Sec:Sr.Super60_NUCLEUS-BT Paper -2(New-Model-P1) Date: 17-09-2023
Time: 02.00Pm to 05.00Pm GTA-02 Max. Marks: 198

# KEY SHEET

## MATHEMATICS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | **ABD** | 2 | **ABD** | 3 | **ACD** | 4 | **BC** | 5 | **AC** |
| 6 | **ABD** | 7 | **1024** | 8 | **5** | 9 | **20** | 10 | **8** |
| 11 | **2** | 12 | **2** | 13 | **5** | 14 | **6** | 15 | **0** |
| 16 | **24** | 17 | **72** | 18 | **12** | 19 | **50** | 20 | **10** |

## PHYSICS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 21 | **ABCD** | 22 | **BD** | 23 | **ABC** | 24 | **AB** | 25 | **AD** |
| 26 | **AB** | 27 | **2.33** | 28 | **0.74** | 29 | **2.25** | 30 | **9** |
| 31 | **4** | 32 | **3** | 33 | **3** | 34 | **3** | 35 | **3** |
| 36 | **74.79** | 37 | **340** | 38 | **2.12** | 39 | **0.36** | 40 | **20.41** |

## CHEMISTRY

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 41 | **ABD** | 42 | **AC** | 43 | **AC** | 44 | **ABC** | 45 | **AC** |
| 46 | **AC** | 47 | **-1.68** | 48 | **2** | 49 | **7.45** | 50 | **-1.10** |
| 51 | **5** | 52 | **7** | 53 | **8** | 54 | **8** | 55 | **2** |
| 56 | **5** | 57 | **2** | 58 | **19.33** | 59 | **36** | 60 | **6** |

# SOLUTIONS

## MATHEMATICS

1. A) $x = t^2 \quad f(t) = t^3 + \frac{1}{t^3} - 4\left(t^2 + \frac{1}{t^2}\right)$

$f(t) = 3t^2 - \frac{3}{t^4} - 8t + \frac{8}{t^3} = \frac{3t^6 - 8t^5 + 8t - 3}{t^4}$

$t = 1, -1, \frac{3-\sqrt{5}}{2}, \frac{3+\sqrt{5}}{2}$

$f_{\min imum} = \left(t + \frac{1}{t}\right)^3 - 3\left(t + \frac{1}{t}\right) - 4\left(t + \frac{1}{t}\right)^2 + 8$

$= 27 - 9 - 36 + 8 \quad = -10 \text{ for } t + \frac{1}{t} = 3$

B) y = 2t $\quad \int_0^4 \frac{f^{/}(y) e^{f(y)} dy}{2} = 5 \quad\quad f(4) = \ell n\, 11$

C) $x^n + \alpha x + \beta = (x - x_1)(x - x_1)(x - x_2)(x - x_3).....(x - x_{n-1})$

Differentiate with respect to x twice and substitute $x = x_1$

$n(n-1) x_1^{n-2} = 2(x_1 - x_2)(x_1 - x_3).....(x_1 - x_{n-1})$

D) $f(x) + f^{/}(x) \le 1 \quad\quad e^x f(x) - e^0 f(0) \le e^x - 1$

2. $\because \tan^2 \frac{3\pi}{16} = \cot^2 \frac{\pi}{16}$ and $\tan^2 \frac{6\pi}{16} = \cot^2 \frac{2\pi}{16}, \tan^2 \frac{5\pi}{16} = \cot^2 \frac{3\pi}{16}$ and

$\tan^2\theta + \cot^2\theta = (\tan\theta + \cot\theta)^2 - 2 = \frac{8}{1 - \cos 4\theta} - 2$

Put $\theta = \frac{\pi}{16}, \frac{2\pi}{16}, \frac{3\pi}{16}$

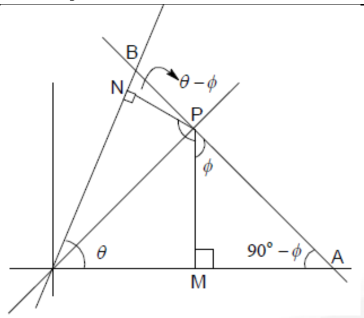
$\left(\tan^2 \frac{\pi}{16} + \tan^2 \frac{7\pi}{16}\right) + \left(\tan^2\left(\frac{2\pi}{16}\right) + \tan^2\left(\frac{6\pi}{16}\right)\right) + \left(\tan^2 \frac{3\pi}{16} + \tan^2 \frac{5\pi}{16}\right) = 34$

3. Equation of tangent line, at $\left(4, \frac{\sqrt{2}}{\sqrt{k}}\right)$ is

$y - \frac{\sqrt{2}}{\sqrt{k}} = \frac{1}{2\sqrt{2}\sqrt{k}}(x - 4)$ and $A = \frac{1}{\sqrt{k}} = \int_2^4 \sqrt{x-2}\, dx$ and $A = \frac{4\sqrt{2}}{3} \frac{1}{\sqrt{x}}$

$\frac{dA}{dx} = \frac{-2\sqrt{2}}{3} k^{-\frac{3}{2}} < 0, \ \forall k > 0 \quad \Rightarrow$ the area decreases as k increases

and $\frac{1}{2}.4\frac{\sqrt{2}}{\sqrt{k}} - \frac{1}{\sqrt{k}} \int_2^4 (x-2)^{\frac{1}{2}} = \frac{8}{3} \quad\quad \Rightarrow k = \frac{1}{8}$

