TARGET IIT-JEE

HINT & SOLUTIONS

ANSWER KEY WITH SOLUTION

PAPER-I CLASS XII (DATE 05-07-09)

MATHEMATICS

Q.	1	2	3	4	5	6	7	8	9	10	11	12
A.	C	A	C	B	D	B	B	C	A,C	A,C	All	B,C
Q.	13	14	15	16	17	18						
A.	B	C	A	B	A	D						

19. A → S; B → R; C → P, D → Q

20. A → S; B → R; C → P, D → Q

PHYSICS

21.	A	**22.**	B	**23.**	A	**24.**	A	**25.**	A	**26.**	B	**27.**	B
28.	B	**29.**	A,B,D	**30.**	A,D	**31.**	A,B,D	**32.**	A	**33.**	A	**34.**	B
35.	D	**36**	C	**37.**	D	**38.**	A						

39. (A) → P,Q,R, (B) → S, (C) → S, (D) → P,Q

40. (A) → P,Q,R (B) → P,Q,R, (C) → P, (D) → S

CHEMISTRY

41.	A	**42.**	B	**43.**	D	**44.**	A	**45.**	A	**46.**	D	**47.**	A
48.	C	**49.**	A,B	**50.**	D	**51.**	B,C	**52.**	A,B,C,D	**53.**	C	**54.**	C
55.	D	**56.**	A	**57.**	C	**58.**	B						

59. (A) → P,R; (B) → Q,R; (C) → Q,R; (D) → Q,S

60. (A) → Q; (B) → T; (C) → Q; (D) → R

MATHEMATICS

1. Let $A = (t, t^2)$; $m_{OA} = t$; $m_{AB} = -\frac{1}{t}$

equation of AB, $y - t^2 = -\frac{1}{t}(x - t^2)$

put $x = 0$

$h = t^2 + 1$ (as $x \to 0$ then $t \to 0$)

now $\lim_{t\to 0}(h) = \lim_{t\to 0}(1+t^2) = 1$ Ans.

2. $I = \int(\sin(100x+x)\cdot(\sin x)^{99}\,dx$

$= \int((\sin(100x)\cos x + \cos 100x \cdot \sin x)(\sin x)^{99})dx$

$= \int \underbrace{\sin(100x)}_{I}\underbrace{\cos x\cdot(\sin x)^{99}}_{II}\,dx + \int \cos(100x)\cdot(\sin x)^{100}\,dx$

$= \frac{\sin(100x)(\sin x)^{100}}{100} - \frac{100}{100}\int\cos(100x)(\sin x)^{100}\,dx + \int\cos(100x)(\sin x)^{100}\,dx$

$= \frac{\sin(100x)(\sin x)^{100}}{100} + C$

3. $f(x, n) = \sum_{k=1}^{n}\log_x\left(\frac{k}{x}\right)$

given: $f(x, 10) = f(x, 11) \Rightarrow \log_x\left(\frac{10!}{x^{10}}\right)$

$= \log_x\left(\frac{11!}{x^{11}}\right) \Rightarrow \frac{10!}{x^{10}} = \frac{11!}{x^{11}} \Rightarrow x = 11$ **Ans.**

4. $l = e\cdot e^e$; $m = 3$; $n = 1 \Rightarrow \frac{lmn}{e^e} = 3e$ Ans.]

5. $f(0^+) = f(0^-) = \frac{ba^n - ab^n}{(b-a)} \Rightarrow$ (D)

6. $\lim_{n\to\infty}\frac{2\times 2}{3\times 1}\cdot\frac{3\times 3}{4\times 2}\cdot\frac{4\times 4}{5\times 3}\cdots\cdots\cdots\frac{(n-1)(n-1)}{n(n-2)}\cdot\frac{n\times n}{(n+1)(n-1)}$

$= \lim_{n\to\infty}\frac{2n}{n+1} = 2.$

7. $f(x) + f\left(\frac{x-1}{x}\right) = \ell n\,|x|$ ...(1)

Replace x by $\frac{x-1}{x}$ in (1)

$f\left(\frac{x-1}{x}\right) + f\left(\frac{1}{1-x}\right) = \ell n\left|\frac{x-1}{x}\right|$ ...(2)

Replace x by $\frac{1}{1-x}$ in (1)

$f\left(\frac{1}{1-x}\right) + f(x) = \ell n\left|\frac{1}{1-x}\right|$ ...(3)

(1) + (2) – (3) gives

$f(x) = \ell n\left|\frac{x}{x-1}\right|$ $\therefore f(2009) = \ell n\frac{2009}{2008}$

8. Each of the factors in the numerator is of the form $n^3 + n - x$.

We expect it to become zero when $x \to 350$ at $n = 7$.

