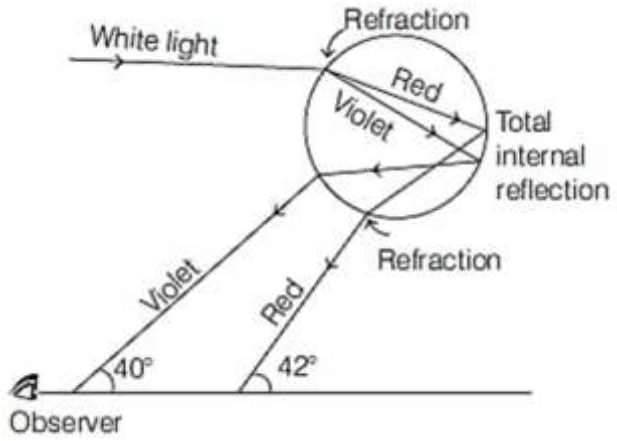
BIOLOGY

. 1 (B)
SOL. 2 (A)
SOL. 3. (c) : Ex situ conservation means "offsite Conservation". It is the process of protecting endangered species of plants and animals by removing it from an unsafe or threatened habitat and placing it or part of it under the care of humans. Botanical garden serve as ex situ conservation of germplasm of different plants, to maintain rare and endemic plant species and also to provide recreation and knowledge about plants to a common man.
Sol.4 (d) : Halophiles, a type of archaebacteria, usually Occur in extreme saline conditions like salt pans, salt Beds and salt marshes
Sol. 5 (c) : TMV is rod shaped measuring 300 × 20 nm. It is made of RNA and proteins.
Sol. 6 (a)
Sol .7 (b) : Ectocarpus possesses haplodiplontic whereas Fucus possesses diplontic life cycle.
Sol. 8 (c) : The alimentary canal of birds have additional chambers, the crop and gizzard. Crop stores and softens the food, however the gizzard helps in crushing and churning the food.
Sol. 9 (a) : The flowers of Brassica are radially symmetrical whereas flowers of Trifolium, Pisum and Cassia are zygomorphic.
Sol. 10 (b) : The given figure in option (b) represents the free central placentation. In free central placentation,ovary is unilocular and ovules are borne on the axis in the center of the ovary and septa are absent. It is seen in Dianthus and Primrose
Sol. 11 (a) : The International Code of Botanical Nomenclature (ICBN) is a set of rules and recommendations dealing with the formal botanical names given to plant. The foundations of ICBN are given in book written by C. Linnaeus named Philosophia Botanica. It is independent of zoological nomenclature.
Sol. 12 (c) : The term "New Systematics" was given by Julian Huxley (1940). This classification takes into account the cytological, morphological, genetical, anatomical, palynological and physiological characters.
Sol. 13 (c) : Ex situ conservation means "offsite conservation". It is the process of protecting endangered species of plants and animals by removing it from an insafe or threatened habitat and placing it or part of it under the care of humans. Botanical garden serve as ex situ conservation of germplasm of different plants, to maintain rare and endemic plant species and also to provide recreation and knowledge about plants to a common man.
Sol. 14 (B)
Sol. 15 (a) : Plasma membrane of eubacteria resembles plasma membrane of eukaryotic cell. But nucleus, ribosomes and cell wall are little different in eukaryotic cell in their structure and organization from eubacterial cell
Sol. 16 (b) : Chemolithotrophs can derive the energy required for growth from the oxidation of inorganic components.
Sol. 17 (C)
SOL. 18 (b) : Lateral meristems are the meristems which are present along the lateral sides of stem and roots.They divide only in radial direction. Intrastelar or vascular cambium ring formed by intra-fascicular (also called fascicular) and inter-fascicular cambium; and cork cambium (phellogen) are examples of this type of meristem. These meristems are responsible for increase in girth of stem and roots.
SOL. 19 (b) : The posterior segment of cockroaches bear appendages named as anal cerci. These are found in both male and female. But male cockroach can be distinguished by female ones by the presence of an extra pair of accessory appendages named as anal styles. It assists during copulation.
SOL. 20 (a) : All those sugars which have free aldehyde or ketone group are called reducing sugars. These are able to reduce cupric ions (Cu+2) into cuprous ions (Cu+). Sucrose, starch are non-reducing sugars.

PHYSICES

Sol.21 (a) Formation of rainbow is shown below. So, processes involved in formation of rainbow in correct order are: refraction,total internal reflection, Refraction. Hence, the correct order is given in option (a)



Sol. 22

17. *(a)* Here, 10 divisions of vernier scall = 11 main scale divisions

So, 1 vernier scale division = $\frac{11}{10}$ main scale divisions

Now, we use formula for least count,

Least count = 1 main scale division − 1 vernier scale division.

