Sri Chaitanya IIT Academy.,India.

✪ A.P ✪ T.S ✪ KARNATAKA ✪ TAMILNADU ✪ MAHARASTRA ✪ DELHI ✪ RANCHI

A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

Sec:Sr.Super60_STERLING&NUCLEUS_BT Paper -2(Adv-2021-P2-Model) Date: 06-08-2023

Time: 02.00Pm to 05.00Pm RPTA-01 Max. Marks: 180

KEY SHEET

PHYSICS

1	AC	2	BD	3	AB	4	BD	5	ABCD	6	ACD
7	1.50	8	1.12	9	4	10	8	11	4.66 or 4.67	12	8.90 or 8.91
13	D	14	A	15	C	16	B	17	5	18	3
19	5										

CHEMISTRY

20	ABD	21	B	22	BCD	23	ABD	24	C	25	CD
26	14	27	83	28	7	29	5	30	8	31	2020
32	C	33	A	34	C	35	C	36	6	37	5
38	2										

MATHEMATICS

39	AB	40	AD	41	ABCD	42	ABC	43	BD	44	BCD
45	15	46	8	47	3	48	3	49	1.5	50	6
51	A	52	C	53	B	54	D	55	2	56	4
57	1										

SOLUTIONS
PHYSICS

1. Let the system be water at $100^0 C$

Heat released by steam $=(4)\left(\frac{L}{1000}\right)(500)+4L=6L$

Heat required by ice $=(10)\left(\frac{L}{1000}\right)(200)+10\left(\frac{L}{6}\right)+10\left(\frac{L}{500}\right)(100)=5.67L$

Using 0.33 L of available heat 0.33g converts into steam.

2. Let $\frac{\ell}{KA}=R$

The resistances will be R, R and $3R$ $\quad \frac{3T-T_0}{R}+\frac{2T-T_0}{R}+\frac{T-T_0}{3R}=0$

$T_0=\frac{16T}{7}$ which is guator then T and 2T.

Heat flows towards the junction in only one rod.

3. Volume of the liquid $=\left(\pi R^2 h\right)(1+\gamma\theta)$

Area of the base $=\pi R^2(1+2\alpha\theta)$

$\therefore$ Height from the bottom $=\frac{volume}{Area}=h\left(\frac{1+\gamma\theta}{1+2\alpha\theta}\right)$

Depth from the top = height of the cylinder – height of the liquid

$=H(1+\alpha\theta)-h\left(\frac{1+\gamma\theta}{1+2\alpha\theta}\right)=H(1+\alpha\theta)-h\left(1+(\gamma-2\alpha)\theta\right)$

4. $\Delta Q=nC\Delta T$ $\quad C$ can be positive or negative depending on the process.

When C is negative, temperature decreases.

5. Average KE per degree of freedom $=\frac{1}{2}KT$

Energies greater than $\frac{5}{2}KT$ and less than $\frac{5}{2}KT$ are possible.

6. $\frac{1}{2}(nM)v^2=n\left(\frac{3}{2}R\right)\Delta T$ $\quad \therefore\ \Delta T=\frac{Mv^2}{3R}$

$Pv=nRT$ $\quad \therefore\ \frac{\Delta P}{P}=\frac{\Delta T}{T}$

7. $V_M=\frac{V_0+2V_0}{2}=\frac{3V_0}{2}$ $\quad \therefore\ \frac{V_M}{V_0}=1.50$

8. $2P_0V_0=nRT_0$

Middle point will be at maximum temperature

$$\left(\frac{3P_0}{2}\right)\left(\frac{3V_0}{2}\right)=nRT_M \quad \therefore \quad \frac{T_M}{T_0}=\frac{9}{8}=1.12$$

9. The outer shell emits power P in both directions.
Sphere has to emit radiation of power $P' = P + P = 2P$

10. $P \alpha T^4$ and $P' \alpha T'^4$

$$\therefore \quad \frac{P'}{P} = \left(\frac{T'}{T}\right)^4 = 2 \text{ and } \left(\frac{T'}{T}\right)^{12} = 8$$

