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ALLEN CAREER INSTITUTE KOTA (RAJASTHAN) path to success

CLASSROOM CONTACT PROGRAMME
(Academic Session : 2016 - 2017)

JEE (Main + Advanced) : LEADER & ENTHUSIAST COURSE

TARGET : JEE (ADVANCED) 2016

Test Type : **ALL INDIA OPEN TEST** Test Pattern : JEE-Advanced

TEST DATE : 12 - 02 - 2017

PAPER-1

PART-1 : MATHEMATICS **ANSWER KEY**

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	A	D	B	C	A	B	A,C	B,C,D	A,B,C	A,C
	Q.	11	12	13							
	A.	B,C,D	A,C	B,C							
SECTION-IV	Q.	1	2	3	4	5					
	A.	5	2	2	5	7					

SOLUTION

SECTION-I

1. Ans. (A)

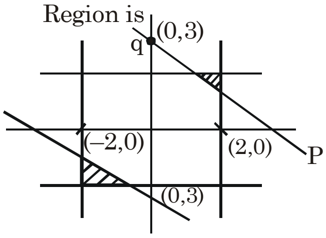
$(2p+2p+6)(-2p-2q+6)<0$

$(p+q+3)(p+q-3)>0$

Also $p^2<4 \Rightarrow p \in (-2,2)$

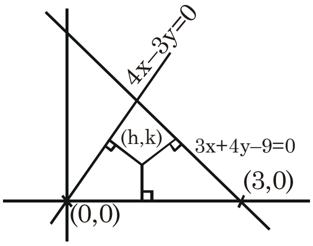
and $q^2<4 \Rightarrow q \in (-2,2)$

Region is



$\therefore$ Area $= 2\times\frac{1}{2}\times1\times1=1$

2. Ans. (D)



$\therefore |k|+\frac{|3h+4k-9|}{5}+\frac{|4h-3k|}{5}=3$

$\therefore k+\frac{9-3h-4k}{5}+\frac{4h-3k}{5}=3$

$h-2k=6 \therefore x-2y=6$

3. Ans. (B)

$$\frac{m!}{(n-1)!(m-n+1)!}>\frac{(m-1)!}{n!(m-1-n)!}\Rightarrow\frac{m}{(m-n+1)(m-n)}>\frac{1}{n}$$

$\therefore mn>(m-n+1)(m-n)$

$\Rightarrow m^2-3mn+m+n^2-n<0$

$m^2-(3n-1)m+n^2-n<0$

$$m\in\left(\frac{3n-1-\sqrt{5n^2-2n+1}}{2},\frac{3n-1+\sqrt{5n^2-2n+1}}{2}\right)$$

clearly some integer must be lying in this interval let it be M(n)

$$\frac{3n-1+\sqrt{5n^2-2n+1}}{2}-1<M(n)<\frac{3n-1+\sqrt{5n^2-2n+1}}{2}$$

$\therefore$ According to sandwich theorem

$$\lim_{n\to\infty}\frac{M(n)}{n}=\frac{3+\sqrt{5}}{2}$$

4. Ans. (C)

$$a_0=\frac{5}{2}=\frac{2^2+1}{2}$$

$$a_1=a_0^2-2=\frac{17}{4}=\frac{2^4+1}{2^2}$$

$$a_2=\frac{2^8+1}{2^4}=\frac{4^4+1}{4^2}$$

Let $a_n=\frac{x^4+1}{x^2}, x=2^{2^{n-1}}$,

$$\prod_{k=0}^{\infty}\left(1-\frac{1}{a_k}\right)=\lim_{n\to\infty}\prod_{k=0}^{n}\left(\frac{a_k-1}{a_k}\right)$$

$$=\lim_{n\to\infty}\frac{a_0-1}{a_0}.\frac{a_1-1}{a_1}.\frac{a_2-1}{a_2}.....\frac{a_n-1}{a_n}$$

$$=\lim_{x\to\infty}\frac{2^2-2+1}{2^2+1}.\frac{4^2-4+1}{4^2+1}.\frac{16^2-16+1}{16^2+1}....\left(\frac{x^2-x+1}{x^2+1}\right)$$

$$=\lim_{x\to\infty}\frac{2^2-1}{2^2+2+1}\ \frac{x^4+x^2+1}{x^4-1}=\frac{3}{7}$$

5. Ans. (A)

Let a variable point on the parabola be $(1+t^2, 2t)$ and its reflection in the given line be (h,k)

$\therefore\ h-(1+t)^2=k-2t=\dfrac{-2\left(1+t^2+2t-2\right)}{2}$

$\therefore\ h-(1+t^2)=-1-t^2-2t+2\Rightarrow h=2(1-t)$ and $k=-(t^2-1)$

$\therefore\ \dfrac{k}{h}=\dfrac{-(t-1)(t+1)}{2(1-t)}\quad\therefore\ t+1=\dfrac{2k}{h}$

and $t=\dfrac{2k}{h}-1$

and $1-t=2-\dfrac{2k}{h}=\dfrac{h}{2}$

$\therefore\ 2h-2k=\dfrac{h^2}{2}$

$\therefore\ 4x-4y=x^2$

$\therefore\ A+B=0.$

6. Ans. (B)

We have to maximize zyxzyy

i.e xy^3z^2 where $x+y+z=1$

$\therefore\ \dfrac{x+3.\frac{y}{3}+2.\frac{z}{2}}{6}\ge\left(x\dfrac{y^3}{3^3}.\dfrac{z^2}{z^2}\right)^{1/6}$

$\therefore\ xy^3z^2\le\dfrac{27.4}{6^6}$

where $x=\dfrac{y}{3}=\dfrac{z}{2}=k$

$\therefore\ k+3k+2k=1\Rightarrow k=\dfrac{1}{6}$

$\therefore\ x=\dfrac{1}{6}\qquad y=\dfrac{1}{2}\qquad z=\dfrac{1}{3}$

7. Ans. (A,C)

L.H.S. > 0 and hence R.H.S > 0

8. Ans. (B,C,D)

(A) $\lim\limits_{x\to0^+}\left(e^{\sin x.\ell n(\tan x)}+e^{\tan x.\ell n(\sin x)}\right)$

$$\lim_{x\to0^+}\left(e^{\frac{\sin x}{x}.\frac{\ell n(\tan x)}{1/x}}+e^{\frac{\tan x}{x}.\frac{\ell n(\sin x)}{1/x}}\right)$$

$1+1=2$

(B) $\lim\limits_{x\to0^+}\dfrac{1-e^{-x}-1+\cos x}{\sqrt{\sin x}\left(\sqrt{1-e^{-x}}+\sqrt{1-\cos x}\right)}$

$$\lim_{x\to0^+}\frac{1-\frac{x^2}{2!}+....-\left(1-\frac{x}{1!}+\frac{x^2}{2!}....\right)}{\sqrt{x}\sqrt{\frac{\sin x}{x}}\left(\sqrt{1-e^{-x}}+\sqrt{1-\cos x}\right)}=1$$

(C) Base is exact 1

(D) $\lim\limits_{n\to\infty}\dfrac{(n+1)(n+2)(2n+3)}{6.\frac{n.(n+1)(2n+1)}{6}}=1$

9. Ans. (A,B,C)

$xdy-y^2dy=ydx\Rightarrow -y^2dy=ydx-xdy$

$\Rightarrow -dy=d\left(\dfrac{x}{y}\right)$

$\therefore\ -y=\dfrac{x}{y}+c$

$-2=\dfrac{4}{2}+c\Rightarrow c=-4$

$\therefore\ -y^2=x-4y$

$x=4y-y^2=4-(y-2)^2$

$(y-2)^2=-(x-4)$

$\therefore$ focus is $\equiv\left(\dfrac{15}{4},2\right)$

equation of directrix

$x=\dfrac{17}{4}\Rightarrow 4x-17=0$

e = 1.

