregulation is the process by which living organisms regulate the water and solute (salt) balance in their bodies to maintain homeostasis. Example - kidney(in human)

(ii) Site of secretion
Hormone - Secreted directly into the bloodstream by endocrine glands (e.g., thyroid, pituitary).
Enzyme - Secreted by exocrine glands or cells into ducts or specific sites (e.g., salivary glands secrete amylase).

(iii) Genetic cross (Black fur = dominant (B), White fur = recessive (b)):
Parents: Pure breeding → BB (black) × bb (white)

	B	B
b	Bb Black	Bb Black
b	Bb Black	Bb Black

F_1 Generation: All Bb (black)
Genotypic ratio: 100% Bb (1:0)
Phenotypic ratio: 100% Black (1:0)

(iv) Flaccid - A cell that has lost water by osmosis and becomes soft and shrink.
Turgid - A cell that has absorbed water by osmosis and becomes swollen and firm.
Example of flaccid condition - A wilted leaf during water shortage.

(v) (a) Abscisic acid (ABA) – causes stomatal closure, wilting, and promotes leaf fall during senescence.
(b) Cytokinins (promote cell division) and Gibberellins or Auxins (promote shoot elongation and branching).
(c) The plant's stem bends toward the light source due to unequal distribution of auxin.
Hormone responsible: Auxin

Question 5

(i) Syringes and needles (plastic and metal parts) and glass bottle

(ii) Family planning (control of population growth through birth control measures)
Maternal and child health care (ensuring the health and well-being of mothers and children)

(iii) (a) Algae → Insect larva → Small fish → Heron
(b) Phytoplankton → Zooplankton → Small fish → Large fish → Shark

(iv) (a) Impulses are conducted in only one direction across a synapse because neurotransmitters are released from the axon terminals of the presynaptic neuron and act only on receptor sites of the postsynaptic membrane. The synapse structure is therefore one-way.
(b) The spinal cord is adapted for its protective function by being enclosed within the bony vertebral column, cushioned by cerebrospinal fluid (CSF), and surrounded by meninges that protect it from mechanical injury and shock.

(v) (a) The main aim of the experiment is to show that oxygen is produced during photosynthesis.
(b) Oxygen is released from Water (H_2O).
(c) The gas present in the test tube makes a glowing splinter bursts into flames. This shows the presence of oxygen. Or bubbles in test tube

Question 6

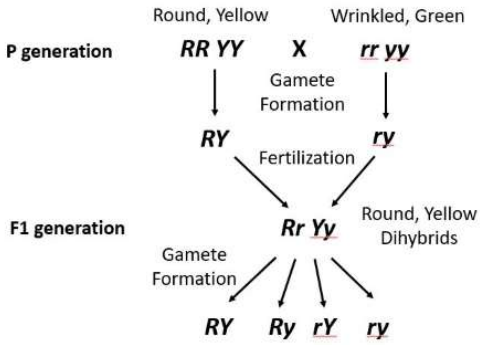
(i) During the formation of gametes, the two alleles for a given trait separate (or segregate) from each other, so that each gamete receives only one allele of each gene.

(ii) (a)The cobalt chloride paper on the dorsal side will turn less pink or turns pink in a much longer time while the one on the ventral side will turn more pink. This occurs because the ventral surface has more number of stomata as compared to the dorsal surface. As a result, the rate of transpiration is more on the ventral side than on the dorsal side of a dicot leaf.
(b) The experimental leaf is a dicot leaf as it shows reticulate venation. More number of stomatal openings on the undersurface of a dicot leaf. So transpiration is more and can be easily observed.

(iii) (a) TSH – Thyroid Stimulating Hormone
(b) LH – Luteinizing Hormone

(iv) 1. Real
2. Inverted
3. Smaller in size

(v)



(a) Genotype of F_1 generation: RrYy

(b) Phenotype of F_1 offspring:Round and yellow seeds

(c) Possible combinations of gametes from F_1 hybrid:RY, Ry, rY, ry

Question 7

(i) Demography: It is the scientific study of human populations, particularly with reference to their size, structure, distribution, and changes due to birth, death, migration, and aging.

Mortality: It refers to rate of death within a population during a specific period.

(ii) (a) Corpus callosum

Location: In the brain, connecting the left and right cerebral hemispheres.

Main function: It allows communication and coordination between the two hemispheres of the brain.

(b) Central canal

Location: In the spinal cord, running longitudinally through its center.

Main function: It contains cerebrospinal fluid (CSF), which nourishes and cushions the spinal cord.

(iii) (a) Excretion is the removal of harmful and unwanted nitrogenous waste products from the body.

