All India Aakash Test Series for JEE (Main)-2020

TEST - 1 - Code-E

Test Date : 06/10/2019

ANSWERS

PHYSICS		CHEMISTRY		MATHEMATICS	
1.	(3)	26.	(4)	51.	(2)
2.	(4)	27.	(2)	52.	(4)
3.	(4)	28.	(4)	53.	(1)
4.	(1)	29.	(2)	54.	(3)
5.	(1)	30.	(4)	55.	(2)
6.	(4)	31.	(1)	56.	(4)
7.	(2)	32.	(4)	57.	(2)
8.	(3)	33.	(2)	58.	(1)
9.	(4)	34.	(3)	59.	(3)
10.	(2)	35.	(4)	60.	(4)
11.	(4)	36.	(1)	61.	(4)
12.	(1)	37.	(2)	62.	(1)
13.	(2)	38.	(4)	63.	(1)
14.	(3)	39.	(2)	64.	(1)
15.	(1)	40.	(3)	65.	(2)
16.	(4)	41.	(4)	66.	(4)
17.	(3)	42.	(4)	67.	(1)
18.	(4)	43.	(3)	68.	(2)
19.	(4)	44.	(1)	69.	(2)
20.	(1)	45.	(3)	70.	(3)
21.	(10)	46.	(20)	71.	(01)
22.	(14)	47.	(68)	72.	(15)
23.	(20)	48.	(50)	73.	(26)
24.	(90)	49.	(04)	74.	(08)
25.	(17)	50.	(10)	75.	(35)

PART - A (PHYSICS)

1. Answer (3)

Hint : $v = u - gt$

Sol. : Speed $= |v| = |u - gt| = u - gt$,

for $t \le \frac{u}{g}$ and $g\left(t - \frac{u}{g}\right)$ for $t > \frac{u}{g}$

2. Answer (4)

Hint : $\frac{dy}{dx} = 0.8x$

Sol. : $\frac{1}{10} = 0.4x^2$

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

$\Rightarrow \frac{dy}{dx} = \frac{0.8}{2} = 0.4 = \mu$

3. Answer (4)

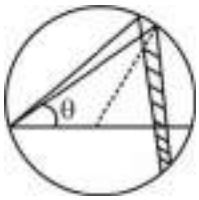
Hint: $F_{net} = \frac{Mv^2}{R}$

Sol. $\frac{Mv^2}{R} = \frac{2F\sqrt{3}}{2} = F\sqrt{3}$

$\Rightarrow \frac{Mv^2}{R} = \frac{GM^2\sqrt{3}}{4R^2 3} \times 4$

$R = \frac{GM}{v^2\sqrt{3}}$

4. Answer (1)



Hint : $V = -G\int \frac{dm}{r}$

Sol.: $r = 2R\cos\theta$

$dr = -2R\sin\theta\, d\theta$

$dM = 2\sigma\, r\theta.\, 2R\sin\theta d\theta$

$dV = -\frac{GdM}{r} = -G\, 4\sigma R\sin\theta.\theta d\theta$

$V = -4G\sigma R\int_0^{\frac{\pi}{2}} \sin\theta.\theta d\theta$

$V = -4G\sigma R = -4G.\frac{M}{\pi R^2}R = -\frac{4GM}{\pi R}$

5. Answer (1)

Hint : $\frac{4M.R^2}{2} = I + \frac{M}{2}\left(\frac{R}{2}\right)^2 + \frac{MR^2}{4}$

Sol. : $I = \left[2 - \left(\frac{1}{4} + \frac{1}{8}\right)\right]MR^2$

$= \left(\frac{16-3}{8}\right)MR^2 = \frac{13}{8}MR^2$

6. Answer (4)

Hint : Translational K.E. at C is zero.

Sol. : There in no change in rotational K.E. as it travels on part *BC*.

7. Answer (2)

Hint : $\vec{v} = 4\hat{i} + (3 - 4t)\hat{j}$

Sol. : $\vec{v}(t = 1\text{ s}) = 4\hat{i} - \hat{j}$

$\vec{a} = -4\hat{j}$

$\vec{v}.\vec{a} = 4 = \sqrt{17}.4.\cos\theta$

$\Rightarrow \theta = \cos^{-1}\frac{1}{\sqrt{17}}$

8. Answer (3)

Hint : $x = 3t$

$y = 4t - 5t^2$

Sol.: $\Rightarrow y = 4 \times \left(\frac{x}{3}\right) - 5\left(\frac{x}{3}\right)^2 = \frac{4x}{3} - \frac{5}{9}x^2$

9. Answer (4)

Hint : $T = m\omega^2 l$

Sol. : $T = m\omega^2 L = 2 \times 400 \times 1 = 800$ N

10. Answer (2)

Hint : $T\cos\theta = mg$

Sol. : $a = \frac{(2M\sin 53° - M\sin 37°)g}{3M}$

$= \frac{\left(2 \times \frac{4}{5} - \frac{3}{5}\right)10}{3} = \frac{10}{3}$ m/s^2

11. Answer (4)

Hint : $w = \int \vec{F}.\vec{dr}$

Sol. : $w = k\int_0^a ydx + k\int_0^b ady = 0 + k\,ab$

12. Answer (1)

Hint : $\left|\vec{\ell} = \vec{r} \times \vec{p}\right|$

Sol. : $\vec{\ell} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & -2 \\ 1 & 2 & -4 \end{vmatrix}$

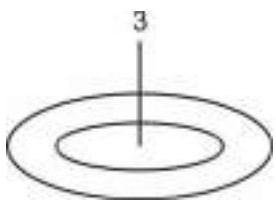
$= \hat{i}(-4+4) - \hat{j}(-8+2) + \hat{k}(4-1)$

$= \left(6\hat{j} + 3\hat{k}\right)$kg m/s

13. Answer (2)

Hint : $I_3 = \int dmr^2$

Sol. : $I_3 = \int dmr^2 = \int_R^{2R} \sigma 2\pi r dr\, r^2$



$= \dfrac{M}{\pi\left(4R^2 - R^2\right)} \dfrac{2\pi}{4} \left[2^4 - 1\right] R^4$

$= \dfrac{5MR^2}{2}$

14. Answer (3)

Hint : Angular Impulse = Change in Angular momentum

Sol. : $Jh = \dfrac{2}{5} mr^2 \omega_0$

$J = \dfrac{2}{5} \dfrac{mr^2}{h} \omega_0 = mV_0$

$\Rightarrow V_0 = \dfrac{2}{5} \dfrac{r^2 \omega_0}{h}$

15. Answer (1)

Hint : $M = \int \lambda dx$

Sol. : $M = \int_0^L \left(ax + \dfrac{bx^2}{L}\right) dx = \dfrac{aL^2}{2} + \dfrac{bL^3}{3L}$

$= \dfrac{aL^2}{2} + \dfrac{bL^2}{3}$

$\chi_{cm} = \dfrac{\int_0^L \left(ax^2 + \dfrac{bx^3}{L}\right) dx}{M} = \dfrac{\dfrac{aL^3}{3} + \dfrac{bL^3}{4}}{\dfrac{aL^2}{2} + \dfrac{bL^2}{3}}$

$= \dfrac{\left(\dfrac{a}{3} + \dfrac{b}{4}\right) L}{\dfrac{a}{2} + \dfrac{b}{3}} = \dfrac{(4a + 3b) L}{2(3a + 2b)}$

16. Answer (4)

Hint : $\Delta L = \dfrac{Mgl}{AY}$

Sol. : $\Delta L_1 = \dfrac{Mgl}{\pi r^2 Y}$

$\Delta L_2 = \dfrac{Mg3L}{4\pi r^2 Y}$

$\Delta L = \Delta L_1 + \Delta L_2 = \dfrac{Mgl}{\pi r^2 Y} \dfrac{7}{4}$

17. Answer (3)

Hint : $dl = \dfrac{F}{AY} dx$

Sol. : $r(x) = R + \dfrac{R}{L}.x$

$\int dl = \int \dfrac{F}{\pi R^2 \left(1 + \dfrac{x}{L}\right)^2 Y} dx$

$\Delta L = \dfrac{F}{\pi R^2 Y} \int_0^L \dfrac{dx}{\left(1 + \dfrac{x}{L}\right)^2}$

$= \dfrac{F}{\pi R^2 Y} L \left(-\dfrac{1}{1 + \dfrac{x}{L}}\right)_0^L$

$= \dfrac{FL}{\pi R^2 Y} \left[-\dfrac{1}{2} + 1\right] = \dfrac{FL}{2\pi R^2 Y}$

18. Answer (4)

Hint : $B = -V \dfrac{dp}{dv}$

Sol. : $B = -V \dfrac{\Delta p}{\Delta v}$

$\Rightarrow \dfrac{-\Delta V}{V} = \dfrac{-\Delta p}{B} = \dfrac{10^3 \times 10 \times 4 \times 10^3}{2.2 \times 10^9}$

