RITS-2
JEE MAINS-2019
ANSWER KEY
Code: 125776

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

SOLUTION

1. Ans. (1)

$\lim\limits_{x\to 1^-} f(x) = \lim\limits_{x\to 1^-}\left(p[x+1]-q[x-1]\right)$

$= p(1)-q(-1) = p+q$

$\lim\limits_{x\to 1^-} f(x) = \lim\limits_{x\to 1^-} p[x+1]-q[x-1] = 2p-q(0) = 2p$

$\because\ f(x)$ is continuos at $x=1$

$\therefore\ p+q=2p \Rightarrow p=q \Rightarrow p-q=0$

2. Ans. (2)

Let n(B) = x n(A) = x + 2

n(F) = y n(C) = y + 3

n(D) = z n(E) = z + 5

x + y + z + x + 2 + y + 3 + z + 5 = 40

x + y + z = 15 but $x \ge 1, y \ge 1$ and $z \ge 1$ So total ways of distribution si ${}^{14}C_2 = 91$

3. Ans. (3)

For the line to be co-planar

$\overline{AB}$, $\vec{a}$ and $\vec{b}$ should be co-planar

$$\begin{vmatrix} 2 & 0 & k \\ 1 & k & -2 \\ 4 & 1 & -1-k \end{vmatrix} = 0$$

$\Rightarrow 2(-k-k^2+2)+k(1-4k)=0$

$-2k-2k^2+4+k-4k^2=0$

$-6k^2-k+4=0$

$6k^2+k-4=0$

This equatiion has two distinct roots So two such planes exist.

4. Ans. (1)

y = $\sin^2x + \text{cosec}^2x + 2 + \cos^2x + \sec^2x + 2 + \tan^2x + \cot^2 x + 2$

= $1 + 6 + 1 + \tan^2x + \cot^2x + \tan^2x + \cot^2x$

= $9 + 2(\tan^2x + \cot^2x)$

= $9 + 2[(\tan x - \cot x)^2 + 2]$

= $13 + 2(\tan x - \cot x)^2$

$y_{min} = 13 = p$

$\left[\frac{p}{3}\right] = 4$

5. Ans. (2)

$C_1 : z+\bar{z} = 2|z-1|$

Put z = x + iy

$2x = 2|x-1+iy|$

$x^2 = x(-1)^2 + y^2$

$Y^2 = 2\left(x-\frac{1}{2}\right)$

$C_2 : \arg(z-(-1-i) = \alpha$

It's a ray emanating from (–1,–1) and making angle α with the positive real axis C_1 and C_2 have exactly one point common

C_2 must be tangent to C_1

y + 1 = m(x + 1)

Solving C_1 and C_2

m = 1

y = x = 1

$P(Z_0) = 1 + i$

$|Z_0| = \sqrt{2}$

6. Ans. (2)

Equation of $\frac{x-2}{1} = \frac{y+1}{1} = \frac{3-3}{1} = \lambda$

for point A, Z = 0 $\Rightarrow$ $\lambda = -3$ $\Rightarrow$ A(–1,–4,0)

Similarly B(0, –3, 1) and C(3, 0, 4)

centroid of AABC $\equiv\left(\frac{2}{3},-\frac{7}{3},\frac{5}{3}\right)$

7. **Ans. (1)**

Let $\cos^{-1}x+\cot^{-1}x = f(x)$

Domain $x\in[-1,1]$ and f(x) is decreasing function in its domain

at $x=-1$ $\underset{\max}{f(x)}=\pi+\frac{3\pi}{4}=\frac{7\pi}{4}$

at x = 1 $\underset{\min}{f(x)}=0+\frac{\pi}{4}=\frac{\pi}{4}$

$\Rightarrow\ \frac{\pi}{4}\le f(x)\le\frac{7\pi}{4}$

k can be 1, 2, 3, 4, 5

8. **Ans. (2)**

$S_n = C_0C_1 + C_1C_2 + C_2C_3 + \dots. C_{n-1}C_0$

$= C_0C_{n-1} + C_1C_{n-2} + C_2C_{n-3} + \dots.. + Cn-_1C_0 = {}^{2n}C_{n-1}$

$\frac{S_{n+1}}{S_n}=\frac{15}{4}\Rightarrow\frac{{}^{2n+2}C_n}{{}^{2n}C_{n-1}}=\frac{15}{4}$ on solving n = 2 or 4