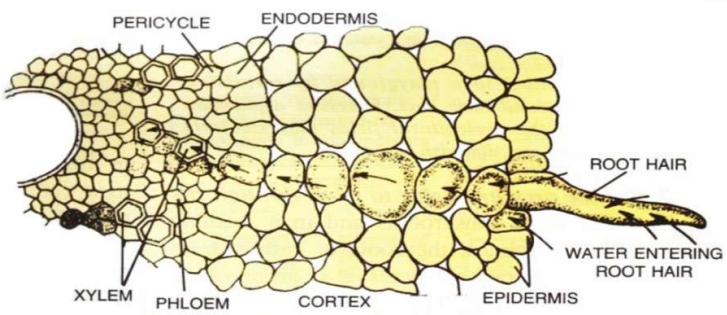
(b) The blood vessel 'A' is renal vein and the blood vessel 'B' is renal artery.

So the blood vessel 'A' contains deoxygenated blood with low concentration of urea and glucose as compared to renal artery whereas the blood vessel 'B' contains oxygenated blood with high concentration of urea and glucose.

(iv) Difference :-

Stomata	Lenticels
Stomata are small openings mostly found on the abaxial surface of leaves.	Lenticels are small openings on the surface of older woody stems.
Stomata are surrounded by bean-shaped guard cells. They can be opened or closed.	Lenticels have no guard cells and they remain open all the time.

(v)



Diagrammatic cross-section of a part of a root showing by arrows the cell-to-cell conduction of water from a root hair to xylem

Question 8

(i) These are emission standards set by the European Union (Euro norms) and adopted in India as Bharat Stage (BS) norms to regulate the amount of air pollutants emitted by vehicles. The aim is to reduce air pollution and improve air quality.

(ii) Cranial capacity - 1450 cm^3
Large head, broad flat and sloping forehead
Almost no chin, less hair on body (ANY TWO)

(iii) A -Umbilical cord
B-Cervix
C-Blood of mother flows into placenta
D-Blood of foetus flows into placenta
E-Amnion
F-Amniotic fluid
G-Opening of the cervix
H- endometrium

(iv) The damaged part is the tympanic membrane, also known as the eardrum.
Normal function of the tympanic membrane:
It acts as a thin, flexible membrane that separates the outer ear from the middle ear.
Its main role is to vibrate in response to sound waves entering the ear canal.

(v) (a) Tropism.
The movement shown is a type of tropism called thigmotropism. Tropism is a directional growth movement of a plant part in response to an external stimulus. In this case, the stimulus is touch or contact with a solid object, which causes the plant to coil around it. This is a directional response because the plant grows specifically in the direction of the support it has touched.
(b) auxin.
When a climbing plant's tendril or stem touches a support, the side of the stem that is in contact with the support produces less auxin. The side of the stem not in contact with the support continues to produce auxin, which causes the cells on that side to grow and elongate more rapidly. This uneven growth rate causes the stem to bend and coil around the support
(c) This movement is advantageous because it allows the plant to access more sunlight and compete with other plants.
By coiling around a support and climbing upwards, the plant is able to reach higher positions. This allows its leaves to be exposed to more sunlight for photosynthesis, which is essential for energy production and growth. It also helps the plant to avoid being shaded by other, taller plants, increasing its chances of survival and reproduction.

SUBJECT: MATHEMATICS

Hint & Solutions

SECTION - A

Q.1

1. Ans. (a)

$$\begin{bmatrix} 2 & 0 \\ 0 & 4 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ -8 \end{bmatrix}$$

$$\begin{bmatrix} 2x+0y \\ 0x+4y \end{bmatrix} = \begin{bmatrix} 2 \\ -8 \end{bmatrix}$$

$$\begin{bmatrix} 2x \\ 4y \end{bmatrix} = \begin{bmatrix} 2 \\ -8 \end{bmatrix}$$

On equating the corresponding terms, $2x = 2$

$\Rightarrow x = 1$

and $4y = -8$

$\Rightarrow y = -2$

$(1, -2)$

2. Ans. (c)

$(x - 2)$ is a factor of $x^3 - kx - 12$

Then putting $x - 2 = 0$

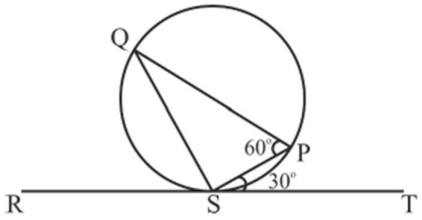
i.e. x 2 in given expression,

Remainder = 0

$8 - 2k - 12 = 0$

$k = -4 = -2$

3. Ans. (d)



$\angle PQS = \angle PST$ ...$(\angle S$ in alternate segment$)$

$= 30°$

In ΔPQS

$\angle PQS + \angle PSQ + \angle SPQ = 180°$

$30° + \angle PSQ + 60° = 180°$

$\angle PSQ = 180° - 90°$

$= 90°$

4. Ans. (b)
5. Ans. (a)
6. Ans. (c)

7. Ans. (b)
Printed Price = ₹3080
Then GST @10% = ₹3080 $\times\frac{10}{100}$ = ₹308

8. Ans. (d)
$\cos^2 A$
$(1+\sin A)(1-\sin A)$
$=1-\sin^2 A = \cos^2 A$

9. Ans. (a)
Coordinates of the centroid G of ΔABC
$=\left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$
$=\left(\frac{-4+6+4}{3}, \frac{-2+2+6}{3}\right)=(2,2)$

