ANSWER KEYS

CHEMISTRY

1. a	2. a	3. b	4. b	5. d	6. d	7. a	8. b	9. a	10. c	11. a	12. b	13. a
14. a	15. d	16. d	17. a	18. a	19. c	20. d	21. d	22. c	23. a	24. a	25. a	26. c
27. d	28. b	29. c	30. b									

PHYSICS

1. d	2. b	3. c	4. d	5. a	6. c	7. c	8. c	9. d	10. c	11. a	12. c	13. a
14. d	15. b	16. a	17. a	18. a	19. a	20. d	21. c	22. c	23. a	24. d	25. a	26. a
27. c	28. b	29. b	30. c									

MATHEMATICS

1. d	2. c	3. b	4. b	5. d	6. d	7. c	8. c	9. d	10. d	11. b	12. d	13. a
14. a	15. b	16. a	17. b	18. d	19. b	20. a	21. a	22. c	23. a	24. d	25. b	26. c
27. b	28. a	29. d	30. a									

CHEMISTRY

Sol 1.

In option (1) 0.5 mole of HCI in solution is neutralized by 0.25 mole of NaOH, heat liberated $\Delta H_1 =$ ¼ of 57.1 kJ. In option (2) HNO_3 is in combination of 0.2 mole of HNO_3 with 0.2 mole of KOH solution; heat liberated $\Delta H_2 = 1/5$ of 57.1 kJ. In option 1 and 2, therefore less amount of heat is released.

Sol 2.

The standard reduction electrode potential of zinc electrode is most negative, so this metal can undergo oxidation most easily and thus can displace tin, lead and copper from their aqueous solution.

Sol 3.

The electron energy in a hydrogen atom is given as

$$E_n = \frac{-2\pi^2 me^4 z^2}{n^2 h^2}$$

$$E_n = \frac{-1312}{n^2}\ kJ\ /\ mol\ \frac{-1312}{2^2} \ = -328\ kJ\ /\ mol \text{ or } 3.28 \times 10^5 \text{ J/mol}$$

Sol 4.

Volume occupied in a FCC structure = 74% the percent of void space = 100 – 74 = 26%

Sol 5.

For the reaction, A_2 (g) + 2 B_2 (g) = 4 C (g) $K = \frac{[c]^4}{[A_2][B_2]^2}$

For backward reaction $\frac{1}{k} = \frac{[A_2][B_2]^2}{[c]^4}$

For the reaction: 2 C (g) ⇌ ½ A_2(g) + B_2 (g); $K' = \frac{[A_2]^{1/2}\,[B_2]}{[C]^2} = \frac{1}{\sqrt{K}} = \frac{1}{\sqrt{2}}$

Sol 6.

A buffer solution is one which resists changes in pH when small quantities of an acid or an alkali are added to it.

Sol 7.

For a second order reaction; Rate = k $[A]^2$

$5 \times 10^{-5} = k (0.25)^2 = k \times 0.0625$

$k = 5 \times 10^{-5} / 0.625 \times 10^{-1} = 8 \times 10^{-4}\ mol^{-1}$

Sol 8.

Chemiluminescence is the emission of light (luminescence), as the result of a chemical reaction, as the result of a chemical reaction, Reverse of it is the absorption of light for a chemical reaction, i.e., a photochemical reaction

Sol 9.

O_2 has unpaired electrons in antibonding molecular orbital.

Sol 10.

The pH a buffer solution containing 0.1 m acetic acid and 0.01 M sodium acetate can be calculated as

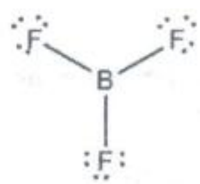
$$pH = pK_a + \log\frac{[salt]}{[salt]}$$

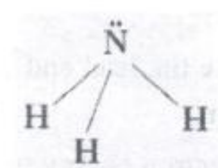
$= 4.74 + \log\frac{0.1}{0.01} = 4.74 + \log 10^{-1}$

$= 4.74 - 1 = 3.73$

Sol 11.

