FIITJEE

ALL INDIA TEST SERIES

FULL TEST – XI

JEE (Advanced)-2019

PAPER – 2

TEST DATE: 13-05-2019

ANSWERS, HINTS & SOLUTIONS

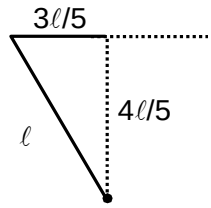
Physics

PART – I

SECTION – A

1. A, B, D

Sol. There will be no normal reaction between rod and ring, because rod is massless. The motion of ring will be free fall under gravity.



Velocity of ring when it leaves contact with rod

$$= \sqrt{2 \times g \times \frac{4\ell}{5}} = \sqrt{\frac{8g\ell}{5}}$$

Angular momentum

$$= m\frac{3\ell}{5}\sqrt{\frac{8g\ell}{5}} = m\sqrt{\frac{72g\ell^3}{125}}$$

2. C, D

Sol. $P_0A + kx_0 = P_iA$

$P_0A + k(x_0 + x) = PA$

$$P = P_0 + \frac{k}{A}(x_0 + x)$$

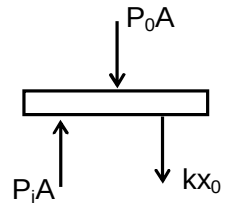
Volume = $v_0 + (x + x_0)A$

$$P = P_0 + \frac{k}{A^2}(V - V_0)$$

$$P = \frac{kV}{A^2} + \left(P_0 - \frac{kV_0}{A^2}\right)$$

$P = mV + C$

$nRT = mV^2 + CV$



$P_0A + kx_0 = P_iA$

3. A, D

Sol. $f = \frac{330}{(330-10)} \times 640$

$= \frac{330}{320} \times 640 = 660\ \text{Hz}$

4. A, B, C

Sol. $q = q_0 \sin\left(\omega t + \frac{\pi}{6}\right)$

$i = q_0 \omega \cos\frac{\pi}{6}$

$\sigma = \frac{q_0}{2}\frac{\sqrt{3}}{2} \Rightarrow q_0 = \frac{24}{\sqrt{3}} = 8\sqrt{3}$

Alternatively

$\frac{q_0^2}{2C} = \frac{1}{2}\frac{(4\sqrt{3})^2}{2} + \frac{1}{2} \times 2 \times (6)^2$

$q_0 = 8\sqrt{3}$

$\frac{1}{2}Li_0^2 = \frac{q_0^2}{2C} \Rightarrow i_0 = 4\sqrt{3}$

5. A, D

Sol. $Td\theta = dm\omega^2 R$

$Td\theta = \rho\omega^2 R^2$

K.E. $= \frac{1}{2}(\rho.2\pi R)R^2\omega^2$

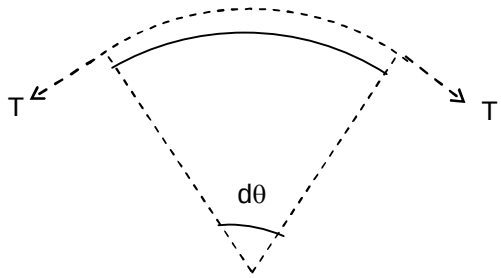
$= \pi\rho R^3\omega^2$

Elastic potential energy

$= \frac{1}{2} \times \frac{(\text{stress})^2}{Y} \times \text{volume}$

$= \frac{1}{2}\frac{\rho\omega^2R^2 \times \rho\omega^2R^2}{YA^2}.A \times 2\pi R$

$= \frac{\pi\rho^2\omega^4R^5}{yA}$



6. A, D

Sol. $d\phi = \frac{\mu_0 i}{2\pi r}adr$

$\phi = \frac{\mu_0 ia}{2\pi}\ln 2$

7. D

Sol. $\frac{V}{2}3\rho g = V\rho g + T$

$T = \frac{V\rho g}{2}$

8. B

Sol. Magnetic field due to long wire is given by $\vec{B} = \frac{\mu_0 i}{2\pi r}\hat{n}$, where $\hat{n}$ is determined by right hand thumb rule.

