T.I.M.E.
Triumphant Institute of
Management Education Pvt. Ltd.

MODEL SOLUTIONS TO IIT JEE 2008
PAPER 2
CODE - 0

PART I

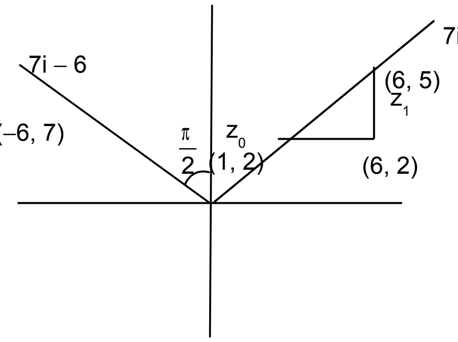
1	2	3	4	5	6	7	8	9	10
D	**C**	**B**	**B**	**D**	**D**	**A**	**C**	**A**	**C**

11	12	13	14	15	16	17	18	19
A	**C**	**C**	**A**	**A**	**B**	**B**	**D**	**C**

20	21	22
A – s	**A – r**	**A – p**
B – p, q	**B – q, s**	**B – s**
C – r	**C – r**	**C – q**
D – p, q, s	**D – p, r**	**D - q**

Section I

1.



⇒ (d)

2. $g(u) = 2\tan^{-1}(e^u) - \frac{\pi}{2}$

$\Rightarrow g'(u) = \frac{2}{1+e^{2u}} e^u$

$g'(-u) = \frac{2e^{-u}}{1+e^{-2u}} = \frac{2e^{2u}}{e^u\left(1+e^{2u}\right)}$

$= \frac{2e^u}{1+e^{2u}} = g'(u)$

∴ g'(u) is even function

∴ g(u) is odd.

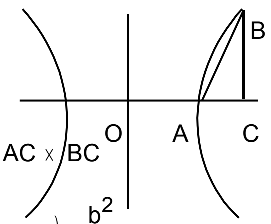
But g'(u) > 0 ⇒ strictly increasing in (–∞, ∞)

⇒ (c)

3. $\frac{\left(x-\sqrt{2}\right)^2}{4} - \frac{\left(y+\sqrt{2}\right)^2}{2} = 1$

$\Rightarrow a^2 = 4,\ e^2 = \frac{4+2}{4} = \frac{6}{4}$

$b^2 = 2$



Area ABC = $\frac{1}{2}$ AC x BC

$= \frac{1}{2}\left(ae - a\right) \times \frac{b^2}{a}$

$= \frac{1}{2}\left(e-1\right)b^2 = \frac{1}{2}\left(\frac{\sqrt{6}}{2} - 1\right)2$

$= \frac{1}{2}\left(\sqrt{6}-2\right) = \frac{\sqrt{6}}{2} - 1 = \frac{\sqrt{3}}{\sqrt{2}} - 1$

$\Rightarrow$ (b)

4. $\int_0^{\pi/4} (y_1 - y_2)\,dx$

$= \int_0^{\pi/4} \left(\sqrt{\frac{1+\sin x}{\cos x}} - \sqrt{\frac{1-\sin x}{\cos x}} \right) dx$

$\sin x = \frac{2t}{1+t^2}$; $\cos x = \frac{1-t^2}{1+t^2}$;

$= \int_0^{\sqrt{2}-1} \left(\sqrt{\frac{1+\frac{2t}{1+t^2}}{\frac{1-t^2}{1+t^2}}} - \sqrt{\frac{\left(1-\frac{2t}{1+t^2}\right)}{\left(\frac{1-t^2}{1+t^2}\right)}} \right) \frac{2dt}{1+t^2}$

$= \int_0^{\sqrt{2}-1} \frac{2t}{\left(1+t^2\right)\sqrt{1-t^2}}.2dt$

$= \int_0^{\sqrt{2}-1} \frac{4t}{\left(1+t^2\right)\sqrt{1-t^2}}\,dt$

$\Rightarrow$ (b)

