HINTS & SOLUTIONS

PART-A : PHYSICS

1. For the given .....

Sol. The output D for the given combination

$D = \overline{(A+B).C} = \overline{(A+B)} + \overline{C}$

If A = B = C = 0 then $D = \overline{(0+0)} + \overline{0} = \overline{0} + \overline{0}$

= 1 + 1 = 1

If A = B = 1, C = 0 then $D = \overline{(1+1)} + \overline{0} = \overline{1} + \overline{0}$

= 0 + 1 = 1

2. A particle .....

Sol. $V = \omega\sqrt{A^2 - \left(\frac{A}{3}\right)^2}$

$V = \omega\sqrt{\frac{8A^2}{9}} = \frac{2\sqrt{2}}{3} A\omega.$

$V_{new} = 2V = \frac{4\sqrt{2}}{3} (A)\omega$

So the new amplitude is given by

$V_{new} = \omega\sqrt{(A_{new})^2 - x^2}$

$\frac{4\sqrt{2}}{3}A\omega = \omega\sqrt{(A_{new})^2 - \left(\frac{A}{3}\right)^2}$

$\frac{32}{9}A^2 = (A_{new})^2 - \frac{A^2}{9}$

$A_{new}^2 = \frac{33A^2}{9}$ $A_{new} = \frac{\sqrt{33}A}{3}$

3. A disc of mass .....

Sol. Torque = $I\alpha$ about the point of contact.

$Kx(R) = (\frac{MR^2}{2} + MR^2)\alpha$, $x = R\theta$

4. A uniform rope .....

Sol. $v = \sqrt{xg}$

$\frac{dx}{dt} = \sqrt{xg} \Rightarrow \int_0^{10} \frac{dx}{\sqrt{x}} = \sqrt{g}\int_0^t dt$

$\Rightarrow$ t = 2sec.

5. In the system .....

Sol. 4a = 4g – T

4a = T

T = 20 N

a = 5

$50 = \frac{n}{2\times 0.6}\sqrt{\frac{20}{\frac{1}{20}}}$

n = 3

$0.2 = \frac{1}{2}5t^2$

$t = \sqrt{0.08}$

$t_1 = 0$ $t_2 = \sqrt{0.08}$ $t_3 = \sqrt{0.16}$

$\Delta t_1 = \sqrt{0.08}$ $\Delta t_2 = \sqrt{0.16} - \sqrt{0.08}$

$\frac{\Delta t_1}{\Delta t_2} = \frac{1}{\sqrt{2}-1}$

6. Initially two .....

Sol. $f = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}}$

$\ell nf = -\ell n2\ell + \frac{1}{2}\ell nT - \frac{1}{2}\ell n\mu$

$\frac{\Delta f}{f} = \frac{1}{2}\frac{\Delta T}{T}$

$\Rightarrow \frac{6}{f} = \frac{1}{2}\frac{2}{100} \Rightarrow$ f = 600 Hz.

7. Two sources .....

Sol. Apparent frequency of S_1 and S_2 heard by observer is

$f_1 = \frac{v}{v-u}f$ and $f_2 = \frac{v}{v+u}f$

$\therefore$ Beat = $f_1 - f_2 = \frac{2uv}{v^2-u^2}f$

8. Two light waves .....

Sol.

$I \propto E^2$

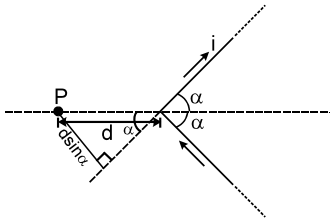
$\therefore \frac{I_1}{I_2} = \frac{2^2}{3^2} = 4/9$

9. In the circuit .....

Sol. $I = \frac{8-0.5}{2.2\times10^3} = \frac{7.5}{2.2}$ mA = 3.4 mA

10. If the magnetic .....

Sol. Let us compute the magnetic field due to any one segment :



$$B = \frac{\mu_0 i}{4\pi(d\sin\alpha)}(\cos0^0 + \cos(180-\alpha))$$

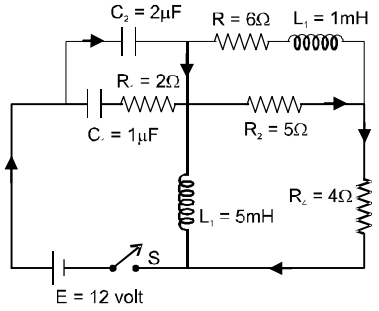
$$= \frac{\mu_0 i}{4\pi(d\sin\alpha)}(1-\cos\alpha) = \frac{\mu_0 i}{4\pi d}\tan\frac{\alpha}{2}$$

Resultant field will be :

$$B_{net} = 2B = \frac{\mu_0 i}{2\pi d}\tan\frac{\alpha}{2} \Rightarrow k = \frac{\mu_0 i}{2\pi d}$$

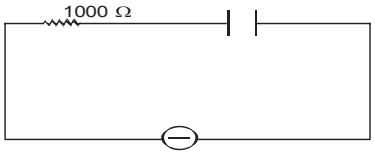
11. Find current .....

Sol.