9. **Ans. (1)**

Given $Z_3 + iwZ_2 = (1 + iw)Z_1$

$Z_3 - Z_1 = iw(Z_1 - Z_2)$

$\frac{Z_3-Z_1}{Z_2-Z_1}=-iw$

$\frac{Z_3-Z_1}{Z_2-Z_1}=e^{i\pi/6}$

$=|Z_3-Z_1|=|Z_2-Z_1|$ with $\angle A=\frac{\pi}{6}$

10. **Ans. (3)**

Centroid of the given triangle = (4, 2)

So, centroid of the image traingle is itself the image of the original centroid

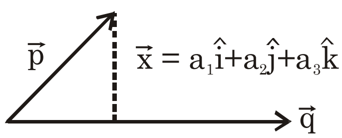
$G_1\equiv(4,-2)$

$G_2\equiv(-4,2)$

$G_3\equiv(2,4)$

Area of $\Delta G_1,G_2,G_3=\left|\frac{1}{2}\begin{vmatrix}4&-2&1\\-4&2&1\\2&4&1\end{vmatrix}\right|=20\,\text{unit}^2$

11. **Ans. (1)**



Component of $\vec{p}$ in the direction of $\vec{q}$

$=\frac{(\vec{p}.\vec{q})\vec{q}}{|\vec{q}|^2}=\frac{-5\hat{i}+5\hat{j}-5\hat{k}}{3}$

Component of $\vec{p}$, perpendicular to

$\vec{q}=\vec{p}-\left(\frac{-5\hat{i}+5\hat{j}-5\hat{k}}{3}\right)$

$=(2\hat{i}+4\hat{j}+3\hat{k})-\left(\frac{-5\hat{i}+5\hat{j}-5\hat{k}}{3}\right)$

$=\frac{11}{3}\hat{i}+\frac{7}{3}\hat{j}-\frac{4}{3}\hat{k}$

12. **Ans. (1)**

Suppose a – d, a , a + d are roots of the given equation

$\therefore$ a - d + a + a + d = 6

$\Rightarrow$ a = 2

$\Rightarrow$ roots are 2 – d, 2, 2 d are the roots and 2. (2 – d) + 2 . (2 + d) + 2 – d) (2 + d) = β_1

$\Rightarrow\ d=\sqrt{12-\beta_1}$

$\Rightarrow\ \beta_1=12-d^2$ and $2(2-d)(2-d)=\beta_2$

$\Rightarrow\ \beta_2=8-2d^2$

Hence $\beta_1+\beta_2=20-3d^2$

$(\beta_1+\beta_2)_{\max}=17$ when d = 1

13. **Ans. (3)**

As $2\alpha^2,\alpha^4,24$ are in AP

So, $2\alpha^4=2\alpha^2+24\Rightarrow\alpha^4-\alpha^2-12=0$

$\Rightarrow(\alpha^2-4)-(\alpha^2+3)=0$

$\therefore\alpha=\pm2$ (As $\alpha^2+3\ne0$ for any real α)

Also, $1,\beta^2,6-\beta^2$ are in G. P

So, $\beta^4=1(6-\beta^2)\Rightarrow\beta^4+\beta^2-6=0$

$\Rightarrow(\beta^2+3)(\beta^2-2)=0\Rightarrow\beta=\pm\sqrt{2}$

(As $\beta^2+3\ne0$ for any real β)

Hence, $\alpha_1^2+\alpha_2^2+\beta_1^2+\beta_2^2=12$

14. **Ans. (4)**

Let α be a root of f(x) = 0

$\therefore\ f(\alpha)=0$ and $f(f(\alpha))=0$

$\Rightarrow\ f(0)=0\Rightarrow b=0$

$\therefore\ f(x)=x(x+a)=0\Rightarrow x=0$ or $x=-a$

$f(f(x))=x(x+a)(x^2+ax+a)=0$

$\therefore\ x^2+ax+a=0$ should have no real roots besides 0 and –a $D=a^2-4a<0\Rightarrow0<a<4$

If the roots of $x^2 + ax + a = 0$ is either x = 0 or x = –a then a = 0

$\therefore\ \alpha \in [0,4) \Rightarrow a = 0,1,2,3$

Number of ordered pairs = 4

15. Ans. (1)

inequation $(x^2 + 1) > 0$ is satisfies $\forall x \in R$

Hence the inequations

$(a-1)x^2 - (a + |a-1| + 2)x + 1 \geq 0$ is satisfied $\forall x \in R$

$\Rightarrow (a-1)x^2 - (a + |a-1| + 2)x + a + 1 \geq 0\ \forall x \in R$

So, $(a - 1) > 0$ and

$D \leq 0 \Rightarrow (a + |a-1| + 2)^2 - 4(a-1) \leq 0$

$(\text{As } a > 1 \Rightarrow |a-1| = a-1)$

$\Rightarrow 4a^2 + 5 \leq 0$ which is not possible for any real values of 'a'

