SRI CHAITANYA EDUCATIONAL INSTITUTIONS, A.P.

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CENTRAL OFFICE- MADHAPUR

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MATHEMATICS

1. The equation of a straight line, perpendicular to $3x-4y=6$ and forming a triangle of area 6 square units with coordinate axes, is

1) $x-2y=6$ 2) $4x+3y=12$ 3) $4x+3y+24=0$ 4) $3x+4y=12$

Sol: $\perp$ line is $4x+3y=k$ and area $\frac{k^2}{24}=6$

$k=\pm 12$

$\therefore$ *line* $4x+3y=12$

2. If the image of $\left(\frac{-7}{5},\frac{-6}{5}\right)$ in a line is $(1,2)$, then the equation of the line is

1) $4x+3y=1$ 2) $3x-y=0$ 3) $4x-y=0$ 4) $3x+4y=1$

Sol : Equation of line through midpoint of $AB=\left(\frac{-1}{5},\frac{2}{5}\right)$ and with slope $\frac{-3}{4}$ is

$y-\frac{2}{5}=\frac{-3}{4}\left(x+\frac{1}{5}\right)$

So $3x+4y=1$

3. If a line l passes through $(k,2k),(3k,3k)$ *and* $(3,1), k\neq 0,$ then the distance from the origin to the line l is

1) $\frac{1}{\sqrt{5}}$ 2) $\frac{4}{\sqrt{5}}$ 3) $\frac{3}{\sqrt{5}}$ 4) $\frac{2}{\sqrt{5}}$

Sol : points are collinear $\frac{k}{2k}=\frac{1-3k}{3-3k}$

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

$\Rightarrow 3k^2+k=0 \Rightarrow k=-1/3$

$\therefore$ *points are* $(-1,-1)(3,1)$

Equation of line $y+1=\frac{1}{2}(x+1)$

$x-2y-1=0$

$\therefore \perp$ distance from origin $= \dfrac{1}{\sqrt{5}}$

4. The area (in square units) of the triangle formed by the lines $x^2 - 3xy + y^2 = 0$ *and* $x + y + 1 = 0$

1) $\dfrac{2}{\sqrt{3}}$ 2) $\dfrac{\sqrt{3}}{2}$ 3) $5\sqrt{2}$ 4) $\dfrac{1}{2\sqrt{5}}$

Sol : $\dfrac{1^2\sqrt{\frac{9}{4}-1.1}}{1.1^2+3.1.1+1.1^2} = \dfrac{\sqrt{5}}{2.(5)} = \dfrac{1}{2\sqrt{5}}$

5. If $x^2 + \alpha y^2 + 2\beta y = a^2$ represents a pair of perpendicular lines, then $\beta =$

1) 4a 2) a 3) 2a 4) 3a

Sol : $\alpha = -1$
apply $\Delta = 0$

$a^2 - \beta^2 = 0 \Rightarrow \beta = a$

6. A circle with centre at (2,4) is such that the line $x + y + 2 = 0$ cuts a chord of length 6. The radius of the circle is

1) $\sqrt{41}$ 2) $\sqrt{11}$ 3) $\sqrt{21}$ 4) $\sqrt{31}$

Sol : $\not{2}\sqrt{r^2 - 32} = \not{6}\,3$
$r^2 = 41 \Rightarrow r = \sqrt{41}$

7. The point at which the circles $x^2 + y^2 - 4x - 4y + 7 = 0$ *and* $x^2 + y^2 - 12x - 10y + 45 = 0$ touch each other is

1) $\left(\dfrac{13}{5}, \dfrac{14}{5}\right)$ 2) $\left(\dfrac{2}{5}, \dfrac{5}{6}\right)$ 3) $\left(\dfrac{14}{5}, \dfrac{13}{5}\right)$ 4) $\left(\dfrac{12}{5}, 2 + \dfrac{\sqrt{21}}{5}\right)$

Sol : $(2,2) : r_1 = \sqrt{4+4-7} = 1$

$(6,5) : r_2 = \sqrt{36+25-45} = 4$

$\left(\dfrac{1\times 6 + 4.2}{5}, \dfrac{1\times 5 + 4.2}{5}\right)$

$= \left(\dfrac{14}{5}, \dfrac{13}{5}\right)$

8. The condition for the lines $lx + my + n = 0$ *and* $l_1x + m_1y + n_1 = 0$ to be conjugate with respect to the circle $x^2 + y^2 = r^2$ is

1) $r^2(ll_1 + mm_1) = nn_1$ 2) $r^2(ll_1 - mm_1) = nn_1$ 3) $r^2(ll_1 + mm_1) + nn_1 = 0$ 4) $r^2(lm_1 + l_1m) = nn_1$

Sol : $r^2(ll_1 + mm_1) = nn_1$

9. The length of the common chord of the two circles $x^2 + y^2 - 4y = 0$ *and* $x^2 + y^2 - 8x - 4y + 11 = 0$

1) $\frac{\sqrt{145}}{4}$ 2) $\frac{\sqrt{11}}{2}$ 3) $\sqrt{135}$ 4) $\frac{\sqrt{135}}{4}$

Sol : $c.c\ is\ s - s' = 0$

$\Rightarrow -8x + 11 = 0$

$\Rightarrow 8x - 11 = 0$

$d = \frac{|-11|}{8}$

Length $2\sqrt{r^2 - d^2} = 2\sqrt{4 - \frac{121}{64}}$

$= 2\sqrt{\frac{135}{64}}$

10. The locus of the centre of the circle which cuts the circle $x^2 + y^2 - 20x + 4 = 0$ orthogonally and touches the line x=2 is

1) $x^2 = 16y$ 2) $y^2 = 4x$ 3) $y^2 = 16x$ 4) $x^2 = 4y$

Sol : $2(-10g + 0) = c + 4 \Rightarrow C = -20g - 4$

$|+g + 2| = \sqrt{g^2 + f^2 - c}$

$\Rightarrow g^2 + 4g + 4 = g^2 + f^2 + 20g + 4$

$\Rightarrow f^2 + 16g = 0$

$\Rightarrow y^2 - 16x = 0$

11. If a normal chord at a point " t" on the parabola $y^2 = 4ax$ subtends a right angle at the vertex, then t=

1) 1 2) $\sqrt{2}$ 3) 2 4) $\sqrt{3}$

Sol : $t^2 = 2$

$t = \sqrt{2}$

12. The slopes of the focal chords of the parabola $y^2 = 32x$ which are tangents to the circle $x^2 + y^2 = 4$ are

1) $\frac{1}{2}, \frac{-1}{2}$ 2) $\frac{1}{\sqrt{3}}, \frac{-1}{\sqrt{3}}$ 3) $\frac{1}{\sqrt{15}}, \frac{-1}{\sqrt{15}}$ 4) $\frac{2}{\sqrt{5}}, \frac{-2}{\sqrt{5}}$

Sol : $y = mx \pm 2\sqrt{1+m^2}$ passes through (8,0)

$\Rightarrow 0 = \not{8}^4 m \pm \not{2}\sqrt{1+m^2}$

$\Rightarrow 4m = \pm\sqrt{1+m^2}$

$\Rightarrow 16m^2 = 1+m^2$

$\Rightarrow 15m^2 = 1$

$\Rightarrow m = \pm\frac{1}{\sqrt{15}}$

13. If tangents are drawn from any point on the circle $x^2+y^2=25$ to the ellipse $\frac{x^2}{16}+\frac{y^2}{9}=1$ then the angle between the tangents is

1) $\frac{2\pi}{3}$ 2) $\frac{\pi}{4}$ 3) $\frac{\pi}{3}$ 4) $\frac{\pi}{2}$

Sol : given circle is a direct or circle to the given ellipse

$\therefore$ angle between tangents is $\theta = \frac{\pi}{2}$

14. An ellipse passing through $\left(4\sqrt{2}, 2\sqrt{6}\right)$ has foci at $(-4,0)$ *and* $(4,0)$. Its eccentricity is

1) $\sqrt{2}$ 2) $\frac{1}{2}$ 3) $\frac{1}{\sqrt{2}}$ 4) $\frac{1}{\sqrt{3}}$

Sol : ae=4

$\Rightarrow \frac{32}{a^2}+\frac{24}{a^2-16}=1$

Solving we get

$\Rightarrow a^2 = 64 \quad a = 8$

$\therefore e = \frac{4}{8} = \frac{1}{2}$

15. A hyperbola passing through a focus of the ellipse $\frac{x^2}{169}+\frac{y^2}{25}=1$. Its transverse and conjugate axes coincide respectively with the major and minor axes of the ellipse. The product of eccentricities is 1. Then the equation of the hyperbola is

1) $\frac{x^2}{144}-\frac{y^2}{9}=1$ 2) $\frac{x^2}{169}-\frac{y^2}{25}=1$ 3) $\frac{x^2}{144}-\frac{y^2}{25}=1$ 4) $\frac{x^2}{25}-\frac{y^2}{9}=1$

Sol : option verification by product of eccentricity =1

$\therefore$ option 3

16. If the line joining $A(1,3,4)$ and B is divided by the point $(-2,3,5)$ in the ratio 1:3 , then B is

1) $(-11,3,8)$ 2) $(-11,3,-8)$ 3) $(-8,12,20)$ 4) $(13,6,-13)$

Sol : $A(1,3,4), B(x,y,z)$

Given ratio = 1:3

$$\therefore (-2,3,5)=\left(\frac{x+3}{4},\frac{y+9}{4},\frac{z+12}{4}\right)$$

$x+3=-8$	$y+9=12$	$z+12=20$
$x=-11$	$y=3$	$z=8$

$\therefore\ B(-11,3,8)$

17. If the direction cosines of two lines are given by $l+m+n=0$ *and* $l^2-5m^2+n^2=0$ then the angle between them is

1) $\frac{\pi}{2}$ 2) $\frac{\pi}{6}$ 3) $\frac{\pi}{4}$ 4) $\frac{\pi}{3}$

Sol : solving given equations

We get $a_1:b_1:c_1=-2:1:1$, $a_2:b_2:c_2=1:1:-2$

$$\therefore \cos\theta=\left|\frac{-2+1-2}{\sqrt{6}\sqrt{6}}\right|=\frac{3}{6}=\frac{1}{2}$$

$\therefore \qquad \theta=60^0$

18. If $A(3,4,5), B(4,6,3), C(-1,2,4)$ *and* $D(1,0,5)$ are such that the angle between the lines $\overleftrightarrow{DC}$ *and* $\overleftrightarrow{AB}$ is θ then $\cos\theta=$

