SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR MPC	Jee Main	Date: 04-09-20
Time:3 hrs	GT-20	Max.Marks:360

KEY SHEET

MATHS

1	**3**	2	**2**	3	**4**	4	**2**	5	**4**
6	**1**	7	**1**	8	**1**	9	**3**	10	**2**
11	**2**	12	**2**	13	**3**	14	**2**	15	**2**
16	**4**	17	**1**	18	**2**	19	**2**	20	**1**
21	**7**	22	**-3**	23	**0**	24	**9**	25	**4.796**

PHYSICS

26	**3**	27	**4**	28	**3**	29	**2**	30	**4**
31	**2**	32	**4**	33	**3**	34	**3**	35	**3**
36	**2**	37	**3**	38	**3**	39	**3**	40	**2**
41	**2**	42	**4**	43	**3**	44	**3**	45	**1**
46	**166**	47	**20**	48	**3**	49	**56**	50	**0.5**

CHEMISTRY

51	**4**	52	**2**	53	**2**	54	**3**	55	**3**
56	**1**	57	**2**	58	**1**	59	**3**	60	**3**
61	**1**	62	**1**	63	**2**	64	**3**	65	**1**
66	**2**	67	**3**	68	**1**	69	**3**	70	**4**
71	**97**	72	**50**	73	**4**	74	**552**	75	**0.3**

HINTS
MATHEMATICS

01. Total possible three-digit number

$=9\times10\times10=900$

Since, selected number has only three divisor which is only possible if number selected is square of prime, then numbers possible are

$11^2.13^2.17^2.19^2.23^2.29^2.31^2=7$

$\therefore$ Required probability $=\dfrac{7}{900}$

02. The given expression is

$$\lim_{x\to0}\frac{x\sqrt[3]{z^2-(z-x)^2}}{\left(\sqrt[3]{8xz-4x^2}+\sqrt[3]{8xz}\right)^4}$$

$$=\lim_{x\to0}\frac{x\sqrt[3]{2xz-x^2}}{\left(\sqrt[3]{x}\sqrt[3]{8z-4x}+\sqrt[3]{8z}\right)^2}$$

$$=\frac{\sqrt[3]{2z}}{\left[2\sqrt[3]{8z}\right]^4}=\frac{1}{2^{23/3}.z}$$

03. Given that

$f(x)=\left(\cos^{-1}x\right)^2+\left(\sin^{-1}x\right)^2$

$f(x)=\left(\cos^{-1}x+\sin^{-1}x\right)^2-2\cos^{-1}x.\sin^{-1}x$

$=\dfrac{\pi^2}{4}-2\sin^{-1}x\left(\dfrac{\pi}{2}-\sin^{-1}x\right)$

$\left(\because\ \sin^{-1}x+\cos^{-1}x=\pi/2\right)$

$=2\left[\left(\sin^{-1}x\right)^2-\dfrac{\pi}{2}\sin^{-1}x\right]+\dfrac{\pi^2}{4}$

$=2\left[\sin^{-1}x-\dfrac{\pi}{4}\right]^2-\dfrac{\pi^2}{8}+\dfrac{\pi^2}{4}$

$=2\left(\sin^{-1}x-\dfrac{\pi}{4}\right)+\dfrac{\pi^2}{8}\geq\dfrac{\pi^2}{8}$

$\therefore$ The minimum value of $f\left(\dfrac{1}{\sqrt{2}}\right)=\dfrac{\pi^2}{8}$

04. Let equation of family of lines through the intersection of the given lines be

$(x+2y-1)+\lambda(2x-y-1)=0$

$\Rightarrow x(1+2\lambda)+y(2-\lambda)=1+\lambda$

$$\Rightarrow\frac{x}{\frac{1+\lambda}{1+2\lambda}}+\frac{y}{\frac{1+\lambda}{2-\lambda}}=1$$

