Physics

1. a,d Speed is $0.5u_0$ at phase angle $= \frac{\pi}{3}$, time at which particle passes equilibrium position for the first time

$$t = \frac{T}{6} + \frac{T}{6} = \frac{T}{3} = \frac{2\pi}{3}\sqrt{\frac{m}{k}}$$

time at which maximum compression occurs

$$t = \frac{T}{6} + \frac{T}{6} + \frac{T}{4} = \frac{7T}{12} = \frac{7\pi}{6}\sqrt{\frac{m}{k}}$$

For passing through the equilibrium position for the second time

$$t = \frac{T}{6} + \frac{T}{6} + \frac{T}{4} + \frac{T}{4} = \frac{5T}{6} = \frac{5\pi}{3}\sqrt{\frac{m}{k}}$$

speed at equilibrium position is u_0 as energy remains conserved.

2. b For escape velocityz

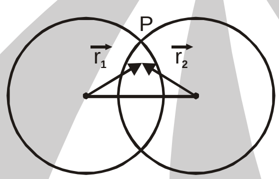
$$\frac{1}{2}mv^2 - \frac{2GmM}{L} = 0$$

$$v = 2\sqrt{\frac{GM}{L}}$$

3. a,b The frequency increases regardless of the direction of wind.

4. a,c,d For $0 < r < R$
magnetic field is along the axis and non zero
for $R < r < 2R$
Field is tangential to the circle of radius r
for $r > 2R$
Field is due to the hollow cylinder and non zero.

5. c,d Net field at P



$$E = E_{(+)} + E_{(-)}$$

$$= \frac{\rho}{3\epsilon_0}\left(\vec{r}_1 - \vec{r}_2\right)$$

Now since $\vec{r}_1 - \vec{r}_2$ is always constant, E is constant in magnitude and direction.

6. d Here

$\Delta d \,\alpha \cos\theta \Delta d\theta$

$\therefore$ as θ increases, Δd decreases

$$\frac{\Delta d}{d} \alpha \cot\theta \Delta\theta$$

as θ increases $\frac{\Delta d}{d}$ decreases

7. a,c here $R = 4.5a_0 = \frac{n^2}{Z}a_0$ and $P = \frac{3h}{2\pi}$

$\Rightarrow$ n = 3
Z = 2
now possible wavelengths

$$\frac{1}{\lambda_1} = RZ^2\left(1 - \frac{1}{3^2}\right) \Rightarrow \lambda_1 = \frac{9}{32R}$$

$$\frac{1}{\lambda_2} = RZ^2\left(1 - \frac{1}{2^2}\right) \Rightarrow \lambda_2 = 9$$

$$\frac{1}{\lambda_3} = RZ^2\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

8. a,b,c,d
Option (a) is correct as the graph seems to be a straight line in the range 0-100K
Option (b) is correct as the area under the graph is more in the range 400-500K than in 0-100K.
Option (c) is correct as the graph is constant in the range 400-500K
Option (d) is correct as specific heat increases in the range 200-300K

9. a $N = mg\cos 60 + \frac{mv^2}{R} = 5 + 2.5 = 7.5N$

10. b at Q

$$mgR\sin 30 - 150 = \frac{1}{2}mv^2$$

$$v = 10\ ms^{-1}$$

11. a V at source = 4000 × 10 = 40000 V
V at consumers end = 200 V
$n_P : n_S$ = 40000 : 200
= 2000 : 1

12. b $i = \frac{P}{V} = \frac{6\times 10^5}{4000} = 150A$

Resistance = 0.4 × 20 $= 8\Omega$

Power dissipated $= i^2R = (150)^2 \times 8$
= 180 kW

$\therefore$ percentage $= \frac{180}{600} \times 100 = 30$

13. b $\Delta L = \int \tau .dt = Q\left(\frac{RB}{2}\right)R$

$\Delta M = \gamma \Delta L$

$\Delta M = -\gamma \frac{BQR^2}{2}$ (showing the direction)