$= \dfrac{4}{2.2}\% = 1.82\%$

19. Answer (4)

Hint : d_1R (cos37° – cos53°)

= d_2R [cos37° + sin37°)

Sol. : $\Rightarrow \frac{d_1}{d_2} = \frac{1+\tan 37°}{1-\tan 37°} = \frac{1+\frac{3}{4}}{1-\frac{3}{4}} = \frac{7}{1}$

20. Answer (1)

Hint : $V\,2.5\,\rho_W g - V\rho_W g = V\,2.5\rho_W a$

Sol. : $\Rightarrow a = \frac{1.5}{2.5}g = \frac{3g}{5} = 6\ \text{m/s}^2$

21. Answer (10)

Hint : $R = \frac{\rho v d}{\eta}$

Sol. : $\frac{\rho v d}{\eta} = \frac{2000}{\sqrt{\pi}}$

$\pi r^2 V = \frac{1000\times 10^{-3}}{10^3}\frac{\pi}{\pi}\times 10^{-2}$ cm/s

$= 10^{-5}\ \text{m}^3/\text{s}$

Flow rate = 10 cm^3/s

$t = \frac{10\times 1000}{10} = 1000$ s $\Rightarrow n = 10$

22. Answer (14)

Hint : $A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\theta}$

Sol. : $\theta = 0 \Rightarrow A = A_1 + A_2 = 14$

23. Answer (20)

Hint : $A = A_0\,e^{-kt}$

Sol. : $A^2 = A_0^2 e^{-2kt}$

$\frac{1}{4} = e^{-2kt}$

$\Rightarrow 2\ln 2 = 2kt$

$t = \frac{\ln 2}{k} = 20$ s

24. Answer (90)

Hint : $U = 4\pi r^2 S$

Sol. : $R = 10r$

$U_f = 4\pi R^2 S = 400\pi r^2 S$

$4\pi r^2 S = E$

$\Rightarrow U_f = 100\,E$

$U_i = 1000\,E$

$\Rightarrow U_i - U_f = 900\,E$

25. Answer (17)

Hint : $\Delta L = \frac{FL}{AY}$

Sol. : $\Rightarrow \frac{\Delta L_1}{\Delta L_2} = \frac{L_1R_2^2}{R_1^2L_2} = \frac{1}{2}\times\frac{9}{4} = \frac{9}{8}$

$\Rightarrow p + q = 17$

PART - B (CHEMISTRY)

26. Answer (4)

Hint : In the absence of magnetic field the orbital which has greater n + l, value, greater will be the energy of that orbital.

Sol. :

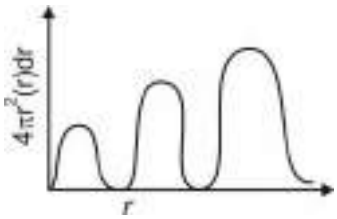
	(n + l) value
n = 4, l = 1	5
n = 4, l = 0	4
n = 3, l = 2	5
n = 3, l = 1	4

If n + l value is same then the orbital with lower value of 'n' will have lower energy

27. Answer (2)

Hint : The points where curve touches the axis (r) is the radial node except at r = 0 and ∞.

Sol. : The correct graph for two radial node is



28. Answer (4)

Hint : $(NH_4)_2SO_4 + 2NaOH \longrightarrow$

$2NH_3 + Na_2SO_4 + 2H_2O$

Sol. : 30 ml of 0.2 N $(NH_4)_2SO_4$ can give 6 meq. of NH_3 on reaction with NaOH.

4 g of NaOH = 100 meq of NaOH. (given in excess)

$\therefore$ 6 meq or m moles of NH_3 will be produced.

Vol. of NH_3 at STP $= 22.4 \times 6 \times 10^{-3}$

$= 134.4$ ml

29. Answer (2)

Hint : It is given that

(At temp. T) RMS of x = Mean velocity of Y

$$\sqrt{\frac{3RT}{M_X}} = \sqrt{\frac{8RT}{\pi M_Y}}$$

$$\frac{3}{M_X} = \frac{8}{\pi M_Y}$$

$$\frac{M_Y}{M_X} = \frac{8}{3\pi} = 0.84$$

$(M_Y < M_X)$

Sol. : Now equate the mean velocity of X and Y

$$\sqrt{\frac{8RT}{\pi M_X}} = \sqrt{\frac{8RT'}{\pi M_Y}}$$

$$\frac{T}{M_X} = \frac{T'}{M_Y}$$

$$\frac{M_Y}{M_X} = \frac{T'}{T}$$

$$\therefore \frac{T'}{T} < 1$$

$(T_2$ or) $T' < T$

30. Answer (4)

Hint : $\because$ Isolated system, q = 0

Work done = 0

$\therefore \Delta U = 0$

Sol. : $\because$ U is the function of temperature.

$\therefore \Delta T$ is also zero (isothermal)

As q = 0 it is adiabatic.

As it is not reversible

$\therefore$ Process equation cannot be applied.

31. Answer (1)

Hint : $\because \ln K_P = \frac{-\Delta H}{RT}$ + constant

Sol. : $\therefore$ Reaction is exothermic

$\therefore \Delta H = -$ve

$\therefore \ln K_p = \frac{-\Delta H}{RT} + C$

Compare y = mx + C

m = (+ve slope)

32. Answer (4)

Hint : $CO + H_2 \xrightarrow{O_2} CO_2 + H_2O$

$C + H_2O \longrightarrow CO + H_2$

First calculate amount of CO that can be obtained from 40 g of C.

Sol. : 40 g of C = $\frac{40}{12}$ moles = moles of CO

= Moles of H_2

Heat of combustion released by water gas

$= 2 \times \frac{40}{12} \times 250$

= 1666.6 kJ

Amount of carbon presents in 90% pure coke sample = 36 g = 3 moles of carbon

Heat of combustion $= 3 \times 400$

$= 1200$ kJ

33. Answer (2)

Hint : $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

Sol. :

	PCl_5	$\rightleftharpoons$	PCl_3	$+ Cl_2$
$t = 0$	3M		3M	2M
$t = t_{eq}$	4.5M		1.5M	0.5 M

34. Answer (3)

Hint : Use Le Chatelier's principle

Sol. : $\because$ Reaction is exothermic so reaction will drift in forward direction by decreasing temperature.

In product side no. of moles of gaseous product are less, so greater pressure is required.

35. Answer (4)

Hint : $K_a = C\alpha^2$

$[H^+] = C\alpha = \sqrt{C \times K_a}$

Sol. : $[H^+]$ by 10^{-3} M acid HB

$= \sqrt{10^{-3} \times 10^{-8}}$

For acid HA

$\sqrt{10^{-3} \times 10^{-8}} = \sqrt{C' \times K_a} = \sqrt{C' \times 10^{-7}}$

$C' = 10^{-4}$ Molar

36. Answer (1)

Hint : In all molecules valency of C is 4.

Sol. : In CH_2Br_2 oxidation state of C is 0.

37. Answer (2)

Hint : Type of lattice formed by A^{2+} and B^{2-} is AB where stoichiometric coefficient is 1 : 1.

Sol. : If A^{2+} is present at body centre then stoichiometric coefficient is found to be 1 : 1.

38. Answer (4)

Hint : Frenkel defect is more favourable if cations and anions have larger size difference.

Sol. : F-centre are produced by trapping of electrons.

39. Answer (2)

Hint : $\frac{P^\circ_A - P_S}{P^\circ_A} = \frac{n_B}{n_B + n_A}$

Sol. : $\frac{760 - P_s}{760} = \frac{0.1}{0.1 + 9.9}$

$760 - P_s = 7.6$

$P_s = 752.4$ mm Hg

40. Answer (3)

Hint. : $y = x \times m$

Sol. : $z = K_f \times m$

$K_f = \frac{zx}{y}$

41. Answer (4)

Hint : After complete discharge of the cell, $E_{cell} = 0$

Sol. : $\therefore E_{cell} = E^\circ_{cell} - \frac{0.06}{2}\log\frac{[Zn^{2+}]}{[Zu^{2+}]}$

$$\frac{1.10 \times 2}{0.06} = -\log\frac{[Cu^{2+}]}{[Zn^{2+}]}$$

$$\frac{[Cu^{2+}]}{[Zn^{2+}]} = 10^{-36.67}$$

42. Answer (4)

Hint : $2NO_2 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} N_2O_4$

$$-\frac{d[NO_2]}{dt} = 2K_1[NO_2]^2 - 2K_2[N_2O_4]$$

Sol. : $\frac{-d[NO_2]}{dt} = 2\left(K_1[NO_2]^2 - K_2[N_2O_4]\right)$

43. Answer (3)

Hint : XeF_6 = Distorted octahedral (sp^3d^2)

$SF_4 = sp^3d$ see – saw

$I_3^- = sp^3d$ linear planar

$XeO_3 = sp^3$

Sol. : $I_3^- = sp^3d$ hybridised

Linear Planar

% of P character = $\frac{3}{5} \times 100 = 60\%$

44. Answer (1)

Hint : $CH_4 \rightarrow sp^3$ hybridised

$CO_2 \rightarrow sp$ hybridised

Sol. : $CH_4 \rightarrow$ Tetrahedral

$CO_2 \rightarrow$ linear

45. Answer (3)

Hint : Work function is directly proportional to ionisation enthalpy.