Hence no such real 'a' exists

16. Ans. (4)

$a_0C_0 - a_1C_1 + a_2C_2 - a_3C_3 + ... + a_{2102}C_{2012}$

$= a_0(C_0 - C_1 + C_2 + ... + C_{2102}) - d(C_1 - 2C_2 + 3C_3 - 4C_4 + {}^{2012}C_{2012})$

$= a_0(0) - d(C_1 - 2C_2 + 3C_3 = 4C_4 + ... - {}^{2012}C_{2012})$

Now $(1 + x)^{2012} = C_0 + C_1x + C_2x^2 + ... + C_{2012}X^{2012}$

Differentiate and put x = –1

$0 = C_1 - 2C_2 + 3C_3 - 4C_4 + ... - {}^{2012}C_{2012}$

17. Ans. (3)

Let $x_i = 2n_i - 1$ where $n_1, n_2, n_3, n_4 \geq 1$

Hence we have

$(2n_1 - 1) + (2n_2 - 1) + (2n_3 - 1) + (2n_4 - 1) = 98$

$n_1 + n_2 + n_3 + n_4 = 51$

giving n_1, n_2, n_3, n_4 each equal to 1

We have $n_1 + n_2 + n_3 + n_4 = 47$

using beggar $\underbrace{0\ 0\ 0\ ......0}_{47}\ \ \underbrace{\emptyset\ \emptyset\ \emptyset}_{3}$

$$\Rightarrow {}^{50}C_3 = \frac{50.49.48}{6} = 19600 = \frac{n}{100} = \frac{n}{100} = 196$$

18. Ans. (2)

For real λ

$f(x) = x^2 + 2bx + 2c^2$

$\Rightarrow (x+b)^2 + 2c^2 - b^2 \geq (2c^2 - b^2)$

$f(x)_{\min} = 2c^2 - b^2$

$g(x) \Rightarrow -x^2 - 2cx + b^2$

$\Rightarrow -(x+c)^2 + c^2 + b^2$

$\Rightarrow (b^2 + c^2) - (x+c)^2 \leq (b^2 + c^2)$

$g(x)_{\max} = b^2 + c^2$

By the given condition $2c^2 - b^2 > b^2 + c^2$

$|c| > \sqrt{2}|b|$

19. Ans. (1)

Since $\cos(n!\pi x)$ will be a proper fraction between –1 and +1 (excluding 0 and 1) and (it is) $\rightarrow 0$ as $m \rightarrow \infty$.

20. Ans. (4)

$x^2 - y^2 = 8$

$$\Rightarrow 2x - 2y\frac{dy}{dx} = 0$$

$$\Rightarrow \frac{-1}{\left(\frac{dy}{dx}\right)} = \frac{-y}{x}$$

At point $\left(\frac{-5}{\sqrt{2}}, \frac{3}{\sqrt{2}}\right)$

$$\Rightarrow \frac{-1}{\left(\frac{dy}{dx}\right)} = \frac{3}{5} = m_1$$

Also $9x^2 + 25y^2 = 225$

$$\Rightarrow 18x + 50y\frac{dy}{dx} = 0$$

$$\Rightarrow -\frac{dy}{dx} = \frac{25y}{9x}$$

At point $\left(\frac{-5}{\sqrt{2}}, \frac{3}{\sqrt{2}}\right)$

$$-\frac{dx}{dy}=-\frac{5}{3}=m_2$$

$\because\ m_1m_2=-1$

so $\theta=90°=\frac{\pi}{2}$

21. Ans. (2)

$\because\ \sin^{-1}x+\sin^{-1}y+\sin^{-1}z=\pi$

$\therefore\ \sin^{-1}x+\sin^{-1}y=\pi-\sin^{-1}z$

$\Rightarrow\ \sin^{-1}\left[x\sqrt{1-y^2}+y\sqrt{1-x^2}\right]=\pi-\sin^{-1}z$

$\Rightarrow x\sqrt{1-y^2}+y\sqrt{1-x^2}=z$

22. Ans. (4)

When x < 0

$\Rightarrow\ |z|=|z-2|$

$\Rightarrow\ |z|^2=|z-2|^2$

$\Rightarrow\ z\bar{z}=(z-2)(\bar{z}-2)$

$\bar{z}+z=2$ so x = 1 which is not possible

also when x > 0

$|z|=|z+2|$

$\Rightarrow\ |z|^2=|z+2|^2$

$\Rightarrow z\bar{z}=(z+2)(\bar{z}+2)$

$\Rightarrow\ z+\bar{z}=-2$ so x = –1 which is not possible

No such z possible

23. Ans. (3)

The system of linear equation will have a non zero solution if $\begin{vmatrix} a^3 & (a+1)^3 & (a+2)^3 \\ a & (a+1) & (a+2) \\ 1 & 1 & 1 \end{vmatrix}=0$

Now operate c_2-c_1 and c_3-c_2, then expand.

