FIITJEE

ALL INDIA TEST SERIES

FULL TEST – II

JEE (Advanced)-2019

PAPER –1

ANSWERS, HINTS & SOLUTIONS

Physics

PART – I

SECTION – A

1. BCD

Sol. $f_{max} = \mu Mg\left(friction = f\right)$

$\alpha_{max} = \frac{f_{max}R}{I_\omega} = \frac{2\mu g}{R}$

At the five of slipping

$\alpha_{max}R = a = \frac{F = 3f_{max}}{3M}$

2. BC

Sol. For the bubble, PV=const.

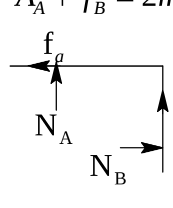
$\therefore \frac{dV}{V} = \frac{-dP}{P}$

$\frac{dV}{V} = \frac{3dr}{r}, dP \approx -\frac{4T}{R}, \ P \approx P_0 \left(\text{according to the question}\right)$

$\therefore \ dr = \frac{4Tr}{3P_0R}$

3. AC

Sol. $A_A + f_B = 2mg$



$f_B \downarrow 2mg$

$N_B = f_A$

$mgR - f_A R - f_B R = 0$

$\Rightarrow mg = f_A + f_B$

Solve to get the ans.

4. BCD

Sol. Taking torque about R.H. side of loop

$\mathrm{mg}\frac{\ell}{2}\text{-}\mathrm{T_1}\ell - \mathrm{ibB}=0$

$= -\pi \mathrm{nir}^2\mathrm{B}\hat{\mathrm{k}}$

5. AD

Sol. $Y = \frac{T/A}{x/\ell}$ where $T = M\left(\ell + x\right)\omega^2 \Rightarrow x = \frac{\ell}{\left(\frac{YA}{M\ell\omega^2} - 1\right)}$

And $ms\Delta\theta = \Delta U$

$$\Delta\theta = \frac{YA\ell}{2ms}\left(\frac{1}{\frac{YA}{M\ell\omega^2} - 1}\right)^2$$

6. AB

Sol. As the prism are identical so deviation will be zero for even number of prism and δ for odd number of prism.

7. AC

Sol. Equivalent diagram is as shown in P is moved 2 cm right them R_1=12, R_3=3

$\frac{\mathrm{R_1}}{\mathrm{R_2}} = \frac{\mathrm{R_2}}{\mathrm{R_4}}$ (Hence wheat stone will be balanced)

If s is moved left $\frac{5}{3}cm$ then $R_4 = \frac{20}{3}$ hence $\frac{R_1}{R_3} = \frac{R_2}{R_4}$ (hence wheat stone will be balanced)

8. A
9. C
10. D
11. B
12. C
13. A

Sol. **(for Q. 11 to 13)**

Take effective value of $g :\rightarrow$

For entry (II) $g_{eff} = \sqrt{3}g$

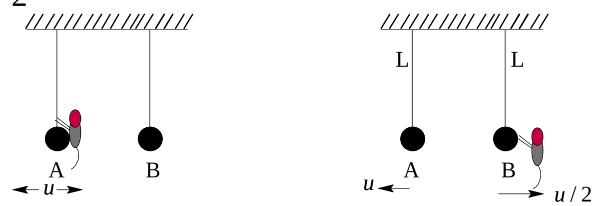
For entry (IV) of column (I)

$g_{eff} = g\sin 30^\circ = g/2$

SECTION – C

14. 8

Sol. $\frac{u}{2}=\sqrt{2g\ell}=8m/s$



15. 1

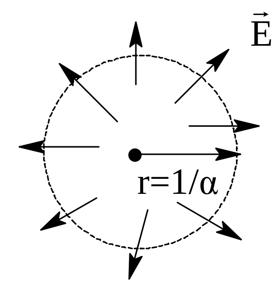
Sol. As the electric field is radial, by applying gauss law, we can write

$$\int \vec{E}.d\vec{s}=\frac{Q}{\varepsilon_0}$$

For $r=\frac{1}{\alpha}$, $\vec{E}=C\left(1-e^{-\alpha\times 1/\alpha}\right)\frac{\hat{r}}{\left(1/\alpha\right)^2}$

$$\therefore \oint \vec{E}.d\vec{s}=C\left(1-e^{-1}\right)\alpha^2\times 4\pi\left(1/\alpha\right)^2$$

$$\Rightarrow \frac{Q}{\varepsilon_0}=4\pi C\left(1-e^{-1}\right)\Rightarrow Q=\left(1-e^{-1}\right)\Rightarrow \therefore N=1$$