$\Rightarrow \frac{x}{a}+\frac{y}{b}=1$

Where, $a=\frac{1+\lambda}{1+2\lambda}$ and $b=\frac{1+\lambda}{2-\lambda}$

Now, let M (h, k) be mid-point of AB

$\therefore a=2h$ and $b=2k$

$\therefore 2h=\frac{1+\lambda}{1+2\lambda}$ and $2k=\frac{1+\lambda}{2-\lambda}$

Eliminating λ from Eq. (i), we get $10hk=h+3k$

Replacing $h\to x$ and $k\to y,$ we have $x+3y=10xy$ is the required equation of locus

05. It is given that the last term of

$\left(\sqrt[3]{2}-\frac{1}{\sqrt{2}}\right)^{n}=\left(\frac{1}{3\sqrt[3]{9}}\right)^{\log_3 8}$

$\Rightarrow {}^{n}C_{n}\left(-\frac{1}{\sqrt{2}}\right)^{n}=\left(\frac{1}{3\sqrt[3]{9}}\right)^{\log_3 8}$

$\Rightarrow (-1)^{n}\left(\frac{1}{2}\right)^{n/2}=\left(\frac{1}{3^{5/3}}\right)^{\log_3 8}$

$=3^{-\frac{5}{3}3\log_3 2}=2^{-5}$

$=\left(\frac{1}{2}\right)^{5}$

$\Rightarrow n=10$

$\therefore$ 5th term in $\left(\sqrt[3]{2^{10}}-\frac{1}{\sqrt{2}}\right)$ is

$T_5=T_{4+1}$

$={}^{10}C_4\left(\sqrt[3]{2}\right)^{10-4}\left(-\frac{1}{\sqrt{2}}\right)^{4}$

$={}^{10}C_4(4)\frac{1}{4}$

$={}^{10}C_4={}^{10}C_6$

06. We know that reflection of $a'x+b'y+c'z+d'=0$

in the plane $ax+by+cz+d=0$ is given

$2(aa'+bb'+cc')(ax+by+cz+d)$

$=(a^2+b^2+c^2)(a'x+b'y+c'z+d')$

$6(x-y+z-3)=2x-3y+4z-3$

$4x-3y+2z-15=0$

07.

The given matrix is

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

$$\Rightarrow \quad A^T = \begin{bmatrix} a & b & c \\ b & c & a \\ c & a & b \end{bmatrix}$$

$$\Rightarrow \quad A^T = A$$

$$\Rightarrow \quad A^T \cdot A = A^2$$

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

$$\therefore \quad |A^T \cdot A| = |A^2|$$

It is given that $A^T A = I$

$$\Rightarrow \quad |I| = |A^2|$$

$$\Rightarrow \quad I = |A|^2$$

Now, $$|A| = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$$

Applying the transformation $R_1 \to R_1 + R_2 + R_3$, we get

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

$$= (a+b+c)\begin{vmatrix} 1 & 1 & 1 \\ b & c & a \\ c & a & b \end{vmatrix}$$

Now, apply $C_2 \to C_2 - C_1$ and $C_3 \to C_3 - C_1$, we get

$$|A| = (a+b+c)\begin{vmatrix} 1 & 0 & 0 \\ b & c-b & a-b \\ c & a-c & b-c \end{vmatrix}$$

$$= (a+b+c)\begin{vmatrix} c-b & a-b \\ a-c & b-c \end{vmatrix}$$

$$= (a+b+c)[bc - c^2 - b^2 + bc - (a^2 - ac - ab + bc)]$$

$$= (a+b+c)[-a^2 - b^2 - c^2 + ac + ab + bc]$$

$$= -(a+b+c)[a^2 + b^2 + c^2 - ab - ac - bc]$$

$$= -(a^3 + b^3 + c^3 - 3abc)$$

$\Rightarrow |A|^2 = (a^3 + b^3 + c^3 - 3)^2 = 1 \quad (\because\ abc = 1) \ldots$(i)

$\because a, b$ and c are positive.