9. D

Sol. $V = -x^2y + 5$

V(5, 2 1) = –45 V
V(1, 1, 1) = +4 V
V(2, 1, 1) = 1 V
V(1, 2, 1) = 3 V

10. B

Sol. $(\mu - 1)t = \Delta x$

$\frac{t}{2} = \Delta x$

$\Delta\phi = \frac{2\pi}{\lambda}\Delta x$

$\Delta\phi = \frac{\pi}{600} \times t$

SECTION – D

11. 00000.11

Sol. $kx = mg + m_0g - \rho Av^2$

$k.\frac{dx}{dt} = \frac{dm}{dt}.g - \rho A.2v.\frac{dv}{dt}$

$\frac{500 \times (5-1)}{30 \times 60} \times \frac{1}{10} = \frac{dm}{dt}$

$= \frac{2000}{30 \times 60 \times 10} = \frac{1}{9} = 0.11.$

12. 00060.00

Sol. $\sin 53° = \frac{R}{OA}$

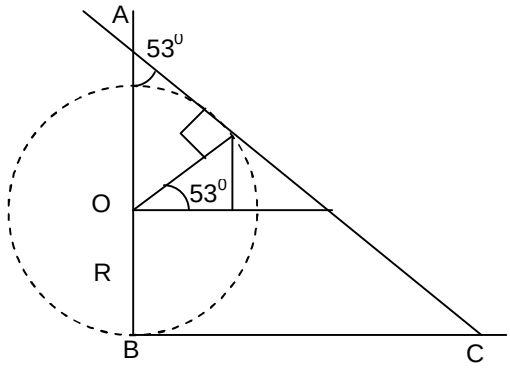
$OA = \frac{5R}{4}$

$AB = \frac{9R}{4}$

$\tan 53 = \frac{BC}{AB}$

$\Rightarrow \quad BC = \frac{9R}{4} \times \frac{4}{3}$

$\Rightarrow \quad BC = 3R = 60$ cm



13. 01000.00

Sol. Potential difference across resistor = iR = 10 × 100 = 1000 V
Which is equal to potential difference across capacitor.

14. 00001.50

Sol. $\frac{4\lambda}{2} = \ell$

$\Delta P = \Delta P \sin \pi/3 = \frac{\sqrt{3}\Delta P_0}{2}$

$\left|\frac{\Delta v}{v}\right| = \frac{\sqrt{3}\Delta p}{2B} = \frac{\sqrt{3}\times\sqrt{3}}{2\times 100}\times 10^{-3}$

$\frac{3}{2}\times 10^{-5} = 1.5 \times 10^{-5}$.

15. 08000.00

Sol. $\vec{a}_{cm} = -(2\hat{i} + 4\hat{j})$

$F_1 = m\vec{a}_{cm}$

$F_1^2 = 20 \times 400$

$= 8000$

16. 00005.00

Sol. $A = A_0 (1 - 0.19)$

$A = A_0 e^{-\lambda t}$

$0.81 = e^{-\lambda t}$

$\lambda = -\ln(0.81)$

$= 2\times 0.10 = 0.20$

$\frac{1}{\lambda} = \frac{1}{0.20} = 5 \text{hours}$

17. 02528.00

Sol. $\frac{u^2}{g} = 4 \Rightarrow u^2 = 4g$

$v_c^2 = \frac{2GM}{R^2}$

$V_e^2 = 24\rho_1 . \frac{4\pi}{3} R$

$u^2 = 4. \frac{GM}{R^2} = 4.G\rho \frac{4}{3}\pi R_3$

$\Rightarrow R^2 = R_e$

18. 00006.00

Sol. Velocity of image : $8 \times \frac{2}{4/3} \times \frac{1}{2} = 6 \text{cm/s}$