10. Ans. (c)
n^{th} term of A.P. = 2n + 5
Put n = 10
10^{th} term of A.P. = 2 × 10 + 5
= 20 + 5 = 25

11. Ans. (b)
Mean proportional of 4 and 9
$=\sqrt{4\times 9} = \sqrt{36} = 6$

12. Ans. (d)
A histogram can be used to determine the mode, and an ogive can be used to graphically determine the median and quartiles.
But mean cannot be expressed graphically.

13. Ans. (c)
Given Height of cylinder h = 3 cm
Volume of cylinder V = 48π
Let Radius of cylinder = r
$V = \pi r^2 h$
$48\pi = \pi r^2 \times 3$
$r^2 = \frac{48}{3} = 16$
$r = \sqrt{16} = 4$ cm

14. Ans. (a)
Maturity value = ₹4884
Deposited value = ₹800 × 6 = ₹4800
Interest earns by him = ₹4884 – ₹4800 = ₹84

15. Ans. (b)
Inequation
$2x+4\le 14$ where $x \varepsilon W$
$\Rightarrow 2x \le 10$
$\Rightarrow x \le 5$
Hence the solution set = {0, 1, 2, 3, 4, 5}

Question-2

1. $I = \dfrac{Px(x+1)R}{2\times12\times100}$

$8329 = \dfrac{P\times36\times37\times75}{2\times12\times100\times10}$

$P = \dfrac{8329\times80}{37\times9} = 2000.95$ ₹

$M.V = Px + I = 2000\times36 + 8329 = 80329$ ₹

2. $\dfrac{1+(\sec A-\tan A)^2}{\operatorname{cosec}A(\sec A-\tan A)} = 2\tan A$

$= \dfrac{(\sec^2 A-\tan^2 A)+(\sec A-\tan A)^2}{\operatorname{cosec}A(\sec A-\tan A)}$

$= \dfrac{(\sec A-\tan A)(\sec A+\tan A)+(\sec A+\tan A)^2}{\operatorname{cosec}A(\sec A-\tan A)}$

$= \dfrac{(\sec A+\tan A)+(\sec A-\tan A)}{\operatorname{cosec}A}$

$= \dfrac{2\sec A}{\operatorname{cosec}A} = 2\dfrac{\frac{1}{\cos A}}{\frac{1}{\sin A}} = 2\tan A$

3. $\angle ABT = 40°$ {ΔOAB is isosceles Δ}

$\angle APT = 100°$ {cycle quadrilateral}

Length of AB = 7 cm. (By tangent secant theorem)

$PT^2 = PA\times PB$

Question-3

1. Using properties of proportion $\dfrac{x}{y} = ?$

$\dfrac{x^3+48x}{12x^2+64} = \dfrac{y^3+75y}{15y^2+125}$

By compounds of dividends prop.

$\dfrac{x^3+48x+12x^2+64}{x^3+48x-12x^2-64} = \dfrac{y^2+75y+15y^2+125}{y^3+75y-15y^2-125}$

$\dfrac{(x+4)^3}{(x-4)^3} = \dfrac{(y+5)^3}{(y-5)^3}$

Taking cube root both sides

$\dfrac{x+4}{x-4} = \dfrac{y+5}{y-5}$

$\therefore$ Again applying compounds of dividends

$\dfrac{x+4+x-4}{x+4-x+4} = \dfrac{y+5+y-5}{y+5-y+5}$

$\dfrac{2x}{8} = \dfrac{2y}{10} \quad \therefore \dfrac{x}{4} = \dfrac{y}{5} \qquad \therefore \dfrac{x}{y} = \dfrac{4}{5}$

2. Given :

$\text{CSA} = 550\ \text{cm}^2$

$l = 25\ \text{cm}$

To find the radius, we can rearrange the formula:

$r = \frac{CSA}{\pi l}$

$r = \frac{550}{\pi(25)}$

Using $\pi = \frac{22}{7}$:

$r = \frac{550}{\frac{22}{7} \times 25} = \frac{550 \times 7}{22 \times 25} = \frac{3850}{550} = 7\ \text{cm}$

To find the number of spheres, we must first calculate the volume of the cone and the volume of one small sphere. The number of spheres is the total volume of the cone divided by the volume of one sphere.