12. A 50 Hz ac source .....

Sol.



$$V_C = 5V$$

$$V_R = 2V$$

$$I_{Rms} = \frac{V_R}{R} = \frac{2}{1000}\text{Amp}$$

= 2mA

$$I_{Rms}\times X_C = V_C$$

$$2mA\times X_C = 5$$

$$X_C = \frac{5000}{2} = 2500\Omega$$

$$\frac{1}{2\pi fc} = 2500$$

$$C = \frac{10^6}{2\pi\times50\times2500}\mu F$$

$$\frac{40}{10\pi} = \frac{4}{\pi} = 1.27\mu F$$

$$V_{max} = i_0 Z$$

$$= 2\sqrt{2}\times10^{-3}\sqrt{1000^2+2500^2}$$

$$= 2\sqrt{2}\times\sqrt{1+6.25} = 7.62V$$

13. In an atom .....

Sol. $T = \frac{2\pi R}{V}$

But $R \propto n^2$

& $V \propto \frac{1}{n}$

So $V \propto \frac{1}{\sqrt{R}}$

So $T \propto R^{3/2}$

$$\frac{T_1}{T_2} = \left(\frac{R}{4R}\right)^{3/2} = \frac{1}{8}$$

14. Two radioactive .....

Sol. $N_A = N_0 e^{-5\lambda t}$

$N_B = N_0\, e^{-\lambda t}$

15. A large open .....

Sol. $-A\frac{dy}{dt} = a\sqrt{2gy}$

$$\frac{2A}{a\sqrt{2g}}\left(\sqrt{H}-\sqrt{\frac{H}{n}}\right) = T_1$$

$$\frac{2A}{a\sqrt{2g}}\left(\sqrt{\frac{H}{n}}-0\right) = T_2$$

$T_1 = T_2$

n = 4.

16. Surface tension .....

Sol. $P_0 - \frac{2S}{R_1} + \rho gh - \frac{2S}{R_2} = P_0$

$$\Rightarrow \frac{2S}{R_1} + \frac{2S}{R_2} = \rho gh$$

17. In determination .....

Sol. (A) $\Delta\ell = \frac{F\ell}{AY}\frac{\Delta\ell}{(F/A)} = \frac{\ell}{Y}$ = slope of curve

$$\frac{\ell}{Y} = \frac{(4-2)\times10^{-3}}{4000\times10^{3}}$$

Given $\ell = 1m \rightarrow$

$$Y = \frac{4000\times10^{3}}{2\times10^{-3}} = 2\times10^{9}\ N/m^2$$

18. Two moles .....

Sol. $V_{rms} = \sqrt{\frac{3RT}{M_{mix.}}}$

$$V_{sound} = \sqrt{\frac{\gamma RT}{M_{mix.}}}$$

$v_{rms} = \sqrt{2}\ V_{sound}$

$$\sqrt{\frac{3RT}{M_{mix.}}} = \sqrt{2}\sqrt{\frac{\gamma RT}{M_{mix}}}$$

$$r = \frac{3}{2}$$

$$r_{mix} = \frac{n_1C_{P_1} + n_2C_{P_2}}{n_1C_{v_1} + n_2C_{v_2}}$$

$$\frac{3}{2} = \frac{2\times\frac{7R}{2} + n\times\frac{5R}{2}}{2\times\frac{5R}{2} + n\times\frac{3R}{2}}$$

$$\Rightarrow \frac{3}{2} = \frac{14+5n}{10+3n} \Rightarrow 30 + 9n = 28 + 10n \Rightarrow n = 2$$

19. Two uniform .....

Sol. $\lambda_1T_1 = \lambda_2T_2$

$$\frac{T_1}{T_2} = \frac{\lambda_2}{\lambda_1} = 2$$

Rate of heat loss $\dot{Q} = 4\pi r^2\sigma eT^4$

$$\frac{\dot{Q}_1}{\dot{Q}_2} = \left(\frac{r_1}{r_2}\right)^2\left(\frac{T_1}{T_2}\right)^4 = 4$$

$$\dot{Q} = -ms\frac{d\theta}{dt} = -\frac{4}{3}\pi r^3\rho s\frac{d\theta}{dt}$$

$$\frac{\left(\frac{d\theta}{dt}\right)_1}{\left(\frac{d\theta}{dt}\right)_2} = \left(\frac{\dot{Q}_1}{\dot{Q}_2}\right)\left(\frac{r_2}{r_1}\right)^3 = 32$$

20. A semi circular .....

Sol. $Mg\left(R + \frac{4R}{3\pi}\right) = \frac{1}{2}\left[\frac{3}{2}MR^2\right]\omega^2$

$$\omega = \sqrt{\frac{4g}{3R}\left(1+\frac{4}{3\pi}\right)}$$

21. A plank P is .....

Sol. Let velocity of c.m. of sphere be v. The velocity of the plank = 2v.

Kinetic energy of plank = $\frac{1}{2}\times m\times(2v)^2 = 2mv^2$

Kinetic energy of cylinder = $\frac{1}{2}mv^2 + \frac{1}{2}\times\left(\frac{1}{2}mR^2\omega^2\right)$

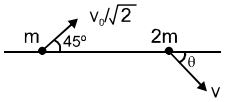
$$= \frac{1}{2}mv^2\left(1+\frac{1}{2}\right) = \frac{3}{2}.\frac{1}{2}mv^2$$

$$\therefore \frac{\text{K.E. of plank}}{\text{K.E. of sphere}} = \frac{2mv^2}{\frac{3}{4}mv^2} = \frac{8}{3}.$$

22. A particle of .....

Sol. Befor collision

After collision



[By momentum conservation in both direction]

$mv_0 = 2mv\cos\theta + \frac{mv_0}{2}$ .....(i)

$0 = \frac{mv_0}{2} - 2mv\sin\theta$ .....(ii)

By (i) & (ii),

$\tan\theta = 45°$

Now again momentum conservation in y–direction

$$\frac{mv_0}{2} = 2mv.\frac{1}{\sqrt{2}} \Rightarrow v = \frac{v_0}{2\sqrt{2}}.$$

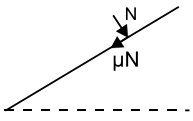
23. A pump is .....

