Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

Sec:Sr.Super60_STERLING BT | Paper -2(Adv-2022-P2-Model) | Date: 14-09-2025

Time: 02.00Pm to 05.00Pm | CTA-03 | Max. Marks: 180

KEY SHEET

MATHEMATICS

1	**2**	2	**1**	3	**6**	4	**5**	5	**8**	6	**4**
7	**2**	8	**2**	9	**AD**	10	**CD**	11	**ABD**	12	**BCD**
13	**BD**	14	**BCD**	15	**C**	16	**A**	17	**D**	18	**B**

PHYSICS

19	**2**	20	**3**	21	**4**	22	**2**	23	**1**	24	**8**
25	**9**	26	**4**	27	**BC**	28	**ABC**	29	**CD**	30	**AC**
31	**AC**	32	**BD**	33	**A**	34	**A**	35	**B**	36	**D**

CHEMISTRY

37	**2**	38	**6**	39	**5**	40	**6**	41	**7**	42	**3**
43	**2**	44	**4**	45	**ABCD**	46	**ABCD**	47	**ABCD**	48	**AC**
49	**ACD**	50	**ABCD**	51	**A**	52	**D**	53	**B**	54	**B**

SOLUTIONS

MATHS

1. Let $f(x)=k^x$ $f(a_{31})=k^{a+30d}$ $f(a_{25})=k^{a+24d}$

$$\sum_{i=6}^{30} f(a_1)=\frac{3}{2^{25}-1}\times 2^5\times\frac{(2^{25}-1)}{2-1}=96$$

2. $f(x)=100\{x\}\Rightarrow f(\sqrt{2})=100\{\sqrt{2}\}=100\times 0.414=41.4$

$$\left[f\sqrt{2}\right]=41$$

3. $$L=\frac{-\lim\limits_{x\to 0}\frac{d}{dx}\prod\limits_{r=2}^{n}(\cos tx)^{-1}}{2x}$$

Let $y=\prod\limits_{r=2}^{n}(\cos 2x)\Rightarrow$

$$\text{Log } y=\sum_{r=2}^{n}\frac{1}{2}\ln(\cos tx)$$

$$\frac{1}{y}\frac{dy}{dx}=-\sum_{r=2}^{n}\tan x$$

$$\Rightarrow\frac{dy}{dx}=-y\sum_{r=2}^{n}\tan rx$$

$$=\frac{1}{2}[2+3+.....n]=\left[\frac{n(n+1)}{2}-1\right]\frac{1}{2}=\frac{n^2+n-2}{4}=10$$

$\Rightarrow n=6$

4. We have (gof) (x) = x

$\Rightarrow g'(f(x)).f'(x)=1$

when $f(x)=-\frac{7}{6}$, $x=1$

$$g'\left(-\frac{7}{6}\right)f'(1)=1$$

$$g'\left(-\frac{7}{6}\right)=\frac{1}{f'(1)}=\frac{1}{5}$$

$$\frac{1}{g'\left(-\frac{7}{6}\right)}=5$$

5. Let f(x) is non-differentiable at x = 0, 1

Also $f\left(\frac{1}{2}+x\right)=f\left(\frac{1}{2}-x\right)$

Hence graph of f(x) is symmetrical about the line x = 1/2

Where derivable is zero

$\text{Local min.} = f\left(\frac{1}{2}\right) = \frac{4}{3}$

$\text{global max.} = f(0) = f(1) = \frac{3}{2}$

$\therefore k = \frac{4}{3} + \frac{3}{2} = \frac{17}{6}$

$6k - 9 = 8$

6. $\int_0^1 f(x)\,dx + \int_1^2 f(x)\,dx + \int_0^{30} f^{-1}(y)\,dy$

$= \int_0^1 \left(4x^3 + 2x - 6\right) dx + \int_1^2 f(x)\,dx + \int_1^2 t\, f'(t)\,dt$

$= \left[x^4 + x^2 - 6x\right]_0^1 + \int_1^2 f(x)\,dx + \left(t\, f(t)\right)_1^2 - \int_1^2 f(t)\,dt$

$= -4 + \left(2f(2) - f(1)\right)$

$= -4 + 2 \times 30 - 0\,a$

7. $A = 2\int_0^1 \left[y\sqrt{1-y^2} - \left(y^2 - 1\right)\right] dy = 2$

8. $\int \frac{dy_1}{y_1} + \frac{dy_2}{y_2} + \frac{dy_3}{y_3} = \int \left(\sin^2 x + \cos^2 x + \frac{2}{x^3} - 1\right) dx$