First, find the height (h) of the cone using the Pythagorean theorem: $l = r^2 + h^2$

$$h = \sqrt{l^2 - r^2} = \sqrt{25^2 - 7^2} = \sqrt{625 - 49} = \sqrt{576} = 24\ \text{cm}$$

Now, calculate the volume of the cone (V_{cone}) using the formula

$V_{\text{cone}} = \frac{1}{3}\pi r^2 h$:

$$V_{\text{cone}} = \frac{1}{3} \times \pi \times (7)^2 \times 24 = \frac{1}{3} \times \pi \times 49 \times 24 = 392\pi\ \text{cm}^3$$

Next, find the volume of one small sphere (V_{sphere}). The diameter is 2 cm, so the radius is 1 cm. The formula for the volume of a sphere is

$V_{\text{sphere}} = \frac{4}{3}\pi r^3$:

$$V_{\text{sphere}} = \frac{4}{3} \times \pi \times (1)^3 = \frac{4}{3}\pi\ \text{cm}^3$$

Finally, find the number of spheres by dividing the volume of the cone by the volume of one sphere:

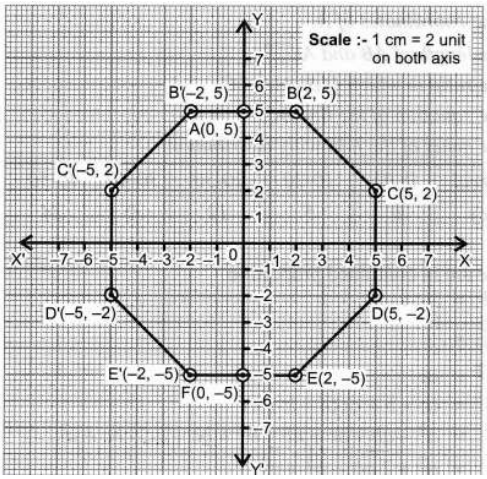
Number of spheres

$$= \frac{V_{\text{cone}}}{V_{\text{sphere}}} = \frac{392\pi}{\frac{4}{3}\pi} = \frac{392 \times 3}{4} = 98 \times 3 = 294$$

(a) The radius of the cone is 7 cm.

(b) The number of spheres formed is 294.

3. (a) Plot A(0, 5), B (2, 5), C (5, 2), D (5, –2), E(2, –5) and F(0, -5)



(b) Reflection of B(2 ,5) on the y-axis = (-2 ,5) i.e.,B'
Reflection of C (5 ,2) on the y-axis = (- 5 ,2) i.e., C'
Reflection of D (5 ,-2) on the y-axis = (- 5 ,-2) i.e.,D'
Reflection of E (2, - 5) on the y-axis = (-2,- 5) i.e.,E'

(c) Figure formed by BCDEE'D'C'B' is regular Octagon.

(d) Area of the figure = 82 units

(e) (5, 0) & (–5, 0)

SECTION - B

Question-4

(i) (a) The Amount invested is ₹8,000

(b) The rate dividend paid by company is 8%

(c) The Amount dividend is ₹800

Given as :

The cost of share = ₹500
Total number of shares = 20
The return percentage = 10%
According to question
Let The Amount invested = ₹A
The rate divided paid = r %

(a) m.v.= number of share - (discount % × number of share)

or, $m.v = 20 - \left(\frac{20}{100} \times 20\right)$

i.e $m \,.\, v = 20 - 4 = 16$

So, Amount invested = no. of shares × m.v.

i.e $A = 500 \times 16 = 8000$

∴ Amount = ₹8000

(b) m.v. × return percent = n.v. × dividend percent

i.e $16 \times \frac{10}{100} = 20 \times \frac{r}{100}$

or, $16 \times 10 = 20 \times r$

∴ $r = \frac{160}{20}$

i.e rate = 8%

Now,

(c) Annual dividend = share cost × number of share × rate %

i.e Annual dividend = $500 \times 20 \times \frac{8}{100}$

∴ Annual dividend = ₹800

(ii) First, rearrange the equation $x^2 + 7x = 19$ into the standard quadratic form $ax^2 + bx + c = 0$

Use the quadratic formula to solve for x, with a = 1, b = 7 and c = –19

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Substitute the values:

$$x = \frac{-7 \pm \sqrt{7^2 - 4(1)(-19)}}{2(1)}$$

$$x = \frac{-7 \pm \sqrt{49 + 76}}{2}$$

$$x = \frac{-7 \pm \sqrt{125}}{2}$$

Calculate the two possible values for x by evaluating the positive and negative roots.

$$x_1 = \frac{-7+\sqrt{125}}{2} \approx \frac{-7+11.18034}{2} \approx 2.09017$$

$$x_2 = \frac{-7-\sqrt{125}}{2} \approx \frac{-7-11.18034}{2} \approx -9.09017$$

Round each value to two significant figures as requested.

