Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.S60_Elite, Target & LIIT-BTs **JEE-MAIN** **Date: 17-01-2025**
Time: 03.00Pm to 06.00Pm **GTM-18/13** **Max. Marks: 300**

KEY SHEET

MATHEMATICS

1	**3**	2	**3**	3	**2**	4	**4**	5	**2**
6	**2**	7	**2**	8	**2**	9	**3**	10	**2**
11	**2**	12	**2**	13	**4**	14	**3**	15	**3**
16	**2**	17	**4**	18	**3**	19	**3**	20	**4**
21	**400**	22	**4**	23	**54**	24	**9**	25	**11**

PHYSICS

26	**4**	27	**2**	28	**4**	29	**2**	30	**1**
31	**2**	32	**4**	33	**3**	34	**4**	35	**1**
36	**1**	37	**2**	38	**2**	39	**2**	40	**2**
41	**3**	42	**2**	43	**2**	44	**4**	45	**4**
46	**750**	47	**6**	48	**10**	49	**9**	50	**2**

CHEMISTRY

51	**3**	52	**2**	53	**1**	54	**3**	55	**2**
56	**2**	57	**3**	58	**3**	59	**2**	60	**1**
61	**3**	62	**4**	63	**3**	64	**1**	65	**3**
66	**4**	67	**1**	68	**1**	69	**4**	70	**1**
71	**25**	72	**3**	73	**3**	74	**4**	75	**15**

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SOLUTION
MATHEMATICS

1. 1^{∞} form

2. $4_{C_3}.4_{C_3}+\left(4_{C_2}.3_{C_1}\right)^2+\left(4_{C_1}.3_{C_2}\right)^2+3_{C_2}.3_{C_2}$

3. $\bar{r}\times\bar{a}=\bar{b}\times\bar{r}$

$\bar{r}\times\left(\bar{a}+\bar{b}\right)=0,\bar{r}=\lambda\left(\bar{a}+\bar{b}\right)=\lambda\left(3\hat{i}-3\hat{j}\right)$

$\left|\bar{r}\right|=1\Rightarrow\lambda\sqrt{18}=1,\qquad\lambda=\frac{1}{3\sqrt{2}},\bar{r}.\left(\hat{i}+\hat{j}+\hat{k}\right)=0$

4. $0\le x\le 1\ \Rightarrow 0\le\frac{1-x}{1+x}\le 1$

5. Point of intersection is $(2,\ -4,\ 7)$ $k=69$

6. $g(x)=f(x)+f(1-x)$

$g^1(x)=f^1(x)-f^1(1-x),x=\frac{1}{2},g^1\left(\frac{1}{2}\right)=f^1\left(\frac{1}{2}\right)-f^1\left(\frac{1}{2}\right)=0,g^1\left(\frac{1}{2}\right)=0$

$g^{11}(x)=f^{11}(x)+f^{11}(1-x)>0$

$Concave\ upwards,\therefore\alpha=\frac{1}{2}$

7. $a_i\times b_i$ is a multiple of 3 if at least one of a_i or b_i is a multiple of 3

If $a_i=3$ then $b_i=1,2,3,4,5,6,7$

If $b_i=3$ or 6 then $a_i=1,2,3,4$

$\therefore$ total possibilities=7+4+4-2=13 $\qquad\therefore$ probability$=\frac{13}{4C_1\times 7C_1}=\frac{13}{28}$

8. $y^2\le 8x$

$4x-3y+4\le 0$ Area of shaded portion is equal to

$\frac{1}{n}\int_{1/2}^{2}\sqrt{8x}$ - area of trapezium ABCD

$2\sqrt{2}\int_{1/2}^{2}\sqrt{x}-\frac{9}{2}=2\sqrt{2}\frac{x^{\frac{3}{2}}}{\frac{3}{2}}\Big|_{\frac{1}{2}}^{2}-\frac{9}{2}$

