MATHEMATICS

Test Admission Ticket No.	Question Booklet Version Code	Question Booklet Sr. No.
	A	84681
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1. If $\vec{u}=\vec{a}-\vec{b}$, $\vec{v}=\vec{a}+\vec{b}$, and $|\vec{a}|=|\vec{b}|=2$, then $|\vec{u}\times\vec{v}|$ is

a) $2\sqrt{16-(\vec{a}\cdot\vec{b})^2}$

b) $2\sqrt{4-(\vec{a}\cdot\vec{b})^2}$

c) $\sqrt{16-(\vec{a}\cdot\vec{b})^2}$

d) $\sqrt{4-(\vec{a}\cdot\vec{b})^2}$

$|\vec{u}\times\vec{v}|=|(\vec{a}-\vec{b})\times(\vec{a}+\vec{b})|=2\vec{a}\times\vec{b}=2|\vec{a}||\vec{b}|\sin\theta$

$=2|\vec{a}||\vec{b}|\sqrt{1-\cos^2\theta}$

$=2\sqrt{|\vec{a}|^2|\vec{b}|^2-|\vec{a}||\vec{b}|\cos^2\theta}$

$=2\sqrt{4\times4-(\vec{a}\cdot\vec{b})^2}$

$=2\sqrt{16-(\vec{a}\cdot\vec{b})^2}$ a

2. The volume of the tetrahedron formed by the points (1, 1, 1), (2, 1, 3) (3, 2, 2) and (3, 3, 4) in cubic units is

a) $\frac{5}{6}$

b) $\frac{6}{5}$

c) 5

d) $\frac{2}{3}$

A B C D

$\vec{AB}=\hat{i}+2\hat{k}$, $\vec{AC}=2\vec{i}+\vec{j}+\vec{k}$, $\vec{AD}=2\vec{i}+2\vec{j}+3\vec{k}$

Volume of the tetrahedron

$=\frac{1}{6}[\vec{AB}\times\vec{AC}\cdot\vec{AD}]=5/6$ a

3. Unit vector perpendicular to $\hat{i}-2\hat{j}+2\hat{k}$ and lying in the plane containing $\hat{i}+\hat{j}-2\hat{k}$ and $-\hat{i}+2\hat{j}+\hat{k}$ is

a) $8\hat{i}-7\hat{j}+11\hat{k}$

b) $8\hat{i}+7\hat{j}-11\hat{k}$

c) $8\hat{i}-7\hat{j}-11\hat{k}$

d) $\frac{1}{\sqrt{234}}(8\hat{i}-7\hat{j}-11\hat{k})$

only $\frac{1}{\sqrt{234}}(8\hat{i}-7\hat{j}-11\hat{k})$ is an unit vector

and $\perp^{ar}$ to $\hat{i}-2\hat{j}+2\hat{k}$

d

(Space for calculation / rough work)

$\hat{i}-2\hat{j}+2\hat{k}$

4. In the group $Q-\{-1\}$ under the binary operation $*$ defined by $a*b=a+b+ab$ the inverse of 10 is

a) $\frac{1}{10}$

b) $\frac{11}{10}$

(d)

c) $\frac{-11}{10}$

d) $\frac{-10}{11}$

5. In the group $\{1, 2, 3, 4, 5, 6\}$ under multiplication mod 7, $2^{-1}\times 4=$

a) 1

(c)

b) 4

c) 2

d) 3

6. The group $(Z, +)$ has

a) exactly one subgroup

b) only two subgroups

(d) infinitely many subgroup.

c) no subgroups

d) infinitely many subgroups

Space for calculation / rough work

7. If $3x$

a)

b)

c)

d)

8. The

a)

b)

c)

d)

9. The

a)

b)

c)

d)