Chemistry

PART – II

SECTION – A

19. B, D

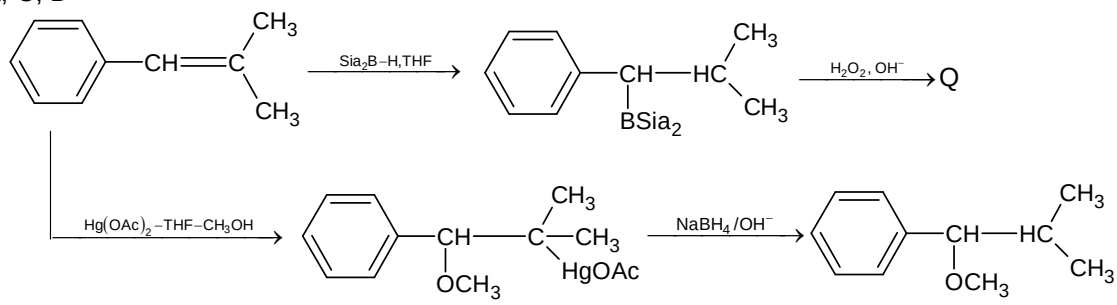
Sol. $Cu^{2+} + 4NH_3 \longrightarrow \left[Cu(NH_3)_4\right]^{2+}$

$Cd^{2+} + 4NH_3 \longrightarrow \left[Cd(NH_3)_4\right]^{2+}$

CdS and CuS both are insoluble in yellow ammonium sulphide.

20. A, C, D

Sol.



21. A, C, D

22. B, C

Sol. Since intermolecular forces are zero hence potential energy increases with decreasing distance, while Z increases by increasing pressure.

23. B, C, D

Sol. α-hydroxy ketones and aldehydes give +ve Tollen's test hence are reducing sugar.

24. A, C

Sol. S_NNGP path hence retention of configuration.

25. B

Sol. $[Co(NH_3)_4(H_2O)Cl]Br$ → shows cis-trans isomerism, paramagnetic. sp^3d^2 hybridization, shows ionization isomerism.

$K_3[Cr(Ox)_2Cl_2]$ → shows cis-trans isomerism, paramagnetic, shows optical isomerism d^2sp^3 hybridization

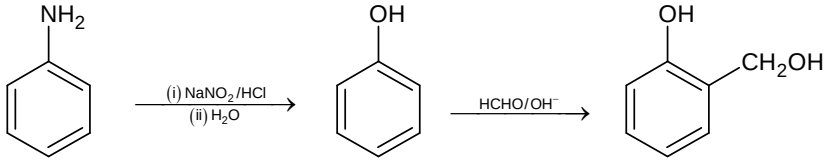
$[Ni(H_2O)_6]Cl_2$ → sp^3d^2 hydridization, paramagnetic

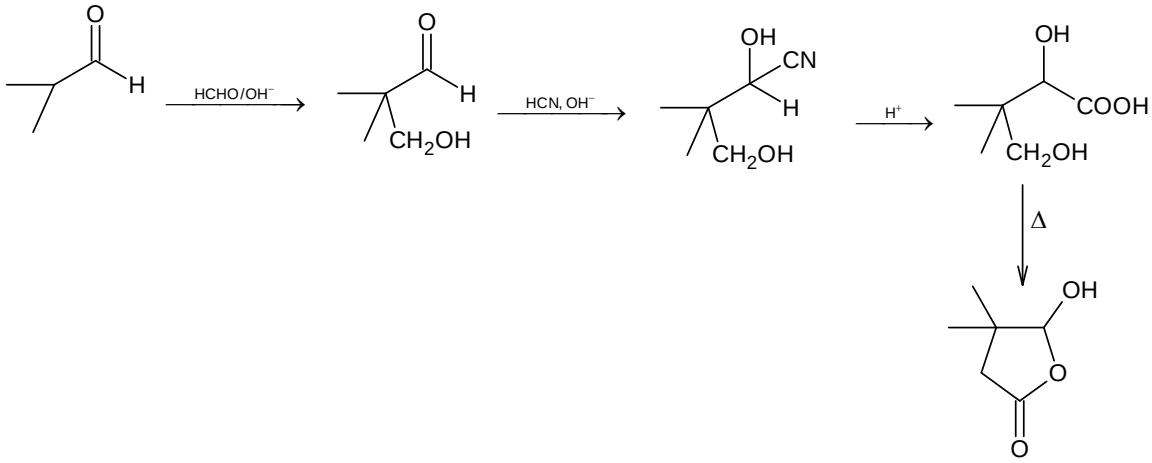
$[Pt(NH_3)_2Cl_2]$ → Geometrical isomerism, dsp^2 hybridization, diamagnetic