$$\frac{a^3 + b^3 + c^3}{3} > \sqrt[3]{a^3 b^3 c^3} = abc = 1$$

$$\Rightarrow \quad a^3 + b^3 + c^3 > 3$$

So, from Eq. (i), we have

$$a^3 + b^3 + c^3 > 3$$

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

$$\Rightarrow \quad a^3 + b^3 + c^3 = 4$$

08. $\vec{a}$ is perpendicular to the normals of both the planes

$\vec{a}.\left(\vec{i} \times \left(\vec{i} + \vec{j}\right)\right) = 0$

and $\vec{a}.(\vec{i}-\vec{j})\times(\vec{j}+\vec{k})=0$

$\Rightarrow \vec{a}.\vec{k}=0$

So $\vec{a}$ is in direction of $\vec{i}-\vec{j}$

$\vec{a}=\pm\frac{1}{\sqrt{2}}(\vec{i}-\vec{j})$

$\cos\theta=\pm\frac{1}{\sqrt{2}}(\vec{i}-\vec{j}).\frac{(\vec{i}-2\vec{j}+2\vec{h})}{3}$

$\cos\theta=\pm\frac{1}{\sqrt{2}}\Rightarrow\theta=\frac{\pi}{4}\text{or}\frac{3\pi}{4}$

10. Given equation of curve is

$(xy^3-x^2)dy-(xy+y^4)dx=0$

$\Rightarrow y^3(xdy-ydx)-x(xdy+ydx)=0$

$\Rightarrow x^2y^3\frac{(xdy-ydx)}{x^2}=x(xdy+ydx)$

$\Rightarrow x^2y^3d\left(\frac{y}{x}\right)=xd(xy)$

$\Rightarrow x^2y^3d\left(\frac{y}{x}\right)=xd(xy)$ (divided by x^3y^2

$\Rightarrow \frac{y}{x}d\left(\frac{y}{x}\right)=\frac{d(xy)}{x^2y^2}$

Now integrating we get $\frac{1}{2}\left(\frac{y}{x}\right)^2+\frac{1}{xy}=c$

It passes through (1, 1)

$C=3/2$

$\frac{2x^2y}{2}\left(\frac{y^2}{x^2}\right)+\frac{2x^2y}{xy}=2x^2y\times\frac{3}{2}$

$y^3+2x-3x^2y=0$

11. We have that any tangent of slope m is

$y=mx\pm\sqrt{a^2m^2+b^2}$. If it passes through (2a, 0) then

$3a^2m^2=b^2$

$3m^2=\frac{b^2}{a^2}=1-e^2$

$3m^2+e^2=1$

12. The given series is

$\cot^{-1}2+\cot^{-1}8+\cot^{-1}18+\cot^{-1}32+......$

$=\cot^{-1}2(1)^2+\cot^{-1}2(2)^2+\cot^{-1}2(3)^2+\cot^{-1}2(4)^2+.....$

So, let $T_n=\cot^{-1}(2n^2)$

$= \tan^{-1}\frac{1}{2n^2}$

$= \tan^{-1}\left[\frac{(2n+1)-(2n-1)}{1+(2n+1)(2n-1)}\right]$

$= \tan^{-1}(2n+1) - \tan^{-1}(2n-1)$

$T_1 = \tan^{-1}3 - \tan^{-1}1$

$T_2 = \tan^{-1}5 - \tan^{-1}3$

$T_3 = \tan^{-1}7 - \tan^{-1}5 \ldots$ and so on

$\therefore S_n = \tan^{-1}(2n+1) - \tan^{-1}1$

$\therefore \lim_{n\to\infty} S_n = \tan^{-1}\infty - \frac{\pi}{4}$

$= \frac{\pi}{2} - \frac{\pi}{4} = \frac{\pi}{4}$

13. $p \leftrightarrow q$ is equivalent to $(p \to q) \wedge (q \to p)$

14. It is clear that l is one of the bisectors of the angle between $3x = 4y = 5$ and $5x + 12y = 3$

Equation of bisector is given by $\frac{|3x-4y-5|}{\sqrt{3^2+4^2}} = \pm\frac{|5x+12y-13|}{\sqrt{5^2+12^2}}$