1) $\frac{7}{9}$ 2) $\frac{2}{9}$ 3) $\frac{4}{9}$ 4) $\frac{5}{9}$

Sol : d.r's of $\overline{DC}$ = (-2,2,-1)

d.r's of $\overline{AB}$ = (1,2,-2)

$$\therefore \qquad \cos\theta=\frac{-2+4+2}{3\times 3}=\frac{4}{9}$$

19. $\lim\limits_{x\to 0}\frac{\sqrt{1+x^2}-\sqrt{1-x+x^2}}{3^x-1}=$

1) $\frac{1}{\log 3}$ 2) $\log 9$ 3) $\frac{1}{\log 9}$ 4) $\log 3$

Sol : Rationnalige Nr

$$\underset{x\to 0}{Lt}\frac{x}{\left(3^x-1\right)\left(\sqrt{1+x^2}+\sqrt{1-x+x^2}\right)}=\underset{x\to 0}{Lt}\frac{1}{\left(\frac{3^x-1}{x}\right)\left(\sqrt{1+x^2}+\sqrt{1-x+x^2}\right)}$$

$$=\frac{1}{\log 9}$$

20. If $f:[-2,2]\to R$ is defined by $f(x)=\begin{cases}\frac{\sqrt{1+cx}-\sqrt{1-cx}}{x} & for \quad -2\le x<0\\ \frac{x+3}{x+1} & for \quad 0\le x\le 2\end{cases}$

is continuous on $[-2,2]$, then c=

1) $\frac{2}{\sqrt{3}}$ 2) 3 3) $\frac{3}{2}$ 4) $\frac{3}{\sqrt{2}}$

Sol : since f is continous at x=0

$$\underset{x\to 0^+}{Lt} f(x)=\underset{x\to 0^-}{Lt} f(x)=f(0)$$

$$\Rightarrow 3=\frac{2c}{2}=3 \Rightarrow c=3$$

21. If $f(x)=x\tan^{-1}x$ then $\lim\limits_{x\to 1}\frac{f(x)-f(1)}{x-1}=$

1) $\frac{\pi+3}{4}$ 2) $\frac{\pi}{4}$ 3) $\frac{\pi+1}{4}$ 4) $\frac{\pi+2}{4}$

Sol : $\underset{x\to 1}{Lt}\frac{f(x)-f(1)}{x-1}=\underset{x\to 1}{Lt}\frac{f'(x)}{1}(l'H\,rule)$

$$=f'(1)=\frac{\pi+2}{4}$$

22. $y=\tan^{-1}\left(\frac{\sqrt{1+a^2x^2}-1}{ax}\right)\Rightarrow\left(1+a^2x^2\right)y''+2a^2xy'=$

1) $-2a^2$ 2) a^2 3) $2a^2$ 4) 0

Sol : put $ax=\tan\theta$ then $y=\frac{1}{2}\tan^{-1}(ax)$

$$y' = \frac{a}{2\left(1+a^2x^2\right)}$$

$$y'\left(1+a^2x^2\right)+2a^2xy'=0$$

23. If $f(x)=\frac{x}{1+x}$ *and* $g(x)=f\left(f(x)\right)$ *then* $g'(x)=$

1) $\frac{1}{(2x+3)^2}$ 2) $\frac{1}{(x+1)^2}$ 3) $\frac{1}{x^2}$ 4) $\frac{1}{(2x+1)^2}$

Sol : $g(x)=\frac{x}{1+2x}$

$$g'(x)=\frac{1}{(1+2x)^2}$$

24. If the curves $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ *and* $\frac{x^2}{25}+\frac{y^2}{16}=1$ cut each other orthogonally , then $a^2-b^2=$

1) 9 2) 400 3) 75 4) 41

Sol : The curves $\frac{x^2}{a_1^2}+\frac{y^2}{b_1^2}=1$ *and* $\frac{x^2}{a_2^2}+\frac{y^2}{b_2^2}=1$

Cuts orthogonally then $a_1^2-a_2^2=b_1^2-b_2^2$

$\therefore a^2-b^2=25-16=9$

25. The condition that $f(x)=ax^3+bx^2+cx+d$ has no extreme value is

1) $b^2>3ac$ 2) $b^2=4ac$ 3) $b^2=3ac$ 4) $b^2<3ac$

Sol : $f'(x)=3ax^2+2bx+c=0$

$\Delta<0$

$4b^2-12ac<0$

$b^2<3ac$

26. If there is an error of $\pm0.04cm$ in the measurement of the diameter of a sphere then the approximate percentage error in its volume, when the radius is 10cm, is

1) ±1.2 2) ±0.06 3) ±0.006 4) ±0.6

Sol : $\frac{dr}{dt}=\pm0.02,\ r=10$

$$v=\frac{4}{3}\pi r^3$$

$\log v = \log\frac{4}{3}\pi + 3\log r$

$\frac{\delta v}{v}\times 100 = 3\frac{\delta r}{r}\times 100$

$=(3)\frac{0.02}{10}(100)$

$=\pm 0.6$

27. The value of c in the Lagrange's mean-value theorem for $f(x)=\sqrt{x-2}$ in the interval $[2,6]$ is

1) $\frac{9}{2}$ 2) $\frac{5}{2}$ 3) 3 4) 4

Sol : $f'(c)=\frac{f(b)-f(a)}{b-a}$

$\frac{1}{2\sqrt{c-2}}=\frac{0-2}{4}$

c-2=1

c=3

28. $\int\frac{dx}{\sqrt{\sin^3 x\cos x}} = g(x)+c \Rightarrow g(x)=$

1) $\frac{-2}{\sqrt{\cot x}}$ 2) $\frac{-2}{\sqrt{\tan x}}$ 3) $\frac{2}{\sqrt{\cot x}}$ 4) $\frac{2}{\sqrt{\tan x}}$

Sol : $\int\frac{dx}{\sin^2 x\sqrt{\cot x}}$

$\int\frac{\cos ec^2 x dx}{\sqrt{\cot x}}$

$=-2\sqrt{\cot x}$

$=\frac{-2}{\sqrt{\tan x}}$

29. If $\int\frac{dx}{(1+\sqrt{x})\sqrt{x-x^2}} = \frac{A\sqrt{x}}{\sqrt{1-x}}+\frac{B}{\sqrt{1-x}}+C$, where C is a real constant then $A+B=$

1) 3 2) 0 3) 1 4) 2

Sol : $\frac{1}{(1+\sqrt{x})\sqrt{x-x^2}} = \frac{Ax}{\sqrt{x-x^2}}+\frac{B}{\sqrt{1+x}}+c$

$1 = Ax\left(\sqrt{1+x}\right)+B$

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

$$1-\sqrt{x}=A+B\sqrt{x}$$

$$\therefore A=1, B=-1$$
$$\therefore A+B=0$$

30. For any integer $n\geq 2,$ let $I_n=\int \tan^n x\,dx.$ If $I_n=\frac{1}{a}\tan^{n-1}x-b\,I_{n-2}$ for $n\geq 2,$ then the ordered pair (a,b)=

1) $\left(n-1,\frac{n-1}{n-2}\right)$ 2) $\left(n-1,\frac{n-2}{n-1}\right)$ 3) $(n,1)$ 4) $(n-1,1)$

Sol : $\int \tan^n x\ dx=\frac{\tan^{n-1}x}{n-1}-I_{n-2}$

$(a,b)=(n-1,1)$

31. If $\int \frac{\left(x^2-1\right)}{(x+1)^2\sqrt{x\left(x^2+x+1\right)}}dx=A\tan^{-1}\left(\sqrt{\frac{x^2+x+1}{x}}\right)+c,$ in which c is a constant then A=

1) $\frac{1}{2}$ 2) 3 3) 2 4) 1

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

$\therefore A=2$

32. By the definition of the definite integral , the value of $\lim_{n\to\infty}\left(\frac{1^4}{1^5+n^5}+\frac{2^4}{2^5+n^5}+\frac{3^4}{3^5+n^5}+.....+\frac{n^4}{n^5+n^5}\right)$ is

1) log2 2) $\frac{1}{5}\log 2$ 3) $\frac{1}{4}\log 2$ 4) $\frac{1}{3}\log 2$

Sol : $\sum_{r=0}^{r=n}\frac{r^4}{r^5+n^5}=\int_0^1\frac{x^4}{1+x^5}dx$

$\Rightarrow \frac{1}{5}\log 2$

33. $\int_0^{\pi/6}\cos^4 3\theta.\sin^2 6\theta d\theta=$

1) $\frac{\pi}{96}$ 2) $\frac{5}{192}$ 3) $\frac{5\pi}{256}$ 4) $\frac{5\pi}{192}$

Sol : put $3\theta = t;$ $3d\theta = dt$

$\frac{1}{3}\int_0^{\pi/2} \cos^4 t.\sin^2 2t\,dt$

$\frac{4}{3}\int_0^{\pi/2} \sin^2 t.\cos^6 t dt$

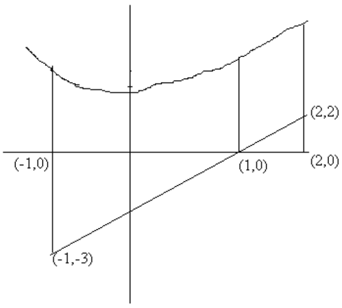
$= \frac{1}{6}.\frac{5}{6}.\frac{3}{4}.\frac{1}{2}.\frac{\pi}{2}$

$= \frac{5\pi}{192}$

34. The area (in square units) of the region bounded by $x = -1, x = 2, y = x^2 + 1 and\ y = 2x - 2$ is

1) 10 2) 7 3) 8 4) 9

Sol:



$\int_{-1}^{2} (x^2 + 1)dx - (2x - 2)dx$

$\Rightarrow \left(\frac{8}{3} + 2\right) - \left\{\frac{-1}{3} - 1\right\} + 2$

$= 3 + 3 + 3$

$= 9$

35. The differential equation of the family of parabolas with vertex at $(0, -1)$ and having axis along the y-axis is

1) $yy' + 2xy + 1 = 0$ 2) $xy' + y + 1 = 0$ 3) $xy' - 2y - 2 = 0$ 4) $xy' - y - 1 = 0$

Sol : $x^2 = 4a(y + 1)$

$2x = 4ay_1$ $a = \frac{x}{2y_1}$

$x^2 = 4.\frac{x}{2y_1}$ $(y + 1)$

$xy_1 = 2y + 2$

$xy_1 - 2y - 2 = 0$

36. The solution of $x\frac{dy}{dx} = y + xe^{y/x}$ with y(1) =0 is

1) $e^{y/x} + \log x = 1$ 2) $e^{-y/x} = \log x$ 3) $e^{-y/x} + 2\log x = 1$ 4) $e^{-y/x} + \log x = 1$