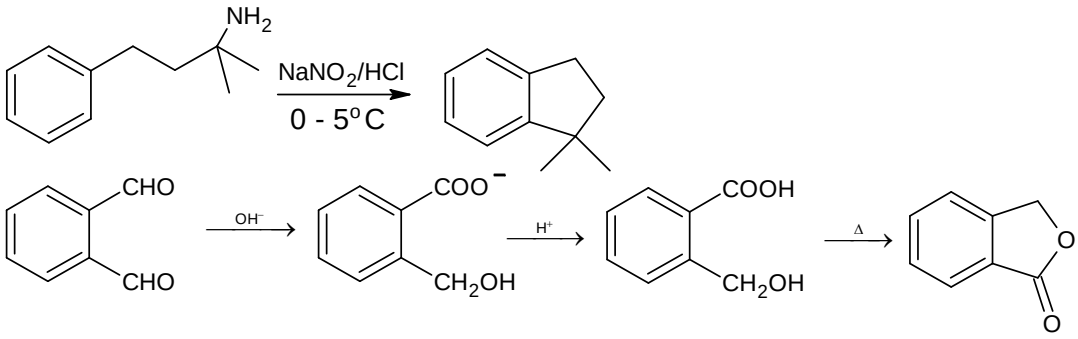
26. C

27. B

Sol.







28. B

SECTION – D

29. 00003.50

Sol. $\left[Ni(NH_3)_6\right]^{2+}, O_2, \left[Ti(H_2O)_5\,Cl\right]NO_3, S_2, Se, \left[Mn(H_2O)_6\right]^{2+}, S$

30. 00000.80

Sol. Leucine form N-terminal then possible combination

Leu – Ala – Phe – gly
Leu – Ala – Gly – Phe
Leu – Phen – Ala – gly
Leu – Phen – Gly – Ala

31. 00001.50

Sol. $2A(s) \longrightarrow 2A^{n+} + 2ne^-$

$B^{2n+} + 2ne^- \longrightarrow B$

$2A(s) + B^{2n+}_{(aq)} \longrightarrow 2A^{n+}_{(aq)} + B(s)$

$\Delta G^o = -nFE^o$

$E^o = \dfrac{9.5}{2nF}$

$E = E^o - \dfrac{RT}{nF}\ell n\dfrac{\left[A^{n+}\right]^2}{\left[B^{2n+}\right]}$

$\dfrac{10^3}{F} = \dfrac{9.5\times10^3}{2nF} - \dfrac{2500}{2nF}\times 2\times 0.7$

$2n = 6,\ \ n = 3$

32. 08250.00

Sol. $A_3B_6(g) \rightleftharpoons 3AB_2(g)$

1

$1-\alpha \qquad 3\alpha$

$n_T = 1+2\alpha$

$\frac{VD_1}{VD_2} = \frac{n_2}{n_1}$

$2 = 1+2\alpha$

$\alpha = 1/2$

$P_{AB_2} = \frac{3\times\frac{1}{2}}{2}\times 4 = 3\,atm$

$P_{A_3B_6} = \frac{\frac{1}{2}\times 4}{2} = 1\,atm$

$K_P = \frac{(3)^3}{1} = (3)^3$

$\Delta_r G^o = -RT\ell n(3)^3$

= - 2500 × 3 × 1.1 = - 8250 J.

