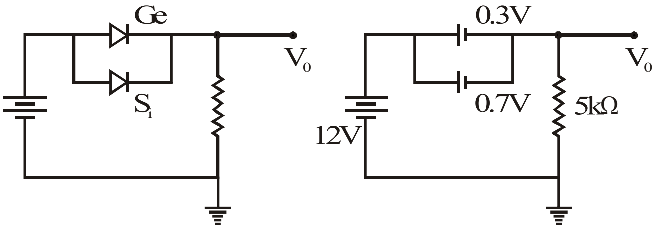
RITS-12
JEE MAINS-2020
ANSWER KEY
Code: 127186

PHYSICS		CHEMISTRY		MATHEMATICS	
1	2	1	2	1	2
2	1	2	2	2	1
3	4	3	1	3	4
4	1	4	1	4	4
5	2	5	2	5	2
6	1	6	4	6	1
7	1	7	3	7	1
8	4	8	3	8	1
9	2	9	1	9	4
10	4	10	2	10	2
11	1	11	2	11	1
12	3	12	4	12	2
13	2	13	2	13	3
14	4	14	4	14	4
15	3	15	1	15	2
16	4	16	1	16	3
17	2	17	3	17	1
18	1	18	3	18	1
19	4	19	1	19	2
20	1	20	4	20	2
1	7	1	2	1	4
2	6	2	3	2	3
3	7	3	8	3	6
4	9	4	8	4	2
5	4	5	5	5	1

SOLUTION

1. Ans. (2)

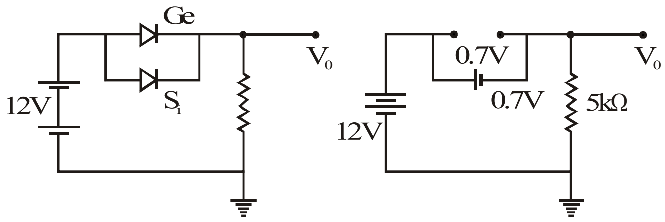
initially



As resistances of diodes are neglisible w.r.t. load resistance

$V_0 = 12 - 0.3 = 11.7$ Volt

Finally



$V_0 = 12 - 0.7 = 11.3$ Volt

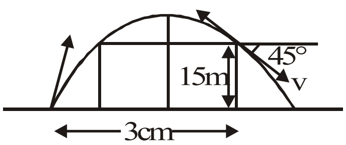
2. Ans. (1)

In FM, modulation index

$$= \frac{\text{frequency deviation}}{\text{mod ulation frequency}}$$

$$= \frac{50 \times 10^3}{7 \times 10^3} = 7.143$$

3. Ans. (4)



$$y = x\tan\theta - \frac{gx^2(1+\tan^2\theta)}{2u^2}$$

$$x^2 = \frac{30 \times 30 \times 10}{45 \times 2}$$

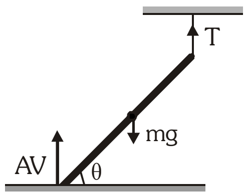
$x^2 = 100$

$V^2 = x^2 + 2 \times 10 \times 15$

$V^2 = 500$

$\Rightarrow \; V = \sqrt{500}\,\text{m/s}$

4. Ans. (1)



$Mg = N + T$ ...(1)

Torque about com will be zero.

$$\therefore \; N \times \frac{\ell}{2}\cos\theta = T \times \frac{\ell}{2}\cos\theta = 0$$

$N = T$

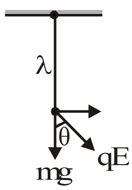
$$\therefore \; T = \frac{mg}{2}$$

5. Ans. (2)

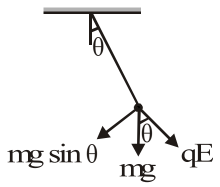
Pendulum will perform oscillatory motion with extreme positions along gravitational force and electronstatic forces.

(1) When pendulum is vertical

torque about line = $qE \sin\theta \times \ell$



(2) When pendulum is along electric field torque about image = mg sin θ × ℓ



$\therefore \quad E = \frac{mg}{q}$

6. Ans. (1)

$$T^2 = 2\pi\sqrt{\frac{\ell}{g_{eff}}}$$

ℓ = length of threads

$$T^1 = \frac{T}{\sqrt{2}}$$

where $T = 2\pi\sqrt{\frac{\ell}{g}}$

$$g_{eff} = 2g = (g + a)$$

$\therefore$ net downwards force = 2mg = mg + iBL

$\therefore \quad i = \frac{mg}{BL}$

7. Ans. (1)

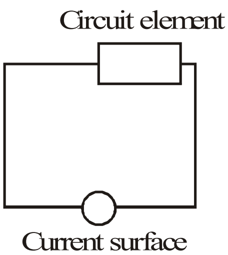
$$n = \frac{180}{18} = 10 \text{ moles}$$