$x_1 \approx 2.09$

$x_2 \approx -9.09$

3. (a) let the order of matrix B be a × b

$$\therefore \begin{bmatrix} 2 & 1 \\ -3 & 4 \end{bmatrix} \times B_{a\times b} = \begin{bmatrix} 7 \\ 6 \end{bmatrix}_{2\times 1}$$

$\Rightarrow a = 2 \;\&\; b = 1$

$\therefore$ The order of the matrix $B = a \times b = 2 \times 1$

(b) Let $B = \begin{bmatrix} x \\ y \end{bmatrix}$

$$\therefore \begin{bmatrix} 2 & 1 \\ -3 & 4 \end{bmatrix} \times \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 7 \\ 6 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 2x+y \\ -3x+4y \end{bmatrix} = \begin{bmatrix} 7 \\ 6 \end{bmatrix}$$

$\Rightarrow 2x + y = 7$ and $-3x + 4y = 6$

On solving the above simultaneous equations

In x and y, we have, x = 2 and y = 3

$\therefore$ The matrix $B = \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$

Question-5

1. The marked price is ₹2000. The manufacturer sells to the wholesaler at a 20% discount.

Discount for wholesaler = 20% of ₹2000 $= \frac{20}{100} \times 2000 = 400$

The cost price for the wholesaler (and selling price for the manufacturer) is:

Cost Price (CP) for wholesaler = ₹2000 – 400 = 160

The wholesaler sells to the retailer at a 12% discount on the marked price.

Discount for retailer = 12% of ₹2000 $= \frac{12}{100} \times 2000 = 240$

The selling price for the wholesaler (and cost price for the retailer) is:

Selling Price (SP) for wholesaler = ₹2000 – 240 = 1760

The GST paid by the wholesaler is given as ₹11.20. The GST paid by the wholesaler is the GST on his selling price minus the GST on his cost price.

GST paid by wholesaler = (GST on SP) - (GST on CP).

Let the rate of GST be r%

$$11.20 = \left(\frac{r}{100} \times 1760\right) - \left(\frac{r}{100} \times 1600\right)$$

$$11.20 = \frac{r}{100}(1760 - 1600)$$

$$11.20 = \frac{r}{100}(160)$$

$$11.20 = 1.6r$$

$$r = \frac{11.20}{1.6} = 7$$

The retailer sells the article to the customer at the marked price of ₹2000. The retailer's cost price is ₹1760 (from step 1).

GST paid by retailer = (GST on retailer's SP) - (GST on retailer's CP).

The GST rate is 7% (from step 2).

$$\text{GST paid by retailer} = \left(\frac{7}{100} \times 2000\right) - \left(\frac{7}{100} \times 1760\right)$$

$$\text{GST paid by retailer} = \frac{7}{100}(2000 - 1760)$$

$$\text{GST paid by retailer} = \frac{7}{100}(240) = \frac{1680}{100} = 16.80.$$

(a) Rate of GST: The rate of GST is 7%.

(b) GST paid by the retailer: The GST paid by the retailer is ₹16.80.

2. The given inequality is $-1\frac{2}{3} \le x + \frac{1}{3} < 2, x \in R$

First, convert the mixed fraction to an improper fraction: $-1\frac{2}{3} = -\frac{(1\times 3)+2}{3} = -\frac{5}{3}$

So the inequality becomes: $-\frac{5}{3} \le x + \frac{1}{3} < 2$

To isolate x, subtract $\frac{1}{3}$ from all parts of the inequality: $-\frac{5}{3} - \frac{1}{3} \le x + \frac{1}{3} - \frac{1}{3} < 2 - \frac{1}{3}$

Simplify the expressions on the left and right sides:

$$-\frac{6}{3} \le x < \frac{6}{3} - \frac{1}{3}$$

$$-2 \le x < \frac{5}{3}$$

The solution set is all real numbers x such that x is greater than or equal to –2 and less than $\frac{5}{3}$. In interval notation, this is $\left[-2, \frac{5}{3}\right)$

On a real line, this is represented by a closed circle at –2 (indicating that –2 is included in the solution) and an open circle at $\frac{5}{3}$ (indicating that $\frac{5}{3}$ is not included), with a line segment connecting the two points.

