

1. (c) Average velocity = $\frac{\frac{x}{v_1} + \frac{x}{v_2}}{\frac{x}{v_1} + \frac{x}{v_2}} = v$

$$\frac{1}{v_1} + \frac{1}{v_2} = \frac{2}{v}$$

2. (a) $t_{1/2} = T$

$$1 \xrightarrow{T} \frac{1}{2} \xrightarrow{T} \frac{1}{4} \xrightarrow{T} \frac{1}{8}$$

$$t_{7/8} = 3T$$

3. (d)

$$(C_v)_{\text{mix}} = \frac{n_1 C_{v1} + n_2 C_{v2}}{n_1 + n_2}$$

$$(C_v)_{\text{mix}} = \frac{2 \times \frac{5}{2}R + 4 \times \frac{3}{2}R}{2 + 4} = \frac{11R}{6}$$

$$\Delta U = n(C_v)_{\text{mix}} RT = 6 \times \frac{11R}{6} \times RT = 11R$$

4. (a) $LC = 0.1 \text{ mm}$

$$\text{Zero Error} = 6 \times LC = 0.6 \text{ mm}$$

$$\text{Reading} = \text{MSR} + \text{VSR} \times LC - \text{Zero Error}$$

$$= [32 \text{ mm} + (0.1)4 \text{ mm}] - 0.6 \text{ mm}$$

$$= 31.8 \text{ mm}$$

$$= 3.18 \text{ cm}$$

5. (b) Both Statements are correct.

6. (c) $K_{\text{metal sheet}} = \infty, t = \frac{2d}{3}$

$$C_1 = \frac{\epsilon_0 A}{d}$$

$$C_2 = \frac{\epsilon_0 A}{d - t + \frac{t}{K}} = \frac{\epsilon_0 A}{d - \frac{2d}{3} + 0} = 3C_1$$

$$\frac{C_2}{C_1} = 3$$

7. (b) Statement I is true due to centrifugal force.

Statement II is incorrect,

At pole $g = g_s$ (no effect)

$$\text{At equator } g = g_s - r\omega^2 \cos^2 \lambda = g_s - r\omega^2$$

$$\therefore (\cos^2 \lambda_{\text{maximum}} \text{ at } \lambda = 0^\circ \text{ i.e. at equator})$$

Effect is maximum at equator.

8. (c)

$$\frac{mv^2}{2R} = \frac{GMm}{(2R)^2} \Rightarrow v = \sqrt{\frac{GM}{2R}} = \sqrt{\frac{Rg}{2}}$$

$$T = \frac{2\pi(2R)}{v} = \frac{4\pi R\sqrt{2}}{\sqrt{Rg}} = \sqrt{32R}$$

9. (b)

$$10. (b) \frac{E}{B} = C$$

$$E = BC$$

$$= 6 \times 10^{-7} \times 3 \times 10^8$$

$$= 18 \times 10$$

$$E = 180 \text{Vm}^{-1}$$

11. (d)

$$(a) \Delta Q = 0$$

$$(b) \Delta Q = \Delta U + \Delta W$$

$$\Rightarrow \Delta U = -\Delta W$$

adiabatic compression ($V \downarrow$)

$$\Delta W = -ve \Rightarrow \Delta U = +ve$$

$$\Delta U \uparrow \Rightarrow T \uparrow$$

$$\Delta U \neq 0$$

$$12. (c) I_{\text{net}} = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$$

$$= I_0 + I_0 + 2I_0 \cos \frac{\pi}{3}$$

$$= 2I_0 + 2I_0 \times \frac{1}{2} = 3I_0$$

$$I_{\text{net}} = I_0 + I_0 + 2I_0 \cos 90^\circ = 2I_0$$

$$\text{Ratio} = \frac{3}{2}$$

$$13. (c) eV_0 = h\nu - \phi$$

$$0 = h\nu - \phi$$

$$\phi = h\nu$$

$$= 6.6 \times 10^{-34} \times 5 \times 10^{14}$$

$$= 33 \times 10^{-20} \text{ J}$$

$$\phi = \frac{33 \times 10^{-20}}{1.6 \times 10^{-19}} = 2.07 \text{ eV}$$

14. (b) $y = \sin \omega t + \cos \omega t$

$$y = \sin \omega t + \sin \left(\omega t + \frac{\pi}{2} \right)$$

$$\Delta \phi = \frac{\pi}{2}$$

$$A_{\text{net}} = \sqrt{1^2 + 1^2 + 2 \times 1 \times 1 \times \cos(\Delta \phi)}$$

$$A_{\text{net}} = \sqrt{2}$$

15. (b) Move in curve path

$$i = neAV_d$$

16. (b) $\Delta L = \frac{FL}{AY}$

$$\frac{\Delta L_A}{\Delta L_B} = \frac{A_B Y_B}{A_A Y_A} = 12$$

17. (c) $H_{\text{max}} = \frac{u^2 \sin^2 \theta}{2g}$

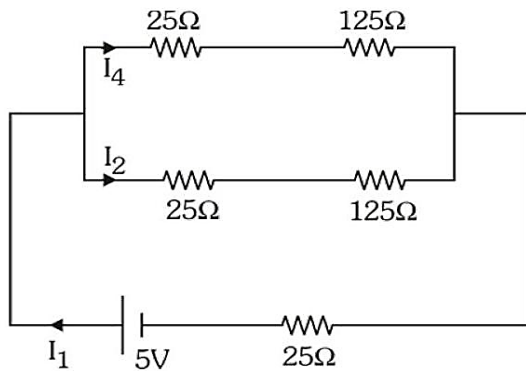
$$\frac{H_1}{H_2} = \frac{\sin^2 \theta_1}{\sin^2 \theta_2} = \frac{1}{3}$$

18. (d) Bandwidth $= 2f_m$

$$= 2 \times 3 \text{ kHz}$$

$$= 6 \text{ kHz}$$

19. (d)



$$R_{eq} = \frac{150 \times 150}{300} + 25 = 100\Omega$$

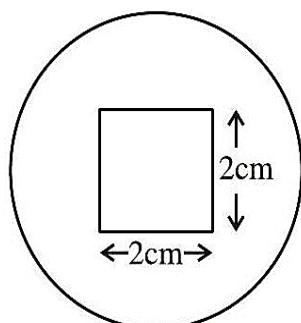
$$I_1 = \frac{5}{10} = 0.05 \text{ A}$$

$$I_2 = I_4 = \frac{0.05}{2} = 0.025 \text{ A}$$

$$\frac{I_1}{I_2} = 2$$

20. (a) After some time both force becomes equal.