Sol. : Be has highest value of ionisation enthalpy among given elements.

46. Answer (20)

Hint : Molarity = $\frac{V}{11.2}$

V is volume strength of H_2O_2 solution.

Sol. : Molarity of given H_2O_2 solution

$= \frac{1}{1120} \times 1000$.

$= \frac{100}{112}$ molar

$\because M = \frac{V}{11.2}$

$\therefore V = 10$

47. Answer (68)

Hint : $\underset{1\,mol}{KClO_3} \xrightarrow{\Delta} KCl + \underset{\frac{3}{2}\,mol}{\frac{3}{2}O_2}$

$\underset{1\,mol}{CO} + \underset{\frac{1}{2}\,mol}{\frac{1}{2}O_2} \longrightarrow \underset{1\,mol}{CO_2}$

Sol. : Mole of CO

PV = nRT

$\frac{1\,atm \times 20}{0.08 \times 300 \times 1000} = \frac{1}{1200}$ moles

$\therefore$ Moles of $O_2 = \frac{1}{2400}$ moles

$\because \frac{3}{2}$ mole of O_2 = 1 mol of $KClO_3$

$\therefore \frac{1}{2400}$ mole of $O_2 = \frac{2}{3} \times \frac{1}{2400}$

$= \frac{1}{3600}$ mol.

Mass of $KClO_3 = \frac{1}{3600} \times 122.5 = 0.034$ g

% purity = $\frac{0.034}{0.05} \times 100 \approx 68\%$

48. Answer (50)

Hint : $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4$

Sol. : Mole percent of Ba in $BaSO_4$

$= \frac{1}{6} \times 100$

$= \frac{50}{3}\%$

49. Answer (04)

Hint : To find out the atomicity, first calculate the molar mass of unknown allotrope of phosphorus.

Sol. : PV = nRT

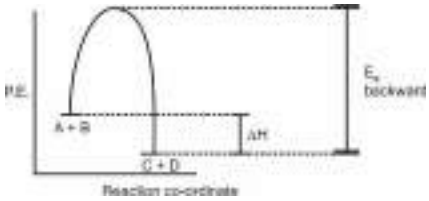
$\frac{304}{760} \times 0.608 = \frac{1.24}{M} \times 0.08 \times 304$

M = 124 g/mol.

$\therefore$ Atomicity = $\frac{124}{31} = 4$

50. Answer (10)

Hint :



Sol. : $\underset{forward}{E_a} - \underset{backward}{E_a} = \Delta H$

$50 - 40 = \underset{forward}{E_a} = 10$ kJ

PART - C (MATHEMATICS)

51. Answer (2)

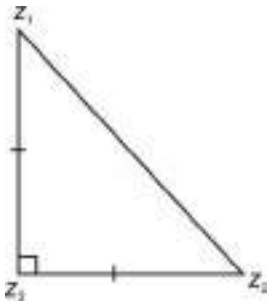
Hint : Rotation of complex number

Sol. : $z_3(1 - i) = z_2 - iz_1$

$\Rightarrow z_3 - z_2 = i(z_3 - z_1)$

$\Rightarrow \dfrac{z_2 - z_3}{z_1 - z_3} = i$

Hence triangle



Area = $\dfrac{1}{2}|z_1 - z_3|^2 = 18$

$\Rightarrow |z_1 - z_3| = |z_3 - z_2| = 6$

Longest side $\sqrt{6^2 + 6^2} = 6\sqrt{2}$

52. Answer (4)

Hint : $\alpha = -\omega$

Sol. : $\alpha = -\omega$

$\Rightarrow 1 + \alpha + \alpha^2 = 1 - \omega + \omega^2 = -2\omega$

Hence other root $-2\omega^2$

Product of roots = $(-2\omega)(-2\omega^2) = 4$

53. Answer (1)

Hint : Number of ways of selection from n identical things is $(n + 1)$

Sol. : $5 \cdot 6 \cdot 7 - 4 = 206$ ways.

54. Answer (3)

Hint : ${}^{10}C_3(2x)^3 \le {}^{10}C_4(2x)^4 \ge {}^{10}C_5(2x)^5$

Sol. : ${}^{10}C_3(2x)^3 \le {}^{10}C_4(2x)^4 \ge {}^{10}C_5(2x)^5$

$\dfrac{{}^{10}C_3}{{}^{10}C_4} \le 2x \le \dfrac{{}^{10}C_4}{{}^{10}C_5}$

$\dfrac{4}{7} \le 2x \le \dfrac{5}{6}$

$\Rightarrow x \in \left[\dfrac{2}{7}, \dfrac{5}{12}\right]$

55. Answer (2)

Hint : $\dfrac{n(n+1)}{2} \le 2020$

Sol. : $\dfrac{n(n+1)}{2} \le 2020$

$\Rightarrow n = 63$

Hence 1, 4, 4, 9, 9, 9,……, 63^2, …….

$\underset{T_{2016}}{\underset{\downarrow}{63^2}}$, 64^2, 64^2, 64^2, $\underset{T_{2020}}{\underset{\downarrow}{64}}$

$\Rightarrow T_{2020} = 64^2 = 4096$

56. Answer (4)

Hint : Determinant on LHS vanishes

Sol. : $0 = \begin{vmatrix} 0 & -x+2 & -x+3 \\ 0 & x-2 & 0 \\ x-1 & x-1 & 2x-4 \end{vmatrix}$

$\Rightarrow (x - 2)(x - 1)(-x + 3)$

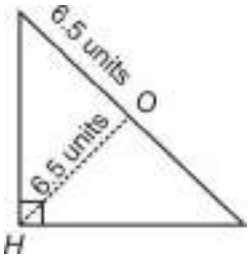
$\Rightarrow x = 1, 2, 3$

3 solutions

57. Answer (2)

Hint : Required distance is $\dfrac{1}{2}$ times hypotenuse

Sol. :



58. Answer (1)

Hint : $\sin\theta = \cos(90° - \theta)$

Sol. : $\dfrac{\sin 17° \sin 43° \sin 77°}{\sin 43° \cos 39°} \cos 47°$

$\Rightarrow \dfrac{1}{4}\dfrac{\sin 51° . \sin 43°}{\sin 43° . \cos 39°} = \dfrac{1}{4}$

59. Answer (3)

Hint : $|z+3i|^2 - 9 = |z-3i|^2 + 18|z-3i|$

Sol. : $|z+3i|^2 - 9 = |z-3i|^2 + 18|z-3i|$

$\Rightarrow |z+3i|^2 = (|z-3i|+3)^2$

$\Rightarrow |z+3i| - |z-3i| = 3$ Branch of Hyperbola

60. Answer (4)

Hint : $D > 0$, $f(1) \geq 0$ and $\frac{-b}{2a} > 1$

Sol. : $D > 0$, $f(1) \geq 0$ and $\frac{-b}{2a} > 1$

$k - 4(k-1) > 0$

$(k-2)^2 > 0$

$K \in R - \{2\}$

Now $+(1) > 0$

$\Rightarrow k > 0$

and $\frac{-b}{2a} > 1$

$\Rightarrow k < -2$

here $k \in \phi$

61. Answer (4)

Hint : $(1-x)^{\frac{41}{3}} = 1 + \frac{41}{3}(-x) + \frac{\frac{41}{3}\left(\frac{41}{3}-1\right)}{2!}(-x)^2 + \frac{\frac{41}{3}\left(\frac{41}{3}-1\right)\left(\frac{41}{3}-2\right)(-x)^3}{3!} + \ldots$

Sol. : $(1-x)^{\frac{41}{3}} = 1 + \frac{41}{3}(-x) + \frac{\frac{41}{3}\left(\frac{41}{3}-1\right)}{2!}(-x)^2 + \frac{\frac{41}{3}\left(\frac{41}{3}-1\right)\left(\frac{41}{3}-2\right)(-x)^3}{3!} + \ldots$

Negative term occur if $\frac{41}{3} - 14$ occurs

Hence 16th term.

62. Answer (1)

Hint : $(A^3B^4)^T = (B^T)^4 (A^T)^3$

Sol. : $(A^3B^4)^T = (B^T)^4 (A^T)^3$

$= (-B)^4 (A)^3 = B^4A^3$

Similarly $(B^4A^3)^T = A^3B^4$

$\therefore$ It is symmetric.

