KEYS SET – C PAPER – I

PHYSICS		CHEMISTRY	
1.	(c)	23.	(c)
2.	(a)	24.	(a)
3.	(b)	25.	(a)
4.	(b)	26.	(c)
5.	(b)	27.	(b)
6.	(b)	28.	(d)
7.	(d)	29.	(b)
8.	(a)	30.	(a)
9.	(c)	31.	(a)
10.	(b)	32.	(a)
11.	(a)	33.	(a)
12.	(d)	34.	(c)
13.	(c)	35.	(b)
14.	(a)	36.	(d)
15.	(a)	37.	(c)
16.	(b)	38.	(c)
17.	(b)	39.	(b)
18.	(b)	40.	(a)
19.	(c)	41.	(b)
20.	(a – q, r)	42.	(A – q)
	(b – q, r)		(B – p)
	(c – q, r)		(C – s)
	(d – q, r, s)		(D – r)
21.	(a - q)	43.	(A – q)
	(b – s)		(B – p)
	(c – r)		(C – s)
	(d – p)		(D – r)
22.	(a - s)	44.	(A – q)
	(b – r)		(B – r)
	(c – q)		(C – q, s)
	(d – p)		(D – p)

MATHEMATICS

45) A	**46) B**	**47) B**	**48) B**	**49) A**	**50) D**	**51) B**	**52) B**	**53) A**	
54) D	**55) A**	**56) C**	**57) D**						
58) D	**59) D**	**60) D**	**61) A**	**62) B**	**63) C**				
64)	a – q; b – p; c – r; d – s								
65)	a – r, q; b – p, s; c – q, r; d – p, s								
66)	a – q; b – r; c – p; d – s								

PHYSICS

1. $B_{net} = B_{cylinder} - B_{hole}$

$$= \frac{\mu_0 J(\pi d^2)}{2\pi d} - \frac{\mu_0 J(\pi r^2)}{2\pi(2d)}$$

$$= \frac{\mu_0 J}{2}\left(d - \frac{r^2}{2d}\right)$$

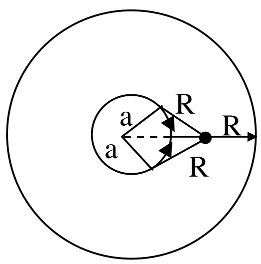
2. $\phi_{total} = E4\pi r^2 = \int_0^r p(r)4\pi r^2 dr$

$$p(r) = \frac{\varepsilon_0}{4\pi r^2}\frac{d}{dr}\left(Ar^2 4\pi r^2\right) = 4A\varepsilon_0 r$$

3. $PV = m\sum v_x^2$

$m = 10^{-23}$ g

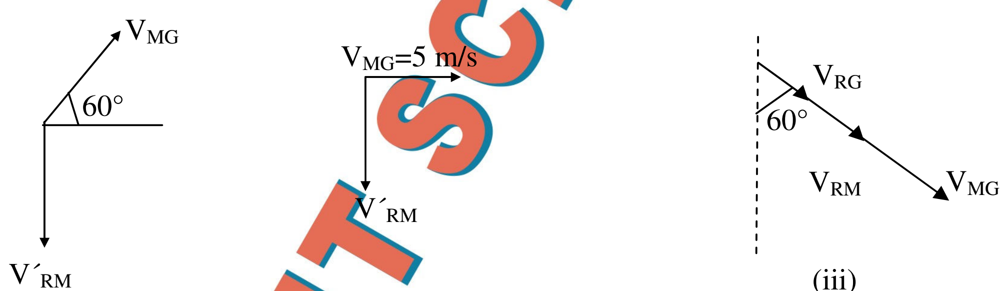
4.



$$b - R = \sqrt{a^2 + R^2}$$

$$R = \frac{b^2 - a^2}{2b}$$

6.



(i) (ii) (iii)

From (iii) $\vec{V}_{RM} = V_{RG} - \vec{V}_{MG}$

As $\vec{V}_{RM}$ is insame direction as that of $\vec{V}_{MG}$, $\vec{V}_{RG}$ will be in same direction.