21. (44)



Solenoid

$$B_{\text{due to solenoid}} = \mu_0 n I$$

$$\Phi_{\text{through square}} = \mu_0 n I \times A \text{ (A = Area)}$$

$$\text{Emf} = \mu_0 n A \times \frac{dI}{dt}$$

$$= \mu_0 n A \times I_0 \omega \cos \omega t$$

$$\text{Emf amplitude} = \mu_0 n A \times I_0 \omega$$

$$= 4\pi \times 10^{-7} \times \frac{50}{10^{-2}} \times 4 \times 10^{-4} \times 2.5 \times 700$$

$$= 44 \times 10^{-4} \text{ V}$$

22. (30)

$$T = 3.14 = \pi$$

$$T = \pi = \frac{2\pi}{\omega} \Rightarrow \omega = 2$$

$$\begin{aligned} F_{\max} &= m a_{\max} \\ &= m(A\omega^2) \\ &= mA(2)^2 \\ &= 5 \times 1 \times 4 \\ &= 20 \text{ N} \end{aligned}$$

23. (3668)

For lowest wavelength of Lyman series

$$\frac{1}{\lambda} = RZ^2 \left[\frac{1}{1^2} - \frac{1}{\infty^2} \right] = RZ^2$$

For lowest wavelength of Balmer series

$$\frac{1}{\lambda'} = RZ^2 \left[\frac{1}{2^2} - \frac{1}{\infty^2} \right] = \frac{RZ^2}{4}$$

$$\lambda' = \frac{4}{RZ^2} = 4 \times 917$$

$$= 3668 \text{ \AA}$$

24. (80) By equation of continuity

$$A_1 V_1 = A_2 V_2$$

$$V_2 = \frac{2 \times 4}{10 \times 10^{-2}} = 80 \text{ cm/s}$$

$$25. (2) B_{\text{at O}} = \frac{\mu_0 I}{4R} = \frac{4\pi \times 10^{-7} \times 14}{4 \times 2.2 \times 10^{-2}}$$

$$= 2 \times 10^{-4} \text{ T}$$

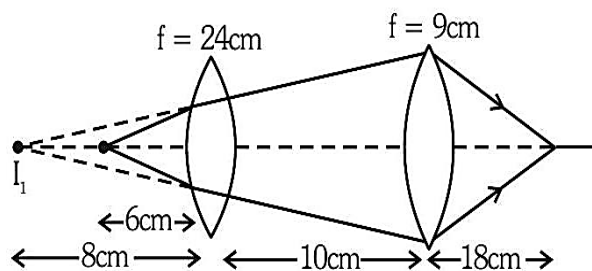
$$26. (34) \text{ From Ist lens } \frac{1}{v} + \frac{1}{6} = \frac{1}{24}$$

$$\begin{aligned} \frac{1}{v} &= \frac{1}{24} - \frac{1}{6} = -\frac{1}{8} \\ v &= -8 \text{ cm} \end{aligned}$$

$$\text{From IInd lens } \frac{1}{v} + \frac{1}{18} = \frac{1}{9}$$

$$\frac{1}{v} = \frac{1}{18}$$

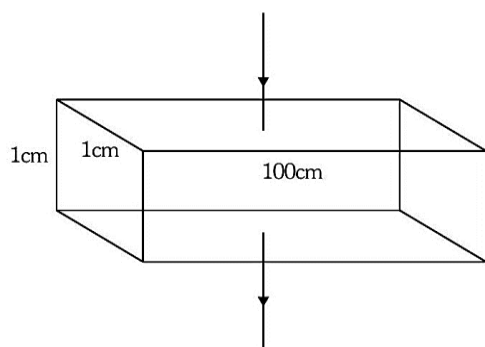
$$v = 18$$



So distance between object and its image

$$= 6 + 10 + 18 = 34 \text{ cm}$$

27. (3)



$$R = \rho \frac{\ell}{A} = \frac{3 \times 10^{-7} \times (1 \times 10^{-2})}{100 \times 1 \times 10^{-4}}$$

$$= 3 \times 10^{-7} \Omega$$

28. (3) $\tau = \vec{r} \times \vec{F}$

Where $\vec{r} = -2\hat{i} + 3\hat{j}$

$$\tau = (-2\hat{i} + 3\hat{j}) \times (-P\hat{k})$$

$$= P(-2\hat{j} - 3\hat{i}) = P(-3\hat{i} - 2\hat{j})$$

$$\Rightarrow \text{So } a = -3, b = -2$$

$$\frac{a}{b} = \frac{3}{2}$$

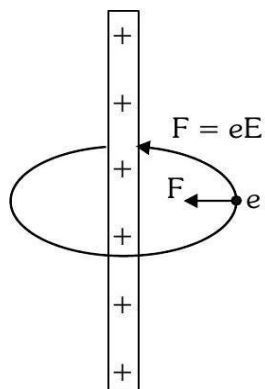
29. (48) $P_{\max} = F_{\max} \times V$

$$F_{\max} = 1400 \text{ g} + \text{friction}$$

$$= 14000 + 2000 = 16000$$

$$P_{\max} = 16000 \times 3 = 48000 \text{ W} = 48 \text{ KW}$$

30. (8)



$$eE = \frac{mV^2}{r}$$

$$e \cdot \frac{2K\lambda}{r} = \frac{mV^2}{r}$$

$$V = \sqrt{\frac{e \cdot 2k\lambda}{m}}$$

$$= \sqrt{\frac{1.6 \times 10^{-19} \times 2 \times 9 \times 10^9 \times 2 \times 10^{-8}}{9 \times 10^{-31}}}$$

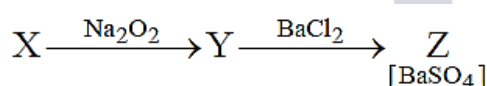
$$= 8 \times 10^6 \text{ m/s}$$

31. (a) Ozonolysis of alkene, gives aldehyde, ketone & carboxylic acid.