Sol : put $y = vx$

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

$v + x\frac{dv}{dx} = v + e^v$

$\frac{dv}{e^v} = \frac{dx}{x}$ $\int e^{-v}dv = \int \frac{dx}{x}$

$\frac{e^{-v}}{-1} = \log x + c$

$-e^{-y/x} = \log x + c$

$x = 1, y = 0$

$-1 = 0 + c = 1\ c = -1$

$\Rightarrow -e^{-y/x} = \log x - 1$

$1 = \log x + e^{-y/x}$

37. The solution of $\cos y + (x\sin y - 1)\frac{dy}{dx} = 0$ is

1) $x\sec y = \tan y + c$ 2) $\tan y - \sec y = cx$ 3) $\tan y + \sec y = cx$ 4) $x\sec y + \tan y = c$

Sol : $\frac{dx}{dy} = \frac{-x\sin y + 1}{\cos y}$

$\frac{dx}{dy} + x\tan y = \sec y$

$I.f = \sec y$ $x\sec y = \int \sec^2 y.dy$

$x\sec y = \tan y + c$

38. If R is the set of all real numbers and if $f : R - \{2\} \to R$ is defined by $f(x) = \frac{2+x}{2-x}$ for $x \in R - \{2\}$, then the range of f is

1) $R - \{-2\}$ 2) R 3) $R - \{1\}$ 4) $R - \{-1\}$

Sol :

$$\frac{2+x}{2-x}=y$$
$$2+x=2y-xy$$
$$x=\frac{2(y-1)}{y+1}$$
$$R-\{-1\}.$$

39. Let Q be the set of all rational numbers in [0,1] and $f:[0,1]\to[0,1]$ be defined by

$$f(x)=\begin{cases} x & for \quad x\in Q \\ 1-x & for \quad x\notin \end{cases}$$

Then the set $S=\{x\in[0,21]:(fof)(x)\}$ is equal to

1) $[0,1]$ 2) –Q 3) $[0,1]-Q$ 4) $(0,1)$

Sol. If x is rational

$f(x)=x\Rightarrow f(f(x))=f(x)=x$ (1)

If x irrational

$f(x)=1-x$

$\therefore fof(x)=1-(1-x)=x$

$\therefore fof(x)=x$ is possible for all values in Domain $[0,1]$

40. $\sum_{k=1}^{2n+1}(-1)^{k-1}.k^2=$

1) $(n-1)(2n-1)$ 2) $(n+1)(2n+1)$ 3) $(n+1)(2n-1)$ 4) $(n-1)(2n+1)$

Sol. By verification $n=1\ or\ 3$

41. If a,b,c and d are real numbers such that $a^2+b^2+c^2+d^2=1$ and $A=\begin{bmatrix} a+ib & c+id \\ -c+id & a-ib \end{bmatrix}$ then

$A^{-1}=$

1) $\begin{bmatrix} a+ib & -c-id \\ c-id & a-ib \end{bmatrix}$ 2) $\begin{bmatrix} a-ib & c+id \\ -c+id & a+ib \end{bmatrix}$ 3) $\begin{bmatrix} a-ib & -c-id \\ c-id & a+ib \end{bmatrix}$ 4) $\begin{bmatrix} a+ib & c+id \\ c-id & a-ib \end{bmatrix}$

Sol. $A^{-1}=\frac{1}{a^2+b^2+c^2+d^2}\begin{bmatrix} a-ib & -c-id \\ c-id & a+ib \end{bmatrix}$

42. If the matrix $A=\begin{bmatrix}1 & 2 & 3 & 0\\ 2 & 4 & 3 & 2\\ 3 & 2 & 1 & 3\\ 6 & 8 & 7 & \alpha\end{bmatrix}$ is of rank 3, then $\alpha =$

1) -5 2) 5 3) 4 4) 1

Sol. By converting matrix into echelon form $\alpha = 5$

43. If k > 1, and the determinant of the matrix A^2, where $A=\begin{bmatrix}k & k\alpha & \alpha\\ 0 & \alpha & k\alpha\\ 0 & 0 & k\end{bmatrix}$, is k^2 then $|\alpha| =$

1) $\frac{1}{k^2}$ 2) k 3) k^2 4) $\frac{1}{k}$

Sol. $\det A = k^2\alpha$, $\det A^2 = k^4\alpha^2$

$\therefore k^4\alpha^2 = k^2, \Rightarrow \alpha^2 = \frac{1}{k^2} \Rightarrow |\alpha| = \frac{1}{k}$

44. The number of solutions for $z^3 + \bar{z} = 0$ is

1) 5 2) 1 3) 2 4) 3

Sol. $z = x + iy$

The number of solutions 5

45. The least positive integer n for which $(1+i)^n = (1-i)^n$ is

1) 8 2) 2 3) 4 4) 6

Sol. $\left(\frac{1+i}{1-i}\right)^n = (i)^n \quad n = 4$

46. If $x = p+q, y = pw+qw^2$ *and* $z = pw^2+qw$ where w is a complex cube root of unity then xyz=

1) p^3+q^3 2) p^2-pq+q^3 3) $1+p^3+q^3$ 4) p^3-q^3

Sol. $xyz = (p+q)(p\omega+q\omega^2)(p\omega^2+q\omega) = p^3+q^3$

47. If $Z_r = \cos\left(\frac{\pi}{2^r}\right) + i\sin\left(\frac{\pi}{2^r}\right)$ for r = 1,2,3,…… then $Z_1 Z_2 Z_3 \ldots\ldots\ldots\ldots \infty =$

1) -2 2) 1 3) 2 4) -1

Sol. $z_1.z_2.......z_\infty = e^{i\left(\frac{\pi}{2}+\frac{\pi}{2^2}+....\infty\right)} = e^{i\pi} = -1$

48. If $x_1\, and\, x_2$ and the real roots of the equation $x^2 - kx + c = 0$ then the distance between the points $A(x_1,0)\ and\ B(x_2, 0)$ is

1) $\sqrt{k^2+4c}$ 2) $\sqrt{k^2-c}$ 3) $\sqrt{c-k^2}$ 4) $\sqrt{k^2-4c}$

Sol. $AB = |x_1 - x_2| = \sqrt{k^2-4c}$

49. If x is real , then the minimum value of $y = \frac{x^2-x+1}{x^2+x+1}$ is

1) 3 2) $\frac{1}{3}$ 3) $\frac{1}{2}$ 4) 2

Sol. Put x = 1. Minimum value is 1/3.

50. If p and q are distinct prime numbers and if the equation $x^2 - px + q = 0$ has positive integers as its roots then the roots of the equation are

1) $1,-1$ 2) 2,3 3) 1,2 4) 3,1

Sol. $\alpha = 1, \beta = p-1$ and p = 3. $\therefore$ the roots are 1,2

51. The cubic equation whose roots are the squares of the roots of $x^3 - 2x^2 + 10x - 8 = 0$ is

1) $x^3 + 16x^2 + 68x - 64 = 0$ 2) $x^3 + 8x^2 + 68x - 64 = 0$

3) $x^3 + 16x^2 - 68x - 64 = 0$ 4) $x^3 - 16x^2 + 68x - 64 = 0$

Sol. $f\left(\sqrt{x}\right) = 0$

52. Out of thirty points in a plane, eight of them are collinear. The number of straight lines that can be formed by joining these points is

1) 296 2) 540 3) 408 4) 348

Sol. No. of straight lines $30c_2 - 8c_2 + 1 = 408$

53. If n is an integer with $0 \le n \le 11$ then the minimum value of $n!(11-1)!$ is attained when a vlue of n =

1) 11 2) 5 3) 7 4) 9

Sol. 11_{C_n} is maximum . If n = 5

54. If $(a+bx)^{-3} = \frac{1}{27} + \frac{1}{3}x + ...$ then the ordered pair $(a,b) =$

1) $(3,-27)$ 2) $\left(1,\frac{1}{3}\right)$ 3) $(3,9)$ 4) $(3,-9)$

Sol. $a^{-3}\left(1+\frac{bx}{a}\right)^{-3} = \frac{1}{a^3}\left(1-3_{C_1}\left(\frac{bx}{a}\right)+.......\right)$

$(a,b) = (3,-9)$

55. The term independent of x in the expansions of $\left(\sqrt{x} - \frac{2}{\sqrt{x}}\right)^{18}$ is

1) $-\binom{18}{9}2^9$ 2) $\binom{18}{9}2^{12}$ 3) $\binom{18}{6}2^6$ 4) $\binom{18}{6}2^8$

Sol. $r = \left(\frac{np}{p+q}\right) = 9$ independent term = T_{10}

$= 18_{C_9}(-2)^9$

56. $\frac{2x^3+x^2-5}{x^4-25} = \frac{Ax+B}{x^2-5} + \frac{Cx+1}{x^2+5} \Rightarrow (A,B,C) =$

1) $(1, 1, 1)$ 2) $(1, 1, 0)$ 3) $(1, 0, 1)$ 4) $(1, 2, 1)$

Sol. A=1,B=0,C=1

57. If $\cos x = \tan y, \cot y = \tan z$ and $\cot z = \tan x$; then $\sin x =$

1) $\frac{\sqrt{5}+1}{4}$ 2) $\frac{\sqrt{5}-1}{4}$ 3) $\frac{\sqrt{5}+1}{2}$ 4) $\frac{\sqrt{5}-1}{2}$

Sol. $\cos^2 x = \sin x$

$\therefore \sin x = \frac{\sqrt{5}-1}{2}$

58. $\tan 81^0 - \tan 63^0 - \tan 27^0 + \tan 9^0 =$

1) 6 2) 0 3) 2 4) 4

Sol. $\tan\theta + \cot\theta = 2\operatorname{cosec}2\theta$

59. If x and y are acute angles such that $\cos x+\cos y=\frac{3}{2}$ and $\sin x+\sin y=\frac{3}{4}$ then $\sin(x+y)=$

1) $\frac{2}{5}$ 2) $\frac{3}{4}$ 3) $\frac{3}{5}$ 4) $\frac{4}{5}$

Sol. By transformations

$\tan\left(\frac{x+y}{2}\right)=\frac{1}{2}$

$\therefore \sin(x+y)=\frac{4}{5}$

60. The sum of the solution in $(0,2\pi)$ the equation $\cos x\ \cos\left(\frac{\pi}{3}-x\right)\cos\left(\frac{\pi}{3}+x\right)=\frac{1}{4}$ is

1) 4π 2) π 3) 2π 4) 3π

Sol. $\cos 3\theta=1$,solutions are $\frac{2\pi}{3},\frac{4\pi}{3}$

Sum = 2π

61. If x > 0, y > 0, z > 0, xy +yz+zx <1 and if $\tan^{-1}x+\tan^{-1}y+\tan^{-1}z=\pi$ then x + y + z =

1) 0 2) xyz 3) 3xyz 4) $\sqrt{xyz}$

Sol. $\sum \tan A=\Pi \tan A$

$x+y+z=xyz$

62. $\sec h^{-1}\left(\frac{1}{2}\right)-\cos ech^{-1}\left(\frac{3}{4}\right)=$

1) $\log_e\left(3\left(2+\sqrt{3}\right)\right)$ 2) $\log_e\left(\frac{1+\sqrt{3}}{3}\right)$ 3) $\log_e\left(\frac{2+\sqrt{3}}{3}\right)$ 4) $\log_e\left(\frac{2-\sqrt{3}}{3}\right)$

Sol. Formulae

63. In any $\Delta ABC,\frac{(a+b+c)(b+c-a)(c+a-b)(a+b-c)}{4b^2c^2}=$

1) $\sin^2 B$ 2) $\cos^2 A$ 3) $\cos^2 B$ 4) $\sin^2 A$

Sol. $\frac{16\Delta^2}{4b^2c^2}=\sin^2 A$

64. The point P(1,3) undergoes the following transformations successively:

i) Reflection with respect to the line y = x

ii) Translation through 3 units along the positive direction of the X-axis

iii) Rotation through an angle of $\frac{\pi}{6}$ about the origin in the clockwise direction.