5. Take $\alpha = \frac{\pi}{8}, \beta = \frac{\pi}{8}, \theta = \frac{\pi}{8}$

$\Rightarrow P\left(-\sin 0, -\cos\frac{\pi}{8}\right) = P\left(0, -\cos\frac{\pi}{8}\right)$

$Q\left(\cos 0, \sin\frac{\pi}{8}\right) = Q\left(1, \sin\frac{\pi}{8}\right)$

$R\left(\cos\frac{\pi}{8}, \sin 0\right) = R\left(\cos\frac{\pi}{8}, 0\right)$

$RQ \Rightarrow \frac{y - \sin\frac{\pi}{8}}{\sin\frac{\pi}{8}} = \frac{x-1}{1-\cos\frac{\pi}{8}}$

Substituting P in RQ $\Rightarrow$ P does not lie on RQ.

$PR \Rightarrow \frac{y-0}{\cos\frac{\pi}{8}} = \frac{x-\cos\frac{\pi}{8}}{\cos\frac{\pi}{8}}$

Substituting Q in PR $\Rightarrow$ Q does not lie on PR.

$PQ \Rightarrow \frac{y - \sin\frac{\pi}{8}}{\sin\frac{\pi}{8} + \cos\frac{\pi}{8}} = \frac{x-1}{1}$

Substituting R in PQ $\Rightarrow$ R does not lie on PQ.

$\Rightarrow$ P, Q, R are not collinear.

$\Rightarrow$ (d)

6. Let n(B only) = y

n(A $\cap$ B) = x

Then n(A only) = 4 – x

$\therefore P(A \cap B) = \frac{x}{10}$

$P(A) = \frac{4}{10}$ and $P(B) = \frac{x+y}{10}$

$\therefore P(A \cap B) = P(A)\,P(B)$

$\Rightarrow \frac{x}{10} = \frac{x+y}{10} \times \frac{4}{10}$

$\Rightarrow 3x = 2y$

$\Rightarrow$ (x + y) is a multiple of 5.

Only possible values are 5 and 10.

$\Rightarrow$ (d)

7. $\bar{a} = i$, $\bar{b} = \cos\alpha i + \sin\alpha j$, α acute

$\bar{r} = i\cos t + \sin t(\cos\alpha\, i + \sin\alpha\, j)$

$r = \sqrt{(\cos t + \sin t\cos\alpha)^2 + \sin^2 t\,\sin^2\alpha}$

$= \sqrt{\cos^2 t + 2\cos t.\sin t.\cos\alpha + \sin^2 t.\cos^2\alpha + \sin^2 t.\sin^2\alpha}$

$= \sqrt{1+\cos\alpha.\sin 2t}$

Max $\Rightarrow \sqrt{1+\cos\alpha}$

$1 + \bar{a}.\bar{b} = 1 + \cos\alpha$

$\Rightarrow \text{Max} = \sqrt{1+ab} = \left[1 + \left(\bar{a} - \bar{b}\right)\right]^{1/2}$

$\sin 2t = \sin\frac{\pi}{2} \Rightarrow t = \frac{\pi}{4}$

$\Rightarrow \hat{u} = \bar{a}.\cos\frac{\pi}{4} + \bar{b}.\sin\frac{\pi}{4} = \frac{1}{\sqrt{2}}\left(\bar{a} + \bar{b}\right)$

$= \frac{\bar{a}+\bar{b}}{\left|\bar{a}+\bar{b}\right|}$

$\therefore \Rightarrow$ (a)

8. $J = \int \frac{e^{3x}}{e^{4x} + e^{2x} + 1}\,dx$

$I = \int \frac{e^{3x} - e^{x}}{e^{4x} + e^{2x} + 1}\,dx$

$= \int \frac{e^{x} - e^{-x}}{e^{2x} + e^{-2x} + 1}\,dx$

$u = e^x + e^{-x} \Rightarrow du = (e^x - e^{-x})dx$

$u^2 = e^{2x} + e^{-2x} + 2$

$\int \frac{du}{u^2 - 1} = \frac{1}{2}\log\frac{u-1}{u+1} + 1$

$= \frac{1}{2}\,\log\left|\frac{e^x + e^{-x} - 1}{e^x + e^{-x} + 1}\right| + C$

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

$\Rightarrow$ (c)