14. b $E.2\pi R = -\frac{d\phi}{dt}$

$$E.2\pi R = \pi R^2 \frac{\Delta B}{\Delta t}$$

$$E = \frac{BR}{2}$$

15. a $^{210}_{84}Po \rightarrow ^{206}_{82}Pb + ^{4}_{2}He + Energy$

Energy $= [(209.982876) - (205.974455 + 4.002603)] \times 932 MeV$

= 5422 KeV
Again after alpha decay
$P_1 = P_2$ (linear momentum conservation)
and $(K.E.)_{Pb} + (K.E.)_{\alpha} = 5422$

$\Rightarrow \frac{P^2}{2\times 206} + \frac{P^2}{2\times 4} = 5422$

$= \frac{P^2}{8}\left[\frac{1}{51.2} + 1\right] = 5422$

$= (K.E.)_{\alpha}\left(\frac{52.2}{51.2}\right) = 5422$

$K.E._{\alpha} = 5319$

16. c Only that reaction is possible in which the product has less mass than reactant.
So only (c) option is correct.

17. c Boltzmann cosntant [K] = $[ML^2T^{-2}K^{-1}]$

coefficient of viscosity $[\eta] = \left[F\frac{dx}{Adv}\right]$

$= \left[\frac{MLT^{-2}.L}{L^2.LT^{-1}}\right]$

$= [ML^{-1}T^{-1}]$

Plank constant $h = \frac{E\lambda}{c}$

$\Rightarrow [h] = \left[\frac{ML^2T^{-2}.L}{LT^{-1}}\right] = [ML^2T^{-1}]$

Thermal conductivity

$\frac{d\theta}{dt} = \frac{KA}{x}(\Delta\theta)$

$\Rightarrow K = \frac{-\left(\frac{dQ}{dt}\right)x}{A\Delta\theta}$

$[K] = [MLT^{-3}K^{-1}]$

18. d In $e \rightarrow f$: μ_2 is denser than μ_1 and μ_3 is rarer than μ_2

so $\mu_2 > \mu_1$ and $\mu_2 > \mu_3$

In $e \rightarrow g$: there is no deviation so $\mu_1 = \mu_2$

In $e \rightarrow h$: μ_2 is rarer than μ_1 and μ_3 is rarer than μ_2

so $\mu_2 < \mu_1$ and $\mu_2 > \mu_3$

also there is no T.I.R. between μ_1 and μ_2

so $\mu_1 < \sqrt{2}\,\mu_2$

In $e \rightarrow i$: there is T.I.R. so $\mu_1 > \sqrt{2}\mu_2$

19. c (1) $^{15}_{8}O \rightarrow ^{15}_{7}N + \beta^+$ (β^+ decay)

(2) $^{238}_{92}U \rightarrow ^{234}_{90}Th + ^{4}_{2}He$ (α decay)

(3) $^{185}_{83}Bi \rightarrow ^{184}_{82}Pb + ^{1}_{1}H$ (proton emission)

(4) $^{239}_{94}Pu \rightarrow ^{140}_{57}La + ^{99}_{37}X$ (fission)

20. a $G \rightarrow E$ (isobaric process)

$W = P\Delta V$

$= P_0(V_G - V_E)$ $\{V_G = 32V_0\}$

$= 31P_0V_0$

$G \rightarrow H$ (isochoric process)

$W = P\Delta V$

$= P_0(V_G - V_H)$

$\{V_H = 8V_0$ by applying adiabatic equation on F and H$\}$

$= P_0\{32V_0 - 8V_0\}$

$= 24P_0V_0$

$F \rightarrow H$ (adiabatic process)

$W = \frac{P_2V_2 - P_1V_1}{1-\gamma} = \frac{P_0(8V_0) - 32P_0V_0}{1 - \frac{5}{3}}$

$= \frac{24P_0V_0}{2/3}$

$= 36P_0V_0$

$F \rightarrow G$ (Isothermal process)