Hence the limit is zero.

9. $|x^2 - 2x - 9| < 6$

$-6 < x^2 - 2x - 9 < 6$

$4 < (x-1)^2 < 16$

$\Rightarrow -4 < x - 1 < -2$ or $2 < x - 1 < 4$

$\Rightarrow -3 < x < -1$ or $3 < x < 5$

Now $0 \le |x^2 - 2x - 9| < 6$

$\Rightarrow 0 < 6 - |x^2 - 2x - 9| \le 6$

$\Rightarrow -\infty < \log_6(6 - |x^2 - 2x - 9|) \le 1$

10. Differentiate both sides

$f(x) + g(x) f'(x) = f(x) + x f'(x)$

either $f'(x) = 0 \Rightarrow f(x) = \text{constant}$

or $g(x) = x$]

11. $f(1^+) = 1 = f(1^-)$ but $f(1) = 2$;

$f(-1^+) = 3 = f(-1^-)$

$f(2^+) = 4$; $f(2^-) = 2$; $f(2) = 4$]

12. $P(-1) = 1 - a_1 + a_2 - a_3$

$= 1 + (a_1 + a_2 + a_3) - 2(a_1 + a_3)$

$\Rightarrow$ P(–1) is odd.

Let $P(x) = 0 \Rightarrow x(a_1 + a_2 + a_3x^2) = -1$

$\Rightarrow$ x divides –1 $\Rightarrow$ x = 1 or –1

P(1) = odd P(–1) = odd

$\Rightarrow$ No integral solution.

13. $f(x) = \begin{cases} -1, & x = -1 \\ 0, & -1 < x < +1 \\ x, & 1 \le x < 2 \\ 4x, & 2 \le x < 5/2 \\ 5x, & 5/2 \le x < 3 \\ 27, & x = 3 \end{cases}$

$f(x) = 13 \Rightarrow 5x = 13 \Rightarrow x = \frac{13}{5}$

Other formula cannot make f(x) equal to 13

$\frac{a}{b} = \frac{13}{5}$ $\therefore a + b = 18$

14. The points of discontinuity are $x = -1, 1, 2, \frac{5}{2}, 3$

15. As $x \to \frac{\pi}{2}$, $2\sin x \to 2^-$

$\therefore f(2\sin x) = 2\sin x$ in the nghd of $x = \frac{\pi}{2}$

$$\lim_{x \to \frac{\pi}{2}} f(2\sin x) = \lim_{x \to \frac{\pi}{2}} 2\sin x = 2$$

16. $f^2\left(\frac{1}{\sqrt{2}}x\right) = f(x)$

Differentiate both sides w.r.t. x

$$\sqrt{2}\, f\left(\frac{1}{\sqrt{2}x}\right) f'\left(\frac{1}{\sqrt{2}}x\right) = f'(x)$$

$$\frac{\frac{x}{\sqrt{2}} f\left(\frac{1}{\sqrt{2}}x\right)}{f'\left(\frac{1}{\sqrt{2}}x\right)} = \frac{xf(x)}{f'(x)} \quad \Rightarrow \frac{xf(x)}{f'(x)} = \text{constant}$$

$$\Rightarrow \quad \frac{f'(x)}{f(x)} = c\,x$$

$\ell n\,|f(x)| = \frac{cx^2}{2} + k \qquad f(x) = A\,.\, e^{\frac{cx^2}{2}}$

$f(0) = 1,\ f(1) = 2 \qquad \Rightarrow \qquad f(x) = 2^{x^2}$

$f(\alpha x) + f(\beta x) = 2^{(\alpha^2 + \beta^2)x^2} = 2^{x^2} = f(x)$.

17. $$\lim_{x\to\infty} \frac{2^{x^2} - x^2}{2^{x^2} + 2^x} = \lim_{x\to\infty} \frac{1 - \frac{x^2}{2^{x^2}}}{1 + 2^{x - \frac{x^2}{2}}} = 1.$$

$$\left(x - \frac{x^2}{2} \to -\infty \text{ as } x \to \infty\right)$$

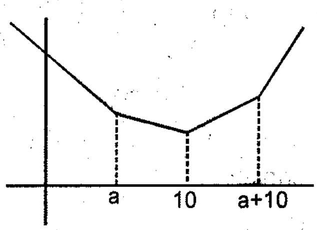
18. $\int 2^{(\sqrt{2}x)^2}\, \ell n\, 2^{4x}\, dx = 2\,\ell n\, 2 \int 2x.2^{2x^2}\, dx$