$\Rightarrow$ LC = 1MSD − 1VSD

$= \left(1-\frac{11}{10}\right)$ MSD

$= -\frac{1}{10}$ MSD

$= -\frac{1}{10} \times 1\,\text{mm}$

$= -0.1\,\text{mm}$

So, magnitude of least count is 0.1 mm.

SOL. 23 (c) Frosted glass has a rough layer which causes irregular refraction and makes glass translucent.

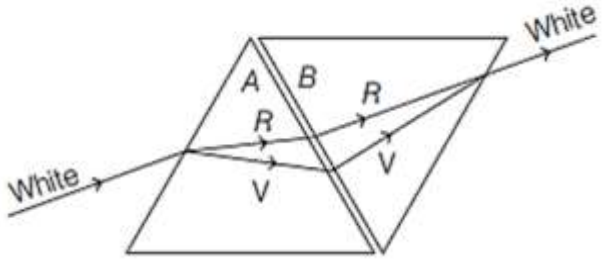
When a transparent tape which has refractive index close to that of glass is pasted over the rough surface of glass, the tape glue fills the roughness of glass. This makes glass surface more smooth and so refraction is more regular. This makes region of tape transparent

SOL. 24

(d) Prism B is inverted relative to prism A. So, dispersion of light caused by prism A and B is in opposite direction.

If bending of light caused by B is less than or more than that of A, then out going beam of light is not white.

So, when both prisms are filled with water at different temperatures, their refractive indices are different and the dispersion produced by A and B are not equal and opposite. Hence, with condition in (d) beam to right of prism B will be coloured.



SOL. 25

28. *(b)* Surface area over which rain is received, $A = 600\,\text{km}^2$

$= 600 \times (10^3)^2\,\text{m}^2$

$= 6 \times 10^8\,\text{m}^2$

Average rainfall, $h = 2.4\,\text{m}$

Volume of water received by rain, V

$= A \times h = 6 \times 10^8 \times 2.4\ \text{m}^3$

Water conserved = 10% of volume received by rain

$= 6 \times 10^8 \times \frac{10}{100} \times 2.4\,\text{m}^3 = 1.44 \times 10^8\ \text{m}^3$

$= 1.4 \times 10^8 \times 10^3\ \text{L} = 1.4 \times 10^{11}\ \text{L}$

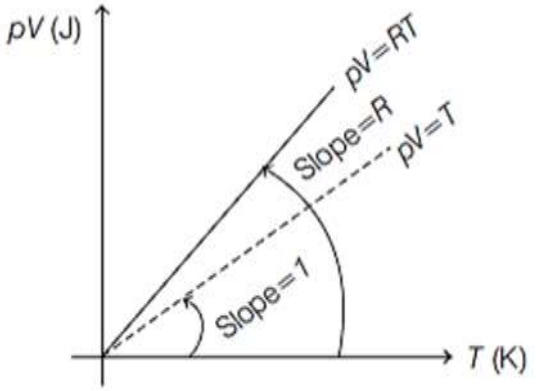
Percentage of total water consumption received by rain is

$= \frac{1.4 \times 10^{11} \times 100}{1.4 \times 10^{12}} = 10\%$

SOL. 26 (a) From gas equation,

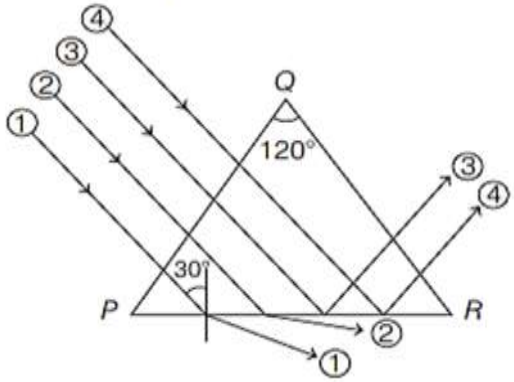
pV = Nrt Here, n = 1mole

So, pV = RT ...(i) Substituting the value of R in Eq. (i), we get pV = 8.3T Clearly, slope of pV versus T line is 8.3, which is greater than one. Hence, following graph is correct.



Sol.27

Total internal, reflection occurs when $n \geq \frac{1}{\sin i_c}$.



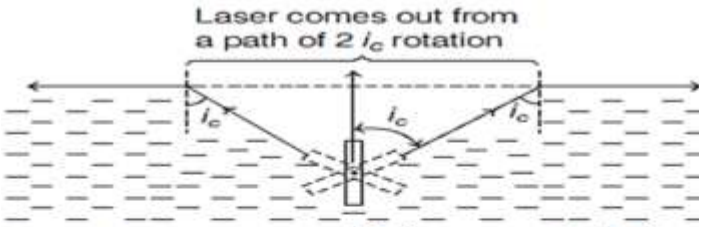
In given situation, angle of incidence of each of ray is 30° over face PR.