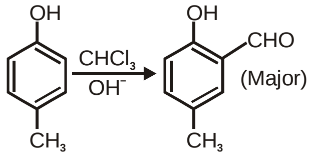
$W = nRT \ln\frac{V_2}{V_1} = 32P_0V_0 \ln\frac{32V_0}{V_0}$

$= 32P_0V_0 \ln 32$

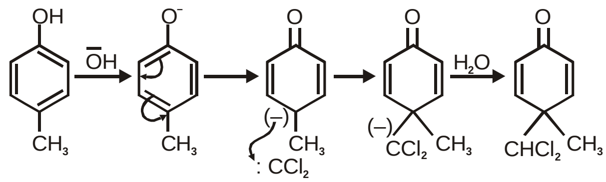
$= 160P_0V_0 \ln 2$

Chemistry

21. b,d



As P–is occupied so –CHO group will attach at O–position.



22. b $Ag_2CrO_4 \rightarrow 2Ag + CrO_4^{2-}$

$2s+0.1 \quad s$

$K_{sp} = \{(2s+0.1)^2\}(s)$

$1.1\times10^{-12} = \{4s^2 + (0.1\times0.1) + 2\times2s\times0.1\}(s)$

$= (4s^2 + 0.01 + 0.4s)(s)$

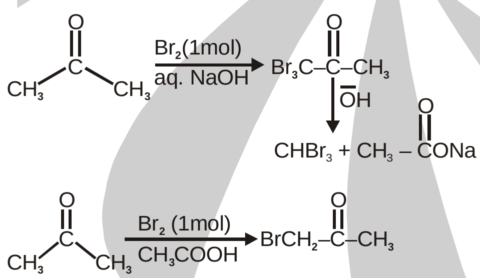
$1.1\times10^{-12} = 4s^3 + 0.01s + 0.4s^2$

By negletcting higher power

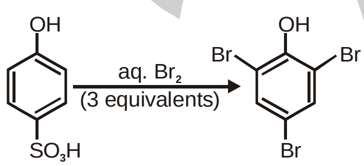
$1.1\times10^{-12} = 0.01s$

$s = \dfrac{1.1\times10^{-12}}{0.01} = 1.1\times10^{-10}$

23. c



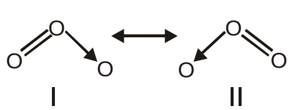
24. b



25. a,b (i) ${}^{9}_{4}Be + {}^{0}_{0}\gamma \rightarrow {}^{8}_{4}Be + {}^{1}_{0}n$

(ii) ${}^{9}_{4}Be + {}^{1}_{1}H \rightarrow {}^{8}_{4}Be + {}^{2}_{1}H$

26. a,c,d



Bond lenghts are equal and diamagnetic.

27. a,b,d

28. c,d Tin and iron are extracted from their respective Ores by carbon reduction.

29. d $Pb^{2+} + 2HCl \longrightarrow PbCl_2 + 2H^+$

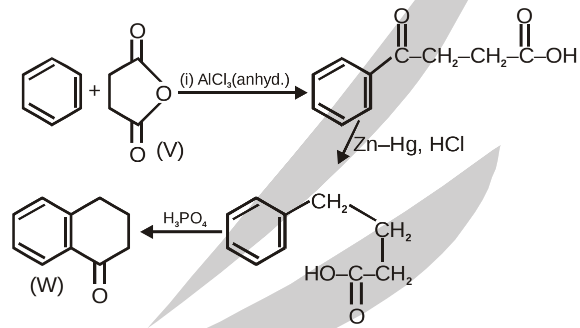
$PbCl_2$ → Soluble in hot water

Cr^{3+} + Ammn. H_2S ↓

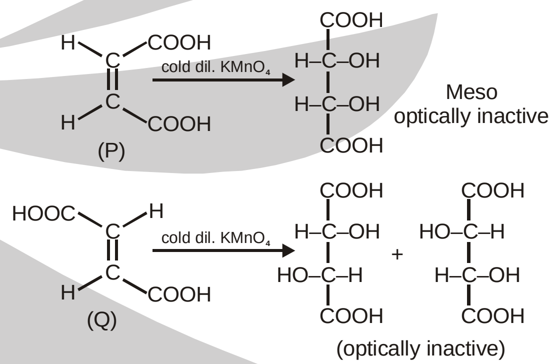
$Cr(OH)_3 \xrightarrow[H_2O_2]{+NaOH} Na_2CrO_4$ (Clear yellow sol.)