10. Ans. (A,C)

Equation of $L_1 \equiv \frac{x}{0} = \frac{y}{-b} = \frac{z-c}{c}$

Equation of $L_2 \equiv \frac{x}{a} = \frac{y}{0} = \frac{z+c}{c}$

Direction of Π is $\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -b & c \\ a & 0 & c \end{vmatrix}$

$$-bc\hat{i} + ac\hat{j} + ab\hat{k}.$$

Equation of Π is

$-bc(x-0) + ac(y-0) + ab(z-c) = 0$

$$-\frac{x}{a} + \frac{y}{b} + \frac{z}{c} - 1 = 0$$

Distance between L_1 & L_2 is

$$= \left|\frac{(0,0,2c).(bc,ac,-ab)}{\sqrt{b^2c^2+a^2c^2+a^2b^2}}\right|$$

$$\therefore \frac{1}{4} = \left|\frac{2abc}{\sqrt{b^2c^2+c^2a^2+a^2b}}\right|$$

$$\frac{1}{a^2} + \frac{1}{b^2} + \frac{1}{c^2} = 64$$

11. Ans. (B,C,D)

Normal

$y = mx - 2m - m^3$ ...(i)

and $y = mx - km - \frac{m}{2} - \frac{m^3}{4}$ ...(ii)

(i) & (ii) same

$$\frac{1}{1} = \frac{m}{m} = \frac{-2m-m^3}{-km - \frac{m}{2} - \frac{m^3}{4}}$$

$$\Rightarrow 1 = \frac{-8-4m^2}{-m^2-4k-2}$$

$\Rightarrow 3m^2 = 4k - 6$

$m^2 \geq 0 \quad \Rightarrow 4k - 6 \geq 0$

$$\Rightarrow k \geq \frac{3}{2}$$

12. Ans. (A,C)

Let $A \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $\begin{bmatrix} a & b \\ c & d \end{bmatrix}\begin{bmatrix} a & c \\ b & d \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$\therefore a^2 + b^2 = 1$

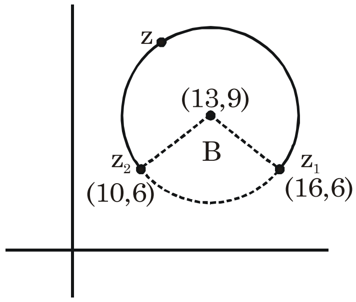
$ac + bd = 0$

$c^2 + d^2 = 1$

$$\det(A - I) = \begin{vmatrix} a-1 & b \\ c & d-1 \end{vmatrix} = ad - a - d - bc + 1$$

a	b	c	d	det(A – I)
1	0	0	1	0
1	0	0	–1	0
–1	0	0	1	0
–1	0	0	–1	4
0	1	1	0	0
0	1	–1	0	2
0	–1	1	0	2
0	–1	–1	0	0

13. Ans. (B,C)



locus is major arc of circle

$$\therefore |z - 13 - 9i| = \sqrt{(13-10)^2 + (9-6)^2}$$

$$\Rightarrow |z - 13 - 9i| = 3\sqrt{2}$$

SECTION–IV

1. Ans. 5

common ratio of G.P is

$-\frac{2}{\pi}\tan^{-1}x$ whose modulus is less than 1.

$$\therefore f(x) = \frac{\tan^{-1}x}{1 + \frac{2}{\pi}\tan^{-1}x}$$

Now domain of $(f(x))^2 + (\sin^{-1}x)^2 = a$ is $x \in [-1,1]$

$$\text{Now, } f(x) = \frac{\pi}{2}\left(1 - \frac{1}{1 + \frac{2}{\pi}\tan^{-1}x}\right)$$

$$\therefore f(x)\Big|_{min} = -\frac{\pi}{2} \text{ at } x = -1$$

$$\text{and } f(x)\Big|_{max} = \frac{\pi}{6} \text{ at } x = 1$$

$\therefore\ f^2(x)\in\left[0,\frac{\pi^2}{4}\right]$ and $\left(\sin^{-1}x\right)^2\in\left[0,\frac{\pi^2}{4}\right]$

$\therefore$ minimum $f^2(x)+(\sin^{-1}x)^2$ is 0

and maximum is $\frac{\pi^2}{2}$

$\therefore\ a\in\left[0,\frac{\pi^2}{2}\right]$

$\therefore$ integral values are 0,1,2,3,4 i.e. 5

2. Ans. 2

$$f(x)+f\left(\frac{x-1}{x}\right)=\tan^{-1}x \qquad ...(1)$$

Replace x by $\frac{x-1}{x}$, we get

$$f\left(\frac{x-1}{x}\right)+f\left(\frac{1}{1-x}\right)=\tan^{-1}\left(\frac{x-1}{x}\right) \qquad ...(2)$$

Replace x by $\frac{1}{1-x}$ in (1) we get

$$f\left(\frac{1}{1-x}\right)+f(x)=\tan^{-1}\left(\frac{1}{1-x}\right) \qquad ...(3)$$

(1)- (2) + (3), we get

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

Also,

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

adding we get

$$2\left(f(x)+f(1-x)\right)=\frac{\pi}{2}+\frac{\pi}{2}+\frac{\pi}{2}\ \forall x\in(0,1)$$

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

Now, $N=\int_0^1 f(x)dx=\frac{1}{2}\int_0^1\left(f(x)+f(1-x)\right)dx=\frac{3\pi}{8}$

3. Ans. 2

Let $g(x) = e^{x/2}f(x)$

then g(x) = 0 has at least 5 distinct zero and using rolle's theorem g'''(x) = 0 has at least two distinct zero.

$$g'(x)=e^{x/2}\left(f'(x)\right)+\frac{1}{2}e^{x/2}f(x)$$

$$g''(x)=e^{x/2}f''(x)+e^{x/2}f'(x)+\frac{1}{4}e^{x/2}f(x)$$

$$g'''(x)=e^{x/2}f'''(x)+\frac{3}{2}e^{x/2}f''(x)+\frac{3}{4}e^{x/2}f'(x)+\frac{1}{8}e^{x/2}f(x)$$

$$=\frac{1}{8}e^{x/2}\left(8f'''(x)+12f''(x)+6f'(x)+f(x)\right)$$

4. Ans. 5

$$I=\int_0^1 x^{1007}\left(1-x^{2016}\right)^{1007}dx$$

Put $x^{1008}=t\Rightarrow x^{1007}dx=\frac{dt}{1008}$

$$\therefore\ I=\frac{1}{1008}\int_0^1\left(1-t^2\right)^{1007}dt=\frac{1}{1008}\int_0^1(1-t)^{1007}(1+t)^{1007}dt$$

$$\therefore\ I=\frac{1}{1008}\int_0^1 t^{1007}(2-t)^{1007}dt$$

Now, Put t = 2z

$$\therefore\ I=\frac{1}{1008}\int_0^{1/2}2^{1007}z^{1007}2^{1007}(1-z)^{1007}\,2dz$$

$$=\frac{2^{2015}}{1008}\int_0^{1/2}z^{1007}(1-z)^{1007}dz$$

$$\therefore\ \frac{N=2^{2015}\times 2\int_0^{1/2}x^{1007}(1-x)^{1007}dx}{\frac{2^{2005}}{1008}\times\int_0^{1/2}z^{1007}(1-z)^{1007}dz}$$

$\therefore\ N = 2016 = 2^5\times 3^2\times 7^1$

$\therefore$ Total 5 divisors of form (4n + 2) ($n\in N$)

5. Ans. 7

Let P denotes the chances of single bacteria to die, then $P=\frac{1}{4}+\frac{1}{2}.P.P+\frac{1}{4}P.P.P$