9. $g(x) = \log_e f(x)$ $\qquad f(x + 1) = x\,.f(x)$

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

$f(x + 1) = e^{g(x + 1)} = x\,.\,e^{g(x)}$

$e^{g(x+1)-g(x)} = x$

$g(x + 1) - g(x) = \log x$

$g(x + 1) = g(x) + \log x$ — (1)

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

$g''(x + 1) = g''(x) - \frac{1}{x^2}$ — (2)

$x + 1 = N + \frac{1}{2} \Rightarrow x = N - \frac{1}{2}$

$\therefore$ (1) $\Rightarrow$ $g''\left(N + \frac{1}{2}\right) - g''\left(N - \frac{1}{2}\right) = \frac{-1}{\left(N - \frac{1}{2}\right)^2}$

$$\Sigma = \frac{-1}{\left(1 - \frac{1}{2}\right)^2} - \frac{1}{\left(2 - \frac{1}{2}\right)^2} - \frac{1}{\left(3 - \frac{1}{2}\right)^2} - \ldots\ldots$$

$$= -1\left[\frac{1}{\frac{1}{4}} + \frac{1}{\frac{9}{4}} + \frac{1}{\frac{25}{4}} + \ldots\ldots..\right]$$

$$= -4\left[\frac{1}{1} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\ldots. + \frac{1}{(2N - 1)^2}\right]$$

$\Rightarrow$ (a)

Section II

10. $b_1 = a_1$

$b_2 = a_1 + a_1r$, $b_3 = a_1 + a_1r + a_1r^2$

$b_4 = a_1 + a_1\,r + a_2\,r^2 + a_3\,r^3$

They are neither in A.P. nor G.P

$\therefore$ Statement 1 is true

b_1, b_2, b_3, b_4 are not in H.P

$\therefore$ Statement 2 is false

$\therefore \Rightarrow$ (c)

11. $x^2 + 2px + q = 0$ and $ax^2 + 2bx + c = 0$ have common root

$\therefore\ \frac{\alpha^2}{2pc - 2pq} = \frac{\alpha}{aq - c} = \frac{1}{2b - 2ap}$

Again $x^2 + 2px + q = 0$ and $cx^2 + bx + a = 0$ have common root

$\frac{\beta^2}{2ap - 2bq} = \frac{\beta}{cq - a} = \frac{1}{2b - 2pc}$

By using statement (2) α, β are real

$\therefore (p^2 - q) > 0$ and $b^2 - ac > 0$

$\therefore (p^2 - q)(b^2 - ac) > 0$

$\therefore \Rightarrow$ (a)

12. Statement 1:

Centre of the circle is at $(-3, 5)$

Radius = 2

If L_1 is a chord of the circle

$2 \times -3 + 3 \times 5 + p - 3 \neq 0$

$p + 6 \neq = \Rightarrow p \neq -6$

If L_2 is to be a diameter of the circle,

$2 \times -3 + 3 \times 5 + p + 3 = 0$

$p = -12$

Statement 1 is true

Statement 2 :

L_1 is a diameter of C

$\Rightarrow$ p lies on L_1

$\Rightarrow -6 + 15 + p - 3 = 0$

$\Rightarrow p + 6 = 0$

$\Rightarrow p = -6$

Now

$L_2 : 2x + 3y - 3 = 0$

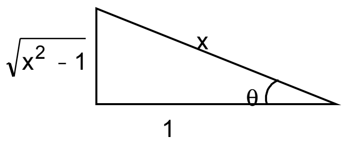
Perpendicular distance if L_2 from p = $\frac{6}{13} < 2$

$\therefore$ L_2 is a chord always

$\therefore$ Statement 2 is false

$\Rightarrow$ (c)

13.



