FIITJEE

ALL INDIA TEST SERIES

CONCEPT RECAPITULATION TEST – III

JEE (Main)-2025

TEST DATE: 21-03-2025

ANSWERS, HINTS & SOLUTIONS

Physics **PART – A**

SECTION – A

1. C

Sol. At any time

$$F_{thrust} - F_{friction} = ma$$

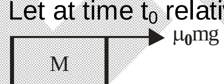
$$\rho a v^2 - \mu mg = ma$$

$$\rho a(2gh) - \left(\frac{a}{A}\right)(\rho Ah)g = (\rho Ah)a'$$

$$2\rho agh - \rho agh = \rho Aha' \; ; \; \frac{a}{A}g = a'$$

2. C

Sol. Let at time t_0 relative motion will occur



$$\mu_0 mg = Ma \quad \text{..... (1)}$$

$$10t_0 - \mu_0 mg = ma \quad \text{..... (2)}$$

From (1) and (2) ;

$$t_0 = \mu_0 m + \frac{\mu_0 m^2}{M}$$

3. A

Sol. $Mg - T = M\frac{dv}{dt}$ ….. (1)

$T + \mu v_e - (M_0 - \mu t)g = (M_0 - \mu t)\frac{dV}{dt}$ ….. (2)

From (1) and (2), we get

$Mg + \mu V_e - (M - \mu t)g = (2M - \mu t)\frac{dv}{dt}$ ….. (3)

$(\mu v_e + \mu g t) = (2M - \mu t)\frac{dv}{dt}$ ….. (4)

$\frac{dv}{dt} = \frac{\mu(v_e + gt)}{(2M - \mu t)}$

$\therefore \quad \frac{dv}{dt} = \frac{\mu(v_e + gt)}{(2M - \mu t)}$

So, correct answer is (A)

4. A

5. A

Sol. $\frac{l}{K_1 A} + \frac{l}{2K_2 A} + \frac{l}{K_3 A} = \frac{l}{KA} + \frac{l}{2K_A} + \frac{l}{KA}$

$\frac{5}{2K} = \left(\frac{1}{K_1} + \frac{1}{2K_2} + \frac{1}{K_3}\right)$

$K_{eq} = \frac{5}{2\left(\frac{1}{K_1} + \frac{1}{2K_2} + \frac{1}{K_3}\right)}$

6. A

Sol. Voltage across capacitor will lag current by 90° ;

$\therefore \quad i_C = \frac{200\sqrt{2}}{10}\sin\left(\omega t + \frac{\pi}{4} + \frac{\pi}{2}\right)$

$i = 20\sqrt{2}\sin\left(\omega t + \frac{3\pi}{4}\right)$

$\therefore$ Correct answer is (A)

7. D

Sol. 2dQ = dU + 2dW

dQ = dU + dW

dQ = dW

$\Rightarrow$ dU = 0

Process is isothermal.

8. B

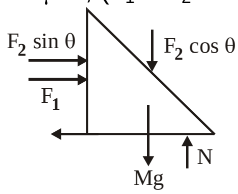
Sol. F = q v × B

= q v_0i × B (–k) = qv_0 B j

9. B

10. C

Sol. f = μN ; (F_1 + F_2 sin θ) = μ (mg + F_2 cos θ)



$$\mu = \frac{F_1 + F_2 \sin\theta}{mg + F_2\cos\theta}$$

11. C

Sol. $W_B = 0$

$W_E = \Delta KE$; $W_B + W_E = \Delta KE$

12. A

Sol. K.E. = $p^2/2m$ and $p = h/\lambda$

13. D

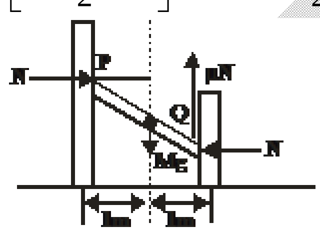
Sol. Drawing F.B.D. of rod PQ

ΣFx = 0

ΣFy = 0 $\Rightarrow$ μN = mg ..... (1)