33. 00020.00

Sol. PV = nRT

8.21 × 3 = n × 0.0821 × 300

n = 1

$2KI + O_3 + H_2O \longrightarrow 2KOH + I_2 + O_2$

$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$

Moles of $O_3 = \frac{1}{2}$ moles of hypo solution

$= \frac{1}{2}\times\frac{200\times 2}{1000} = 0.2$

Mole % $= \frac{0.2}{1}\times 100 = 20$

34. 00140.00

Sol. $W_{ABC} = -PV\ell n\frac{P_1}{P_2}$

$= -2\ell n4$

= -2 × 2 × 0.7 = - 2.8 atm L

W_{net} = -2.8 + 4.2 = 1.4 L atm

= 140 J

$\Delta U = q + W$

W = - q

q = - 140 J.

$W_{CDBEA} = W_{DB} + W_{EA}$

= 1.2 × 2.5 + 0.3 × 4

= 4.2 L atm

35. 00050.40

Sol.

$$H_2O_2(\ell) \longrightarrow H_2O(\ell) + \frac{1}{2}O_2(g)$$

a

$a - x$ x x / 2

$$K = \frac{2.303}{t}\log\frac{a}{a-x}$$

$$\frac{0.693}{180} = \frac{2.303}{360}\log\frac{a}{a-x}$$

$$\frac{a}{a-x} = 4$$

$3a = 4x$

$$x = \frac{3}{4}a = \frac{3}{4}\times 6 = \frac{9}{2} = 4.5$$

Volume of O_2 at S.T.P. = 4.5 × 11.2 L = 50.4 litre.

36. 00001.60

Sol. Mohr's salt, Oxalic acid, Ferrous oxalate, Sodium nitrite, Sodium thiosulphate, Ethyl alcohol, Hydrogen sulphide, Stannous chloride.

Mathematics

PART – III

SECTION – A

37. D

Sol. $\left(\sum_{r=1}^{n} r\sqrt{{}^nC_r}\right)^2 \le \left(\sum_{r=1}^{n} r^2\right)\left(\sum_{r=1}^{n} {}^nC_r\right)$

38. A, B

Sol. $S \le (a_1 + a_3 + ...)(a_2 + a_4 + ...) \le \left(\frac{\sum a_i}{2}\right)^2 = \frac{1}{4}$

39. A, B, C

Sol. Let the foot of the perpendicular from origin to the line be $P(2\lambda + 3, 3\lambda + 2, \lambda + 2)$

$2(2\lambda + 3) + 3(3\lambda + 2) + (\lambda + 2) = 14\lambda + 14 = 0$

$\Rightarrow \lambda = -1$

$\Rightarrow P(1, -1, 1)$

$\therefore$ length of perpendicular is $\sqrt{3}$

$\Rightarrow$ side (a) $= \sqrt{3} \cdot \frac{2}{\sqrt{3}} = 2$

Area $= \frac{\sqrt{3}}{4}a^2 = \sqrt{3}$

Circum radius $= \frac{2}{3} \cdot \sqrt{3} = \frac{2}{\sqrt{3}}$, inradius $= \frac{1}{3} \cdot \sqrt{3} = \frac{1}{\sqrt{3}}$, Centroid is $\left(\frac{2}{3}, \frac{-2}{3}, \frac{2}{3}\right)$

40. A, B, D

Sol. $\cos C = \frac{2b}{a} = \frac{a^2 + b^2 - c^2}{2ab} \Rightarrow 3b^2 = a^2 - c^2$

41. B, D

Sol. $f(x) = \frac{1}{3}x\tan 3(x-1)$

42. A, C

Sol. $I_n = \int_0^{\infty} \frac{dx}{\left(x + \sqrt{1+x^2}\right)^n} = \int_1^{\infty} \frac{1}{t^n} \frac{t + \frac{1}{t}}{2t} dt$ (Put $t = x + \sqrt{1+x^2}$)

$= \frac{1}{2}\int_1^{\infty} \frac{t^2+1}{t^{n+2}} dt = \frac{1}{2}\left[\frac{t^{-n+1}}{-n+1} + \frac{t^{-n-1}}{-n-1}\right]_1^{\infty} = \frac{n}{n^2-1}$

43. C

Sol. $f_1(x) = \tan^{-1}x + \frac{x}{1+x^2}\begin{cases} > 0 & \text{if } x > 0 \\ = 0 & \text{if } x = 0 \\ < 0 & \text{if } x < 0 \end{cases}$