Put $x^2 = t$

$$= 2\,\ell n\, 2 \int 2^{2t}\, dt = 2\,\ell n\, 2\,.\, \frac{2^{2t}}{2\ell n 2} + c$$

$$= 2^{2t} + c = 2^{2x^2} + c$$

19. (A)–(S); (B) – (R); (C) – (P);(D) – (Q) **Ans.**



(A) Min. value occurs at $x = 10$

$f(0) = |10 - a| + |10 - a - 10|$

$= 10 - a + a = 10$

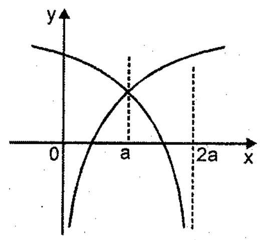
(B) $$\lim_{x \to 0} \frac{\frac{x\,.\,4\sin^4 x}{x^5} - a\frac{(\sin x - \tan x)^2}{x^5}}{\frac{\tan^5 x}{x^5} + a\frac{\sin^8 x}{x^5}}$$

$$= \frac{4 - 0}{1 + 0} = 4$$

(C) $$\lim_{n \to \infty} \frac{n^{a-1} \times \sin^2(n!)}{1 + \frac{1}{n}}$$

$= \frac{0}{1} = 0 \ (a - 1 < 0)$

(D)



One intersection point. By trial $x = a$

20. (A) – S; (B) – R; (C) – P; (D) – Q Ans.

(A) $\frac{f(x)}{x} = \sqrt{x\sqrt{x\sqrt{x......}}} = \sqrt{x.\frac{f(x)}{x}} = \sqrt{f(x)}$

$f^2(x) = x^2 f(x) \quad \Rightarrow \quad f(x) = x^2$

$f'(x) = 2x \quad \Rightarrow \quad f'(5) = 10$ Ans.

(B) $(x^4 + 4x^3 + 6px^2 + 4qx + r) = (x + a)(x^3 + 3x^2 + 9x + 3)$

comparing coefficients

$a = 1$; $6p = 12 \Rightarrow p = 2$

$4q = 12 \Rightarrow q = 3$ and $r = 3$

hence $p + q + r = 8$ Ans.

(C) $x_1 + x_2 = -p$; $x_1x_2 = q$

Given $2x_1x_2 - x_1 = x_2 + 4$

$2x_1x_2 - (x_1 + x_2) = 4$

$2q + p = 4$ Ans.

(D) $$L = \lim_{x\to 0} \frac{DN^r}{2x} = -\lim_{x\to 0} \frac{D\prod_{r=2}^{n}(\cos rx)^{1/r}}{2x}$$

$$\text{let } y = \prod_{r=2}^{n}(\cos rx)^{1/r} \Rightarrow \ell n\, y = \sum_{r=2}^{n}\left(\frac{1}{r}\ell n(\cos rx)\right)$$

$$\frac{1}{y}\frac{dy}{dx} = -\sum_{r=2}^{n}\tan(rx) - Dy = y\sum_{r=2}^{n}\tan(rx)$$

$$\Rightarrow \quad -D\prod_{r=2}^{n}(\cos rx)^{1/r} = +y\sum_{r=2}^{n}\tan(rx)$$

$$\therefore\ L = \frac{y\lim_{x\to 0}\sum_{r=2}^{n}\tan(rx)}{2x} = \frac{1}{2}\,[2 + 3 + 4 + ... + n]$$

$$= \frac{1}{2}\left[\frac{n(n+1)}{2} - 1\right] = \frac{n^2 + n - 2}{4}$$

$$\therefore\ \frac{n^2 + n - 2}{4} = 10 \Rightarrow n^2 + n - 42 = 0$$

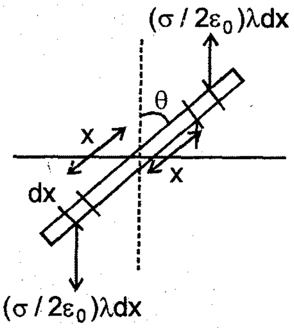
$$\Rightarrow (n + 7)(n - 6) = 0 \Rightarrow n = 6 \text{ Ans.}$$