7. If $3x \equiv 5 \pmod 7$, then

$3x \equiv 5 \pmod 7$, then $x = 4$

a) $x \equiv 2 \pmod 7$

Ans:-
$x \equiv 4 \pmod 7$

(c)

b) $x \equiv 3 \pmod 7$

c) $x \equiv 4 \pmod 7$

d) none of these

8. The argument of the complex number $\sin\left(\frac{6\pi}{5}\right)+i\left(1+\cos\frac{6\pi}{5}\right)$ is

a) $\frac{\pi}{10}$ (c)

b) $\frac{5\pi}{6}$

c) $\frac{-\pi}{10}$

d) $\frac{2\pi}{5}$

9. The maximum value of $n < 101$ such that $1+\sum_{k=1}^{n} i^k = 0$ is

a) 96 (c)

b) 97

c) 99

d) 100

Space for calculation / rough work

10. The value of $\left(-1+\sqrt{-3}\right)^{62}+\left(-1-\sqrt{-3}\right)^{62}$ is

a) 2^{62}

$$2^{62}\left[\left(\frac{-1+\sqrt{-3}}{2}\right)^{62}+\left(\frac{-1-\sqrt{-3}}{2}\right)^{62}\right]$$

b) 2^{61}

c) -2^{62}

$$2^{62}\{\omega^{62}+\omega^{124}\} = 2^{62}\{\omega^2+\omega\} = 2^{62}(-1)$$

d) 0

$$= -2^{62}$$

11. All complex numbers z which satisfy the equation $\left|\frac{z-6i}{z+6i}\right|=1$ lie on the

a) imaginary axis

$$\left|\frac{(x+iy)-6i}{x+iy+6i}\right|=1 \quad \text{or,} \quad \frac{(x+iy)-6i}{(x+iy+6i)} \times \frac{x-iy-6i}{x-i(y+6)} = 1$$

b) real axis

c) neither of the axes

$$= \frac{(y^2+x^2+12y-36) - i\,12x}{x^2+(y+6)^2}$$

d) none of these

solve it

12. The value of $\sin\left[\cot^{-1}\left\{\cos\left(\tan^{-1}x\right)\right\}\right]$ is

a) $\left(\sqrt{\frac{1+x^2}{2+x^2}}\right)$

$$= \sin\left[\cot^{-1}\left\{\cos\left(\cos^{-1}\frac{1}{\sqrt{1+x^2}}\right)\right\}\right]$$

b) $\left(\sqrt{\frac{2+x^2}{1+x^2}}\right)$

$$= \sin\left[\cot^{-1}\left(1/\sqrt{1+x^2}\right)\right]$$

c) $\left(\sqrt{\frac{x^2-2}{x^2-1}}\right)$

$$= \frac{\sqrt{1+x^2}}{\sqrt{2+x^2}}$$

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

Space for calculation / rough work

13. The value of $\alpha(\neq 0)$ for which the function $f(x) = 1 + \alpha x$ is the inverse of itself is

a) -2

b) 2

c) -1

d) 1

Let $y = f(x)$, $y = 1 + \alpha x \Rightarrow x = \frac{y-1}{\alpha}$

$f(x)$ is the inverse of it self

$\frac{x-1}{\alpha} = (1 + \alpha x)$

or, $(\alpha^2 - 1)x + (\alpha + 1) = 0$

$(\alpha + 1)\{\alpha x - x + 1\} = 0$

$\alpha = -1$

(C)

14. If x^r occurs is the expansion of $\left(x + \frac{1}{x}\right)^n$, then its coefficient is

a) $\frac{n!}{(r!)^2}$

b) $\frac{n!}{(r+1)!\,(r-1)!}$

c) $\frac{n!}{\left(\frac{n+r}{2}\right)!\left(\frac{n-r}{2}\right)!}$

d) $\frac{n!}{\left[\left(\frac{r}{2}\right)!\right]^2}$

(C)

K_{th} term $= {}^nC_K\, x^K \left(\frac{1}{x}\right)^{n-K}$; coefficient of x^{2K-n}