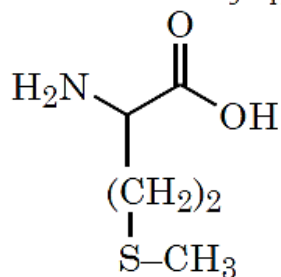
32. (d) Assertion & Reason are correct and Reason is correct explanation.

∴ Successive I.E. always increases.

33. (d)



Methionine: $\text{C}_5\text{H}_{11}\text{NO}_2\text{S}$

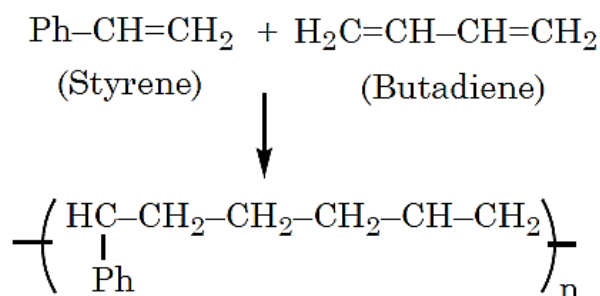


34. (d) Assertion is correct.

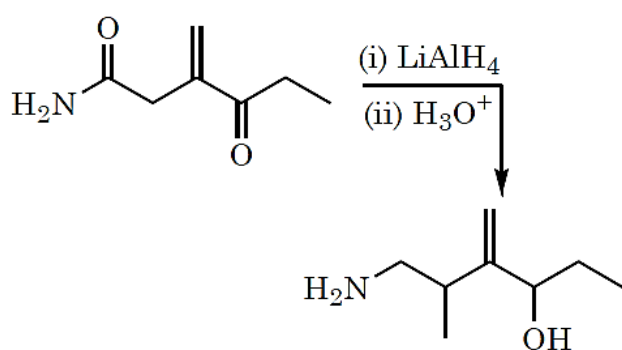
$$\begin{aligned} & \text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O} \\ M &= \frac{3.15 \times 1000}{126 \times 250} \\ &= \frac{12.6}{126} = 0.1 \end{aligned}$$

Reason is correct. It is used as a fact in explanation of assertion.

35. (b)



36. (a)



37. (c) Fe^{3+} coagulation negatively charged sol blood.

38. (b) Saponification: Alkaline hydrolysis.

39. (b) Stability order of cations is: $\text{C} < \text{A} < \text{B} < \text{D}$

40. (c)

FCC.

$$a\sqrt{2} = 4r$$

$$r = \frac{a\sqrt{2}}{4}$$

$$\Rightarrow a = 2\sqrt{2}r$$

BCC

$$4r = a\sqrt{3}$$

41. (d) Washing soda: $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

Soda ash: Na_2CO_3

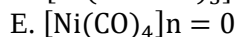
42. (d) Respiration, is a natural process, So balance of CO_2 and O_2 not disturbed by respiration.

43. (b)

A. $[\text{Fe}(\text{CN})_6]^{3-n} = 1$

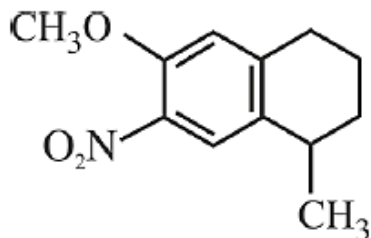
B. $[\text{FeF}_6]^{3-n} = 5$

C. $[\text{CoF}_6]^{3-n} = 4$

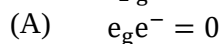
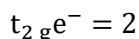
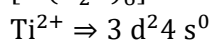
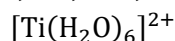


44. (a) $E > C > D > A > B$

45. (d)

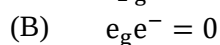
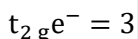
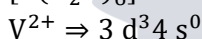


46. (b) A-IV, B-I, C-II, D-III



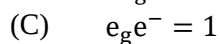
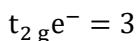
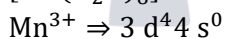
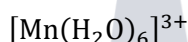
$$\text{CFSE} = [-0.4 \times 2 + 0.6 \times 0] \Delta_0$$

$$= -0.8 \Delta_0$$



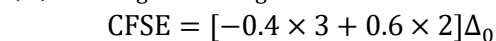
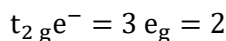
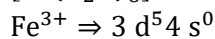
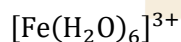
$$\text{CFSE} = [-0.4 \times 3 + 0.6 \times 0] \Delta_0$$

$$= -1.2 \Delta_0$$



$$\text{CFSE} = [-0.4 \times 3 + 0.6 \times 1] \Delta_0$$

$$= -0.6 \Delta_0$$



$$= 0 \Delta_0$$

47. (d) Both A and R are true and R is the correct explanation of A.

Due to mass difference in isotopes of hydrogen, these have different physical property.

48. (d)

$16 \text{ gCH}_4 = 1 \text{ moleCH}_4$ contains $10 \times 6.02 \times 10^{23}$ electrons

$$= 60.2 \times 10^{23}$$

1 g H_2 = 0.5 mole H_2 gas occupy 11.35 litre volume

at STP

1 mole of N_2 = 28 g

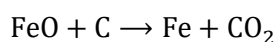
0.5 mole of SO_2 = 32 g

49. (c) On moving from top to bottom metallic character increases while on moving from left to right metallic decreases.

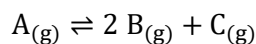
$K > Ca > Be$

50. (b)

at $600^\circ C$,



51. (3)



$$t = 0 \quad 450$$

$$t_{\text{met}} \quad 450 - x \quad 2x \quad x$$

$$P_T = P_A + P_B + P_C$$

$$720 = 450 - x + 2x + x$$

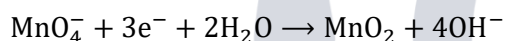
$$2x = 270$$

$$x = 135$$

$$\text{Fraction of A decomposed} = \frac{135}{450} = 0.3 = 3 \times 10^{-1}$$

$$\text{So, } x = 3$$

52. (3) In faintly alkaline medium,



No. of electrons gained = 3

53. (4)

A $\rightarrow$ Endothermic (Atomisation)

B $\rightarrow$ Endothermic (Atomisation)

C $\rightarrow$ Endothermic (Vapourisation)

D $\rightarrow$ Exothermic (Combustion)

E $\rightarrow$ Endothermic (Dissolution)