In BF_3, B is sp^2 – hybridized; in NH_3, N is sp^3 – hybridized





Sol 12.

$4FeCl_3 + 3K_4[Fe(CN)_6] \rightarrow Fe_4[Fe(CN)_6]_3 + 12KCl$

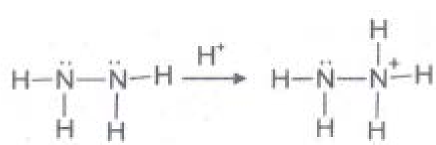
Prussain blue

Sol 13.

$CaO + SiO_2 \rightarrow CaSiO_3$ (slag)

Sol 14.

$N_2H_5^+$ contains a coordinate bond between N and H.



Sol 15.

Na_2O_2, H_2O_2, BaO_2 contain peroxide linkages.

Sol 16.

Argon is the most abundant inert gas in atmosphere.

Sol 17.

The greenhouse effect is widely used to describe the trapping of exess heat by the rising concentration of carbon dioxide in the atmosphere The carbon dioxide strongly absorbs infrared and does not allow as much of it to escape into space.

Sol 18.

Salts with smaller sized cations have more lattice energy.

Sol 19.

When octahedral holes are occupied in a ccp arrangement, the coordination number is 6, i.e., 6 nearest neighbors.

Sol 20.

20 volume H_2O_2 is a solution of H_2O_2, 1L of which gives 20 L of O_2 at STP.

$2H_2\,O_2 \rightarrow 2H_2\,O + O_2$

2x 34g 22.4 at STP

22.4L of O_2 is obtained from 68 g of H_2O_2 20L of O_2 will be obtained from $\frac{68}{22.4}\ x\ 20 = 60.71$ g thus 20 volume H_2O_2 contains 60.71 g of H_2O_2

Sol 21.

Pyrex glass is a mixture of sodium aluminum borosilicate.

Sol 22.

$SO_3 + H_2\,O\ (1) \rightarrow H_2SO_4$

$P_2O_5 + H_2O\ (1) \rightarrow 2HPO_3$

$N_2O(g) + H_2\,O(1) \rightarrow H_2\,N_2\,O_2$ (hypontrous acid)

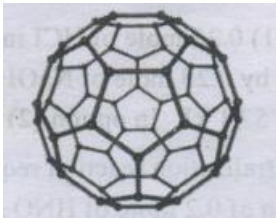
$B_2\,O_3 + H_2O\ (1) \rightarrow 2HBO_2$

Sol 23.

$2Na_2S_2o_3 + AgBr \rightarrow Na\ [Ag\ (S_2\,O_3)_2] + NaBr$

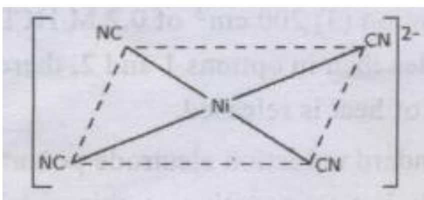
Sol. 24

Fullerene is an allotrope of carbon.



Sol.25

$[Ni\ (CN)_4]^{2-}$ is a square planer complex , it is diamagnetic.



Sol. 26

$[(CH_3)_2CH_2CH_2CH_2]CuLi + CH_3CH_2Br \rightarrow (CH_3)_2CH_2CH_2CH_2CH_3 + (CH_3)_2CH_2CH_2Cu + LiBr$

Sol.27

NH_3^+ in anilinium ion is meta directing.

