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_NUCLEUS & STERLING_BT Paper -2(Adv-2021-P2-Model) Date: 08-10-2023

Time: 02.00Pm to 05.00Pm CTA-06 & CTA-09 Max. Marks: 180

KEY SHEET

PHYSICS

1	**AC**	2	**CD**	3	**ABC**	4	**BD**	5	**ACD**	6	**BD**
7	**19**	8	**16**	9	**5**	10	**4**	11	**1.41**	12	**4**
13	**A**	14	**D**	15	**C**	16	**B**	17	**9**	18	**1**
19	**1**										

CHEMISTRY

20	**AB**	21	**BD**	22	**ABC**	23	**ABC**	24	**ABD**	25	**ABD**
26	**6**	27	**16**	28	**9**	29	**15**	30	**6**	31	**4**
32	**D**	33	**C**	34	**B**	35	**C**	36	**6**	37	**2**
38	**2**										

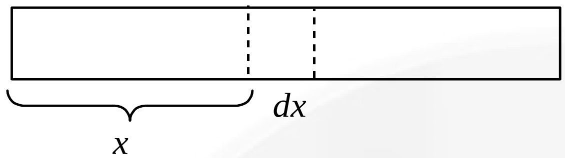
MATHEMATICS

39	**BCD**	40	**A**	41	**CD**	42	**ABC**	43	**ACD**	44	**ABCD**
45	**1**	46	**4**	47	**1**	48	**7**	49	**10**	50	**505**
51	**A**	52	**D**	53	**C**	54	**A**	55	**0**	56	**5**
57	**5**										

SOLUTIONS

PHYSICS

01. Stress is $\frac{F}{A}$, $\therefore$ it will be same at all points.



Young's modulus on element dx will be $Y_0 + \frac{Y_0}{L}x$

Let extension in dx be dy

then $\frac{F}{A} = \left(Y_0 + \frac{Y_0 x}{L}\right)\frac{dy}{dx}$

$$\int_0^L \frac{FL}{A}\frac{dx}{(Y_0 L + Y_0 x)} = \int_0^{\Delta L} dy$$

ΔL : total alongation in rod.

02. $T = Ma_c \quad ....(i)$

$$T\ell = \frac{M\left(4\ell^2\right)}{12}\alpha \quad .....(ii)$$

$$T + M\left(a_c + \ell\alpha\right) = \frac{Mv_0^2}{\ell} \quad ....(iii)$$

From (i), (ii) and (iii)

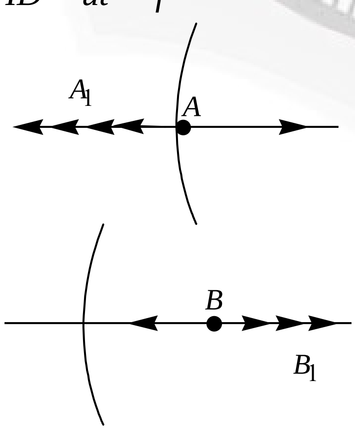
$$a_c = \frac{v_0^2}{5\ell} \qquad \alpha = \frac{3v_0^2}{5\ell}$$

03. $A \Rightarrow OD = -ut$

$ID = ?$

$$\frac{1}{-ut} + \frac{1}{ID} = \frac{1}{-f}$$

$$\frac{1}{ID} = \frac{1}{ut} - \frac{1}{f}$$



$$ID = \frac{utf}{f - ut} = \frac{f}{\frac{f}{ut} - 1}$$

$$B \Rightarrow OD = -(2f - ut)$$

$$ID = ?$$

$$\frac{1}{-(2f - ut)} + \frac{1}{ID} = \frac{1}{-f}$$

$$\frac{1}{ID} = \frac{1}{2f - ut} - \frac{1}{f}$$

$$ID = \frac{(2f - ut)f}{-f + ut} = \frac{(2f - ut)f}{-f + ut}$$

04. Applying Bernoulli's theorem

$$\frac{P_0 + \rho g h_1}{\rho g} = \frac{P_0}{\rho g} + \frac{v_1^2}{2g} = \frac{P_0}{\rho g} + \frac{v_2^2}{2g} - h_2$$

$$v_1^2 = 2gh_1$$

$$v_2^2 = 2g(h_1 + h_2)$$

$$S_1 v_1 = S_2 v_2 \Rightarrow S_2 = S_1\sqrt{\frac{h_1}{h_1 + h_2}} = S_1\sqrt{\frac{1}{1 + h_2/h_1}}$$

05. Process $4 \to 1$ *and* $2 \to 3$ are isochoric. Equation of processes

$1 \to 2$ *and* $3 \to 4$ is $PV^{-1} = \text{constant}$.