PV = nRT

P × 0.1 = 10 × 8.314 × 1000

P = 8.314 × 10^5 Pa

8. Ans. (4)



$$\frac{dV}{dt} = \frac{8-2}{3} = 2$$

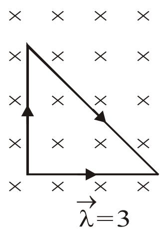
Potential rises with time across capacitor Q = CV

$$\frac{dQ}{dt} = i = C\frac{dV}{dt}$$

1 = C × 2

$\Rightarrow$ C = 0.5 F

9. Ans. (2)



Force due to magnetic field

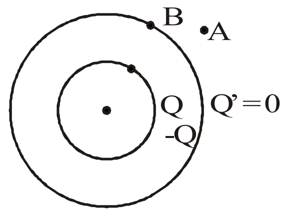
$$= i(\vec{\ell} \times \vec{B}) = 2 \times [0.03\hat{i} \times 2(-\hat{k})] = (0.12\hat{j})N$$

$\therefore$ Acceleration $= \frac{F}{m}$

$$= \frac{0.12}{10 \times 10^{-3}} = (12 m/s^2)\hat{j}$$

10. Ans. (4)

There will be no change on outer surface of outer sphere.



$\therefore \quad V_A = V_B = 0$

$$V_0 = \frac{kQ}{r_a} - \frac{kQ}{r_b} = \frac{Q}{4\pi \in_0}\left[\frac{1}{r_a} - \frac{1}{r_b}\right]$$

But $V_C \neq 0$

11. Ans. (1)

$$A = A_0 \, e^{-\frac{b}{2m}t}$$

$$A = A_0 \, e^{-\frac{xt}{2\delta Ld}}$$

12. Ans. (3)

$$|V| = \left|-\frac{d\phi}{dt}\right| = \oint \vec{E}.\vec{d}l$$

$$\Rightarrow \quad \pi b^2 \frac{B}{\Delta t} = E \times 2\pi a$$

$\therefore$ Force on circular wheel

$$= E \times q = E \times 2\pi a \times \lambda = \frac{\pi b^2 B}{\Delta t} \times \lambda$$

Torque about centre $= a \times F = \frac{\pi b^2 B}{\Delta t} \times \lambda a = I_C \alpha$

$$\therefore \quad I_C \times \frac{\omega}{\Delta t} = \frac{\pi b^2 B \lambda a}{\Delta t}$$

$$\therefore \quad \omega = \frac{\pi b^2 B \lambda a}{I_C} = \frac{\pi b^2 a B \lambda}{2I}$$

13. **Ans. (2)**

Since momentum is transfered to mirror so reflected light is of less momentum so it will have more wavelength.

14. **Ans. (4)**

$$\lambda = \frac{h}{\sqrt{2mT_A}}$$

$$\Rightarrow T_A = \frac{h^2}{2m\lambda_A^2}$$

$$T_B = T_A - 1.5$$

$$\frac{h}{4\times 2m\lambda_A^2} = \frac{h}{\lambda_A^2 \times 2m} - 1.5$$

$$\frac{3}{4}\times\frac{h}{2m\lambda_A^2} = 1.5\text{eV}$$

$$\Rightarrow T_A = \frac{h}{2m\lambda_A^2} = 2.00\text{eV}$$

$\therefore$ $T_B = T_A - 1.5 = 0.5$ eV

$\therefore$ $2 = 4.25 - \phi_A$

$0.5 = 4.7 - \phi_B$

$\Rightarrow$ $\phi_B = 4.2$ eV

15. **Ans. (3)**

By newton's formula $f^2 = x.x'$

$$\therefore\ |m| = \frac{f+x'}{f+x} = \frac{V}{x}$$

$$= \frac{fx+f^2}{fx+x^2} = \frac{f(f+x)}{x(f+x)}$$

$$|m| = \frac{f}{x}$$

16. **Ans. (4)**

Mass of spherical shell of width 'dr' of radius r = dm

$$= \rho_0\left(1-\frac{r^2}{R^2}\right).4\pi r^2.dr$$

$$\therefore\ m = \int_0^R dm$$

$$= \frac{\rho_0}{R^2}\int_0^R (R^2 - r^2)4\pi r^2 dr$$

$$= \frac{\rho_0 \times 4\pi}{R^2}\left[R^2\int_0^R r^2 dr - \int_0^R r^4 dr\right]$$

$$\therefore\ m = \frac{\rho_0 \times 4\pi}{R^2}\left[\frac{R^5}{3} - \frac{R^5}{5}\right]$$

$$m = \frac{\rho_0 \times 8\pi R^3}{15}$$

$\therefore$ Gravitational force on unit mass of $r > R$

$$\therefore\ F = \frac{GM\times 1}{r^2} = \frac{G\times 8\pi\rho_0 R^3}{15r^2}$$