$\Rightarrow 13(3x-4y-5) = \pm 5(5x+12y-13)$

Taking positive sign, we get $39x - 52y = 25x + 60y$

$\Rightarrow x = 8y$ (i)

Taking negative sign we get, $39x - 52y - 65 = -25x - 60y + 65$

$\Rightarrow 32x + 4y = 65$ (ii)

Hence, possible equation of l can be

$x = 8y$

and $32x + 4y = 65$

15. Integrating given equation $\int \frac{dx}{x^2\left(x^n+1\right)^{\frac{n-1}{n}}} = \int \frac{dx}{x^2.x^{n-1}\left(1+x^{-n}\right)^{\frac{n-1}{n}}}$

$= \int \frac{dx}{x^{n+1}\left(1+x^{-n}\right)^{\frac{n-1}{n}}}$

Put $1 + x^{-n} = 1$

$-nx^{-n-1}dx = dt$

$\frac{dx}{x^{n+1}} = -\frac{dt}{n}$

$= -\frac{1}{n}\int \frac{dt}{t^{\frac{n-1}{n}}}$

$= \frac{1}{n}\int t^{\frac{-n+1}{n}} dt = -\frac{1}{n}\left[\frac{t^{\frac{-n+1}{n}+1}}{-\frac{n+1}{n}+1}\right]+c$

$= -\frac{1}{n}\left[\frac{t^{1/n}}{1/n}\right]+c = t^{1/n}+c$

Hence, $f(x) = (1+x^{-n})$

16. Here, the given function $f(x) = \sum_{n=0}^{\infty}\frac{x^n}{n!}(\log a)^n = \sum_{n=0}^{\infty}\frac{(x\log a)^n}{n!}$

$= e^{x\log a}\left(\because e^x = \sum_{n=0}^{\infty}\frac{x^n}{n!}\right)$

$= e^{\log a^x = a^x}$

$\Rightarrow f(x) = a^x$

$\Rightarrow f(x) = a^x$

Now, $LP(0) = \lim_{x\to 0}\frac{f(0-h)-f(0)}{-h} = \lim_{h\to 0}\frac{a^{-h}-1}{-h}$

$= \log_e a$

$Rf'(0)\lim_{h\to 0}\frac{f(0+h)-f(0)}{h}$

$\lim_{h\to 0}\frac{f(0+h)-f(0)}{h}$

$\Rightarrow Lf'(0) = Rf'(0)$

$\therefore f(x)$ is differentiable at x = 0

17. Let the series is

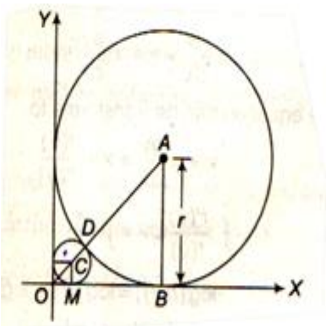
So, new series is $x_1+1, x_2+2, x_3+3.....x_n+n$

$\therefore$ Mean of the new series is

$= \frac{1}{n}\sum_{i=1}^{n}(x_i+i) = \frac{1}{n}\sum_{i=1}^{n}x_i + \frac{1}{n}(1+2+3+......+n)$

$= \vec{x} + \frac{n+1}{2}$

18. Let the two circle shown are



In $\Delta OCM, \sin\theta = \frac{CM}{OC} = \frac{1}{\sqrt{1^2+1^2}} = \frac{1}{\sqrt{2}}$

$\Rightarrow \theta = 45^0$

$\sin 45^0 = \frac{AB}{OA}$

$\frac{1}{\sqrt{2}} = \frac{r}{OC+CD+AD} = \frac{r}{\sqrt{2}+1+r}$

$\Rightarrow \sqrt{2}+r+1 = \sqrt{2}r$

$\frac{\sqrt{2}+1}{\sqrt{2}-1} = r$

$3+2\sqrt{2} = r$

19. Let us consider

$f(z) = g(z)(z-i)(z+i)+az+b$

Where g(z) is quotient when it is divided by $(z-i)(z+i)$ and az + b is remainder