16. 2

Sol. $\mathrm{mr}^2\beta=\int_0^\theta \frac{2q}{2\pi}d\alpha\, vBr\cos\alpha$

$$\beta=\frac{dw}{dt}=\frac{qUB\sin\theta}{\pi\ mr}----(1)$$

$$-ma=\int_0^\theta 2\frac{q}{2\pi}d\alpha\, rwB\cos\alpha$$

$$a=\frac{dv}{dt}=\frac{qrwB\sin\theta}{\pi\ m}----(2)$$

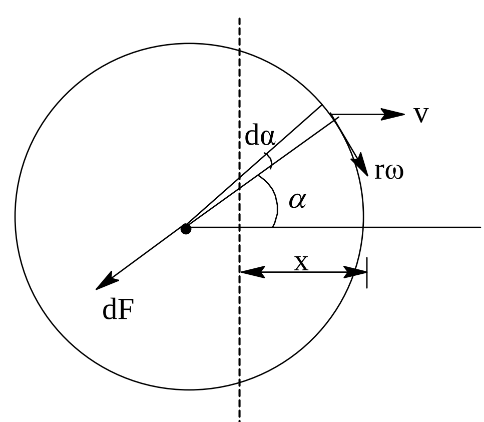
$$=\frac{dw}{dv}=\frac{v}{r^2w}\Rightarrow r^2\int_0^w wdw=-\int_{v_0}^{v} v\,dv$$

$$\Rightarrow v=\frac{v_0}{\sqrt{2}}$$

$$\frac{vdv}{dx}=\frac{qrwB\sin\theta}{\pi m}$$

$$\int_{v_0}^{v_0/\sqrt{2}}\frac{vdv}{\sqrt{v_0^2-v^2}}=\frac{qrB}{m\pi}\int_0^\pi \sin^2\theta d\theta$$

$$\Rightarrow q=\frac{\sqrt{2}mv_0}{Br}$$



$x=r-r\cos\theta$

$dx=r\sin\theta d\theta$

17. 6

Sol. Consider the object as two portion 'A uniform rod' and 'A frustum' with thermal resistance R_1 and R_2 respectively then

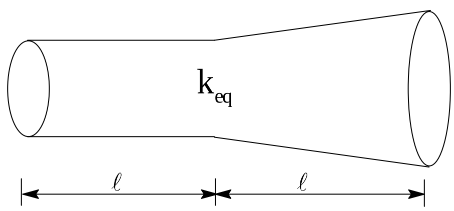
$$R_1 = \frac{\ell_1}{k_1 A_1} = \frac{\ell}{k\pi r^2}$$

And $R_2 = \frac{\ell_2}{k_2 A_2} = \frac{\ell}{(2k)(\pi r_1 r_2)} = \frac{\ell}{4k\pi r^2}$

$\therefore$ Equivalent thermal resistance $R_{eq} = R_1 + R_2$

$$\Rightarrow R_{eq} = \frac{5\ell}{4k\pi r^2} ....(1)$$

Now if we consider the same lamina with equivalent thermal conductivity K_{eq} , then



$$R_{eq} = R_1 + R_2 = \frac{\ell}{k_{eq}\pi r^2} + \frac{\ell}{k_{eq}\left(2\pi r^2\right)} = \frac{3\ell}{2k_{eq}\pi r^2} ....(2)$$

By equating the terms of R_{eq} from eqn. (1) & (2), we get

$$\frac{5\ell}{4k\pi r^2} = \frac{3\ell}{2k_{eq}\pi r^2}$$

$$k_{eq} = \frac{6k}{5}$$

$$\therefore N = 6$$

18. 2

Sol. t1 = RC; t2 = R/L

→LC = t1t2 = 0.1 sec -> T = 2pie $\sqrt{\frac{1}{LC}}$

T = 2 sec.

Chemistry

PART – I

SECTION – A

19. ABCD

Sol. $E^0_{Cr^{3+}/Cr^{2+}} < E^0_{Fe^{3+}/Fe^{2+}} < E^0_{Co^{3+}/Co^{2+}}$

20. BC

Sol. Hydrolysis requires a $\beta-$galactosidase, showing that galactose and mannose are linked by a $\beta-$galactosidic linkage. For sugar to be reducing, one of the hexoses must have free hemiacetal form.
The methylation /hydrolysis procedure shows the point of attachment of the glycosidic bond to mannose. C_1 is anomeric carbon on mannose ring and both $\alpha-\beta$ forms satisfy the above conditions.