21. **[A]** kinetic energy

$$=\left[\frac{1}{2}mv_p^2\right]=\frac{1}{2}mv_p^2=\frac{1}{2}\mu ax\left(-v\frac{dy}{dx}\right)^2$$

$$=\frac{1}{2}\mu a\frac{I}{\mu}m^2 \Rightarrow K.E=\frac{1}{2}m^2Ta$$

22. **[B]**



$$\tau=2\left(\frac{\sigma}{2\varepsilon_0}\lambda dx\right)x\sin\theta=\frac{\sigma}{\varepsilon_0}\lambda\int_0^{\ell/2}xdx\sin\theta$$

$$\tau=\frac{\sigma}{2\varepsilon_0}\lambda\frac{\ell^2}{4}.\sin\theta \Rightarrow \tau=-I\alpha$$

$$\alpha=-\tau/I=\frac{\sigma}{2\varepsilon_0}\lambda\frac{\ell^2}{4}.\frac{12}{m\ell^2}\sin\theta$$

$$\alpha=-\left(\frac{3\sigma\lambda}{2m\varepsilon_0}\theta\right)(\text{for small angle})$$

$$T=2\pi\sqrt{\frac{2m\varepsilon_0}{3\sigma\lambda}}$$

23. **[A]**
The man must swim along the direction of shortest distance.

24. **[A]** $V=\frac{dx}{dt}$

$$\Rightarrow dt=\frac{dx}{V}=\int_0^L\frac{dx}{\sqrt{\frac{T_0+\frac{15T_0}{L}.x}{\mu}}}$$

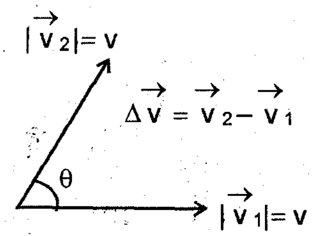
$$t=\frac{2}{5}L\sqrt{\frac{1}{T_0\mu}}$$

25. **[A]**

26. **[B]**
Mirror in convex in nature and produces diminished image at closer distance but due to small size, it appears distant.

27. **[B]** The magnitude of relative velocity between two particles, with their velocity vector at angle θ is

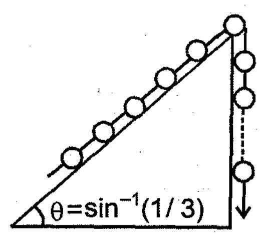
$$|\vec{\Delta v}|=\sqrt{v^2+v^2-2v.v\cos\theta}=2v\sin\left(\frac{\theta}{2}\right)$$



Here, θ varies between 0 and 2π. Therefore, average value of $|\vec{\Delta v}|$ will be :

$$\langle|\vec{\Delta v}|\rangle=\frac{\int_0^{2\pi}2v\sin\left(\frac{\theta}{2}\right)}{2\pi}=\frac{4}{\pi}v>v$$

28. **[B]**
Let m be the mass of each ball. Let n ball hang vertically.



Then (nm) g – T = nma = nm $\frac{g}{2}$ ...(1)

The number of balls lying on the incline is(16 – n)

$\therefore$ T – (16 – n) mg sin θ = (16 – n) m $\frac{g}{2}$ ...(2)

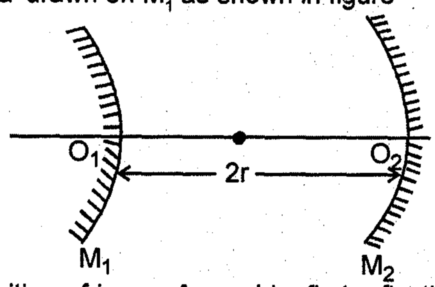
From (1) and (2) we get

$$nmg-(16-1)\,mg\times\frac{1}{3}=(16-n)\frac{mg}{2}+\frac{mng}{2}$$

$$\therefore\ n-(16-n)\frac{1}{3}=\frac{16-n}{2}+\frac{n}{2}$$

$$\text{i.e., } n-\frac{16}{3}+\frac{n}{3}=\frac{16}{2}-\frac{n}{2}+\frac{n}{2}$$

29. **[A,B,D]**
The system consists of a convex mirror M_1 and a concave mirror M_2. The object is a small circle of radius 'a' drawn on M_1 as shown in figure



The position of image formed by first reflection at M_2 is given by

$$\frac{1}{v_1}+\frac{1}{2r}=\frac{2}{r}$$

$$\therefore \quad \frac{1}{v_1}=\frac{2}{r}-\frac{1}{2r}=\frac{3}{2r} \qquad \therefore \; v_1=\frac{2r}{3}$$

A real image is formed at a distance $\frac{2r}{3}$ from M_2 with manification

$$m_1=\frac{v_1}{u}=\frac{2r}{3}\times\frac{1}{2r}=\frac{1}{3}$$

$\therefore$ radius of the first image r_1 is $\frac{a}{3}$

The se

30. **[A,D]**
Along x-axis Q is in stable equilibrium position at origin. Along y-axis, Q is in unstable equilibrium position at origin.