$\therefore\ P^3+2P^2-4P+1=0\Rightarrow(P-1)(P^2+3P-1)=0$

$$\therefore\ P=\frac{-3+\sqrt{13}}{2}$$

$$\therefore\ 1-P=1-\left(\frac{\sqrt{13}-3}{2}\right)=\frac{5-\sqrt{13}}{2}$$

PART-2 : PHYSICS

ANSWER KEY

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	B	B	B	C	B	A,D	B,D	A,C	B,C	A,C
	Q.	11	12	13							
	A.	A,B	A,C	B,C							
SECTION-IV	Q.	1	2	3	4	5					
	A.	1	3	2	2	4					

SOLUTION

SECTION-I

1. Ans. (B)

Sol. $p(r^3)^{5/3} = c$

$pr^5 = c$

$p = \frac{c}{r^5}$

$\frac{dp}{dT} = -\frac{5c}{r^6} \times \frac{dr}{dT}$

$\frac{1}{p}\frac{dp}{dT} = \frac{r^5}{c} \times \frac{-5c}{r^6} \times k = \frac{-5k}{r}$

2. Ans. (B)

Sol. $\frac{1}{v} + \frac{1}{-30} = \frac{1}{-20}$

$\frac{1}{v} = -\frac{1}{20} + \frac{1}{30} = \frac{-3+2}{60}$

$v = -60$

$m_1 = -\left(\frac{-60}{-30}\right) = -2$

$\frac{1}{v} + \frac{1}{20} = \frac{1}{30}$

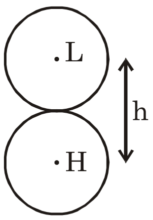
$\frac{1}{v} = \frac{1}{30} - \frac{1}{20} = \frac{2-3}{60} \Rightarrow v = -60$

$m_2 = -\left(\frac{-60}{20}\right) = 3$

$m_1 m_2 = -6$

3. Ans. (B)

Sol.



$\Delta Q = 0 = \Delta U + W$

$= n_1 C_v \Delta T + n_2 C_v \Delta T$

$- m_L gh + m_H gh$

$\Rightarrow \Delta T = -\frac{(m_H - m_L)}{(n_1 + n_2)C_V}\frac{gh}{2}$

$= 1 \times \frac{(131-4)\times 10 \times 1 \times 10^{-3}}{2 \times \frac{3}{2} \times \frac{25}{3} \times 2}$

$= \frac{-127 \times 10^{-2}}{2 \times \frac{3}{2} \times \frac{25}{3} \times 2} = -2.54 \times 10^{-2}\,°C$

4. Ans. (C)

Sol. $360° \rightarrow 200$ div.

$15° \rightarrow 200 \times \frac{18}{360}$ div.

$LC = \frac{1nm}{200}$

$\Rightarrow x = 10 \times \frac{1}{200}$ mm

$F = \frac{1}{20} \times 100 \times 10^{-3}$ = 5 mN

5. Ans. (B)

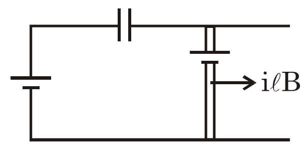
Sol. $1^{st} \rightarrow$ RORI & 2^{nd} RORI

or 1^{st} ROVI or 2^{nd} VORI

VI for 1^{st} lens is real object for 2^{nd}. So 2^{nd} situation is not possible.

6. Ans. (A,D)

Sol.



$\varepsilon - B\ell v - \frac{q}{c} - iR = 0$

$i\ell B = \frac{mdv}{dt}$

$\ell Bq = mv$

$\varepsilon - B\ell v - \frac{mv}{B\ell c} = \frac{mR}{B\ell}\frac{dv}{dt}$

$a = 0$

$\Rightarrow v = \frac{\varepsilon}{B\ell + \frac{m}{B\ell c}} = \frac{\varepsilon B\ell c}{B^2\ell^2 c + m}$

$q = \frac{mv}{B\ell}$

7. Ans. (B,D)

Sol.

$\ell_1 + e = \frac{\lambda}{4}$

$\ell_2 + e = \frac{3\lambda}{4}$

$\lambda = 2(\ell_2 - \ell_1)$

$\Rightarrow v = f\lambda$

$\frac{\Delta v}{v} = \frac{(\Delta\ell_2 + \Delta\ell_1)}{\ell_2 - \ell_1}$

$e = \frac{\ell_2 - 3\ell_1}{2}$

Case-1 : $\frac{\Delta v}{v}\% = \frac{0.1\times 100}{33} \approx 0.3\%$

$e = \frac{50 - 51}{2} = -ve$

Case-2 : $\frac{\Delta v}{v}\% = \frac{0.1\times 100}{50.8} \approx 0.2\%$

$\Rightarrow e = \frac{76 - 75.6}{2} = 0.2 = +ve$

Case-3 : $\frac{\Delta v}{v}\% = \frac{0.1\times 100}{30.4} \approx 0.33\%$

$e = \frac{46.0 - 46.8}{2} = -ve$

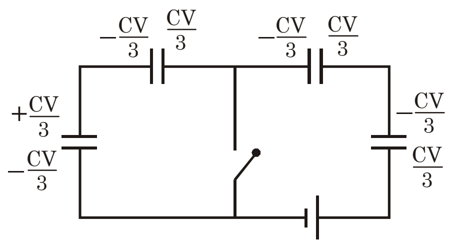
Case-4 : $\frac{\Delta v}{v}\% = \frac{0.1\times 100}{31.5} \approx 0.32\%$

$e = \frac{48.2 - 48.0}{2} = 0.1cm$

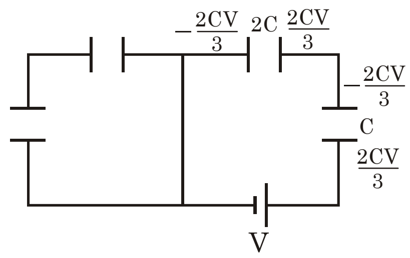
8. Ans. (A,C)

Sol. $\frac{1}{2C} + \frac{1}{2C} + \frac{1}{C} + \frac{1}{C} = \frac{1}{C_{eq}}$

$\Rightarrow \frac{1+1+2+2}{2C} \Rightarrow C_{eq} = \frac{C}{3}$



After short



$\Delta Q_{flow} = \frac{2CV}{3}$

$\Delta W = \frac{CV}{3} \times V = \frac{CV^2}{3}$

9. Ans. (B,C)

Sol. $\frac{dH}{dT} = b(T - T_0)$

$= 3 \times 10^{-3} \times 2\pi \times 0.5 \times \ell \times 80$

$= 2.4\pi \times 10^{-11}$ cal/sec

Case-2

$\frac{dH}{dt} = 3\times 10^{-3} \times 1 \times \ell \times (T - 20) \times 2\pi$

$= \frac{2\pi k\ell}{\ell n(2)} \times (100 - T)$

$3(T - 20) = \frac{2.8\times 10^{-3}}{0.7}(100 - T)$

$3T - 60 = 400 - 4T$

$7T = 460$

$T = \frac{460}{7} = 65.7°C$

$\frac{\frac{dH'}{dt}}{\frac{dH}{dt}} = \frac{3\times 10^{-3}\times \ell\left(\frac{460}{7} - 20\right)\times 2\pi}{2.4\pi \times 10^{-1} \times \ell}$

$= \frac{1}{40}\left(\frac{460 - 140}{7}\right) = \frac{320}{280}$

10. Ans. (A,C)

Sol. $\frac{kQ}{r} = 900$

$\frac{kQ}{r^2} = 90$

$\Rightarrow r = 10$ m

$Q = \frac{900\times 10}{9\times 10^9} = 1\mu C$

$(8-x)^2 + (7-y)^2 = 10^2$

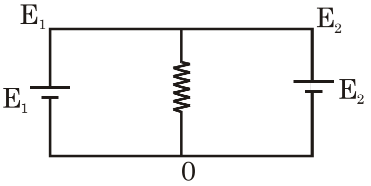
$$E_{surface} = 3\times10^6 = \frac{9\times10^9\times10^{-6}}{r^2}$$