$=\frac{4\sqrt{2}}{3}\left(2\sqrt{2}-\frac{1}{2\sqrt{2}}\right)-\frac{9}{2}\qquad=\frac{4\sqrt{2}}{3}\left(\frac{8-1}{2\sqrt{2}}\right)-\frac{9}{2}\qquad=\frac{14}{3}-\frac{9}{2}=\frac{28-27}{6}=\frac{1}{6}$

9. $sub:t=x+y$

10. X must have 1,2 remaining 3 elements can be selected in 2.2.2=8

11. Conceptual

12. $\int\left(\frac{x}{2}\sec^2\frac{x}{2}+\tan\frac{x}{2}\right)dx,\qquad\int\left(x\ f^1(x)+f(x)\right)dx=x\ f(x)+c$

13. Conceptual

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14. $1=\alpha\left(\frac{\sqrt{3}}{2}-\frac{i}{2}\right)+\beta(1+i)$ equate real and imaginary parts $\alpha-2\beta=0$

15. Conceptual

16. Term independent of x is ${}^{8}c_3a^3=448$ coefficient of x^4 $x^4={}^{8}c_5.2^5=1792$

$f'(x)=3x^2+2xf'(1)+f''(2)$

17. I: $f''(x)=6x+2f'(1)$

$f'''(x)=6$ then $f(0)=6$

II:

$f(g(x))=x \quad f'(x)=3x^2+6x-33, f'(g(x).g'(x))=1$

$g'(2)=\frac{1}{f'(g(25))} \quad g(2)=-1,=\frac{1}{f'(-1)}=\frac{1}{-36}, k=-36$

18. $AB=I \qquad T_r(C_r)=r.+(r-1)=(2r-1)$

19. $x\neq 0, y\neq 0, z\neq 0$

$\Delta=0, a+b+c=1$

20. $I=-I\Rightarrow 2I=0 \qquad I=0$

21. Conceptual

22. Let $x_i-10=y_i$ for i=1,2,3,4,5

$6y=\sqrt{\frac{25}{5}-\left(\frac{5}{5}\right)^2}=2$

S.D $=1-21.6y=4$

23. Foci of ellipse $=(1\pm 3,1\pm 0) \qquad =(4,1)(-2,1)$

$e_E=\sqrt{1-\frac{16}{25}}=\frac{3}{5}, e_H=\frac{5}{3}=\sqrt{1+\frac{b^2}{a^2}}, \quad \frac{b^2}{a^2}=\frac{16}{9}$

And $2al=6\Rightarrow ae=3\Rightarrow a^2+b^2=9, a^2.\frac{25}{9}=9, a^2=\frac{81}{25}\ b^2=\frac{144}{25}$

Hyperbola: $\frac{25x^2}{81}-\frac{25y^2}{144}=1$

$\frac{2a}{e}=\frac{54}{25}$

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

$=(9-x^4)^{\frac{1}{4}}, f(f(x))=\left(9-\left((9-x^4)^{1/4}\right)^4\right)^{\frac{1}{4}}$

$f(f(x))=(x)$

$f^{2n+1}(x)=(9-x^4)^{\frac{1}{4}} \quad f^{2n}(x)=x$

$f^{2025}(\sqrt{2})=5^{\frac{1}{4}} \qquad f^{2024}(\sqrt{2})=\sqrt{2}$

25. By using graph

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PHYSICS

26. $U = \frac{3}{2}PV$

$= \frac{3}{2} \times 3 \times 10^6 \times 2$

$= 9 \times 10^6\ J$

27. $p_c = p_0 - \frac{2S}{r_1}, p_D = p_0 - \frac{2S}{r_2}$

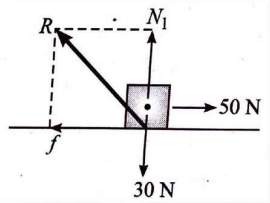
$p_C + \rho g h_1 = p_D + \rho g h_2$

$p_C - p_D = \rho g (h_2 - h_1)$

$h_2 - h_1 = \frac{2S}{\rho g}\left(\frac{1}{r_2} - \frac{1}{r_1}\right)$

$= \frac{2S(r_1 - r_2)}{\rho g r_1 r_2}$

28.