31. **[A,B,D]**
Electrostatics force on A is zero, while on B is
$|F_B| = |q_B| E = (1)(10) = 10$ N
(along negative x-direction)

$$a_b=\frac{F_B}{m_B}=10 m/s^2$$

Just before collision,

$$v_B=\sqrt{2a_B s}=\sqrt{2\times 10\times 1.8}=6 m/s$$

Now, from conservation of linear momentum, velocity of combined mass will be,

$(m_A + m_B)v = m_B v_B$ or

$v = 3$ m/s

At equilibrium position, net force on the system is zero. Let x_0 be the compression in the spring in equilibrium, then

Kx_0 = electrostatic force

or $18x_0 = 10$

or $x_0=\frac{5}{9}$ m

or equilibrium position will be at $x=-\frac{5}{9}$ m.

Angular frequency of SHM will be :

$$\omega=\sqrt{\frac{K}{m_A+m_B}}=\sqrt{\frac{18}{2}}=3 rad/s$$

At $x=\frac{5}{9}$ m, speed is 3 m/s. Therefore, from

$$v=\omega\sqrt{A^2-x^2}$$

we have $3=3\sqrt{A^2-x^2}$

or $A^2 - x^2 = 1$

$$\therefore \quad A^2 = 1 + x^2 = 1+\frac{25}{81}=\frac{106}{81}$$

$$\therefore \quad A=\frac{\sqrt{106}}{9} m$$

32. **[A]**

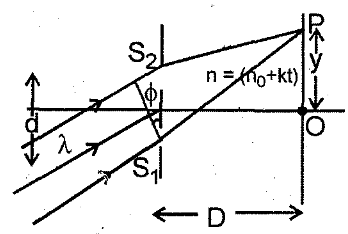
$\frac{I_1}{I_2}=\left(\frac{a_1}{a_2}\right)^2$ only when other propeties like density of medium, speed of wave etc. remains the same

$$\left(I=\frac{1}{2}\rho v w^2 a^2\right)$$

In incident and reflected waves medium is same. Therefore, other properties are same. Hence,

$$\frac{I_i}{I_r}=\left(\frac{a_i}{a_r}\right)^2$$

33,34,35 [A,B,D]



(a) $S_1P - S_2P = \frac{dy}{D}$

$\Delta x = (n_0 + kt)\,\frac{dy}{D} - d\sin\phi = 0$

For central maxima.

$\therefore \; y=\frac{D\sin\phi}{n_0+kt}$ y-coordinats of central maximum

(b) $\frac{dy}{dt}=\frac{-kD\sin\phi}{(n_0+kt)^2}$ = velocity of central maximum

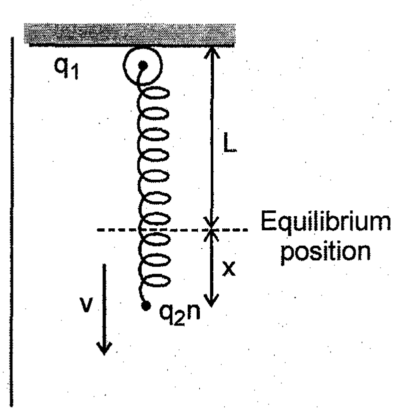
(c) For central maxima to be formed at O

$n'\left(\frac{n}{n'}-1\right)b=d\sin\phi$ Here $n' = n_0 + kt$, n = refractive index of plate

$$n=n_0+kt+\frac{d\sin\phi}{b}$$

36,37,38 **[C,D,A]**

Sol.



Let ℓ be the natural length of the spring.

$$K(L-\ell) = mg + \frac{q_1q_2}{4\pi \epsilon_0 L^2} \text{ ....(1)}$$

$$\frac{1}{2}mv^2 + \frac{1}{2}k(x+L-\ell)^2 + \frac{q_1q_2}{4\pi \epsilon_0 (L+x)^2} - mg(x+L) = \text{constant}$$

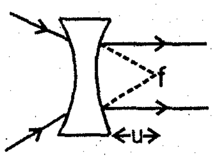
differentiating with respect to t,

$$\frac{d^2x}{dt^2} = -\left(\frac{k}{m} + \frac{q_1q_2}{2\pi \epsilon_0 L^3}\right)x \text{ So, } w = \sqrt{\frac{k}{m} + \frac{q_1q_2}{2\pi \epsilon_0 L^3}};$$

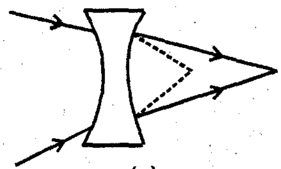
$$A = \frac{v_0}{\omega} \quad \text{and } y = L + A \sin \omega t$$