So, $i = 30°$

$$\Rightarrow \quad \frac{1}{\sin i} = \frac{1}{\sin 30°} = 2$$

Hence, for total internal reflection at surface PR, $n \geq 2$. As refractive index for 3 and 4 is more than 2, only rays 1 and 2, pass from face PR while rays 3 and 4 pass through face QR (as shown in diagram).

Sol. 28 (c) When angle of incidence of laser on surface of water is less than critical incidence, it goes out otherwise reflected back into the tank



For water, $i_c = \sin^{-1}\left(\frac{1}{n}\right) = \sin^{-1}\left(\frac{1}{1.33}\right)$

$\Rightarrow i_c = \sin^{-1}(0.75)$

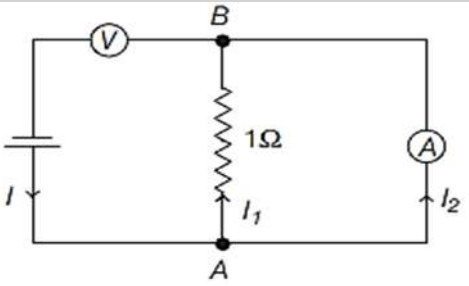
$\Rightarrow i_c \approx 50°$

If ω = angular speed and t = time to travel an arc of $2i_c$, then using $\omega t = 2i_c$.

We have, $t = \frac{2i_c}{\omega}$

$$= \frac{2 \times \frac{50}{180} \times \pi}{\left(\frac{2\pi}{60}\right)} = 16.67\,\text{s}$$

Sol.29 (b) When a voltmeter put in series, it still reads potential drop and when an ammeter is connected in parallel, it still shows current through it.



Let I = current through cell, then potential drop read by voltmeter is

$V = I \cdot R_V$ (this is reading of voltmeter)

Where, R_V is the resistance of voltmeter

In loop AB,

$V_{AB} = I_1 \times 1 = I_2 \times R_A$ and $I = I_1 + I_2$

Where, R_A is the resistance of ammeter

We substitute for I_1 from above equation to get

$$\Rightarrow \quad I = I_2 R_A + I_2 = I_2(R_A + 1)$$

$$\Rightarrow \quad I_2 = \frac{I}{(R_A + 1)}$$

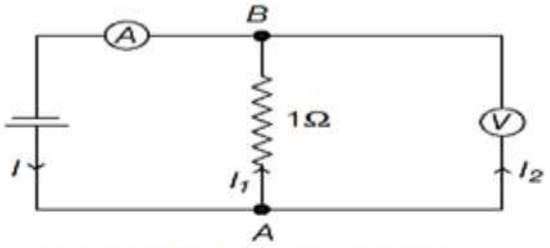
(this is reading of ammeter)

Now given,

$$\frac{\text{voltmeter reading}}{\text{ammeter reading}} = 1 \times 10^3 = \frac{IR_V}{\left(\frac{I}{R_A + 1}\right)}$$

So, $R_V(R_A + 1) = 1000$ ...(i)

Case b



Let I = current through cell, then ammeter reading in this case is I.

Also, in loop AB,

$V_{AB} = I_1 \times 1 = I_2 \times R_V$

As, $I = I_1 + I_2 = I_2 R_V + I_2$

$= I_2(R_V + 1)$

So, $I_2 = \frac{I}{(R_V + 1)}$

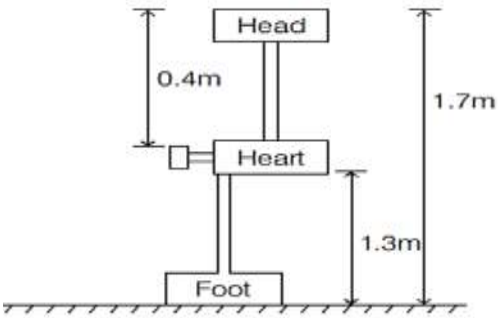
Hence, voltmeter reading is $V = I_2 R_V$

$= \frac{IR_V}{(R_V + 1)}$ (this is reading of voltmeter)

Now given, voltmeter reading ÷ ammeter reading = 0.999 Ω.

Sol. 30

(c)



$$\text{Pressure at head level} = p_{\text{heart}} - \rho gh$$
$$= 13.3 - 10^3 \times 10 \times 0.4$$
$$= 9.3\,\text{kPa}$$
$$\text{Pressure at foot level} = p_{\text{heart}} + \rho gh$$
$$= 13.3 + 10^3 \times 10 \times 1.3$$
$$= 26.3\,\text{kPa}$$
$$\text{So, ratio} = \frac{26.3}{9.3} \approx 2.9 \text{ or } 3$$

SOL. 31 (b) : In one dimensional motion, the body can have one value of velocity at a time but not two values of velocities at a time.