The final position of the point P is

1) $\left(\frac{6\sqrt{3}+1}{2},\frac{\sqrt{3}-6}{2}\right)$ 2) $\left(\frac{\sqrt{7}}{2},\frac{-5}{\sqrt{2}}\right)$

3) $\left(\frac{6+\sqrt{3}}{2},\frac{1-6\sqrt{3}}{2}\right)$ 4) $\left(\frac{6+\sqrt{3}-1}{2},\frac{6+\sqrt{3}}{2}\right)$

Sol. I (3,1) II (6,1) III $\left(\frac{6\sqrt{3}+1}{2},\frac{\sqrt{3}-6}{2}\right)$

65. The locus of the centroid of the triangle with vertices at $(a\cos\theta,\sin\theta),(b\sin\theta,-b\cos\theta)$ and $(1,0)$ is (Here θ is a parameter)

1) $(3x+1)^2+9y^2=a^2+b^2$ 2) $(3x-1)^2+9y^2=a^2-b^2$

3) $(3x-1)^2+9y^2=a^2+b^2$ 4) $(3x+1)^2+9y^2=a^2-b^2$

Sol. $a\cos\theta+b\sin\theta=3x-1$

$a\sin\theta-b\cos\theta=3y$

$(3x-1)^2+9y^2=a^2+b^2$

66. If the mean and variance of a binomial variate X are 8 and 4 respectively then P (X < 3) +

1) $\frac{265}{2^{15}}$ 2) $\frac{137}{2^{16}}$ 3) $\frac{137}{2^{16}}$ 4) $\frac{265}{2^{16}}$

Sol. $n=16\ p=1/2, q=1/2$

$p(X<3)=p(X=0)+p(X=1)+p(X=2)$

$\frac{137}{2^{16}}$

67. A random variable X has the probability distribution given below, Its variance is

X	1	2	3	4	5
$P(X=x)$	K	2K	3K	2K	K

1) $\frac{16}{3}$ 2) $\frac{4}{3}$ 3) $\frac{5}{3}$ 4) $\frac{10}{3}$

Sol. $\sum x_i^2 p(x=x_i) - u^2 = \frac{4}{3}$

68. A candidate takes three tests in succession and the probability of passing the first test is a p. The probability of passing each succeeding test is p or $\frac{P}{2}$ according as he passes or fails in the preceding one. The candidates is selected if the passes at least two tests. The probability that the candidate is selected is

1) $p^2(2-p)$ 2) $p(2-p)$ 3) $p+p^2+p^3$ 4) $p^2(1-p)$

Sol. $pp(1-p)+p(1-p)\frac{p}{2}+(1-p)\frac{1}{2}p+ppp$

$p^2(2-p)$

69. A six-faced unbiased die is thrown twice and the sum of the numbers appearing on the upper face is observed to be 7. The probability that the number 3 has appeared at least once is

1) $\frac{1}{5}$ 2) $\frac{1}{2}$ 3) $\frac{1}{3}$ 4) $\frac{1}{4}$

Sol. Sum =7 = $\{(1,6)(6,1)(2,5)(5,2)(4,3)(3,4)\} = n(s) = 6$

$n(E) = 2$

$p(E) = \frac{1}{3}$

70. If A, B and C are mutually exclusive an exhaustive events of a random experiment such that $P(B) = \frac{3}{2}P(A)$ and $P(C) = \frac{1}{2}P(B)$ then $P(A \cup C) =$

1) $\frac{10}{13}$ 2) $\frac{3}{13}$ 3) $\frac{6}{13}$ 4) $\frac{7}{13}$

Sol. $p(A \cup C) = p(A) + p(C) - p(A \cap C)$

$= p(A) + p(C) - 0 = \frac{4}{13} + \frac{3}{13} = \frac{7}{13}$

71. If $x_1, x_2, ...x_n$ are n observations such that $\sum_{i=1}^{n} x_1^2 = 400$ and $\sum_{i=1}^{n} x_1 = 80$ then the least value of n is

1) 18 2) 12 3) 15 4) 16

Sol. $\frac{\Sigma (x_i)^2}{n} - \left(\frac{\Sigma x_i}{n}\right)^2 \geq 0$ by verification n = 16

72. The mean of four observations is 3. If the sum of the squares of these observations is 48 then their standard deviation is

1) $\sqrt{7}$ 2) $\sqrt{2}$ 3) $\sqrt{3}$ 4) $\sqrt{5}$

Sol. $x_2 + x_2 + x_3 + x_4 = 4(3)$

$\therefore \sigma = \sqrt{\frac{48}{4} - (3)^2} = \sqrt{12 - 9} = \sqrt{3}$

73. The shortest distance between the skew lines

$\bar{r} = (\bar{i} + 2\bar{j} + 3\bar{k}) + t(\bar{i} + 3\bar{j} + 2\bar{k})$ and $\bar{r} = (4\bar{i} + 5\bar{j} + 6\bar{k}) + t(2\bar{i} + 3\bar{j} + \bar{k})$ is

1) $\sqrt{6}$ 2) 3 3) $2\sqrt{3}$ 4) $\sqrt{3}$

Sol. Shortest distance = $\frac{\left[\bar{a} - \bar{c} \quad \bar{b} \quad \bar{d}\right]}{\left|\bar{b} \times \bar{d}\right|}$

74. If x, y, z are non-zero real numbers, $\bar{a} = x\bar{i} + 2\bar{j}, \bar{b} = y\bar{j} + 3\bar{k}$ and $\bar{c} = x\bar{i} + y\bar{j} + z\bar{j}$ are such that $\bar{a} \times \bar{b} = z\bar{i} - 3\bar{j} + \bar{k}$ then $\left[\bar{a}\,\bar{b}\;\bar{c}\right] =$

1) 3 2) 10 3) 9 4) 6

Sol. $\bar{a} + \bar{b} = 6\bar{i} - 3x\bar{j} + xy\bar{k}$

$\therefore z = 6$

$x = 1$

$y = 1$

$\left[\bar{a}\,\bar{b}\,\bar{c}\right] = 6 - 3 + 6$

75. If $\bar{a}, \bar{b}$ and $\bar{c}$ are vectors with magnitudes 2,3 and 4 respectively than the best upper bound of $\left|\bar{a}-\bar{b}\right|^2 + \left|\bar{b}-\bar{c}\right|^2 + \left|\bar{c}-\bar{a}\right|^2$ among the given values is

1) 93 2) 97 3) 87 4) 90

Sol. $2\left(\bar{a}^2 + \bar{b}^2 + \bar{c}^2\right) - 2\left(\bar{a}.\bar{b} + \bar{b}.\bar{c} + \bar{c}\bar{a}\right) --- (1)$

And $\left(\bar{a}+\bar{b}+\bar{c}\right)^2 \geq 0 ----- (2)$

From (1) & (2) . Ans. 87

76. The angle between the lines $\bar{r} = \left(2\bar{i} - 3\bar{j} + k\right) + \lambda\left(\bar{i} + 4\bar{j} + 3k\right) and \left(\bar{i} - \bar{j} + 2k\right) + \mu\left(\bar{i} + 2\bar{j} - 3k\right)$ Is

1) $\frac{\pi}{2}$ 2) $\cos^{-1}\left(\frac{9}{\sqrt{91}}\right)$ 3) $\cos^{-1}\left(\frac{7}{\sqrt{84}}\right)$ 4) $\frac{\pi}{3}$

Sol. Dr's Off lines $(1,4,3)$ & $(1,2,-3)$

Here $a_1a_2 + b_1b_2 + c_1c_2 = 0, \theta = \frac{\pi}{2}$

77. If $\bar{a}, \bar{b}$ and $\bar{c}$ are non-coplanar vectors and if $\bar{d}$ is such that $\bar{d} = \frac{1}{x}\left(\bar{a}+\bar{b}+\bar{c}\right)$ and $\bar{d} = \frac{1}{y}\left(\bar{b}+\bar{c}+\bar{d}\right)$ where x and y are non-zero real numbers, then $\frac{1}{xy}\left(\bar{a}+\bar{b}+\bar{c}+\bar{d}\right) =$

1) $3\bar{c}$ 2) $-\bar{a}$ 3) $\bar{0}$ 4) $2\bar{a}$

Sol. $\bar{a}+\bar{b}+\bar{c}-x\bar{d} = \bar{0}$ & $-y\bar{a}+\bar{b}+\bar{c}+\bar{d} = \bar{0}$

$\Rightarrow \bar{a}+\bar{b}+\bar{c}+\bar{d} = \bar{0}$

78. Three non-zero non-collinear vectors $\bar{a}, \bar{b}, \bar{c}$ are such that $\bar{a}+3\bar{b}$ is collinear with $\bar{c}$, while $\bar{c}$ is $3\bar{b}+2\bar{c}$ collinear with $\bar{a}$. Then $\bar{a}+3\bar{b}+2\bar{c} =$

1) $\bar{0}$ 2) $2\bar{a}$ 3) $3\bar{b}$ 4) $4\bar{c}$

Sol. $\bar{a}+3\bar{b}+2\bar{c} = \mu\bar{a}$

$\mu\bar{a}-3\bar{b}-2\bar{c}-\bar{0}=-\bar{a}-3\bar{b}+\lambda\bar{c}=0\Rightarrow\lambda=-2$

$\bar{a}+3\bar{b}+2\bar{c}=\bar{0}$

79. If an a triangle ABC, $r_1=2, r_2=3\ and\ r_3=6$ then a =

1) 4 2) 1 3) 2 4) 3

Sol. $a^2=(r_2+r_3)(r_1-r)=9\Rightarrow a=3$

80. If the angle of a triangle are in the ratio 1 : 1: 4 then the ratio of the perimeter of the triangle to its largest side is

1) $\sqrt{2}+2:\sqrt{3}$ 2) $3:2$ 3) $\sqrt{3}+2:\sqrt{2}$ 4) $\sqrt{3}+2:\sqrt{3}$