39. **(A) → P,Q,R, (B) → S, (C) → S, (D) → P,Q**

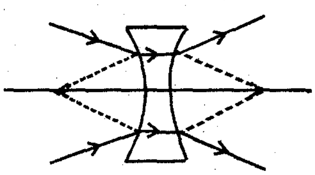
(A) $\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{v} = \frac{1}{f} + \frac{1}{u}$



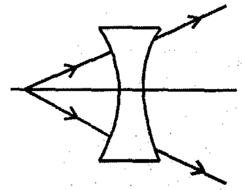
(a)


(c)

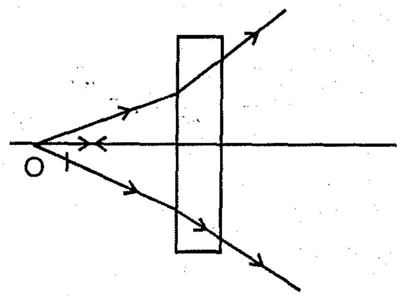
u = positive, f = negative,
If |u| = |f|, v = ∞
(a) If u = f, the emergent beam is a parallel beam.


(b)

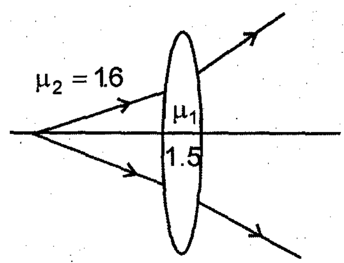
(b) If |u| > |f|, v = negative, the emergent beam is a divergent beam.
(c) If |u| < |f|, v = positive, the emergent beam is a convergent beam.
(B) If the divergent beam of light passes through a diverging lens, the emergent beam must be a divergent beam.



(C) When the divergent beam of light passes through a glass slab, the emergent beam must be a divergent beam.



(D) $\frac{1}{f'} = \left(\frac{\mu_1}{\mu_2} - 1\right)\left(\frac{1}{R_2} - \frac{1}{R_2}\right)$



(a)

(a) If $\mu_1 < \mu_2$, f′ = negative
The converging lens acts as a diverging lens the emergent beam is a divergent beam.
The diverging lens acts as a converging lens, the emergent beam is a covergent beam.

40. **(A) → P,Q,R (B) → P,Q,R, (C) → P, (D) → S**

CHEMISTRY

41. **[A]**
$S - 1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
$S^* - 1s^2, 2s^2, 2p^6, 3s^2, 3p^3, 3d^1$
n + *l* + m = 3 + 3 + 3+ 3 + 3 + 0 + 2 + 2 = 19 **Ans.**

42. **[B]**
Sol. $xc_{(s)} + y/2\, H_{2\,(g)} \rightarrow C_xH_y$

$$\Delta H_f^\circ C_xH_y = x.\Delta H^\circ_C C_{(s)} + y/2\, \Delta H_C^\circ H_2 - \Delta H_C^\circ\, C_xH_y$$

$$= -bx - cy/2 + a = -(bx + cy/2 - a)$$

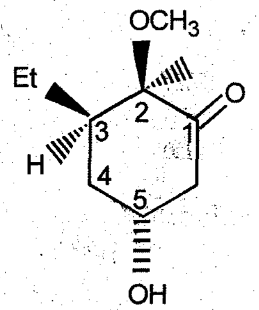
43. **[D]**
Basicity order is N sp^3 > N sp^2 > N sp^2 (Delocalised lone pair)

44. **[A]**
$CH_2 = CH - C \equiv C - CH_2 - CH = CH_2$

```
                        Et
                        |
CH2 = CH - C ≡ C - C - CH = CH2
1      2     3    4   |5  6     7
                      CH2
                        |
                  Me - CH
                        |
                       CH - Me
                        |
                       Me
```

45. [A] $\frac{C_P}{C_v} = \frac{n_1C_p + n_2C_p + n_3C_p}{n_1C_v + n_2C_v + n_3C_v} = 1.43$

46. [D]



47. [A]

48. [C]

The heat absorbed in process AC

(a) $\Delta Q = -\Delta W = nRT_0 \ln P_0/3P_0 = -RT_0 \ln 3$

(b) the work done in path CA

$= -nRT_0 \ln \frac{3P_0}{P_0} = -RT_0 \ln 3$

(c) for A to B

$\frac{P_0V_1}{T_0} = \frac{2P_0V_2}{T_0/2} \Rightarrow \frac{V_2}{V_1} = \frac{1}{4}$