11. $u_1 = \sqrt{\frac{2RT}{4\times10^{-3}}}$ $\quad v_3 = \sqrt{\frac{3RT}{28\times10^{-3}}}$ $\quad \therefore \quad \left(\frac{u_1}{v_3}\right)^2 = 4.66 \ \ or \ \ 4.67$

12. $u_2 = \sqrt{\frac{8RT}{\pi 4\times10^{-3}}}$ $\quad v_1 = \sqrt{\frac{2RT}{28\times10^{-3}}}$

$$\left(\frac{u_2}{v_1}\right)^2 = 8.90 \ \ or \ \ 8.91$$

13. $\frac{yA}{\ell}(\ell\alpha\theta + x) = \frac{2y2A}{2\ell}(2\ell 2\alpha\theta - x) \quad \therefore \quad x = \frac{7\ell\alpha\theta}{3}$

14. $F = \frac{Ay}{\ell}(\ell\alpha\theta + x) = \frac{10Ay\alpha\theta}{3}$

15. $x = \left(\frac{3}{2}R\right)T = \frac{3}{2}P_0V_0$

$$y = \frac{3}{2}[4P_0V_0 - P_0V_0] \quad \therefore \ \frac{y}{x} = 3$$

16. Heat is absorbed when the product PV increases.

When pressure increases at V_0, $\quad Q_1 = \frac{3}{2}(2P_0V_0 - P_0V_0)$

When volume increases at $2P_0$, $\quad Q_2 = \frac{5}{2}(4P_0V_0 - 2P_0V_0)$

$\therefore$ heat absorbed $= \frac{13P_0V_0}{2}$

$\Delta w = P_0V_0 \quad \therefore \quad$ Efficiency $= \frac{P_0V_0}{\left(\frac{13P_0V_0}{2}\right)} = \frac{2}{13}$

17. Mean free path $\alpha \ \frac{T}{P}$ $\quad y = 2.5x \quad \therefore \ \sqrt{\frac{10y}{x}} = 5$

18. $PV = nRT = \frac{3n}{4}R(T + \Delta T)$

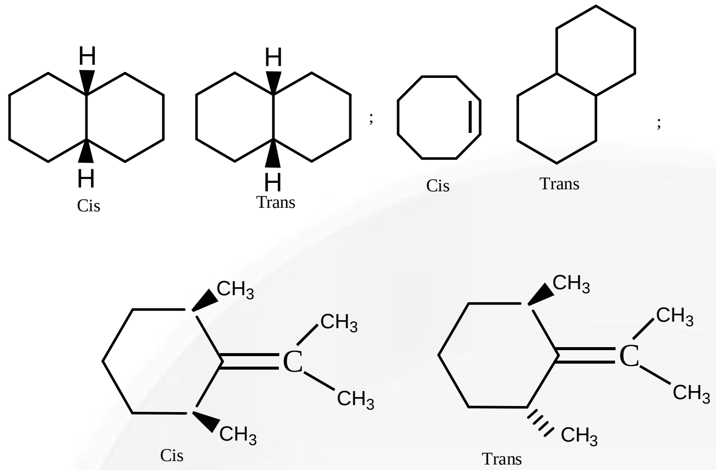
$$\therefore \ \frac{T}{\Delta T} = 3$$

19. $\Delta Q = \left[(5)\left(\frac{3}{2}R\right) + (4)\left(\frac{5}{2}R\right) + 3\left(\frac{10}{2}R\right)\right]2$

$= 65R \qquad \therefore \ x = 5$

CHEMISTRY

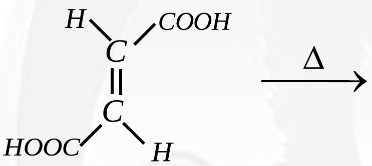
20.