63. Answer (1)

Hint : If $(1 + \tan A)(1 + \tan B) = 2$

$\Rightarrow A + B = n\pi + \frac{\pi}{4}\ n \in Z$

Sol. : $\tan\theta = \tan 30°$

$\Rightarrow \theta = n\pi + \frac{\pi}{6}, n \in Z$

64. Answer (1)

Hint : $-1 \leq \sin\theta \leq 1$

Sol. : $\sin^2 A + \sin^2 B + \sin^2 C = 3$

Hence no such triangle possible.

65. Answer (2)

Hint : $\begin{vmatrix} 3 & -6 & 6 \\ 2 & k^2 & 1 \\ 1 & -5k & 5 \end{vmatrix} = 0$

Sol. : $\begin{vmatrix} 3 & -6 & 6 \\ 2 & k^2 & 1 \\ 1 & -5k & 5 \end{vmatrix} = 0$

$3(5k^2 + 5k) + 6(10-1) + 6(-10k - k^2) = 0$

$\Rightarrow 15k^2 + 15k + 54 - 60k - 6k^2 = 0$

$\Rightarrow 9k^2 - 45k + 54 = 0$

$\Rightarrow k^2 - 5k + 6 = 0$

$\Rightarrow k = 2$ or 3

66. Answer (4)

Hint : $\left|z-\left(\frac{-1}{z}\right)\right| \geq \left||z|-\left|\frac{-1}{z}\right|\right|$

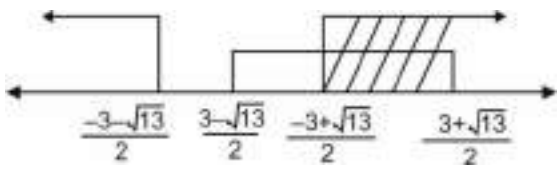
Sol. : $\left|z-\left(\frac{-1}{z}\right)\right| \geq \left||z|-\left|\frac{-1}{z}\right|\right|$

$3 \geq \left|r-\frac{1}{r}\right|$

$\Rightarrow \left|\frac{r^2-1}{r}\right| \leq 3$

$-3r \leq r^2 - 1 \leq 3r$

$\Rightarrow 0 \leq r^2 + 3r - 1$ and $r^2 - 3r - 1 \leq 0$



$|z|_{max} = \frac{3+\sqrt{13}}{2}$ $\quad |z|_{min} = \frac{-3+\sqrt{13}}{2}$

$|z|_{max} + |z|_{min} = \frac{2\sqrt{13}}{2} = \sqrt{13}$

67. Answer (1)

Hint : $(1+x)^n = {}^nC_0 + {}^nC_1x + {}^nC_2x^2 + ...$

Sol. :
$(1+x)^n = {}^nC_0 + {}^nC_1x + {}^nC_2x^2 + ...$
$(1-x)^n = {}^nC_0 - {}^nC_1x + {}^nC_2x^2 - {}^nC_3x^3 + ...$

$(1 + x)^n + (1 - x)^n = 2^nC_0 + 2.^nC_2x^2 + 2^nC_4x^4 + 2^nC_6 \times x^6 + ...$

Diff. both sides, $n(1 + x)^{n-1} - n(1 - x)^{n-1}$

$= 4^nC_2.\, x + 8.^nC_4\, x^3 + 12.^nC_6\, x^5 + ...$

Put $x = 1$

$n.2^{n-1} = 4.^nC_2 + 8.^nC_4 + 12.^nC_6 + ...$

68. Answer (2)

Hint : $|A| = 3abc - a^3 - b^3 - c^3$

Sol. : $|A| = 3abc - a^3 - b^3 - c^3$

Also A is orthogonal $\Rightarrow |A| = \pm 1$

$|A| = \frac{-1}{2}\left((a-b)^2 + (b-c)^2 + (c-a)^2\right) < 0$

$\Rightarrow |A| = -1$

$\Rightarrow -1 = 3abc - a^3 - b^3 - c^3$

$\Rightarrow a^3 + b^3 + c^3 - 3abc = 1$

69. Answer (2)

Hint : $(y - 2x)^2 + (2z - 4y)^2 + (4x - z)^2 = 0$

Sol. : $(y - 2x)^2 + (2z - 4y)^2 + (4x - z)^2 = 0$

$\Rightarrow \frac{y}{x} = 2,\ \frac{z}{y} = 2$

$\Rightarrow \frac{y}{x} = \frac{z}{y}$

$\Rightarrow y^2 = zx$

x, y, z are in G.P.

70. Answer (3)

Hint : $\frac{\operatorname{cosec}\frac{A}{2} + \operatorname{cosec}\frac{B}{2} + \operatorname{cosec}\frac{C}{2}}{3} \geq \left(\operatorname{cosec}\frac{A}{2}\operatorname{cosec}\frac{B}{2}\operatorname{cosec}\frac{C}{2}\right)$

Sol. : $\frac{\operatorname{cosec}\frac{A}{2} + \operatorname{cosec}\frac{B}{2} + \operatorname{cosec}\frac{C}{2}}{3} \geq \left(\operatorname{cosec}\frac{A}{2}\operatorname{cosec}\frac{B}{2}\operatorname{cosec}\frac{C}{2}\right)$

$\operatorname{cosec}\frac{A}{2} + \operatorname{cosec}\frac{B}{2} + \operatorname{cosec}\frac{C}{2} \geq 3(8)^{1/3} \geq 6$

$\left(\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2} \leq \frac{1}{8}\right)$

71. Answer (01)

Hint : $\begin{vmatrix} 1-\lambda & 2 & 3 \\ 0 & 1-\lambda & 2 \\ 1 & 1 & 2-\lambda \end{vmatrix} = 0$

Sol. : $\begin{vmatrix} 1-\lambda & 2 & 3 \\ 0 & 1-\lambda & 2 \\ 1 & 1 & 2-\lambda \end{vmatrix} = 0$

$\Rightarrow (1-\lambda)\,((1-\lambda)(2-\lambda)-2) - 2(-2) + 3(-(1-\lambda)) = 0$

$\Rightarrow \lambda^3 - 4\lambda^2 - 1 = 0$

$\Rightarrow A^3 - 4A^2 = I$

$\Rightarrow |A^3 - 4A^2| = 1$

72. Answer (15)

Hint : $x + y + z + w + v = 6$

$x, v \geq 0$ and $y, z, w \geq 2$

Sol. : $x + y + z + w + v = 6$

$x, v \geq 0$ and $y, z, w \geq 2$

Number of ways = ${}^6C_4 = \frac{6\times 5}{2} = 15$

73. Answer (26)

Hint : Given expression reduces to $9\text{cosec}^2x + 4\sec^2x + 1$

Sol. : $\frac{9\cos^2 x}{\cos^2 x\ \sin^2 x} + \frac{4\sin^2 x}{\cos^2 x\ \sin^2 x} + 1$

$\Rightarrow 9\text{cosec}^2x + 4\sec^2x + 1$

$\Rightarrow 14 + 4\tan^2x + 9\cot^2x \geq 14 + 12$

(by AM – GM inequality)

≥ 26

74. Answer (08)

Hint : $2\sin 4x \cos 4x = \cos 4x$

Sol. : $2\sin 4x \cos 4x = \cos 4x$

$\Rightarrow \cos 4x = 0$ or $\sin 4x = \frac{1}{2} = \sin\frac{\pi}{6}$

$\Rightarrow \cos 4x = \cos\frac{\pi}{2}$ or $4x = n\pi + (-1)^n\frac{\pi}{6}$

$\Rightarrow 4x = 2n\pi \pm \frac{\pi}{2}$

or $x = \frac{n\pi}{4} + (-1)^n\frac{\pi}{24}, n \in Z$

$\Rightarrow x = \frac{n\pi}{2} \pm \frac{\pi}{8}, n \in Z$

Acceptable values = $\frac{\pi}{8}, \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}$

Acceptable values = $\frac{\pi}{24}, \frac{5\pi}{24}, \frac{13\pi}{24}, \frac{17\pi}{24}$

No. of solutions = 8

75. Answer (35)

Hint : AIIDN will be order of letters for forming dictionary.

Sol. : AIIDN will be order of letters for forming dictionary.