SOL. 32

Displacement $(s) = t^3 - 6t^2 + 3t + 4$ m.

Velocity $(v) = \frac{ds}{dt} = 3t^2 - 12t + 3$

Acceleration $(a) = \frac{dv}{dt} = 6t - 12.$

When $a = 0$, we get $t = 2$ seconds.

Therefore velocity when the acceleration is zero is

$v = 3 \times (2)^2 - (12 \times 2) + 3 = -9$ m/s

SOL. 33

Given $u = 0$.

Distance travelled in 10 s, $S_1 = \frac{1}{2} a \cdot 10^2 = 50a$

Distance travelled in 20 s, $S_2 = \frac{1}{2} a \cdot 20^2 = 200a$

$\therefore \quad S_2 = 4S_1$

SOL. 34

Here, $\vec{u} = 2\hat{i} + 3\hat{j},\ \vec{a} = 0.3\hat{i} + 0.2\hat{j}, t = 10$ s

As $\vec{v} = \vec{u} + \vec{a}t$

$\therefore \quad \vec{v} = (2\hat{i} + 3\hat{j}) + (0.3\hat{i} + 0.2\hat{j})(10)$

$= 2\hat{i} + 3\hat{j} + 3\hat{i} + 2\hat{j} = 5\hat{i} + 5\hat{j}$

$|\vec{v}| = \sqrt{(5)^2 + (5)^2} = 5\sqrt{2}$ units

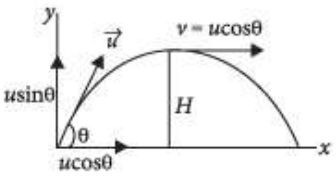
SOL. 35 (c) : Time required to reach the ground is dependent on the vertical motion of the particle. Vertical motion of both the particles A and B are exactly same. Although particle B has an initial velocity, but that is in horizontal direction and it has no component in vertical (component of a vector at a direction of 90° = 0) direction. Hence they will reach the ground simultaneously.

SOL. 36.

Let v be velocity of a projectile at maximum height H.

$v = u\cos\theta$

According to given problem, $v = \frac{u}{2}$



$\therefore \quad \frac{u}{2} = u\cos\theta \Rightarrow \cos\theta = \frac{1}{2} \Rightarrow \theta = 60°$

SOL. 37.

$a = r\omega^2$; $\omega = 2\pi\upsilon$

22 revolution = 44 s

1 revolution = 44/22 = 2 s

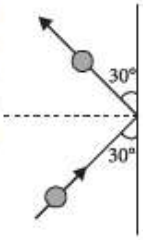
$\upsilon = 1/2$ Hz

$a = r\omega^2 = 1 \times \frac{4\pi^2}{4} = \pi^2$ m/s^2.

It is the centripetal acceleration towards the centre.

SOL. 38

Components of momentum parallel to the wall are in the same direction and components of momentum perpendicular to the wall are opposite to each other. Therefore change of momentum $= 2mv\sin\theta$.

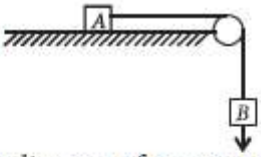


$F \times t$ = change in momentum $= 2mv\sin\theta$

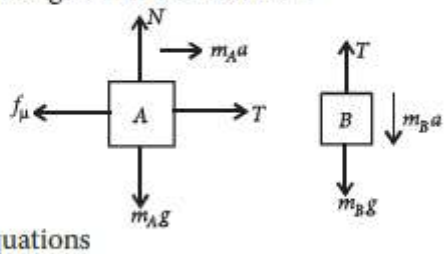
$\therefore \quad F = \frac{2mv\sin\theta}{t}$

$= \frac{2 \times 0.5 \times 12 \times \sin 30°}{0.25} = 48 \times \frac{1}{2} = 24$ N.

SOL. 39



Free body diagram of two masses is



We get equations

$T + m_A a = f$ or $T = \mu N_A$ (for $a = 0$)

and $T = m_B a + m_B g$ or $T = m_B g$ (for $a = 0$)

$\therefore \quad \mu N_A = m_B g \Rightarrow m_B = \mu m_A = 0.2 \times 2 = 0.4$ kg

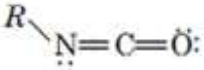
SOL. 40

$$(a): F_{centripetal} = \frac{mv^2}{R}; \quad v = \left(36 \times \frac{5}{18}\right) m/s$$

$$F_{centripetal} = \frac{500 \times \left(36 \times \frac{5}{18}\right)^2}{50} = 1000\ N$$

CHEMISTERY

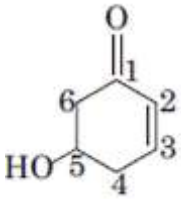
SOL. 41 (a) Hybridisation is determined from the steric number (number of atoms bonded to the central atom + the number of lone pairs). Number of hybrid orbitals must be equal to the steric number.
From the Lewis structure.
(i) Steric number of N-atom = 3 (2 bonded atoms + 1 lone pair),\Hybridisation = sp^2 (3 hybrid orbitals).
(ii) Steric number of C-atom = 2(2 bonded atoms), \Hybridisation = sp (2 hybrid orbitals).