4. 


$$PA.PB=\frac{PM.PN}{\cos\phi\cos(\theta-\phi)}$$

$$\Delta=\frac{2PM.PN}{\cos\theta+\cos(2\phi-\theta)}$$

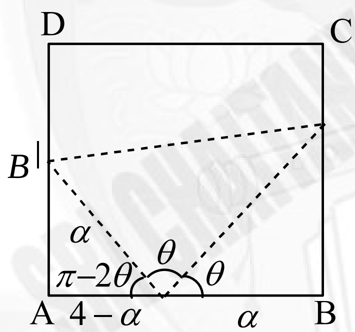
For PA.PB to be minimum $2\phi-\theta=0\Rightarrow\theta=2\phi$

$\therefore OA=OB\Rightarrow\Delta OAB$ is isosceles

Slope of $PA=\tan\left(90^0+\phi\right)=-\cot\phi=-\cot\frac{\theta}{2}$

$\tan\theta=3\Rightarrow\frac{2t}{1-t^2}=3\Rightarrow 3-3t^2=2t$

$3t^2+2t-3=0\qquad t=\frac{-2\pm\sqrt{4+36}}{6}=\frac{-1\pm\sqrt{10}}{3}$

5. 

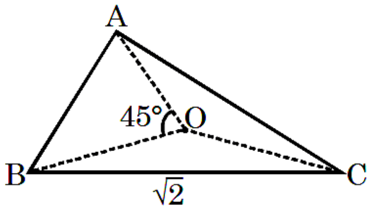

$\cos(\pi-2\theta)=\frac{4-\alpha}{\alpha}\qquad \alpha-2=2\cot^2\theta$

Equation of crease is $y-0=\tan\theta\left(x-(4-\alpha)\right)$

$y=(x-2)\tan\theta+2\cot\theta$

$c=\frac{a}{m}\Rightarrow 2\cot\theta=\frac{a}{\tan\theta}\quad\Rightarrow a=2\quad\Rightarrow y^2=8(x-2)$ is equation of parabola.

6. $\because\ OA+OB=4\qquad\Rightarrow OA.OB\le 4$




$\therefore \text{ar}(\Delta AOB)=\frac{1}{2}(OA)(OB)\times\frac{1}{\sqrt{2}}\le\sqrt{2}$

Let h = altitude drawn from the vertex C to the base AOB.

So, $h \le \sqrt{2}$

$\therefore \quad V = \frac{1}{3} \times ar(AOB) \times h \le \frac{1}{3} \times \sqrt{2} \times \sqrt{2} = \frac{2}{3}$

But $V = \frac{2}{3} \Rightarrow$ equality holds everywhere

So, OA = OB = 2 & $h = \sqrt{2}$

Also, BC $\perp$ base AOB $\Rightarrow \angle OBC = 90^0$

So, $OC = \sqrt{6}$

And, $AB = \sqrt{4+4-8\times\frac{1}{\sqrt{2}}} = \sqrt{8-4\sqrt{2}}$

$\therefore \; AC = \sqrt{8-4\sqrt{2}+2} = \sqrt{10-4\sqrt{2}}$

$> \sqrt{9-4\sqrt{2}} = \left(2\sqrt{2}-1\right)$

7. Each element in subsets appear as the number of subsets of S

1 element subsets = $10C_0$

2 element subsets = $10C_1$

3 element subsets = $10C_2$

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11 element subsets = $10C_{10}$

Number of times an element 'i' appears is $2^{10}$ times

K = (1+3+5+7+9+-----------------+21) $2^{10}$ = (121)(1024)

8. Consider f(x) = sinx/x

f(x) is decreasing function and concave down in the given interval

$\therefore$ for any $x_1, x_2, x_3 \in \left(0, \frac{\pi}{2}\right)$

We can write $f\left(\frac{x_1+x_2+x_3}{3}\right) \ge \frac{f(x_1)+f(x_2)+f(x_3)}{3}$

$x_1 = A, x_2 = B, x_3 = C$

$$\frac{\sin\left(\frac{A+B+C}{3}\right)}{\frac{A+B+C}{3}} \ge \frac{\frac{\sin A}{A}+\frac{\sin B}{C}+\frac{\sin C}{C}}{3}$$

$$\frac{9}{\pi}\sin\frac{\pi}{3} \ge \frac{\sin A}{A}+\frac{\sin B}{B}+\frac{\sin C}{C}, M = \frac{9\sqrt{3}}{2\pi}$$

9. Let $u = \left|z^2\right|\left|z^2+\frac{1}{z^2}+z+\frac{1}{z}-2i\right| = \left|\left(z^2+\bar{z}^2\right)+\left(z+\bar{z}\right)-2i\right|$

$= \left|\left(z+\bar{z}\right)^2 - 2z\bar{z} + \left(z+\bar{z}\right) - 2i\right|$

Let z = x + iy

$\therefore u = \left|(2x)^2 - 2 + 2x - 2i\right|$

$u = 2\left|2x^2 + x - 1 - i\right|$

$u^2 = 4\left(\left(2x^2 + x - 1\right)^2 + 1\right)$

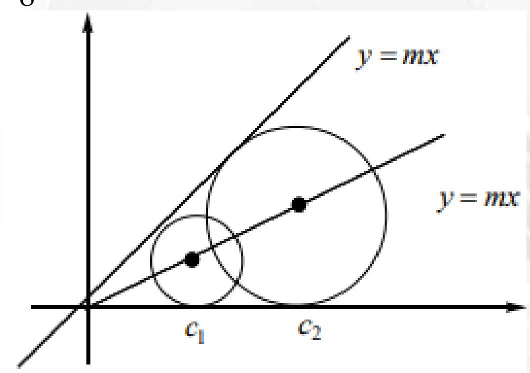
$\because |z| = 1 \qquad \therefore x^2 + y^2 = 1$

$\therefore -1 \le x \le 1$

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

$= 2\left(\left(x + \frac{1}{4}\right)^2 - \frac{9}{16}\right)$

$\frac{-9}{8} \le t \le 2 \qquad \therefore u_{max}^2 = 20$

10. 