17. **Ans. (2)**

$$V = \frac{\pi d^2}{4}\times h$$

vernier scale reading = (6 ± 0.01) cm

ruler scale reading = (10 ± 1) cm

$$\therefore\ \left(\frac{\Delta V}{V}\right) = \left(2\frac{\Delta d}{d} + \frac{\Delta h}{h}\right)$$

$$\therefore\ \frac{\Delta V}{V}\% = \left(\frac{2\times 0.1}{6} + \frac{1}{10}\right)\times 100\%$$

= 0.1 + 0.033

= 0.133 × 10%

= 13.3 %

18. **Ans. (1)**

Length of micro scope tube = $v_0 + u_e = \ell$ on increasing length $u_e \uparrow$

$$m = \frac{v_0}{u_0}\times\frac{v}{u_e}$$

$\therefore$ $u_e\uparrow \Rightarrow m\downarrow$

19. **Ans. (4)**

$$\ell = n\frac{\lambda}{2} \qquad \Rightarrow \qquad \lambda = \frac{2\lambda}{n}$$

$$f = \frac{nV}{2\ell}$$

$$400 = \frac{n\times 350}{2\ell}$$

$$\ell = \frac{n\times 350}{800} = \frac{7}{16}n$$

n = 1, 2, 3, ...

20. **Ans. (1)**

$$V = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{10}{0.1}} = 10\text{m/s}$$

y = 2 sin (20 t – 2x)

$$\frac{\partial y}{\partial t} = v_p = 0.02\cos(t - 2x)$$

Energy density

$$= \frac{I}{V}\times\text{Area} = \frac{\partial\times A^2\omega^2\cos^2(\omega t - kx)\times\text{Area}\times v}{v}$$

At near position,

Energy density = $\mu \times A^2\,\omega^2$

$= 0.1 \times 4 \times 10^{-4} \times 400$

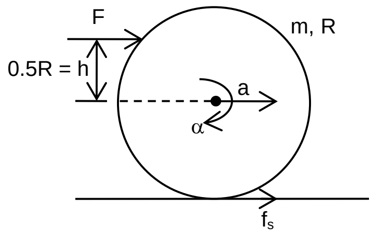
$= 1.6 \times 10^{-2}$ J/m

1. 7

Sol. $F + f_s = ma \quad ....(i)$

$$Fh - f_s R = \frac{2}{5} mR^2 \alpha$$

$$\frac{F}{2} - f_s = \frac{2}{5} ma \quad ...(ii) \qquad [\because a = \alpha R]$$



Solving (i) and (ii), we get

$$\frac{3F}{2} = \frac{7}{5} ma$$

$$\therefore a = \frac{15F}{14m}$$

From equation (i) $f_s = \frac{15F}{14} - F = \frac{F}{14}$

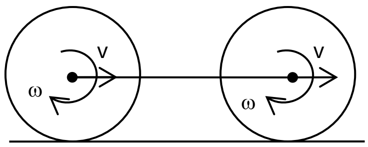
$$f_s \le \mu N$$

$$\frac{F}{14} \le \mu mg$$

$$\therefore F \le 7mg \qquad \therefore F_{max} = 7mg$$

2. 6

Sol. Using conservation of angular momentum of two discs system about an axis passing through point of contact of one disc and fixed to the ground.



$$\frac{mR^2}{2}\omega_0 = 2\left(\frac{mR^2}{2}\omega + mvR\right)$$

$$\frac{mR^2}{2}\omega_0 = 3m\omega R^2 \qquad [\because v = \omega R]$$

$$\omega = \frac{\omega_0}{6}$$

3. 7

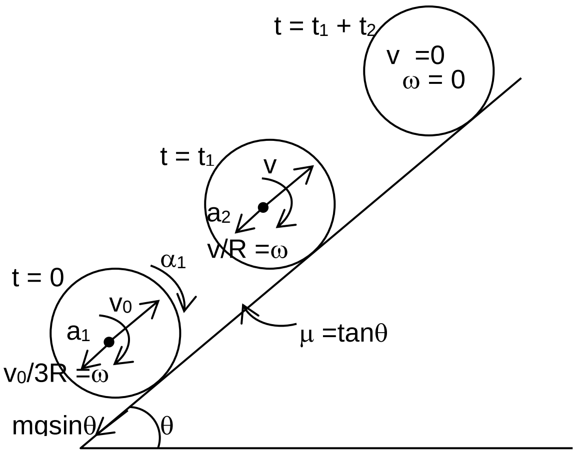
Sol. Let after time $'t_1'$ pure rolling will start