Sol. $P = \frac{mgh + \frac{1}{2}mv^2}{t}$ = 4000 watt

= 5.36 HP

24. A block of .....

Sol. Resultant force $= N\sqrt{1+\mu^2} = mg\cos\theta\sqrt{1+\mu^2}$



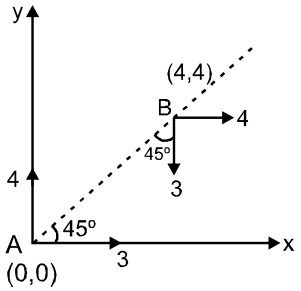
25. A perfect smooth .....

Sol. $N\cos30° = g\,m_A\sin30° + m_B\,g\sin30°$

$N = 20\sqrt{3}$ N

26. At an instant .....

Sol.



$v_{BA} = v_B - v_A$

$= [4\hat{i} - 3\hat{j}] - [3\hat{i} + 4\hat{j}] = \hat{i} - 7\hat{j}$

$v_{app} = 4\cos45° + 3\cos45° + 3\cos45° - 4\cos45°$

$= 6\cos45°$

$= 3\sqrt{2}$ m/s

27. A point charge .....

Sol. Flux due to +q is $\phi_1 = \dfrac{q}{6\varepsilon_0}$

Flux due to –q is also in same direction because it is kept below the square.

$\phi_2 = \dfrac{q}{24\varepsilon_0}$

$\phi = \phi_1 + \phi_2 = \dfrac{5q}{24\varepsilon_0}$

28. Three identical .....

Sol. The net charge on middle plate is zero and is placed in uniform electric field. Hence net force on middle plate is zero.

29. In the given .....

Sol. Current in the circuit is given by

$i = \dfrac{\varepsilon}{7+x}$

Power generated in 5Ω,

$= \left(\dfrac{\varepsilon}{7+x}\right)^2 \times 5 = 5\left(\dfrac{\varepsilon}{7+x}\right)^2$

Power will be max when 7 + x is minimum
i.e., for x = 0

30. A beam of .....

Sol. $f_m = -R/2$

$f_\ell = 40$ m

$\dfrac{1}{F} = \dfrac{1}{f_m} - \dfrac{2}{f_\ell}$

$-\dfrac{1}{7.5} = -\dfrac{2}{R} - \dfrac{2}{40}$

$\dfrac{2}{R} = -\dfrac{2}{40} + \dfrac{10}{75}$

$= -\dfrac{1}{20} + \dfrac{2}{15} = -\dfrac{15+40}{20\times15}$

$\dfrac{2}{R} = \dfrac{255}{3\times15}$

R = 24 cm.

PART-B : CHEMISTRY

31. The correct statement .....

Sol. Facts

32. If urea is added in .....

Sol. Non volatile solute is added in the solution therefore.
V.P.↓, RLVP↑, T_f↓, ΔT_f ↑, T_b↑, ΔT_b↑, π ↑

33. In a compound XY.....

Sol. Radius ratio = $\dfrac{90}{200}$ = 0.45

Radius ratio lies between 0.414 and 0.732 and represent octahedral void.
Y^- is larger than X^+ so Y^- will form FCC and X^+ will occupy voids .
So co-ordination no of X^+ = 6

34. Calculate the temperature.....

Sol. $\Delta G = \Delta H - T\Delta S$
0 = +131.3 – T(+0.1336)
(for spontaneity)

$T > \dfrac{131.3}{0.1336}$ = 982.8 K

t°C > 982.8 – 273 = 709.8°C

35. When borax is .....

Sol. $[B_4O_5(OH)_4]^{2-} + 5H_2O \rightleftharpoons 2B(OH)_3 + 2[B(OH)4]^-$

36. A 1.5 m solution .....

Sol. Let mass of solvent in 1.5 m solution = m_1 Kg and let mass of solvent in 3 m solution = m_2 Kg.

Therefore molality of resulting solution = $\dfrac{1.5m_1 + 3m_2}{m_1 + m_2}$ = 2.

$\therefore \dfrac{m_1}{m_2} = \dfrac{2}{1}$

Therefore required ratio = $\dfrac{109}{59}$.

37. The value of K_p for .....

Sol.

	CO_2 (g) + C(s) $\rightleftharpoons$ 2 CO(g)		
t = 0		0.48	—
t = equi^m	0.48 - x	—	2x

$K_P = \dfrac{(2x)^2}{(0.48-x)} = 3$

x = 0.33 bar

38. When freshly .....

Sol. Theory based

39. Which of the following .....

Sol. Refer theory.

40. How many of the .....

Sol. (i) Planar molecules : XeF_2, ClF_3, H_2O, $[XeF_5]^-$, I_3^-, BCl_3, XeF_4.