30. a

31. a



32. b



33. b

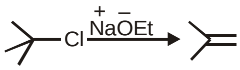
34. c

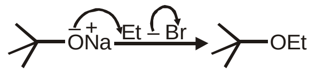
35. a $Cl_2 + NaOH(\text{cold and dil.}) \rightarrow NaCl + NaOCl$

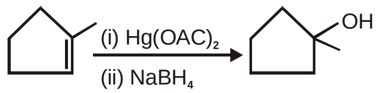
$Cl_2 + NaOH(\text{Hot and conc.}) \rightarrow NaCl + NaClO_3$

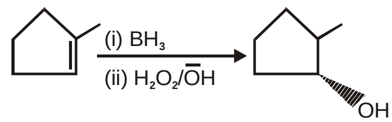
$Cl_2 + SO_2 \xrightarrow{\text{Charcoal}} \underset{(R)}{SO_2Cl_2} \xrightarrow{+P} \underset{(S)}{PCl_5} \xrightarrow{+H_2O(\text{Hot})} \underset{(T)}{H_3PO_4} + HCl$

36. a

37. a (i) 

(ii) 

(iii) 

(iv) 

38. d $PbO_2 + H_2SO_4 \xrightarrow{\Delta} PbSO_4 + H_2O + O_2$

$Na_2S_2O_3 + H_2O + Cl_2 \rightarrow NaCl + NaHSO_4 + S$

$N_2H_4 + I_2 \rightarrow N_2 + 4HI$

$XeF_2 + 2NO \rightarrow Xe + 2NOF$

39. d $Fe^{3+} + e^- \rightarrow Fe^{2+} \;(E^\circ = +0.77V)$ ...(i)

$Fe^{2+} + 2e^- \rightarrow Fe \;(E^\circ = -0.44V)$ ...(ii)

$Fe^{3+} + 3e^- \rightarrow Fe \;(E^\circ = ?)$ ...(iii)

$\Delta G^\circ_1 + \Delta G^\circ_2 = \Delta G^\circ_3$

$-0.77F - (-0.44 \times 2F) = -3FE^\circ_3$

or $-0.77F + 0.88F = -3FE^\circ_3$

or $E^\circ_3 = -\dfrac{0.11}{3} = -0.04\text{ V}$

40. a In case of CH_3COOH and KOH, conductivity decreases due to absorption of OH^- by H^+ and then remains constant.
In case of KI and $AgNO_3$, conductivity don't increase till precipitation of AgI.
In case of NaOH and HI, conductivity decreases due to neutralisation and then increases due to availability of more number of ions.

Mathematics

41. a,c Equation of circle $(x-3)^2 + y^2 + \lambda y = 0$

$x^2 + y^2 - 6x + \lambda y + 9 = 0$

$2\sqrt{f^2 - c} = 2\sqrt{7}$

$\left(\dfrac{\lambda}{2}\right)^2 - 9 = 7$

$\lambda = \pm 8$

$x^2 + y^2 - 6x \pm 8y + 9 = 0$

42. b,d $\lim\limits_{n\to\infty} \dfrac{1^a + 2^a + \cdots n^a}{(n+1)^{a-1}\left[(na+1) + (na+2) + \cdots (na+n)\right]}$

$\lim\limits_{n\to\infty} \dfrac{(1^a + 2^a + \cdots n^a)}{(n+1)^{a-1}\left[n^2a + \dfrac{n(n+1)}{2}\right]}$

$\lim\limits_{n\to\infty} \dfrac{1^a + 2^a \cdots n^a}{n^2(n+1)^{a-1}\left[a + \dfrac{1}{2}\left(1 + \dfrac{1}{n}\right)\right]}$