Sol.28

$CH_3CH_2CN + CH_3CH_2OH + H_2O \rightarrow CH_3CH_2\ COO\ CH_2CH_3 + NH_3$

Sol.29

Mol. wt. $2 \times VD = 2 \times 73 = 146$

Number of carbon atoms $= \frac{49.3}{12} \times \frac{146}{100} = 6$

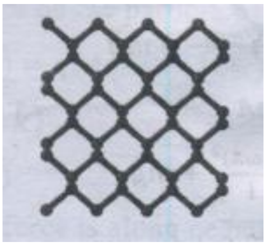
Number of hydrogen atoms $= \frac{6.84}{1} \times \frac{146}{100} = 6$

Number of oxygen atoms $= \frac{100-(49.3+6.84)}{16} \times \frac{146}{100} = 4$

Molecular formula of the compound is $C_6H_{10}O_4$

Sol.30

Black phosphorous is the most thermodynamically stable allotropic form of phosphorus. The atoms are linked together in puckered sheets, like graphite. Because of these structural similarities black phosphorus is also flaky like graphite and possess other similar properties.



PHYSICS

Sol.1

$[X] = [\epsilon_0][L][\frac{V}{[T]}]$

$= [M^{-1}A^2L^{-3}T^4][L][ML^2T^{-3}A^{-1}]$

$= [A]$

= current

Sol. 2

We know that $v = \sqrt{2gh}$

$\therefore h = \frac{u^2}{2g} = \frac{(29.4)^2}{2\times 9.8} = 44.1m$

Again $h' = ut + \frac{1}{2}gt^2$

As $h' = 0$

We get 0= $29.4t - \frac{1}{2} \times 9.8 \times t^2$

⇒ t = 65

Sol. 3

Using law of conservation of momemtum

$1 \times V_g = 200 \times 10^{-3} \times 5$

$\Rightarrow V_g = \frac{1m}{s}$

Sol.4

Given $l_z = 2I_d$

Or $I_d = \frac{I_z}{2}$

Also $l_z = M\frac{(l^2+l^2)}{12}$

$=\frac{Ml^2}{6}$

$\Rightarrow I_d = \frac{Ml^2}{12}$

Similarly $2I_m = I_2 \Rightarrow \mathrm{I_m} = \frac{I_2}{2} = \frac{Ml^2}{12}$

$\Rightarrow l_m = l_a$

Sol.5

A car running with uniform velocity has a net zero force acting on it.

Sol.6

From the law of conversation of angular momentum

$mv_{max}\, r_{min} = mv_{\mathrm{min}}\, r\_max$

i.e.$\frac{V_{max}}{V_{min}} = \frac{r_{max}}{r_{min}}$

$$= \frac{a(1+e)}{a(1-e)} = \frac{1+e}{1-e}$$

Sol.7

It is obvious from the relation

$V = \sqrt{2gh}$

That v depends upon g and h.it also depends upon viscosity but not on density

Sol.8

Given $OR^2 = l^2 - \left(\frac{l}{2}\right)^2$

$$= [l(1+\alpha_2 t)]^2 - \left[\frac{1}{2}(1+\alpha_1 t)\right]^2$$

Expanding and neglecting terms containing squares and higher powers, we get $\alpha_1 = 4\alpha_2$

Sol. 9

Average kinetic energy of a molecule is given by $K.E._{av} = \frac{1}{2} m v_{rms^2} = \frac{1}{2} m \left(\frac{3RT}{m}\right)$

$$= \frac{3}{4} m \left(\frac{2RT}{m}\right)$$

$$= \frac{3}{4} m v_p^2 as\ v_p = \sqrt{\frac{2RT}{m}}$$

Sol.10

When bob passes through the mean positive, tension in the string is maximum

i.e.$T_{max} = \frac{m v_{max}^2}{1} mg$

as$v_{max} = \omega A$

$\therefore T_{max} = \frac{m(\omega A)^2}{l} + mg$

Now $\omega = \sqrt{g/l}$

$\therefore T_{max} = \frac{m\left[\left(\frac{g}{l}\right)A\right]^2}{l} + mg$

$= mg + m\frac{A^2}{l^2} g = mg\left[1 + \left(\frac{A}{l}\right)^2\right]$

Sol.11

Amplitude of the vibration = lθ and $x = A \cos \omega t$

Where $\omega = \sqrt{\frac{g}{l}}$

$\therefore x = l\theta \cos \sqrt{\frac{g}{l}} t$

Ans is (1)