(ii) SF_4 – See - Saw shape

PCl_5 – Trigonal bipyramidal

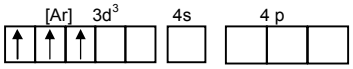
SF_6 – Square bipyramidal

IF_7 – Pentagonal bipyramidal

41. Amongst the .....

Sol. (1) $[Cr(H_2O)_6]^{3+}$

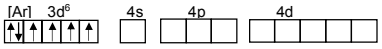
Cr^{+3} [Ar] $3d^3$ 4s 4 p



unpaired electrons = 3

(2) $[Fe(H_2O)_6]^{2+}$

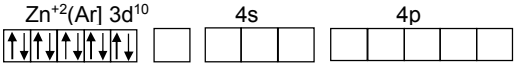
Fe^{+2} [Ar] $3d^6$ 4s 4p 4d



unpaired electrons = 4

(3) $[Zn(H_2O)_6]^{2+}$

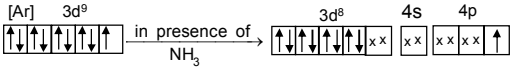
Zn^{+2}(Ar] $3d^{10}$ 4s 4p



unpaired electron = 0

(4) $[Cu(NH_3)_4]^{2+}$

[Ar] $3d^9$ $\xrightarrow[NH_3]{\text{in presence of}}$ $3d^8$ 4s 4p



unpaired electron = 1

42. Find the solubility .....

Sol. $As_2S_3 \rightleftharpoons 2As^{3+} + 3S^{2-}$

$2s'$ $3s' + 10^{-2}$

$\approx 10^{-2}$

Now, $[As^{3+}]^2 [S^{2-}]^3 = K_{sp}$

$\therefore (2s')^2 (10^{-2})^3 = \left(\frac{1}{625} \times 10^{-24}\right)$

$\therefore s' = 2 \times 10^{-11}$ mol/L.

43. A gas $\left(C_{v,m} = \frac{5}{2}R\right)$ behaving .....

Sol. $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$

or या $T_2 = 150$ K

$$\Delta H_m = nC_P\Delta T = \frac{7}{2}R(150 - 600) = -1575R$$

44. For 1st order reaction .....

Sol. $C_t = C_0\, e^{-Kt}$

$\ln C_t = \ln C_0 - Kt$

$y = C + mx$

Slope $= -1 \Rightarrow K = 1\ min^{-1}$

Half life = 0.693 min

45. $XeF_6 + H_2O \longrightarrow A + B$.....

Sol. $XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$

46. In the given process .....

Sol. $CaC_2 + N_2 \xrightarrow{\Delta} CaCN_2 + C \xrightarrow{H_2O} CaCO_3 + NH_3$

47. What is the IUPAC .....

Sol . Mercury(II) tetrathiocyanato-S-cobaltate(II)

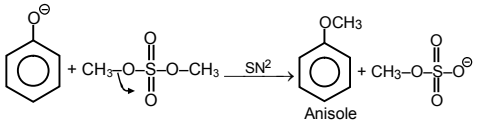
48. In the electrolysis of .....

Sol. At anode the reaction is

$H_2O \rightarrow O_2 + 4H^+ + 4e$

49. Which combination .....

Sol.

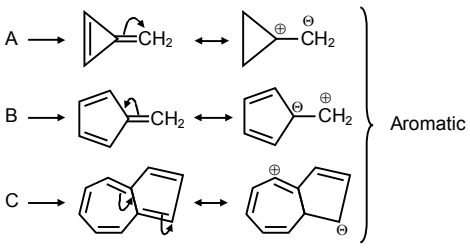


50. Condensation .....

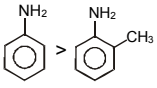
Sol. Dacron is condensation polymer of Glycol and Terphthalic acid.

51. Which of the following .....

Sol.



52. Select the incorrect .....

Sol. Basic-strength :  (due to ortho effect)

53. What is true about .....

Sol. It shows the phenomenon of inversion of sugar in acidic medium.

$C_{12}H_{22}O_{11} \xrightleftharpoons{H_3O^{\oplus}} C_6H_{12}O_6 + C_6H_{12}O_6$

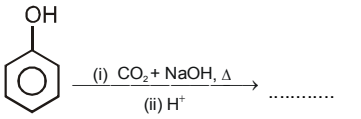
Sucrose Glucose fructose

α = + 66.5° +52.5° –92.7°

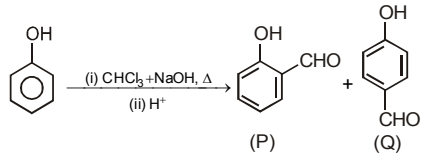
55. $CH_3-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[(2)\ H_2/Pd/BaSO_4]{(1)\ PCl_5}$ .....

Sol. P is $CH_3–CH=O$

Q is $CH_3–CH=CH–CH=O$

56. 

.....

Sol. 

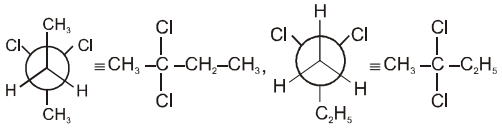
57. The three compounds .....

Sol. $CH_3-CH\equiv C-H \xrightarrow{T.R} CH_3-C\equiv C-Ag$ (white ppt.)

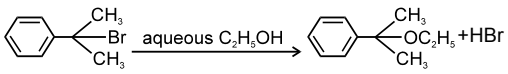
$CH_3–CH=O \xrightarrow{T.R} CH_3COO^{\Theta} + Ag\downarrow$ (silver mirror)

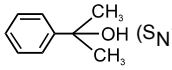
$C_6H_5 - NO_2 \xrightarrow{T.R}$ No reaction

58. In the Newman projection .....

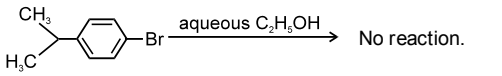
Sol. 