A …. $\rightarrow \frac{4!}{2!} = 12$

IA … $\rightarrow$ 3! = 6

II … $\rightarrow$ 3! = 6

ID …$\rightarrow$ 3! = 6

INA ….$\rightarrow$ 2! = 2

INI ….$\rightarrow$ 2! = 2

INDIA …$\rightarrow$ 1

35 words

❒ ❒ ❒

All India Aakash Test Series for JEE (Main)-2020

TEST - 1 - Code-F

Test Date : 06/10/2019

ANSWERS

PHYSICS		CHEMISTRY		MATHEMATICS	
1.	(1)	26.	(3)	51.	(3)
2.	(4)	27.	(1)	52.	(2)
3.	(4)	28.	(3)	53.	(2)
4.	(3)	29.	(4)	54.	(1)
5.	(4)	30.	(4)	55.	(4)
6.	(1)	31.	(3)	56.	(2)
7.	(3)	32.	(2)	57.	(1)
8.	(2)	33.	(4)	58.	(1)
9.	(1)	34.	(2)	59.	(1)
10.	(4)	35.	(1)	60.	(4)
11.	(2)	36.	(4)	61.	(4)
12.	(4)	37.	(3)	62.	(3)
13.	(3)	38.	(2)	63.	(1)
14.	(2)	39.	(4)	64.	(2)
15.	(4)	40.	(1)	65.	(4)
16.	(1)	41.	(4)	66.	(2)
17.	(1)	42.	(2)	67.	(3)
18.	(4)	43.	(4)	68.	(1)
19.	(4)	44.	(2)	69.	(4)
20.	(3)	45.	(4)	70.	(2)
21.	(17)	46.	(10)	71.	(35)
22.	(90)	47.	(04)	72.	(08)
23.	(20)	48.	(50)	73.	(26)
24.	(14)	49.	(68)	74.	(15)
25.	(10)	50.	(20)	75.	(01)

PART - A (PHYSICS)

1. Answer (1)

Hint : $V\,2.5\,\rho_W g - V\rho_W g = V\,2.5\rho_W a$

Sol. : $\Rightarrow a = \frac{1.5}{2.5}g = \frac{3g}{5} = 6\ \text{m/s}^2$

2. Answer (4)

Hint : $d_1R\,(\cos37° - \cos53°)$

$= d_2R\,[\cos37° + \sin37°)$

Sol. : $\Rightarrow \frac{d_1}{d_2} = \frac{1+\tan37°}{1-\tan37°} = \frac{1+\frac{3}{4}}{1-\frac{3}{4}} = \frac{7}{1}$

3. Answer (4)

Hint : $B = -V\frac{dp}{dv}$

Sol. : $B = -V\frac{\Delta p}{\Delta v}$

$\Rightarrow \frac{-\Delta V}{V} = \frac{-\Delta p}{B} = \frac{10^3\times10\times4\times10^3}{2.2\times10^9}$

$= \frac{4}{2.2}\% = 1.82\%$

4. Answer (3)

Hint : $dl = \frac{F}{AY}dx$

Sol. : $r(x) = R + \frac{R}{L}.x$

$\int dl = \int \frac{F}{\pi R^2\left(1+\frac{x}{L}\right)^2 Y}dx$

$\Delta L = \frac{F}{\pi R^2 Y}\int_0^L \frac{dx}{\left(1+\frac{x}{L}\right)^2}$

$= \frac{F}{\pi R^2 Y}L\left(-\frac{1}{1+\frac{x}{L}}\right)_0^L$

$= \frac{F\,L}{\pi R^2 Y}\left[-\frac{1}{2}+1\right] = \frac{FL}{2\pi R^2 Y}$

5. Answer (4)

Hint : $\Delta L = \frac{Mgl}{AY}$

Sol. : $\Delta L_1 = \frac{Mgl}{\pi r^2 Y}$

$\Delta L_2 = \frac{Mg3L}{4\pi r^2 Y}$

$\Delta L = \Delta L_1 + \Delta L_2 = \frac{Mgl}{\pi r^2 Y}\ \frac{7}{4}$

6. Answer (1)

Hint : $M = \int \lambda dx$

Sol. : $M = \int_0^L\left(ax + \frac{bx^2}{L}\right)dx = \frac{aL^2}{2} + \frac{bL^3}{3L}$

$= \frac{aL^2}{2} + \frac{bL^2}{3}$

$\chi_{cm} = \frac{\int_0^L\left(ax^2 + \frac{bx^3}{L}\right)dx}{M} = \frac{\frac{aL^3}{3}+\frac{bL^3}{4}}{\frac{aL^2}{2}+\frac{bL^2}{3}}$

$= \frac{\left(\frac{a}{3}+\frac{b}{4}\right)L}{\frac{a}{2}+\frac{b}{3}} = \frac{(4a+3b)\,L}{2(3a+2b)}$

7. Answer (3)

Hint : Angular Impulse = Change in Angular momentum

Sol. : $Jh = \frac{2}{5}mr^2\omega_0$

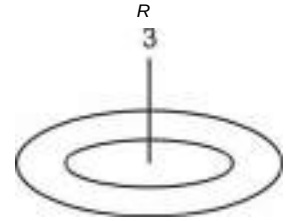
$J = \frac{2}{5}\frac{mr^2}{h}\omega_0 = mV_0$

$\Rightarrow V_0 = \frac{2}{5}\frac{r^2\omega_0}{h}$

8. Answer (2)

Hint : $I_3 = \int dmr^2$

Sol. : $I_3 = \int dmr^2 = \int_R^{2R}\sigma 2\pi r dr\, r^2$



$$= \frac{M}{\pi\left(4R^2 - R^2\right)} \frac{2\pi}{4} \left[2^4 - 1\right] R^4$$

$$= \frac{5MR^2}{2}$$

9. Answer (1)

Hint : $\left|\vec{\ell} = \vec{r} \times \vec{p}\right|$

Sol. : $\vec{\ell} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & -2 \\ 1 & 2 & -4 \end{vmatrix}$

$= \hat{i}(-4+4) - \hat{j}(-8+2) + \hat{k}(4-1)$

$= \left(6\hat{j} + 3\hat{k}\right)$ kg m/s

10. Answer (4)

Hint : $w = \int \vec{F}.\vec{dr}$

Sol. : $w = k\int_0^a ydx + k\int_0^b ady = 0 + k\,ab$

11. Answer (2)

Hint : $T\cos\theta = mg$

Sol. : $a = \dfrac{(2M\sin 53° - M\sin 37°)g}{3M}$

$= \dfrac{\left(2 \times \frac{4}{5} - \frac{3}{5}\right)10}{3} = \dfrac{10}{3}$ m/s^2

12. Answer (4)

Hint : $T = m\omega^2 l$

Sol. : $T = m\omega^2 L = 2 \times 400 \times 1 = 800$ N

13. Answer (3)

Hint : $x = 3t$

$y = 4t - 5t^2$

Sol. : $\Rightarrow y = 4 \times \left(\dfrac{x}{3}\right) - 5\left(\dfrac{x}{3}\right)^2 = \dfrac{4x}{3} - \dfrac{5}{9}x^2$

14. Answer (2)

Hint : $\vec{v} = 4\hat{i} + (3 - 4t)\hat{j}$

Sol. : $\vec{v}(t = 1\text{ s}) = 4\hat{i} - \hat{j}$

$\vec{a} = -4\hat{j}$

$\vec{v}.\vec{a} = 4 = \sqrt{17}.4.\cos\theta$

$\Rightarrow \theta = \cos^{-1}\dfrac{1}{\sqrt{17}}$

15. Answer (4)

Hint : Translational K.E. at *C* is zero.

Sol. : There is no change in rotational K.E. as it travels on part *BC*.

16. Answer (1)

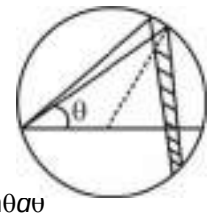
Hint : $\dfrac{4M.R^2}{2} = I + \dfrac{M}{2}\left(\dfrac{R}{2}\right)^2 + \dfrac{MR^2}{4}$

Sol. : $I = \left[2 - \left(\dfrac{1}{4} + \dfrac{1}{8}\right)\right]MR^2$

$= \left(\dfrac{16-3}{8}\right)MR^2 = \dfrac{13}{8}MR^2$

17. Answer (1)

Hint : $V = -G\int \dfrac{dm}{r}$



Sol. : $r = 2R\cos\theta$

$dr = -2R\sin\theta\, d\theta$

$dM = 2\sigma\, r\theta.\, 2R\sin\theta d\theta$

$dV = -\dfrac{GdM}{r} = -G\,4\sigma R\sin\theta.\theta d\theta$

$V = -4G\sigma R\int_0^{\frac{\pi}{2}} \sin\theta.\theta d\theta$

$V = -4G\sigma R = -4G.\dfrac{M}{\pi R^2}R = -\dfrac{4GM}{\pi R}$

18. Answer (4)

Hint : $F_{net} = \dfrac{Mv^2}{R}$

Sol. : $\dfrac{Mv^2}{R} = \dfrac{2F\sqrt{3}}{2} = F\sqrt{3}$

$\Rightarrow \dfrac{Mv^2}{R} = \dfrac{GM^2\sqrt{3}}{4R^2 3} \times 4$

$R = \dfrac{GM}{v^2\sqrt{3}}$

19. Answer (4)

Hint : $\frac{dy}{dx} = 0.8x$

Sol. : $\frac{1}{10} = 0.4x^2$

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

$\Rightarrow \frac{dy}{dx} = \frac{0.8}{2} = 0.4 = \mu$

20. Answer (3)

Hint : $v = u - gt$

Sol. : Speed $= |v| = |u - gt| = u - gt$,

for $t \le \frac{u}{g}$ and $g\left(t - \frac{u}{g}\right)$ for $t > \frac{u}{g}$