Let centre of $C_1$ be $(a, na) \Rightarrow (a-9)^2 + (na-6)^2 = (na)^2$

$\therefore a^2 - a(18 + 12n) + 117 = 0$

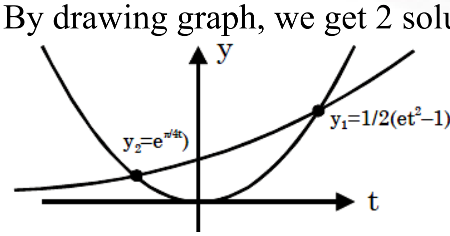
$m = \frac{2n}{1-n^2}$

$\Rightarrow r_1 r_2 = n^2 a_1 a_2 = n^2 117$

$\Rightarrow \frac{117}{2} = n^2(117) \Rightarrow n^2 = \frac{1}{2} \Rightarrow m^2 = 8$

11. $e^{t\int_0^{\infty} \frac{dx}{\left(x^2+1\right)\left(1+x^{2022}\right)}} = e^{t^2} \int_0^t xe^{-x^2} dx \qquad e^{\frac{\pi}{4}t} = \frac{1}{2}\left(e^{t^2} - 1\right)$

By drawing graph, we get 2 solutions



12. $\sqrt{2023}x^3 - 4047x^2 + 2 = 0 \quad \Rightarrow \sqrt{2023}x^3 - x^2 - 2\left(2023x^2 - 1\right) = 0$

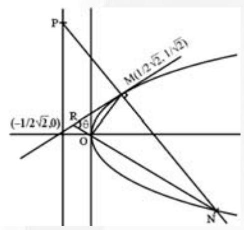
$\left(\sqrt{2023}x - 1\right)\left(x^2 - 2\sqrt{2023}x - 2\right) = 0$

The roots are $\sqrt{2023} - \sqrt{2025}, \dfrac{1}{\sqrt{2023}}, \sqrt{2023} + \sqrt{2025}$

13. $y^2 = \sqrt{2}x \Rightarrow a = \dfrac{1}{2\sqrt{2}}$

Its directrix $x = -\dfrac{1}{2\sqrt{2}}$ intersects

The line $2\sqrt{2}x - \sqrt{2}y + 3 = 0$ at $P\left(-\dfrac{1}{2\sqrt{2}}, \sqrt{2}\right)$




Equation of normal is $y = mx - 2am - am^3$ passing through $\left(-\dfrac{1}{2\sqrt{2}}, \sqrt{2}\right)$

$\Rightarrow \sqrt{2} = \dfrac{-1}{2\sqrt{2}}m - 2\dfrac{1}{2\sqrt{2}}m - \dfrac{1}{2\sqrt{2}}m^3$

$m^3 + 3m + 4 = 0 \quad \Rightarrow m = -1$

Foot of normal is $M\left(am^2, -2am\right) \equiv M\left(\dfrac{1}{2\sqrt{2}}, \dfrac{1}{\sqrt{2}}\right)$

$\because t_1 = 1 \Rightarrow t_2 = -t_1 - \dfrac{2}{t_1} = -3 \quad \Rightarrow$ Other end of normal is $N\left(\dfrac{9}{2\sqrt{2}}, -\dfrac{3}{\sqrt{2}}\right)$

Slope of $RN = m_{ON} = -\dfrac{2}{3}$

Slope of $RM = 1 \quad \Rightarrow \tan\theta = \left|\dfrac{1+\frac{2}{3}}{1-\frac{2}{3}}\right| = 5$

14. $f(x) = ax^3 + bx^2 + cx + 4 \quad f'\left(\dfrac{-2}{3}\right) = \dfrac{5}{3}, f''\left(\dfrac{-2}{3}\right) = 0$

Degree of $f'(x)$ is two $f''(x)$ is one

$\Rightarrow f'(x) = k\left(x + \dfrac{2}{3}\right)^2 + c \Rightarrow f'\left(\dfrac{-2}{3}\right) = c = \dfrac{5}{3}$

$f'(x) = \dfrac{k}{2}\left(x + \dfrac{2}{3}\right)^2 + \dfrac{5}{3} \quad f(x) = \dfrac{k}{2}\left(x + \dfrac{2}{3}\right)^3 + \dfrac{5x}{3} + b$

But $f\left(\frac{-2}{3}\right)=0-\frac{10}{9}+b$ And $y\left(\frac{-2}{3}\right)=\frac{5}{3}\left(\frac{-2}{3}\right)+\frac{100}{27}\Rightarrow b=\frac{100}{27}$

$$f(0)=4\Rightarrow\frac{k}{2}\left(\frac{2}{3}\right)^3+\frac{100}{27}=4 \quad \Rightarrow\frac{k}{2}=1$$

$$\therefore f(x)=\left(x+\frac{2}{3}\right)^3+\frac{5}{3}x+\frac{100}{27} \quad =x^3+2x^2+3x+4$$

a = 1, b = 2, c = 3 a + b + c = 6

15. Let $A(\lambda+1,\lambda+2,\lambda+3)$

$\therefore(\lambda+1)+(\lambda+2)+(\lambda+3)=0\Rightarrow\lambda=-6 \qquad \Rightarrow A(-5,-4,-3)$

Let line $L_1$ and $L_2$ lies on plane P, then normal to the plane P will be 5i + 4j + 3k.