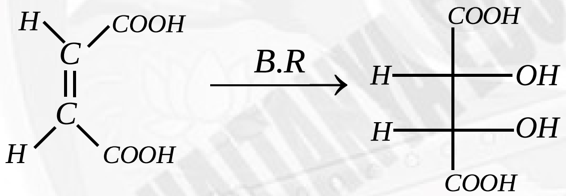
21.

CONCEPTUAL

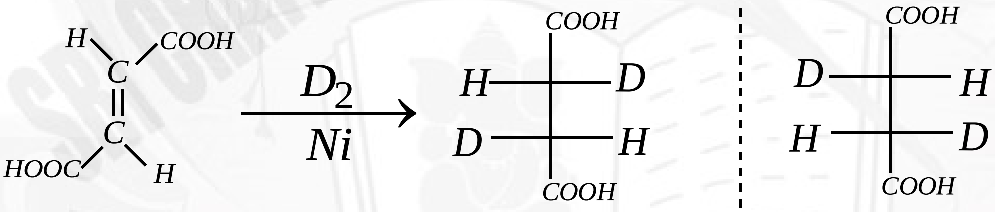
22.



no, anhydride



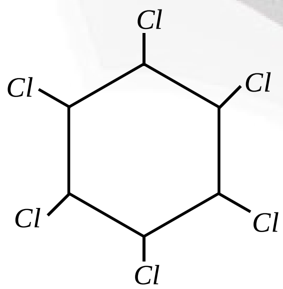
Meso



23. a,b,d are without any symmetry element.

24. Only salicylic acid is carboxylic acid.

25.



has 9 stereoisomers and only one enantiomeric pair and 7 meso compounds.

26 & 27. Enolizable $H_3 = 14$

Chiral centres $= 5$

sp^2 carbons = 25

28. CONCEPTUAL

29. OPTICALLY ACTIVE = 2 ; MESO COMPOUNDS = 2

30. CONCEPTUAL

31. CONCEPTUAL

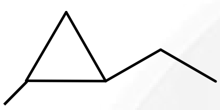
32&33. *In* "13" $\longrightarrow$ "c" is without symmetry elements.

In "14" $\longrightarrow$ "y" is without symmetry elements.

34 . C is chiral

35. Only three double bonds can exhibit geometrical isomerism.

36.



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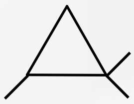
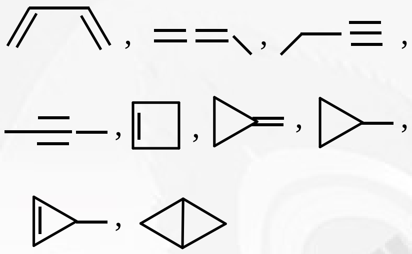


2

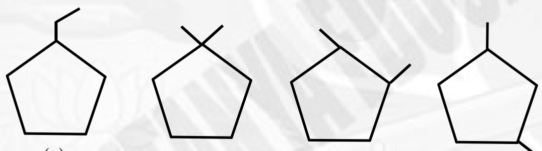
37.

$C_4H_6 \rightarrow$



38.

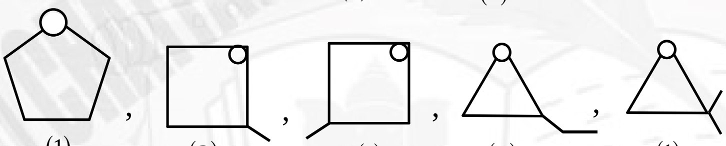
$C_7H_{14} \rightarrow$



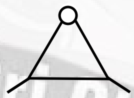
(1) (1) (3) (3)

$= 8$

$C_4H_8O \rightarrow$



(1) (2) (1) (2) (1)

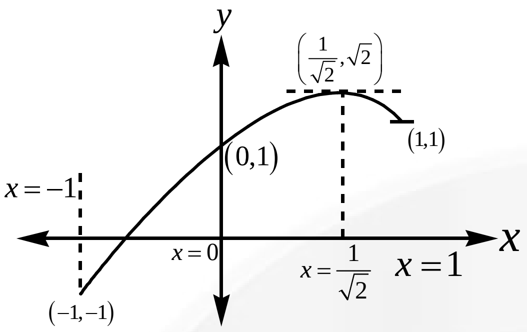


(3)

$= 10$

MATHEMATICS

39.