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

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

$x = 2,\ y = \frac{2}{\sqrt{3}}$

$\sec^{-1}\frac{2}{\sqrt{3}} = \sec^{-1}2 + c$

$\frac{\pi}{6} = \frac{\pi}{3} + c \Rightarrow c = \frac{\pi}{6} - \frac{\pi}{3} = \frac{-\pi}{6}$

$\Rightarrow \sec^{-1}y = \sec^{-1}x - \frac{\pi}{6}$

$y = \sec\left(\sec^{-1}x - \frac{\pi}{6}\right)$ — (1)

Statement 1 is true

Consider the relation

$$\frac{1}{y} = \frac{2\sqrt{3}}{x} - \sqrt{1 - \frac{1}{x^2}} \qquad = \frac{2\sqrt{3}}{x} - \frac{\sqrt{x^2 - 1}}{x}$$

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

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

From (1)

$$\frac{1}{y} = \cos\left(\sec^{-1}x - \frac{\pi}{6}\right)$$

$$= \cos\left(\sec^{-1}x\right)\cos\frac{\pi}{6} + \sin\left(\sec^{-1}x\right).\sin\frac{\pi}{6}$$

$$= \cos\left(\cos^{-1}\frac{1}{x}\right).\frac{\sqrt{3}}{2} - \frac{\sqrt{x^2-1}}{2}$$

Statement 2 is false
Statement 1 is true
⇒ (c)

Section III

14. $f(x) = \dfrac{x^2 + ax + 1 - 2ax}{x^2 + ax + 1}$

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

$$f'(x) = \frac{\left(x^2 + ax + 1\right)(-2a) + 2ax(2x + a)}{\left(x^2 + ax + 1\right)^2}$$

$$= \frac{-2ax^2 - 2a^2x - 2a + 4ax^2 + 2a^2x}{\left(x^2 + ax + 1\right)^2}$$

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

$$f''(x) = \frac{\left(x^2 + ax + 1\right)^2[4ax] - 4a\left(x^2 - 1\right)\left(x^2 + ax + 1\right)(2x + a)}{\left(x^2 + ax + 1\right)^4}$$

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

$$f''(-1) = \frac{(2-a)^2(-4a)}{(2-a)^4} = \frac{-4a}{(2-a)^2}$$

$(2 + a)^2 f''(1) + (2 - a)^2 f''(-1) = 0$
⇒ (a)

15. $f'(x) = \dfrac{2a\left(x^2 - 1\right)}{\left(x^2 + ax + 1\right)^2}$

Since $a > 0$, $x^2 - 1$ is < 0
When $x \in (-1, 1)$
⇒ (a)

16. $g(x) = \displaystyle\int_0^{e^x} \frac{f'(t)}{1 + t^2}\,dt$

$$\Rightarrow g'(x) = \frac{f'(e^x)}{1 + (e^x)^2} \times e^x$$

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

⇒ (b)

17. $\left(3\bar{i} + \bar{j} + 2\bar{k}\right) \times \left(\bar{i} + 2\bar{j} + 3\bar{k}\right)$

$$= \begin{vmatrix} \bar{i} & \bar{j} & \bar{k} \\ 3 & 1 & 2 \\ 1 & 2 & 3 \end{vmatrix}$$

$= -\bar{i} - 7\bar{j} + 5\bar{k}$

Unit vector $= \dfrac{1}{5\sqrt{3}}\left(-\bar{i} - 7\bar{j} + 5\bar{k}\right)$

⇒ (b)

18. Shortest distance
$(-1, -2, -1) \to$ point on L_1
$(2, -2, 3) \to$ point on L_2

Shortest distance $= \dfrac{1}{5\sqrt{3}}\begin{vmatrix} 3 & 0 & 4 \\ 3 & 1 & 2 \\ 1 & 2 & 3 \end{vmatrix}$

$$= \frac{3(-1) + 4 \times 5}{5\sqrt{3}} = \frac{17}{5\sqrt{3}}$$

⇒ (d)