54. (4) H_2O , CO , N_2 , NO , has two lone pair of electrons

55. (2)



in XeO_3 , Oxidation state of Xe = +6

in XeF_4 , Oxidation state of Xe = +4

So difference in oxidation state = 2

56. (40535)

$$\because \pi = CRT$$

$$\pi = \frac{n}{V} RT$$

$$\pi = \frac{\omega RT}{V M}$$

$$M = \frac{\omega RT}{\pi \times V}$$

$$M = \frac{0.63 \times 0.083 \times 300}{1.29 \times 10^{-3} \times 300 \times 10^{-3}}$$

$$M = 40535 \text{ gm/mol}$$

57. (4) $\mu = \sqrt{n(n+2)} \text{ BM}$

$$4.90 = \sqrt{n(n+2)}$$

$$n = 4$$

58. (1)

$$\Delta E = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right)$$

$$1.47 \times 10^{-17} = 2.18 \times 10^{-18} \times 9 \left(\frac{1}{n^2} - \frac{1}{(n+1)^2} \right)$$

$$\frac{1.47}{1.96} = \frac{3}{4} = \frac{1}{n^2} - \frac{1}{(n+1)^2}$$

$$\text{So, } n = 1$$

59. (66)

$$\Lambda_m = \frac{k}{C} \times 1000$$

$$\text{Given } k = 5 \times 10^{-5} \text{ S cm}^{-1}$$

$$C = 0.0025 \text{ M}$$

$$\Lambda_m = \frac{5 \times 10^{-5} \times 10^3}{0.0025} = \frac{5 \times 10^{-2}}{2.5 \times 10^{-3}}$$

$$= 20 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\alpha = \frac{20}{400} = \frac{1}{20}$$

$$K_a = \frac{C\alpha^2}{1-\alpha} = \frac{0.0025 \times \frac{1}{20} \times \frac{1}{20}}{\frac{19}{20}}$$

$$= \frac{0.0025}{19 \times 20} = 6.6 \times 10^{-6}$$

$$= 66 \times 10^{-7}$$

60. (1)

(A) For zero order $t_{1/2} = \frac{[A]_0}{2K}$ as concentration decreases half life decreases (Correct statement)

(B) If order w.r.t. that reactant is zero then it will not affect rate of reaction. (Correct statement)

(C) Order can be fractional but molecularity cannot be (Incorrect statement)

(D) For zero order reaction unit is $\text{molL}^{-1} \text{s}^{-1}$ and for second order reaction unit is $\text{mol}^{-1} \text{Ls}^{-1}$ (Correct statement)

61. (a)

$$\int_0^{t^2} (f(x) + x^2) dx = \frac{4}{3} t^3, \forall t > 0$$

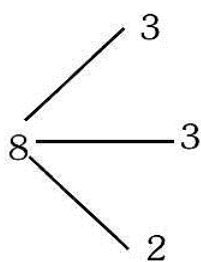
$$(f(t^2) + t^4) = 2t$$

$$f(t^2) = 2t - t^4$$

$$t = \frac{\pi}{2} \Rightarrow f\left(\frac{\pi^2}{4}\right) = \frac{2\pi}{2} - \frac{\pi^4}{16}$$

$$= \pi - \frac{\pi^4}{16} = \pi \left(1 - \frac{\pi^3}{16}\right)$$

62. (b)



$$\text{Ways} = \frac{8!}{3!3!2!} \times 3!$$

$$= \frac{8 \times 7 \times 6 \times 5 \times 4}{4}$$

$$= 56 \times 30$$

$$= 1680$$

63. (d) ($x = e^{\ln x}$)

$$\int \left(\left(\frac{x}{e} \right)^{2x} + \left(\frac{e}{x} \right)^{2x} \right) \log_e x dx = \int [e^{2(x \ln x - x)} + e^{-2(x \ln x - x)}] \ln x dx \quad x \ln x - x = t$$

$$\ln x \cdot dx = dt$$

$$\int (e^{2t} + e^{-2t}) dt$$

$$\frac{e^{2t}}{2} - \frac{e^{-2t}}{2} + C$$

$$= \frac{1}{2} \left(\frac{x}{e} \right)^{2x} - \frac{1}{2} \left(\frac{e}{x} \right)^{2x} + C$$

$$\alpha = \beta = \gamma = \delta = 2$$

$$\alpha + 2\beta + 3\gamma - 4\delta = 4$$

64. (a) Equation of plane $A(x - 1) + B(y - 2) + C(z - 0) = 0$

Put $(1, 4, 1) \Rightarrow 2B + C = 0$

Put $(0, 5, 1) \Rightarrow -A + 3B + C = 0$

Sub: $B - A = 0 \Rightarrow A = B, C = -2B$

$$1(x - 1) + 1(y - 2) - 2(z - 0) = 0$$

$$x + y - 2z - 3 = 0$$

Image is $(\alpha, \beta, \gamma)_{pt} \equiv (1, 2, 6)$

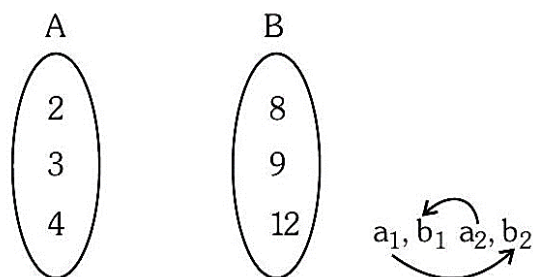
$$\frac{\alpha - 1}{1} = \frac{\beta - 2}{1} = \frac{\gamma - 6}{-2} = \frac{-2(1 + 2 - 12 - 3)}{6}$$

$$\frac{\alpha - 1}{1} = \frac{\beta - 2}{1} = \frac{\gamma - 6}{-2} = 4$$

$$\alpha = 5, \beta = 6, \gamma = -2 \Rightarrow \alpha^2 + \beta^2 + \gamma^2$$

$$= 25 + 36 + 4 = 65$$

65. (a)



a_1 divides b_2

Each element has 2 choices

$$\Rightarrow 3 \times 2 = 6$$

a_2 divides b_1

Each element has 2 choices

$$\Rightarrow 3 \times 2 = 6$$

$$\text{Total} = 6 \times 6 = 36$$

$$66. (d) |\text{adjadj}(2A)| = |2A|^{(n-1)^2}$$

$$= |2A|^4$$

$$= (2^3 |A|)^4$$

$$= 2^{12} |A|^4 \Rightarrow 2^{16}$$

$$|A| = \frac{1}{5!6!7!} 5!6! \begin{vmatrix} 1 & 6 & 42 \\ 1 & 7 & 56 \\ 1 & 8 & 72 \end{vmatrix}$$

$$R_3 \rightarrow R_3 \rightarrow R_2$$

$$R_2 \rightarrow R_2 \rightarrow R_1$$

$$|A| = \begin{vmatrix} 1 & 8 & 42 \\ 0 & 1 & 14 \\ 0 & 1 & 16 \end{vmatrix} = 2$$