$r^2 = 3\times10^{-3}$

$r = \sqrt{30}$cm

11. Ans. (A,B)

Sol.



$$P = \frac{(E_1 - E_2)^2}{R_1}$$

12. Ans. (A,C)

Sol. $f - mg\sin 37 = ma$

$f = ma + mg\sin\theta \le \mu mg\cos\theta$

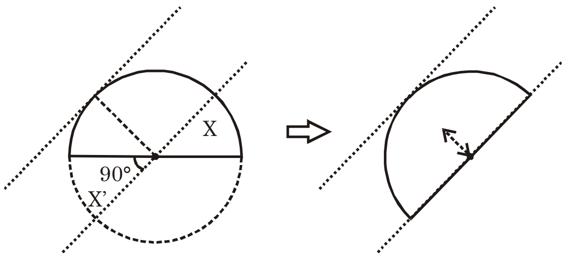
$a \le 8 - 6 = 2\text{m/s}^2$

$\mu mg\cos\theta + mg\sin\theta = ma_{max}$

$a_{max} = 14\ \text{m/s}^2$

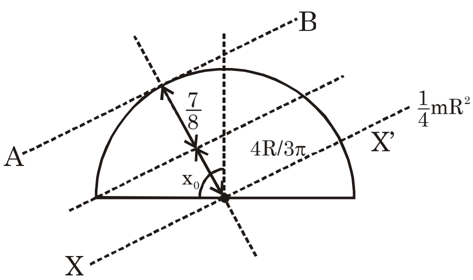
13. Ans. (B,C)

Sol.



$$I_{XX'} + I_{XX'} = \frac{1}{4}\times 2m\times r^2$$

$$I_{XX'} = \frac{1}{4}mr^2$$



$$x = \frac{4R}{3\pi}\sin\theta = \frac{4R}{3\pi}\times\frac{3\pi}{32} = \frac{1}{8}m$$

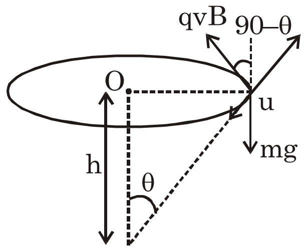
$$I_C = \frac{1}{4}\times1\times1^2 - 1\times\frac{1}{64} = \frac{15}{64}$$

$$I_{AB} = \frac{15}{64} + 1\times\frac{49}{64} = 1\text{kg m}^2$$

SECTION-IV

1. Ans. 1

Sol.



$qvB\sin\theta = mg$

$$qvB\cos\theta = \frac{mv^2}{h\tan\theta}$$

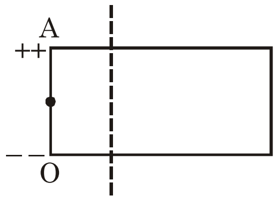
$$qvB = \frac{mv^2}{h\sin\theta}$$

$$mg = \frac{mv^2}{h}$$

$\Rightarrow n = 1$

2. Ans. 3

Sol.



$$mg = eE = \frac{eV}{h}$$

$$V = \frac{mgh}{e}$$

$$Pd = V - iR = V - \frac{V}{4} = \frac{3V}{4} = \frac{3mgh}{4e}$$

3. Ans. 2

Sol. $e\times\frac{kQ}{R} = 1.44\text{keV} \Rightarrow$ charge is constant

$$\Rightarrow \frac{kQ}{R} = 1440\text{V}$$

$$\Rightarrow Q = \frac{1440}{9\times10^9}V = Ne$$

$$N = \frac{1440}{9\times10^9\times1.6}\times10^{19} = 10^{12}$$

$N = N_0(1 - e^{-\lambda t})$

$10^{12} = 4\times10^{12}(1 - e^{-\lambda t})$

$\Rightarrow e^{-\lambda t} = \frac{1}{4} \Rightarrow$ 2 half lives $\Rightarrow$ 2 hrs

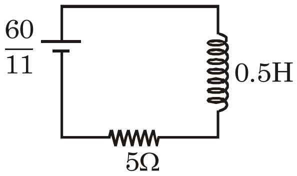
$N_d = 10^{12}$

$$N_S = \frac{1}{3}\times10^{12} = \frac{N_0}{4}$$

$\Rightarrow$ 2 half lifes.

4. Ans. 2

Sol. $\dfrac{\dfrac{180}{11}+\dfrac{0}{3}}{\dfrac{6}{\dfrac{1}{6}+\dfrac{1}{3}}}=\dfrac{60}{11}\Rightarrow$



$i_T=\dfrac{60}{11\times5}\left(1-e^{-\frac{5\times0.1\ell n2}{0.5}}\right)$

$=\dfrac{12}{11}\left(\dfrac{1}{2}\right)=\dfrac{6}{11}A$

$\dfrac{60}{11}-2\times\dfrac{6}{11}=\dfrac{180}{11}-i\times6$

$i\times6=\dfrac{180-48}{11}=\dfrac{132}{11}=12$

i = 2A

5. Ans. 4

Sol. $40\sqrt{2}\times60^\circ\times m=2mv$

$10\sqrt{2}=v$

$v\geq\sqrt{5g\ell}$

$200\geq50l$

$l\leq4$ m

PART-3 : CHEMISTRY — ANSWER KEY

	Q.	1	2	3	4	5	6	7	8	9	10
SECTION-I	A.	C	C	B	A	A	A,C,D	A,C,D	A,B	A,B,C,D	A,B,C,D
	Q.	11	12	13							
	A.	A,B,C,D	D	A,B,C,D							
SECTION-IV	Q.	1	2	3	4	5					
	A.	3	1	2	2	4					

SOLUTION

SECTION-I

1. Ans.(C)

2. Ans.(C)

$H_2\rightarrow2H^++2e^-$

$2CuBr+2e^-\rightarrow2Cu(s)+2Br^-$

$E_{cell}=0.6=E^0_{cell}-\dfrac{0.06}{2}\log[H^+]^2[Br^-]^2$

$0.6=E^0_{cell}+0.48$

$0.12=E^0_{cell}=E^0_{oxidation}+E^0_{reduction}=E^0_{reduction}$

3. Ans. (B)

Sol. $CaC_2+N_2\longrightarrow CaCN_2+C$

Mixture of $CaCN_2$ and carbon is known as nitrolim. It is used as a fertiliser.

4. Ans. (A)

Sol. $FeSO_4$ absorb NO gas and forms brown ring.