$\lim\limits_{n\to\infty} \dfrac{1^a + 2^a + \cdots n^a}{n^a n\left(1 + \dfrac{1}{n}\right)^{a-1}\left[a + \dfrac{1}{2}\left(1 + \dfrac{1}{n}\right)\right]}$

$\lim\limits_{n\to\infty} \dfrac{\dfrac{1}{n}\sum\limits_{r=1}^{n}\left(\dfrac{r}{n}\right)^a}{a + \dfrac{1}{2}}$

$= \dfrac{2}{2a+1}\int_0^1 x^a dx = \dfrac{2}{(2a+1)(a+1)} = \dfrac{1}{60}$

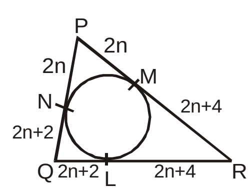
$\Rightarrow 2a^2 + 3a - 119 = 0$

$\Rightarrow a = \dfrac{-3 \pm 31}{4}$

$= 7, -\dfrac{17}{2}$

43. b,d $\therefore$ $PQ = 4n+2,\ QR = 4n+6,\ PR = 4n+4$

$\therefore \cos P = \dfrac{PQ^2 + PR^2 - QR^2}{2PQ.PR}$



$\Rightarrow \dfrac{1}{3} = \dfrac{(4n+2)^2 + (4n+4)^2 - (4n+6)^2}{2(4n+2)(4n+4)}$

$\Rightarrow 16n^2 - 48n - 64 = 0$

$\Rightarrow n = -1, 4$

$\therefore$ Sides of triangle are 18, 20, 22.

44. a,d $\begin{vmatrix} -5+\alpha & 0 & 0 \\ 0 & 3-\alpha & -2 \\ 0 & -1 & 2-\alpha \end{vmatrix} = 0$

$(3-\alpha)(2-\alpha)-2=0$

$\alpha = 1, \alpha = 4$

45. a,b,c

$3^x = 4^{x-1}$

$x = (x-1)\log_3 4$

$x = 2x\log_3 2 - 2\log_3 2$

$x = \dfrac{2\log_3 2}{2\log_3 2 - 1}$

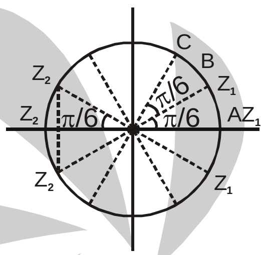
$= \dfrac{2}{2-\log_2 3} = \dfrac{1}{1-\log_4 3}$

46. c,d $\omega = \cos\dfrac{\pi}{6} + i\sin\dfrac{\pi}{6}$

$P = \omega^n = \cos\dfrac{n\pi}{6} + i\sin\dfrac{n\pi}{6}$

$H_1 = Z \in C, \text{Re} Z > \dfrac{1}{2}$

$H_2 = Z \in C\left(\text{Re} Z < -\dfrac{1}{2}\right)$

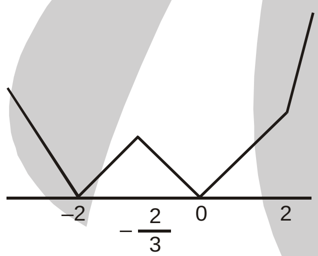


Angle between Z_1 and Z_2

$= \pi - 2.\dfrac{\pi}{6} = \dfrac{2\pi}{3}$ and $\pi - \dfrac{\pi}{6} = \dfrac{5\pi}{6}$