(iii) Steric number of O-atom = 3
(1 bonded atom + 2 lone pair)
\Hybridisation = sp2 (3 hybrid orbitals).

Sol. 42 (d) One isomer is an alkyne and the other one is an alkadiene. Since, they have two different functional groups, they are functional group isomers

sol. 43 (D)
Principal functional group is ketone.\C1 is carbonyl carbon atom.Locants for hydroxyl groups and double bonds are 5 and 2, which are preferred over 3 and 5, since the lower number at first difference (2 compared to 3) is preferred. Hence, the IUPAC name of given compound is 5-hydroxycyclohex-2-en-1-one.



Sol. 44 (d) Water-gas shift reaction is
In this reaction, hydrogen gas is produced from the reaction of steam with carbon dioxide.

$$CO + H_2O \xrightarrow{FeO \cdot Cr_2O_3\ (Catalyst)} CO_2 + H_2$$

Sol. 45 (c) Temporary hardness (caused by bicarbonates of calcium or magnesium) can be removed by using lime, $Ca(OH)_2$.

$$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3 + 2H_2O$$

Sol. 46 (b) Among anions with same charge, the one having greatest size has maximum polarisability. Thus, I−ion having most polarisability.

Sol. 47 (a) Of all the s-block elements, Mg and Be salts do not impart colour to flame.

Sol. 48 (d) For a spontaneous process in an isolated system, the change in entropy is positive, i.e, $\Delta S > O$. $(\Delta S_{surroundings})$, i.e., $\Delta S_{total} = \Delta S_{system} + \Delta S_{Surroundings}$ for a spontenceus process, ΔS_{total} must be positive, i.e., ΔS_{total} is also termed as $\Delta S_{universe}$.
However, if a system is not isolated, the entropy change of both the system and surroundings are to be taken into account because system and surroundings together constitute the isolated system thus, the total entropy change (ΔS) total is sum of the change in entropy of the system (ΔS) system and the change in entropy of the surroundings

Sol. 49 (C)

(a) $PbO + HCl \longrightarrow PbCl_2 + H_2O$ (not correct option)

(b) $2Pb(NO_3)_2 \longrightarrow 2PbO + 4NO_2 + O_2$ (not correct option)

(c) $Pb_3O_4 + 4HNO_3 \longrightarrow 2Pb(NO_3)_2 + PbO_2 + 2H_2O$ (correct option)

(d) $Pb + air\ (contains\ O_2, H_2O\ and\ CO_2) \xrightarrow[temperature]{room}$ Protective layer of varying composition, mainly $PbCO_3$ is formed only on the surface. (not correct option)

Sol. 50 (a) (i) Energy of the 2sorbital of different elements decreases as nuclear charge (equal to atomic number) of atom increases.
(ii) There are n2 orbitals in a shell with principal quantum number n.\total number of electrons = 2n2
(iii) Extra stability of half-filled orbitals is due to greater exchange energy.
(iv) For two electrons will be in the same orbital, their spin quantum numbers must be different. It is not irrespective of their spin

Sol. 51 (B)

$$w = -P_{ext}\Delta V = -2.5(4.50 - 2.50)$$

$= -5$ L atm $= -5 \times 101.325$ J $= -506.625$ J

$\Delta U = q + w$

As, the container is insulated, thus $q = 0$

Hence, $\Delta U = w = -506.625$ J

SOL. 52 (A)

For free expansion of an ideal gas, $P_{ex} = 0$,

$w = -P_{ex}\Delta V = 0$

For adiabatic process, $q = 0$

According to first law of thermodynamics,

$\Delta U = q + w = 0$

As internal energy of an ideal gas is a function of temperature, DU = 0, \ DT = 0

SOL. 53 (B)

For the given reaction, enthalpy of reaction can be calculated as

$= \Sigma B.E.(\text{reactants}) - \Sigma B.E.(\text{products})$

$= [B.E._{(C\equiv C)} + B.E._{(H-H)} + 4 \times B.E._{(C-H)}] - [B.E._{(C-C)} + 6 \times B.E._{(C-H)}]$

$= [606.10 + 431.37 + 4 \times 410.50] - [336.49 + 6 \times 410.50]$

$= 2679.47 - 2799.49 = -120.02$ kJ mol^{-1}

SOL. 54 (B)

Using Gibbs'-Helmholtz equation,

$$\Delta G = \Delta H - T\Delta S$$

During adsorption of a gas, entropy decreases *i.e.* $\Delta S < 0$

For spontaneous adsorption, ΔG should be negative, which is possible when ΔH is highly negative.