5. Ans. (A)

6. Ans. (A,C,D)

(A) [HCl] = 0.1 M

$[H^+]=0.1$ M

(B) $[H_2SO_4]=C$

$HSO_4^-\rightarrow H^+ + SO_4^{2-}$ + Ka_2

C-x   C + x   x

$[H^+]=C+x$

(C) $[HA]=10^{-5}$ M

$K_a=10^{-2}$ M

Weak acid will dissociate completely

$[H^+]=10^{-5}$ M

(D) $H_2O\rightarrow H^++OH^-$

x   C + x

$10^{-14}=(x)(C+x)$

$10^{-14}=2x^2$

$x=\dfrac{1}{\sqrt{2}}\times10^{-7}=C$

$[NaOH]=\dfrac{1}{\sqrt{2}}\times10^{-7}$

$[OH^-]=C+x=\sqrt{2}\times10^{-7}$

$[H^+]=\dfrac{1}{\sqrt{2}}\times10^{-7}$

7. Ans. (A,C,D)

8. Ans. (A, B)

Sol. $HNO_2+NH_2-\underset{\underset{O}{\|}}{C}-NH_2\longrightarrow\underset{(x)}{N_2}+\underset{(y)}{CO_2}+\underset{(z)}{H_2O}$

$Mg+\underset{(x)}{N_2}\longrightarrow\underset{(w)}{Mg_3N_2}\xrightarrow{H_2O}\underset{(p)}{NH_3}\xrightarrow[CuO]{}\underset{(x)}{N_2}$

$$\underset{(y)}{Ca(OH)_2 + CO_2} \longrightarrow \underset{\text{Milky solution}}{CaCO_3}$$

$$\underset{(p)}{NH_3} + K_2HgI_4/OH^{\ominus} \longrightarrow \underset{\text{Brown ppt.}}{HgO\cdot Hg}\begin{matrix}NH_2\\ I\end{matrix}$$

9. Ans. (A, B, C, D)

Sol. $[Ag(NH_3)_2]^+ \rightarrow$ sp hybridisation (linear)

$[Ag(CN)_2]^- \rightarrow$ sp hybridisation (linear)

$[Au(CN)_2]^- \rightarrow$ sp hybridisation (linear)

$ICl_2^{\ominus} \rightarrow sp^3d$ hybridisation (linear)

10. Ans. (A, B, C, D)

Sol.

$$\underset{\text{(Impure)}}{Ni + 4CO} \xrightarrow{50°-60°} \underset{\text{Tetrahedral}}{Ni(CO)_4} \xrightarrow{200°-230°C} \underset{\text{(pure)}}{Ni} + CO\uparrow$$

Maximum 5 atoms are in one plane in $Ni(CO)_4$

11. Ans. (A,B,C,D)

12. Ans. (D)

13. Ans. (A,B,C,D)

SECTION-IV

1. Ans. (3)

$$\Rightarrow \frac{1}{90nm} = R_H\left[\frac{1}{1} - \frac{1}{\infty}\right]$$

$$\Rightarrow \frac{1}{54nm} = \frac{1}{90}z^2\left[\frac{1}{4} - \frac{1}{16}\right]$$

$$\Rightarrow \frac{90\times4\times16}{12\times54} = \frac{80}{9} = z^2$$

$z = 3$

2. Ans.(1)

This is 4n + 2 series, therefore nuclides whose mass no equal to 4n + 2 may form, only possible nuclide is U^{234}

3. Ans. (2)

Sol. $[M(AB)_3]^{\pm n}$ and $[Ma_4b_2]^{\pm n}$ have two geometrical isomer

4. Ans. (2)

5. Ans. (4)

JEE (Main + Advanced) : LEADER & ENTHUSIAST COURSE

TARGET : JEE (ADVANCED) 2016

Test Type : **ALL INDIA OPEN TEST** Test Pattern : JEE-Advanced

TEST DATE : 12 - 02 - 2017

PAPER-2

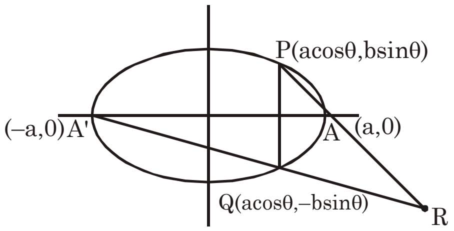
PART-1 : MATHEMATICS **ANSWER KEY**

	Q.	1	2	3	4	5	6	7	8	9	10
SECTION-I	A.	D	C	B	A	C	C	B,D	A,C	A,B	A,B
	Q.	11	12	13	14	15	16	17	18		
	A.	A,D	A,B,C	A,C	A,C	B	D	A	A		

SOLUTION

SECTION-I

1. Ans. (D)



$y = \frac{b\sin\theta}{a(\cos\theta - 1)}(x-a)$ {Equation of PA}

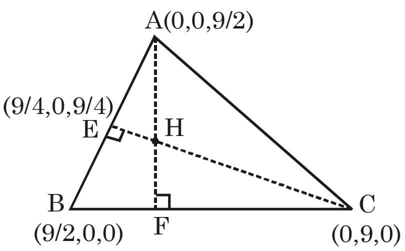
$y = -\frac{b}{a}\cot\frac{\theta}{2}(x-a)$

$y = -\frac{b}{a}\tan\frac{\theta}{2}(x+a)$ {Equation of QA'}

Eliminating θ; $y^2 = \frac{b^2}{a^2}(x^2 - a^2)$

$\Rightarrow \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

2. Ans. (C)



$CE \equiv \vec{r} = (0,9,0) + \lambda(1,-4,1)$

$H \equiv (\lambda, 9-4\lambda, \lambda)$

Equation of plane passing through A & perpendicular to BC is x – 2y = 0.

∵ H lies on this plane

$\lambda - 2(9-4\lambda) = 0 \Rightarrow \lambda = 2$

$\alpha + \beta + \gamma = 9 - 2\lambda = 5$

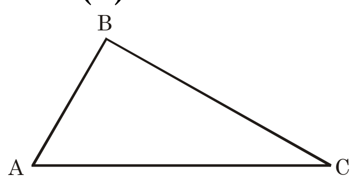
3. Ans. (B)

$I = \int_0^1 \frac{x^2 - 2x + 2 + x^2 - 1}{\sqrt{x^2 - 2x + 2}}dx$

$= \int_0^1 \left(\sqrt{x^2-2x+2} + \frac{(x-1)}{\sqrt{x^2-2x+2}}.(x+1)\right)$

$= \int_0^1 \left(\frac{d}{dx}(x+1)\sqrt{x^2-2x+2}\right)dx = 2 - \sqrt{2}$

4. Ans. (A)



Let 'C' be the origin and $\overrightarrow{CA} = \vec{a}$ and $\overrightarrow{CB} = \vec{b}$ be the position vectors of A and B

$\vec{x} = \vec{a} + \lambda(\vec{a} - \vec{b})$ $\{\vec{x} = c\vec{x}\}$

$\vec{a} + \lambda(\vec{a} - \vec{b}) = \left(\frac{1}{2}\vec{a} + \frac{1}{3}\vec{b}\right)k$ $\{\because c\vec{x} \parallel \vec{\mu}\}$

$1 + \lambda = \frac{k}{2}; -\lambda = \frac{k}{3}$

$1 - \frac{k}{3} = \frac{k}{2} \Rightarrow 1 = \frac{5k}{6} \Rightarrow k = \frac{6}{5}$

$\Rightarrow c\vec{x} = \frac{3}{5}\vec{a} + \frac{2}{5}\vec{b} \Rightarrow \lambda + \mu = 1$

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5. Ans. (C)

B_i :– i rupee coin

& 4 – i paisa coin

$0 \le i \le 4$

$$P(B_i) = \frac{1}{5}$$

E :- Two randomly drawn coin both found to be rupee coin.

$$P(B_2/E) = \frac{\frac{1}{5}\left\{\frac{^2C_2}{^4C_2}\right\}}{\frac{1}{5}\left\{\frac{^2C_2}{^4C_2}+\frac{^3C_2}{^4C_2}+\frac{^4C_2}{^4C_2}\right\}} = \frac{1}{1+3+6}$$

$$P(B_2/E) = \frac{1}{10}$$

Similarly $P(B_3/E) = \frac{3}{10}$

$$P(B_4/E) = \frac{6}{10}$$

P(next drawn coin is rupee coin)

$$= \frac{1}{10}\times\frac{2}{4}+\frac{3}{10}\times\frac{1}{4} = \frac{1}{8}$$

6. Ans. (C)

$$F(x) = \int_0^x f(t)dt \Rightarrow xF\left(\frac{1}{x}\right) = x\int_0^{1/x} f(t)dt$$