$$a_1 = \frac{mg\sin\theta + f_K}{m} = \frac{2mg\sin\theta}{m}$$

$$= 2g\sin\theta$$

$$f_K R = \frac{mR^2}{2}\alpha_1 \Rightarrow mg\sin\theta R = \frac{mR^2}{2}\alpha_1$$

$$\alpha_1 = \frac{2g\sin\theta}{R}$$



$$v = \omega R$$

$$v_0 - 2g\sin\theta t_1 = \left(\omega_0 + \frac{2g\sin\theta}{R} t_1\right) R$$

$$\frac{2v_0}{3} = 4g\sin\theta t_1 \quad \Rightarrow \quad t_1 = \frac{v_0}{6g\sin\theta} \text{ and } v = v_0 - \frac{v_0}{3} = \frac{2v_0}{3}$$

$$a_2 = \frac{g\sin\theta}{1+\frac{I_{CM}}{mR^2}} = \frac{2}{3}g\sin\theta$$

$$\therefore\ v - a_2 t_2 = 0 \Rightarrow t_2 = \frac{v}{a_2} = \frac{2v_0/3}{2/3\left(g\sin\theta\right)} = \frac{v_0}{g\sin\theta}$$

$\therefore$ Total time of rise up the plane

$$t = t_1 + t_2 = \frac{v_0}{6g\sin\theta} + \frac{v_0}{g\sin\theta} = \frac{7v_0}{6g\sin\theta}$$

4. 9

Sol. $$\frac{\Delta P}{P}\times 100\% = \left(\frac{3\Delta a}{a} + \frac{2\Delta b}{b} + \frac{1}{2}\frac{\Delta c}{c} + \frac{\Delta d}{d}\right)\times 100\%$$

5. 4

Sol. $$x_{cm} = \frac{\sigma\left(\frac{3}{4}\pi R^2\right)\frac{R}{6} + \sigma\left(\frac{\pi R^2}{4}\right)\frac{R}{2}}{\sigma\pi R^2} = \frac{R}{4}$$

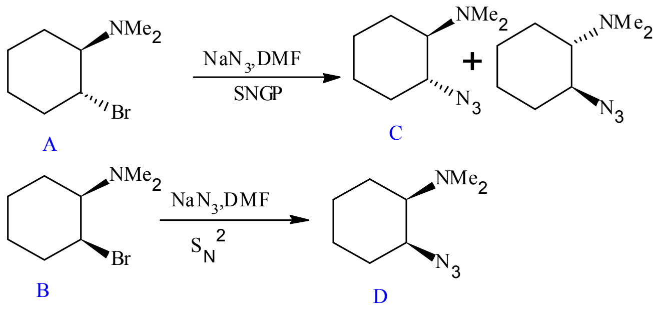
CHEMISTRY

1. **Ans. (2)**

$\lambda_{(NaBr)} = \lambda_{Na+} \times X_{Br^-} = 12 \times 10^{-3}$

$\lambda = \dfrac{K}{1000 \times M} \Rightarrow K = 12 \times 10^{-3} \times 10^{3} \times 0.1 = 1.2$

2. **Ans. (2)**



3. **Ans. (1)**

$$CrO_4^{-2} + H_2O_2 \xrightarrow[\text{in presence of Organic solvent}]{\text{Acidic medium}} CrO_5$$

4. **Ans. (1)**

$$n = \frac{PV}{ZRT} = \frac{81.06 \times 10^6 \times V_1}{1.95 \times R \times 223} \quad \text{(i)}$$

$$n = \frac{20.265 \times 10^6 \times V_2}{1.1 \times R \times 373} \quad \text{(ii)}$$

$$\frac{20.265 \times 10^6 \times V_2}{1.1 \times R \times 373} = \frac{21.06 \times 10^6 \times 10m^3}{1.95 \times R \times 223}$$

$V_2 = 3.77$

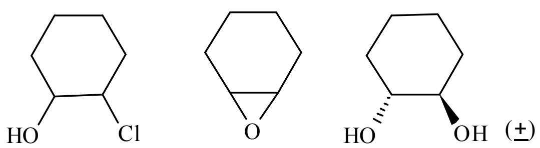
5. **Ans. (2)**

$Au + HNO_3 + 3HCl \rightarrow AuCl_4^{-2} + NO$

$Cu + dil\ HNO_3 \rightarrow Cu(NO_3)_2 + NO$

Au, Cu : transition metals. NO : paramagnetic colourless gas.