$\Rightarrow$ Eq. of plane P is

5x + 4y + 3z = 0 $\therefore$ Dr's of line through origin and $\perp$ to $L_3$ is

$(5i+4j+3k)\times(i+j+k) \qquad$ = <1, –2, 1>

**<u>16&17</u>**

$$AB=A^2B^2-(AB)^2$$

$$A=A^2B-ABA$$

$$A(I-AB+BA)=0$$

$$|A|=0$$

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|---|
| For $2\times2$ matrices A and B the following relation holds good for some scalar x. |
| $\lvert A+xB\rvert=\lvert A\rvert+x^2\lvert B\rvert+x((TrA)(TrB)-(TrAB))$ |

$$|A+3B|-|B+3A|$$

$$=(|A|+9|B|+3((TrA)(TrB)-(TrAB)))-(|B|+9|A|+3((TrA)(TrB)-(TrAB)))$$

$$=8|B|-8|A|=8(3)-8(0)=24$$

$$|A-5B|-|B-5A|$$

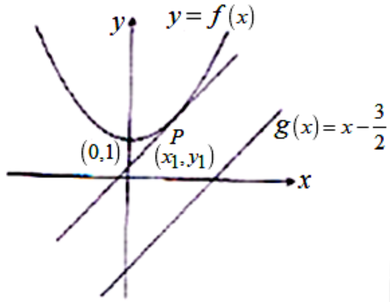
$$=(|A|+25|B|-5((TrA)(TrB)-(TrAB)))-(|B|+25|A|-5((TrA)(TrB)-(TrAB)))$$

$$=24|B|-24|A|=24(3)-24(0)=72$$

18. $g(x)=x-k$ where $k=\int_0^1 f(t)\,dt$ ............... (1)

$$f(x)=\frac{x^3}{2}+1-x\int_0^x g(t)\,dt=\frac{x^3}{2}+1-x\int_0^x(t-k)\,dt=\frac{x^3}{2}+1-x\left[\left(\frac{t^2}{2}-kt\right)_0^x\right]$$

$$\frac{x^3}{2}+1-x\left(\frac{x^2}{2}-kx\right)=1+kx^2$$




$f(x)=1+kx^2$ ............... (2)

From (1) $=\int_0^1\left(1+kt^2\right)dt=t+\left.\frac{kt^3}{3}\right|_0^1=1+\frac{k}{3}\Rightarrow\frac{2k}{3}=1\Rightarrow k=\frac{3}{2}$

$\therefore g(x)=x-\frac{3}{2}\Rightarrow g$ is linear with slope 1 and cuts the y–axis at $\frac{3}{2}$

Also $f(x)=1+\frac{3x^2}{2}$ which is a quadratic polynomial

Now $f^{/}(x)\big]_P=3x_1=1\Rightarrow x_1=\frac{1}{3}$ $\quad y_1=1+\frac{3}{2}.\frac{1}{9}=1+\frac{1}{6}=\frac{7}{6}$

Hence $P\left(\frac{1}{3},\frac{7}{6}\right)$

Perpendicular distance from P on the line $y=x-\frac{3}{2}$ is

$$d=\left|\frac{\frac{1}{3}-\frac{7}{6}-\frac{3}{2}}{\sqrt{2}}\right|=\left|\frac{-\frac{5}{6}-\frac{3}{2}}{\sqrt{2}}\right|=\left|\frac{-7}{3\sqrt{2}}\right|=\frac{7}{3\sqrt{2}}$$

19. Tangent parallel to $y=x-\frac{3}{2}$ is $y=x+\lambda$ to $y=1+\frac{3x^2}{2}$

$x+\lambda=1+\frac{3x^2}{2}\Rightarrow\frac{3x^2}{2}-x+(1-\lambda)=0$

$\lambda=\frac{5}{6}$ $y=x+\frac{5}{6}$

Area of triangle $OAB=\frac{1}{2}\times\frac{5}{6}\times\frac{5}{6}=\frac{25}{72}$

20. $y=1+\frac{3x^2}{2}$ $\quad x=1+\frac{3y^2}{2}$

Least distance = $2\left[\frac{\frac{5}{6}}{\sqrt{2}}\right]=\frac{5\sqrt{2}}{6}=\frac{5}{3\sqrt{2}}$

# PHYSICS

21. ${}^{n}C_2 = 3, n = 3$

So initially atoms was in n = 2.