Let $\frac{1}{x} = nT + E$

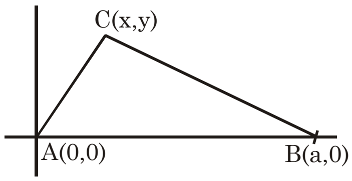
$$\lim_{x\to0} xF\frac{1}{x} = \lim_{n\to\infty}\frac{1}{nT+E}\int_0^{nT+E} f(t)dt$$

$$= \lim_{n\to\infty}\frac{1}{nT+E}\left\{\int_0^{nT} f(t)dt + \int_{nT}^{nT+E} f(t)dt\right\}$$

$$= \lim_{n\to\infty}\frac{n}{nT+E}\int_0^{T} f(t)dt + \frac{1}{nT+E}\int_0^{E} f(t)dt$$

$$= \frac{1}{T}\int_0^T f(t)dt = \frac{1}{3}\times 6 = 2$$

7. Ans. (B,D)



$\tan A = \frac{y}{x}$ $\tan B = \frac{y}{a-x}$

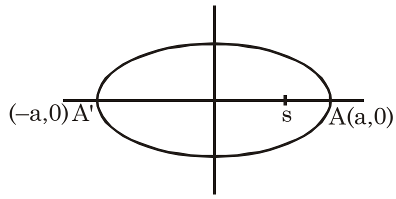
$\tan\frac{B}{2} = \frac{2x}{y}$ $\left\{\because \tan A \tan\frac{B}{2} = 2\right\}$

$$\Rightarrow \frac{4\frac{x}{y}}{1-\frac{4x^2}{y^2}} = \frac{y}{a-x}$$

$$\frac{4x}{y^2-4x^2} = \frac{1}{a-x}$$

$y^2 = 4ax$

8. Ans. (A,C)



$P_1 \Rightarrow y^2 = -4(a-ae)(x-a)$ ......(1)

$P_2 \Rightarrow y^2 = 4(a+ae)(x+a)$ ......(2)

Solving $\Rightarrow$ $(1-e)(a-x) = (1+e)(x+a)$

$x(2) = a(1-e-1-e)$

$x = -ae$

Put in (1) $y^2 = -4a(1-e)(-ae-a)$

$y^2 = 4a^2(1-e^2) = 4b^2$

$P \equiv (-ae, 2b)$ $Q = (-ae, -2b)$

$PQ = 4b$

Differentiating

$$y' = \frac{-2a(1-e)}{y} \Rightarrow m_1 = \frac{-a}{b}(1-e)$$

$$y' = \frac{2a(1+e)}{y} \Rightarrow m_2 = \frac{a}{b}(1+e)$$

$$m_1m_2 = -\frac{a^2}{b^2}(1-e^2) = -1$$

9. Ans. (A,B)

Let A :– Person owns Sedan

B :– Person owns SUV

E :– Person keeps driver

$P(A) = \frac{3}{10}$, $P(B) = \frac{4}{10}$, $P(E/A\bar{B}) = \frac{6}{10}$, $P(E/\bar{A}B) = \frac{7}{10}$,

$P(E/AB) = \frac{9}{10}$

$$P(E)=P(A\bar{B})P(E/A\bar{B})+P(\bar{A}B)P(E/\bar{A}B)+P(AB)P(E/AB)$$

$$=\frac{3}{10}\times\frac{6}{10}\times\frac{6}{10}+\frac{7}{10}\times\frac{4}{10}\times\frac{7}{10}+\frac{3}{10}\times\frac{4}{10}\times\frac{9}{10}$$

$$P(E)=\frac{206}{500}$$

$$P\left(\bar{A}B\cup AB/E\right)=\frac{\frac{243}{1000}+\frac{108}{1000}}{\frac{412}{1000}}=\frac{76}{103}$$

10. Ans. (A,B)

$f(x+f(y)) = f(x) + x + f(x-y)$ ...(1)

Put y = 0 ($f(0) = \lambda$ say)

$f(x+\lambda) = 2f(x) + x$ ....(2)

$x = -\lambda$ in (2)

$\lambda = 2f(-\lambda) + \lambda$

$f(-\lambda) = \lambda$

Put $y = -\lambda$ in (1)

$\Rightarrow f(x+\lambda) = f(x) + x + f(x+\lambda)$

$\Rightarrow f(x) = -x$

11. Ans. (A,D)

$(a+b) = 20e^{i\alpha}$

$(a^2+b^2) = 16e^{i\beta}$

$$\left(a^3+b^3\right)=\frac{1}{2}(a+b)\left\{3\left(a^2+b^2\right)-(a+b)^2\right\}$$

$$=10e^{i\alpha}\left\{48e^{i\beta}-400e^{i2\alpha}\right\}$$

$$\Rightarrow 3520\le\left|a^3+b^3\right|\le 4480$$

12. Ans. (A,B,C)

$(f'(x)-f(x))\,g^2(x) = g(x)+g'(x)$

$(g'(x)+g(x))\,f^2(x) = f(x)-f'(x)$

$\Rightarrow\ -(g(x)+g'(x))f^2(x)g^2(x)=g(x)+g'(x)$

$\Rightarrow\ g(x)+g'(x)=0 \Rightarrow \log g(x) = -x + c$

$\Rightarrow\ g(x) = \lambda e^{-x}$

$$g(x)=(1-\sqrt{2})e^{-x}\quad\left\{\because g(0)=1-\sqrt{2}\right\}$$

Similarly $f(x) = (\sqrt{2}-1)e^{x}$

13. Ans. (A,C)

$f(x) = 2^x - 1 - x^2$

$$\left.\begin{array}{l}f(0)=0\\ f(1)=0\\ f(2)<0\\ f(5)>0\end{array}\right\}\Rightarrow \begin{array}{c}f(x)=0\\ \text{has atleast}\\ \text{3 distinct}\\ \text{real roots}\end{array}$$

Now $f'(x) = 2^x\ell n2 - 2x$

$f''(x) = 2^x\ell n^2 2 - 2$

$f'''(x) = 2^x\ell n^3 2$

$\because$ $f''(x) = 0$ has exactly one real roots

$\Rightarrow$ $f(x) = 0$ has exactly 3 distinct real roots

14. Ans. (A,C)

$$\int_0^{\pi/2}\theta^{100}\sin\theta d\theta=-\theta^{100}.\cos\theta\Big|_0^{\pi/2}+100\int_0^{\pi/2}\theta^{99}.\cos\theta d\theta$$

$$\frac{\int_0^{\pi/2}\theta^{100}\sin\theta d\theta}{\int_0^{\pi/2}\theta^{99}\cos\theta d\theta}=100=\alpha$$

$$100\beta=\int_0^{\pi/2}(100\theta^{99}\sin\theta+\theta^{100}\cos\theta)d\theta$$

$$=\int_0^{\pi/2}(\theta^{100}\sin\theta)'d\theta$$

$$\beta=\left(\frac{\pi}{2}\right)^{100}.\frac{1}{100}$$

Solution for Question 15 to 16

Let α be positive real root

$\Rightarrow$ $a(\alpha^3+\alpha) + b\alpha^2 + (\alpha^4+1) = 0$ ....(1)

$$(\sqrt{a^2+b^2})_{min}=\frac{\alpha^4+\alpha}{\sqrt{(\alpha^3+\alpha)^2+\alpha^4}}$$

{(1) represents line & $\sqrt{a^2+b^2}$ is distance of point on line from origin}

$$(a^2+b^2)_{min}=\frac{\alpha^8+2\alpha^2+1}{\alpha^6+3\alpha^4+\alpha^2}=\frac{\left(\alpha^2+\frac{1}{\alpha^2}\right)^2}{\alpha^2+\frac{1}{\alpha^2}+3}$$