$f_2(x)$ is not continuous at $x = 1$

$$f_3(x)=\begin{cases}(x+1) & ; \text{ if } x\in[-2,0)\\ 0 & ; \text{ if } x=0\\ (x+1)e^{-\frac{2}{x}} & ; \text{ if } x\in(0,2]\end{cases}$$

$\lim\limits_{x\to\frac{\pi}{4}} f_4(x)=1$

44. D

Sol. C_1 reduces to $(z-\bar{z})^2=(z+\bar{z}) \Rightarrow -4y^2 = 2x$
C_2 reduces to $(3x - 2y + 3) + i(-y + 1) = 0 \Rightarrow$ point where $3x - 2y + 3 = 0$ and $-y + 1 = 0$ intersect
C_3 is simply $\sqrt{2}\times$ distance from fixed line = distance from fixed point
C_4 is similar interpretation as above however fixed point lies on the fixed line

45. A

Sol. Use slope form

46. A

Sol. $\tan\frac{x}{2}=\cot\frac{x}{2}-2\cot x$

$$\cot^{-1}\left(k^2+\frac{3}{4}\right)=\cot^{-1}\left(\frac{2k-1}{2}\right)-\cot^{-1}\left(\frac{2k+1}{2}\right)$$

$$\sum_{k=1}^{\infty}\frac{1}{(2k-1)2k(2k+1)}=\frac{1}{2}\sum_{k=1}^{\infty}\left(\frac{1}{2k-1}+\frac{1}{2k+1}-\frac{2}{2k}\right)$$

$$\sum_{k=1}^{\infty}\frac{1}{(4k-1)(4k+1)}=\frac{1}{2}\sum_{k=1}^{\infty}\left(\frac{1}{4k-1}-\frac{1}{4k+1}\right)=\frac{1}{2}\sum_{k=1}^{\infty}\int_0^1\left(x^{4k-2}-x^{4k}\right)dx=\frac{1}{2}\int_0^1(1-x^2)\sum_{k=1}^{\infty}x^{4k-2}dx$$

SECTION – D

47. 00000.00

Sol. Distance of directrix from $\left(4\sqrt{3},2\right)$ is $\sqrt{3}$ and from (2, 0) is 1

$$d^2=\left(4\sqrt{3}-2\right)^2+2^2>\left(\sqrt{3}+1\right)^2$$

48. 00002.00

Sol. f(n, m) = n + 2m, each chord defines one segment, with each point of intersection creating 2 additional segments

49. 00008.00

Sol. The curve is symmetric in all 4 quadrants. Confining to first quadrant, curve is $r^2 = 4\cos\theta$

$$A=4\int_0^{\pi/2}\frac{1}{2}r^2d\theta=8\int_0^{\pi/2}\cos\theta d\theta=8$$

50. 00007.50

Sol. Use series expansion, $L=\frac{2}{5}-2\times\frac{2}{15}=\frac{2}{15}$

51. 00008.00

Sol. $|z|_{max}=\sqrt{3}+1$ and $|z|_{min}=\sqrt{3}-1$

52. 00004.00

Sol. $I_{n+1} = \int_0^{\pi/2} \cos^n x\left[\cos nx - \sin(n+1)x \sin x\right]dx$

$= I_n + \frac{\cos^{n+1} x}{n+1}\sin(n+1)x\Big|_0^{\pi/2} - \int_0^{\pi/2} \cos^{n+1} x \cos(n+1)x dx$

$\Rightarrow 2I_{n+1} = I_n$

53. 00004.00

Sol. Curve is one arm of hyperbola with foci (2, 4) and (2, –4)

54. 00000.08

Sol. Non-adjacent numbers with 0 = ${}^6C_3 \cdot 3 \cdot 3!$

Non-adjacent numbers without 0 = ${}^6C_4 4!$

$P = \frac{3 \cdot 3! \ {}^6C_3 + 4! \ {}^6C_4}{9000} = \frac{2}{25}$