21. Answer (17)

Hint : $\Delta L = \frac{FL}{AY}$

Sol. : $\Rightarrow \frac{\Delta L_1}{\Delta L_2} = \frac{L_1 R_2^2}{R_1^2 L_2} = \frac{1}{2} \times \frac{9}{4} = \frac{9}{8}$

$\Rightarrow p + q = 17$

22. Answer (90)

Hint : $U = 4\pi r^2 S$

Sol. : $R = 10r$

$U_f = 4\pi R^2 S = 400\pi r^2 S$

$4\pi r^2 S = E$

$\Rightarrow U_f = 100\ E$

$U_i = 1000\ E$

$\Rightarrow U_i - U_f = 900\ E$

23. Answer (20)

Hint : $A = A_0 e^{-kt}$

Sol. : $A^2 = A_0^2 e^{-2kt}$

$\frac{1}{4} = e^{-2kt}$

$\Rightarrow 2\ln 2 = 2kt$

$t = \frac{\ln 2}{k} = 20$ s

24. Answer (14)

Hint : $A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\theta}$

Sol. : $\theta = 0 \Rightarrow A = A_1 + A_2 = 14$

25. Answer (10)

Hint : $R = \frac{\rho v d}{\eta}$

Sol. : $\frac{\rho v d}{\eta} = \frac{2000}{\sqrt{\pi}}$

$\pi r^2 V = \frac{1000 \times 10^{-3}}{10^3} \frac{\pi}{\pi} \times 10^{-2}$ cm/s

$= 10^{-5}$ m^3/s

Flow rate = 10 cm^3/s

$t = \frac{10 \times 1000}{10} = 1000$ s $\Rightarrow n = 10$

PART - B (CHEMISTRY)

26. Answer (3)

Hint : Work function is directly proportional to ionisation enthalpy.

Sol. : Be has highest value of ionisation enthalpy among given elements.

27. Answer (1)

Hint : $CH_4 \rightarrow sp^3$ hybridised

$CO_2 \rightarrow sp$ hybridised

Sol. : $CH_4 \rightarrow$ Tetrahedral

$CO_2 \rightarrow$ linear

28. Answer (3)

Hint : XeF_6 = Distorted octahedral (sp^3d^2)

$SF_4 = sp^3d$ see – saw

$I_3^- = sp^3d$ linear planar

$XeO_3 = sp^3$

Sol. : I_3^- = sp^3d hybridised

Linear Planar

% of P character = $\frac{3}{5} \times 100$ = 60%

29. Answer (4)

Hint : $2NO_2 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} N_2O_4$

$$-\frac{d[NO_2]}{dt} = 2K_1[NO_2]^2 - 2K_2[N_2O_4]$$

Sol. : $\frac{-d[NO_2]}{dt} = 2\left(K_1[NO_2]^2 - K_2[N_2O_4]\right)$

30. Answer (4)

Hint : After complete discharge of the cell, $E_{cell} = 0$

Sol. : $\therefore E_{cell} = E^\circ_{cell} - \frac{0.06}{2}\log\frac{[Zn^{2+}]}{[Zu^{2+}]}$

$$\frac{1.10 \times 2}{0.06} = -\log\frac{[Cu^{2+}]}{[Zn^{2+}]}$$

$$\frac{[Cu^{2+}]}{[Zn^{2+}]} = 10^{-36.67}$$

31. Answer (3)

Hint. : $y = x \times m$

Sol. : $z = K_f \times m$

$$K_f = \frac{zx}{y}$$

32. Answer (2)

Hint : $\frac{P^\circ_A - P_S}{P^\circ_A} = \frac{n_B}{n_B + n_A}$

Sol. : $\frac{760 - P_s}{760} = \frac{0.1}{0.1 + 9.9}$

$760 - P_s = 7.6$

P_s = 752.4 mm Hg

33. Answer (4)

Hint : Frenkel defect is more favourable if cations and anions have larger size difference.

Sol. : F-centre are produced by trapping of electrons.

34. Answer (2)

Hint : Type of lattice formed by A^{2+} and B^{2-} is AB where stoichiometric coefficient is 1 : 1.

Sol. : If A^{2+} is present at body centre then stoichiometric coefficient is found to be 1 : 1.

35. Answer (1)

Hint : In all molecules valency of C is 4.

Sol. : In CH_2Br_2 oxidation state of C is 0.

36. Answer (4)

Hint : $K_a = C\alpha^2$

$[H^+] = C\alpha = \sqrt{C \times K_a}$

Sol. : $[H^+]$ by 10^{-3} M acid HB

$= \sqrt{10^{-3} \times 10^{-8}}$

For acid HA

$\sqrt{10^{-3} \times 10^{-8}} = \sqrt{C' \times K_a} = \sqrt{C' \times 10^{-7}}$

$C' = 10^{-4}$ Molar

37. Answer (3)

Hint : Use Le Chatelier's principle

Sol. : $\because$ Reaction is exothermic so reaction will drift in forward direction by decreasing temperature.

In product side no. of moles of gaseous product are less, so greater pressure is required.

38. Answer (2)

Hint : $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

Sol. :

	PCl_5	$\rightleftharpoons$	PCl_3	$+ Cl_2$
$t = 0$	3M		3M	2M
$t = t_{eq}$	4.5M		1.5M	0.5 M

39. Answer (4)

Hint : $CO + H_2 \xrightarrow{O_2} CO_2 + H_2O$

$C + H_2O \longrightarrow CO + H_2$

First calculate amount of CO that can be obtained from 40 g of C.

Sol. : 40 g of C = $\frac{40}{12}$ moles = moles of CO

= Moles of H_2

Heat of combustion released by water gas =

$2 \times \frac{40}{12} \times 250$

= 1666.6 kJ

Amount of carbon presents in 90% pure coke sample = 36 g = 3 moles of carbon

Heat of combustion = 3 × 400

= 1200 kJ

40. Answer (1)

Hint : $\because \ln K_P = \frac{-\Delta H}{RT}$ + constant

Sol. : $\therefore$ Reaction is exothermic

$\therefore \Delta H$ = –ve

$\therefore \ln K_p = \frac{-\Delta H}{RT} + C$

Compare y = mx + C

m = (+ve slope)

41. Answer (4)

Hint : $\because$ Isolated system, q = 0

Work done = 0

$\therefore \Delta U = 0$

Sol. : $\because$ U is the function of temperature.

$\therefore \Delta T$ is also zero (isothermal)

As q = 0 it is adiabatic.

As it is not reversible

$\therefore$ Process equation cannot be applied.

42. Answer (2)

Hint : It is given that

(At temp. T) RMS of x = Mean velocity of Y

$$\sqrt{\frac{3RT}{M_X}} = \sqrt{\frac{8RT}{\pi M_Y}}$$

$$\frac{3}{M_X} = \frac{8}{\pi M_Y}$$

$$\frac{M_Y}{M_X} = \frac{8}{3\pi} = 0.84$$

($M_Y < M_X$)

Sol. : Now equate the mean velocity of X and Y

$$\sqrt{\frac{8RT}{\pi M_X}} = \sqrt{\frac{8RT'}{\pi M_Y}}$$

$$\frac{T}{M_X} = \frac{T'}{M_Y}$$

$$\frac{M_Y}{M_X} = \frac{T'}{T}$$

$$\therefore \frac{T'}{T} < 1$$

(T_2 or) $T' < T$

43. Answer (4)

Hint : $(NH_4)_2SO_4 + 2NaOH \longrightarrow$

$2NH_3 + Na_2SO_4 + 2H_2O$

Sol. : 30 ml of 0.2 N $(NH_4)_2SO_4$ can give 6 meq. of NH_3 on reaction with NaOH.

4 g of NaOH = 100 meq of NaOH. (given in excess)

$\therefore$ 6 meq or m moles of NH_3 will be produced.

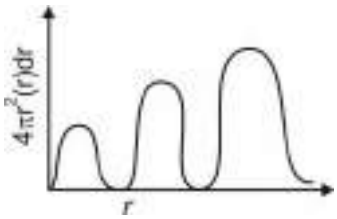
Vol. of NH_3 at STP = $22.4 \times 6 \times 10^{-3}$

= 134.4 ml

44. Answer (2)

Hint : The points where curve touches the axis (r) is the radial node except at r = 0 and ∞.