47. a,b Critical point of f(x) are

$x = -2, -\dfrac{2}{3}, 0, 2$



$x < -2 \quad y = -2x - x - 2 + 2 - x = -2x - 4$

$-2 \le x < -\dfrac{2}{3} \quad y = -2x + x + 2 + 3x + 2 = 2x + 4$

$-\dfrac{2}{3} \le x < 0 \quad y = -2x + x + 2 - 3x - 2 = -4x$

$0 \le x < 2 \quad y = 2x + x + 2 - (2-x) = 4x$

$x \ge 2 \quad y = 2x + x + 2 + 2 - x = 2x + 4$

f(x) has local maximum at $x = -\dfrac{2}{3}$ and local minimum at $x = -2, 0$

48. b,c,d

For n = 1

$P = [\omega^2] \Rightarrow P^2 = [\omega^4] \ne 0$

For n = 2

$P = \begin{bmatrix} \omega^2 & \omega^3 \\ \omega^3 & \omega^4 \end{bmatrix} = \begin{bmatrix} \omega^2 & 1 \\ 1 & \omega^4 \end{bmatrix}$

$\Rightarrow P^2 = \begin{bmatrix} \omega^4+1 & \omega^2+\omega^4 \\ \omega^2+1 & 2\omega^4 \end{bmatrix} \ne 0$

For n = 3

$P = \begin{bmatrix} \omega^2 & 1 & \omega \\ 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \end{bmatrix}$

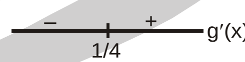
$\Rightarrow P^2 = \begin{bmatrix} \omega^2 & 1 & \omega \\ 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \end{bmatrix} \begin{bmatrix} \omega^2 & 1 & \omega \\ 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

$\therefore\ P^2 \ne 0,$ when n is not multiple of 3.

49. c $g(x) = e^{-x} f(x)$

$g'(x) = e^{-x}(f'(x) - f(x))$

$f'(x) - f(x) = 0$



$f'\left(\dfrac{1}{4}\right) = f\left(\dfrac{1}{4}\right)$

$x < \dfrac{1}{4},\ f'(x) - f(x) < 0$

$f'(x) < f(x)$

50. d $\because\ f''(x) - 2f'(x) + f(x) \ge e^x$

$\Rightarrow e^{-x}f''(x) - 2e^{-x}f'(x) + e^{-x}f(x) \ge 1$

$\Rightarrow e^{-x}f''(x) - e^{-x}f'(x) - e^{-x}f'(x) + e^{-x}f(x) \ge 1$

$\Rightarrow \dfrac{d}{dx}\left(f'(x)e^{-x} - f(x)e^{-x}\right) \ge 1$

$\Rightarrow \dfrac{d^2}{dx^2}\left(e^{-x}f(x)\right) \ge 1 \ \ \forall\ x \in [0,1]$

Let g(x) is concave upward and g(0) = g(1) = 0

Hence $g(x) < 0 \ \ \forall\ x \in (0,1)$

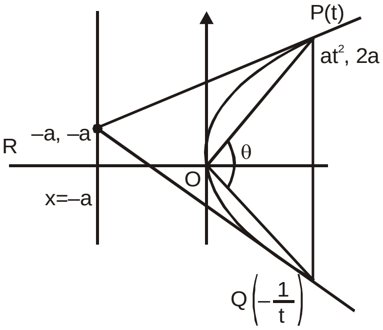
$\Rightarrow f(x) < 0 \ \ \forall\ x \in (0,1)$

51. d Tangent at P and Q meet on the directrix $x = -a$

$\therefore\ y = -2a + a = -a$

$\therefore\ R = (-a, -a)$

Also $R = -a, a\left(t - \frac{1}{t}\right)$



$\Rightarrow t - \frac{1}{t} = -1$

$\Rightarrow t^2 + t - 1 = 0$

$t = \frac{-1 \pm \sqrt{5}}{2}$

$m_{OP} = \frac{2}{t},\ m_{OQ} = -2t$

$\therefore\ \tan\theta = \frac{\frac{2}{t} + 2t}{1 - 4} = \frac{2}{3}t + \frac{1}{t}$