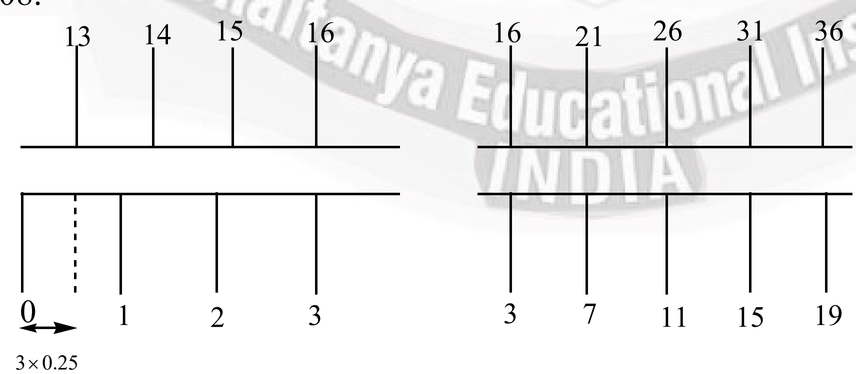
Molar specific heat capacity for $1 \to 2$ *and* $2 \to 3$ *is* $C = C_V + \frac{R}{2}$, since $T_1 = T_3$

$$|\Delta U_{12}| = |\Delta U_{23}|$$

06. $v_{app} = \sqrt{\frac{2F\ell}{m}}$

$$a_c = \omega^2 \frac{\ell}{2} - \frac{F}{2m}$$

07 & 08.



09 & 10.

$$\Delta x = d \sin\theta = n\lambda$$

$\Rightarrow n = \dfrac{d}{\lambda}\sin\theta$

13. $L\sin\theta\dfrac{d\theta}{dt} = mg\ell\sin\theta$

$L\Omega = mgl$

$\Omega = \dfrac{mgl}{I\omega_s}$

14. $\Omega = \dfrac{(5)(10)(0.5)}{(2)\times\dfrac{(100)(2\pi)}{60}} rad/s$

$\Omega = \dfrac{25\times 60}{400\pi} rad/s$

$\Omega = \dfrac{25\times 60}{400\pi}\times\dfrac{60}{2\pi} rev/\min$

$= \dfrac{25\times 60\times 60}{800\pi^2} rev/\min$

$= 11.4 rev/\min$

15. For spherical mirror $\dfrac{1}{v}+\dfrac{1}{u}=\dfrac{1}{f}$. Here $\dfrac{1}{x}+y=\dfrac{1}{f}\Rightarrow y=-\dfrac{1}{x}+\dfrac{1}{f}$

For $x\to\infty, y=\dfrac{1}{y}\Rightarrow f=\dfrac{1}{0.5}=2m=200cm$

16. $\dfrac{dy}{dx}=+\dfrac{1}{x^2}=\dfrac{1}{(2)^2}=\dfrac{1}{4}=0.25$

17. $V_1 = \dfrac{m_1-m_2}{m_1+m_2}U_1 - \dfrac{2m_2}{m_1+m_2}U$

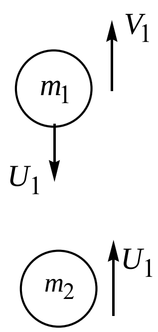
$V_1 = \dfrac{m_1-m_2-2m_2}{m_1+m_2}U$

$V_1 = \left(\dfrac{m_1-3m_2}{m_1m_2}\right)U$

V_1 will be maximum when $m_2 >> m_1$

$\therefore V_1 = -3U$

$\therefore h = 9h$

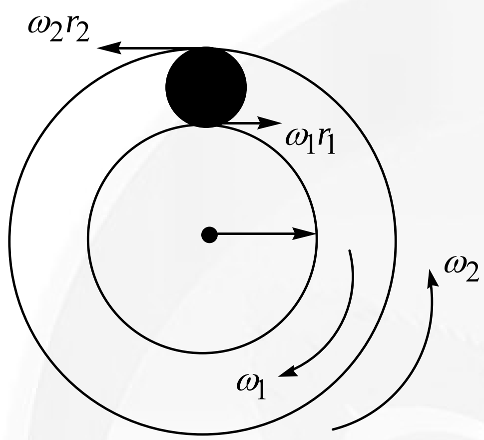


18. $\omega = \dfrac{\omega_1 r_1 + \omega_2 r_2}{r_2 - r_1} = \dfrac{10+30}{0.5} = 80 rad/s$