Clearly domain of f is $[-1,1]$. Verify all alternatives from graph.

40. $f(x)$ is defined only when

$3-e^{2x}\ge 0 \Rightarrow 3\ge e^{2x} \Rightarrow e^{2x}\le 3 \Rightarrow 2x\le \log_e 3$

$\frac{1}{f(x)}$ is defined only when $3-e^{2x}>0 \Rightarrow 3>e^{2x} \Rightarrow e^{2x}<3 \Rightarrow 2x<\log_e 3$

41. Put $x=0=y \Rightarrow f(0)=0$

$f^1(0)=\underset{h\to 0}{lt}\frac{f(h)-f(0)}{h}=\left(f^1(0)\right)^3$

$\Rightarrow \quad f^1(0)=0 \ or\ 1\left(\because \ f^1(0)\ge 0\right)$

$\Rightarrow \quad f(x)=k(a)x+k$

$\Rightarrow \quad f(x)=0 \ or\ \left(\because \ f(0)=0\right)$

42. $f(x)=\begin{cases}-x-3 & x<0\\ x-3 & 0\le x<1\\ -x>2>a & 1\le x<2\end{cases} \quad g(x)=\begin{cases}2>x & x<0\\ 2-x & 0\le x<2\\ 1-2 & 2\ge 2\end{cases}$

$h(x)=\begin{cases}-1 & x<0\\ -1 & 0\le x<1\\ 0-h>3-x & 1\le x<2\\ a-L-1>x & x\ge 2\end{cases}$

$a-L>2=-1 \quad \Rightarrow \quad a-L=-3$

43. $R.H.L\ f\left(0^+\right)=\underset{x\to 0^+}{Lt}\ 3-\left[\cot^{-1}\left(\frac{2x^3-3}{x^2}\right)\right]$

$=3-\underset{x\to 0^+}{LT}\left[\cot^{-1}\left(\frac{2x^3-3}{x^2}\right)\right]$

$=3-3 \qquad =0$

$$L.H.L\ f\left(0^-\right)=\underset{x\to 0^-}{Lt}\left\{x^2\right\}\cos\left(e^{\frac{1}{x}}\right)=0$$

44. $f(x)=\left[\tan^2 x\right]$

AT $x=0\ as\ x\to 0^-\tan x<0\Rightarrow \tan^2 x>0$

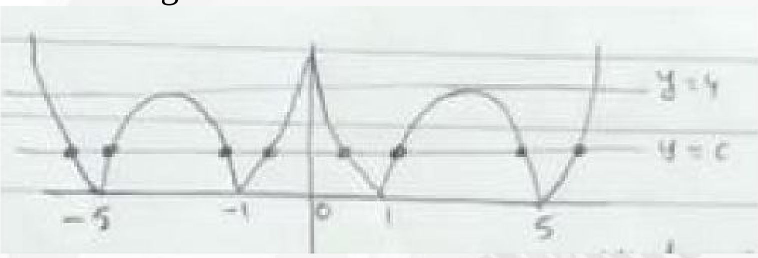
$x\to 0^+\tan x>0\Rightarrow \tan^2 x>0$

$f\left(0^-\right)=f\left(0^+\right)$

$f(x)$ at constant at $x=0$

45 & 46. For domain of $g(x), f(x)>0\Rightarrow\ x\notin[1,5]$

Sum of integers $=1+2+3+4+5=15$



47. $$f(x)=\begin{cases}-2 & -2\le x<-1\\ -1 & -1\le x\le -\frac{1}{2}\\ 2x^2-1 & -\frac{1}{2}<x\le 2\end{cases}$$