$N_1 = 30\ N$

$f = \mu N_1 = 0.5 \times 30 = 15\ N$

Contact surface

$R = \sqrt{N_1^2 + f^2}$

$= \sqrt{(30)^2 + (15)^2}$

$= 15\sqrt{5}\ N$

29. $\frac{1}{\lambda} \propto Z^2 \Rightarrow \lambda \propto \frac{1}{Z^2}$

$\lambda_{He^+} : \lambda_{Li^{++}} : \lambda_{Be^{+++}} = \frac{1}{2^2} : \frac{1}{3^2} : \frac{1}{4^2}$

$= 36 : 16 : 9$

30. $\vec{\tau} = \vec{p} \times \vec{E} = \left(\alpha\hat{i} - \beta\hat{j}\right) \times \left(2\beta\hat{i} + 3\alpha\hat{j}\right)$

$= 3\alpha^2\hat{k} + 2\beta^2\hat{k} = \left(3\alpha^2 + 2\beta^2\right)\hat{k}$

31. $\vec{\tau} = \vec{M} \times \vec{B}$

32. $[\text{Pressure}] = \left[\frac{Force}{Area}\right] = ML^{-1}T^{-2}$

33. $K = K_0 \cos^2 \omega = \frac{K_0}{2}[1 + \cos 2\omega t]$

For maximum value of $K = \cos 2\omega t = 1$

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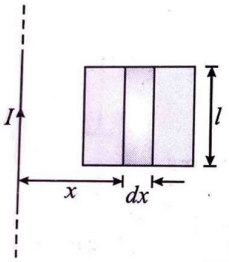
$K_{max} = K_0 = U_{max} = E$

34.



Magnetic fields due to long wire

$B = \frac{\mu_0 I}{2\pi x}, dA = ldx$

$d\Phi = BdA$

$\Phi = \frac{\mu_0 Il}{2\pi}\int_a^{a+l}\frac{dx}{x}$

$= \frac{\mu_0 Il}{2\pi} ln\left(1+\frac{l}{a}\right) = MI$

$M = \frac{\mu_0 l}{2\pi} ln\left(1+\frac{l}{a}\right)$

35. Conceptual (gauss theorem)

36. $R_{eq} = R_1 + R_2$

$R = \frac{l}{KA}$

37. $\vec{\tau} = \vec{r} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 1 \\ 7 & 3 & -5 \end{vmatrix}$

$= \hat{i}(5-3) - \hat{j}(-5-7) + \hat{k}(3+7) \qquad = 2\hat{i} + 12\hat{j} + 10\hat{k}$

38. Planet's follow law of conservation of angular momentum

39. $V = E - Ir$

$When\ I = 0,\ E = 2.0V$

$When\ I = 5\ A,\ 0 = 2 - 5r$

$r = 0.4\Omega$

40. $\omega < \omega_0$ *i.e.* $X_C > X_L$, *Current Leads*

$\omega > \omega_0$ *i.e.* $X_L > X_C$, *Voltage Leads*

$\omega = \omega_0$ *i.e.* $X_L > X_C$, *Same phase*

$\omega = \sqrt{2}\omega_0, \omega^2 = 2\omega_0^2 = \frac{2}{LC}, \omega L = \frac{2}{\omega C} \Rightarrow X_L = 2X_C.$

41. First law of thermodynamics is based on law of conservation of energy and it can be written as $dQ = dU - dW$. Where dW is work done on the system.

42. $\left(\frac{\Delta R}{R}\times 100\right)_{max} = \frac{\Delta V}{V}\times 100 + \frac{\Delta I}{I}\times 100 \qquad T^2 = \rho^a r^b \sigma^c, a = 1, b = 3, c = -1$

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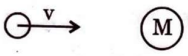
43. $I = \frac{P}{A}$

44.