59. After the reaction (if any) .....

Sol. 

(strong acid) + 

(S_N1 product)



No reaction.

Because aryl halide have resonance stabilized C – X bond,

and do not give S_N reaction.

PART-C : MATHEMATICS

61. Number of solutions……..

Sol. $\underset{[-5,5]}{3\sin x + \sin 3x + \sin^2 x} = \underset{[5,\infty]}{5\sec^2 x}$

62. The number of……

Sol. $t = x\tan\theta$

$$\int_o^{\pi/2} \frac{\ell n\, x + \ell n \tan\theta}{x^2 \sec^2\theta} \cdot x\sec^2\theta\, d\theta = \frac{\pi \ell n\, 2}{4}$$

$$\frac{1}{x}\int_o^{\pi/2} \left(\ell n\, x + \ell n \tan\theta\right) d\theta = \frac{\pi \ell n\, 2}{4}$$

$$\frac{\ell n\, x}{x}\frac{\pi}{2} = \frac{\pi \ell n\, 2}{4}$$

$$\frac{\ell n\, x}{x} = \frac{\ell n\, 2}{2}$$

$\Rightarrow$ Two values = x = 2, 4

63. If $H_1, H_2, H_3 \ldots H_{100}$ ……..

Sol. $\frac{1}{a}, \frac{1}{H_1}, \frac{1}{H_2}, \ldots\ldots \frac{1}{H_n}, \frac{1}{b}$ are in AP

$$\frac{1}{H_1} = \frac{1}{a} + d \qquad \frac{1}{H_n} = \frac{1}{b} - d$$

$$H_1 = \frac{a}{1+ad} \qquad H_n = \frac{b}{1-bd}$$

$$\frac{H_1 + a}{H_1 - a} + \frac{H_n + b}{H_n - b}$$

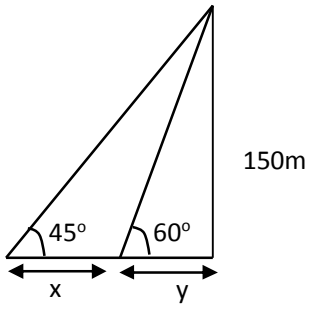
$$= \frac{\frac{a}{1+ad} + a}{\frac{a}{1+ad} - a} + \frac{\frac{b}{1-bd} + b}{\frac{b}{1-bd} - b}$$

$$= \frac{2+ad}{-ad} + \frac{2-bd}{bd}$$

$$= -2 + \frac{2}{d}\left(\frac{1}{b} - \frac{1}{a}\right) = -2 + (n+1)2 = 2n$$

64. A man in a boat……..

Sol. $\frac{x}{v}$ =2



tan 60° = $\frac{150}{y}$

x + y = 150

x + $\frac{150}{\sqrt{3}} = 150$

x = 150 - 50 $\sqrt{3}$

x = 50 (3 - $\sqrt{3}$)

Velocity = $\frac{25\left(3-\sqrt{3}\right)60}{1000}$ km/h

= $\frac{3}{2}\left(3-\sqrt{3}\right)$ = $\frac{9-3\sqrt{3}}{2}$

65. Value of ……..

Sol. $\lim_{x\to 0}\frac{x^{600}-(\sin x)^{600}}{x^2\left(\frac{\sin x}{x}\right)^{600}x^{600}}$

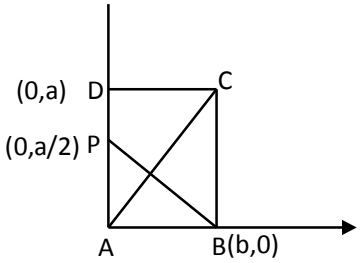
$\lim_{x\to 0}\frac{x^{600}-\left(x-\frac{x^3}{6}....\right)^{600}}{x^{602}}$

$\lim_{x\to 0}\frac{x^{600}-x^{600}\left\{{}^{600}C_0+{}^{600}C_1\left(-\frac{x^2}{6}+...\right)\right\}}{x^{602}}$

= 100

66. Let P is the midpoint……..

Sol. Slope of AC = $\sqrt{2} = \frac{a}{b}$



$m_{BP} = \frac{\frac{a}{2}-0}{-b} = \frac{-a}{2b} = \frac{-1}{\sqrt{2}}$

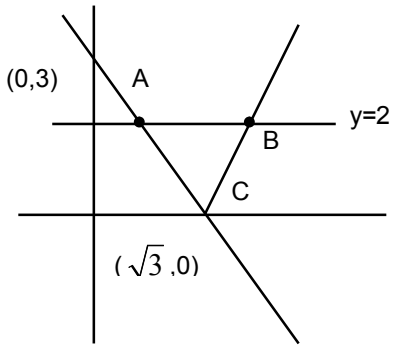
67. Let orthocenter……..