If $t = \frac{\sqrt{5} - 1}{2}, \frac{1}{t} = \frac{\sqrt{5} + 1}{2}$

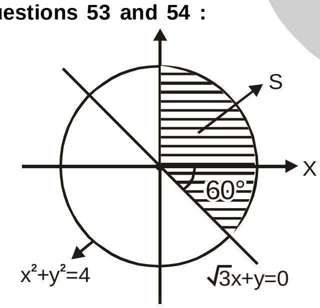
$\tan\theta = \frac{2}{3}\left|\frac{\sqrt{5} - 1 + \sqrt{5} + 1}{2}\right| = \frac{2}{3}\sqrt{5}$

and $t = \frac{-1 - \sqrt{5}}{2}, \frac{1}{t} = \frac{-2}{-\sqrt{5} - 1} \Rightarrow \tan\theta = -\frac{2}{3}\sqrt{5}$

52. b $L_{pcs} = a\left(t + \frac{1}{t}\right)^2$

$= a\left(\frac{\sqrt{5} - 1}{2} + \frac{2}{\sqrt{5} - 1}\right)^2 = 5a$

Solution for Questions 53 and 54 :



53. c $\min_{z \in S}|1 - 3i - z| = \frac{\left|\sqrt{3} \times 1 - 3\right|}{\sqrt{3 + 1}}$

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

54. b Area of $S = \frac{\pi r^2}{4} + \frac{\pi/3}{2\pi}.\pi r^2$

$= \frac{1}{4}\pi.16 + \frac{1}{6}.\pi.16$

$= \frac{20\pi}{3}$

Solution for Question no. 55 and 56 :

55. d Let E_1 = Balls drawn from box B_1
E_2 = Balls drawn from box B_2
E_3 = Balls drawn from box B_3
E = One ball white and other ball is red.

$\therefore\ P(E_2/E) = \frac{P(E_2)P(E/E_2)}{P(E_1)P(E/E_1) + P(E_2)P(E/E_2) + P(E_3).P(E/E_3)}$

$= \frac{\frac{1}{3}\frac{2 \times 3}{{}^9C_2}}{\frac{1}{3}.\frac{1 \times 3}{{}^6C_2} + \frac{1}{3} \times \frac{2 \times 3}{{}^9C_2} + \frac{1}{3} \times \frac{3 \times 4}{{}^{12}C_2}}$

$= \frac{\frac{1}{6}}{\frac{1}{5} + \frac{1}{6} + \frac{2}{11}} = \frac{55}{181}$

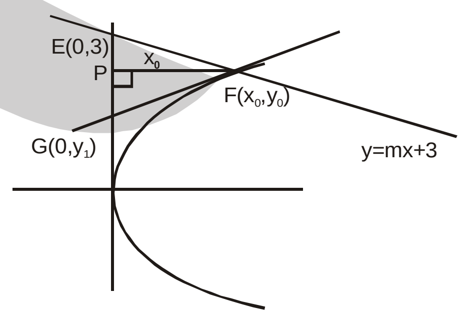
56. a $P(E) = P(WWW) + P(BBB) + P(RRR)$

$= \frac{1}{6} \times \frac{2}{9} \times \frac{3}{12} + \frac{2}{6} \times \frac{4}{9} \times \frac{5}{12} + \frac{3}{6} \times \frac{3}{9} \times \frac{4}{12}$