SOL. 55 (A)

$$\Delta G = \Delta H - T\Delta S$$

If $\Delta H < 0$ and $\Delta S > 0$

$\Delta G = (-\text{ve}) - T(+\text{ve})$

then at all temperatures, $\Delta G = -$ve, spontaneous reaction.

If $\Delta H < 0$ and $\Delta S = 0$

$\Delta G = (-\text{ve}) - T(0) = -$ve at all temperatures.

SOL. 56 (a) : Vapour pressure is directly related to temperature. Greater is the temperature, greater will be the vapour pressure. So to keep it constant, temperature should be constant.

SOL. 57 (D)

K_p and K_c are related by the equation,

$$K_p = K_c(RT)^{\Delta n_g}$$

where Δn_g = difference in the no. of moles of products and reactants in the gaseous state.

for $2C_{(s)} + O_{2(g)} \rightleftharpoons 2CO_{2(g)}$

$\Delta n_g = 2 - (1) = 1 \neq 0$

SOL. 58 (a) : The value of K is high which means reaction proceeds almost to completion i.e., the system will contain mostly products.

SOL. 59 b) : CH3COOH + H2O □ CH3COO– + H3O+

As acetic acid is a weak acid so, it also contains some undissociated CH3COOH along with CH3COO– and H3O+ ions.

SOL. 60 (c) : HCl cannot accept H+ ion, therefore cannot act as Bronsted Base

MATHS

Sol. 1 (C)

$3^{1/3}$	$7^{1/7}$	1
0	0	10
3	0	7
6	0	4
9	0	1
3	7	0
0	7	3

$\therefore$ no. of terms are 6

Sol. 2 (B)

Given that $T_5 + T_6 = 0$

$${}^nC_4\, a^{n-4}(-b)^4 + {}^nC_5\, a^{n-5}(-b)^5 = 0$$

$$\Rightarrow a^{n-5}b^4\,[{}^nC_4\, a - {}^nC_5 b] = 0$$

$$\Rightarrow {}^nC_4 a = {}^nC_5 b \quad (\because a \neq 0, b \neq 0)$$

$$\Rightarrow \frac{a}{b} = \frac{{}^nC_5}{{}^nC_4} = \frac{n-4}{5}$$

Sol. 3 (D)

Origin lies left to the line. Points (2, 3/4) & (1/4, −1/4) lie in the smaller part & also in the circle so only two points.

Sol. 4 (A)

$$\frac{z_1}{r_1} = \frac{z}{r} = e^{i\pi}$$

$$\frac{z_1}{3r} = -\frac{-z}{r}$$

$$z_1 = -3z = -3(4 - 3i)$$

$$z_1 = -12 + 9i$$

Sol. 5 (A)

$\bar{z}z^3 + z\bar{z}^3 = 350$

$z\bar{z}(\bar{z}^2 + z^2) = 350$

Put $z = x + iy$

$(x^2 + y^2)(x^2 - y^2) = 175$

$(x^2 + y^2)(x^2 - y^2) = 5.5.7$

$x^2 + y^2 = 25$

$x^2 - y^2 = 7$

$x = \pm 4, y = \pm 3$

$x, y \in I$

Area = $8 \times 6 = 48$ sq. units

Sol. 6 (C)

common diff. = d, in A.P.

$T_7 = 9 \Rightarrow a + 6d = 9 \Rightarrow a = (9 - 6d)$

$T_1T_2T_7 = a \cdot (a + d)\, 9 = (9 - 6d)(9 - 5d)\, 9$

$= 9(30d^2 - 99d + 81) = 27(10d^2 - 33d + 27)$

Min value at $d = \frac{-(-33)}{2 \cdot 10} = \frac{33}{20}$

Sol. 7 (B)

.4 $x^2 - |x + 2| + x > 0$

Case - I $x \geq -2 \Rightarrow x^2 - x - 2 + x > 0$

$\Rightarrow x \in (-\infty, -\sqrt{2}) \cup (\sqrt{2}, \infty)$

$\therefore x \in [-2, -\sqrt{2}) \cup (\sqrt{2}, \infty)$

Case - II $x < -2$

$\Rightarrow x^2 + x + 2 + x > 0$

$\Rightarrow x^2 + 2x + 2 > 0$

$\Rightarrow x \in R \quad (\because D < 0)$

$\therefore x \in (-\infty, -2)$

$x \in$ (Case - I) $\cup$ (Case - II)