$E_3 - E_2 = 68 \quad eV$

Hence Z = 6 $\qquad \lambda_{\min} = \dfrac{12400}{E_3 - E_1} = 28.49\overset{0}{A}$

22. Let potential of point A is x and potential of point B is zero. Consider charge flown through 3V battery is $q_0$.

$2(3-x) + q_0 + (0-x)2 = 0 \qquad -q_0 - (x-3)\times 1 + (2-x+3)2 = 0$

23. In figure-1

$\dfrac{1}{v} + \dfrac{1}{u} = \dfrac{1}{f} \qquad \dfrac{1}{v} + \dfrac{1}{-60} = \dfrac{1}{-30}$

$V = -60$

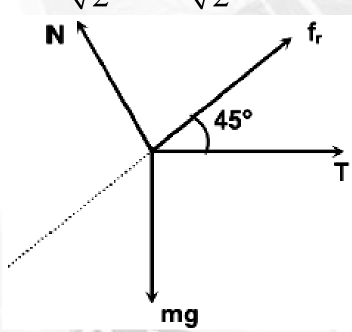
Hence $m = -\dfrac{v}{v} = -1$

In figure-2, images will not separated.

24. Torque about centre must be zero $\Rightarrow \quad T = f_r$

$T\cos 45^0 + f_r = mg\sin 45^0$

$T\dfrac{\left(\sqrt{2}+1\right)}{\sqrt{2}} = \dfrac{100}{\sqrt{2}}$




$T = \dfrac{100}{\left(\sqrt{2}+1\right)}$

25. The maximum energy of photon depends on the energy of electrons incident.

26. Optical path difference = $\left(n_1L_1 - n_2\lambda_2\right)$

$\Delta\phi = \dfrac{2\pi}{\lambda}\Delta x$

27. Speed of projection $\left(v_0\right) = \sqrt{\dfrac{2GM}{R}}$ ….(1)

$\dfrac{1}{2}mv^2 - \dfrac{GMm}{R} = \dfrac{1}{2}mv^2 - \sqrt{\dfrac{2GM}{r}}$ …..(2)

$v=\sqrt{\dfrac{2GM}{r}}$ $\quad \int_R^{4R}\sqrt{r}\,dr=\sqrt{2GM}\int_0^t dt$ $\quad t=\dfrac{7}{3}\sqrt{\dfrac{2R^3}{GM}}$.

28. pitch = 0.2 mm
Total division = 200
Least count = 0.001 mm
-ve zero error = $40\times L.C.=0.04mm$
Reading = 0.6 mm + 100 $\times L.C.=0.7mm$
Thickness = 0.7 mm + 0.04 mm = 0.74 mm

29. In time dt shift in centre of mass of system (ball + liquid)

$$dS_{CM}=\frac{m_1ds_1+m_2ds_2}{M}=\frac{(\rho_bV)vdt-(\rho_\ell V)vdt}{M} \quad \text{.....(i)}$$

Momentum of system $M.\dfrac{dS_{cm}}{dt}$ ....(ii)

$=(\rho_0V)v-(V\rho_\ell)v$

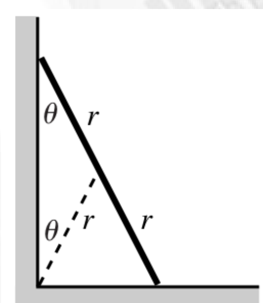
Therefore momentum of liquid $=(V\rho_\ell)v$

$=2.25gm/cm^3$.

30. $\upsilon=\sqrt{\dfrac{2gr(1-\cos\theta)}{1+\beta}}$

The horizontal component of this is

$$\upsilon_x=\sqrt{\frac{2gr}{1+\beta}}\sqrt{(1-\cos\theta)}\cos\theta$$




$$\upsilon_x=\frac{\sqrt{2gr}}{3}\equiv\frac{\sqrt{g\ell}}{3}$$

31. $d\sin\theta\pm(\mu-1)t=\Delta x$

$d\left(\dfrac{3\lambda}{2d}\right)\pm\dfrac{3\lambda}{2}=\Delta x$

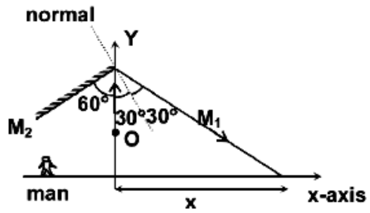
$\Delta x=3\lambda$

Hence maximum intensity will occur at 'O'.

$I=4I_0=16.00\,W/m^2$

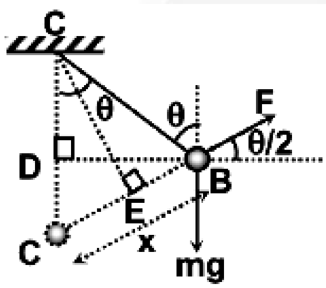
32. $\tan60^0=\dfrac{x}{2}$ $\quad x=2\sqrt{3}m$

Hence total length $=4\sqrt{3}m$.




33. For similar triangles ABD and ACE

$$\frac{\frac{x}{2}}{\ell}=\frac{h}{x} \qquad \ldots.(i)$$




For equilibrium of ball B

$$\Rightarrow \frac{mg}{\frac{kq^2}{x^2}}=\frac{\cos\left(\frac{\theta}{2}\right)}{\sin\theta}=\frac{1}{2\sin\left(\frac{\theta}{2}\right)}=\frac{1}{2\frac{h}{x}} \quad \Rightarrow \frac{kq^2}{x}=2mgh$$

$$W=\Delta U_{electrostatic}+\Delta U_{gravitational}$$

$$=2mgh+mgh=3mgh=3\times 1\times 10\times 0.1=3J$$

34. $$\frac{1+1}{\gamma_{\min}-1}=\frac{1}{\frac{5}{3}-1}+\frac{1}{\frac{7}{5}-1}\Rightarrow \gamma_{\min}=\frac{3}{2}$$

$$M_{mix}=\frac{n_1M_1+n_2M_2}{n_1+n_2}=\frac{1\times 4+1\times 32}{2}=18$$

$$f_1=\frac{3v_1}{4\ell_1}, f_2=\frac{3v_2}{2\ell_2}$$

$$\frac{f_1}{f_2}=\frac{6v_1}{v_2}\frac{\ell_2}{2\ell_1}=6\sqrt{\frac{\gamma H_2}{\gamma_{mix}}\frac{T_{H_2}}{T_{mix}}\frac{M_{mix}}{M_{H_2}}}\times 2=3$$