Sol. A: $\left(\frac{1}{\sqrt{3}},2\right)$

B: $\left(\frac{5}{\sqrt{3}},2\right)$

C: $\left(\sqrt{3},0\right)$

H: $\left(\sqrt{3},\frac{4}{3}\right)$



68. If p(x) is a polynomial……..

Sol. $p(x) = 2x^2 + ax^3 + bx^4$

$p'(x) = 4x + 3ax^2 + 4bx^3$

4 + 3a + 4b = 0

8 + 12a + 32b = 0

2 + 3a + 8b = 0

–2 + 4b = 0

69. Let $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ ……..

Sol. $|\vec{c}-\vec{a}|^2 = (\vec{c}-\vec{a}).(\vec{c}-\vec{a}) = (2\sqrt{2})^2$

$\vec{c}^2+\vec{a}^2-2\vec{c}.\vec{a}=8$

$\vec{c}^2-2|\vec{c}|.+a^2=8$

$\vec{c}^2-2|\vec{c}|+1=0$

$(\vec{c}-1)^2=0 \quad \Rightarrow \quad |\vec{c}|=1$

$|(\vec{a}\times\vec{b})\times\vec{c}|=|\vec{a}\times\vec{b}||\vec{c}|\sin 30^o$

$=\frac{1}{2}(\vec{a}\times\vec{b})$

$$\vec{a}\times\vec{b}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & 1 & -2\\ 1 & 1 & 0\end{vmatrix}=2\hat{i}-2\hat{j}+\hat{k}$$

$|(\vec{a}\times\vec{b})|=3$

$|(\vec{a}\times\vec{b})\times\vec{c}|=\frac{3}{2}$

70. Let $f(x)=\begin{cases}\sin\left(\frac{\pi}{4}\{x\}\right)\\ \cos\left(\frac{\pi}{4}\{1-x+[x]\}\right)\end{cases}$ .....

Sol. $$f(x)=\begin{cases}\sin\left(\frac{\pi}{4}\{x\}\right) & 2n-1\le x<2n\\ \cos\left(\frac{\pi}{4}(1-\{x\})\right) & 2n\le x<2n+1\end{cases}$$

$f(2n)=\frac{1}{\sqrt{2}}$ $\qquad$ $f(2n-1)=0$

$f(2n^+)=\frac{1}{\sqrt{2}}$ $\qquad$ $f((2n-1)^+)=0$

$f(2n^-)=\frac{1}{\sqrt{2}}$ $\qquad$ $f((2n-1)^-)=1$

71. Let A, B, C are angles.....

Sol. cotA cotB + cotB cotC + cotA cotC = 1

2 cotB = cotA + cotC

cotB (2 cotB) + cotA cotC = 1

$\frac{\text{cotA}+\text{cotC}}{2}\ge\sqrt{\text{cotAcotC}}$

$\text{cotB}\ge\sqrt{1-2\text{cot}^2B}$

$3\text{cot}^2\text{B}\ge 1$

$\cot B\ge\frac{1}{\sqrt{3}}$

72. If standard deviation.....

Sol. $S.D=\sqrt{\frac{\Sigma\left(x_i-\bar{x}\right)^2}{n}}$

$\Rightarrow\sqrt{\frac{\Sigma\left(x_i-y_i-\bar{x}+\bar{y}\right)^2}{n}}$

$\Rightarrow\sqrt{\frac{\Sigma\left(x_i-\bar{x}\right)^2+\Sigma\left(y_i-\bar{y}\right)^2-2\Sigma\left(x_i-\bar{x}\right)\left(y_i-\bar{y}\right)}{n}}$

$=\sqrt{9+16-2\frac{\Sigma\left(x_i-\bar{x}\right)\left(y_i-\bar{y}\right)}{n}}$

73. Let P, Q, R be.....

Sol. ABC=3I

BCA=3I

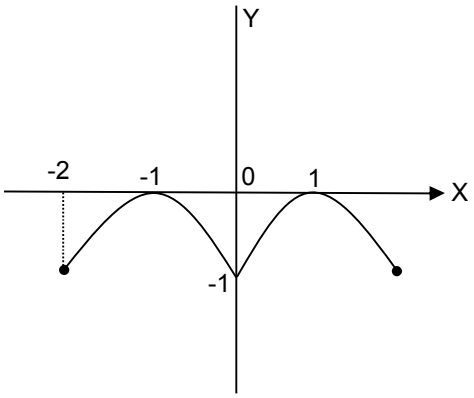
CAB=3I

$\Rightarrow\det(ABC+BCA+CAB)$

$\Rightarrow\det(9\text{I})=729$

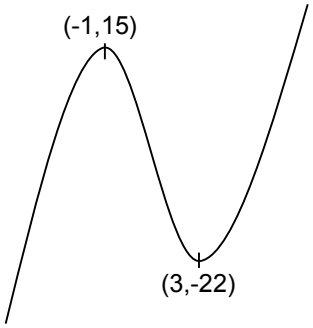
74. Let $f(x)=\begin{cases}(x+1)^3 & -2<x\le -1\\ x^{\frac{2}{3}}-1 & -1<x\le 1\\ -(x-1)^2 & 1<x<2\end{cases}$ .....

Sol.



75. Let f(x) is a cubic……..

Sol. As x = 1 is point of inflection of curve so x = –1 and x = 3 and point of local maximum and local minimum hence



Distance = 37

76. Let (α, β) and……..

Sol. Equation of normal y = mx – 4m- $2m^3$

12 = 18 m – 4 m – $2m^3$

$m^3 - 7m + 6 = 0$

m = 1, – 3, 2

Point of parabola ($2m^2$, – 4m)

$(\alpha,\beta), (\gamma,\delta) = (2,-4) \& (8,-8)$

77. If α, β, γ are roots……..

Sol. –C = $(\alpha+\beta)(\beta+\gamma)(\gamma+\alpha)$

$= (\alpha\beta + \alpha\gamma + \beta^2 + \beta\gamma)(\gamma+\alpha)$

$= \alpha^2\beta + \alpha\beta^2 + \beta^2\gamma + \beta\gamma^2 + \alpha\gamma^2 + \alpha^2\gamma + 2\alpha\beta\gamma$