$\Rightarrow x \in (-\infty, -\sqrt{2}) \cup (\sqrt{2}, \infty)$

Ailter $|x + 2| < x^2 + x \Rightarrow -(x^2 + x) < x + 2 < x^2 + x$

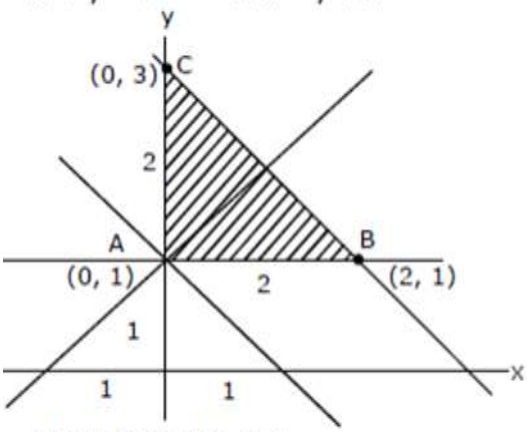
Sol. 8 (A)

$x^2 - y^2 + 2y - 1 = 0$

$x^2 - (y - 1)^2 = 0$

$(x + y - 1)(x - y + 1) = 0$

$x + y = 1 \quad \& \; x - y + 1$



angle bisector are

$y = 1$ & $x = 0$

A (0, 1), B(2, 1), C(0, 3)

area $\Delta ABC = \frac{1}{2} \cdot 2 \cdot 2 = 2$ sq. units

Sol. 9 (B)

$0 < \cos\phi = \frac{1}{3} < \frac{1}{2}$ & $\theta = \frac{\pi}{6}$

$\Rightarrow \cos\frac{\pi}{2} < \cos\phi < \cos\frac{\pi}{6}$

$\Rightarrow \frac{\pi}{2} > \phi > \frac{\pi}{3} \Rightarrow \frac{\pi}{3} < \phi < \frac{\pi}{2}$

$\Rightarrow \frac{\pi}{3} + \frac{\pi}{6} < \phi + \theta < \frac{\pi}{2} + \frac{\pi}{6} \Rightarrow \frac{\pi}{2} < \phi + \theta < \frac{2\pi}{3}$

Sol. 10 (A)

Hyp. $xy - 3x - 2y = 0$

$f(x, y) = xy - 3x - 2y$

$\frac{\delta f}{\delta x} = 0 \Rightarrow y = 3$

$\frac{\delta f}{\delta y} = 0 \Rightarrow x = 2$ Centre (2, 3)

Asy. $xy - 3x - 2y + C = 0$

will pass through (2, 3)

$C = 6$

$xy - 3x - 2y + 6 = 0$

$(y - 3)(x - 2) = 0$

$x - 2 = 0, y - 3 = 0$

Sol. 11 (C)

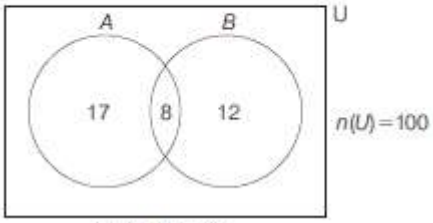
$$|z+1-i|^2+|z-5-i|^2$$
$$=(x+1)^2+(y-1)^2+(x-5)^2+(y-1)^2$$
$$=2(x^2+y^2-4x-2y)+28$$
$$=2(4)+28=36 \qquad [\because x^2+y^2-4x-2y=4]$$

Sol. 12

Exp. **(d)**

Let the population of city is 100.

Then, $n(A) = 25$, $n(B) = 20$ and $n(A \cap B) = 8$



Venn diagram

So, $n(A \cap \overline{B}) = 17$ and $n(\overline{A} \cap B) = 12$

According to the question, Percentage of the population who look into advertisement is

$$= \left[\frac{30}{100} \times n(A \cap \overline{B})\right] + \left[\frac{40}{100} \times n(\overline{A} \cap B)\right] + \left[\frac{50}{100} \times n(A \cap B)\right]$$

$$= \left(\frac{30}{100} \times 17\right) + \left(\frac{40}{100} \times 12\right) + \left(\frac{50}{100} \times 8\right)$$

$= 5.1 + 4.8 + 4 = 13.9$

SOL. 13.

Exp. **(c)**

We have, $f(x) = \frac{x}{1+x^2}$

$$\therefore \quad f\left(\frac{1}{x}\right) = \frac{\frac{1}{x}}{1+\frac{1}{x^2}} = \frac{x}{1+x^2} = f(x)$$

$\therefore \quad f\left(\frac{1}{2}\right) = f(2)$ or $f\left(\frac{1}{3}\right) = f(3)$ and so on.

So, $f(x)$ is many-one function.

Again, let $y = f(x) \Rightarrow y = \frac{x}{1+x^2}$

$\Rightarrow \quad y + x^2 y = x \Rightarrow yx^2 - x + y = 0$

As, $x \in R$

$\therefore \quad (-1)^2 - 4(y)(y) \geq 0 \Rightarrow 1 - 4y^2 \geq 0$

$\Rightarrow \quad y \in \left[\frac{-1}{2}, \frac{1}{2}\right]$

$\therefore$ Range = Codomain $= \left[\frac{-1}{2}, \frac{1}{2}\right]$

So, $f(x)$ is surjective.