24. Ans. (3)

$B=CAC^{-1}$

$B^2=(CAC^{-1})(CAC^{-1})=CA^2C^{-1}$

$B^3=B^2B=(CA^2C^{-1})(CAC^{-1})$

$=CA^2(C^{-1}C)AC^{-1}$

$=CA^2.AC^{-1}$

$=CA^3C^{-1}$

25. Ans. (3)

$\omega^{r_1}+\omega^{r_2}+\omega^{r_3}=0 \qquad \{1+\omega+\omega^2=0\}$

$r_1 \quad r_2 \quad r_3$

$\downarrow \quad \downarrow \quad \downarrow$

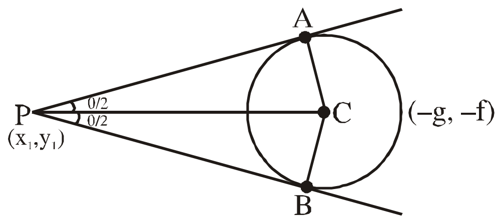
3 or 6   1 or 4   2 or 5

required prob. $=\frac{2\times2\times2\times\underline{|3}}{6^3}=\frac{2}{9}$

26. Ans. (1)

In right angled ΔPAC

$$\tan\frac{\theta}{2}=\frac{CA}{PA}=\sqrt{\frac{g^2+f^2-c}{S_1}}$$



Now $\cos\theta=\frac{1-\tan^2\frac{\theta}{2}}{1+\tan^2\frac{\theta}{2}}$

27. Ans. (3)

Equation of the tangent at the vertex is

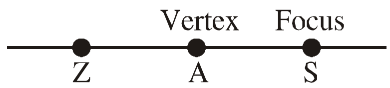
$x-y+1=0$ ...(i)

Equation of the axis of the parabola is $x+y+k=0$ ...(ii) Since it passes through (0, 0)

$0+0+k=0$

$\Rightarrow k=0$

$\therefore$ Equation of axis is $x+y=0$ ...(iii)



Where z is a point on directrix

Solving (i) and (iii) we get $A\left(\frac{-1}{2},\frac{1}{2}\right)$

$\therefore$ z is (–1, 1)

Now directrix is $x-y+c=0$ ...(iv)

But equation (iv) is passes through z

$-1-1+c=0$

$\Rightarrow c=2$

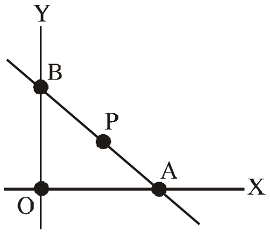
So directrix is $x-y+2=0$

Using PS = PM

$PS^2=PM^2$

28. Ans. (2)

Equation of a tangent to the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is $\frac{x\cos\theta}{a}+\frac{y\sin\theta}{b}=1$



$A \to \left(\frac{a}{\cos\theta},0\right) B \to \left(0,\frac{b}{\sin\theta}\right)$

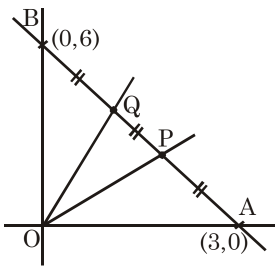
Let P is the mid point of $AB, P \to (h,k)$

$k=\frac{a}{2\cos\theta}$ ...(i)

$k=\frac{b}{2\cos\theta}$ ...(ii)

Eliminate θ by (i) and (ii)

29. Ans. (2)



$P\left(\frac{6}{3},\frac{6}{6}\right) \equiv (2,2)$

$Q\left(\frac{3}{3},\frac{12}{6}\right) \equiv (1,4)$

$m_{OP}=1$ and $m_{OQ}=4$

$\Rightarrow \quad m_{OP}+m_{OQ}=\frac{10}{2}$

30. Ans. (4)

Probability that problem is not solved by $1^{st}=1-\frac{1}{2}=\frac{1}{2}$

Probability that problem is not solved by $2^{nd}=1-\frac{1}{3}=\frac{2}{3}$

Probability that problem is not solved by $3^{rd}=1-\frac{1}{4}=\frac{3}{4}$

$\therefore$ Probability that problem is not solved by any one of the three $=\frac{1}{2}.\frac{2}{3}.\frac{3}{4}=\frac{1}{4}$