67. (d)

$$\begin{array}{ccc} \bullet & \bullet & \bullet \\ A(1, 2) & P(h, k) & B(4\cos\theta, 4\sin\theta) \end{array}$$

$$\frac{12\cos\theta + 2}{5} = h \Rightarrow 12\cos\theta = 5h - 2$$

$$\frac{12\sin\theta + 4}{5} = k \Rightarrow 12\sin\theta = 5k - 4$$

Sq & add:

$$144 = (5h - 2)^2 + (5k - 4)^2$$

$$\left(x - \frac{2}{5}\right)^2 + \left(y - \frac{4}{5}\right)^2 = \frac{144}{25}$$

$$\text{Centre} \equiv \left(\frac{2}{5}, \frac{4}{5}\right) \equiv (\alpha, \beta)$$

$$\begin{aligned} AC &= \sqrt{\left(1 - \frac{2}{5}\right)^2 + \left(2 - \frac{4}{5}\right)^2} \\ &= \sqrt{\frac{9}{25} + \frac{36}{25}} = \frac{\sqrt{45}}{5} = \frac{3\sqrt{5}}{5} \end{aligned}$$

68. (d) P(odd number 7 times) = P(odd number 9 times)

$${}^nC_7 \left(\frac{1}{2}\right)^7 \left(\frac{1}{2}\right)^{n-7} = {}^nC_9 \left(\frac{1}{2}\right)^9 \left(\frac{1}{2}\right)^{n-9}$$

$${}^nC_7 = {}^nC_9$$

$$\Rightarrow n = 16$$

Required

$$P = {}^{16}C_2 \times \left(\frac{1}{2}\right)^{16}$$

$$= \frac{16 \cdot 15}{2} \times \frac{1}{2^{16}} = \frac{15}{2^{13}}$$

$$\Rightarrow \frac{60}{2^{15}} \Rightarrow k = 60$$

69. (b) $g(x) = f(x) + f(1-x) + f''(x) > 0, x \in (0,1)$

$$g'(x) = f'(x) - f'(1-x) = 0$$

$$\Rightarrow f'(x) = f'(1-x)$$

$$x = 1-x$$

$$x = \frac{1}{2}$$

$$g'(x) = 0$$

$$\text{at } x = \frac{1}{2}$$

$$g''(x) = f''(x) + f''(1-x) > 0$$

g is concave up

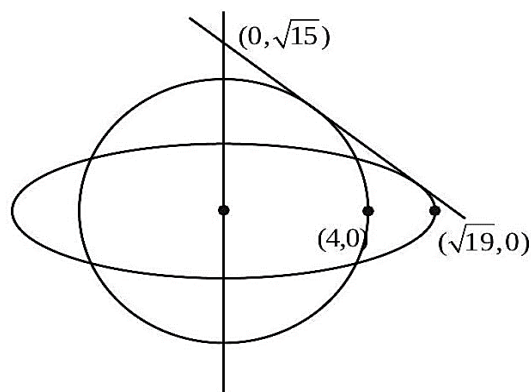
$$\text{hence } \alpha = \frac{1}{2}$$

$$\tan^{-1} 2\alpha + \tan^{-1} \frac{1}{\alpha} + \tan^{-1} \frac{\alpha+1}{\alpha}$$

$$\Rightarrow \tan^{-1} 1 + \tan^{-1} 2 + \tan^{-1} 3 = \pi$$

70. (b)

$$\frac{x^2}{19} + \frac{y^2}{15} = 1$$



Let tang be

$$y = mx \pm \sqrt{19m^2 + 15}$$

$$mx - y \pm \sqrt{19m^2 + 15} = 0$$

Parallel from (0,0) = 4

$$\left| \frac{\pm \sqrt{19m^2 + 15}}{\sqrt{m^2 + 1}} \right| = 4$$

$$19m^2 + 15 = 16m^2 + 16$$

$$3m^2 = 1$$

$$m = \pm \frac{1}{\sqrt{3}}$$

$\theta = \frac{\pi}{6}$ with x-axis

Required angle $\frac{\pi}{3}$.

71. (c) $\vec{a} = 2\hat{i} + 7\hat{j} - \hat{k}$

$$\vec{b} = 3\hat{i} + 5\hat{k}$$

$$\vec{c} = \hat{i} - \hat{j} + 2\hat{k}$$

$$\vec{d} = \lambda(\vec{a} \times \vec{b}) = \lambda \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 7 & -1 \\ 3 & 0 & 5 \end{vmatrix}$$

$$\vec{d} = \lambda(35\hat{i} - 13\hat{j} - 21\hat{k})$$

$$\lambda(35 + 13 - 42) = 12$$

$$\lambda = 2$$

$$\vec{d} = 2(35\hat{i} - 13\hat{j} - 21\hat{k})$$

$$(\hat{i} + \hat{j} - \hat{k})(\vec{c} \times \vec{d})$$

$$= \begin{vmatrix} -1 & 1 & -1 \\ 1 & -1 & 2 \\ 70 & -26 & -42 \end{vmatrix} = 44$$

72. (c) $S_n = 4 + 11 + 21 + 34 + 50 + \dots + n$ terms

Difference are in A.P.