35. $v=v_0\tan\theta \qquad a=v_0\sec^2\theta\frac{d\theta}{dt}$

$y=\ell\sin\theta \qquad v_0=\ell\cos\theta\frac{d\theta}{dt} \qquad a=\frac{v_0^2}{\ell}\sec^3\theta$

$T\cos\theta=ma \qquad T\sin\theta=mg \qquad a\tan\theta=g$

$$\frac{V_0^2}{\ell}\sec^3\theta\tan\theta=g \qquad V_0^2=\frac{\cancel{g\ell}\,3\sqrt{3}}{\cancel{8}}\times\sqrt{3} \qquad V_0=3$$

**36&37**

$W_{AB}+W_{BC}+W_{CA}=W_{CD}+W_{DA}+W_{AC}$

$0+W_{BC}-W_{AC}=0+W_{DA}+W_{AC}$

$W_{BC}-W_{DA}=2W_{AC}$

$W_{BC}=R(T_C-T_B)=R(400-T_B)$

$W_{DA}=R(T_A-T_D)=R(289-T_D)$

$A\to C$ is a polytropic process $\left(P\propto V\Rightarrow PV^{-1}=constant\right)$

For process $A\to C$ $\quad W_{AC}=\frac{R}{(1-\alpha)}(T_C-T_A)=\frac{R}{2}(T_C-T_A)$

$\Rightarrow R(400-T_B)-R(289-T_D)=\frac{2R}{2}(400-289)$

$111-T_B+T_D=111$

$\Rightarrow T_B=T_D$

For process $A\to B$

$\frac{P_1}{T_A}=\frac{P_2}{T_B}\Rightarrow T_B=\frac{P_2}{P_1}289$ ….(i)

$\frac{P_2}{T_C}=\frac{P_1}{T_D}\Rightarrow T_D=\frac{P_1}{P_2}400$ …..(ii)

From (i) and (ii)

$T_BT_D=289\times400$

$\Rightarrow \quad T_B^2=289\times400$

$T_B=17\times20=340K$

$W_{AB}=0, W_{BC}=R(T_C-T_B)=R(400-340)=60R$

$W_{CD}=0, W_{DA}=R(T_A-T_D)=R(289-340)=-51R$

$W_{net}=W_{AB}+W_{BC}+W_{CD}+W_{DA}=9R=9\times8.31=74.79J$

**38&39**

The energy of photon incident on plate $A=\frac{1240eV-nm}{500nm}=2.48eV$

The maximum kinetic energy of emitted photoelectrons from plate A

$K_{\max}=hv-\phi=(2.48-\phi)eV$

The maximum kinetic energy of photoelectrons reaching the plate $B=k_{\max}+e\times1.64$

$=(2.48-\phi+1.64)eV$

The maximum energy of photons emitted from plate B $=\frac{1240eV-nm}{620nm}=2eV$

The maximum energy of emitted photons from plate B = maximum kinetic energy of photoelectrons striking the plate B $\Rightarrow$ $2eV=(2.48-\phi+1.64)eV\Rightarrow\phi=2.12eV$

40. $\lambda=\sqrt{\frac{150}{V}}$

# CHEMISTRY

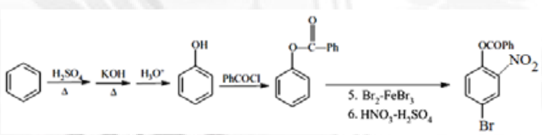
41. NCERT
A XI Part -2 (394)
B XI Part -2 (395)
C XI Part -2 (124)
D XI Part -2 (304)

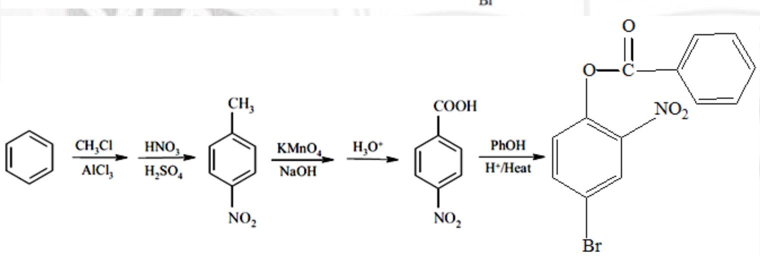
42. $X = (SiH_3)_3 \overset{+}{N}H \overset{-}{Cl}$ $Y = (SiH_3)_3 N$
$P = (CH_3)_3 N$ $Q = qNH_4Cl$
Lone pain on 'N' in Y is involved in back bonding hence it is less basic then P.
Y is planar about 'N' but tetrahedral about silicon.
$(CH_3)_3 N + CH_3COOH \rightarrow (CH_3)_3 \overset{+}{N}H\, CH_3CO\overline{O}$ salt (acid-base reaction)