$= \alpha\beta(\alpha+\beta+\gamma) + \beta\gamma(\alpha+\beta+\gamma) + \alpha\gamma(\alpha+\gamma)$

$= -3\alpha\beta - 3\beta\gamma + \alpha\gamma\ (-3-\beta)$

$= -3(4) - \alpha\beta\gamma$

= –12 – 11

C = 23

78. If $\int_{\alpha}^{\beta} |\sin x|\, dx = 8$ .....

Sol. $\left.\begin{aligned}\beta-\alpha &= 4\pi\\ \beta+\alpha &= \frac{9\pi}{2}\end{aligned}\right\} \begin{aligned}\alpha &= \frac{\pi}{4}\\ \beta &= \frac{17\pi}{4}\end{aligned}$

$$I = \int_{-\pi}^{17\pi} \frac{x\cos^3 x\,dx}{1+\sin^4 x} \Rightarrow I = \int_{-\pi}^{17\pi} \frac{(16\pi - x)\cos^3 x\,dx}{1+\sin^4 x}$$

$$2I = \int_{-\pi}^{17\pi} \frac{16\pi.\cos^3 x\,dx}{1+\sin^4 x} = 16\pi.9\int_0^{2\pi} \frac{\cos^3 x\,dx}{1+\sin^4 x}$$

$$= 144\pi 2\int_0^{\pi} \frac{\cos^3 x\,dx}{1+\sin^4 x} = 0$$

79. Two squares are……..

Sol. n(S) = $^{64}C_2$ = 63 x 32

n(E) = 7 x 7 x 2 ={number of ways of choosing 2 x 2 square}x 2

p(E) = $\frac{7\times7\times2}{63\times32} = \frac{7}{144}$

80. Let |z| = 2 and……..

Sol. $Z = 2e^{j\theta}$

w = $2e^{i\theta} + \frac{1}{2e^{i\theta}}$

= $2e^{i\theta} + \frac{1}{2}\left(e^{-i\theta}\right)$

= $\frac{5}{2}\cos\theta + i\frac{3}{2}\sin\theta$

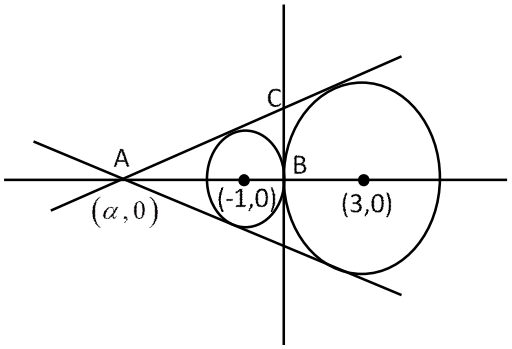
w represent an ellipse then area of region = $\pi.a.b$

= $\pi.\frac{5}{2}.\frac{3}{2}$

= $\frac{15\pi}{4}$

81. Area of Δ formed……..

Sol. $(\alpha,0) \equiv \left(\frac{-1.3-3.1}{3-1}, 0\right)$



$\alpha = (-3,0)$

$\angle CAB = 30^\circ$

tan 30° = $\frac{CB}{3} \Rightarrow CB = \sqrt{3}$

area = $\frac{1}{2}2\sqrt{3}\times3 = 3\sqrt{3}$

82. Perpendicular is……..

Sol. drs of line = $\begin{vmatrix} i & j & k \\ 1 & 2 & 3 \\ 2 & 3 & 4 \end{vmatrix}$ = –i + 2j – k

Point on the line (1, –1, –1)

Equation of line $\frac{x-1}{1}=\frac{y+1}{-2}=\frac{z+1}{1}=\lambda$

$(\lambda+1,-2\lambda-1,\lambda-1)$

λ - 1 + 4 λ +2+ λ -1 = 0

6 λ = -2

$\lambda = \frac{-1}{3}$

83. The converse……..

Sol. Converse of p → q is q → p

(q →r) → p

$(q \vee r) \to p$

$= (\sim q \vee r) \to p$

$= (q \wedge \sim r)^{\vee} p$

84. Let $[a_{ij}]$ is a……..

Sol. for A^{-1} exists $|A| \neq 0$

Case – I : Exactly one element is zero

$^5C_3 \times \lfloor\underline{4} = 240$

Case – II : No element is zero

$A = \begin{vmatrix} a & b \\ c & d \end{vmatrix}$

|A| = ad – bc = 0 ad = bc = 6 $\boxed{8}$

ad = bc = 12 $\boxed{8}$

$\Rightarrow {}^5C_4 \times \lfloor\underline{4}$ - 16 = 120 – 16

= 104

Total = 344

85. Let y=f(x) satisfies……..

Sol. If = $e^{\int 2\tan x dx} = e^{2\ell n(\sec x)}$

If = $\sec^2 x$

y . $\sec^2 x = \int \sin x.\sec^2 x\, dx$

y $\sec^2 x$ = sec x + C

C = –2

$\sec^2 x.y$ = sec x -2

$\Rightarrow \int_0^{20\pi} (\cos x - 2\cos^2 x)dx = -2\int_0^{20\pi} \cos^2 x dx$

$= -2.\ 20\int_0^{\pi} \cos^2 x dx$

$= -80\int_0^{\pi/2} \cos^2 x dx = -20\pi$

86. The coefficient……

$(1+x^2)^{25}(1+x^{25})$ ……..