$$\text{Let } T_n = an^2 + bn + c$$

$$T_1 = a + b + c = 4$$

$$T_2 = 4a + 2b + c = 11$$

$$T_3 = 9a + 3b + c = 21$$

By solving these 3 equations

$$a = \frac{3}{2}, b = \frac{5}{2}, c = 0$$

$$\text{So } T_n = \frac{3}{2}n^2 + \frac{5}{2}n$$

$$S_n = \sum T_n$$

$$= \frac{3}{2} \sum n^2 + \frac{5}{2} \sum n$$

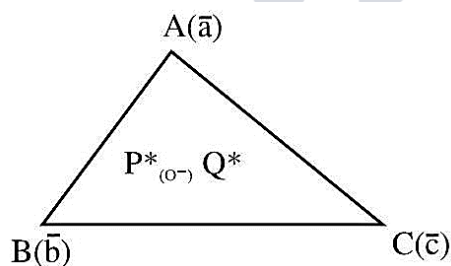
$$= \frac{3}{2} \frac{n(n+1)(2n+1)}{6} = \frac{5}{2} \frac{(n)(n+1)}{2}$$

$$= \frac{n(n+1)}{4} [2n+1+5]$$

$$S_n = \frac{n(n+1)}{4} (2n+6) = \frac{n(n+1)(n+3)}{2}$$

$$\frac{1}{60} \left(\frac{29 \times 30 \times 32}{2} - \frac{9 \times 10 \times 12}{2} \right) = 223$$

73. (d)



$$\overrightarrow{PA} + \overrightarrow{PB} + \overrightarrow{PC} = \vec{a} + \vec{b} + \vec{c}$$

$$\overrightarrow{PG} = \frac{\vec{a} + \vec{b} + \vec{c}}{3}$$

$$\Rightarrow \vec{a} + \vec{b} + \vec{c} = 3\overrightarrow{PG} = \overrightarrow{PQ}$$

74. (d) $\sim [p \vee (\sim (p \wedge q))]$

$$\sim p \wedge (p \wedge q)$$

75. (a) Let $9^{\tan^2 x} = P$

$$\frac{9}{P} + P = 10$$

$$P^2 - 10P + 9 = 0$$

$$(P - 9)(P - 1) = 0$$

$$P = 1, 9$$

$$9^{\tan^2 x} = 1, 9^{\tan^2 x} = 9$$

$$\tan^2 x = 0, \tan^2 x = 1$$

$$x = 0, \pm \frac{\pi}{4} \therefore x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$$

$$\beta = \tan^2(0) + \tan^2\left(+\frac{\pi}{12}\right) + \tan^2\left(-\frac{\pi}{12}\right)$$

$$= 0 + 2(\tan 15^\circ)^2$$

$$2(2 - \sqrt{3})^2$$

$$2(7 - 4\sqrt{3})$$

$$\text{Then } \frac{1}{6}(14 - 8\sqrt{3} - 14)^2 = 32$$

$$76. (a) (1 + x)^P(1 - x)^Q$$

$$\left(1 + px + \frac{p(p-1)}{2!}x^2 + \dots\right)$$

$$\left(1 - qx + \frac{q(q-1)}{2!}x^2 - \dots\right)$$

$$p - q = 4$$

$$\frac{p(p-1)}{2} + \frac{q(q-1)}{2} - pq = -5$$

$$p^2 + q^2 - p - q - 2pq = -10$$

$$(q + 4)^2 + q^2 - (q + 4) - q - 2(4 + q)q = -10$$

$$q^2 + 8q + 16 - q^2 - q - 4 - q - 8q - 2q^2 = -10$$

$$-2q = -22$$

$$q = 11$$

$$p = 15$$

$$2(15) + 3(11)$$

$$30 + 33 = 63$$

$$77. (a) \frac{x}{1} = \frac{y-6}{-2} = \frac{z+8}{5} = \lambda$$

$$\frac{x-5}{4} = \frac{y-7}{3} = \frac{z+2}{1} = \mu$$

$$\frac{x+3}{4} = \frac{y-3}{-3} = \frac{z-6}{1} = \gamma$$

Intersection of (a) & (b) "A"

$$(\lambda, -2\lambda + 6, 5\lambda - 8) \& (4\mu + 5, 3\mu + 7, \mu - 2)$$

$$\lambda = 1, \mu = -1$$

$$A(1, 4, -3)$$

Intersection of (a) & (c) "B"

$$(\lambda, -2\lambda + 6, 5\lambda - 8) \& (6\gamma - 3, -3\gamma + 3, \gamma + 6)$$

$$\lambda = 3$$

$$\gamma = 1$$

$$B(3, 0, 7)$$

Mid point of A&B $\Rightarrow (2, 2, 2)$

Perpendicular distance from the plane

$$2x - 2y + z = 14$$

$$\Rightarrow \left| \frac{2(b) - 2(b) + 2 - 14}{\sqrt{4 + 4 + 1}} \right| = 4$$

$$78. (c) \frac{2z-3i}{qz+2i} \in \mathbb{R}$$

$$\frac{2(x+iy) - 3i}{4(x+it) + 2i} = \frac{2x + (2y-3)i}{4x + (4y+2)i} \times \frac{4x - (4y+2)i}{4x - (4y+2)i}$$

$$4x(2y-3) - 2x(4y+2) = 0$$

$$x = 0, y \neq -\frac{1}{2}$$

$$79. (b) (22)^{2022} + (2022)^{22}$$

divided by 3

$$(21+1)^{2022} + (2022)^{22}$$

$$= 3k + 1$$

$$(\alpha = 1)$$

Divided by 7

$$(21+1)^{2022} + (2023-1)^{22}$$

$$7k + 1 + 1 (\beta = 2)$$

$$7k + 2$$

$$\text{So } \alpha^2 + \beta^2 \Rightarrow 5$$

$$80. (a) \sum f_i = 62$$

$$\Rightarrow 3k^2 + 16k - 12k - 64 = 0$$

$$\Rightarrow k = \text{or } -\frac{16}{3} \text{ (rejected)}$$

$$\mu = \frac{\sum f_i x_i}{\sum f_i}$$

$$\mu = \frac{8 + 2(15) + 3(15) + 4(17) + 5}{62} = \frac{156}{62}$$

$$\sigma^2 = \sum f_i x_i^2 - (\sum f_i x_i)^2$$

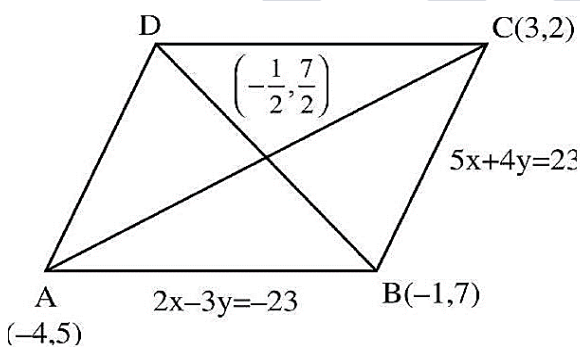
$$= \frac{8 \times 1^2 + 15 \times 13 + 17 \times 16 + 25}{62} - \left(\frac{156}{62}\right)^2$$