Hence the required Probability $1-\frac{1}{4}=\frac{3}{4}$

31. Ans. (2)

32. Ans. (1)

33. Ans. (1)

34. Ans. (3)

Sol. Newton's second law gives

$$N+Mg\cos\theta=\frac{mv^2}{R}$$

Conservation of mechanical energy gives

$$\frac{1}{2}mv^2=mg\,R(1-\cos\theta)\Rightarrow v^2=2gR(1-\cos\theta)$$

$$N=\frac{mv^2}{R}-mg\cos\theta=mg(2-3\cos\theta)$$

Also $2N\cos\theta=Mg\Rightarrow 2mg(2-3\cos\theta)\cos\theta=Mg$

Maximum value of upward force can be achieved by $\frac{d}{d\theta}(2-3\cos\theta)\cos\theta=0$

$\Rightarrow \sin\theta=0$ or $\cos\theta=\frac{1}{3}$

So $2mg(2-1)\frac{1}{3}=Mg,\frac{2}{3}m=M$

$$\frac{m}{M}>\frac{3}{2}$$

So minimum value is $\frac{3}{2}$

35. Ans. (1)

Sol. The moment of inertia will be least about the centre of mass of the rod.

$$X_{cm}=\frac{1}{m}\int xdm=\frac{1}{m}\int_0^L(1+kx)dx=\frac{L^2}{2}+\frac{KL^3}{3}$$

$$M=\int dm=\int_0^L(1+kx)dx=\left(L+\frac{KL^2}{2}\right)$$

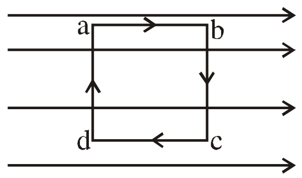
$$X_{cm}=\frac{\frac{L^2}{2}+\frac{KL^3}{3}}{L+\frac{KL^2}{2}}=\frac{\frac{L}{2}+\frac{KL^2}{3}}{1+\frac{KL}{2}}=\frac{\frac{3L+2KL^2}{6}}{\frac{2+KL}{2}}$$

$$X_{cm}=\left(\frac{3L+2KL^2}{6+3KL}\right)$$

36. Ans. (4)

Sol. As electric field and gravitational fields are conservative the work done by them in any closed loop must be zero.

Lets make a charge q_0 move along a square loop abcd as shown.



The work done along bc and da will be zero as $\theta = 90°$. But the net work done is not zero as strength of $\vec{E}$ along ab and cd are different. So these lines cannot qualify as electric or gravitational field lines not even non-uniform.

37. Ans. (2)

Sol. As the sphere is grounded it's potential will always be zero. As the particle gets closer to the sphere the charge density will increase so as to balance the effect of the charge.

38. Ans. (2)

Sol. $PT^{3/2} = \text{constant}$

$$P \times \left(\frac{PV}{nR}\right)^{3/2} = \text{constant} \Rightarrow P^{\frac{5}{2}} V^{\frac{3}{2}} = \text{constant}$$

$$\Rightarrow PV^{\frac{3}{5}} = \text{constant}$$

$C = C_v + \frac{R}{1-x}$ for a process $PV^x = \text{constant}$

$$\Rightarrow C = \frac{5R}{2} + \frac{R}{1-\frac{3}{5}} = \frac{5R}{2} + \frac{R}{2/5} = 5R$$

39. Ans. (4)

Sol. For non-uniform circular motion the total acceleration will be the resultant of radial and tangential. So it need not be directed towards the centre but for the radial acceleration we need a variable force as the acceleration is always directed towards the center.

40. Ans. (4)

Sol. The nuclear force favors parallel spin. So the nuclear force between the protons will be stronger but the protons are also going to repel each other. So in order to find the net force we need to have numerical values to compare them.

41. Ans. (1)

42. Ans. (3)

Sol. $\tan\phi = \frac{X_L}{R}$,

$$X_L = 2\pi fL = 2\pi \times 50 \times \frac{2}{\pi} \times 10^{-3} = 0.2\,\Omega$$

$\tan\phi = \frac{0.2}{0.15} = \frac{4}{3}$ and in LR circuit voltage leads current.

43. Ans. (3)

Sol. As the loop enters the region it will experience a magnetic force in a direction opposite to gravity but still gravitational force may be greater than the magnetic force and speed may increase. Once it gets completely inside the speed will increase after that instant.