Sol. G.T. of $(1+x^2)^{25} = {}^{25}C_r\, x^{2r}$

Coefficient of x^{50} in $(1+x^2)^{25}(1+x^{25}+x^{40}+x^{45}+x^{50})$

Coefficient of $x^{50} = {}^{25}C^{25} + {}^{25}C_5 + 1$

$= 1 + {}^{25}C_5 + 1$

87. Number of real……..

Sol. $C_2 \to C_2 - C_1$

$C_3 \to C_3 - C_1$ $C_3 \to C_3 - 2C_2$

$$\begin{vmatrix} x^2 & 2x+1 & 4x+4 \\ 4x^2 & 4x+1 & 8x+4 \\ 9x^2 & 6x+1 & 12x+4 \end{vmatrix} = \begin{vmatrix} x^2 & 2x+1 & 2 \\ 4x^2 & 4x+1 & 2 \\ 9x^2 & 6x+1 & 2 \end{vmatrix}$$

$R_1 \to R_1 - R_2$

$R_2 \to R_2 - R_3$

$$\begin{vmatrix} -3x^2 & -2x & 0 \\ -5x^2 & -2x & 0 \\ 9x^2 & 6x+1 & 2 \end{vmatrix} = 2\left(6x^3 - 10x^3\right)$$

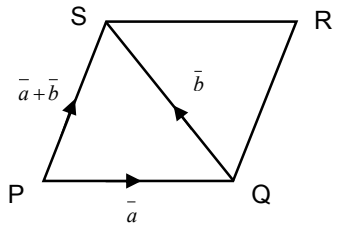
$= -8x^3 = 2x + 6$

$= 4x^3 + x + 3 = 0$ one real root

88. Let PQRS is a……

Sol. $\overrightarrow{QR} = \bar{a} + \bar{b} = 3i + 4j + 5k = \overrightarrow{PS}$

$\overrightarrow{PR} = 2\bar{a} + \bar{b} = 4i + 5j + 6k$



$$\overrightarrow{PQ} \times (i + j - k) = \begin{vmatrix} i & j & k \\ 1 & 1 & 1 \\ 1 & 1 & -1 \end{vmatrix} = -2i + 2j$$

Volume = $\begin{vmatrix} 3 & 4 & 5 \\ 4 & 5 & 6 \\ -2 & 2 & 0 \end{vmatrix} = |5(18) - 6(6+8)| = |90 - 84| = 6$

89. If $y = \alpha x + \beta$ is……

Sol. $y = mx - 2m^2$

$y = \alpha x - \beta$

$m = \alpha,\ -2m^2 = \beta$

$\beta = -2\alpha^2$

$\Rightarrow x^2 = \dfrac{-y}{2}$

90. The sum of……

$\sin^8 x + \cos^8 x$ ……

Sol. $\sin^8 x + \cos^8 x \le \cos^2 x + \sin^2 x$

$\Rightarrow$ Max value = 1

$$\frac{\sin^8 x + \cos^8 x}{2} \ge \sqrt{\sin^8 x \times \cos^8 x}$$

$$\sin^8 x + \cos^8 x \ge 2\sin^2 x \cos^4 x = \frac{1}{8}\sin^2 2x$$

MAIN MAJOR TEST (MMT)

(JEE MAIN PATTERN)

TARGET : JEE (MAIN + ADVANCED) 2019

DATE : 30-12-2018 **COURSE : VIJAY (JR) & AJAY (05ER), AWASAR (ECC)**

ANSWER KEY

SET-1

PART-A (PHYSICS)

1.	(4)	**2.**	(3)	**3.**	(3)	**4.**	(4)	**5.**	(3)	**6.**	(1)	**7.**	(3)
8.	(2)	**9.**	(1)	**10.**	(2)	**11.**	(1)	**12.**	(3)	**13.**	(3)	**14.**	(2)
15.	(3)	**16.**	(4)	**17.**	(1)	**18.**	(2)	**19.**	(2)	**20.**	(1)	**21.**	(3)
22.	(2)	**23.**	(3)	**24.**	(2)	**25.**	(4)	**26.**	(4)	**27.**	(4)	**28.**	(4)
29.	(4)	**30.**	(2)										

PART-B (CHEMISTRY)

31.	(4)	**32.**	(4)	**33.**	(2)	**34.**	(2)	**35.**	(3)	**36.**	(2)	**37.**	(2)
38.	(3)	**39.**	(1)	**40.**	(1)	**41.**	(2)	**42.**	(2)	**43.**	(3)	**44.**	(2)
45.	(4)	**46.**	(4)	**47.**	(1)	**48.**	(2)	**49.**	(3)	**50.**	(4)	**51.**	(4)
52.	(4)	**53.**	(3)	**54.**	(3)	**55.**	(2)	**56.**	(2)	**57.**	(1)	**58.**	(3)
59.	(1)	**60.**	(3)										

PART-C (MATHEMATICS)

61.	(4)	**62.**	(2)	**63.**	(3)	**64.**	(1)	**65.**	(2)	**66.**	(4)	**67.**	(2)
68.	(1)	**69.**	(2)	**70.**	(2)	**71.**	(3)	**72.**	(4)	**73.**	(4)	**74.**	(2)
75.	(1)	**76.**	(1)	**77.**	(3)	**78.**	(4)	**79.**	(3)	**80.**	(4)	**81.**	(3)
82.	(3)	**83.**	(1)	**84.**	(4)	**85.**	(1)	**86.**	(2)	**87.**	(2)	**88.**	(3)
89.	(4)	**90.**	(1)										