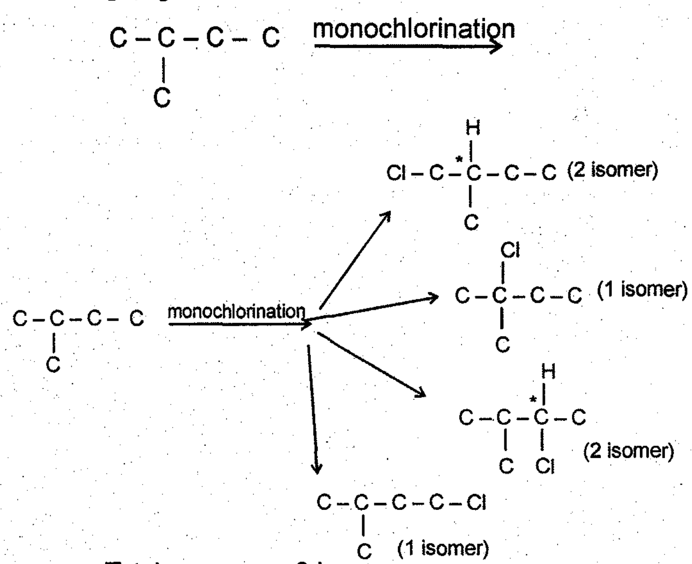
Hence volume decreases.

(d) for BC

$\frac{V_2}{V_1} = \frac{4}{3}$

Hence volume increases.

49. [A,B]



Total 6 isomer

x = 6 Optically active isomer = 4

y = 4

z = 4

u = 2

(A) y = z

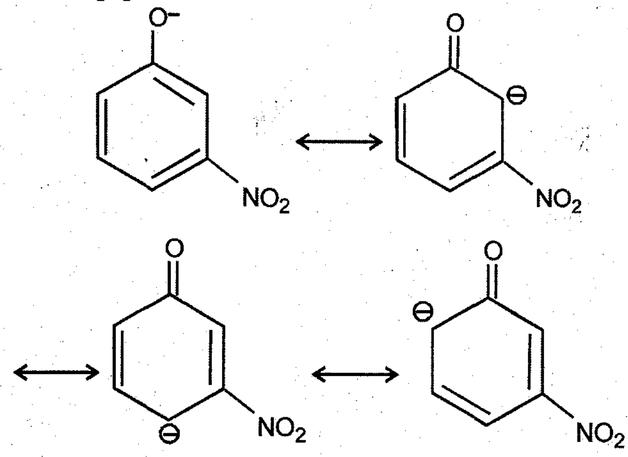
(B) $2(x - y) = z \Rightarrow 2(6 - 4) = 4 = z$

(C) $2x = 3y + 4 \Rightarrow 12 \neq 3 \times 4 + 2$

(D) $4x = 3(y + z) - u$

$= 3(4 + 4) - 2 = 10 \neq 4x$

50. [D]



51. [B,C]

Liq L ⇌ VapL

work done $= -P\Delta V = -\Delta n\,RT = -5 \times R \times (273 + 273)$

$= -5\,R \times 546$

$= -5 \times 0.0821 \times 546$

$= -224$ lit atm

work done by the system = – 224 lit atm

Enthalpy change

= no of moles × Latent heat of vapourisation

= 5 × 273 lit atm = 1365 lit atm

Entropy change $= \frac{\Delta H_{vap}}{T} = \frac{1365}{546} = 2.5\,\text{lit atm/k}$

$\Delta U = \Delta Q + \Delta w = (1365 - 224)$ lit atm = 1141 lit atm

52. [A,B,C,D]

(A) At const P, $\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow \frac{2V}{T_0} = \frac{6V}{T} \Rightarrow T = 3T_0$

(B) BC is an isochoric process.

$\Delta U = \Delta Q \Rightarrow \Delta Q = nC_v(T_C - T_B)$

$= n \times \frac{3}{2}R(3T_0 - T_0) = 3nRT_0$

(C) $\Delta S = nR \ln \frac{V_2}{V_1} = nR \ln \frac{6v}{2v} = nR \ln 3$

(D) total work done = – ve

53. C 54. C 55. D

Sol. meq of H_2SO_4 used for organic compound

$= 50 \times 0.05 \times 2 - 25 \times 0.1 = 5 - 2.5 = 2.5$

m. moles of $NH_3 = 2.5$

moles of N $= 2.5 \times 10^{-3}$

wt of N $= 2.5 \times 10^{-3} \times 14$

% of N $= \frac{2.5 \times 10^{-3} \times 14}{0.303} \times 100 = 11.55\ \%$

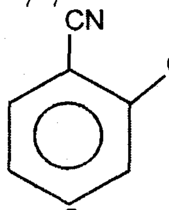
% of O = 100 – (69.4 + 5.8 + 11.55) = 13.25