$$f(|x|)=\left\{2x^2-1\quad -2\le x\le 2\right.$$

$$|f(x)|=\begin{cases}2 & -2\le x\le -1\\ 1 & -1\le x\le -\frac{1}{2}\\ -\left(2x^2-1\right) & -\frac{1}{2}<x\le\frac{1}{\sqrt{2}}\\ 2x^2-1 & -\frac{1}{\sqrt{2}}<x\le 2\end{cases}$$

$$g(x)=\begin{cases}2x^2-1 & -2\le x<-1\\ 2x^2-1 & -1\le x\le -\frac{1}{2}\\ 0 & -\frac{1}{2}<x<\frac{1}{\sqrt{2}}\\ ax^2-2 & \frac{1}{\sqrt{2}}\le x\le 2\end{cases}$$

$\left|f(x)\right|$ is non differentiable at 3 points.

$g(x)$ is non differentiable at 3 points.

48. CONCEPTUAL

49 & 50

Let $x^2 = 4\cos^2\theta + \sin^2\theta$

Then $f(x) = \sqrt{3}\left|\sin\theta\right| + \sqrt{3}\left|\cos\theta\right|$

$\min = \sqrt{3}(1) = \sqrt{3}$

$\max = \sqrt{3}\sqrt{2} = \sqrt{6}$

50. CONCEPTUAL

51. $f(x) = \begin{cases} \dfrac{\pi}{2} & x \neq 0 \\ 0 & x = 0 \end{cases}$

$g(x) = \begin{cases} 1 & \sin^2 x = 1 \Rightarrow x = \pm\dfrac{\pi}{2} \\ 0 & \sin^2 x < 1 \end{cases}$

Range $g|x=1|is\{0,1\}$

$h(x) = \sin^{-1}\left\{\frac{1}{2}\left(\cos\pi\left(g(x) + \cos 2\left(f(x)\right)\right)\right)\right\}$

Is discontinuous.

52. CONCEPTUAL

53. Since $f\left(x+\frac{7}{4}\right) = f\left(\frac{7}{4}-x\right) \forall x \in R$

So, $f(x)$ is symmetric about $x = \frac{7}{4}$

Hence $\frac{-b}{2a} = \frac{7}{4} \Rightarrow \frac{-b}{a} = \frac{7}{2}$

Also $f(x) = 7x + a$ has only one real solution, so

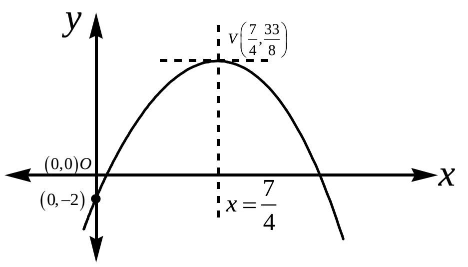
$ax^2 + bx + a = 7x + a \Rightarrow ax^2 + x(b-7) = 0$ has discriminant zero.

$\Rightarrow \quad (b-7)^2 - 4(a)(0) = 0 \Rightarrow b = 7$

Putting $b = 7$ in equation (1), we get $a = -2$

So, $f(x) = -2x^2 + 7x - 2$ Hence, $(a+b) = (-2+7) = 5$

54. Clearly from the graph of $f(x) = -2x^2 + 7x - 2$,



Minimum value of $f(x)$ in $\left[0,\frac{3}{2}\right]$ is $F_{\min}(x=0)=-2$

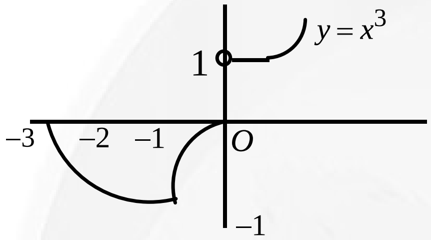
55. $2[x]=[x]+2\{x\}$

$\{x\}=\frac{[x]}{2}\to 0<\frac{[x]}{2}<2\Rightarrow [x]=0,1$

For $[x]=0\to x=0$

$[x]=1\to x=1+\frac{1}{2}=\frac{3}{2}$

56.



All is not differentiable at 5 points.

57.