Energy loss will be maximum when collision will be perfectly elastic

(By momentum)

Maximum energy loss $= K_i - K_f$

$$= \frac{1}{2}m\upsilon^2 - \frac{1}{2}(m-M)\upsilon' = \frac{1}{2}m\upsilon^2 - 1(m+M)\frac{m^2\upsilon^2}{(m+M)^2} = \frac{1}{2}m\upsilon^2\left[1-\frac{m}{3+M}\right] = \left(\frac{M}{m+M}\right)\frac{1}{2}m\upsilon^2$$

Statement 1 is false

45. work done on an object doesn't depend on the initial velocity of the object,Work done by a force is frame-dependent.

46. $n_1\lambda_1 = n_2\lambda_2$

47. $E = cB$

48. $x = 2t + 4t^2 \Rightarrow \frac{dx}{dt} = V_x = 2 + 8t \Rightarrow \frac{d^2x}{dt^2} = a_x = 8m/s^2$

$$\& \; y = 3t^2 \Rightarrow \frac{dy}{dt} = V_y = 6t \Rightarrow \frac{d^2x}{dt^2} = a_y = 6m/s^2$$

$$\therefore a = \sqrt{a^2x + a^2{}_y} = \sqrt{8^2 + 6^2} = 10m/s$$

49. $\frac{hc}{\lambda} = \phi + eV \quad .....(i)$

$$\frac{hc}{\lambda} = \phi + \frac{eV}{4} \quad .....(ii)$$

$$(i) - 4(ii) \Rightarrow -\frac{hc}{3\lambda} = -3\phi \Rightarrow \phi = \frac{hc}{9\lambda} = \frac{hc}{n\lambda}$$

$n = 9$

50. $y = 2\sin(100\,\pi t - 2\pi x)$

$= A\sin(\omega t - kx)$

$\omega = 10\pi, k = 2\pi$

$wave\,velocity\, v = \frac{\omega}{k} = 50m/s$

$$\mu = \frac{M}{L} = \frac{20\times10^{-3}}{50\times10^{-2}} = 0.04kg/m$$

$$v = \sqrt{\frac{T}{\mu}}$$

$$T = \mu v^2 = (0.04)(50)^2 = 100N = 50\lambda$$

$\lambda = 2$

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CHEMISTRY

51. Key: 3

Sol: Bhor's model did not consider wave nature of electron.

52. Key: 2

Sol: $$E_{cell} = E^0_{cell} - \frac{0.0591}{2}\log\frac{\left[Zn^{2+}\right]}{\left[Cu^{2+}\right]}$$

$$1.1591 = 1.1 - \left(\frac{0.0591}{2}\right)\log\left(10^{-2}\right)$$

53. **Aldol condensation**

54. Key: 3

Reaction is second order with respect to A and zero order with respect to B

55. Key: 2

i) $BF_3 - trigonal\ planar - \mu = 0$

ii) $SO_3 - trigonal\ planar - \mu = 0$

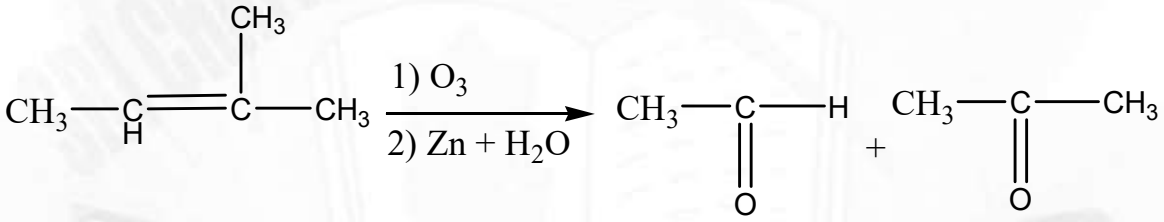
iii) $CCl_4 - tetrahedral - \mu = 0$

iv) $H_2O - bent - \mu \neq 0$

56. Key: 2

$W = 0.5 \times 20 = 10\ atm.ltr$

57.