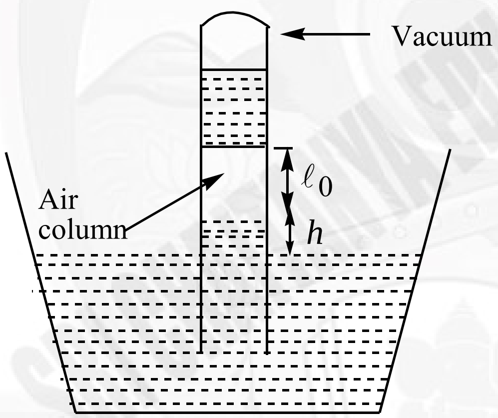
$V_c = 10 - 0.25 \times 80 = -10 m/s$

$k = \dfrac{1}{2} \times m \times (10)^2 + \dfrac{1}{2} \times m \times \left(\dfrac{1}{4}\right)^2 \times \dfrac{2}{5} \times 80^2$

$k = M \times 130 J$



19. $T = 300k$



$T = 330k$

$V \alpha T$

$\dfrac{A\ell_0}{300} = \dfrac{A(\ell_0 + x)}{330}$

$(\ell_0 + x) = \dfrac{11\ell_0}{10}$

$\ell_0 = 10cm$

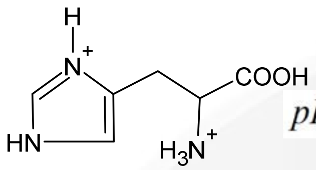
$x = 1cm$

$(\ell_0 + x) = 11cm$

CHEMISTRY

20. CONCEPTUAL
21. CONCEPTUAL
22.

$pKa_2 = 6$



$pKa_1 = 1.8$

$pKa_3 = 9.17$

23. $Y = H_2O, X = Na_2SiO_3, R = SiF_4$

$Q = H_2SiF_6,\ M = H_4SiO_4$

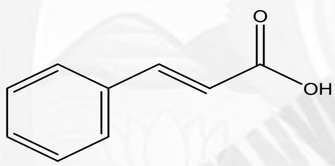
24. $Cl > F > Br > I$: electron affinity

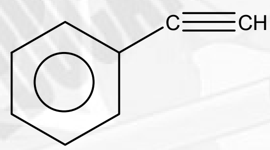
25. $Na_3N < Mg_3N_2 < AlN : LE$

$Na^{+}_{(g)} > Mg^{2+}_{(g)} > Al^{3+}_{(g)}$: Ionic radius

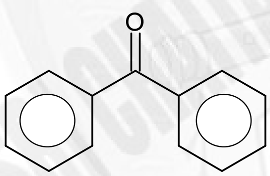
$F^{-} < Cl^{-} < I^{-}$: Polarisability

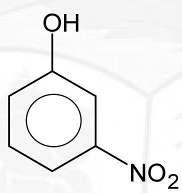
26 & 27

P= 

, Q= 

28 & 29

P= 

N= 

30. X = Na_3AlF_6 ; $Y = AlF_3$; $Z = NaBF_4$

31. X = Na_3AlF_6 ; $Y = AlF_3$; $Z = NaBF_4$

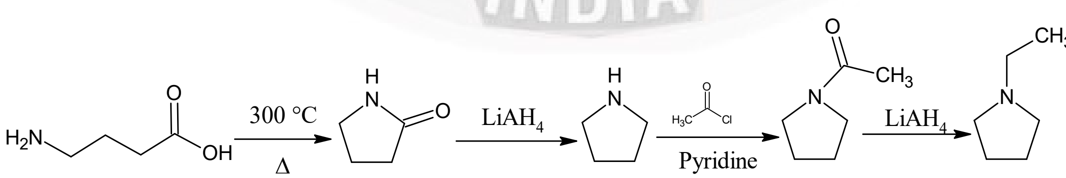
34. $CaC_2 + N_2 \xrightarrow{\Delta} CaCN_2 + C$

35. Anion of X is: NCN^{2-}

$(N = C = N)^{2-}$

36. a, b, d, f, h, i

37.