44. Ans. (1)

Sol. $\frac{F}{\ell} = \frac{\mu_0 i_1 i_2}{2\pi d}$

Using the concept, parallel currents attract and opposite connects repel,

Force acting on wire i_2 will be highest followed by i_3 and then i_1

45. Ans. (2)

Sol. $V_{in}\rho_{water} g = V\rho_{wax} g, V_{out} = \frac{V}{2}$

$$Ah = \frac{AL}{2}, \frac{dh}{dt} = \frac{1}{2}\frac{dL}{dt} = 2\,cm/hr$$

46. Ans. (1)

Sol. Escape speed = $\sqrt{\frac{2GM}{R}}$

$$Ve' = \sqrt{\frac{2GM/2}{R/2}} = Ve$$

Ve = escape speed of each

Using $Vrms = \sqrt{\frac{3RT}{M}}$

If the rms speed of a gas molecule is more than the escape speed of the planet then the molecule will escape.

47. Ans. (2)

48. Ans. (3)

Sol. Using $\mu = \frac{C}{V}$

$$\frac{\mu_2}{\mu_1} = \frac{v_1}{v_2} \Rightarrow \mu_2 = \left(\frac{v_1}{v_2}\right)\mu_1 = \left(\frac{2\times 10^8}{2.5\times 10^8}\right)\times 1.5$$

$$\mu_2 = \frac{6}{5} \Rightarrow \mu_2 = 1.2$$

49. Ans. (2)

50. Ans. (3)

Sol. Using, $\Delta E = \frac{hc}{\lambda} = \frac{1242\text{eV}-\text{nm}}{0.021\text{nm}}$

$$= \frac{1242}{21\times 10^{-3}}\text{eV} = 59\text{KeV}$$

51. Ans. (1)

Sol. Using, $\lambda = \frac{h}{p}$

$P = \sqrt{2mK}$, where K is Kinetic energy

As kinetic energy is doubled and velocity is also doubled mass becomes half if initial, hence momentum remains unchanged and so is de-Broglie's wavelength

52. Ans. (1)

53. Ans. (1)

Sol. Given $\sigma = \frac{q_1}{4\pi R^2} = \frac{q_2}{4\pi r^2}$

$V_1 = \frac{1}{4\pi\varepsilon_0}\frac{q_1}{R}$, $V_2 = \frac{1}{4\pi\varepsilon_0}\frac{q_2}{r}$, $\frac{V_2}{V_1} = \frac{R}{r}$

54. Ans. (3)

55. Ans. (3)

56. Ans. (2)

Sol. As the sphere is floating completely submerged the upthrust will be equal to weight of the sphere.

$B = \rho_w Vg$

V= total volume of the concrete

$$Mg = \left[\rho_c \times \frac{4\pi}{3}\left(R^3 - r^3\right) + \rho_s \times \frac{4\pi}{3}r^3\right]g$$

$B = Mg$

$$\Rightarrow Mg = \rho_W \times \frac{4\pi}{3}R^3 g = \left(\rho_C \times \frac{4\pi}{3}\left(R^3 - r^3\right) + \rho_S\frac{4\pi}{3}r^3\right)g$$

Solving this we will get $r = \left(\frac{2}{3}\right)^{1/3} R$

$$\frac{\text{mass of concrete}}{\text{mass of sawdust}} = 4$$

57. Ans. (1)

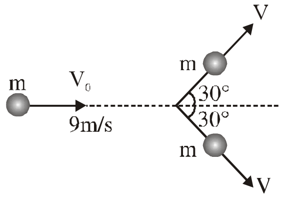
Sol. As the system is already balanced about Y-axis, the mass has to be kept on the line OE Using

$$X_{cm} = \frac{2\times(-2) + 2\times(-2) + 8(2)}{M} = 0$$

$\Rightarrow 8x = 8 \quad \Rightarrow x = 1m$

58. Ans. (4)

Sol.



Using momentum conservation

mv_0 = mvcos30° + mvcos30°

$9 = \frac{\sqrt{3}}{2}v \times 2 \Rightarrow 9 = \sqrt{3}v$

$\Rightarrow \quad v = 3\sqrt{3}\, m/s$

As there was no momentum along Y-axis the speed of each ball has to be same.