19. Equation of the plane is
$-1(x + 1) - 7(y + 2) + 5(z + 1) = 0$
$-x - 7y + 5z - 10 = 0$
$x + 7y - 5z + 10 = 0$
Distance $= \dfrac{1 + 75 + 10}{\sqrt{75}} = \dfrac{13}{\sqrt{75}}$
⇒ (c)

Section IV

20. $\begin{vmatrix} 1 & 3 & -5 \\ 3 & -k & -1 \\ 5 & 2 & -12 \end{vmatrix}$

$12k + 2 - 3(-36 + 5) - 5(6 + 5k) = 0$
$12k + 2 + 108 - 15 - 30 - 25k = 0$
$-13k + 65 = 0 \Rightarrow k = 5$
(a) → s
(b) → p, q
(c) → r

(d) → p, q, s

21.

(A) $y = \dfrac{x^2 + 2x + 4}{x + 2}$

$y' = \dfrac{(x+2)(2x+2) - (x^2 + 2x + 4)}{(x+2)^2}$

$= \dfrac{x^2 + 4x}{(x+2)^2}$

$y'' = \dfrac{(x+2)^2(2x+4) - (x^2 + 4x)2(x+2)}{(x+2)^4}$

For extremum, y' = 0 ⇒ x = 0, –4

At x = 0, y''> 0 ⇒ x = 0 gives a min. pt & min. value = 2

At x = –4, y'' < 0 ⇒ x = –4 gives a max. pt & max value = –6

∴ ⇒ (r)

(B) (A + B) (A – B) = (A – B) (A + B)

⇒ AB = BA --------(1)

$(AB)^T = (-1)^k AB$

⇒ $B^T A^T = (-1)^k BA$ (using 1)

– BA = = $(-1)^k$ BA

(because B is skew symmetric and A is symmetric)

⇒ k is an odd integer.

∴ k is 1 or 3

∴⇒ (q), (s)

(C) $a = \log_3 \log_3 2 \Rightarrow 3^a = \log_3 2$

⇒ $3^{-a} = \log_2 3$

We have

$1 < 2^{-k + 3^{-a}} < 2$

⇒ $0 < -k + \log_2 3 < 1$

⇒ $\log_2 3 - 1 < k < \log_2 3$

⇒ Integer value that k takes is 1.

⇒ (r)

(D) $\sin\theta = \cos\varphi = \sin\left(\dfrac{\pi}{2} - \varphi\right)$

$\Rightarrow \theta = n\pi + (-1)^n\left(\dfrac{\pi}{2} - \varphi\right)$

For n = 1, we get $\dfrac{\theta - \varphi - \frac{\pi}{2}}{\pi} = 0$

For n = 2, we get $\dfrac{\theta + \varphi - \frac{\pi}{2}}{\pi} = 2$

⇒ (p), (r).

22.

(A) ENDEA is considered as 1 letter

Remaining letters are E, N, O, L

So 4 + 1 = 6 letters ⇒ 5!

⇒ (p)

(B) E_ _ _ _ _ _ _ E

The remaining letters are 2N, E, D, A, O, L

Required number of permutations = $\dfrac{7!}{2!}$

= 21 × 5!

⇒ (s)

(C) D, L, N can occur only in the first four places

⇒ D, L, N, N occurs in the first four places

No. of ways = $\dfrac{4!}{2!}$ = 12

Remaining are 3E, A, 0, fill in the 5 places

No. of ways = $\dfrac{5!}{3!}$ = 20

Total no. of ways = (5 × 4 × 3 × 2) × 2

= 2 × 5!

⇒ (q)

(D) x x x x x

_ _ _ _ _ _ _ _ _

5 odd positions

A, E and O occur only in odd positions

∴ A, E, E, E, O occupy 5 places = $\dfrac{5!}{3!}$ = 20

Remaining 4 places are filled by

N, N, L, D in $\dfrac{4!}{2!}$ ways = 12

= 2 × 5!