6. **Ans. (4)**



(I) (II) (III)

7. **Ans. (3)**

$BaC_2 + H_2O \rightarrow Ba(OH)_2 + C_2H_2$

$SrC_2 + H_2O \rightarrow Sr(OH)_2 + C_2H_2$

$Be_2C + H_2O \rightarrow Be(OH)_2 + CH_4$

8. **Ans. (3)**

Gold number is 0.06 so 0.06mg will be required for 10 ml, so for 100 ml 0.6 mg will be required.

9. **Ans. (1)**

$FeCl_3$ forms $Fe(OH)_3 \downarrow$

10. **Ans. (2)**

Facts

11. Ans. (2)

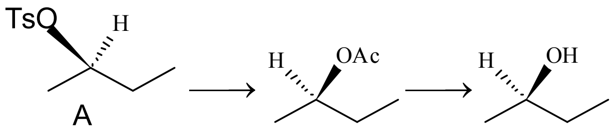
$$C_6H_5CH_2-\underset{\underset{NH}{\|}}{C}-CH_3 \xrightarrow{Ni/H_2} C_6H_5-CH_2-\underset{\underset{NH_2}{|}}{CH}-CH_3$$

Addition-elimination

12. Ans. (4)

H_2O_2 produces electrolysis followed by hydrolysis.

13. Ans. (2)



14. Ans. (4)

15. Ans. (1)

16. Ans. (1)

0.06 ppm, so in 10^6 ml water = 0.06 gm SO_2

$$[SO_2] = \frac{0.06}{64\times10^3} = \frac{6}{64}\times10^{-5}$$

$[H^+] = \frac{12}{64}\times10^{-5}$, So pH = 5 -(log 12 – log64)

= 5.7

17. Ans. (3)

Mozingo reduction.

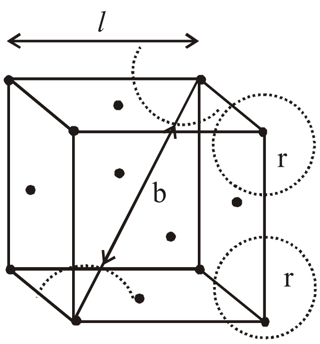
18. Ans. (3)

$d_{x^2-y^2}$: e^- density is present along x & y axis.

d_{z^2} : e^- density is in xy plane also.

19. Ans. (1)

given $\frac{a}{b} = \frac{1}{2}$



then length (a) = l – 2r

then length (b) = $l\sqrt{3} - 2r$

$$\frac{l-2r}{l\sqrt{3}-2r} = \frac{1}{2}$$

$$2l - 4r = l\sqrt{3} - 2r$$

$$2l - l\sqrt{3} = 2r$$

$$\frac{r}{l} = \left(\frac{2-\sqrt{3}}{2}\right) = 0.134$$

20. Ans. (4)

$$B_2H_6 + 2NH_3 \rightarrow \underset{(A)}{[BH_2(NH_3)_2]BH_4} \xrightarrow{\Delta} \underset{(B)}{B_3N_3H_6}$$

3

3 2

1. 2

Sol. $Na \rightarrow Na^{+1}$

$F \rightarrow F^{-1}$

2. 3

3. 8

Sol. CO :- $KK\sigma_{2s}^2 \ \overset{*}{\sigma}_{2s}^2 \ \pi_{2p_x}^{\ 2} \ \pi_{2p_y}^{\ 2} \ \sigma_{2p_z}^{\ 2}$

Bond order = $\frac{1}{2}(8- \ 2) = 3$

CN^- :- $KK\sigma_{2s}^2 \ \overset{*}{\sigma}_{2s}^2 \ \pi_{2p_x}^{\ 2} \ \pi_{2p_y}^{\ 2} \ \sigma_{2p_z}^{\ 2}$

Bond order = $\frac{1}{2}(8- \ 2) = 3$

O_2 : Bond order = 2

$\therefore$ sum of the bond orders = 3+3+2 = 8.