58. KEY:3

$$K_c' = \sqrt{\frac{1}{K_c}} = 12.5.$$

59. Key: 2

Sol: Greater the stability of conjugate base, more will be acidic strength

Equivalent resonance structures give more stability

60. Key: 1

Sol:

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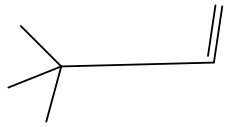
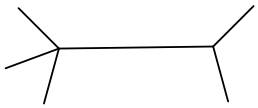
x = 

y = 

61. KEY: 3

Sol: For ideal behaviour

$$P_{total} = 0.25\times 512 + 0.75\times 344$$

$$= 386mm\ \ Hg < 600mm\ \ Hg$$

Hence, the solution shows positive deviation

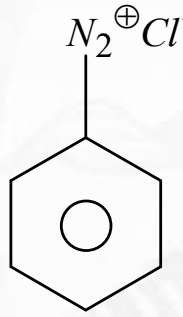
$$\Rightarrow \Delta H_{mix} = positive$$

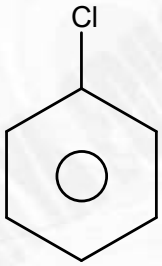
62. Key:4

Sol: acetic acid is less acid than benzoic acid.

63. Key: 3

Sol:

P = 

Q = 

64. Key: 1

$$CH_3 - C \equiv CH + H_2O \xrightarrow[333K]{Hg^{+2}/H^{\oplus}} CH_3 - CO - CH_3$$

65. Key:3

$$H_2N - \underset{\underset{R}{|}}{CH} - COOH \rightleftharpoons H_3N^+ - \underset{\underset{R}{|}}{CH} - COO^-$$

Sol:

66. KEY: 4

$$\Delta H = [435 + 240] - [2\times 430] = -185$$

67. KEY: 1

68. Key: 1

(i) $Cl_2 > Br_2 > F_2 > I_2$: BDE

(ii) $(H-O) > (H-S) > (H-Se)$:BDE

(iii) $(H-F) > (H-Cl) > (H-Br)$:BDE

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(iv) $(N-H)>(P-H)>(As-H)$: BDE

69. Key: 4

Sol: $\left[Al^{3+}\right]^1\left[OH^-\right]^3=3\times10^{-34}$ $\left[OH^-\right]=10^{-11}$

$\therefore$ minimum pH required to precipitate $Al(OH)_3$ is 3

$\left[Mg^{2+}\right)\left[OH^-\right)^2=3\times10^{-12}$

$\left[OH^-\right)=10^{-6}$

$\therefore$ Minimum pH required to precipitate $Mg(OH)_2$ is 8

70. Key:1

(i) In group 14, the stability of +2 oxidation state increases down the group due to inert pair effect

(ii) Stable oxidation state of Thallium is +1 due to inert pair effect

71. Key: 25

In first row of transition series, highest O.S is +7. (exhibited by Mn, Z= 25)

72. Key: 3

Sol: $2KIO_3+5H_2C_2O_4+H_2SO_4\rightarrow K_2SO_4+I_2+10CO_2+6H_2O$

73. Key : 3

Sol: (i) $\left[Co(NH_3)_6\right]^{3+}:d^6;d^2sp^3;dia:t_{2g}^6e_g^0$

(ii) $[CoF_6]^{3-}:d^6;sp^3d^2;para$ (4 unpaired electrons): $t_{2g}^4e_g^2$

(iii) $\left[Cu(NH_3)_4\right]^{2+}:d^9:para:square\ planar$: (one unpaired electron)

(iv) $\left[Zn(OH_2)_6\right]^{2+}:d^{10}:dia:sp^3d^2:t_{2g}^6e_g^4$

(v) $\left[Cr(CN)_6\right]^{3-}:d^3:Para:d^2sp^3:t_{2g}^3e_g^0$ (three unpaired electrons)

74. II, III, IV, VIII gives tollen's test

75. KEY: 15

Sol: Eqivalent weight of metal= 15 $g.eq^{-1}$

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