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

$$(a^2+b^2)_{min}\ge\frac{1}{\frac{1}{2}+\frac{3}{4}}=\frac{4}{5}$$

for equality $\alpha^2 = 1$

15. Ans. (B)

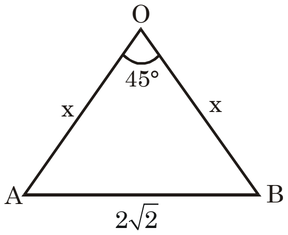
16. Ans. (D)

17. Ans.(A)

Let O be the origin & $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ be P.Vs of A,B,C,D respectively.

$$\cos\theta = \left|\frac{(\vec{a}\times\vec{b})\times(\vec{b}\times\vec{c})}{\frac{\ell^2}{\sqrt{2}}\cdot\frac{\ell^2}{\sqrt{2}}}\right| = \left|\frac{\frac{\ell^2}{\sqrt{2}}\cdot\frac{\ell^2}{\sqrt{2}} - \frac{\ell^2}{\sqrt{2}}\ell^2}{\frac{\ell^4}{2}}\right| = \sqrt{2}-1$$

18. Ans. (A)



$$\frac{1}{\sqrt{2}} = \frac{2x^2-8}{2x^2}$$

$$\sqrt{2}x^2 = 2x^2 - 8$$

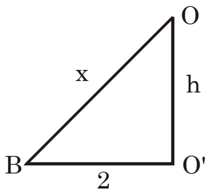
$$x^2(2-\sqrt{2}) = 8$$

$$x^2 = 4(2+\sqrt{2})$$

$$h = \sqrt{x^2-4}$$

$$h = \sqrt{4+4\sqrt{2}}$$

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



$$v = \frac{1}{3}\times 8\times 2\sqrt{\sqrt{2}+1}$$

$$= \frac{16\sqrt{\sqrt{2}+1}}{3}$$

PART-2 : PHYSICS

ANSWER KEY

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	A	B	D	A	D	A	B,C	B,C	A,B,D	A,D
	Q.	11	12	13	14	15	16	17	18		
	A.	A,D	A,C,D	B,C	A,C	C	A	B	A		

SOLUTION

SECTION-I

1. Ans. (A)

Sol. $F_{y\,max} = T\sin\theta$

$$\sin\theta \approx \tan\theta = \frac{\partial y}{\partial x}$$

$y = A \sin kx \sin \omega t$

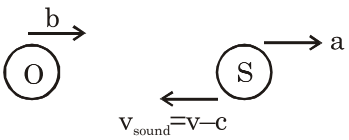
$$\frac{\partial y}{\partial x_{max}} = Ak \Rightarrow F_{y\,max} = TAk$$

$$= 10\times 2\times 10^{-3}\times\frac{2\pi}{1.6}$$

$$= \frac{\pi}{40}\text{N}$$

2. Ans. (B)

Sol.



$$f = \frac{v-c+b}{v-c+a}\times n$$

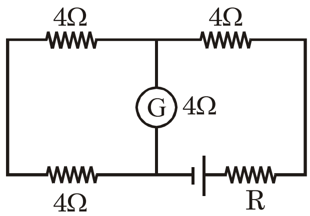
3. Ans. (D)

Sol. $$\lambda = \frac{h}{mv} = \frac{h}{m\sqrt{\frac{3RT}{M}}} \propto \frac{1}{\sqrt{MT}}$$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{M_2T_2}{M_1T_1}} = \sqrt{\frac{4\times 400}{2\times 300}}$$

4. Ans. (A)

Sol. (1)

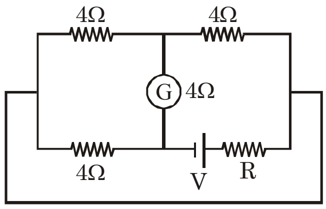


$$i = \frac{V}{\frac{32}{12}+4+R}$$

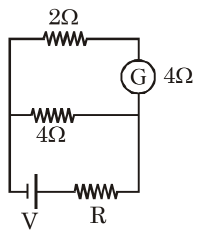
$$i_g = i\times\frac{8}{12} = \frac{2V}{\left(\frac{8}{3}+4+R\right)3}$$

$$0.2 = \frac{2V}{20+3R}$$

(2)



$\Rightarrow$



$$i = \frac{V}{\frac{24}{10} + R}$$

$$i_G = i \times \frac{4}{10}$$

$$= \frac{V}{\frac{24}{10} + R} \times \frac{4}{10}$$

$2V = 2.4 + R$

$2V = 4 + 0.6R$

$4 + 0.6\,R = 2.4 + R$

$\Rightarrow 1.6 = 0.4\,R \Rightarrow R = 4\Omega$

5. Ans. (D)

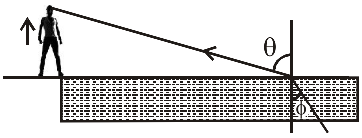
Sol. $V = \frac{kQ}{0.1} = 15 \times 10^3 \Rightarrow Q = \frac{1.5 \times 10^3}{k}$

$$V' = \frac{kq}{0.1} = \frac{k(Q-q)}{R} = 10 \times 10^3$$

$$\Rightarrow q = \frac{10^3}{k}, R = \frac{0.5 \times 10^3}{10 \times 10^3} = 5\text{cm}$$

6. Ans. (A)

Sol.

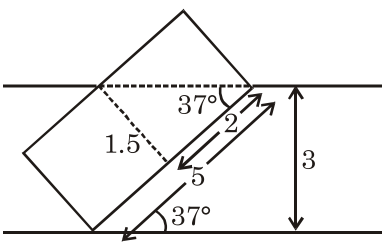


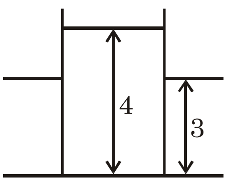
$$d_I = \frac{d}{n}\frac{\cos^3\theta}{\cos^3\phi}$$

as θ increase, d_I decrease

7. Ans. (B,C)

Sol.





fraction full = $\frac{3}{5} + \frac{1}{5} = \frac{4}{5}$

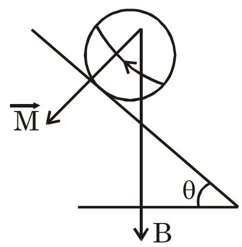
$\Rightarrow$ 20 % empty

N = wt. of 1cm column of water

$$= 1 \times \pi \times \frac{(1.5)^2}{4} \times 10 \times 10^{-3} = \frac{9\pi}{1600}\text{N}$$

8. Ans. (B,C)

Sol.



MB $\sin\theta$ = mg $\sin\theta \times$ R

$$B = \frac{mg}{\pi i R}$$

9. Ans. (A,B,D)

Sol. Beat frequency : $f_1 - f_2 = \pm 5$

$\Rightarrow f_1 = f_2 \pm 5$

$f_1 = f_2 + 5$ or $f_1 = f_2 - 5$

$f_1 = 596$ Hz or $f_1 = 586$ Hz

Intensity : $I = I_0 \cos^2\left(\frac{\omega_1 - \omega_2}{2}\right)t$

$$= I_0 \cos^2 \frac{2\pi}{2}(f_1 - f_2)t$$

$$= I_0 \cos^2 \pi \times 5 \times \frac{27}{20}$$

$$= I_0 \cos^2 \frac{9\pi}{4} = \frac{I_0}{2}$$

10. Ans. (A,D)

Sol. $T = 2\pi\sqrt{\frac{R^3}{GM}}$

$v = A\omega$

$A_1 > A_2$

$\Rightarrow v_1 > v_2$

11. Ans. (A,D)

Sol. ${}^{11}_{6}C \rightarrow {}^{11}_{5}B + {}^{0}_{+1}e + v$

$Q = (M_C - M_B - 2me)C^2$

$= 933.6$ keV

12. Ans. (A,C,D)

Sol. Force in both springs is always same.