Sol. : The correct graph for two radial node is



45. Answer (4)

Hint : In the absence of magnetic field the orbital which has greater n + l, value, greater will be the energy of that orbital.

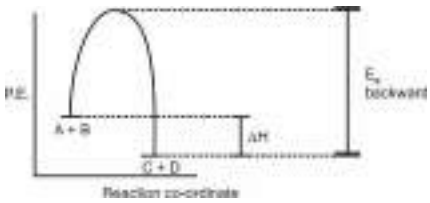
Sol. :

	(n + l) value
n = 4, l = 1	5
n = 4, l = 0	4
n = 3, l = 2	5
n = 3, l = 1	4

If n + l value is same then the orbital with lower value of 'n' will have lower energy

46. Answer (10)

Hint :



Sol. : $E_{a\,\text{forward}} - E_{a\,\text{backward}} = \Delta H$

$50 - 40 = E_{a\,\text{forward}} = 10$ kJ

47. Answer (04)

Hint : To find out the atomicity, first calculate the molar mass of unknown allotrope of phosphorus.

Sol. : PV = nRT

$$\frac{304}{760} \times 0.608 = \frac{1.24}{M} \times 0.08 \times 304$$

M = 124 g/mol.

$$\therefore \text{Atomicity} = \frac{124}{31} = 4$$

48. Answer (50)

Hint : $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4$

Sol. : Mole percent of Ba in $BaSO_4$

$$= \frac{1}{6} \times 100$$

$$= \frac{50}{3}\%$$

49. Answer (68)

Hint : $\underset{1\,\text{mol}}{KClO_3} \xrightarrow{\Delta} KCl + \underset{\frac{3}{2}\,\text{mol}}{\frac{3}{2}O_2}$

$\underset{1\,\text{mol}}{CO} + \underset{\frac{1}{2}\,\text{mol}}{\frac{1}{2}O_2} \longrightarrow \underset{1\,\text{mol}}{CO_2}$

Sol. : Mole of CO

PV = nRT

$$\frac{1\,\text{atm} \times 20}{0.08 \times 300 \times 1000} = \frac{1}{1200} \text{ moles}$$

$\therefore$ Moles of O_2 = $\frac{1}{2400}$ moles

$\because \frac{3}{2}$ mole of O_2 = 1 mol of $KClO_3$

$\therefore \frac{1}{2400}$ mole of O_2 = $\frac{2}{3} \times \frac{1}{2400}$

$= \frac{1}{3600}$ mol.

Mass of $KClO_3 = \frac{1}{3600} \times 122.5 = 0.034$ g

$$\%\text{ purity} = \frac{0.034}{0.05} \times 100 \approx 68\%$$

50. Answer (20)

Hint : Molarity = $\frac{V}{11.2}$

V is volume strength of H_2O_2 solution.

Sol. : Molarity of given H_2O_2 solution

$$= \frac{1}{1120} \times 1000.$$

$$= \frac{100}{112} \text{ molar}$$

$\because M = \frac{V}{11.2}$

$\therefore V = 10$

PART - C (MATHEMATICS)

51. Answer (3)

Hint : $\dfrac{\operatorname{cosec}\frac{A}{2}+\operatorname{cosec}\frac{B}{2}+\operatorname{cosec}\frac{C}{2}}{3} \geq \left(\operatorname{cosec}\frac{A}{2}\operatorname{cosec}\frac{B}{2}\operatorname{cosec}\frac{C}{2}\right)$

Sol. : $\dfrac{\operatorname{cosec}\frac{A}{2}+\operatorname{cosec}\frac{B}{2}+\operatorname{cosec}\frac{C}{2}}{3} \geq \left(\operatorname{cosec}\frac{A}{2}\operatorname{cosec}\frac{B}{2}\operatorname{cosec}\frac{C}{2}\right)$

$\operatorname{cosec}\frac{A}{2}+\operatorname{cosec}\frac{B}{2}+\operatorname{cosec}\frac{C}{2} \geq 3(8)^{1/3} \geq 6$

$\left(\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2} \leq \frac{1}{8}\right)$

52. Answer (2)

Hint : $(y-2x)^2+(2z-4y)^2+(4x-z)^2=0$

Sol. : $(y-2x)^2+(2z-4y)^2+(4x-z)^2=0$

$\Rightarrow \frac{y}{x}=2,\ \frac{z}{y}=2$

$\Rightarrow \frac{y}{x}=\frac{z}{y}$

$\Rightarrow y^2 = zx$

x, y, z are in G.P.

53. Answer (2)

Hint : $|A| = 3abc - a^3 - b^3 - c^3$

Sol. : $|A| = 3abc - a^3 - b^3 - c^3$

Also A is orthogonal $\Rightarrow |A| = \pm 1$

$|A| = \frac{-1}{2}\left((a-b)^2+(b-c)^2+(c-a)^2\right) < 0$

$\Rightarrow |A| = -1$

$\Rightarrow -1 = 3abc - a^3 - b^3 - c^3$

$\Rightarrow a^3 + b^3 + c^3 - 3abc = 1$

54. Answer (1)

Hint : $(1+x)^n = {}^nC_0 + {}^nC_1x + {}^nC_2x^2 + ...$

Sol. :
$(1+x)^n = {}^nC_0 + {}^nC_1x + {}^nC_2x^2 + ...$
$(1-x)^n = {}^nC_0 - {}^nC_1x + {}^nC_2x^2 - {}^nC_3x^3 + ...$

$(1+x)^n + (1-x)^n = 2{}^nC_0 + 2.{}^nC_2x^2 + 2{}^nC_4x^4 + 2{}^nC_6 \times x^6 + ...$

Diff. both sides, $n(1+x)^{n-1} - n(1-x)^{n-1}$

$= 4{}^nC_2.\ x + 8.{}^nC_4\ x^3 + 12.{}^nC_6\ x^5 + ...$

Put $x = 1$

$n.2^{n-1} = 4.{}^nC_2 + 8.{}^nC_4 + 12.{}^nC_6 + ...$

55. Answer (4)

Hint : $\left|z-\left(\frac{-1}{z}\right)\right| \geq \left||z|-\left|\frac{-1}{z}\right|\right|$

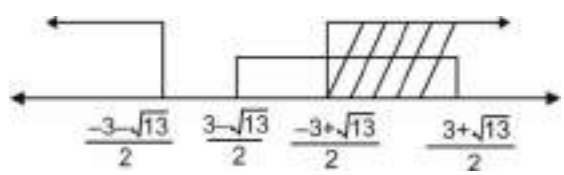
Sol. : $\left|z-\left(\frac{-1}{z}\right)\right| \geq \left||z|-\left|\frac{-1}{z}\right|\right|$

$3 \geq \left|r-\frac{1}{r}\right|$

$\Rightarrow \left|\frac{r^2-1}{r}\right| \leq 3$

$-3r \leq r^2 - 1 \leq 3r$

$\Rightarrow 0 \leq r^2 + 3r - 1$ and $r^2 - 3r - 1 \leq 0$



$|z|_{max} = \frac{3+\sqrt{13}}{2}$ $\quad |z|_{min} = \frac{-3+\sqrt{13}}{2}$

$|z|_{max} + |z|_{min} = \frac{2\sqrt{13}}{2} = \sqrt{13}$

56. Answer (2)

Hint : $\begin{vmatrix} 3 & -6 & 6 \\ 2 & k^2 & 1 \\ 1 & -5k & 5 \end{vmatrix} = 0$

Sol. : $\begin{vmatrix} 3 & -6 & 6 \\ 2 & k^2 & 1 \\ 1 & -5k & 5 \end{vmatrix} = 0$

$3\left(5k^2 + 5k\right) + 6(10-1) + 6\left(-10k - k^2\right) = 0$

$\Rightarrow 15k^2 + 15k + 54 - 60k - 6k^2 = 0$

$\Rightarrow 9k^2 - 45k + 54 = 0$

$\Rightarrow k^2 - 5k + 6 = 0$

$\Rightarrow k = 2$ or 3

57. Answer (1)

Hint : $-1 \le \sin\theta \le 1$

Sol. : $\sin^2 A + \sin^2 B + \sin^2 C = 3$

Hence no such triangle possible.

58. Answer (1)

Hint : If $(1 + \tan A)(1 + \tan B) = 2$

$\Rightarrow A + B = n\pi + \frac{\pi}{4}\ n \in Z$

Sol. : $\tan\theta = \tan 30°$

$\Rightarrow \theta = n\pi + \frac{\pi}{6}, n \in Z$

59. Answer (1)

Hint : $(A^3B^4)^T = (B^T)^4 (A^T)^3$

Sol. : $(A^3B^4)^T = (B^T)^4 (A^T)^3$

$= (-B)^4 (A)^3 = B^4A^3$

Similarly $(B^4A^3)^T = A^3B^4$

$\therefore$ It is symmetric.