4. 8

Sol. Use $r \ \mu \ \frac{P}{\sqrt{M}}$

5. 5

Sol.

$$N_2O_4 \rightleftharpoons 2NO_2$$

	N_2O_4	$2NO_2$
Initial moles	1	0
After reaction	$1 - \alpha$	2α

$\therefore$ Total moles at equilibrium = 1 + α = 1 + 0.66 = 1.66

1 mole of $N_2O_4 \rightarrow$ 1.66 mole at equilibrium

$\frac{10}{92}$ mole of $N_2O_4 \rightarrow \frac{1.66 ´ \ 10}{92}$ = 0.18 mole at equilibrium

PV = $\frac{w}{m}RT$

PART C - MATHEMATICS

1. Ans. (2)

$$x-\frac{x^3}{6}<\sin x<x\ \forall\ x>0$$

$$\Rightarrow f\left(x-\frac{x^3}{6}\right)>f(\sin x)>f(x)$$

$$\Rightarrow \frac{f\left(x-\frac{x^3}{6}\right)}{f(x)}<\frac{f(\sin x)}{f(x)}<1$$

$$\Rightarrow \lim_{x\to\infty}\frac{f\left(x-\frac{x^3}{6}\right)}{f(x)}<\lim_{x\to\infty}\frac{f(\sin x)}{f(x)}<1$$

2. Ans. (1)

$f'(x) = (3\sin^2 x + 2\lambda \sin x)\cos x$

$= 3 \sin x \cos x \left(\sin x+\frac{2\lambda}{3}\right)$

sinx is increasing for $-\frac{\pi}{2}<x<\frac{\pi}{2}$

$$\Rightarrow -1<-\frac{2\lambda}{3}<0 \ \Rightarrow\ 0<\lambda<\frac{3}{2}$$

3. Ans. (4)

$$x^3-x+\frac{1}{x}-\frac{k}{x^2}=0$$

$\Rightarrow x^6-x^4+x^2-kx=0$ .... (i)

and $x^4-x^2+1-\frac{k}{x}=0$ .... (ii)

Adding (i) & (ii)

$$x^6+1=k\left(x+\frac{1}{x}\right)\geq 2 \quad [\because x>0]$$

$$\Rightarrow \int_0^1 x^6dx\geq\int_0^1(2k-1)dx \ \Rightarrow \int_0^1 x^6dx\geq 2k-1$$

But $\int_0^1 x^6dx\geq\frac{1}{10}$

$$\therefore 2k-1\leq\frac{1}{10}\ \Rightarrow\ k\leq\frac{11}{20}$$

4. Ans. (4)

Since $f^{-1}og^{-1}(x) = (gof)^{-1}(x)$

domain of $(gof)^{-1}(x)$ is range of gof(x) which is [–5, –2].

$\Rightarrow$ Number of integers are 4

5. Ans. (2)

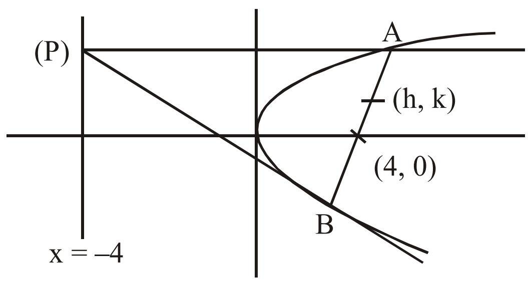
$AX = \lambda X \Rightarrow (A - \lambda I)X = O$

$$X\neq O\Rightarrow\begin{vmatrix}4-\lambda & 6 & 6\\ 1 & 3-\lambda & 2\\ -1 & -5 & -2-\lambda\end{vmatrix}=0$$

$\Rightarrow (\lambda - 1)(\lambda - 2)^2 = 0$

$\Rightarrow \lambda = 1, 2$

6. Ans. (1)



Equation of AB

$T = S_1$

$yk - 8(x + h) = k^2 - 16h$

this chord passing through (4, 0)

$0 - 8(4 + h) = k^2 - 16h$

$y^2 = 8(x - 4)$

So, focus is (6, 0)

7. **Ans. (1)**

For $A \cap B \neq \phi$ (0, c) lies with in ellipse

$$\frac{x^2}{3}+\frac{2y^2}{3}=1$$

So, $c \in \left[-\frac{\sqrt{6}}{2}, \frac{\sqrt{6}}{2}\right]$

8. **Ans. (1)**

$x \in (1, e) \Rightarrow \log x \in (0, 1)$

$\log x > (\log x)^2$

$$\Rightarrow \frac{\log x}{1-x} < \frac{(\log x)^2}{1-x}$$

$$\Rightarrow -\frac{1}{x} < \frac{1}{1-x} < \frac{\log x}{1-x} < \frac{\log^2 x}{1-x}$$