Sol. 12

Given $R^3 = 1000r^3$

$\Rightarrow R = 10r$

Capacitance of large drop $= \frac{1000q}{R} = \frac{1000q}{10r} 100C$

Sol.13

Volume of cylindrical wire

$V = \pi r^2 l$

New volume, $V' = (\pi r')^2(2l)$

As $V = V'$

$\pi r'^2 2l = \pi r^2 l$

$r'^2 = r^2/2$

Also Resistance, R=ρ$\frac{l}{a}$ = ρ$\frac{l}{\pi r^2}$

New Resistance, R'=ρ$\frac{2l}{\pi\left(\frac{r^2}{2}\right)} = 4R$

∴ change in resistance $= R' - R = 4R - R = 3R$

% change $= \frac{3R}{R} \times 100 = 300\%$

Sol. 14

The mass m is reduced to half i.e m/2 for a half needle and length is reduced to l/2.

$T = 2\pi\sqrt{\frac{l}{MB}}$

And $T' = 2\pi\sqrt{\frac{l'}{M'B}} = 2\pi\sqrt{\frac{l'}{M'B}}$

Or $\frac{r'}{r} = \sqrt{\frac{l'}{l} \times \frac{M}{M'}}$ Moment of Inertia of thin needle is

$l = \frac{m}{12} \times l^2 \Rightarrow l' = \frac{m}{2\times12} \times \left(\frac{l}{12}\right)^2$

$\Rightarrow \frac{l'}{l} = \frac{1}{8}$

Sol.15

Ratio of magnetic moments of unbroken needle and a piece is

$\frac{M'}{M} = \frac{1}{2}$

Ans is (2)

Sol.16

$dq = Idt = I_0\left(1 - e^{-t\,/T}\right)$

$= \dfrac{E}{R}\left(1 - e^{-t\,/T}\right)$

$\therefore q = \int_0^T \frac{E}{R}(1 - e^{-t\,/T}\,)\,dt = \frac{E}{R}\left[t + Te^{-t\ \,/T}\right]_0^T$

$= \dfrac{E}{R}\left[T + \dfrac{T}{e} - T\right] = \dfrac{E}{R}.\dfrac{T}{e}$

Sol.17

Bothe the statements are self-explanatory

Sol.18

Using E = hv

$1.6 \times 10^{-19} \times 14.4 = 6.6 \times 10^{-34} \times v$

$\Rightarrow v = \frac{14.4 \times 1.6 \times 10^{-19}}{6.6 \times 10^{-34}} = 3.49 \times 10^{15}\,HZ$

Which falls in UV Range

Sol.19

Focal length as well as aperture has to be increased to increase both resolving power and magnifying power of a telescope

So.20

H Polaroid is prepared by stretching polyvinyl alcohol and then impregnating with iodine

Sol.21

Energy rate of incident photon = nhv

Energy rate of reflected photon = nhv

The rate of change of momentum after reflection $= \frac{2nhv}{c}$

$\Rightarrow$ Force exerted$= \frac{2nhv}{c}$

Sol.22

Refractive index, □ $= \frac{\sin(A+\delta m)}{\sin□(A/2)}$

i.e.$\sqrt{3} = \frac{\sin\left(\frac{A+\delta m}{2}\right)}{\sin(60/2)} = \frac{\sin(A+\delta m)}{\sin\ 30}$

$\therefore \sin\frac{(A+\delta m)}{2} = \sqrt{3}\sin 30 = \sqrt{3} \times \frac{1}{2}$

$\Rightarrow \frac{A+\delta m}{2} = 60^0 \Rightarrow \mathrm{A} + \delta_\mathrm{m} = 120^0$

Or $60+\delta_m = 120^0$

$\Rightarrow \delta_m = 60^0$

Sol.23

From the relation $p = \sqrt{2mE}$

$$\frac{P_\alpha}{P_p} = \sqrt{\frac{2M_\alpha E_\alpha}{2M_p E_p}}$$

$$= \sqrt{\frac{2\times 4M_p \times E_\alpha}{2\times M_p \times 16E_\alpha}} = \frac{1}{2}$$

But $\frac{\lambda_p}{\lambda_\alpha} = \frac{P_\alpha}{P_p} \Rightarrow \frac{\lambda_p}{\lambda_\alpha} = \frac{1}{2}$

Sol 24.