Sol. $A:B:C=1:1:4$

$A=B=30^0$

$C=120^0$

$\therefore a+b+c:c=2R\left(\frac{1}{2}+\frac{1}{2}+\frac{\sqrt{3}}{2}\right):2R\left(\frac{\sqrt{3}}{2}\right)$

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

PHYSICS

81. A closed pipe is suddenly opened and changed to an open pipe of same length. The fundamental frequency of the resulting open pipe is less than that of 3rd harmonic of the earlier closed pipe by 55 Hz. Then the value of fundamental frequency of the closed pipe is

1) 165 Hz 2) 110 Hz 3) 55 Hz 4) 220 Hz

Sol. $\frac{3v}{4l}-\frac{v}{2l}=55$

$\therefore\frac{v}{4l}=55hz$

82. A convex lens has its radii of curvature equal .The focal length of the lens is f .If it is divided vertically into two identical plano-convex lenses by cutting it, then the focal length of the plano-convex lens is (μ-the refractive index of the material of the lens)

1) f 2) $\frac{f}{2}$ 3) $2f$ 4) $(\mu-1)f$

Sol. Lens in cut in two parts vertically, focal power becomes half

Hence focal length becomes 2f

83. A thin converging lens of focal length f=25 cm forms the image of an object on a scerren placed at a distance of 75 cm from the lens .The screen is moved closer to the lens by a distance of 25cm .The distance through which the object has to be shifted so that its image on the screen is sharp again is

1) 37.5 cm 2) 16.25 cm 3)12.5 cm 4) 13.5 cm

Sol. $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$

$\frac{1}{75}-\frac{1}{u}=\frac{1}{25}$

$u=\frac{-75}{2}$

$\frac{1}{v^1}-\frac{1}{u^1}=\frac{1}{f}$

$\frac{1}{50}-\frac{1}{u^1}=\frac{1}{25}$

$u^1=50$

$\Delta u=50-37.5=12.5$ c.m

84. In a double slit interference experiment , the fringe width obtained with a light of wavelength $5900\overset{0}{A}$ was 1.2 mm for parallel narrow slits placed 2mm apart. In this arrangement , if the slit separation is increased by one – and –half times the previous value, then the fringe width is

1) 0.9 mm 2) 0.8 mm 3) 1.8 mm 4) 1.6 mm

Sol. $\beta \propto \frac{1}{d}$ .Here d is made 2.5 times. No. Answer

85. A charge Q is divided into two charges q and Q –q .The value of q such that the force between them is maximum, is

1) Q 2) $\frac{3Q}{4}$ 3) $\frac{Q}{2}$ 4) $\frac{Q}{3}$

Sol. $\frac{Q}{2}$

86. Two concentric hollow spherical shells have radii r and r and R(R>>r). A charge Q is distributed on them such that the surface charge densities are equal .The electric potential at the centre is

1) $\frac{Q(R+r)}{4\pi\in_0(R^2+r^2)}$ 2) $\frac{Q(R^2+r^2)}{4\pi\in_0(R+r)}$ 3) $\frac{Q}{R+r}$ 4)0

Sol. According to Dimensions $\frac{Q}{4\pi\in_0}\frac{R+r}{R^2+r^2}$

87. Wires A and B have resistivities ρ_A and ρ_B, $(\rho_B=2\rho_A)$ and have lengths l_A & l_B.If the diameter of the wire B is twice that of A and the two wires have same resistance , then $\frac{l_B}{l_A}$ is

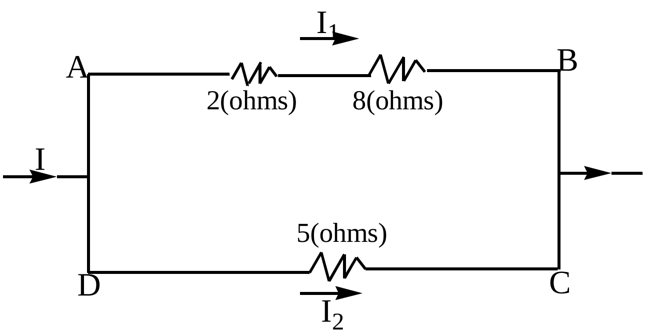
1) 2 2) 1 3) 1/2 4) 1/4

Sol. $R=\rho\frac{l}{\pi r^2}$

Since same resistance $\frac{l_B}{l_A}=\frac{\rho_A}{\rho_B}.\frac{r_B^{\ 2}}{r_A^{\ 2}}$

= 2

88. In the circuit shown , the heat produced in 5 ohms resistance due to current through it is 50 J/s .Then the heat generated/second in 2 ohms resistance is



1) 5 J/s 2) 4 J/s 3) 9 J/s 4) 10 J/s

Sol. $\frac{Q}{t}=i^2R$

$i^2=10$

$Q_{2\Omega}=\left(\frac{i}{2}\right)^2\times 2$

$=\frac{i^2}{4}\times 2=5$

89. A steady current flows in a long wire. It is bent into a circular loop of one turn and the magnetic field at the centre of the coil is B. If the same wire is bent into a circular loop of n turns , the magnetic field at the centre of the coil is

1) B/n 2) nB 3) nB^2 4) n^2B

Sol. $B\propto n^2$

$\therefore n^2B$

90. An electrically charged particle enters into a uniform magnetic induction field in a direction perpendicular to the field with a velocity V. Then , it travels

1) in a straight line without acceleration

2) with force in the direction of the field

3) in a circular path with a radius directly proportional to V^2

4) in a circular path with a radius directly proportional to its velocity

Sol. $r=\frac{mv}{Bq}(or)\, r\propto v$

91. At a certain place, the angle of dip is 60^0 and the horizontal component of earth's magnetic field (B_H) is $0.8\times10^{-4}T$..The earth's overall magnetic field is

1) $1.5\times10^{-4}T$ 2) $1.6\times10^{-3}T$ 3) $1.5\times10^{-3}T$ 4) $1.6\times10^{-4}T$

Sol. $B_H=B\cos\delta$

$0.8\times10^{-4}=B\cos 60$

$B=1.6\times10^{-4}T$

92. A coil of wire of radius r has 600 turns and a self inductance of 108mH .The self inductance of a coil with same radius and 500 turns is

1) $80\,mH$ 2) $75\,mH$ 3) $108\,mH$ 4) $90\,mH$

Sol. $L=\frac{\mu_0 N^2\pi r}{2}$

$L\propto N^2$

$\frac{L_1}{L_2}=\frac{N_1^2}{N_2^2}$

93. A capacitor $50\mu F$ is connected to a power source $V=220\sin 50t$ (V in volt, t in second .The value of rms current (in Amperes)

1) $\frac{\sqrt{2}}{0.55}A$ 2) $0.55A$ 3) $\sqrt{2}$ 4) $\frac{(0.55)}{\sqrt{2}}A$

Sol. $i_{rms}=\frac{V_{R.M.S}}{X_C}=\frac{\frac{220}{\sqrt{2}}}{\frac{1}{W.C}}$

$=\frac{220}{\sqrt{2}}\times 50\times 50\times 10^{-6}$

$=\frac{0.55}{\sqrt{2}}A$

94. The electric field for an electromagnetic wave in free space is $\vec{E}=\vec{i}30\cos\left(kz-5\times 10^8 t\right)$ where magnitude of E is in V/m. The magnitude of wave vector, k is (velocity of em wave in free space $=3\times 10^8 m/s$)

1) $0.46\,rad\,m^{-1}$ 2) $3\,rad\,m^{-1}$ 3) $1.66\,rad\,m^{-1}$ 4) $0.83\,rad\,m^{-1}$

Sol. Magnitude of wave vector $v=\frac{w}{k}$

$c=\frac{w}{k}\Rightarrow 3\times 10^8=\frac{5\times 10^8}{k}$

$k=\frac{5}{3}=1.66\,rad/m$

95. The energy of a photon is equal to the kinetic energy of a proton .If λ_1 is the de Broglie wavelength of a proton , λ_2 the wavelength associated with the photon, and if the energy of the photon is E, then (λ_1/λ_2) is proportional to

1) E^4 2) $E^{1/2}$ 3) E^2 4) E

Sol. $E=h\vartheta=\frac{p^2}{2m}$

$p=\sqrt{2mE}$

$\lambda_1 = \frac{h}{p}; \lambda_2 = \frac{hc}{E}$

$\frac{\lambda_1}{\lambda_2} = \frac{\frac{h}{p}}{\frac{hc}{E}} = \frac{E}{PC} = \frac{E}{\sqrt{2mEC}} = \frac{\sqrt{E}}{\sqrt{2mC}}$

$\frac{\lambda_1}{\lambda_2} \propto E^{\frac{1}{2}}$

96. The radius of the first orbit of hydrogen is r_H ,and the energy in the ground state is $-13.6eV$. Considering a μ^--particle with a mass 207 m_e revolving round a proton as in Hydrogen atom , the energy and radius of proton and μ^--combination respectively in the first orbit are (assume nucleus to be stationary)

1) $-13.6\times 207eV, \frac{r_H}{207}$ 2) $-207\times 13.6eV, 207\,r_H$

3) $\frac{-13.6}{207}eV, \frac{r_H}{207}$ 4) $\frac{-13.6}{207}eV, 207r_H$

Sol. $\frac{mv^2}{r} = \frac{kze^2}{r^2}$; $mv^2 = \frac{kze^2}{r}$

$r = \frac{kze^2}{mv^2}$

$r = \frac{kze^2}{m\times n^2n^2}\times 4\pi^2m^2r^2$

$r \propto \frac{1}{m}$

$T.E \propto m$

97. If the radius of a nucleus with amss number 125 is 1.5 Fermi, then radius of a nucleus with mass number 64 is

1) $0.48\,Fermi$ 2) $0.96\,Fermi$ 3) $1.92\,Fermi$ 4) $1.2\,Fermi$

Sol. $R = R_0A^{1/3}$

$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3}$

$\frac{1.5}{R_2}\left(\frac{125}{64}\right)^{1/3} = \left(\frac{5}{4}\right)^{1/3}$

$R_2 = \frac{1.5 \times 4}{5} = 1.2\, fermi$

98. A crystal of intrinsic silicon at room temperature has a carrier concentration of $1.6 \times 10^{16} / m^3$.If the donor concentration level is $4.8 \times 10^{20} / m^3$, then the concentration of holes in the semiconductor is

1) $53 \times 10^{12} / m^3$ 2) $4 \times 10^{11} / m^3$ 3) $4 \times 10^{12} / m^3$ 4) $5.3 \times 10^{11} / m^3$

Sol. $n_1^2 = n_e n_h$

$\left(1.6 \times 10^{16}\right)^2 = 4.8 \times 10^{20} \times n_h$

$n_h = 5.3 \times 10^{11} / m^3$

99. The output characteristics of an n-p-n transistor represent , [I_C=Collector current, V_{CE}= potential difference between collector and emitter, I_B =Base current , V_{BB} =voltage given to base ; V_{BE} =the potential difference between base and emitter]