Hence, $f(x)$ is surjective but not injective.

Sol. 14.

Exp. **(d)**

Given, $f(x) = (x+1)^2 - 1, x \geq -1$

$\Rightarrow \quad f'(x) = 2(x+1) \geq 0$, for $x \geq -1$

$\Rightarrow$ $f(x)$ is one-one.

Since, codomain of the given function is not given, hence it can be considered as R, the set of real and consequently f is not onto.

Hence, f is not bijective. Statement II is false.

Also, $f(x) = (x+1)^2 - 1 \geq -1$ for $x \geq -1$

$\Rightarrow \quad R_f = [-1, \infty)$

Clearly, $f(x) = f^{-1}(x)$ at $x = 0$ and $x = -1$

$\therefore$ Statement I is true.

Sol. 15

Exp. **(d)**

Since, for every elements of A, there exists elements $(3, 3), (6, 6), (9, 9), (12, 12) \in R \Rightarrow R$ is reflexive relation.

Now, $(6, 12) \in R$ but $(12, 6) \notin R$, so it is not a symmetric relation.

Also, $(3, 6), (6, 12) \in R \Rightarrow (3, 12) \in R$

$\therefore$ R is transitive relation.

Sol. 16

***Exp.* (c)**

Given that, $f(n) = \begin{cases} \frac{n-1}{2}, & \text{when } n \text{ is odd} \\ -\frac{n}{2}, & \text{when } n \text{ is even} \end{cases}$

and $f : N \to I$, where N is the set of natural numbers and I is the set of integers.

Let $x, y \in N$ and both are even.

Then, $f(x) = f(y)$

$\Rightarrow \quad -\frac{x}{2} = -\frac{y}{2} \Rightarrow x = y$

Again, $x, y \in N$ and both are odd.

Then, $f(x) = f(y) \Rightarrow \frac{x-1}{2} = \frac{y-1}{2} \Rightarrow x = y$

So, mapping is one-one.

Since, each negative integer is an image of even natural number and positive integer is an image of odd natural number. So, mapping is onto. Hence, mapping is one-one onto.

Sol. 17

***Exp.* (b)**

Given that, $f(x) = \log (x + \sqrt{x^2 + 1})$

Now, $f(-x) = \log (-x + \sqrt{x^2 + 1})$

$\therefore\ f(x) + f(-x) = \log (x + \sqrt{x^2 + 1}) + \log (-x + \sqrt{x^2 + 1})$

$= \log (1) = 0$

Hence, $f(x)$ is an odd function.

Sol. 18 Exp. (b)

Sol. 19.

***Exp.* (b)**

Given that, $f(x) = \sin^4 x + \cos^4 x$

$\therefore\ f(x) = (\sin^2 x + \cos^2 x)^2 - 2 \sin^2 x \cos^2 x$

$= 1 - \frac{1}{2}(2 \sin x \cos x)^2$

$= 1 - \frac{1}{2}(\sin 2x)^2$

$= 1 - \frac{1}{2}\left(\frac{1 - \cos 4x}{2}\right)$

$= \frac{3}{4} + \frac{1}{4}\cos 4x$

$\therefore$ The period of $f(x) = \frac{2\pi}{4} = \frac{\pi}{2}$

[$\because \cos x$ is periodic with period 2π]

Sol. 20

***Exp.* (c)**

Let $x + iy = \frac{\alpha + i}{\alpha - i}$

$\Rightarrow x + iy = \frac{(\alpha + i)^2}{\alpha^2 + 1} = \frac{(\alpha^2 - 1) + (2\alpha)i}{\alpha^2 + 1}$

$= \frac{\alpha^2 - 1}{\alpha^2 + 1} + \left(\frac{2\alpha}{\alpha^2 + 1}\right)i$

On comparing real and imaginary parts, we get

$x = \frac{\alpha^2 - 1}{\alpha^2 + 1}$ and $y = \frac{2\alpha}{\alpha^2 + 1}$

Now, $x^2 + y^2 = \left(\frac{\alpha^2 - 1}{\alpha^2 + 1}\right)^2 + \left(\frac{2\alpha}{\alpha^2 + 1}\right)^2$

$= \frac{\alpha^4 + 1 - 2\alpha^2 + 4\alpha^2}{(\alpha^2 + 1)^2}$

$= \frac{(\alpha^2 + 1)^2}{(\alpha^2 + 1)^2} = 1$

$\Rightarrow \quad x^2 + y^2 = 1$

So, $S = \left\{\frac{\alpha + i}{\alpha - i} ; \alpha \in \mathbf{R}\right\}$ lies on a circle with radius 1.