Emprical formula

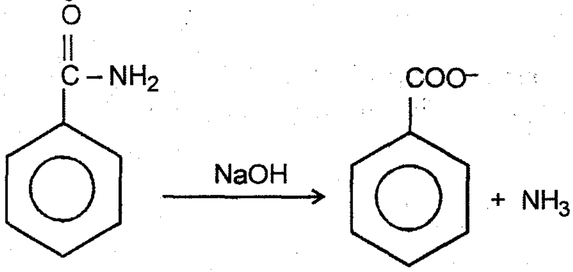
$\frac{69.4}{12} = \frac{5.78}{0.825} = 7 \Rightarrow \frac{5.8}{1} = \frac{5.8}{0.825} = 7$

$\frac{11.55}{14} = 0.825 = 1 \Rightarrow \frac{13.25}{16} = 0.825 = 1$

C_7H_7NO

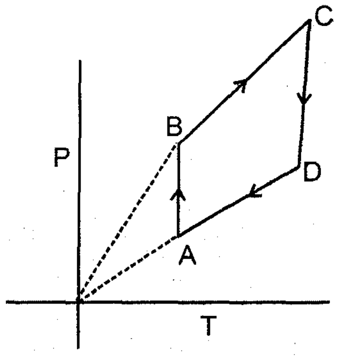


$\neq$ C_7H_5NO



56. **A** **57.** **C** **58.** **B**

Sol.



BC & DA are isochoric process

$w_1 = w_2 = 0$

CD is an isothermal process

$\Delta Q = -\Delta W = nRT \ln p_1/p_2$

$= \frac{1}{2} R \times 600 \ln P_c / P_D$

$\frac{P_B}{T_B} = \frac{P_C}{T_C} \Rightarrow \frac{2 \times 10^5}{300} = \frac{P_c}{600}$

$P_C = 4 \times 10^5$ N/m²

Hence $\Delta Q = 300 R \ln \frac{4 \times 10^5}{2 \times 10^5} = 300 R \ln 2$

$W_{AB} = -nR \times 300 \ln \frac{10^5}{2 \times 10^5}$

$= \frac{1}{2} R \times 300 \ln 2 = 150 R \ln 2$

$W_{CD} = -\frac{1}{2} R \times 600 \ln \frac{4 \times 10^5}{2 \times 10^5}$

$= -300 R \ln 2$

Net work done = – ve

59. **(A) → P,R; (B) → Q,R; (C) → Q,R; (D) → Q,S**

60. **(A) → Q; (B) → T; (C) → Q; (D) → R**

[A]

$$2N_2O_5(s) \rightleftharpoons 4NO_{2(g)} + O_2(g)$$

$a - x \quad 2x \quad x/2$

at t = t $\frac{5}{2} x \propto V_t - V_0$, $\frac{5}{2} a \propto V_\infty - V_0$

$\Rightarrow \frac{(a-x)5}{2} \propto V_\infty - V_t$

$\frac{a}{a-x} \propto \frac{V_\infty - V_0}{V_\infty - V_t}$

$\frac{A_0}{A_t} = \frac{V_\infty - V_0}{V_\infty - V_t}$

If $V_0 = 0 \Rightarrow \frac{A_0}{A_t} = \frac{V_\infty}{V_\infty - V_t}$

[B]

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$

		glucose	fractose
t = 0	a	0	0
t = t	a – x	x	x
t = ∞	0	a	a

at time t = t

$r_t = xp - xq \Rightarrow r_t = x(p-q)$

at time t = ∞

$r_\infty = a(p-q)$

$r_\infty - r_t = (a-x)(p-q)$

$\frac{a}{a-x} = \frac{r_\infty}{r_\infty - r_t}$

$\frac{A_0}{A_t} = \frac{r_\infty}{r_\infty - r_t}$

(C) $CH_3COOC_2H_5 + H_2O \rightarrow CH_3COOH + C_2H_5OH$

t = 0	a	0	0
t = t	a – x	x	x
t = ∞	0	a	a

at t = t

$x \propto V_t - V_0$

$a \propto V_\infty - V_0$

$a - x \propto V_\infty - V_t$

$\frac{a}{a-x} = \frac{V_\infty - V_0}{V_\infty - V_t}$

If initially volume of NaOH = 0

$V_0 = 0$

$\frac{A_0}{A_t} = \frac{V_\infty}{V_\infty - V_t}$

(D) $2H_2O_2 \rightarrow 2H_2O + O_2$

$a - x \quad x \quad x/2$

at t = 0, $a \propto V_0$

t = t $a - x \propto V_t$

$\frac{a}{a-x} = \frac{V_0}{V_t}$