The solution to the inequality is $-2 \le x < \frac{5}{3}$. The solution on the real line is represented by the interval $\left[-2, \frac{5}{3}\right)$

3. The formula for the nth term of an arithmetic progression (AP) is given by:

We are given: First term (a) = 20

Common difference (d) = 5

Last term (a_n) = 255

Substituting these values into the formula to find the number of terms (n)

$255 = 20 + (n - 1)5$

$255 - 20 = (n - 1)5$

$235 = (n - 1)5$

$\frac{235}{5} = n - 1$

$47 = n - 1$

$n = 47 + 1 \qquad \therefore\ n = 48$

The formula for the sum of the first n terms of an AP is: $S_n = \frac{n}{2}(a + \ell)$

Where, n = 48, a = 20 & $l = 255$

Substituting these values:

$S_{48} = \frac{48}{2}(20 + 255)$

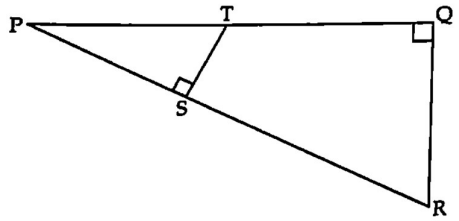
$S_{48} = 24(275)$

$S_{48} = 6600$

The number of terms of the AP is 48 and the sum of all its terms is 6600.

Question-6

(a) Given, $\angle PQR = \angle PST = 90°$, PQ = 5 cm and PS = 2 cm.



(a) In ΔPQR & ΔPST,

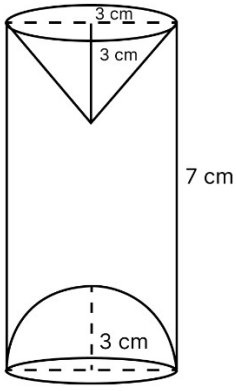
$\angle PQR = \angle PST = 90°$ (Given)

$\angle QPR = \angle SPT$ (Common)

$\therefore \Delta PQR \sim \Delta PST$ (Δ AA axion)

(c) Given, radius of each of hemisphere, cone and cylinder (r) = 3 cm.

Height of cylinder $(h_1) = 7$ cm, Height of cone $(h_2) = 3$ cm



The volume of the remaining solid
= volume of cylinder – volume of cone – volume of hemisphere

$$= \pi r^2 h_1 - \frac{1}{3}\pi r^2 h_2 - \frac{2}{3}\pi r^3$$

$$= \pi r^2\left(h_1 - \frac{1}{3}h_2 - \frac{2}{3}r\right)$$

$$= \frac{22}{7}\times(3)^2\left(7 - \frac{1}{3}\times 3 - \frac{2}{3}\times 3\right)$$

$$= \frac{22}{7}\times 9\times 4$$

$$= 113.14 \approx 113\ \text{cm}^3$$

(Correct to the nearest whole number)

Question-7

(a) Given, $\angle ADB = 55^0$, AC is a tangent, $\angle ACO = x^0$, $\angle AOE = y^0$

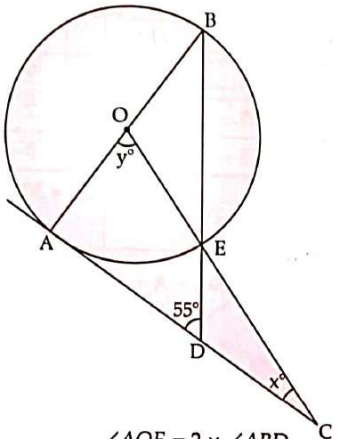
In ΔABD,

$\therefore$ $\angle BAD = 90^0$ (Radius OA is perpendicular to tangent AC)

and $\angle ABD + \angle BAD + \angle ADB = 180^0$ (Angle sum property)

$\Rightarrow \angle ABD + 90^0 + 55^0 = 180^0$

$\Rightarrow \angle ABD = 180^0 - 145^0 = 35^0$



$\therefore$ $\angle AOE = 2 \times \angle ABD$

(Angle at centre is twice the angle at circumcenter)

$\Rightarrow$ $y^0 = 2 \times 35^0$

$\therefore$ $y^0 = 70^0$

In ΔAOC,

$\angle ACO + \angle OAC + \angle AOC = 180^0$ (Angle sum property)

$\Rightarrow$ $x^0 + 90^0 + 70^0 = 180^0$ ($\angle OAC = 90^0$, since radius is $\perp$ r to tangent)

$\Rightarrow x^0 = 180^0 - 160^0$

$= 20^0$

Hence, $x = 20^0$

And $y = 70^0$ Ans.

(b) Give, scale factor, 1 : k = 1 : 30

(i) Actual height of the building = k × Height of the model

$= 30 \times 80$ cm

$= 2400$ cm

$= \frac{2400}{100}$ m

$= 24$ m Ans.

(ii) Actual volume of tan = k^3 × Volume of the model tank

$\Rightarrow 27\ m^3 = (30)^3 \times$ Volume of the model tank

$\Rightarrow$ Volume of the model tank $= \frac{27m^3}{30\times30\times30}$

$= \frac{27\times100\times100\times100}{30\times30\times30} cm^3$

$= 1000\ cm^3$ Ans.