For (i) or (ii)

X–component of $V_{RG} = V_{RG_x} = V_{MG}\cos 60° = 10\cos 60° = 5\ m/s$

$V_{RG}\sin 60° = 5\ m/s$

$$V_{RG} = \frac{5\times 2}{\sqrt{3}} = \frac{10}{\sqrt{3}}$$

14 $\Delta U = 0$ (for cycle)

$W_{net} = \theta_{net}$

$W_{net} = \theta_{net} = \theta_{cd} + \theta_{ab} = -1.97 \times 10^5$ J

15. $\Delta U = U_b - U_a$

$= -7.98 \times 10^5$ J

$W = P\Delta U$

$= -1.3 \times 10^5$ J

16. $\Delta U = U_d - U_c$

$= 6.52 \times 10^5$ J

$$W = \int_{Vc}^{Vd} pdv = 363\times10^3 \text{Pa} \ (0.4513 - 0.2202)$$

$= +8.39\times10^4$ J

$\theta = \Delta V + W = +7.36 \times 10^3$ J

$\theta = -9.33 \times 10^5$ J

CHEMISTRY KEY AND SOLUTIONS

23. Ans. c

Increase in the strength of conjugate base increases nucleophilicity

24. Ans. a

$$\begin{matrix} N_2 & +3H_2 \ f & 2NH_3 \\ \frac{0.15}{3} & \frac{0.6}{3} & \frac{0.3}{3} \end{matrix}$$

If x = moles of N_2 added and y = mole of N_2 reacted

$$\frac{0.15 + x - y}{3} \quad \frac{0.6 - 3y}{3} \quad \frac{0.3 + 2y}{3}$$

$Q \ \frac{0.3 + 2y}{3} = \frac{2x0.3}{3}$ and $Keq_1 = Keq_2$

solving for x = 38.4

25. Ans. a

26. Ans. c

$$E \propto \frac{z^2}{n^2} : \frac{E_{He^+}}{E_H} = \frac{Z^2{}_{He^+}}{n^2{}_{He^+}} \times \frac{n_H^2}{z_H^2}$$

$$Q \ n = 1 \text{ for both } \frac{E_{He^+}}{E_h} = \frac{4}{1}$$

27. Ans. b

Moles of MgSO4 = moles of $CaCO_3$

120 gm = 100 gm

12×10^{-3}gm10×10^{-3}gm

10^3 gm (1Kg) water contains = 10^{-2} gm of $CaCO_3$

10^6 gm (one million parts)------→? 10 ppm

28. Ans. d

$$cl^- = 8\times\frac{1}{8}+6\times\frac{1}{2} == 4;\ Na^+ = 12\times\frac{1}{4}+1=4$$

29. Ans. b

Birch reduction

30. Ans. a

$$Fe^{3+}+\left[Fe(CN)_6\right]^{4-} \rightarrow Fe_4\left[Fe(CN)_6\right]_3$$

Ferric ferro cyanide deep blue (or) Prussian blue complex

31. Ans. a

No $\propto$ -H. on the carbo cation

32. Ans. a
33. Ans. a
34. Ans. c

Value of K_c depends on the stoichiometry at equilibrium

35. Ans. b

36. Ans. d

$$Zn(OH)_2 + 2NaOH \rightarrow Na_2Zno_2 + H_2O$$

$$\left(ZnO_2^- \text{ anion}\right)$$

37. Ans. c

$Zn(OH)_2$ is amphoteric

38. Ans. c

39. Ans b

$$\Delta G = -RT \ln K$$

$$K = \frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]} = \frac{C_2}{C_1} \Rightarrow \ln k = \ln\frac{C_2}{C_1}$$

40. Ans. a

$$E\ cell = E^o\ cell - \frac{0.0591}{2}\log\frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]}$$

$$E^o\ cell - \frac{0.0591}{2}\log\frac{\left[Cu^{2+}\right]}{\left[Zn^{2+}\right]}$$

$$\Delta G \text{ would be} - \text{ve If } \frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]} > 1$$

41. Ans. b

$$E\ cell = E^o\ cell - \frac{0.0591}{2}\log\frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]}$$

$$1.1591 = 1.1 - \frac{0.0591}{2}\log\frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]}$$

42. a – q : b – p : c – s : d – r

43. a – q : b – p : c – s : d – r

44. a – q : b – r : c – q, s : d – p

[redacted]

SECTION – A

45. $\bar{a}\times\bar{b}=\bar{c};\ \bar{b}\times\bar{c}=\bar{a};\ \bar{c}\times\bar{a}=\bar{b}$

$\Rightarrow \bar{c}.\left(\bar{a}\times\bar{b}\right)=\bar{c}.\bar{c};\ \bar{a}.\left(\bar{b}\times\bar{c}\right)=\bar{a}.\bar{a};\ \bar{b}.\left(\bar{c}\times\bar{a}\right)=\bar{b}.\bar{b}$

$\Rightarrow\left[\bar{c}\,\bar{a}\,\bar{b}\right]=\left|\bar{c}\right|^2;\ \left[\bar{a}\ \bar{b}\ \bar{c}\right]=\left|\bar{a}\right|^2;\ \left[\bar{b}\ \bar{c}\ \bar{a}\right]=\left|\bar{b}\right|^2$