59. Ans. (1)

60. Ans. (2)

Sol. Given u + v = 100 cm

Using Lens formula with sign convection

$$\frac{1}{(100-u)} + \frac{1}{u} = \frac{1}{f} \text{ and } \frac{1}{(60-u)} + \frac{1}{(u+40)} = \frac{1}{f}$$

equating them, u = 30 cm

Now putting in any of the equations

$$\frac{1}{70} + \frac{1}{30} = \frac{1}{f} \Rightarrow \frac{1}{f} = \frac{1}{21\text{cm}}$$

$P = 5\ m^{-1}$

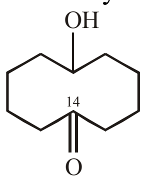
61. Ans. (3)

All the six face centred Cl^- ions and body centred Na^+ is removed, so formula will be Na_3Cl_3, so Z = 3

62. Ans. (1)

7 pairs of electrons means sp^3d^3 hybridization, in which planar structure is possible for five bond pairs and two lone pairs i.e pentagonal planar

63. Ans. (4)

Given reactant is ketal, which on hydrolysis dissociates to from phenol and 

64. Ans. (2)

Mn_2O_7, Cl_2O_7, SeO_2 are acidic oxides, so can react with bases while ZnO, Al_2O_3, BeO, PbO, As_2O_3 are amphoteric oxides, so they can also react with bases

65. Ans. (4)

At anode : $M_{(S)} \longrightarrow M^{2+}_{(aq)} + 2e^-$

At cathode : $M(OH)_{2(S)} \longrightarrow M^{2+} + 2OH^-_{(aq)}$

$M^{2+}_{(aq)} + 2e^- \longrightarrow M_{(S)}$

Net cell rx^{n} :

$$\left\{M_{(s)}\right\}_a + \left\{M(OH)_{2(S)}\right\}_c \longrightarrow$$

$$\left\{M^{2+}_{(aq)}\right\}_a + \left\{2OH^-_{(aq)}\right\}_c + \left\{M_{(s)}\right\}_c$$

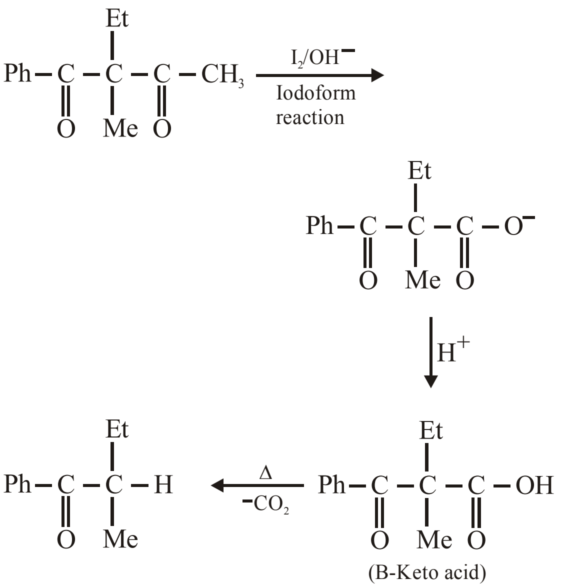
So, Applying nernst equation

$$E_{cell} = E^0_{cell} - \frac{0.059}{2}\log_{10}\left\{[M^{2+}]_a[OH^-]^2_c\right\}$$

66. Ans. (4)

For free expansion since ΔS_{sys} is non zero so ΔS_{total} & ΔG_{sys} are non zero.

67. Ans. (2)



68. Ans. (2)

On mixing HCl and H_2S, Ag^+ And Cu^{2+} will be precipitated out. Now Ca^{2+} will give white ppt with Na_2CO_3.

69. Ans. (3)

$$\text{Efficiency} = \frac{\text{work done}}{\text{heat supplied}} = 1 - \frac{T_2}{T_1}$$

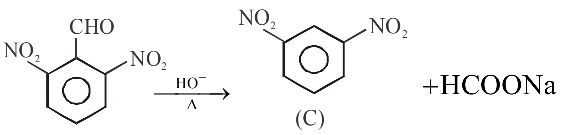
$$= \frac{\text{work done}}{37.3} = 1 - \frac{283}{373}$$

70. Ans. (2)

$[Fe(en)_3]^{2+}$ is obtained as X

Since 'en' is a strong field ligand, so the complex will be low spin & diamagnetic Hybridization will be d^2sp^3 (i.e inner orbital complex)

71. Ans. (1)



$$HCOONa \xrightarrow{H_3O^+} HCOOH$$

72. Ans. (2)

Balance the given reaction in basic medium as

$$8CrO_4^{2-} + 3S_2O_3^{2-} + H_2O \rightarrow 8CrO_2^- + 6SO_4^{2-} + 2OH^-$$

so, $\dfrac{\text{rate of consumption of } CrO_4^{2-}}{\text{rate of formation of } OH^-} = \dfrac{8}{2} = 4$

73. Ans. (1)

74. Ans. (3)

$$R-C\equiv N \xrightarrow{RMgX} \underset{\displaystyle \overset{|}{R}}{R-C}=NMgX \xrightarrow{H_2O/H^+}$$

$$\underset{\displaystyle \overset{|}{R}}{R-C}=0$$

(Ketone)

75. Ans. (3)

That is critical temperature (not inversion temperature) at which distinction between a liquid and a gas disappear.