$$\sigma^2 = \frac{500}{62} - \left(\frac{156}{62}\right)^2$$

$$\sigma^2 + \mu^2 = \frac{500}{62}$$

$$[\sigma^2 + \mu^2] = 8$$

$$81. (529)$$



A & C point will be $(-4,5)$ & $(3,2)$ mid point of AC will be $\left(-\frac{1}{2}, \frac{7}{2}\right)$

equation of diagonal BD is

$$y - \frac{7}{2} = \frac{\frac{7}{2} - 5}{-\frac{1}{2} - (-4)}$$

$$\left(x + \frac{1}{2}\right)$$

$$\Rightarrow 7x + y = 0$$

Distance of A from diagonal BD

$$= d = \frac{23}{\sqrt{50}}$$

$$\Rightarrow 50 d^2 = (23)^2$$

$$50 d^2 = 529$$

82. (24)

$$\Delta = \begin{vmatrix} 6\lambda & -3 & 3 \\ 2 & 6\lambda & 4 \\ 3 & 2 & 3\lambda \end{vmatrix} = 0 \text{ (For No Solution)}$$

$$2\lambda(9\lambda^2 - 4) + (3\lambda - 6) + (2 - 9\lambda) = 0$$

$$18\lambda^3 - 14\lambda - 4 = 0$$

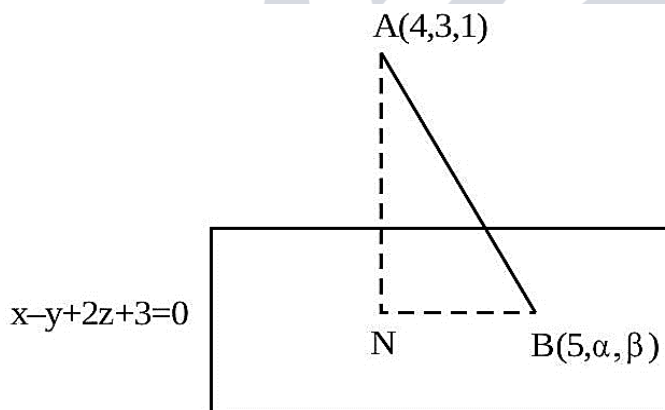
$$(\lambda - 1)(3\lambda + 1)(3\lambda + 2) = 0$$

$$\Rightarrow \lambda = 1, -1/3, -2/3$$

$$\text{For each } \lambda, \Delta_1 = \begin{vmatrix} 6\lambda & -3 & 4\lambda^2 \\ 2 & 6\lambda & 1 \\ 3 & 2 & \lambda \end{vmatrix} \neq 0$$

$$\text{Ans. } 12 \left(1 + \frac{1}{3} + \frac{2}{3} \right) = 24$$

83. (7)



$$AN = \sqrt{6}$$

$$5 - \alpha + 2\beta + 3 = 0$$

$$\Rightarrow \alpha = 8 + 2\beta$$

N is given by

$$\frac{x-4}{1} = \frac{y-3}{-1} = \frac{z-1}{2} = \frac{-(4-3+2+3)}{1+1+4}$$

$$\Rightarrow x = 3, y = 4, z = -1$$

$$\Rightarrow N \text{ is } (3, 4, -1)$$

$$BN = \sqrt{4 + (\alpha - 4)^2 + (\beta + 1)^2}$$

$$= \sqrt{4 + (2\beta + 4)^2 + (\beta + 1)^2}$$

$$\text{Area of } \triangle ABN = \frac{1}{2} AN \times BN = 3\sqrt{2}$$

$$\Rightarrow \frac{1}{2} \times \sqrt{6} \times BN = 3\sqrt{2}$$

$$BN = 2\sqrt{3}$$

$$\Rightarrow 4 + (2\beta + 4)^2 + (\beta + 1)^2 = 12$$

$$(2\beta + 4)^2 + (\beta + 1)^2 - 8 = 0$$

$$5\beta^2 + 18\beta + 9 = 0$$

$$(5\beta + 3)(\beta + 3) = 0$$

$$\beta = -3$$

$$\Rightarrow \alpha = 2$$

$$\Rightarrow \alpha^2 + \beta^2 + \alpha\beta = 9 + 4 - 6 = 7$$

84. (11)

$$f(x) = (x + 1)(ax + b)$$

$$1 = 2a + 2b$$

$$f'(x) = (ax + b) + a(x + 1)$$

$$1 = (3a + b)$$

$$\Rightarrow b = 1/4, a = 1/4$$

$$f(x) = \frac{(x + 1)^2}{4}$$

$$f'(x) = \frac{x}{2} + \frac{1}{2}$$

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

$$\alpha + 1 = 4$$

$$\alpha = 3$$

normal at (3,4)

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

$$y = 0$$

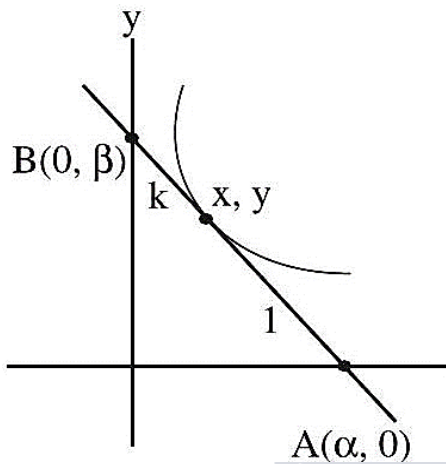
$$x = 8 + 3$$

85. (6) equation of tangent at P(x, y)