So, $-1 < I_1 < I_2$

9. **Ans. (4)**

$\cos^3 20° - \sin^3 10° - \sin^3 50°$

$$\cos^3\theta = 4\cos^3\theta - 3\cos\theta$$

$$\sin^3\theta = 3\sin\theta - 4\sin^3\theta$$

$$\Rightarrow \frac{\cos 60° + 3\cos 20°}{4} - \left(\frac{3\sin 10° - \sin 30°}{4}\right) - \left(\frac{3\sin 50° - \sin 150°}{4}\right)$$

$$= \frac{1}{4}[\cos 60° + 3(\cos 20 - \sin 10° - \sin 50) + \sin 30 + \sin 150]$$

$$= \frac{1}{4}\left[\frac{3}{2} + 3(\cos 20 - 2\sin 30° \cos 20)\right]$$

$$= \frac{3}{8} + 0 = \frac{a}{b}$$

$b - a = 8 - 3 = 5$

10. **Ans. (2)**

$$\sum_{r=1}^{5} {}^{20}C_{2r-1} = k \Rightarrow {}^{20}C_1 + {}^{20}C_3 + {}^{20}C_5 + {}^{20}C_7 + {}^{20}C_9$$

$$\Rightarrow {}^{20}C_1 + {}^{20}C_3 + ... + {}^{20}C_9 = 2^{18}$$

$$k^6 = (2^{18})^6 \Rightarrow 2^{108} = 2^3[2^{105}]$$

$$= 8[2^{21\times 5}] = 8[32]^{21} = 8[33-1]^{21}$$

$= 8[M(11) - 1] = 8M(11) - 8 = 8M(11) - 11 + 3$

$= (8M(11) - 11) + 3$

11. **Ans. (1)**

Unit's place at $3^{4n} = 1$, $3^{4n+1} = 3$, $3^{4n+2} = 9$, $3^{4n+3} = 7$

Units place at $7^{4n} = 1$, $7^{4n+1} = 7$, $7^{4n+2} = 9$, $7^{4n+3} = 3$

We have 25 probability each for 4n, 4n + 1, 4n + 2, 4n + 3

Now, for digit equal to 8 at units place

$$P = \frac{25\times 25 + 25\times 25}{100\times 99} = \frac{1850}{9900} = \frac{37}{198}$$

12. **Ans. (2)**

$$S_n = \sum_{r=1}^{n} \frac{2r+1}{r^2(r+1)^2} = \sum_{r=1}^{n}\left(\frac{1}{r^2} - \frac{1}{(r+1)^2}\right)$$

$$S_{20} = \left(\frac{1}{1} - \frac{1}{2^2}\right) + \left(\frac{1}{2^2} - \frac{1}{3^2}\right) + ...\left(\frac{1}{20^2} - \frac{1}{21^2}\right)$$

$$S_{20} = 1 - \frac{1}{441} = \frac{440}{441}$$

So, $\sqrt{n+1} = \sqrt{441} = 21$

13. **Ans. (3)**

$\angle PAD = 39° = \angle DBA$ (Alternate segments are asked)

BCD = 103°

$\angle BAD = 77°$

$\angle ADB = 180° - 77° - 39° = 64°$

14. **Ans. (4)**

E _ _ E _ _ _

Total 4 posibilities and to arrange NWYRA we can arrange them in 5! ways

Total = 5! × 4 = 480

Answer = 480 – 1 = 479 (as rearrangements are asked)

15. **Ans. (3)**

D > 0

For this maximum value of k = 6 = 2 × 3

So, number of divisors = (1 + 1)(1 + 1) = 4

So, number of proper divisors = 4 – 2 = 2

16. **Ans. (3)**

We have, $\log\frac{dy}{dx} = 9x - 6y + 6$

$$\Rightarrow \frac{dy}{dx} = e^{9x+6}\cdot e^{-6y}$$

$\Rightarrow e^{6y}dy = e^{9x+6}dx$

Integrating, $\frac{e^{6y}}{6} = \frac{e^{9x+6}}{9} + c$

Putting x = 0, y = 1; we get

$$\frac{e^6}{6} = \frac{e^6}{9} + c \Rightarrow c = \frac{e^6}{18}$$

$\therefore$ Solution is $\frac{e^{6y}}{6} = \frac{e^{9x+6}}{9} + \frac{e^6}{18}$