21. AC

Sol. Octanol and water are insoluble.

22. CD

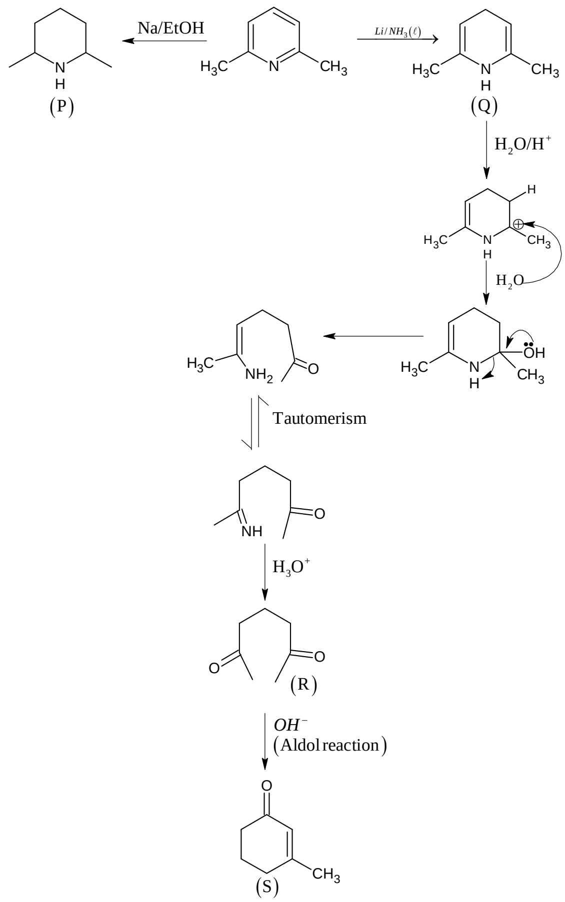
Sol. ΔG is the thermodynamical concept

23. AB

Sol. β-Keto acid on heating shows de-carboxylation on heating, through enol form

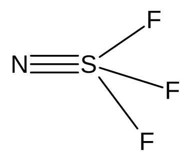
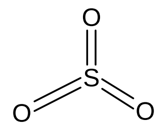
24. ABC

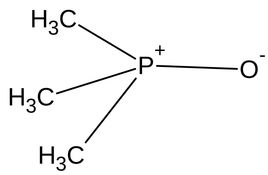
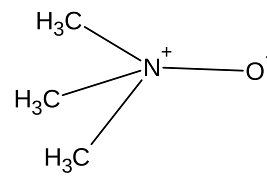
Sol.



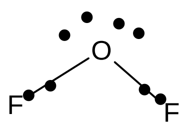
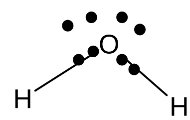
25. ABC

Sol.

(pπ-dπ back bonding is possible)

(Less space is available for lone pairs)

26. B
27. C
28. C
29. A
30. C
31. C

Sol. **(for Q. 29 to 31)**
Increasing in polarity of the solvent will increase the rate if T.S. has more charge density in comparison to reactant**.**

SECTION – C

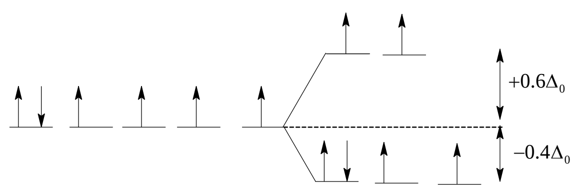
32. 4

Sol.
$$Ag_2C_2O_4 \longrightarrow 2Ag^+ + C_2O_4^{-2}$$
$$C_2O_4^{-2} + H_2O \longrightarrow OH^- + HC_2O_4^{-1}$$
$$HC_2O_4^{-1} + H_2O \longrightarrow OH^- + H_2C_2O_4$$
$$\left[C_2O_4^{2-}\right]_0 = \frac{\left[Ag^+\right]}{2} = \left[C_2O_4^{2-}\right] + \left[H_2C_2O_4^-\right] + \left[H_2C_2O_4\right]$$
$$= \left[C_2O_4^{2-}\right] + \frac{\left[H^+\right]\left[C_2O_4^{2-}\right]}{Ka_2} + \frac{\left[C_2O_4^{-2}\right]\left[H^+\right]^2}{Ka_1 Ka_2}$$
$$= \left[C_2O_4^{2-}\right]\left[1 + \frac{10^{-5}}{5\times10^{-5}} + \frac{10^{-10}}{25\times10^{-7}}\right]$$
$$\frac{[Ag^+]}{2} = \frac{K_{sp}}{[Ag^+]^2}\left[1.20004\right]$$