76. Ans. (3)

λ_m^{∞} for $CH_3COOH = 91 + 421.5 - 126 = 386.5$

$$\lambda_m^{\infty} = \frac{\frac{1}{R}\left(\frac{\ell}{a}\right)\times 1000}{\text{Molarity}} = \frac{\frac{1}{520}\times(2.01)\times 1000}{0.1}$$

$= 38.65$

So, $\alpha = \lambda_m^c / \lambda_m^{\infty} = 38.65/386.5 = 0.1$

Now, $[H^+] = C\propto = 0.1 \times 0.1 = 10^{-2}$

so, pH = 2

77. Ans. (3)

$CH_3-\overset{\overset{\displaystyle O}{||}}{C}-Cl$ give acylation product but Me_3C-COCl gives alkylation (due to stable carbocation $Me_3C^{\oplus}$)

78. Ans. (1)

Formation of micelle occurs above kraft temperature. Colloid of $Fe(OH)_3$ in excess NaOH is negatively charged, so will move towards anode. Also Co-agulation value decreases as Co-agulation power increases.

79. Ans. (2)

Enthalpy 'H' is a state function, so independent of path.

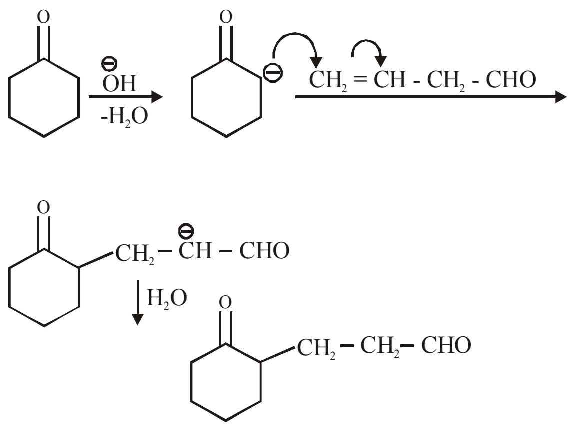
80. Ans. (1)

Aldehyde (not acid) will be obtained on reductive ozonolysis by $O_3/Zn/H_2O$.

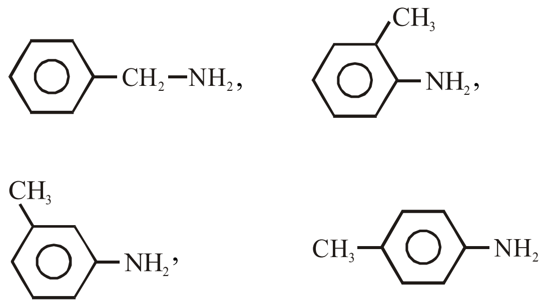
81. Ans. (1)

First of all, Aldol condensation occurs

$$\overset{\ominus}{C}H_2-CHO + CH_2=0 \longrightarrow \underset{\displaystyle OH}{\underset{|}{C}H_2}-CH_2-CHO \xrightarrow[-H_2O]{\Delta} CH_2=CH-CHO$$



82. Ans. (2)



83. Ans. (2)

As NH_3 is strong field ligand while F^- is weak field ligand so $[Co(NH_3)_6]^{3+}$ is diamagnetic while $[CoF_6]^{3-}$ is paramagnetic $[Ni(CO)_4]$ is tetrahedral while $[Ni(CN)_4]^{2-}$ is square planar

84. Ans. (4)

At high pressure, $Z = 1 + \frac{Pb}{RT}$

85. Ans. (3)

Cupellation is used when impurity has tendency to form volatile oxides.

86. Ans. (4)

$$XeF_2 + H_2O \longrightarrow Xe + O_2 + HF$$

87. Ans. (1)

$$NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$$

88. Ans. (2)

$$\underset{\substack{6\times10^{-3}\\ \text{moles}}}{Ca^{2+}} + \underset{\substack{3\times10^{-3}\\ \text{moles}}}{C_2O_4^{2}} \longrightarrow CaC_2O_4$$

$$3\times10^{-3} \quad 0 \quad 3\times10^{-3}$$

Molarity of remaining $Ca^{2+} = \frac{3\times10^{-3}}{150\times10^{-3}}$

89. Ans. (1)

NaCl type crystals normally show schotky defect.

90. Ans. (2)

For the line almost parallel to x-axis, Entropy change (ΔS) should be nearly zero, which is true for $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$