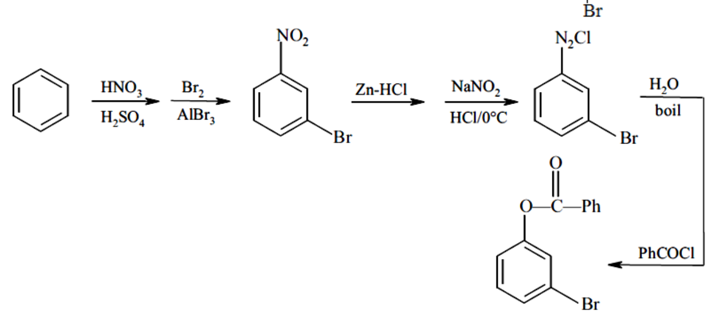
43. (A) At anode $H_2O \rightarrow \frac{1}{2}O_2 + 2e + 2H^+$
At cathode $2H_2O + Ze \rightarrow H_2 + ZO\overline{H}$ $O_2$ is paramagnetic
(B) $H_2O_2$ is not paramagnetic
(C) $\underset{Cmc}{Pbs + HNO_3} \rightarrow \underset{paramagnetic}{NO}$
(D) potassium react with water

44. (A) z > 1 $\frac{d_i}{d_r} > 1 \Rightarrow d_r < d_i$
(B) Always repulsions z > 1
(C) First law of thermodynamics is valid for real gas (or) ideal gas
(D) 'z' linearly varies with p.

45. Monosaccharides cant be hydrolysed

46. 

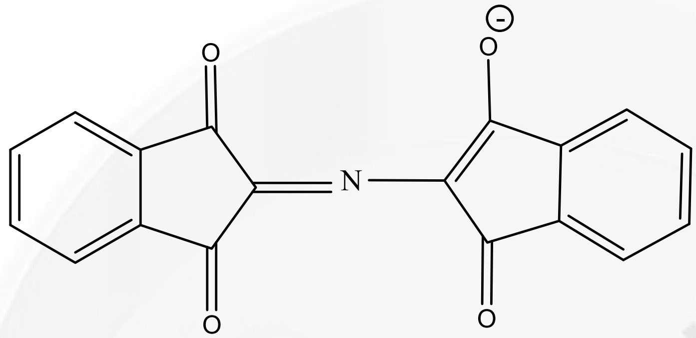



47. $\frac{K_1}{K_2} = \frac{1}{16}$

$Ea_1 - Ea_2 = 4RT\ell n_2 = 1 - 68k.cal / mol$

48. NCERT (carbohydrates practical lab manual)
Page No : 9
(Replica)

x = 

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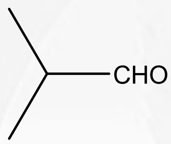
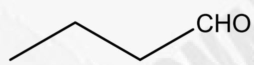
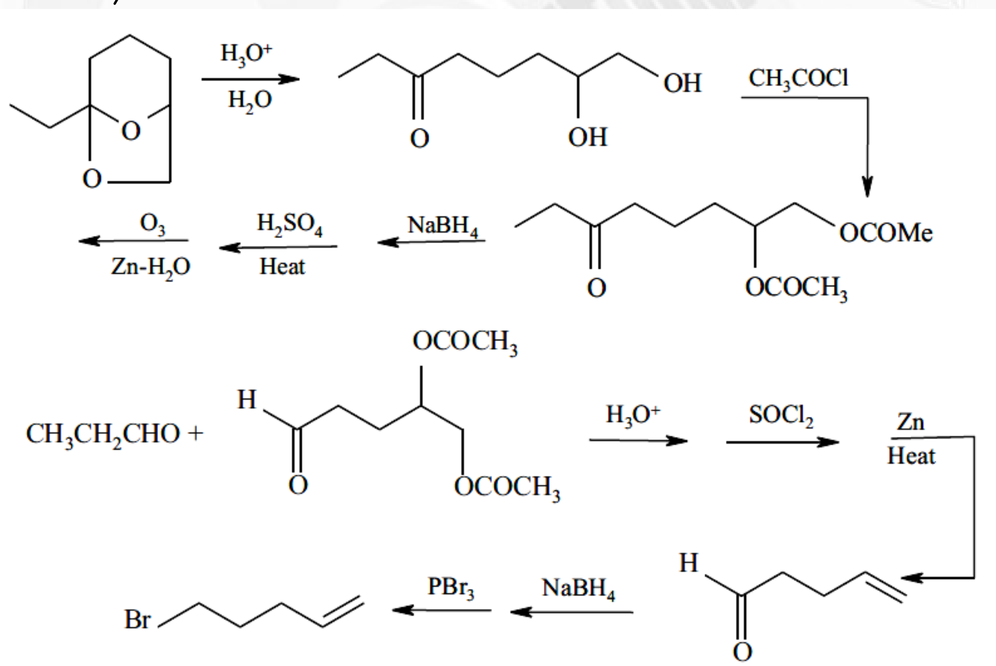
y = 1 

b = 1 


49.
Molecular mass of given compound= 142
Moles of reactant = 0.05 moles
Molecular mass of R= 149
Mass of $R = 0.05 \times 149 = 7.45$ grams