$\Sigma\tau$ about centre of mass = 0

$$\left[N\times\frac{l}{2}\sin\theta\right][2] = \mu N\times\frac{l}{2}\cos\theta \Rightarrow \tan\theta = \frac{\mu}{2}$$



Hence $\sec\theta = \left(\sqrt{\mu^2+4}\right)/2$

Thus, $\left(\frac{l/2}{1}\right) = \frac{\sqrt{\mu^2+4}}{2} \Rightarrow l = \sqrt{\mu^2+4}$

$\Rightarrow\ l = \sqrt{0.25+4} = \frac{\sqrt{17}}{2}$ metres

14. B

Sol. $e = -\frac{d\phi}{dt}$

$i = \frac{e}{R}$ where R is resistance

$H = i^2Rt$

The emf will induce from zero to some maximum value and then from maximum to zero.

15. A

Sol. N_b reaches maximum when activity of A will be equal to activity of B.

i.e., $\lambda_a N_a = \lambda_b N_b \Rightarrow N_b = \frac{\lambda_a N_a}{\lambda_b}$

16. C

Sol. $f_0 = \frac{c}{\lambda} = \frac{c}{4(l+e)}$ and $\frac{c}{c_0} = \sqrt{\frac{273+\theta}{273}}$

$\therefore \; f_0' = \frac{c_0}{4(l+e)}\sqrt{1+\frac{\theta}{273}}$

If temperature is same, first overtone will be $3f_0$

$\therefore$ at 273°C first overtone is $3\sqrt{2}\,f_0$.

17. B

Sol. $V_0 = \sqrt{\frac{GM}{3R/2}} = \sqrt{\frac{2GM}{3R}}$

In order to escape to infinity let $(V - V_0)$ is the speed change required. Thus,

$\frac{-GMm}{(3R/2)} + \frac{1}{2}m(v)^2 = 0$

Thus, $v = \sqrt{\frac{4GM}{3R}}$

Thus speed change required = $v - v_0$

$\Delta V = \sqrt{\frac{4GM}{3R}} - \sqrt{\frac{2GM}{3R}}$; $\Delta V = \sqrt{\frac{GM}{3R}}\left(2-\sqrt{2}\right)$

18. B

Sol. At any time

$Kx - IlB = ma$ ….. (1)

$\frac{q}{C} = Bvl$

$I = BlCa$ ….. (2)

From (1) and (2)

$kx = a(B^2l^2C + m)$

$a = \left(\frac{K}{B^2l^2C+m}\right)x$ ….. (3)

Since motion of connector will be opposite to the displacement from equilibrium. Therefore equation (3) represents S.H.M.

$$\omega = \sqrt{\frac{K}{B^2l^2C+m}}$$

$$V_{max} = X_0\omega$$

$$\therefore \quad q_{max} = BlCV_{max}$$

$$q_{max} = BlCX_0\omega$$

$$X_0\sqrt{\frac{KC}{1+\frac{m}{B^2l^2C}}}$$

19. A
Sol. Velocity of image of particle B

$$\bar{v}_B = 5(\hat{i}) + 4(-\hat{i}) = \hat{i}$$

velocity of image of particle A

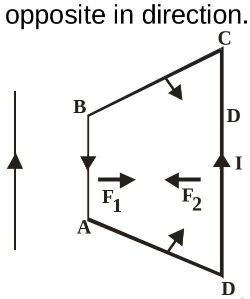
$$v_A = 10(-\hat{i}) + 4(-\hat{i}) - 10\hat{j}$$
$$= 14(-\hat{i}) - 10\,j$$

Relative velocity of image

$$\bar{V}_{BA} = \bar{V}_B - \bar{V}_A = \hat{i} - \left[14(-\hat{i}) - 10\hat{j}\right] = 15\hat{i} + 10\,\hat{j}$$

$$|\bar{V}_{BA}| = \sqrt{325}\,\text{cm/sec}$$

20. B
Sol. Magnitude of force on AB (F_1) and magnitude of force on CD (F_2) will be equal in magnitude and opposite in direction.