$\log_e |y_1 y_2 y_3| = \frac{-2}{x^2} + C$

$= \lim_{x \to 0^+} \frac{y_1 y_2 y_3}{e^{3x} \sin x} = \lim_{x \to 0^+} \frac{2x \pm e^{-1/x^2}}{e^{3x} \sin x} = 2$

9. $\frac{dy}{dx} = \frac{(x+1)^2 + y - 3}{x+1} = x + 1 + \frac{y-3}{x+3}$

Putting $x + 1 = X$ and $y - 3 = Y$

$\frac{dY}{dX} = X + \frac{Y}{X}$

$\Rightarrow \frac{dy}{dx} - \frac{y}{x} = x$

Solution is $\frac{y}{x} = x + c$

$\Rightarrow y - 3 = (x+1)^2 + (2+1)$

It passes through $(2, 0) \Rightarrow c = -4$

Equation of curve is $y = x^2 - 2x$

Area bounded $= \int_0^2 \left(2x - x^2\right) dx = \frac{4}{3}$ sq.u

10. $u = \int_0^\infty \frac{1}{x^4 + 7x^2 + 1} dx$ put $X = \frac{1}{t}, dx = \frac{-1}{t^2} = dt$

$$u = \int_\infty^0 \frac{1}{\frac{1}{t^4} + \frac{7}{t^2} + 1}\left(\frac{-dt}{t^2}\right) = \int_0^\infty \frac{t^2 dt}{t^4 + 7t^2 + 1} = v$$

$\Rightarrow u = v$

$$\Rightarrow 2u = \int_0^\infty \frac{\left(1 + \frac{1}{x^2}\right)dx}{\left(x - \frac{1}{x}\right)^2 + 9} = \int_0^\infty \frac{dt}{t^2 + 9} = \frac{\pi}{6} \text{ where } t = x - \frac{1}{x}$$

11. $\frac{dy}{dx} + (2\tan x)y = \sin x (\text{LDE})$

$\Rightarrow y(x) = \cos x - 2\cos^2 x$

$(A)\ y'\left(\frac{\pi}{6}\right) = \frac{2\sqrt{3} - 1}{2}$ $(B) y(\pi) = -3$

$(C)\ y(x) = -1 \Rightarrow 2\cos^2 x - \cos x - 1 = 0$

but $x \in (0, 2\pi) \Rightarrow x = \frac{2\pi}{3}, \frac{4\pi}{3}$

$(D) \int_0^{\frac{\pi}{2}} y(x)\, dx = 1 - \frac{\pi}{2}$

12. $f(x) f''(x) - f(x) f'(x) = (f'(x))^2$

$\therefore \frac{f''(x) - f'(x)}{f'(x)} = \frac{f'(x)}{f(x)}$

One integration we set

$\ln(f'(x)) - x = \ln(f(x)) + c$

$\therefore \ln(f(x)) = e^x + d$

$f(0) = 1 \Rightarrow d = -1$

$f(x) = e^{e^x - 1}$

Hence, $\lim_{x \to -\infty} f(x) = e^{-1}$

$\lim_{x \to -0} \frac{f(x) - 1}{x} = 1$

13. $f(x)=x^2-2ax+a(a+1)$

$f(x)=(x-a)^2+a=a+\sqrt{x-a}=f^{-1}(x)$

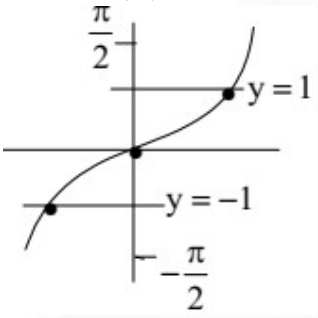
$(x-a)^2=\sqrt{x-a}$

$x=a$ or $a+1$

if $a=5049$, then $a+1=5050$

if $a+1=5049$, then $a=5048$

14. (A) $\text{sgn}(x)=\sin^{-1}x$ has three solutions



(B) $|x^2-4|x|+3|=1$

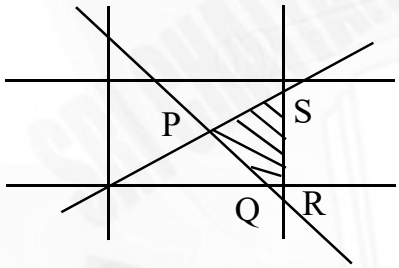
has six solutions

(C) $\log_{10}(-x)=4\Rightarrow x=-10^4=\alpha\Rightarrow \text{sgn}(\alpha)=-1$

(D) $\sin^{-1}x+\cos^{-1}x+\tan^{-1}x\neq 0$ and $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$ can't be equal for same 'x'