1) Change in $I_C\ as\ I_B$ and V_{BB} are changed

2) Changes in I_C with changes in V_{CE} (I_B= constant)

3) Changes in I_B with changes in V_{CE} 4) Change in $I_C\ as\ V_{BE}$ is changed

Sol. Change in I_c with changes in $V_{CE}\left(I_B = constant\right)$

100. A T.V transmitting Antenna is 128m tall. If the receiving Antenna is at the ground level, the maximum distance between them for satisfactory communication in L.O.S. mode is, (Radius of the earth $6.4 \times 10^6 m$)

1) $64 \times \sqrt{10} km$ 2) $\frac{128}{\sqrt{10}} km$ 3) $128 \times \sqrt{10} km$ 4) $\frac{64}{\sqrt{10}} km$

Sol. Maximum distance $d = \sqrt{2Rh}$

$d = \sqrt{2 \times 6400 \times \frac{128}{\sqrt{10}}} = \frac{128}{\sqrt{10}} km$

101. A wheel which is initially at rest is subjected to a constant angular acceleration about its axis.It rotates through an angle of 15^0 in time t secs. The increase in angle through which it rotates in the next 2t secs is

1) 90^0 2) 120^0 3) 30^0 4) 45^0

Sol. $\theta \propto t^2$

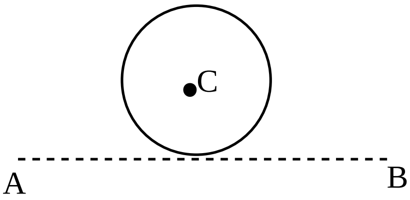
$15 \propto t^2$

For total time of '3t', $\theta \propto (3t)^2$

$\theta = 135^0$

$\therefore$ For Further '2t'time, Angle $= 135 - 15 = 120^0$

102. A thin wire of length l having linear density ρ is bent into a circular loop with C as its centre , as shown in figure. The moment of inertial of the loop about the line AB is



1) $\frac{5\rho l^3}{16\pi^2}$ 2) $\frac{\rho l^3}{16\pi^2}$ 3) $\frac{\rho l^3}{8\pi^2}$ 4) $\frac{3\rho l^3}{8\pi^2}$

Sol. $I = \frac{3MR^2}{2}$

$= \frac{3}{2}[l\rho]\left(\frac{l}{2\pi}\right)^2$

$= \frac{3l^3\rho}{8\pi^2}$

103. The ratio between kinetic and potential energies of a body executing simple harmonic motion, when it is at a distance of $\frac{1}{N}$ of its amplitude from the mean position is

1) $N^2 + 1$ 2) $\frac{1}{N^2}$ 3) N^2 4) $N^2 - 1$

Sol. $K.E = \frac{1}{2}m\omega^2\left[A - \left(\frac{A}{N}\right)^2\right]$

$P.E = \frac{1}{2}m\omega^2\frac{A^2}{N^2}$

$\frac{K.E}{P.E} = N^2 - 1$

104. A satellite is revolving very close to a planet of density ρ. The period of revolution of satellite is

1) $\sqrt{\frac{3\pi\rho}{G}}$ 2) $\sqrt{\frac{3\pi}{2\rho G}}$ 3) $\sqrt{\frac{3\pi}{\rho G}}$ 4) $\sqrt{\frac{3\pi G}{\rho}}$

Sol. $T = 2\frac{\pi r}{\vartheta} = \frac{2\pi R}{\sqrt{G\frac{M}{R}}}$

$\sqrt{\frac{3\pi}{\rho G}}$

105. Two wires of the same material and length but diameters in the ratio 1:2 are stretched by the same force. The elastic potential energy per unit volume for the wires when stretched by the same force will be in the ratio

1) $16:1$ 2) $1:1$ 3) $2:1$ 4) $4:1$

Sol. $U = \frac{1}{2}(strain)^2 Y$

$U \propto (\Delta l)^2$

$U \propto \left(\frac{1}{r^2}\right)^2$

$U \propto \frac{1}{r^4}$

$\therefore 16/1$

106. When a big drop of water is formed from n small drops of water, the energy loss is 3E, where E is the energy of the bigger drop .If R is the radius of the bigger drop and r is the radius of the smaller drop , then number of smaller drops(n) is

1) $\frac{4R}{r^2}$ 2) $\frac{4R}{r}$ 3) $\frac{2R^2}{r}$ 4) $\frac{4R^2}{r^2}$

Sol. $4\pi R^2 T\left(n^{1/3}-1\right) = 3\left(4\pi R^2 T\right)$

$n^{\frac{1}{3}} = 4 = \frac{R}{r}$

$n = 64$

$= 4\times 4^2$

$= 4\left(\frac{R}{r}\right)^2$

107. A steam at 100^0C is passed into 1kg of water contained in a calorimeter of water equivalent 0.2kg at 9^0C, till the temperature of the calorimeter and water in it is increased to 90^0C.The mass of steam condensed in kg is nearly (sp. Heat of water =1 cal/g.^{0}C, Latent heat of vaporization $= 540\,cal/g$)

1) 0.81 2) 0.18 3) 0.27 4) 0.54

Sol. $m[540 + 1\times10] = 1200\times1\times81$

$m = 176g$

= 0.18 kg

108. A very small hole in an electric furnace is used for heating metals. The hole nearly acts as a black body . The area of the hole is 200 mm^2. To keep a metal at 727^{0}C, heat energy flowing through this hole per sec, in joules is $\left(\sigma = 5.57\times10^{-8} Wm^{-2}k^{-4}\right)$

1) 22.68 2) 2.268 3) 1.134 4) 11.34

Sol. $Q = \sigma AT^4$

$= \left(5.67\times10^{-8}\right)\left(2\times10^{-4}\right)\left(10^3\right)^4 \quad = 11.34 J/S$

109. Five moles of Hydrogen initially at STP is compressed adiabatically so that its temperature becomes 673 K. The increase in internal energy of the gas, in Kilo Joules is (R=8.3 J/mole-K; $\gamma = 1.4$ for diatomic gas)

1) 80.5 2) 21.55 3) 41.50 4) 65.55

Sol. $du = -d\omega$

$= -\frac{nR}{r-1}\left(T_2 - T_1\right)$

$= \frac{5\times8.3}{1.4-1}(400)$

$= 41.5$

110. The volume of one mole of the gas is changed from V to 2V at constant pressure P. If γ is the ratio of specific heats of the gas, change in internal energy of the gas is

1) $\frac{r.PV}{\gamma-1}$ 2) $\frac{R}{\gamma-1}$ 3) PV 4) $\frac{PV}{\gamma-1}$

Sol. $dU = nC_V dT = \frac{R}{\gamma-1}(T_2 - T_1) = \frac{P(v_2 - v_1)}{\gamma-1} = \frac{pv}{\gamma-1}$

111. A bus moving on a level road with a velocity V can be stopped at a distance of x, by the ap0plication of a retarding force F. The load on the bus is increased by 25% by boarding the passengers. Now, if the bus is moving with the same speed and it the same retarding force is applied , the distance travelled by the bus before it stops is

1) $1.25x$ 2) x 3) 5x 4) 2.5x

Sol. $Fx = \frac{1}{2}mv^2$

$Fx_1 = \frac{1}{2}\left(\frac{5m}{4}\right)v^2$

$\frac{x_1}{x} = \frac{5m}{4m};$

$x_1 = 1.25x$

112. A cannon shell fired breaks into two equal parts at its highest point. One part retraces the path to the cannon with kinetic energy E_1 and kinetic energy of the second part is E_2 Relation between $E_1 \& E_2$ is

1) $E_2 = 15E_1$ 2) $E_2 = E_1$ 3) $E_2 = 4E_1$ 4) $E_2 = 9E_1$

Sol. $m(u\cos\theta) = \frac{m}{2}(-\cos\theta) + \frac{m}{2}v$

$mu\cos\theta + \frac{mu\cos\theta}{2} = \frac{m}{2}v$

$\frac{3}{2}mu\cos\theta = \frac{m}{2}v$

$v = 3u\cos\theta$

$E_1 = \frac{1}{2}\frac{M}{2}(u\cos\theta)^2$

$E_2 = \frac{1}{2}\frac{m}{2}(3u\cos\theta)^2$

$E_2 = \frac{1}{2}\frac{m}{2}(u\cos\theta)^2 9$

$E_2 = 9E_1$

113. The force required to move a body up a rough inclined plane is double the force required to prevent the body from sliding down the plane. The coefficient of friction when the angle of inclination of the plane is 60^0 is

1) $\frac{1}{3}$ 2) $\frac{1}{\sqrt{2}}$ 3) $\frac{1}{\sqrt{3}}$ 4) $\frac{1}{2}$

Sol. $F = mg(\sin\theta + \mu\cos\theta)$

$F = mg\sin\theta - \mu mg\cos\theta$

$mg(\sin\theta + \mu\cos\theta) = 2mg(\sin\theta - \mu\cos\theta)$

$\sin\theta + \mu\cos\theta = 2\sin\theta - 2\mu\cos\theta$

$3\mu\cos\theta = \sin\theta$

$3\mu = \tan\theta$

$\mu = \frac{1}{3}\times\sqrt{3}$ $\mu = \frac{1}{\sqrt{3}}$

114. A mass M kg is suspended by a weightless string. The horizontal force required to hold the mass at 60^0 with the vertical is

1) Mg 2) $Mg\sqrt{3}$ 3) $Mg(\sqrt{3}+1)$ 4) $\frac{Mg}{\sqrt{3}}$

Sol. $Mg = T\cos\theta$

$F = T\sin\theta$

$\frac{F}{Mg} = Tan\theta$

$F = Mg\tan 60^0$

$F = Mg(\sqrt{3})$

115. A body is projected at an angle θ so that its range is maximum. If T is the time of flight then the value of maximum range is (acceleration due to gravity = g)

1) $\frac{g^2T}{2}$ 2) $\frac{gT}{2}$ 3) $\frac{gT^2}{2}$ 4) $\frac{g^2T^2}{2}$

Sol. $\frac{U^2 \sin 2(45^0)}{g} = \frac{U^2 \times 1}{g}$

$T = \frac{2U \sin 45^0}{g}$

$T = 2U \times \frac{1}{\sqrt{2}g} = \sqrt{2}\frac{U}{g}$

$U = \frac{Tg}{\sqrt{2}}$

$R = \frac{T^2 g^2}{g2} = \frac{1}{2} gT^2$

116. The path of a projectile is given by the equation $y = ax - bx^2$, where a and b are constants and x and y are respectively horizontal and vertical distances of projectile from the point of projection .The maximum height attained by the projectile and the angle of projection are respectively