$3e^{6y} = 2e^{9x+6} + e^6$

17. Ans. (1)

If a line makes angle θ_1, θ_2, θ_3 with the planes x=0, y = 0, z = 0 then

$\sin^2\theta_1 + \sin^2\theta_2 + \sin^2\theta_3 = 1$

Here, $\theta_1 = \theta_2 = a$

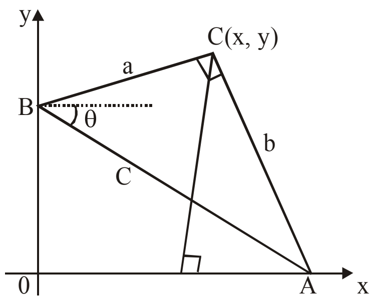
$\therefore\ 2\sin^2\alpha + \sin^2\theta_3 = 1$

$1 - 2\sin^2\alpha = \sin^2\theta_3 \geq 0$

$\cos 2\alpha \geq 0$

$$\Rightarrow 2\alpha \in \left[0, \frac{\pi}{2}\right] \Rightarrow \alpha \in \left[0, \frac{\pi}{4}\right]$$

18. Ans. (1)



x = acos(B – θ) = acosBcosθ + asinBsinθ

$$= \frac{a^2}{c}\cos\theta + \frac{ab}{c}\sin\theta = \frac{a}{c}(a\cos\theta + b\sin\theta)$$

y = bsin(θ + A) = bsinθcosA + bcosθsinA

$$= \frac{b^2}{c}\sin\theta + \frac{ab}{c}\cos\theta = \frac{b}{c}(b\sin\theta + a\cos\theta)$$

$\therefore \frac{y}{x} = \frac{b}{a}$; straightl ine

19. Ans. (2)

$$\sqrt{3} = \left|(\vec{b} - \vec{a}) \cdot \frac{(\vec{p} \times \vec{q})}{|\vec{p} \times \vec{q}|}\right|$$

$$\Rightarrow \sqrt{3} = |\vec{b} - \vec{a}|\cos 30° \Rightarrow |\vec{b} - \vec{a}| = AB = 2$$

20. Ans. (2)

Clearly, $\vec{r} \cdot \vec{a} = \beta[\vec{a}\ \ \vec{b}\ \ \vec{c}] = \frac{1}{8}\beta$

$$\vec{r} \cdot \vec{a} = \beta[\vec{a}\ \ \vec{b}\ \ \vec{c}] = \frac{1}{8}\beta$$

$$\vec{r} \cdot \vec{b} = \gamma[\vec{a}\ \ \vec{b}\ \ \vec{c}] = \frac{1}{8}\gamma$$

$$\therefore \vec{r} \cdot (\vec{a} + \vec{b} + \vec{c}) = \frac{1}{8}(\alpha + \beta + \gamma)$$

$$\therefore \alpha + \beta + \gamma = 8\vec{r} \cdot (\vec{a} + \vec{b} + \vec{c})$$

1. 4

Sol. $\tan^2 x = 1$

$\tan x = \pm 1$

2. 3

Sol. $cot\left(\frac{A}{2}\right), cot\left(\frac{B}{2}\right), cot\left(\frac{C}{2}\right)$ are in A.P.

$$cot\left(\frac{A}{2}\right)cot\left(\frac{B}{2}\right)cot\left(\frac{C}{2}\right) = cot\left(\frac{A}{2}\right) + cot\left(\frac{B}{2}\right) + cot\left(\frac{C}{2}\right)$$

$$cot\left(\frac{A}{2}\right)cot\left(\frac{C}{2}\right) = 3$$

A.M. ≥ G.M

$$\frac{cot\left(\frac{A}{2}\right) + cot\left(\frac{C}{2}\right)}{2} \geq \sqrt{3}$$

Minimum value of $cot\left(\frac{B}{2}\right)$ is $\sqrt{3}$

$K^2 = 3$

3. 6

Sol. $$tan\left(\frac{A-B}{2}\right) = \frac{a-b}{a+b}cot\left(\frac{C}{2}\right)$$

$$\frac{1}{\sqrt{63}} = \frac{5-4}{5+4}cot\left(\frac{C}{2}\right)$$

$c^2 = 36$

$c = 6$

4. 2

Sol. $r^2 - 4r - 12 = 0$

$r = 6, r = -2$

$\sin\theta = \frac{1}{2}, \quad \sin\theta = \frac{-3}{2}$

$\theta = \frac{\pi}{6}, \frac{5\pi}{6}$

$(r, \theta) = \left(6, \frac{\pi}{6}\right)$ and $\left(6, \frac{5\pi}{6}\right)$

5. 1

Sol. $$tan\left(2tan^{-1}\left(\frac{1}{5}\right)\right) = \frac{5}{12}$$

$$17x^2 - 17x\,tan\left(\frac{\pi}{4} - 2tan^{-1}\left(\frac{1}{5}\right)\right) - 10 = 0$$

$$(x-1)(17x+10) = 0$$