$$[Ag^+]^3 = 2\times K_{sp}\times[1.20004]$$
$$[Ag^+]^3 = 2\times 5\times 10^{-11}\times[1.20004]$$
$$[Ag^+]^3 = 10^{-10}\times[1.20004]$$
$$[Ag^+]^3 = 10^{-12}\times[120.004]$$
$$[Ag^+] = 10^{-4}\times[4.932]$$
$$\text{solubility} = \frac{[Ag^+]}{2} = 10^{-4}\times\frac{4.932}{2} = 10^{-4}\times 2.46$$

33. 3

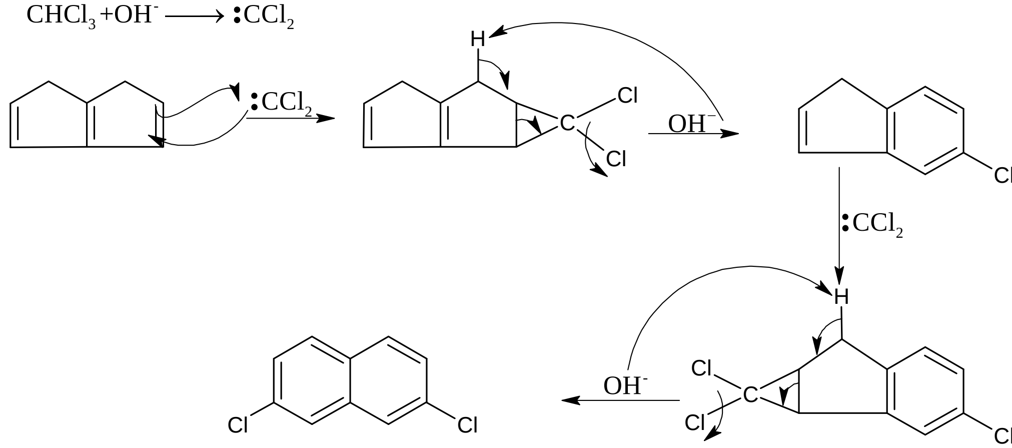
Sol. $CFSE = E_{\text{ligand field}} - E_{\text{isotopic field}}$



$$=\left[4\times\left(\frac{-2}{5}\Delta_0\right)+\left(2\times\frac{3}{5}\Delta_0\right)+P\right]-P$$
$$=\frac{-2}{5}\Delta_0$$
$$=\frac{-2}{5}\times 75 \Rightarrow x = -30$$
$$\Rightarrow \left|\frac{x}{10}\right| = 3$$

34. 2

Sol. $CHCl_3 + OH^- \longrightarrow :CCl_2$



It has two plane of symmetry

35. 4

Sol. Volume of unit cell= $\frac{\sqrt{3}}{2}\times(4.53)^2\times7.41\times10^{-24}cm^3$

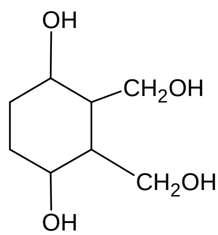
so mass= $1.211\times10^{-22}g$

molecules of H_2O= $\frac{1.211\times10^{-22}}{18}\times6.023\times10^{23}=4$

number of H atom=4

36. 4

Sol.



(A)

Mathematics

PART – III

SECTION – A

37. BCD

Sol. $I = \int_{-1}^{1}\left(e^{x^3} + e^{-x^3}\right)dx > 2$

Graph is concave upwards

$\Rightarrow I < f(0) + f(1)$

38. ACD

Sol. $f'(x) = e^{-\frac{1}{x^2}}.\frac{2}{x^3} + \frac{\pi}{2}\sqrt{1+\sin\frac{\pi x}{2}}$

And $\lim_{x\to 0^+}\frac{e^{-\frac{1}{x^2}}}{x^3} = 0$

Also $\lim_{x\to\infty} f(x) = \infty$

f''(x) does not exist for x=3, 7, 11….