$\Rightarrow\left|\bar{a}\right|^2=\left|\bar{b}\right|^2=\left|\bar{c}\right|^2$

$\Rightarrow\left|\bar{a}\right|=\left|\bar{b}\right|=\left|\bar{c}\right|$

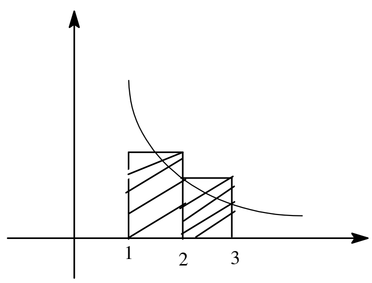
46. Q Winning of the 1st race and the 2nd race are independent, required probability $=\frac{1}{2}$

47. As the given matrix is skew symmetric $\left|A\right|=0$ if 'n' is odd.

48. Consider the coefficient x^n in

$(1+x)^m+(1+x)^{m+1}+......+\infty$

49.



Sum of area of rectangles $>\int_1^{n+1}\frac{dx}{x}$

$\Rightarrow\left(1+\frac{1}{2}+\frac{1}{3}+.....+\frac{1}{n}\right)>\int_1^{n+1}\frac{dx}{x}=\ln(n+1)\quad\Rightarrow\sum_{r=1}^{n}\frac{1}{r}>\ln(n+1)$

50. $\left(x^2-1\right)^6=0$ has roots -1 and 1 repeated 6 times each.

$\therefore\frac{d}{dx}\left(x^2-1\right)^6=0$ has roots -1 and 1 repeated 5 times each and there is a root between -1 and 1 by Rolle's theorem and so on

51. The 'm' white balls should be split into 'r' non empty lots in ${}^{m-1}C_{r-1}$ Similarly the case with black balls. Now these lots can be arranged in two ways viz., BWBW…. or WBWB……..

52. Equation of tangent $y=mx-am^2\ \rightarrow(1)$

Let the coordinate of mid point of PQ is (h,k) then equation of PQ is

$hx-ky=h^2-k^2\ \rightarrow\ (2)$ From (1) & (2) we get $k^3=h^2(k-a)$

Hence the curve is $y^3=x^2(y-a)$

53. $f'(x) = \underset{h \to 0}{lt} \dfrac{(K-1)\sin(K-h)\pi}{-h}$

$= \underset{h \to 0}{lt} \dfrac{(K-1)(-1)^{K-1}\sin \pi h}{-h}$

$= \pi(K-1)(-1)^K$

SECTION – B

54:. The assertion A is false since the lines $x-1=0, x-2=0, x-3=0$ satisfy $\begin{vmatrix} 1 & 0 & -1 \\ 1 & 0 & -2 \\ 1 & 0 & -3 \end{vmatrix} = 0$

But they are not concurrent. The reason R is true.

(Note: we must note that the determinant $\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$ does not represent the area of any triangle related with given lines).

55: Statement – II is the solution of Statement – I

56:. $y = mx + \dfrac{a}{m}$

$10 = 4m - 1\dfrac{9/4}{m} \Rightarrow 16m^2 - 40m + 9 = 0$

$m_{12} + m_2 = \dfrac{40}{16} = \dfrac{5}{2}; m_1 m_2 = \dfrac{9}{16} \Rightarrow m_1 = \dfrac{1}{4}, m_2 = \dfrac{9}{4}$

Every parabola is symmetric about its axis only (a) is true.

57. D

SECTION – C

Passage –I

To trace the curve, whose equation is of the form $y = \dfrac{a_1x^2 + b_1x + c_1}{a_2x^2 + b_2x + c_2}$, we observe the following points

(i) If $a_1x^2 + b_1x + c_1 = 0$ has imaginary roots, the curve never cuts the x-axis

(ii) $a_2x^2 + b_2x + c_2 = 0$ gives the values of 'x' for which y becomes infinite

(iii) The curve cuts y-axis when x = 0, i.e., $y = \dfrac{c_1}{c_2}$

(iv) $y = \dfrac{a_1 + \dfrac{b_1}{x} + \dfrac{c_1}{x^2}}{a_2 + \dfrac{b_2}{x} + \dfrac{c_2}{x^2}}$, Hence

$\underset{x \to \pm\infty}{Lt} = \dfrac{a_1}{a_2}$

In general the curve meets the line $y = \dfrac{a_1}{a_2}$ at one finite point for the equation $\dfrac{a_1}{a_2} = \dfrac{a_1x^2 + b_1x + c_1}{a_2x^2 + b_2x + c_2}$ is linear in x .