15. Conceptual

16. $x+y-2=0,\ x=3y,\ x=\frac{9}{4},\ y=1$



$P\left(\frac{3}{2},\frac{1}{2}\right),\ Q(2,0),\ R\left(\frac{9}{4},0\right),\ S\left(\frac{9}{4},\frac{3}{4}\right)$

area $=\frac{11}{32}$

17. $x_1=10,\ y_1=5$ $PQ=\min=\sqrt{(10-5)^2+5^2}=5\sqrt{2}-2\Rightarrow PQ^2=\left(5\sqrt{2}-2\right)^2$

18. $\frac{1}{2}$

PHYSICS

19. $W = q\Delta V$

20. Opposite faces having equal and opposite charges

21. $W_g = m(V_A - V_B)$

$$V_A = -\frac{GM_1}{R} - \frac{GM_2}{2R}$$

and $V_B = -\frac{2GM_2}{2R} - \frac{GM_1}{2R}$

22. $\frac{n_1}{\gamma_1 - 1} + \frac{n_2}{\gamma_2 - 1} = \frac{n_1 + n_2}{\gamma_{mean} - 1}$

23. $\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

24. Velocity of object relative to mirror

$$[\vec{v}_{om}]_\perp = 16\hat{i} - (-18\hat{i}) = +34\hat{i}\ m/s$$

Velocity of its image

$$[\vec{v}_{im}]_\perp = -34\hat{i}\ m/s$$

Now velocity of image w.r.t ground observer

$$[\vec{v}_{ig}]_\perp = [\vec{v}_{im}]_\perp + [\vec{v}_m]_\perp$$

25. $\frac{1}{v} + \frac{1}{-20} = \frac{1}{-30}$

$$v_{ix} = \frac{v^2}{u^2}v_0$$

Lateral magnification, $m = \frac{h_i}{h_0} = -\frac{v}{u}$

or $h_i = -h_0\frac{v}{u}$

now $v_{iy} = -h_0\frac{\left[u\frac{dv}{dt} - v\frac{du}{dt}\right]}{u^2}$

26. $\tau = PE\sin\theta$

$I\alpha = PE\sin\theta$

$$\alpha = \frac{PE}{I}$$

$\alpha = \omega^2\theta$

27. Conceptual

28. $R = \frac{u^2\sin 2\theta}{g + \frac{Eq.}{m}}$

$$T_1 = \frac{u\sin\theta}{g - \frac{Eq.}{m}}$$

$$T_2 = \frac{u\sin\theta}{g + \frac{Eq.}{m}}$$

$$T = T_1 + T_2$$

29. Conceptual

30. $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{I}{O} = \frac{v}{u}$$

31. $dq = \rho dv$

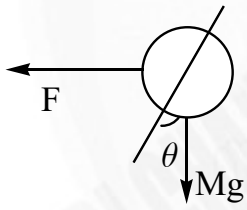
$$dq = \rho\left(4\pi r^2 dr\right)$$

$$E\oint ds = \frac{q}{\varepsilon_0}$$

32. Work done is area under curve

$$dQ = dU + dW$$

33.



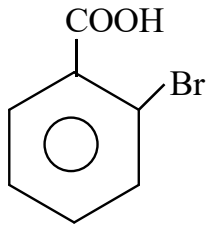
34. Opposite faces should have equal and opposite charges, earthed surface potential zero

35. $\frac{\theta_A - \theta_F}{R} = \frac{\theta_A - \theta_B}{R_1}$

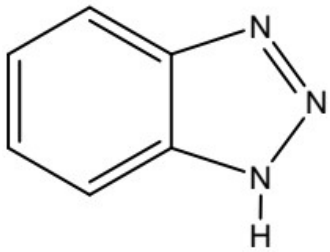
36. $E = \sigma t_s^4.\left(4\pi R_s^2\right)$

CHEMISTRY

37.



38.