39. AD

Sol. $\frac{2x^4 + 2y^4 + 4z^4 + 1}{4} \ge 2xyz$

And $x^4 y + xy^4 + \frac{4}{x^2y^3} + \frac{1}{x^3y^2} + 8 \ge 5 - 2$

$\Rightarrow \ell_2 > 10$ (equality cannot hold)

40. AB

Sol. (Put $x = y + \frac{1}{2}$)

41. AB

Sol. $\left(\frac{1}{x-1}+1\right) - \left(\frac{4}{x-4}+1\right) - \left(\frac{5}{x-5}+1\right) + \left(\frac{8}{x-8}+1\right) = \frac{6x^2 - 27x}{40}$

$\Rightarrow x = 0$

Also $\frac{2x-9}{(x-1)(x-8)} - \frac{2x-9}{(x-4)(x-5)} = \frac{3}{40}(2x-9)$

And x=9

42. ABD

Sol. Condition is satisfied for (a, b+c-2a)

$\Rightarrow b + c = 2003$

43. AD

Sol. Let

x: Total No of ways of selecting even number of red balls
even number of red balls
y: Total No of ways of selecting
odd numbers of red balls
(2-1)(4-1)(6-1)(8-1)(10-1)=x-y (2+1)(4+1)(6+1)(8+1)(10+1)=x+y

44. D

45. A

46. C

Sol. **(for Q. 44 to 46)**

(I) $\left(2+\frac{1}{2}+\frac{1}{2^3}+.......\right)+\left(\frac{1}{2^2}+\frac{1}{2^4}+....\right)$

(II) $f(t)=f^{-1}(t)$ $(t=\sin x)$
(t=1)

(III) $x=2n\pi+\frac{\pi}{4}$

(IV) $\alpha+\beta=a-1+\frac{4}{a-1}+1\geq 5$

(i) $\sum_{n=0}^{\infty}\tan^{-1}\sqrt{n+2}-\tan^{-1}\sqrt{n}$

(ii) $a^2+b^2+c^2<2(ab+bc+ca)$

(iii) $(ab+bc+ca)(a-b)=0$

$\Rightarrow ab+bc+ca=0$

(iv) $P^2+Q^2+R^2+S^2=1$

47. D

48. A

49. C

Sol. **(for Q. 47 to 49)**

(I) $|x|+|2y|=2$ and points are $\left(\pm\frac{2}{5},\pm\frac{4}{5}\right)$

(II) $(x-3)^2+(y-4)^2=4$ required minimum and maximum slopes of target from origin

(III) $3[(x-1)^2+(y-2)^2+10]$

(IV) Points are on

$|Z|=\frac{2}{\sqrt{3}}$

$AP^2+BP^2+CP^2=3|Z|^2+|Z_1|^2+|Z_2|^2+|Z_3|^2$

$-Z(\bar{Z}_1+\bar{Z}_2+\bar{Z}_3)-Z(Z_1+Z_2+Z_3)$

$=1+3\times\frac{4}{3}=5$

(i) Minimum distance

$\sqrt{4+(\tan\alpha-\cot\alpha)^2}-\sqrt{3}=2-\sqrt{3}$

(ii) $n_2=1-\frac{1}{1+n_1}$

(0 ,0) and (-2, 2)

(iii) $T_n\frac{\sqrt{n^2+(n-1)^2}-\sqrt{n^2-(n-1)^2}}{4}$

(iv) $(x+y-5)(3x+2y)(3x-2y)=0$

SECTION – C

50. 8

Sol. E_1: Dot removed from odd face.

$P(E_1)=\frac{9}{21}$

E_2: Dot removed from even face.

$P(E_2) = \frac{12}{21}$ E: Die shows odd numbers of dots.

$P(E) = P(E \cap E_1) + P(E \cap E_2) = \frac{11}{21}$

51. 9

Sol. $\left|Z(a+bi) - Z\right| = \left|(a+bi)Z\right|$

$\Rightarrow a = \frac{1}{2}$

$a^2 + b^2 = 64$

52. 2

Sol. $\begin{bmatrix} 1 & 2n & na+8\sum_{k=0}^{n-1} k \\ 0 & 1 & 4n \\ 0 & 0 & 1 \end{bmatrix}$

53. 9

Sol. A.M.=G.M.

$\frac{r_1}{2} = \frac{r_2}{4} = \frac{r_3}{5} = \frac{r_4}{8} = k$

54. 8

Sol. $t_1 + t_2 = 2$

$\frac{2-m_2}{1+2m_2} = \sqrt{3}$

and $\frac{m_3-2}{1+2m_3} = \sqrt{3}$

$t_1 + t_2 + t_3 = \frac{p}{q} = \frac{3}{11}$