$f(i) = ai+b = i$ (i)

$f(-i) = -ai+b = 1+i$ (ii)

On solving equation (i) and (ii) we get

$2b = 1+2i$

$b = \frac{1}{2}+i$ and $a = \frac{i}{2}$

Hence, required remainder = az + b

$= \frac{1}{2}iz+\frac{1}{2}+i = \frac{1}{2}(iz+1)+i$

20. Given that $xdy = \left(y + x\frac{f(y/x)}{f'(y/x)}\right)dx$

$\Rightarrow \frac{dy}{dx} = \frac{y}{x}+\frac{f(y/x)}{f^1(y/x)}$ $\left(\text{Putting } \frac{y}{x} = v\right)$

$\frac{dy}{dx} = v + x\frac{dv}{dx}$

The equation can be transforms to

$v + x\frac{dv}{dx} = v + \frac{f(v)}{f'(v)}$

$\Rightarrow \int \frac{f'(v)}{f(v)}dv = \int \frac{dx}{x}$

$\log|f(v)| = \log|x| + \log c$

$|f(y/x)| = c|x|$ where c > 0

21. The word DEGREE is made by D, G, R, EEE 4 letters word formation are

1. Three same one different $EEE^3C_1 = 3$

2. Two same and two different $EE^3C_2 = 3$

3. All are different $^4C_4 = 1$

Total possible ways = 3 + 3 + 1 = 7

22. Given $AB \perp BC$, then we can find that

Direction ratio of AB are –k, -1,2

Direction ratio of BC are 3, 1, - 4

by $a_1a_2 + b_1b_2 + c_1c_2 = 0$

$-3k - 1 - 8 = 0$

$k = -3$

23. Here, it is given that

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

Replacing $x \to \frac{1}{x}$

$$2f\left(\frac{1}{x}\right) - 4x^2 f\left(\frac{1}{x}\right) = 2x^2 g\left(\frac{1}{x}\right)$$

$$\Rightarrow -3x^2 f(x) = g(x) + 2x^2 g\left(\frac{1}{x}\right)$$

$$f(x) = -\left[\frac{g(x) + 2x^2 g\left(\frac{1}{x}\right)}{3x^2}\right]$$

Since, g(x) and x^2 are odd function and even functions, respectively. So, f(x) is an odd function that f(x) is given even $\Rightarrow f(x) = 0\ \forall x$

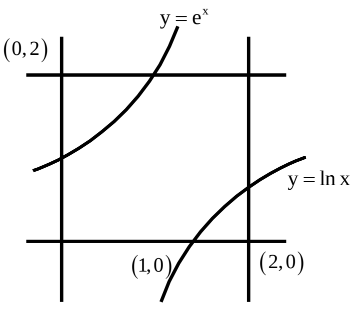
24. $a_{2r} = a_{2r-1} + d$

$$\sum_{r=1}^{10^{99}} a_{2r} = \sum_{r=1}^{10^{99}} a_{2r-1} + 10^{99} d$$

$100^{100} = 10^{99} + 10^{99} d$

$10 = 1 + d \Rightarrow d = 9$

25 Area = Area square $-2\int_1^2 \ln x\,dx$



$4 - 2(x\ln x - x)^2$

$= 4 - 2(2\ln 2 - 1) = 6 - 4\ln 2$

PHYSICS

26. $a=\frac{Eq}{m}, v=u+at, \lambda=\frac{h}{mv}$. For the Broglie's wave length to become half of its initial value, its speed is to be increased to $2v_0$

$v_x=0+\frac{Eq}{m}t, v_y=v_0$ and $v^2=v_x^2+v_y^2$

i.e.,, $4v^2=v^2+v^2 \Rightarrow v_x=\sqrt{3}v \Rightarrow t=\sqrt{3}\frac{mv}{qE}$