Hence $\bar{F}_1 + \bar{F}_2 = 0$ resultant of $\bar{F}_3 + \bar{F}_4$ will be away from the long straight wire.

SECTION – B

21. 2
Sol. Conservation of energy

$$\frac{1}{2}mv_0^2 = mgR + \frac{1}{2}mv^2, v = v_0\cos\theta$$

$$\frac{1}{2}v_0^2 = gR + \frac{v_0^2\cos^2\theta}{2}$$

$$v_0^2\left[1-\cos^2\theta\right] = gR$$

$$v_0 = \frac{\sqrt{2gR}}{\sin\theta}$$

22. 9
Sol. Net retardation $a = \dfrac{F_{ext} + \mu_k mg}{m} = 4.5$

If body stop at time t, then

$V = u + at$

$0 = 45 - 4.5t \quad \Rightarrow t = 10\,\text{sec}$

When block stops, F_{ext} will try to bring the block back ward while frictional force will oppose its motion, since block is stationary therefore at this moment, frictional force will be static. Whose maximum value will be $\mu_s mg = 30\text{N}$. Since static frictional force is self adjusting therefore it will be 25 N and block will not move after t = 10 sec.

$$S = \frac{u^2}{2a} = 225\,\text{m}$$

23. 25

Sol. Time taken by the layer of ice to increase its thickness by $x = x_2 - x_1$

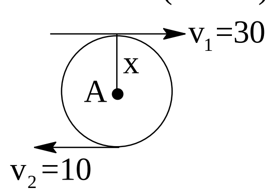
$$t = \frac{\rho L}{2K\theta}(x_2^2 - x_1^2) = \frac{.9 \times 80}{2 \times .005 \times 10}\left[(15)^2 - (10)^2\right]$$

$t = 9 \times 10^4\,\text{sec}$; t = 25 Hours

24. 25

Sol. Let x be the distance of axis of rotation from the top of sphere A (downward). Since angular velocity of the top and bottom point of sphere A will be same, therefore,

$$\omega = \frac{30}{x} = \frac{10}{(2R - x)}$$



$$\frac{30}{x} = \frac{10}{20 - x}$$

$\Rightarrow$ x = 15

$\therefore$ Distance from ground

= 2R + (2R – x)

= 20 + 5 = 25 cm

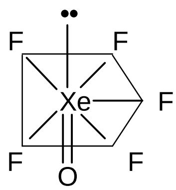
25. 8

Sol. $t = \int \frac{dy}{V_y} = \int_0^d \frac{dy}{Ky^{1/2}} = \frac{2\sqrt{d}}{k}$.

Chemistry PART – B

SECTION – A

26. D
Sol. Fluorine is most reactive amongst halides and has highest oxidising power

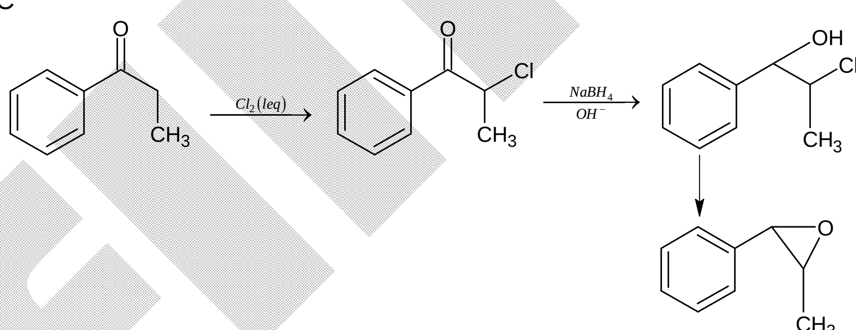
27. D
Sol.