We have $N = \frac{N_0}{16}$ and T = 10□s

using $\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T}$

$\left(\frac{1}{2}\right)^4 = \left(\frac{1}{2}\right)^{t/T} \Rightarrow \frac{t}{T} = 4$

Or t = 4T = 4x 100 = 400□s

Sol 25.

Whenever a transistor is used In a circuit, the emitter base junction is always forward biased and base collective junction is reverse biased.

Sol 26.

Minimum of three geo synchronous satellites are required to communicate over the whole of earth.

Sol 27.

As $\bar{E} = E.\hat{\imath}\ and\ \vec{B} = B\ \hat{k}$

Velocity of the particle will be along q. $\vec{E}$ direction

$\Rightarrow \vec{V} = AqE\hat{\imath}$

Magnetic force on the particle will be

$$\vec{F} = q\left(\vec{V}\ x\ \vec{B}\right) = q(AqE\hat{\imath})\ x\ \left(B\hat{k}\right)$$

= q^2 AEB ($\hat{\imath}\ x\ \hat{k}$)

= q^2 AEB (- $\hat{\jmath}$)

As Magnetic force is along negative y – axis, whatever is the sign of q. All ions will be deflected towards negative y- direction.

Sol 28.

In circular orbit of a satellite

Potential Energy = - 2 x Kinetic energy

= - 2x $\frac{1}{2}\ mv^2 = -mv^2$

The total mechanical energy should be zero for escape from the gravitational pull which implies that kinetic energy should be +mv^2

Sol 29.

Let x be the maximum extension of the spring. From conservation of mechanical energy decrease in gravitational potential = increaseinclastic potential energy.

$\Rightarrow Mgx = \frac{1}{2}\ Kx^2$

or$x = \frac{2Mg}{K}$

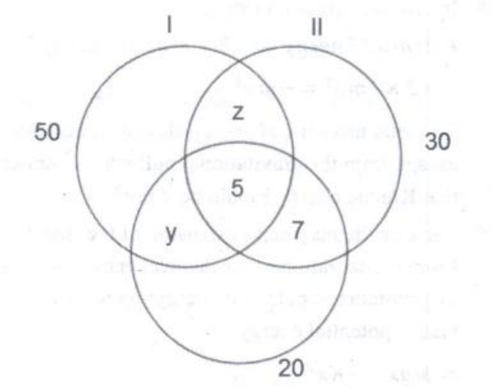
Sol 30.

$$V_{cm} = \frac{m_1 v_1 +\ m_2 v_2}{m_1 +\ m_2} = \frac{10\ x\ 14 + 4\ x\ 0}{10 + 4} = \frac{140}{14}$$

= 10m/s.

MATHEMATICS

Sol 1.



$78 = 50 - (x + y + 5\ ) + 30 - (y + z + 5) + 20 - (x + x + 5\ ) + (x + y + z) + 5$

$\Rightarrow 78 = 100 - (x + y + z\ ) - 10$

Hence required answer $= 12 + 5 = 17$

Sol 2.

We know that the range of sin x is [- 1, 1]. Here [ ] refers to greatest integer function, so, the outcomes will only be the integers ranging in [- 1, 1] which are [- 1, 0, 1]

Sol 3.

Put z=xiy in given equality it reduces to $x^2 + y^2 = 1$ which is equation of a circle.

Sol 4.

Since one root is zero, product of roots is also zero, therefore $c = 0$

Only one root is zero, so sum of roots is never zero, therefore $b \neq 0$

Sol 5.