Passage - II

So. $\lim_{n\to\infty} x^{2n} = \begin{cases} 0, & \text{if } x^2 < 1 \\ 1, & \text{if } x^2 = 1 \\ \infty, & \text{if } x^2 > 1 \end{cases}$

$= \begin{cases} 0, & \text{if } -1 < x < 1 \\ 1, & \text{if } x = \pm 1 \\ \infty, & \text{if } x < -1 \text{ or, } x > 1 \end{cases}$

$\therefore \quad F(x) = \lim_{n\to\infty} \frac{x^{2n}.f(x) + g(x)}{x^{2n} + 1}$

$$= \begin{cases} \dfrac{0.f(x)+g(x)}{0+1}, & -1 < x < 1 \\ \dfrac{1.f(x)+g(x)}{1+1}, & x = \pm 1 \\ \dfrac{f(x)+\dfrac{g(x)}{x^{2n}}}{1+\dfrac{1}{x^{2n}}}, & x < -1 \text{ or } x > 1 \end{cases} \quad \therefore \quad F(x) = \begin{cases} g(x), & \text{if } -1 < x < 1 \\ \dfrac{f(x)+g(x)}{2}, & \text{if } x = \pm 1 \\ f(x), & \text{if } x < -1 \text{or } x > 1 \end{cases}$$

SECTION – D

64. b) $\sum\sum_{0 \le i < j \le n} \left(nc_i + nc_j\right) = \sum\sum_{0 \le i < j \le n} nc_i + \sum\sum_{0 \le i < j \le n} nc_j = n2^{n-1} + \sum_{j=1}^{n} j.nc_j = n2^n$

c) $\sum\sum_{0 \le i < j \le n} i\, nc_j = \sum_{j=1}^{n} nc_j \left(0+1+2+...+j-1\right) = \sum_{j=1}^{n} nc_j . \frac{j(j-1)}{2}$

$= \frac{1}{2}\sum_{j=1}^{n} j^2\, nc_j - \frac{1}{2}\sum_{j=1}^{n} j\, nc_j = \frac{1}{2}(n+1)n.2^{n-2} - \frac{1}{2}n2^{n-1} = (n-1)n2^{n-3}$

d) $\sum_{r=0}^{n} r.nc_r = \sum_{r=0}^{n} r.(n-1)c_{r-1}.\frac{n}{r}$

$= n.2^{n-1}$

65. $\overline{AB} = -2 + i$, rotate $\overline{AB}$ by $\pm\frac{\pi}{2}$

$\overline{AB} = i(-2+i) = -1-2i$, $\overline{AB}' = 1+2i$

$\overline{p} = \overline{a} + (-1-2i), \quad \overline{q} = b + (-1-2i)$

$\overline{p}' = 3+i+1+2i, \quad \overline{q}' = 1+2i+1+2i$

66: Homegenise the curve

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

$(3-2a)x^2 + (4a-2b)xy + (4b-1)y^2 = 0$ ………..(*)

A) $Co.of\,.x^2 + Co.of\,.y^2 = 0$

$3 - 2a + 4b - 1 = 0$

$a - 2b = 1 \Rightarrow a - 2b + 1 = 2$ ----------- (1)

B) $a - 2b = 1 \Rightarrow ax + by = 1$ passes through the point $(1,-2)$ so it represents a family of concurrent lines

$\therefore$ The distance of the farthest chord cannot exceed the distance of the point $(1,-2)$ from the origin i.e $\sqrt{5}$

C) Perpendicular distance from $(0,0)$ to $ax + by = 1$ is $\dfrac{1}{\sqrt{a^2+b^2}}$

Area of isosceles triangle $= \dfrac{1}{a^2+b^2}$

$\therefore \quad a^2 + b^2 = (2b+1)^2 + b^2 = 5b^2 + 4b + 1 \geq \dfrac{1}{5}$

$\therefore \dfrac{1}{a^2+b^2} = 5$

D) Equation of perpendicular from (0,0) to the chord is $bx - ay = 0$

Equation of bisector of (*) is

$$\frac{x^2 - y^2}{xy} = \frac{3 - 2a - 4b + 1}{2a - b}$$

$$\frac{x^2 - y^2}{xy} = \frac{3 - 2(1+2b) - 4b + 1}{2a(1+2b) - b}$$

and this satisfies (1)

$$\therefore \quad \frac{1 - \left(\frac{b}{1+2b}\right)}{\frac{b}{1+2b}} = \frac{2-8b}{2+3b}$$

$$\frac{3b^2 + 4b + 1}{b(1+2b} = \frac{2-8b}{2+3b}$$

which is a cubic in b

$\therefore$ so at most 3 values if b are possible