60. Answer (4)

Hint : $(1-x)^{\frac{41}{3}} = 1 + \frac{41}{3}(-x) + \frac{\frac{41}{3}\left(\frac{41}{3}-1\right)}{2!}(-x)^2 + \frac{\frac{41}{3}\left(\frac{41}{3}-1\right)\left(\frac{41}{3}-2\right)(-x)^3}{3!} + \ldots$

Sol. : $(1-x)^{\frac{41}{3}} = 1 + \frac{41}{3}(-x) + \frac{\frac{41}{3}\left(\frac{41}{3}-1\right)}{2!}(-x)^2 + \frac{\frac{41}{3}\left(\frac{41}{3}-1\right)\left(\frac{41}{3}-2\right)(-x)^3}{3!} + \ldots$

Negative term occur if $\frac{41}{3} - 14$ occurs

Hence 16th term.

61. Answer (4)

Hint : $D > 0$, $f(1) \ge 0$ and $\frac{-b}{2a} > 1$

Sol. : $D > 0$, $f(1) \ge 0$ and $\frac{-b}{2a} > 1$

$k - 4(k-1) > 0$

$(k-2)^2 > 0$

$k \in R - \{2\}$

Now $+(1) > 0$

$\Rightarrow k > 0$

and $\frac{-b}{2a} > 1$

$\Rightarrow k < -2$

here $k \in \phi$

62. Answer (3)

Hint : $|z + 3i|^2 - 9 = |z - 3i|^2 + 18|z - 3i|$

Sol. : $|z + 3i|^2 - 9 = |z - 3i|^2 + 18|z - 3i|$

$\Rightarrow |z + 3i|^2 = \left(|z - 3i| + 3\right)^2$

$\Rightarrow |z + 3i| - |z - 3i| = 3$ Branch of Hyperbola

63. Answer (1)

Hint : $\sin\theta = \cos(90° - \theta)$

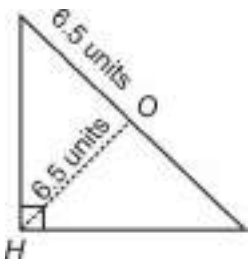
Sol. : $\dfrac{\sin 17° \sin 43° \sin 77°}{\sin 43° \cos 39°} \cos 47°$

$\Rightarrow \dfrac{1}{4}\dfrac{\sin 51°.\sin 43°}{\sin 43°.\cos 39°} = \dfrac{1}{4}$

64. Answer (2)

Hint : Required distance is $\dfrac{1}{2}$ times hypotenuse

Sol. :



65. Answer (4)

Hint : Determinant on LHS Vanishes

Sol. : $0 = \begin{vmatrix} 0 & -x+2 & -x+3 \\ 0 & x-2 & 0 \\ x-1 & x-1 & 2x-4 \end{vmatrix}$

$\Rightarrow (x-2)(x-1)(-x+3)$

$\Rightarrow x = 1, 2, 3$

3 solutions

66. Answer (2)

Hint : $\dfrac{n(n+1)}{2} \le 2020$

Sol. : $\dfrac{n(n+1)}{2} \le 2020$

$\Rightarrow n = 63$

Hence 1, 4, 4, 9, 9, 9,……, 63^2, …….

$\underset{T_{2016}}{\underset{\downarrow}{63^2}}$, 64^2, 64^2, 64^2, $\underset{T_{2020}}{\underset{\downarrow}{64}}$

$\Rightarrow T_{2020} = 64^2 = 4096$

67. Answer (3)

Hint : ${}^{10}C_3(2x)^3 \le {}^{10}C_4(2x)^4 \ge {}^{10}C_5(2x)^5$

Sol. : ${}^{10}C_3(2x)^3 \le {}^{10}C_4(2x)^4 \ge {}^{10}C_5(2x)^5$

$\dfrac{{}^{10}C_3}{{}^{10}C_4} \le 2x \le \dfrac{{}^{10}C_4}{{}^{10}C_5}$

$\dfrac{4}{7} \le 2x \le \dfrac{5}{6}$

$\Rightarrow x \in \left[\dfrac{2}{7}, \dfrac{5}{12}\right]$

68. Answer (1)

Hint : Number of ways of selection from n identical things is $(n + 1)$

Sol. : $5 \cdot 6 \cdot 7 - 4 = 206$ ways.

69. Answer (4)

Hint : $\alpha = -\omega$

Sol. : $\alpha = -\omega$

$\Rightarrow 1 + \alpha + \alpha^2 = 1 - \omega + \omega^2 = -2\omega$

Hence other root $-2\omega^2$

Product of roots = $(-2\omega)(-2\omega^2) = 4$

70. Answer (2)

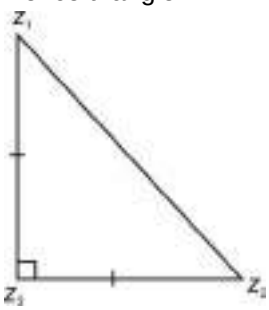
Hint : Rotation of complex number

Sol. : $z_3(1 - i) = z_2 - iz_1$

$\Rightarrow z_3 - z_2 = i(z_3 - z_1)$

$\Rightarrow \dfrac{z_2 - z_3}{z_1 - z_3} = i$

Hence triangle



Area = $\dfrac{1}{2}|z_1 - z_3|^2 = 18$

$\Rightarrow |z_1 - z_3| = |z_3 - z_2| = 6$

Longest side $\sqrt{6^2 + 6^2} = 6\sqrt{2}$

71. Answer (35)

Hint : AIIDN will be order of letters for forming dictionary.

Sol. : AIIDN will be order of letters for forming dictionary.

A …. $\rightarrow \frac{4!}{2!} = 12$

lA … $\rightarrow$ 3! = 6

lI … $\rightarrow$ 3! = 6

lD …$\rightarrow$ 3! = 6

INA ….$\rightarrow$ 2! = 2

INI ….$\rightarrow$ 2! = 2

INDIA …$\rightarrow$ 1

35 words

72. Answer (08)

Hint : $2\sin 4x \cos 4x = \cos 4x$

Sol. : $2\sin 4x \cos 4x = \cos 4x$

$\Rightarrow \cos 4x = 0$ or $\sin 4x = \frac{1}{2} = \sin\frac{\pi}{6}$

$\Rightarrow \cos 4x = \cos\frac{\pi}{2}$ or $4x = n\pi + (-1)^n \frac{\pi}{6}$

$\Rightarrow 4x = 2n\pi \pm \frac{\pi}{2}$

or $x = \frac{n\pi}{4} + (-1)^n \frac{\pi}{24}, n \in Z$

$\Rightarrow x = \frac{n\pi}{2} \pm \frac{\pi}{8}, n \in Z$

Acceptable values = $\frac{\pi}{8}, \frac{3\pi}{8}, \frac{5\pi}{8}, \frac{7\pi}{8}$

Acceptable values = $\frac{\pi}{24}, \frac{5\pi}{24}, \frac{13\pi}{24}, \frac{17\pi}{24}$

No. of solutions = 8

73. Answer (26)

Hint : Given expression reduces to

$9\text{cosec}^2 x + 4\sec^2 x + 1$

Sol. : $\frac{9\cos^2 x}{\cos^2 x \sin^2 x} + \frac{4\sin^2 x}{\cos^2 x \sin^2 x} + 1$

$\Rightarrow 9\text{cosec}^2 x + 4\sec^2 x + 1$

$\Rightarrow 14 + 4\tan^2 x + 9\cot^2 x \geq 14 + 12$

(by AM – GM inequality)

≥ 26

74. Answer (15)

Hint : $x + y + z + w + v = 6$

$x, v \geq 0$ and $y, z, w \geq 2$

Sol. : $x + y + z + w + v = 6$

$x, v \geq 0$ and $y, z, w \geq 2$

Number of ways = ${}^6C_4 = \frac{6 \times 5}{2} = 15$

75. Answer (01)

Hint : $\begin{vmatrix} 1-\lambda & 2 & 3 \\ 0 & 1-\lambda & 2 \\ 1 & 1 & 2-\lambda \end{vmatrix} = 0$

Sol. : $\begin{vmatrix} 1-\lambda & 2 & 3 \\ 0 & 1-\lambda & 2 \\ 1 & 1 & 2-\lambda \end{vmatrix} = 0$

$\Rightarrow (1-\lambda)((1-\lambda)(2-\lambda) - 2) - 2(-2) + 3(-(1-\lambda)) = 0$

$\Rightarrow \lambda^3 - 4\lambda^2 - 1 = 0$

$\Rightarrow A^3 - 4A^2 = I$

$\Rightarrow |A^3 - 4A^2| = 1$

❒ ❒ ❒