⇒ (q)

PART II

23	24	25	26	27	28	29	30	31	32
C	**A**	**A**	**C**	**D**	**B**	**A**	**A**	**B**	**B**

33	34	35	36	37	38	39	40	41
D	**B**	**C**	**A**	**B**	**C**	**D**	**D**	**C**

42	43	44
A – p	**A – p, q, r, s**	**A – q**
B – q, r, s	**B – q**	**B – p, r**
C-s	**C-p, q, r, s**	**C – p, s**
D-q	**D-p, q, r, s**	**D – q, s**

Section I

23. $F = \frac{1}{4\pi\varepsilon_0}\frac{q/3 \times 2q/3}{\left(\sqrt{3}R\right)^2}$

24. $\lambda_1 = \frac{1}{4}\lambda_2$

25. P moves up implies direction $\hat{j}$

26. $\frac{1}{2}kx^2 = \frac{1}{2}4ky^2$

27. $v^2 = u^2 - 2gh$; $u^2 = 5gR$

$\Rightarrow v^2 = \frac{u^2}{4} \Rightarrow h = \frac{15}{8}R$

28. $P_1 = \frac{4T}{R}; P_2 < \frac{4T}{R}$

air flowing from 1 to 2 equalizing pressure.

29. $\frac{3\lambda}{4} = 0.75 \Rightarrow \lambda = 1$ m

f = 340 Hz; T increases f increases; beat decreases $\Rightarrow$ n = 340 + 4

30. $C = \frac{\varepsilon_0 A}{(d-x)+\frac{x}{K}}$

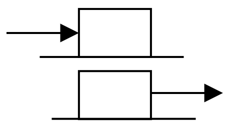
$x = \frac{d}{3}vt$

31. Only region I and IV are to be reckoned for TIR.

Section II

32. Relative angular velocity is inversely proportional to distance.

33.



Pushing or pulling does not imply any angle. Hence to be taken as horizontal. Thus statement -1 is wrong

34. For earth radius is large; never zero potential.

35. Soft iron is easy to magnetize / demagnetize

Section III

36. $E = \frac{1}{4\pi\varepsilon_0}\frac{Ze}{R^2}$

37. $\rho = d\left(1-\frac{r}{R}\right)$

$\int \rho\, 4\pi r^2 dr = Ze$

38. Standard E variation for uniform sphere

39. $2kxR = I\alpha = \frac{3}{2}MR^2\frac{a}{R}$

$Ma = \frac{4}{3}kx$

40. $\omega = \sqrt{\frac{4k}{3M}}$

41. $f = I_{CM}\alpha = \frac{Ma}{2} = \frac{2}{3}kx$

$\frac{2}{3}kA = \mu mg$

$2\frac{1}{2}kA^2 = \frac{1}{2}I\omega^2$

Section IV

42.

(A) Potential energy graph is a parabola, with minimum at $x = x_0$.

(B) q is motion with zero acceleration starting from origin (y = 0)
r is zero acceleration starting from ($y = y_0$)
s is constant acceleration.

(C) $R = \frac{u^2 \sin 2\theta}{g}$ for same θ, $R \propto u^2 \Rightarrow$ Parabola passing through the origin.
$\Rightarrow$ (s)

(D) $T = 2\pi\sqrt{\frac{\ell}{g}}$
$T^2 \propto \ell$
$\Rightarrow$ Straight line passing through origin.
$\Rightarrow$ (q)

43. A, C, D

If $|u| < |f| \Rightarrow$ virtual image
If $|u| > |f| \rightarrow$ Real image, magnified
If $|u| = |f| \rightarrow$ Image at infinity
$\Rightarrow$ p, q, r, s

(B) For all u, virtual, diminished image
$\Rightarrow$ q

44.