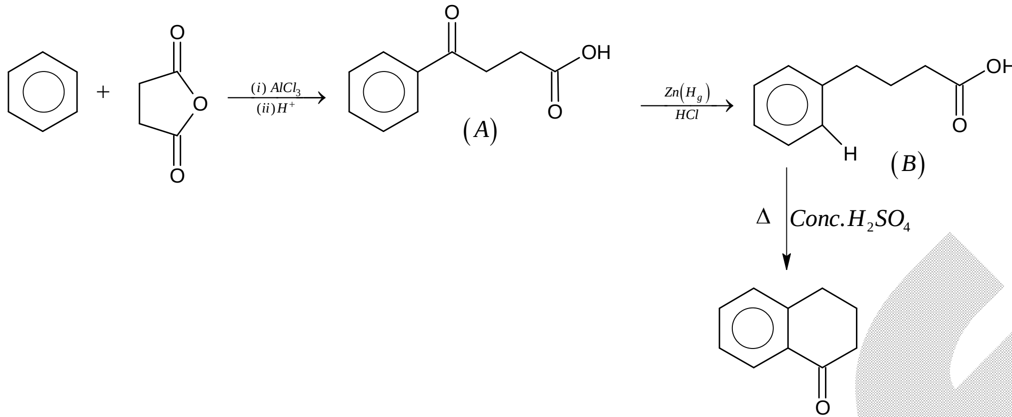
Hybridisation $-sp^3d^3$
Shape – pentagonal monopyramidal

28. C
Sol. Macromolecular colloids like starch, gelatin are generally lyophilic.

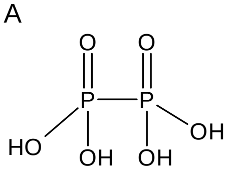
29. A
Sol. $\underset{sp^3d}{\left[XeF_3\right]^+}\ \underset{sp^3d^2}{\left[SbF_6\right]^-}$

30. A
Sol. In $\left(\bullet CF_3\right), \%$ p-character because of which bond angle decreases

31. C
Sol.


32. A
Sol.


33. B
Sol. $Bi^{3+} \xrightarrow{KI} BiI_3 \xrightarrow[KI]{excess} [BiI_4]^-$
(A) (B)
Black ppt yellow brown solution

34. A
Sol.

$H_4P_2O_6$

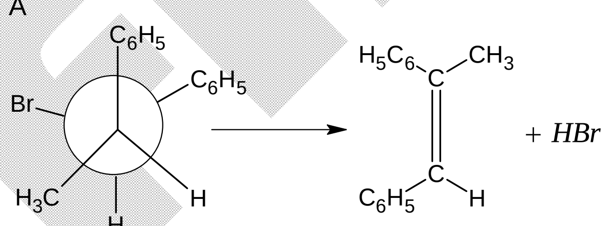
35. A
Sol. Because of stability of half filled f-subshell configuration.

36. C
Sol. $AgBr = x + y$

$$AgBr = \frac{K \times 1000}{M}$$

M – molarity of $AgBr$ solution

8 (solubility in g/L) = $\dfrac{K \times 1000}{(x+y)} \times 188$

37. A
Sol.


38. C
Sol. $-OH$ group of phenol cannot be replaced by iodine as it does not undergo nucleophilic substitution reaction under normal conditions.

39. B
Sol. Greater the activation energy of a reaction, greater is the temperature dependence of rate constant of reaction.

40. C

Sol. $\frac{1}{\lambda} = RZ^2\left(1-\frac{1}{4}\right)$ for lyman line

41. C

Sol. Methoxy group stabilises the cationic intermediate by $+M$ effect

42. C

Sol. Cl_2 is present simultaneously in two equilibria. Decrease in its concentration shift both equilibria forward.

43. D

Sol. Point B represents exactly half neutralisation of acid. At this point concentration acid left and its conjugate base are equal.