(c) Given, $\begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix} M = 6I$

$\Rightarrow \begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix} M = 6\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$\Rightarrow \begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix} M = \begin{bmatrix} 6 & 0 \\ 0 & 6 \end{bmatrix}$ ……(1)

(i) $(2 \times 2)\ (m \times n) = (2 \times 2) \rightarrow$ Order of matrix, M = 2 × 2 Ans.

(ii) Let, $M = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

$\therefore \begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix}\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} 6 & 0 \\ 0 & 6 \end{bmatrix}$ [using (i)]

$\Rightarrow \begin{bmatrix} 4a+2c & 4b+2d \\ -a+c & -b+d \end{bmatrix} = \begin{bmatrix} 6 & 0 \\ 0 & 6 \end{bmatrix}$

$\therefore$ $4a + 2c = 6$ ….(ii)

$-a + c = 0$ ….(iii) × 4

Solving equation (ii) and (iii),

$4a + 2c = 6$

$\underline{-4a + 4x = 0}$ $\Rightarrow$ $c = 1$

$6c = 6$

$-a + 1 = 0$ $\Rightarrow$ $a = 1$

And $4b + 2d = 0$ …..(iv)

$\Rightarrow$ $-b + d = 6$ …(v) × 4

Solving equations (iv) and (v)

$4b + 2d = 0$

$\underline{-4b + 4d = 24}$

$6d = 24$

$\Rightarrow$ d = 4

From equation (iv),

-b + 4 = 6 $\Rightarrow$ -b = 2

$\Rightarrow$ b = -2

$\therefore$ $M = \begin{bmatrix} 1 & -2 \\ 1 & 4 \end{bmatrix}$

Question-8

(a) Let a and d be the first term and common difference respectively.

By first condition,

$a_1 + a_2 + a_3 = 42$

$\Rightarrow$ $a + a + d + a + 2d = 42$

$\Rightarrow$ $3a + 3d = 42$

$\Rightarrow$ $3(a + d) = 42$

$\Rightarrow$ $a + d = \frac{42}{3} = 14$

$\Rightarrow$ $d = 14 - a$ ….(i)

By second condition,

$a_1 \times a_3 = 52$

$\Rightarrow$ $a \times (a + 2d) = 52$

$\Rightarrow$ $a^2 + 2ad = 52$ …..(ii)

From equations (i) and (ii), we have

$a_2 + 2a(14- a) = 52$

$\Rightarrow$ $a^2 + 28a - 2a^2 = 52$

$\Rightarrow$ $-a^2 + 28a = 52$

$\Rightarrow$ $a_2 - 28a + 52 = 0$

$\Rightarrow$ $a^2 - 26a - 2a + 52 = 0$

$\Rightarrow$ $(a - 26)(a - 2) = 0$

$\Rightarrow$ $a - 26 = 0$ or $a - 2 = 0$

$\Rightarrow$ a = 26 or a = 2

$\therefore$ a = 26 or 2

From equation (i),

When a = 26, d = 14 – 26 = -12

And when a = 2, d = 14 – 2 = 12

Then, d = 12 or -12

(b) Given, A(3, 8), B(-1, 2) and C(6, -6)

(i) Slope of BC $(m_1) = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6-2}{6-(-1)} = \frac{-8}{7}$ Ans.

(ii) Slope of a line perpendicular to BC (m) $= -\frac{1}{m_1} = -\frac{1}{-8/7} = \frac{7}{8}$

Let the equation of the line perpendicular to BC and through A be

$y - y_1 = m(x - x_1)$

$\Rightarrow \quad y-8=\frac{7}{8}(x-3)$

$\Rightarrow \quad 8(y-8)=7(x-3)$

$\Rightarrow \quad 8y-64=7x-21$

$\Rightarrow \quad 7x-8y-21+64=0$

$\Rightarrow \quad 7x-8y+43=0$

Which is the required equation

Question-9

(a) Given, assumed mean (A) = 45.

Number of patients	Mid-value (x_i)	$d_i = x_i - A$	Number of days (f_i)	f_id_i
10-20	15	-30	5	-150
20-30	25	-20	2	-40
30-40	35	-20	7	-70
40-50	45	0	9	0
50-60	55	10	2	20
60-70	65	20	5	100
			$\sum f_i = 30$	$\sum f_id_i = -140$

Mean = $A+\frac{\sum f_id_i}{\sum f_i}$

$=45+\left(-\frac{140}{30}\right)=45-4.667=40.333=40.33$

(Correct to 2 decimal places) Ans.