1) $\frac{2a^2}{b}, \tan^{-1}(a)$ 2) $\frac{b^2}{2a}, \tan^{-1}(b)$ 3) $\frac{a^2}{b}, \tan^{-1}(2b)$ 4) $\frac{a^2}{4b}, \tan^{-1}(a)$

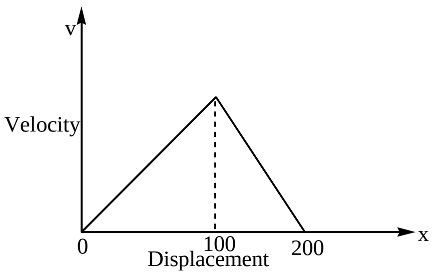
Sol. $Y = ax - bx^2$

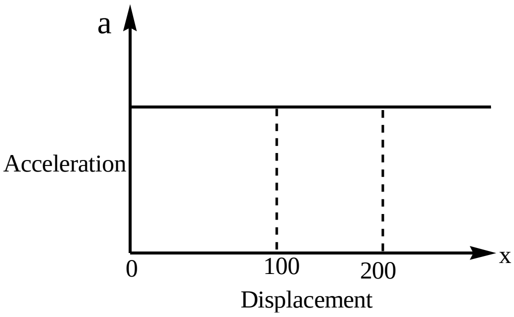
$a = \tan\theta$, $b = \frac{g}{2v^2 \cos^2 \theta}$

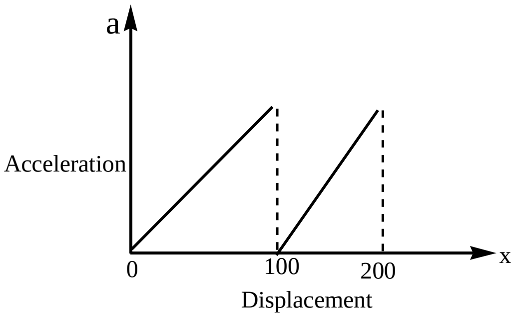
$\frac{a^2}{4b} = H$,

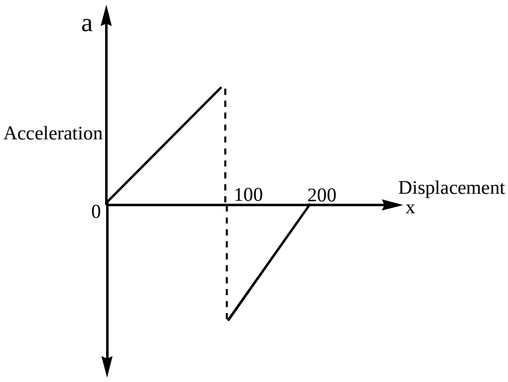
$\theta = \tan^{-1}(a)$

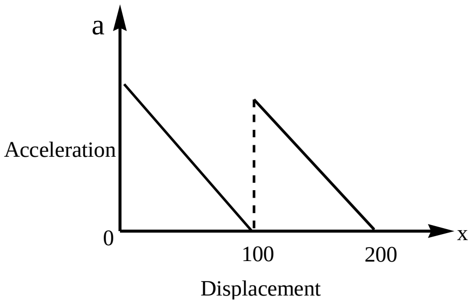
117. Velocity(v) versus displacement (x) plot of a body moving along a straight line is as shown in the graph .The corresponding plot of acceleration (a) as a function of displacement (x) is



1) 

2) 

3) 

4) 

118. A person walks along a straight road from his house to a market 2.5kms away with a speed of 5 km/hr and instantly turns back and reaches his house with a speed of 7.5 kms/hr. The average speed of the person during the time interval 0 to 50 minutes is (in m/sec)

1) $4\frac{2}{3}$ 2) $\frac{5}{3}$ 3) $\frac{5}{6}$ 4) $\frac{1}{3}$

Sol. For motion from house to market, $t = \frac{2.5}{5} = 0.5h = 30\min$

For remaining 20 min $\left(= \frac{1}{3}h\right)$ distance = $\left(\frac{1}{3}\right)$ 7.5 = 2.5 kmph.

$\therefore V_{av} = \frac{5}{\frac{50}{60}} = 6kmph = {}^{5}\!/_{3}\, m/s$

119. If C the velocity of light , h Planck's constant and G Gravitational constant are taken as fundamental quantities , then the dimensional formula of mass is

1) $h^{-1/2}G^{1/2}C^{0}$ 2) $h^{1/2}C^{1/2}G^{-1/2}$ 3) $h^{-1/2}C^{1/2}G^{-1/2}$ 4) $h^{-1/2}C^{-1/2}G^{-1/2}$

Sol. $m \propto C^{a}h^{b}G^{C}$

$ML^{0}T^{0} = \left(LT^{-1}\right)^{a}\left(ML^{2}T^{-1}\right)^{b}\left(M^{-1}L^{3}T^{-2}\right)^{C}$

$ML^{0}T^{0} = L^{a+2b+3c}\ M^{b-c}T^{-a-b-2c}$

$b-c=1$

$b=1+c$

$a+2b+3c=0$

$-\left(a+b+2c\right)=0$

$a+b+2c=0$

$a+2b+3c=0$

$-b-c=0$

$-b=-c$

(or)

Option verification

$\left(ML^{2}T^{-1}\right)^{1/2}\left(M^{-1}L^{3}T^{-2}\right)^{-1/2}$

$=M^{\frac{1}{2}}.M^{\frac{1}{2}}$

$\left(ML^{2}T^{-1}\right)^{\frac{1}{2}}\left(LT^{-1}\right)^{\frac{1}{2}}\left(M^{-1}L^{3}T^{-2}\right)^{\frac{-1}{2}}$

$ML^{1}L^{1/2}L^{-3/2}T^{\frac{-1}{2}-\frac{1}{2}-1} = M$

120. Match the following (Take the relative strength of the strongest fundamental forces in nature as one)

A	B
Fundamental forces in nature	Relative strength
a) Strong nuclear force	e) 10^{-2}
b) weak nuclear force	f) 1
c) Electromagnetic force	g) 10^{10}

d) Gravitational force h) 10^{-13}

i) 10^{-39}

The correct match is

1) (a)–(f), (b)-(i),(c)-(e), (d)-(h) 2) (a)–(f), (b)-(h),(c)-(e), (d)-(h)

3) (a)–(f), (b)-(h),(c)-(e), (d)-(i) 4) (a)–(f), (b)-(e),(c)-(h), (d)-(i)

Sol Conceptual

121. What is Z in the following reaction sequence?

$C_6H_5NH_2$ i) $NaNO_2 + HCl / 273\ K$

ii) $H_3PO_2 + H_2O$

iii) $CO, HCl;$ anhydrous $AlCl_3 / CuCl$

1) $C_6H_5CO_2H$ 2) C_6H_5OH 3) C_6H_5CHO 4) C_6H_6

Sol. Conceptual

122. $H_3CMgBr + CO_2 \xrightarrow{Dry\ ether} Y \xrightarrow{H_3O^{\otimes}} Z$

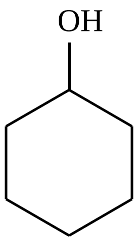
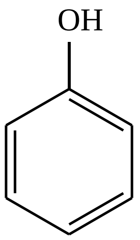
Identify Z from the following:

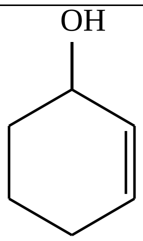
1) Ethyl acetate 2) Acetic acid 3) Propanoic acid 4) Methyl acetate

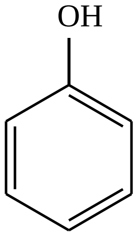
Sol. Conceptual

123. $X \xrightarrow{Y} Benzoquinone$

Identify X and Y in the above reaction:

X	Y
1) 	Zn
2) 	$Na_2Cr_2O_7 / H_2SO_4$

3)  $Na_2Cr_2O_7 / H_2SO_4$

4)  Zn

Sol. Conceptual

124. $C_6H_5-O-CH_2CH_3 \xrightarrow[\Delta]{HI} Y+Z$

Identify Y and Z in the above reaction:

	X	Y
1)	C_6H_5OH	H_3CCH_3
2)	C_2H_5I	C_6H_5CHO
3)	C_6H_5I	H_3CCH_2OH
4)	C_6H_5OH	H_3CCH_2I

Sol. Conceptual

125. Which one of the following is more readily hydrolysed by S_N^1 mechanism?

1) $(C_6H_5)_2C(CH_3)Br$ 2) $C_6H_5CH_2Br$

3) $C_6H_5CH(CH_3)Br$ 4) $(C_6H_5)_2CHBr$

Sol. Conceptual

126. What are the substances which mimic the natural chemical messengers?

1) Antibiotics 2) Antagonists 3) Agonists 4) Receptors

Sol. Conceptual

127. Lactose is disaccharide of ________

1) $\alpha-D-$Glucose and $\alpha-D-$Fructose 2) $\beta-D-$Glucose and $\beta-D-$Galactose

3) $\alpha-D-$Glucose and $\beta-D-$Ribose 4) $\alpha-D-$Glucose and $\beta-D-$Galactose

Sol. Conceptual

128. Identify the copolymer from the following:

1) $\left[CH_2-CH=CH-CH_2-\underset{\displaystyle C_6H_5}{\underset{|}{CH}}-CH_2\right]_n$ 2) $\left[CF_2-CF_2\right]_n$

3) $\left[CH_2-\underset{\displaystyle Cl}{\underset{|}{C}}=CH-CH_2\right]_n$ 4) $\left[CH_2-\underset{\displaystyle Cl}{\underset{|}{CH}}\right]_n$

Sol. Conceptual

129. Matching the following:

List-I	List-II
A) sp^3	I) $\left[Co(NH_3)_6\right]^{3+}$
B) dsp^2	II) $\left[Ni(CO)_4\right]$
C) sp^3d^2	III) $\left[Pt(NH_3)_2Cl_2\right]$
D) d^2sp^3	IV) $\left[CoF_6\right]^{3-}$
	V) $\left[Fe(Co)_5\right]$

Sol. Conceptual

130. Which one of the following ions has same number of unpaired electrons as those present in V^{3+} ion?

1) Fe^{3+} 2) Ni^{2+} 3) Mn^{2+} 4) Cr^{3+}

Sol. Conceptual

131. The structure of $XeOF_4$ is

1) Trigonal bipyramidal 2) Square planar

3) Square pyramidal 4) Pyramidal

Sol. Conceptual

132. The charring of sugar takes place when treated with concentrated H_2SO_4. What is the type of reaction involved in it?