$= \frac{41}{324} = \frac{82}{648}$

57. a $y^2 = 16x, a = 4$

$x_0 = 4t^2, y_0 = 8t$



Tangent at F is
$yt = x + 4t^2$
$G = (0, 4t)$
$EG = |t - 3|$

$\Delta EFG = \frac{1}{2}|4t - 3| \times 4t^2$

$= 2t^2|4t - 3|$

$S = 2t^2(4t-3);\ t \ge \frac{3}{4}$

and $S = 2t^2(3-4t) = t < \frac{3}{4}$

$\frac{ds}{dt} = -24t^2 + 12t = 0$

$\Rightarrow t = 0, \frac{1}{2}$

$\boxed{t = \frac{1}{2}}$

$\therefore\ \frac{d^2s}{dt^2} = -48t + 12 < 0$ at $t = \frac{1}{2}$

$\therefore\ F = (1,4) \Rightarrow x_0 = 1, y_0 = 4$ and $y_1 = 4$

Now y = mx + 3 passes through F

$\therefore$ 4 = m + 3 $\Rightarrow m = 1$

$S_{max} = 2t^2(3-4t)$ at $t = \frac{1}{2}$

$2 \times \frac{1}{4}(3-2) = \frac{1}{2}$

58. b (P) $\left(\frac{1}{y^2}\left(\frac{\frac{1}{\sqrt{1+y^2}} + \frac{y^2}{\sqrt{1+y^2}}}{\frac{\sqrt{1-y^2}}{y} + \frac{y}{\sqrt{1-y^2}}}\right) + y^4\right)^{1/2}$

$= \left(\frac{1}{y^2}\left(\frac{\sqrt{1+y^2} \times y\sqrt{1-y^2}}{1-y^2+y^2}\right)^2 + y^4\right)^{1/2} = 1$

(Q) $\cos x + \cos y = -\cos z$

$\sin x + \sin y = -\sin z$

squaring and adding

2 + 2cos (x – y) = 1

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

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

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

(R) The given expression can be written as

$\cos 2x\left(\cos\left(\frac{\pi}{4} - x\right) - \cos\left(\frac{\pi}{4} + x\right)\right) = \sin 2x \sec x(\cos x - \sin x)$

$\Rightarrow \cos 2x\, 2\sin\frac{\pi}{4}\sin x = 2\sin x\cos x\sec x(\cos x - \sin x)$

$\Rightarrow \cos 2x = \sqrt{2}(\cos x - \sin x)$

$\Rightarrow \cos^2 2x = 2 - 2\sin 2x$

$\Rightarrow (\sin 2x - 1)^2 = 0 \Rightarrow \sin 2x = 1$

$\Rightarrow 2x = \frac{\pi}{2} \Rightarrow x = \frac{\pi}{4}$

$\therefore\ \text{sex} = \sqrt{2}$

(S) The given equation can be written as

$\frac{x}{\sqrt{1-x^2}} = \frac{x\sqrt{6}}{1+6x^2}$

$\Rightarrow 6(1-x^2) = 1 + 6x^2$

$\Rightarrow 12x^2 = 5 \Rightarrow x^2 = \frac{5}{12}$

$\therefore\ x = \frac{1}{2}\sqrt{\frac{5}{3}}$

59. a Points of intersection of L_1 and L_2 is (5, –2, –1)

Required plane is perpendicular to P_1 and P_2

$\therefore 7a + b + 2c = 0$

$3a + 5b - 6c = 0$

$\frac{a}{-6-10} = \frac{b}{6+42} = \frac{c}{32}$

$\Rightarrow \frac{a}{1} = \frac{b}{-3} = \frac{c}{-2}$

$\therefore$ Equation of plane is $x - 3y - 2z = d$

$\because$ Plane passing through (5, –2, –1)

$\therefore\ 5 + 6 + 2 = d \Rightarrow d = 13$

$\therefore$ Equation of plane x – 3y – 2z = 13

a = 1, b = –3, c = –2, d = 13

60. c (P) $V = [2(a \times b)\ 3(b \times c)\ \ c \times a]$

$= 6[\bar{a} \times \bar{b}\ \ \bar{b} \times \bar{c}\ \ \bar{c} \times \bar{a}]$

$= 6[a\ b\ c]^2 = 6 \times 4 = 24$

(Q) $v = [3(a+b)(b+c)2(a+c)]$

$= 6(a+b)\{(b+c) \times (c+a)\}$

$6(a+b)\{b \times c + b \times a + c \times a\}$

$= 12[a\ b\ c] = 60$

(R) $\frac{1}{2}\{(2a+3b) \times (a-b)\}$

$\frac{1}{2}\{-2(a \times b) + 3(b \times a)\}$

$= \frac{5}{2}|(a \times b)| = 5 \times 20 = 100$

(S) $|a \times (a+b)|$

$= |a \times a + a \times b| = |a \times b| = 30$