As $\alpha + ß = 4$

Or

$\alpha^3 + ß^2 = (\alpha + ß)^3 - 3\alpha ß\ (\alpha + ß) = 44$

$\Rightarrow 64 - 3ab\ (4) = 44$

$\Rightarrow 12\alpha ß = 20 \Rightarrow \alpha ß = \frac{5}{3} \Rightarrow$product of roots $= \frac{5}{3}$

$\therefore$equation is $x^2 - 4x + \frac{5}{3} = 0$

Sol 6.

Applying the transformations

R3 = (R1 + R2) – R3, we get

$$\begin{vmatrix} a & a+b & a+b+c \\ 3a & 4a+3b & 5a+4b+3c \\ 2a & 4a+2b & 5a+4b+2c \end{vmatrix}$$

BY R2 = R2 – R3

$$\begin{vmatrix} a & a+b & a+b+c \\ a & b & 5a+4b+3c \\ 2a & 4a+2b & 5a+4b+2c \end{vmatrix}$$

Applying R3 = R3 – (R1 + R2),

$$\begin{vmatrix} a & a+b & a+b+c \\ a & b & c \\ 0 & 3b & 4\alpha+3b \end{vmatrix}$$

Applying transformation R1 = R1 – R2

$$\begin{vmatrix} 0 & a & a+b \\ a & b & c \\ 0 & 3b & 4a+3b \end{vmatrix}$$

Expanding with respect to A_{21}, we get

$-a\,(a(4a + 3b) - 3b\,(a + b)) = -\,a^3$

We know that a = i, hence, $i^e = i$

Sol 7.

The number of ways of painting six different faces is 6!

Sol 8.

Put n = 1, 2

${}^1C_0 - 1/2\ \ {}^1C_1 = 1 - \frac{1}{2} = 1/2$

For n = 2, we get

${}^2C_0 - ½\ {}^2C_1 + {}^2C_3 = 1 - 1 \intercal 1/3 = 1/$

Only option (3) satisfies the above results.

Sol 10.

$\frac{3+5\ 7+.\ .\ .\ .\ .\ n\ (terms\ )}{5+8+11+.\ .\ .\ .\ .10\ terms} = 7$

$\Rightarrow \frac{\frac{n}{2}[6+(n-1)2]}{\frac{10}{2}[10+(10-1)3]} = 7$

$\Rightarrow \frac{n[n+2]}{5[37]} = 7 \Rightarrow n^2 + 2n = 35 \text{ x } 37$

$\Rightarrow n^2 + 2n - 35 \text{ x } 37 = 0 \Rightarrow (n + 37)\ (n - 35\ ) = 0 \Rightarrow n = 35$

Sol 13.

On applying the L' Hospital rule, we get $Lt_{x \to 0} \sin x = 0$

Sol 14.

$Rf' (0) = \lim_{h \to 0} \frac{r\ (0+h) - f\ (0)}{h} = \lim_{h \to 0} \frac{h^{\frac{3}{2}} - 0}{h}$

$= \lim_{h \to 0} h^{1/2} = 0$

$Lf' (0) = \lim_{h \to 0} \frac{f'\ (o-h\ ) - f\ (0)}{-h}$

$= \lim_{h \to 0} \frac{(h)^{\frac{3}{2}} - 0}{(-h)}$

$= \lim_{h \to 0} (h)^{\frac{1}{2}} = 0$

Now $lf' (0) = Rf' (0) \Rightarrow f' (0) = 0$

Sol 15.