27. We know that $\beta=\frac{\alpha}{1-\alpha}=\frac{0.96}{1-0.96}=24$

The collector current I_C is given by

$I_C=\frac{V_C}{R}=\frac{0.5V}{800\Omega}=0.625\times10^{-3}A$

Further $I_B=\frac{I_C}{\beta}=\frac{0.625\times10^{-3}}{24}$

$=26\times10^{-6}A=26\mu A$

28. For the smooth portion BC,

$v^2-0=2g\sin\phi\times\ell$

For the rough portion CO

$u=v=\sqrt{2g\sin\phi.\ell}$

$a=g(\sin\phi-\mu\cos\phi)$

Therefore $0-2g\ell\sin\phi=2g(\sin\phi-\mu\cos\phi)\ell$

$\mu=2\tan\phi$

29. As $\frac{N_0}{e^{-6\lambda t}}=N_1$ and $\frac{N_0}{e^{-3\lambda t}}=N_2$

Now, $N_1=\frac{N_2}{e}$

Gives $t=\frac{1}{3\lambda}$

31. Decreasing R increases current in XY and there by increases the potential drop across XP and the balance point may be obtained. The current may be increased also by increasing V.

32. The straight line is perpendicular to the direction of the electric field. Hence $W=\vec{F}.\Delta\vec{S}=0$

33. $\oint E_p dS=\frac{Q+Q'}{\varepsilon_0}$ where Q' is the charge outside the sphere

$Q_1'=\int_R^r dQ=\int_R^r \frac{\alpha}{r}\times4\pi r^2 dr$

$E_p\times4\pi r^2=\frac{Q+2\pi\alpha(r^2-R^2)}{2r^2\varepsilon_0}$

E is independent of r if $\frac{Q}{4\pi r^2\varepsilon_0} - \frac{\alpha R^2}{2r^2\varepsilon_0} = 0$

$Q = 2\pi R^2\alpha$

34. Potential drop across C_1 is maximum.

Hence, energy stored in C_1 is maximum as energy $\propto (\text{potential drop})^2$

36. Initial velocity of particle, $v_i = 20\,ms^{-1}$

Final velocity of the particle, $v_f = 0$

$W_{net} = \Delta KE = -400\,J$

37. Upthrust is independent of all factors of the body such as its mass, size, density etc., except the volume of the body inside the fluid. Fraction of volume immersed in the liquid $V_{in} = \left(\frac{\rho}{\sigma}\right)V$ i.e., it depends upon the densities of the block and liquid. So, there will be no change in it if system moves upward or downward with constant velocity or some acceleration. Therefore, the upthrust on the body due to liquid is equal to the weight of the body in air.

38. The self-inductance L of a solenoid of length *l* and area of cross section A with fixed number of turns is $L = \frac{\mu_0 N^2 A}{\ell}$ Obviously, L increases with *l* decreases and A increases

39. During process A and B, pressure and volume both ae decreasing. Therefore, temperature and hence internal energy of the gas will decreases $(T \propto PV)$ or $\Delta V_{A\to B}$ = negative. Further $\Delta W_{A\to B}$ is negative

In process B to C, pressure of the gas is constant while volume is increasing. Hence, temperature should increase or $\Delta U_{B\to C}$ =positive. During C to A volume is constant while pressure is increasing. Therefore, temperature and hence internal energy of the gas should increase or $\Delta U_{C\to A}$ = positive. During process CAB, volume of the gas is decreasing. Hence, work done by the gas is negative.