(A) Free expansion for ideal gas in insulated container, internal energy remains constant, temperature remains constant, and no heat loss.
$\Rightarrow$ (q)
For pV^n = constant process.
$\Delta Q = \Delta U + \Delta W$
$= \frac{\Delta(pV)}{\gamma - 1} - \frac{\Delta(pV)}{n-1}$
$= \Delta(nRT)\left(\frac{1}{\gamma - 1} - \frac{1}{n-1}\right)$
If $n > 1$, $\Delta T < 0$
If $n > \gamma$, $\Delta Q < 0$
$n < \gamma$, $\Delta Q > 0$

(B) n = 2 p, r

(C) $n = \frac{4}{3}$ p, s

(D) $\Delta Q = \Delta U + \Delta W$
From fig. $\Delta W > 0$
$\Delta T > 0 \Rightarrow \Delta U > 0$
$\Rightarrow \Delta Q > 0$
$\Rightarrow$ q, s

PART III

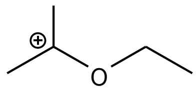
45	46	47	48	49	50	51	52	53	54
D	**A**	**C**	**C**	**B**	**C**	**B**	**A**	**D**	**D**

55	56	57	58	59	60	61	62	63
A	**B**	**A**	**B**	**A**	**D**	**B**	**A**	**D**

64	65	66
A – r, s	**A – p**	**A – q**
B – p, q	**B – q**	**B – p**
C – p, q, r	**C – p, r**	**C – p, q, r**
D –p, s	**D –p, s**	**D –p, q**

Section I

45. (I) > (III) > (II) > (IV)



(I)

Stabilised by hetero atom and has six hyperconjugative structures

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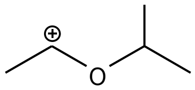

(III)

Stabilised by hetero atom and has three hyperconjugative structures

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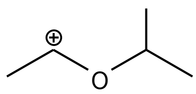

(II)

Only five hyperconjugative structures

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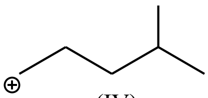


(IV)

Only two hyperconjugative structures

46. Cellulose has a β-glycosidic linkage. While structures (A) and (B) have β glycosidic linkages, only the structure (A) is a triacetate.

47. $C_6H_5-\overset{O}{\overset{||}{C}}-\overset{*}{C}H_2-\overset{O}{\overset{||}{C}}-OH$ is a β keto acid which undergoes readily decarboxylation to give $C_6H_5CO\overset{*}{C}H_3$ which is (E). (E) undergoes iodoform reaction to give (F) which is C_6H_5COONa and (G) which is $\overset{*}{C}HI_3$.

48. CuF_2 is coloured because Cu^{2+} with d^9 configuration is the cation.

49. $[Ni(CO)_4]$ – sp^3

$Ni(CN)_4^{2-}$ - dsp^2

50. Tetraammine nickel (II)–tetrachloronickelate (II)

51. 1 mole of hydrogen = 2 equivalents
0.1 mole of hydrogen = 0.02 equivalents
Current required = 0.02 F
= 0.02×96500 C
Time (Sec) = $\dfrac{0.02 \times 96500}{10 \times 10^{-3}}$
= 19.3×10^4

52. Surfactant molecules with larger hydrophobic end will have lesser solubility, greater tendency to associate and hence form micelles readily.

53. $MX : K_{sp} = S^2$ $\quad S = \sqrt{4 \times 10^{-8}}$

$MX_2 : K_{sp} = 4S^3$ $\quad S = \sqrt[3]{\dfrac{3.2 \times 10^{-14}}{4}}$

$M_3X : K_{sp} = 27S^4$ $\quad S = \sqrt[4]{\dfrac{2.7 \times 10^{-15}}{27}}$

$MX > M_3X > MX_2$

Section II

54. Statement (1) is not correct as an orange red dye is formed. Statement (2) is true because the red colour is due to extended conjugation

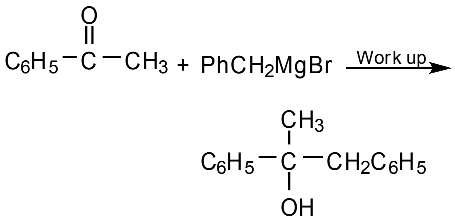
55. Statement (1) is true and statement (2) is also true and is correct explanation for statement (1). In $[Fe(H_2O)_5NO]^{2+}$, Fe is in +1 state with 3 unpaired electrons.