38. Anion of beryl: $Si_6O_{18}^{12-}$

$S_2O_7^{2-}$: disulphate ion

MATHEMATICS

39. $f(x)$ Range is (i,e)

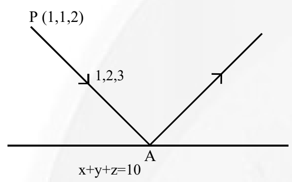
$$\underset{n\to\infty}{Lt}\ e^{\sin^2 x}\left(\frac{1}{n}+\frac{1}{n^2}+........+\frac{1}{n^m}\right) \qquad = f(x)$$

$$f(x)= e^{\sin^2 x}\frac{\cos^2 x}{1-\cos^2 x}=e^{\cos^2 x}$$

40. D is R $\quad \underset{x\to\alpha}{Lt}\ g(x)=l$ from sandwich theorem but $g(x)$ need not to be l

41. $\lambda=1\ or\ -1$

42.



Find point A $A\Rightarrow A(\lambda+1,\ 2\lambda+1,\ 3\lambda+2)$ be on $x+y+z=10$

Take image of any random point on L in plane $x+y+z=10$ through A & B

$$\therefore \frac{x-2}{3}=\frac{y-3}{2}=\frac{z-5}{1}$$

43. $\Rightarrow$ Put $x=10$

$$f(10)+(5)=1 \quad \Rightarrow\ f(5)=\frac{1}{5} \quad \Rightarrow\ f(x)=t \qquad \forall \underset{f(x)}{lt}$$

$$f(t)=\frac{1}{t} \qquad f(x)=\frac{1}{x} \quad \forall\ x\in\left[\frac{1}{5},5\right]$$

Study the graph by assuming for some α,

$f(\alpha)=10\ (or)>10$

44. Put $A=\begin{bmatrix} a & b \\ c & d\end{bmatrix}$ and solve

45. Minimum sum occurs at $\cot x=10$

$$\therefore x=\sec^{-1}\left(\frac{\sqrt{101}}{10}\right)$$

46. $\because f(x)=2\times\max\{|x-1|\div|x-3|,|2x-1|\}$

$\therefore x=1,\frac{3}{2}$ point of non-differentiability and minimum value is 2

47. $$\sum_{r=1}^{2019}\left(\frac{r}{2020}\right)^{2019x}=1$$

Plot the graph of $\sum_{r=1}^{2019}\left(\frac{r}{2020}\right)^{2019x}=y\ and\ y=1$

48. $f(x)=g(x)$ no solutions $\alpha=0$

$f(x)=h(x)$ has solutions

$x=1,2,3,4,5,6,8 \quad \alpha=0 \qquad \beta=7$

49. $f'(1)=\lim_{h\to 0}\dfrac{e^{(1+h)^{10}-1}+h^2\sin\frac{1}{h}-1}{h} \quad =\lim_{h\to 0}\dfrac{e^{(1+h)^{10}-1}-1}{h}=10$

50. $\lambda=\lim_{t\to 0}\left(\dfrac{\sum_{k=1}^{100} f(1+tk)-100}{t}\right)$

$$=\lim_{t\to 0}\left(\frac{f(1+t)-1}{t}+\frac{f(1+2t)-1}{t}+......+\frac{f(1+100t)-1}{t}\right)$$

$$=f'(1)+2f'(1)+......+100f'(1)$$

$$=f'(1)(1+2+......+10)=10\times 5050 \qquad \therefore \frac{\lambda}{100}=505$$

51 & 52

$9[abc]\vec{r}=\vec{a}+2\vec{b}-3\vec{c}$

$9[abc]\vec{r}.(\vec{b}\times\vec{c})=[abc] \quad \dfrac{\vec{r}.(\vec{b}\times\vec{c})}{|\vec{b}\times\vec{c}|}=\dfrac{1}{9\sin\theta}$

$\sin\theta=\dfrac{1}{2} \quad \theta=\pi/6,5\pi/6 \quad \vec{r}.(\vec{c}\times\vec{a})=4/9\sqrt{3}$

53& 54. $|A|=1$ or $|A|=-1$

$A=A^{-1}$ take $A=\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ and solve in 2 cases.

55. S_1 : limit value is 1

S_2 : must be exist

S_3 : True

S_4 : False given limit $a\to 0$ not $x\to 0$

56. Locus equation is $x^2+y^2=25$

(x,y) can be $(5,0),(-5,0),(0,5),(0,-5),$

$(4,3),(4,-3),(-4,3),(-4,-3),(3,4),(3,-4),(-3,4),(-3,-4)$

57. L can be $x+2y=1$ or $2x-y=2$