40. $S = \frac{1}{2}\frac{V}{4}t^2 = \frac{1}{2}\frac{V}{1}(t-3)^2 \Rightarrow t = 6$ min

41. $2mgl = \frac{1}{2}\frac{2m}{3}(V_1+V_2)^2 \Rightarrow (V_1+V_2) = \sqrt{6gl}$............(1)

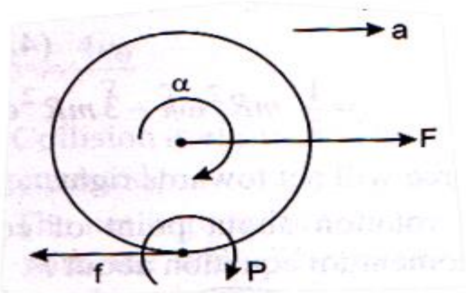
$mV_1 = 2mV_2 \Rightarrow V_1 = 2V_2$.................(2)

From (1) & (2)

$V_1 == \sqrt{\frac{8gl}{3}}$

42. As sphere is rolling we can apply torque equation about point of constant (about P)

$FR = I_p\alpha$



$\Rightarrow FR = \left(\frac{7}{5}MR^2\right)\alpha$

$\Rightarrow R\alpha = \frac{5F}{7M} = a$ (acceleration of CM)

Equation of translator motion

$F - f = mA \Rightarrow f = \frac{2}{7}F$.(i)

For no sliding, $f \le \mu mg \Rightarrow F = \frac{7}{2}\mu mg$

43. At t = 0, $f_r = mg\sin\theta$

when kt = mg $\sin\theta, f_r = 0$

$\frac{mg\sin\theta}{k} < t < \frac{mg\sin\theta + \mu mg\cos\theta}{k}$

Frictional force increase,

$t > \frac{mg\sin\theta + \mu mg\cos\theta}{k}$

44. As, $a_2 > a_1$ hence $v_1 > v_2$ As the liquid is non-viscous, there is no loss of energy, i.e., energy per unit volume of the liquid is the same at every point. So option (3) is incorrect.

45. The required capacitance $C = 2\mu F$

Potential difference V = 1kV = 1000V

Capacitance of each capacitor $C_1 = 1\mu F$ and it can withstand a potential difference of $V_1 = 400\,V$

Let the n capacitors are connected in series and there are m rows of such capacitors.

As the potential difference across each row is 1000V

So, the potential difference across each capacitor $= \frac{1000}{n}$

Minimum number of capacitors that must be connected in series in a row are

$\frac{1000}{n} = 400 \Rightarrow n = 2.5$

According to question a capacitor can bear only 400 V, so we can take n = 3.

$\frac{1}{C'} = \frac{1}{1} + \frac{1}{1} + \frac{1}{1} = \frac{3}{1}$

46. $n_{max} = \frac{d}{\lambda} = \frac{0.1\times10^{-3}}{600\times10^{-9}} = 166.67$

$n_{max} = 166$

47. $\frac{1}{f} = (1.5-1)\left(\frac{1}{30} - \frac{1}{\infty}\right)$

$\Rightarrow \frac{1}{f} = \frac{0.5}{30} = \frac{1}{60}$

$\Rightarrow f_L = 60\,cm$

$f_M = 15\,cm$

So, $P_{net} = 2P_L + P_M$

$= 2\left[\frac{100}{60}\right] + \left[-\frac{100}{-15}\right]$

$= \frac{300}{30} = 10D$

Therefore, $fm_{net} = -\frac{1}{P_{net}}$

$= -10\,cm$

$\therefore R = -20cm$

48. As, $\lambda = \frac{v}{n} = \frac{330}{500} = 0.66\,m = 66cm$

The successive resonance lengths are at $\frac{\lambda}{4}, \frac{3\lambda}{4}, \frac{5\lambda}{4}, \frac{7\lambda}{4}$ and so on,

Within one metre, length of the tube, total number of resonance is $3\left(\text{as}\frac{7\lambda}{4}\text{is more than }1.0\,m\right)$

49. Applying work energy theorem to body

$\Delta KE =$ work done by force delivering power

$= \int_{t=2}^{4} Pdt = \int_{2}^{4} 3t^2 dt = 56J$

50. Beats are produced due to the difference in apparent frequency of the two tuning forks.

CHEMISTRY

51. Hall – Heroults process : used for the extraction of Aluminium

53. More positive E^0_{SRP}:Good OA

54. Gd(Z=64): $[Xe]4f^7 5d^1 6s^2$

55. $Na_2B_4O_7.10H_2O \xrightarrow{\Delta} Na_2B_4O_7 \xrightarrow{\Delta} NaBO_2 + B_2O_3$