We know that $y = 4x - 5$ is tangent is

$Y^2 = px^3 + q$, hence slope of tangent is

$$\frac{dy}{dx} = \frac{3px^2}{2y}$$

$\left(\frac{dy}{dx}\right)_{(2,3)} = \frac{12p}{6}$

Slope of tangent = 2p

Slope of given tangent $y = 4x - 5$ is equal to 4 Hence p = 2

Sol 16.

$$I = \int \sqrt{2\cos^2\left(\frac{x}{8}\right)}\ dx$$

$= \sqrt{2} \int \cos(x/8)\ dx\ = \sqrt{2}\frac{\sin(x/8)}{1/8} + c$

$= 8\sqrt{2}\sin(x\ /\ 8)\ + c$

Sol 17.

$$I = \int 1.\log x dx$$

$= (\log x)\ x\ - \int \frac{1}{x}.x dx + c$

= xlogx – x + c

= x (log x - 1) + c

Sol 18.

$$I = \int_0^{\pi} \sqrt{2\sin^2\left(\frac{x}{2}\right) dx}$$

$$= \sqrt{2}\int_0^{\pi} \sin\left(\frac{x}{2}\right) dx = \sqrt{2}\left[\frac{-\cos\left(\frac{x}{2}\right)}{\left(\frac{1}{2}\right)}\right]_0^{\pi}$$

$$= \sqrt{2}\left[-\cos\frac{\pi}{2} + \cos 0\right] = 2\sqrt{2}$$

Sol 19.

The order of differential equation = number of arbitrary constants = 2

Sol 20.

$$\frac{dy}{dx} + \frac{1}{y\sqrt{1-x^2}} = 0$$

$\text{ydy} + \frac{dx}{\sqrt{1-x^2}} = 0$

Integrating

$$\frac{y^2}{2} + \sin^{-1} x = c$$

$y^2 + 2\sin^{-1} x = c$

Sol 21.

Given vertices are of a right angled triangle and the orthocenter of a right angled triangle lies on the intersection of perpendicular. i.e. (0, 0)

Sol 22.

If denominator of x is less than denominator of y, then it can be started as a vertical ellipse.

The ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is a vertical ellipse if $a^2 < b^2$

Sol 23.

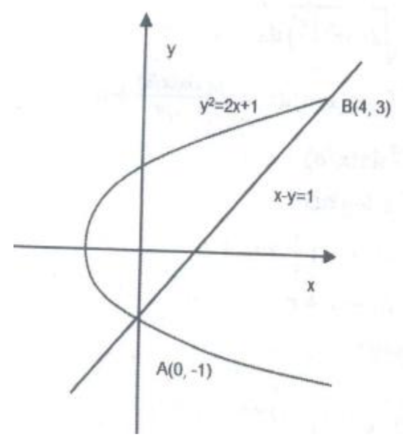
We can simply check b the options as no two lines are perpendicular to each other hence it must be either rhombus or parallelogram, now we can check the slopes of diagonals as, the diagonals are also not perpendicular, hence it is a parallelogram.

Sol 25.

Repaired probability $=\left(1-\frac{1}{4}\right)\left(1-\frac{1}{3}\right)=1/2$

Sol 28.

Points of intersection of curves $y^2 = 2x + 1$andX – y = 1 are given by



$(x - 1)^2 = x + 1$

$x^2 - 2z + 1 = 2x + 1$

$x^2 - 4x = 0 \Rightarrow x = 0, x = 4 \Rightarrow y = -1, y = 3$

∴ (0, 1) and (4, 3) are points of intersection Limits are

$\frac{y^2-1}{2} \le x \le y+1, 1 \le y \le 3$

Required area $=\int_{-1}^{3}\int_{\frac{y^2-1}{2}}^{y+1} dxdy = \int_{-1}^{3}\left[(y+1)-\left(\frac{y^2-1}{2}\right)\right]dy$

$=\frac{1}{2}\int_{-1}^{3}(2y-y^2+2)dy = \frac{1}{2}\left[y^2-\frac{y^3}{3}+3y\right]_{-1}^{3}$

$=\frac{1}{2}\left[(9-9+9)-\left(1+\frac{1}{3}-3\right)\right]=\frac{16}{3}$

Sol 30.

$1+\log_e z+\frac{(\log_e z)^2}{2!}+\frac{(\log_e z)^3}{3!}+.....=e^{\log_e z}\left[\because 1+x+\frac{x^2}{2!}+\frac{x^3}{3!}\right]+..........=e^x$

$= z$