(b) Given, $\frac{\sqrt{5x}+\sqrt{2x-6}}{\sqrt{5x}-\sqrt{2x-6}}=\frac{4}{1}$

Applying compound and dividend,

$\frac{(\sqrt{5x}+\sqrt{2x-6})+(\sqrt{5x}-\sqrt{2x-6})}{(\sqrt{5x}+\sqrt{2x-6})-(\sqrt{5x}-\sqrt{2x-6})}=\frac{4+1}{4-1}$

$\Rightarrow \frac{\sqrt{5x}+\sqrt{2x-6}+\sqrt{5x}-\sqrt{2x-6})}{\sqrt{5x}+\sqrt{2x-6}-\sqrt{5x}-\sqrt{2x-6}}=\frac{5}{3}$

$\Rightarrow \frac{2\sqrt{5x}}{2\sqrt{2x-6}}=\frac{5}{3}$

Squaring both sides, we get,

$\frac{5x}{2x-6}=\frac{25}{9}$

$\Rightarrow 25(2x-6)=9\times 5x$

$\Rightarrow 50x-150=45x$

$\Rightarrow 50x-45x=150 \qquad \Rightarrow 5x=150$

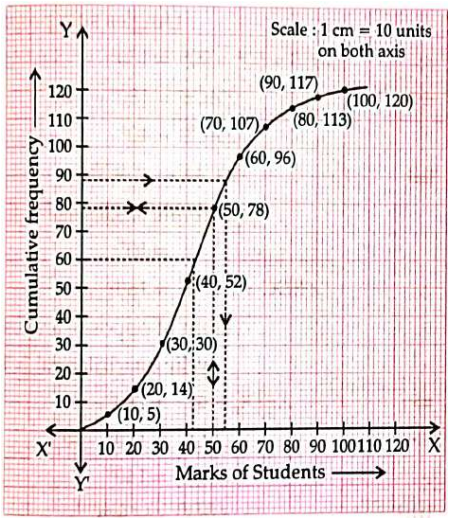
$\Rightarrow x=30$ Ans.

Question-10

(a)

Marks	Number of students	Cumulative frequency
0-10	5	5
10-20	9	14
20-30	16	30
30-40	22	52
40-50	26	78
50-60	18	96
60-70	11	107
70-80	6	113
80-90	4	117
90-100	3	120

$\therefore$ N = 120



(i) Median marks = $\frac{N}{2}$ th observation

$= \frac{120}{2}$ th observation

$= 60^{th}$ observation

= 43 (from give) Ans

(ii) Number of students who did not pass

= 78 (from ogive) Ans

(iii) Upper quartile = $\frac{34}{4}$ the observation

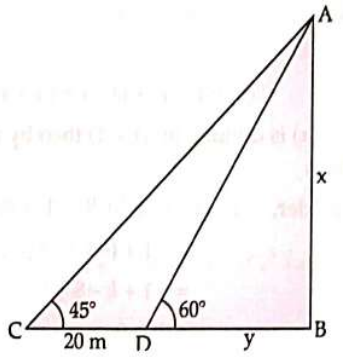
$= \frac{34 \times 120}{4}$ th observation

$= 90^{th}$ observation

= 56 (from ogive)

(b) Let AB = x be the height of the tower and CD = 20 m be the distance he walked towards the tower

Let BD = y



In ΔABD,

$$\tan 60^\circ = \frac{x}{y}$$

$$\Rightarrow \quad \sqrt{3} = \frac{x}{y}$$

$$\Rightarrow \quad y = \frac{x}{\sqrt{3}} \quad \ldots.(i)$$

In ΔABC,

$$\tan 45^\circ = \frac{x}{y+20}$$

$$\Rightarrow \quad 1 = \frac{x}{y+20}$$

$$\Rightarrow \quad x = y + 20 \quad \ldots..(ii)$$

From equation (i) and (ii), we get

$$x = \frac{x}{\sqrt{3}} + 20$$

$$\Rightarrow \quad \sqrt{3}\,x = x + 20\sqrt{3}$$

$$\Rightarrow \quad \sqrt{3}\,x - x + 20\sqrt{3}$$

$$\Rightarrow \quad (\sqrt{3}-1)\,x = 20\sqrt{3}$$

$$\Rightarrow \quad x = \frac{20\sqrt{3}}{\sqrt{3}-1}$$

$$\Rightarrow \quad x = \frac{20\sqrt{3}(\sqrt{3}+1)}{(\sqrt{3}-1)(\sqrt{3}+1)}$$

$$\Rightarrow \quad x = \frac{20\sqrt{3}(\sqrt{3}+1)}{(\sqrt{3})^2(1)^2} = \frac{20\sqrt{3}(\sqrt{3}+1)}{3-1} = 10\sqrt{3}(\sqrt{3}+1)$$

$$= 10\sqrt{3}\times\sqrt{3} + 10\sqrt{3} = 30 + 10 \times 1.732 = 30 + 17.32 = 47.32 \text{ m}$$

(Correct to 2 significant figures)

$\therefore$ Height of tower is 47.32 m Ans.