$Na_2B_4O_7.10H_2O \xrightarrow{H_2SO_4} Na_2SO_4 + H_3BO_3$

56. In $K_2CrO_4 : Cr^{+6}$

57. Pyrophosphorous acid: 2 P – OH; 2 P – H and 2 P = O

58. $\left[Ni(CO)_4\right] : Ni(0) : sp^3$ $\left[Au(CN)_2\right]^- : Au(I) : sp$

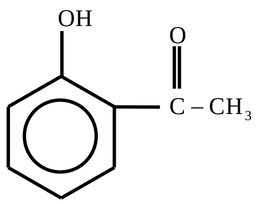
$\left[Pt(CN)_4\right]^{2-} : Pt(II) : dsp^2$ $\left[Au(CN)_4\right]^- : Au(III) : dsp^2$

59. Classical smog: reducing smog

Photochemical smog: oxidizing smog

60. Tripeptide is made with three amino acids i.e., aspargine, Isoleucine, and Phenylalanine

61. Nylon – 2,6 TS made with glycine and amino caproic acid

62. 

gives azodye and also gives iodoformtest

63. Methanamine $\dfrac{\text{Pkb}}{3.38}$ Ethanamine 3.29

N_1N -diethylethanamine 9.38

N – ethyl ethanamine 3.00

64. The IUPAC name of allybromide is 3-Bromo-propene and tert- Butylbromide is 2-Bromo-2-methyl propane

65. $CH_3(CH_2)_9-\underset{\underset{O}{\|}}{C}-O-C_2H_5 \xrightarrow[2.K_2O]{1.DIBAL-H} CH_3(CH_2)_9-\underset{\underset{O}{\|}}{C}-H$

66. $CH_3-CH_2-CH_2-O-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-CH_3 \xrightarrow{con.HI} CH_3-CH_2-CH_2-OH, CH_3-CH_2-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-I$

67. Conceptual

68. E_2 – elimination

69. $2A \rightleftharpoons B+C$

$$Q=\frac{(B)(C)}{(A)^2}=\frac{2\times\frac{1}{2}}{\left(\frac{1}{2}\right)^2}=4$$

$\Delta G^0=-2.303RT\log K$

Given $\Delta G^0=2494.2\,J$, favour reverse reaction

So, log K should be – ve, i.e., K should be 10^{-x}

$\Rightarrow K<Q$

70. Z > 1 means less compressible gas while Z < 1 means more compressible gas

71. $CH_3OH(\ell)+\frac{3}{2}O_2(g)\rightarrow CO_2(g)+2H_2O(\ell);\ \Delta H=-726\,kJ\,mol^{-1}$

$\Delta G_{reaction}=\Delta G_{products}-\Delta G_{reactants}$

$=[-394.4-2\times237.2]-[-166.2]=-868.8+1662=-702.6\,kJ$

Efficiency, $\eta=\dfrac{\Delta G}{\Delta H}\times100=\dfrac{-702.6}{-726}\times100=96.78\%=97\%$

72. 10mL of 0.5 M NaCl $=10\times0.5$ millimoles of NaCl

= 5 millimoles of NaCl

100 mL of total sol requires NaCl = 5 millimoles

1000 mL (i.e., 1L) sol requires NaCl $=\dfrac{5\times1000}{100}=50$ millimoles

73. Boltzmann constant $k=\dfrac{R}{N_A}$

$R=(1.380\times10^{-23})\times(6.023\times10^{23})$

Both the data have 4 significant figures each, the result will also have 4 significant figures R = 8.312

74. Edge length = $2(re+ra)$ = $2(95+181)$ = 552

75. Mass of Acetic acid adsorbed by 2 gm of charcoal = $\frac{(0.6-05)\times 60\times 100}{1000}=0.6$

Mass of Acetic acid adsorbed per gm of charcoal = $=\frac{0.6}{2}=0.3$