44. C

Sol. $\left[Br^-\right] = \frac{4\times10^{-13}}{4\times10^{-4}} = 10^{-9}M$

Mass of $NaBr$ added of $200\,ml = 103\times\frac{10^{-9}}{1000}\times200$

$= 2.06\times10^{-8}g$

45. C

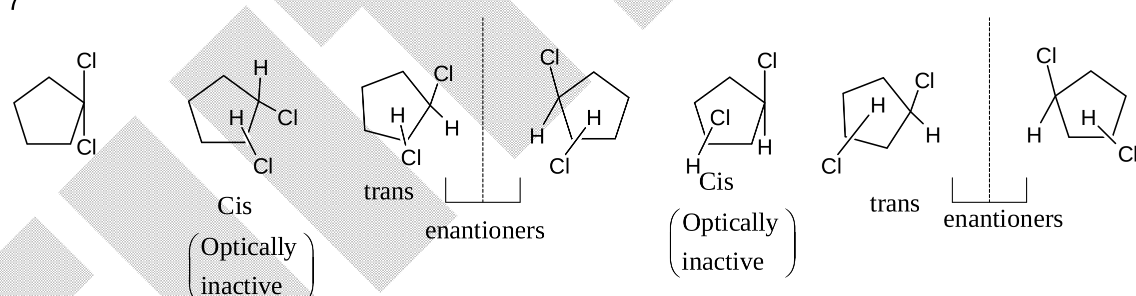
Sol. Greater the charge density, greater is hydration.

SECTION – B

46. 1

47. 7

Sol.



Total isomers = 7

48. 10

49. 3

Sol. $\left(\mathrm{Ni}\left(\mathrm{CN}\right)_4\right)^{2-}$ is dsp^2 hybridised and diamagnetic

50. 1

Sol. Equivalents of $KMnO_4 = 5x$

Equivalents of $K_2Cr_2O_7 = 6y$

Equivalents of oxidising agent must be same $5x = 6y$

$x - y = 6 - 5 \Rightarrow 1$

Mathematics

PART – C

SECTION – A

51. D
Sol. $a = 3, b = -4, c = 1$

52. D

53. C
Sol. Put $x = i$ and equate the real part

54. C
Sol. $x^2 dx + y^2 dy = \dfrac{d(xy)}{(xy)^2}$

55. B
Sol. Let $x = \dfrac{\log_2 y}{111}$ these $y^3 - 16y^2 + 8y - 4 = 0$

56. C
Sol. $\sec^{-1}\sqrt{1+x^2} = \tan^{-1} x, \cos^{-1}\dfrac{1-x^2}{1+x^2} = 2\tan^{-1} x$

57. C
Sol. $\left(\dfrac{x-2y-4}{\sqrt{5}}\right)^2 = \dfrac{12}{\sqrt{5}}\left(\dfrac{2x+y}{\sqrt{5}}\right)$ (if is parabola)

58. C
Sol. $\tan\dfrac{\theta}{2}\tan\dfrac{\theta}{2} = \dfrac{1+e}{1-e}$ if focus is $(-ae, \theta)$

59. D
Sol. $f(x) = \tan\left(\dfrac{\pi}{4} - \dfrac{x}{2}\right)$

60. B

61. B

62. D

63. C

64. B

65. B
Sol. $b^2 + c^2 - a^2, c^2 + a^2 - b^2, a^2 + b^2 - c^2$ are in AP.

66. B

67. A

68. D
Sol, Both the roots opposite in sign

69. A
Sol. $adj(AB) = adjB.adjA$

70. C

SECTION – B

71. 7
Sol. $\int_0^{\frac{\pi}{2}} \frac{(1-\tan x)^2}{(1+\tan x)^4} \sec^2 x\, dx = \frac{1}{3}$

72. 105
Sol. $\frac{\lfloor 7}{\lfloor 4 \ \lfloor 2} = 105$

73. 50
Sol. $OM = \sqrt{\left(50\sqrt{5}\right)^2 - (100)^2} = 50m$

74. 8

75. 0
Sol. $\Delta = 0$