39. Meta directing groups :
$-NO_2, -CN, -COR, -COOH, SO_3H$
Total 5 groups are meta directing groups

40. 6

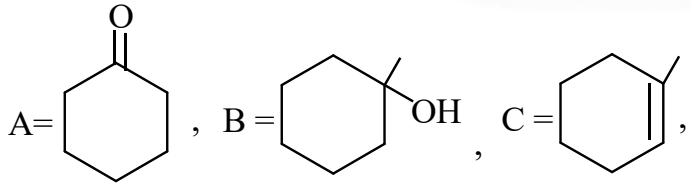
41. III, VI, VIII $\rightarrow$ Phenolic ether will not give cleavage with HI

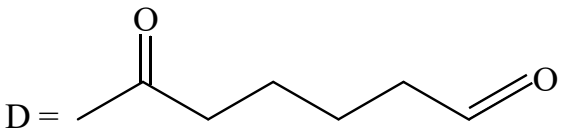
42. II, III and IV are correct

43. $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-CH_3 \xrightarrow{Br_2/hv} CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\underset{*}{CH}(Br)-CH_3$ (One chiral carbon)

44. Given reaction is Gabriel-Phthalimide synthesis, which is involved SN_2 reaction and which is applicable for the preparation of primary amines. Secondary and tertiary amines cannot be prepared by using Gabriel-Phthalimide synthesis. From the given list 2 and 8 cannot be prepared, because these amines are 2^0 amines. From the remaining molecules 3rd and 5th cannot be prepared, because for the preparation of these amines, substrates must be vinyl and aryl halides, which are not suitable substrates for SN_2 reactions. Remaining three amines along with amide (7th molecule) can be prepared by using Gabriel. Phthalimide reaction.

45.



D = 
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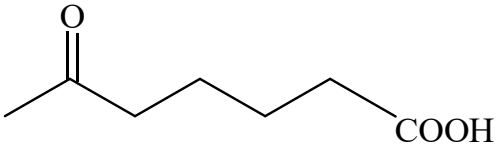
E = 

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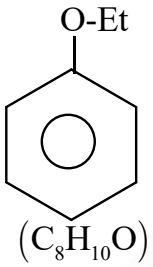
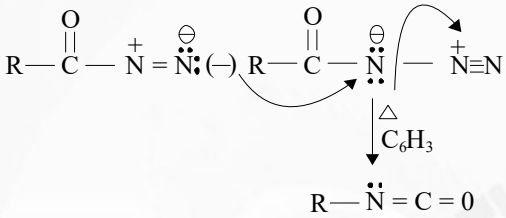


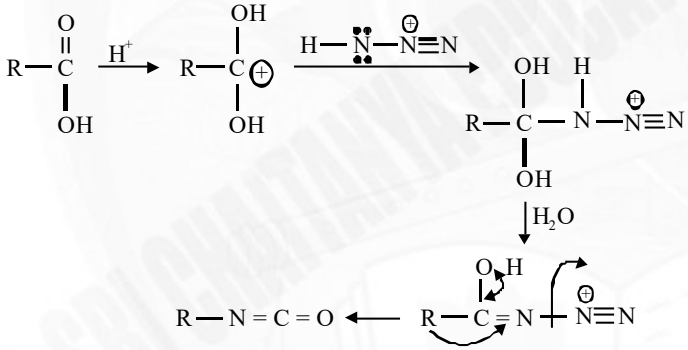
$(C_8H_{10}O)$

Q = phenol, R = Ethyliodide, S = Salicylic acid, T = Asprine, W = ethyne

47. Curtius



No evidence for formation of Nitrene

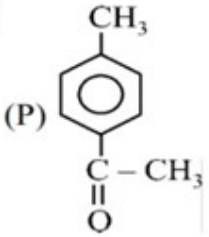


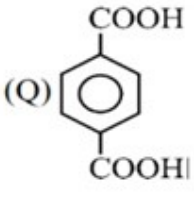
Migration is intra molecular no internee formation.

48. $A = Ph - CH_2 - CH_2 - CH_2 - OH$

49. A, C, D will give stable hydrates

50.





51. Conceptual

52. $P = C_6H_5COONH_4$

$Q = C_6H_5CONH_2$

$R = C_6H_5CH_2NH_2$

53. $Br-CH_2CH_2CHO \xrightarrow{Zn-Hg/HCl} Br-CH_2CH_2CH_3$

54.