50. $E = E^0_{Cu^{+2}/Cu} - \frac{0.06}{2}\log\left[H^+\right]^2$

$E^{-0}_{Cu^{+2}/Cu} = 0.322 + \frac{0.06}{\cancel{2}} \times \cancel{2}\log^2$

= 0.322 + 0.018 = 0.34 V

$\therefore$ For given cell $E = E^0_{Cu/Cu^{+2}} + E^0_{Zn^{+2}/Zn}$

= - 0.34 – 0.760 = -1.1 V

51. I – Covalent

II – ionic

IE = 3.62 + 1.52 = 5.14

52. $DS_{AB} = \frac{q_{AB}}{T_{AB}} = \frac{R_{\cancel{V}}\ell n\frac{1}{2}}{T_{\cancel{AB}}}$

$DS_{C\to D} = R\ell n2 = -R\ln\frac{1}{2}$

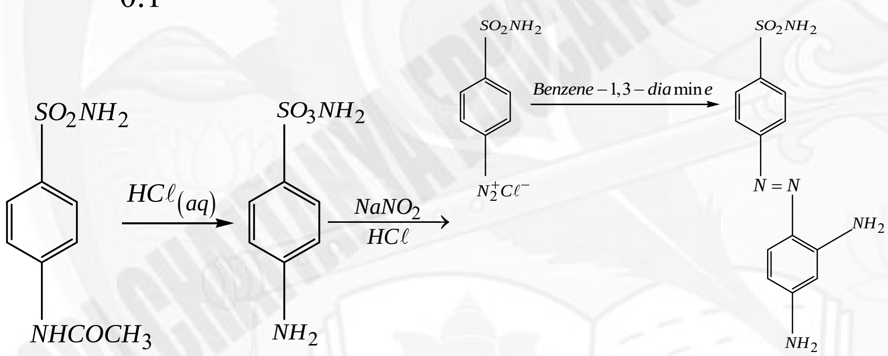
$2S_{AB} + \Delta S_{C\to D} = 2R\ell n\frac{1}{2} - R\ell n\frac{1}{2}$

$= R\ell n\frac{1}{2}$

$= -R\ell n2$ $\qquad \therefore P = 7$ bar

53. $K_p = \frac{(0.9)^2}{0.1}\times 1 = 8$

54.




55. NCERT page no: 231 Part1 XII

$4FeCr_2O_4 + 8K_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

56. number of unpaired electro n = 4 $(24)^{\frac{1}{2}}$.

NCERT XII Part -1 Page No. 243-228

57. none of the 3dorbital is empty

58. mol. wt. $[M] = \frac{1000\times K_f \times w}{\Delta T \times W}$

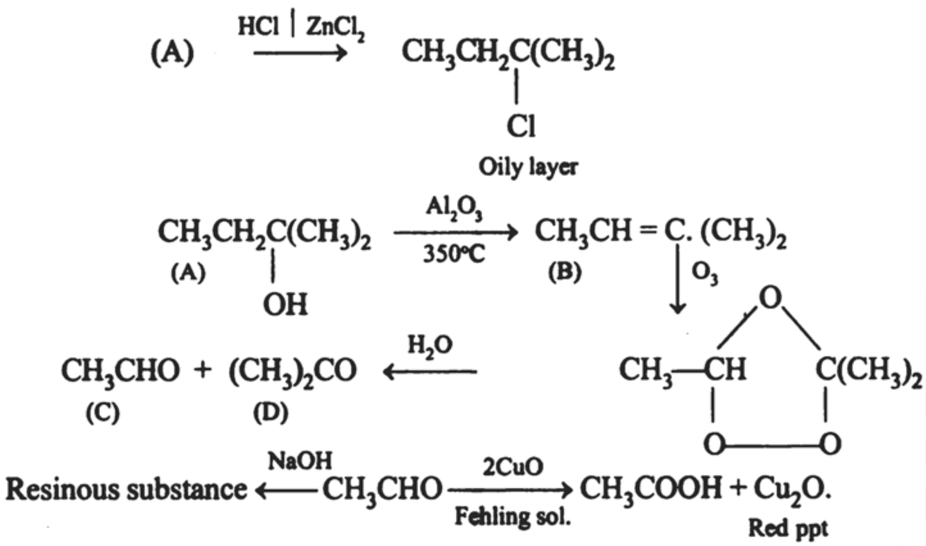
here $K_f = 40,\quad w = 0.0088\ g,\quad \Delta T = 8^0C,\ W = 0.50g$.

$M = \frac{100\times 40\times 0.0088}{8\times 0.50} = 88$.

Empirical formula of (A) = $C_5H_{12}O$.

Empirical formula weight of (A) $= 12\times 5 + 1\times 12 + 16 = 88$.

As the empirical weight and molecular weight (calculated) are same, therefore, the molecular formula is $C_5H_{12}O$.

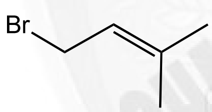


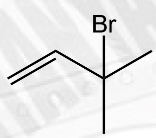

0.5 mole of C contains one mole of carbon atoms from which 1/3 mole of compound D is prepared. Mass = (1/3) x molecular mass of D= 58/3=19.33

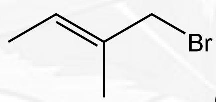
59. $\therefore$ Specific surface area $= 6\times10^{19}\times0.15\times\left(10^{-9}\right)=9$

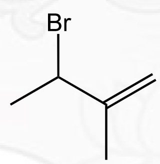
Edge length of cube = 3 m, Volume of the cube = 27 $m^3$.

Number of unit cells= $27/\left(27\times10^{-36}\right)$

60. 

(1), 

(1), 

(2), 

(2)