$kx_1 = 2kx_2$

13. Ans. (B,C)

14. Ans. (A,C)

Sol. $\dfrac{Q^2}{2\times 4\pi\epsilon_0 R} + 8\pi R^2 S = U$

$\dfrac{Q^2}{8\pi\epsilon_0 R} + 8\pi R^2 S = U$

$\dfrac{dU}{dR} = 0$

$\Rightarrow R^3 = \dfrac{Q^2}{8\pi\epsilon_0 \times 16\pi S}$

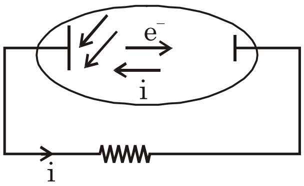
$P = P_0 + \dfrac{4S}{R} - \dfrac{\sigma^2}{2\epsilon_0}$

$= P_0 + \dfrac{4S}{R} - \dfrac{Q^2}{2\epsilon_0 \times 16\pi^2 R^4}$

$= P_0 + \dfrac{4S}{R} - \dfrac{Q^2}{32\pi^2\epsilon_0 R} \times \dfrac{128\pi^2 S\epsilon_0}{Q^2} = P_0$

15. Ans. (C)

Sol.

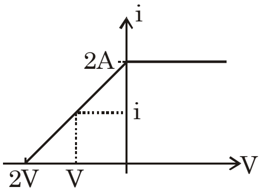


$V_{emit} > V_{Collector}$

$V = -iR$

$V_{Stop} = \dfrac{hC}{e\lambda} - \dfrac{\phi}{e}$

$= \dfrac{1240}{310} - 2 = 2$



$i = 2 + V$

$\Rightarrow i = 2 - iR$

$i(1 + R) = 2$

$i = \dfrac{2}{1+R}$

16. Ans. (A)

Sol. $P = i^2R = \dfrac{4R}{(1+R)^2}$

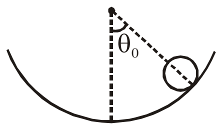
$\dfrac{dP}{dR} = 0 \Rightarrow 4(1+R)^2 - 4R \times 2(1+R) = 0$

$4 + 4R = 8R$

$R = 1\Omega$

17. Ans. (B)

Sol.



θ_0 = amplitude

$\rightarrow$ same.

ΔU = oscillation energy

$\rightarrow$ same

$\Delta U = \dfrac{1}{2}mV_C^2 + \dfrac{1}{2}I_C\omega^2$

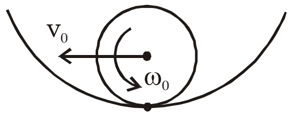
$= \dfrac{1}{2}mV_C^2 + \dfrac{1}{2}I_C\dfrac{V_C^2}{R^2}$

$= \dfrac{1}{2}V_C^2\left(m + \dfrac{I_C}{R^2}\right)$

$I\uparrow \Rightarrow V_C\downarrow$

18. Ans. (A)

Sol. At bottom, sphere is rolling.



I suddenly increases.

$L_i = mV_0R + I_0\omega_0 = mV_0R + I_0\dfrac{V_0}{R}$

$L_{after} = mvR + I\omega = V_0\left(mR + \dfrac{I_0}{R}\right)$

$= V\left(mR + \dfrac{I}{R}\right)$

τ about point of contact is zero.

$\Rightarrow v\downarrow$

$\Rightarrow K = \dfrac{1}{2}mV^2 + \dfrac{1}{2}I\omega^2$

$= \dfrac{1}{2}mV^2 + \dfrac{1}{2}\dfrac{Iv^2}{R^2}$

$= \dfrac{1}{2}v^2\left(m + \dfrac{I}{R^2}\right)$

$= \dfrac{L^2}{2(I + mR^2)}$

$\Rightarrow K\downarrow$

PART-3 : CHEMISTRY

ANSWER KEY

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	C	D	A	B	D	C	C,D	B	A,B,C	A,B,C
	Q.	11	12	13	14	15	16	17	18		
	A.	B,C,D	A,B,C	B,D	C	B	A	B	D		

SOLUTION

SECTION-I

1. **Ans.(C)**

2. **Ans.(D)**

Balanced reaction are

$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$

$4IO_3^- + 20I^- \rightarrow 12I_2 + 12H_2O$

$2Cu(IO_3)_2 + 24\ KI \rightarrow 2CuI + 13I_2 + 12H_2O$

evolved I_2 will react with $Na_2S_2O_3$

equivalents of I_2 evolved = eq. of hypo

$n_{I_2} \times 2 = 52 \times 0.1 \times 1$

$n_{I_2} = 2.6$

$n_{Cu(IO_3)_2} = \frac{2}{13} \times 2.6$

$[Cu_{(IO_3)_2}] = \frac{2 \times 2.6}{13 \times 20}$

$= 2 \times 10^{-2}$

3. **Ans(A)**

1000 ml solution contains 10 mol C_2H_5OH

1000 gm solution contains 460 gm C_2H_5OH

$W_{H_2O} = 540$ gm = 30 mol H_2O

$$P_T = \frac{1 \times 40 + 3 \times 20}{40} = 25 mmHg$$

4. **Ans. (B)**

Sol. (A) π antibonding $\rightarrow$ gerade

(B) σ bonding moleuclar orbital $\rightarrow$ gerade

(C) σ antibonding molecular orbital $\rightarrow$ ungerade

5. **Ans. (D)**

6. **Ans. (C)**

7. **Ans. (C,D)**

8. **Ans. (B)**

9. **Ans. (A,B,C)**

Sol. $Q_{12} = C_p(T_2 - T_1)$

$Q_{34} = C_p(T_4 - T_2)$

$Q_{56} = C_p(T_6 - T_5)$

$T_1 = T_3 = T_5 = T_7 = 298K$

for adiabatic step = 2 – 3

$P_3^{1-r}\ T_3^r = P_2^{1-r}\ T_2^r$

$$\left(\frac{32}{1}\right)^{\frac{1-r}{r}} T_3 = T_2$$

$$T_2 = (32)^{\frac{-2/3}{5/3}} T_3$$

$$= (32)^{-2/5}\ T_3 = \frac{1}{4} T_3 = \frac{1}{4} T_1$$

$T_4 = 32^{-2/5}\ T_5 = 2^{-2/5}\ T_3 = T_2 = T_6$

$Q_{total} = C_p \times 3\ (T_2 - T_1)$

$$= \frac{5}{2} R \times 3 \left(-\frac{3}{4} \times 300\right) = 45 \times 75 = -3375 \text{ cal.}$$

$$\Delta S_{sys} = 0 + 1 \times R\ln \frac{1}{(32)^3}$$

$\Delta S_{sys} = -15R\ \ell n2$

10. **Ans. (A, B, C)**

Sol. Statement (D) is incorrect because there are gerade as well as ungerade orbitals exist.

11. **Ans. (B, C, D)**

Sol. 'X' $\Rightarrow B_3N_3H_6$

12. **Ans. (A, B, C)**

Sol. Metal is Ag.

$Ag^+ + \text{dil. } HCl \rightarrow AgCl\downarrow$

(X)

(X) is insoluble in dil.HNO_3 but soluble in NH_3 solution, cyanide solution and Hyposolution.

13. **Ans. (B,D)**

14. **Ans. (C)**

15. **Ans. (B)**

Sol. Only O_2 is released finally.

$2MNO_4^- + 10I^{\ominus} + 16H^+ \rightarrow SI_2 + 2Mn^{+2} + 8H_2O$

$I_2 + O_3 \xrightarrow{\text{alkaline}} IO_3^- + O_2$

16. **Ans.(A)**

Sol. $P_4 + IO_3^{\ominus} \rightarrow H_3PO_4 + I_2$

white

17. **Ans. (B)**

18. **Ans. (D)**