56. Statement (1) is true and statement (2) is also true but statement (2) is not the correct explanation of statement (1).
These geometrical isomers are optically inactive as they have plane of symmetry. A molecule may be optically active even if it has axis of symmetry.

57. The natural asymmetry between the conversion of heat and work is due to the fact that heat cannot be completely converted to work.

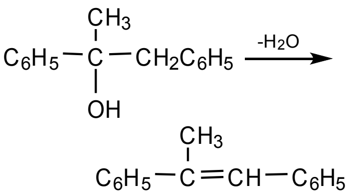
Section III

58.

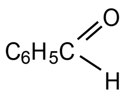


(H)

59.



(I)

60. J = 

K = $C_6H_5COCH_3$
L = $C_6H_5COO^-K^+$

61. Effective number of particles in HCP =
$\frac{1}{6} \times 12 + \frac{1}{2} \times 2 + 3 = 6$

62. Volume of Unit cell = $6 \times \frac{\sqrt{3}}{4} (2r)^2 \times 4r\sqrt{\frac{2}{3}}$
$= 24\sqrt{2}\, r^3$

63. PF = 0.74
VF = 0.26

Section IV

64. (A) $\rightarrow$ R, S
(B) $\rightarrow$ P, Q
(C) $\rightarrow$ P, Q, R
(D) $\rightarrow$ P, S

(A) It has no carbon and hence the sodium fusion extract does not give blue colour with $FeSO_4$.
No phenolic –OH group, hence does not give $FeCl_3$ test.
Gives white ppt. of AgCl with $AgNO_3$.
Forms Hydrazone with aldehydes as it has hydrazine content.

(B) Forms Prussian blue.
Gives positive $FeCl_3$ test as it has phenolic –OH group.
Gives yellow ppt. of AgI with $AgNO_3$.
Does not form hydrazone as there is no hydrazine content.

(C) Forms Prussian blue.
Gives positive $FeCl_3$ test as there is phenolic –OH group.
Gives white ppt. of AgCl with $AgNO_3$.
Does not form hydrazone as there is no hydrazine content.

(D) Forms Prussian blue.
No phenolic –OH group, hence does not give $FeCl_3$ test.
Give pale yellow ppt. of AgBr with $AgNO_3$.
Forms Hydrazone with aldehydes as it has hydrazine content.

65. (A) $\rightarrow$ P
(B) $\rightarrow$ Q
(C) $\rightarrow$ P, R
(D) $\rightarrow$ P, S

(A) PbS is converted to PbO by roasting
$2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$

(B) $CaCO_3$ on calcination gives CaO
$CaCO_3 \rightarrow CaO + CO_2$

(C) ZnS is converted to Zn either by roasting followed by carbon reduction.
$2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
$ZnO + C \rightarrow Zn + CO$

(D) Cu_2S to Cu involves roasting and self reduction
$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$
$Cu_2S + 2Cu_2O \rightarrow 6Cu + SO_2$

66. (A) $\rightarrow$ Q
(B) $\rightarrow$ P
(C) $\rightarrow$ P, Q, R
(D) $\rightarrow$ P, Q
(A) Orbital angular momentum of the electron in a hydrogen like A. O = $\sqrt{l(l+1)}\,\frac{h}{2\pi}$

(B) A hydrogen – like are electron wave function obeying Pauli's principle : Principle quantum number.

(C) Size, shape and orientation of orbital : Principle azimuthal and magnetic quantum numbers.

(D) Probability density of the electron at the nucleus : Principal and azimuthal quantum number.