1) Dehydration reaction 2) Hydrolysis reaction

3) Addition reaction 4) Disproportionation reaction

Sol. Conceptual

133. What is the role of limestone during the extraction of iron from haematite ore?

1) Leaching agent 2) Oxidizing agent 3) Reducing agent 4) flux

Sol. Conceptual

134. In an atom the order of increasing energy of electrons with quantum numbers (i) n = 4, l = 1

(ii) n = 4, l = 0 (iii) n = 3, l = 2 and (iv) n = 3, l = 1 is

1) (iii) < (i) < (iv) < (ii) 2) (ii) < (iv) < (i) < (iii)

3) (i) < (iii) < (ii) < (iv) 4) (iv) < (ii) < (iii) < (i)

Sol. Conceptual

135. The number of angular and radial nodes of 4d orbital respectively are

1) 3, 1 2) 1, 2 3) 3, 0 4) 2, 1

Sol. Number of angular nodes = l = 2

Number of radial node = n – l – 1 =4 – 2 – 1 =1

136. The oxidation state and covalency of Al in $\left[AlCl\left(H_2O\right)_5\right]^{2+}$ are respectively

1) +6, 6 2) +3, 6 3) +2, 6 4) +3, 3

Sol. Conceptual

137. The increasing order of the atomic radius of Si, S, Na, Mg, Al is

1) $S < Si < Al < Mg < Na$ 2) $Na < Al < Mg < S < Si$

3) $Na < Mg < Si < Al < S$ 4) $Na < mg < Al < Si < S$

Sol. Conceptual

138. The number of electrons in the valence shell of the central atom of a molecules is 8. The molecule is

1) BCl_3 2) BeH_2 3) SCl_2 4) SF_6

Sol. SCl_3

139. Which one of the following has longest covalent bond distance?

1) C-C 2) C-H 3) C-N 4) C-O

Sol. Conceptual

140. The ratio of rates of diffusion of gases X and Y is 1 : 5 and that of Y and Z is 1 : 6. The ratio of rates of diffusion of Z and X is

1) 1 : 30 2) 1 : 6 3) 30 : 1 4) 6 : 1

Sol. $\frac{r_X}{r_Y} = \frac{1}{5}$

$\frac{r_Y}{r_Z} = \frac{1}{6}$ $\frac{r_Z}{r_X} = 30:1$

141. The molecular interactions responsible for hydrogen bonding in HF

1) ion-induced dipole 2) dipole-dipole

3)dipole-induced dipole 4) ion-dipole

Sol. Conceptual

142. $KMnO_4$ reacts with Kl KI in basic medium to form I_2 and MnO_2. When 250 mL of 0.1 M KI solution is mixed with 250 mL of 0.02 M $KMnO_4$ in basic medium, what is the number of moles of I_2 formed?

1) 0.015 2) 0.0075 3) 0.005 4) 0.01

Sol. No. of milli equalents of $KMnO_4$ = No. of milli equalents of I_2

$0.02 \times 3 \times 250 =$ No. of milli equivalent of I_2

No. of equivalents of I_2 = 0.015

$\therefore$ No. of moles of $I_2 = \frac{0.015}{2} = 0.0075$

143. The oxide of a metal contains 40% of oxygen. The valency of metal is 2. What is the atomic weight of the metal?

1) 24 2) 13 3) 40 4) 36

Sol. 40 gm of oxygen combined with 60 gm of metal

8 gm of oxygen combined _________ of metal

$= \frac{60\times8}{40} = 12$

$\therefore$ Atomic weight = Equivalent weight $\times$ valency

$12 \times 2 = 24$

144. The temperature of K at which $\Delta G = 0$, for a given reaction with $\Delta G = -20.5 kJ\,mol^{-1}$ and $\Delta S = -50.0\,JK^{-1}\,mol^{-1}$ is

1) -410 2) 410 3) 2.44 4) -2.44

Sol. $T = \frac{\Delta H}{\Delta S} = \frac{-20.5\times10^3}{-50.0} = 410$

145. In a reaction A + B⇌ C + D, 40% of B has reacted at equilibrium, when 1 mol of A was heated with 1 mol of B in a 10 litre closed vessel. The value of K_C is

1) 0.44 2) 0.18 3) 0.22 4) 0.36

Sol. $K_C = \frac{0.4\times0.4}{0.6\times0.6} = 0.44$

146. If the ionic product of $Ni(OH)_2$ is 1.9×10^{-15}, the molar solubility of $Ni(OH)_2$ in 1.0M NaOH is

1) $1.9\times10^{-18}M$ 2) $1.9\times10^{-13}M$ 3) $1.9\times10^{-15}M$ 4) $1.9\times10^{-14}M$

Sol. $K_{sp} = s\times(1)^2$

$s = 1.9\times10^{-15}$

147. Temporary hardness of water is removed in Clark's process by adding

1) Caustic Soda 2) Calgon 3) Borax 4) Lime

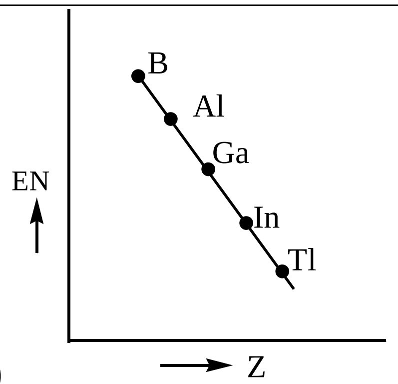
Sol. Conceptual

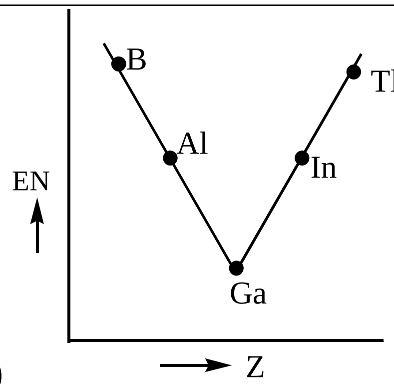
148. KO_2 exhibits paramagnetic behavior. This is due to the paramagnetic nature of ____

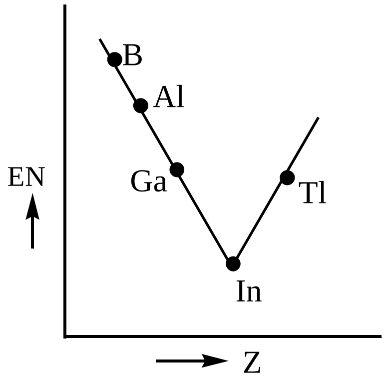
1) KO^- 2) K^+ 3) O_2 4) O_2^-

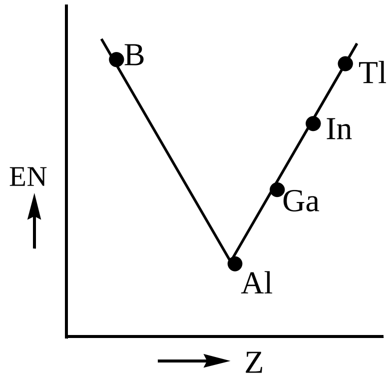
Sol. Conceptual

149. Which one of the following correctly represents the variation of electro negativity (EN) with atomic number (Z) of group 13 elements ?

1) 

2) 

3) 

4) 

Sol. Conceptual

150. Which one of the following elements reacts with steam ?

1) C   2) Ge   3) Si   4) Sn

Sol. Conceptual

151. What are X and Y in the following reaction ?

$$CF_2Cl_2 \xrightarrow{uv} X + Y$$

1) $CF_2\dot{C}l, \dot{C}i$ 2) C_2F_4, Cl_2 3) $CFCl_2, F$ 4) $:C\dot{C}l_2, F_2$

Sol. Conceptual

152. What are the shapes of ethyne and methane ?

1) square planar and linear   2) tetrahedral and trigonal planar

3) Linear and tetrahedral   4) trigonal planar and linear

Sol. Conceptual

153. What is Z in the following reaction ?

$$CH_3 - CH_2 - CO_2^- Na^+ \xrightarrow[\Delta]{NaOH/CaO} Z$$

1) propane   2) n-butane   3) ethane   4) ethyne

Sol. $CH_3-CH_2-COO^-Na^+ \xrightarrow{NaoH/CaO} CH_3-CH_3+Na_2CO_3$

Ethane

154. Which one of the following gives sooty flame on combustion ?

1) C_2H_4 2) CH_4 3) C_2H_6 4) C_6H_6

Sol. Aromatic compounds gives sooty flame on combustion

155. Which one of the following elements on doping with germanium, make it a p-type semiconductor ?

1) Bi 2) Sb 3) As 4) Ga

Sol. Conceptual

156. The molar mass of a solute X in g mol^{-1}, if its 1% solution is isotonic with a 5% solution of cane sugar (molar mass = 342 g mol^{-1}), is

1) 68.4 2) 34.2 3) 136.2 4) 171.2

Sol. $\frac{w_1}{m_1}=\frac{w_2}{m_2}$

$\frac{1}{x}=\frac{5}{342}$

$x=68.4$

157. Vapour pressure in mm Hg of 0.1 mole of urea in 180 g of water at 25^0C is

(The vapour pressure of water at 25^0C is 24 mm Hg)

1) 2.376 2) 20.76 3) 23.76 4) 24.76

Sol. $\frac{\Delta p}{p^0}=\frac{n\times GMW\ \ solvent}{weight\ of\ \ solvent}$

$\frac{\Delta p}{24}=0.1\times\frac{18}{180}$

$\Delta p=0.24$

$p_s=p^0-\Delta p$

=24 – 0.24 = 23.76 mm of Hg

158. At 298 K the molar conductivities at infinite dilution (A_m^o) of NH_4Cl, KOH and KCl are 152.8, 272.6 and 149.8 S cm^2 mol^{-1} respectively. The A_m^o of NH_4OH in S cm2 mol^{-1}

and % dissociation of 0.01 M NH_4OH with $A_m = 25.1$ S cm2 mol^{-1} at the same temperature are

1) 275.6, 0.91 2) 275.6, 9.1 3) 266.6, 9.6 4) 30, 84

Sol. $\hat{N}H_4OH = 275.6$

$$\alpha = \frac{\hat{c}}{\hat{\propto}} \times 100 = \frac{25.1}{275.6} \times 100 = 9.1$$

159. In a first order reaction the concentration of the reactant decreases from 0.6M to 0.3M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M in minutes is

1) 1.2 2) 12 3) 30 4) 3

Sol. $t_{\frac{1}{2}} = 15$ min.

$$0.1 \xrightarrow{15} 0.05 \xrightarrow{15} 0.025$$

Two half lifes = 30 min.

160. Assertion (A): van der Waals' forces are responsible for chemisorptions.

Reason (R) : High temperature is favourable for chemisorptions.

The correct answer is

1) (A) is false, but (R) is true

2) Both (A) and (R) are correct. (R) is the correct explanation of (A).

3) Both (A) and (R) are correct. (R) is not the correct explanation of (A).

4) (A) is true, but (R) is false

Sol. Conceptual