$$Y - y = \frac{dy}{dx}(X - x)$$

$$Y = 0$$

$$X = \frac{-y dx}{dy} + x$$



$$\frac{k\alpha + 0}{k + 1} = x, \alpha = \frac{k + 1}{k}x$$

$$\frac{k + 1}{k}x = -y \frac{dx}{dy} + x$$

$$x + \frac{x}{k} = -y \frac{dx}{dy} + x$$

$$x \frac{dy}{dx} + ky = 0 \quad \frac{dy}{dx} + \frac{k}{x}y = 0$$

$$y \cdot x^k = C$$

$$C = 1$$

$$100 \cdot \left(\frac{1}{10}\right)^k = 1$$

$$K = 2$$

$$\frac{dy}{dx} = \ln(2x + 1)$$

$$y = \frac{(2x + 1)}{2}(\ln(2x + 1) - 1) + c$$

$$2 = \frac{1}{2}(0 - 1) + C$$

$$C = 2 + \frac{1}{2} = \frac{5}{2}$$

$$y(1) = \frac{3}{2}(\ln 3 - 1) + \frac{5}{2}$$

$$= \frac{3}{2}\ln 3 + 1$$

$$4y(1) = 6\ln 3 + 4$$

$$4y(1) - 5\ln 3 = 4 + \ln 3$$

86. (16)

$$\frac{(a-2d)}{4}, \frac{(a-d)}{2}, a, 2(a+d), 4(a+2d)$$

$$a = 2$$

$$\left(\frac{1}{4} + \frac{1}{2} + 1 + 6\right) \times 2 + (-1 + 2 + 8)d = \frac{49}{2}$$

$$2\left(\frac{3}{4} + 7\right) + 9d = \frac{49}{2}$$

$$9d = \frac{49}{2} - \frac{62}{4} = \frac{98 - 62}{4} = 9$$

$$d = 1$$

$$\Rightarrow a_4 = 4(a + 2d)$$

$$= 16$$

87. (24) $f(x) = \sec^{-1} \frac{2x}{5x+3}$

$$\left| \frac{2x}{5x+3} \right|$$

$$\left| \frac{2x}{5x+3} \right| \geq 1 \Rightarrow |2x| \geq |5x+3|$$

$$(2x)^2 - (5x+3)^2 \geq |5x+3|$$

$$(7x+3)(-3x-3) \geq 0$$

$$\frac{+}{-1 - \frac{3}{7}}$$

$$\therefore \text{domain} \left[-1, \frac{-3}{5} \right) \cup \left(\frac{-3}{5}, \frac{-3}{7} \right]$$

$$\alpha = -1, \beta = \frac{-3}{5}, \gamma = \frac{-3}{5}, \delta = \frac{-3}{7}$$

$$3\alpha + 10(\beta + \gamma) + 21\delta = -3$$

$$-3 + 10\left(\frac{-6}{5}\right) + \left(\frac{-3}{7}\right)21 = -24$$

88. (26664)

2, 1, 2, 3

$$- - \frac{1}{2} \frac{3!}{2!} = 3$$

$$- - \frac{23!}{2!} = 6$$

$$- - \frac{3!}{2!}$$

$$\text{Sum of digits of unit place} = 3 \times 1 + 6 \times 2 + 3 \times 3$$

$$= 24$$

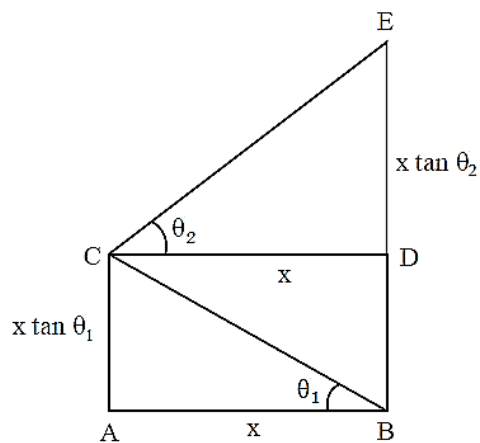
required sum

$$= 24 \times 1000 + 24 \times 100 + 24 \times 10 + 24 \times 1$$

$$= 24 \times 1111$$

Ans ; 26664

89. (6)



$$\sqrt{3}BE = 4AB$$

$$\text{Ar}(\Delta CAB) = 2\sqrt{3} - 3$$

$$\frac{1}{2}x^2 \tan \theta_1 = 2\sqrt{3} - 3$$

$$BE = BD + DE$$

$$= x(\tan \theta_1 + \tan \theta_2)$$

$$BE = AB(\tan \theta_1 + \cot \theta_1)$$

$$\frac{4}{\sqrt{3}} \tan \theta_1 + \cot \theta_1 \Rightarrow \tan \theta_1 = \sqrt{3}, \frac{1}{\sqrt{3}}$$

$$\theta_1 = \frac{\pi}{6}$$

$$\theta_1 = \frac{\pi}{3}$$

$$\text{as } \frac{\theta_2}{\theta_1} \text{ is largest } \therefore \theta_1 = \frac{\pi}{6} \theta_2 = \frac{\pi}{3}$$

$$\therefore x^2 = \frac{(2\sqrt{3} - 3) \times 2}{\tan \theta_1} = \frac{\sqrt{3}(2 - \sqrt{3}) \times 2}{\tan \frac{\pi}{6}}$$

$$x^2 = 12 - 6\sqrt{3} = (3 - \sqrt{3})^2$$

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

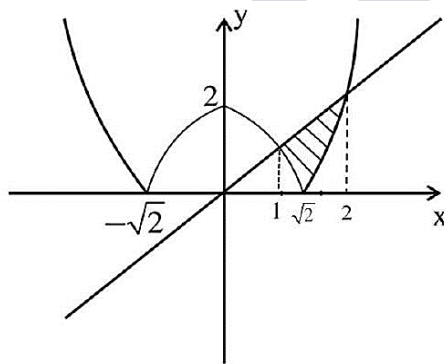
Perimeter of ΔCED

$$= CD + DE + CE$$

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

Ans :

90. (27) $|x^2 - 2| \leq y \leq x$



$$A = \int_1^{\sqrt{2}} (x - (2 - x^2)) dx + \int_{\sqrt{2}}^2 (x - (x^2 - 2)) dx$$

$$= \left(1 - 2\sqrt{2} + \frac{2\sqrt{2}}{3}\right) - \left(\frac{1}{2} - 2 + \frac{1}{3}\right) + \left(2 - \frac{8}{3} + 4\right) - \left(1 - \frac{2\sqrt{2}}{3} + 2\sqrt{2}\right)$$

$$= -4\sqrt{2} + \frac{4\sqrt{2}}{3} + \frac{7}{6} + \frac{10}{3} = \frac{-8\sqrt{2}}{3} + \frac{9}{2}$$

$$6A = -16\sqrt{2} + 27 \therefore 6A + 16\sqrt{2} = 27$$

Ans: 27