Power of x; x^{2K-n}. ${}^nC_K$

Let $x^{2K-n} \equiv x^r$;

$r = 2K - n \Rightarrow K = \frac{n+r}{2}$

Now ${}^nC_K = {}^nC_{\frac{n+r}{2}} = \frac{n!}{\frac{n+r}{2}!\ \frac{n-r}{2}!}$

15. If $\tan A - \tan B = x$ and $\cot B - \cot A = y$ then $\cot(A - B) =$

a) $\frac{1}{y} - \frac{1}{x}$

b) $\frac{1}{x} - \frac{1}{y}$

c) $\frac{1}{x} + \frac{1}{y}$

d) none of these

(C)

$\cot(A-B) = \frac{1 + \tan A \cdot \tan B}{\tan A - \tan B}$ — ①

$\frac{1}{\tan B} - \frac{1}{\tan A} = \frac{\tan A - \tan B}{\tan A \cdot \tan B} = y$ — ②

Given. $\tan - \tan B = x$ — ③

Eq ② + 3 ÷ $\tan A \cdot \tan B = x/y$; put this value in eqn ①

$\cot(A-B) = \frac{1 + x/y}{x} = \frac{1}{x} + \frac{1}{y}$

Space for calculation / rough work

16. $\cos^2\frac{\pi}{12}+\cos^2\frac{\pi}{4}+\cos^2\frac{5\pi}{12}=$ $\cos^2 15^\circ+\frac{1}{2}+\cos^2 75^\circ$

a) $\frac{3}{2}$ $\quad = \cos^2 15^\circ + 1-\sin^2 75^\circ+1/2$

b) $\frac{3-\sqrt{3}}{2}$ $\quad$ a $\quad = \cos^2 15^\circ - \sin^2 75^\circ + 3/2$

c) $\frac{2}{3}$ $\quad = \cos^2 15^\circ - \cos^2(90^\circ-15^\circ)+3/2$

d) $\frac{2}{3+\sqrt{3}}$ $\quad = \frac{3}{2}+\cos^2 15^\circ - \cos^2 15^\circ$

$= 3/2$

17. If $\sin\theta$, $\cos\theta$, and $\tan\theta$ are in G.P then $\cot^6\theta-\cot^2\theta$ is

a) 1

b) $\frac{1}{2}$ $\quad$ a

c) 2

d) 3

$\cos^2\theta = \sin\theta\cdot\tan\theta \Rightarrow \cos^3\theta=\sin^2\theta$

or, $\cos^3\theta = 1-\cos^2\theta$ or, $\cos^3\theta+\cos^2\theta-1=0$

solve it for θ and replace in $\cot^6\theta-\cot^2\theta=1$

18. If $\frac{3x^2-2x+4}{(x-1)^6}=\frac{A_1}{x+1}+\frac{A_2}{(x+1)^2}+\frac{A_3}{(x+1)^3}+\frac{A_4}{(x+1)^4}+\frac{A_5}{(x+1)^5}+\frac{A_6}{(x+1)^6}$ then

$(A_1+A_3+A_5,\ A_2-A_4-A_6)=$

a) $(0,0)$

Put $x=0$,

then $A_1+A_2+A_3+A_4+A_5+A_6=4$

b) $(-8,-12)$

only "d" $(-8, 12)$ satisfies

c) $(8,-12)$ $\quad$ d

the solution

d) $(-8, 12)$

19. If $\log_2\left(2^{x-1}+6\right)+\log_2\left(4^{x-1}\right)=5$, then $x=$; $\log_2\left(2^{x-1}+6\right)\left(2^{2x-2}\right)=5$

a) 4
b) 1
c) 3
d) 2

(d)

or, $\left(2^{x-1}+6\right)\left(2^{2x-2}\right)=2^5$; Let $y=2^{x-1}$

$(y+6)y^2=32$ or $(y-2)(y^2+8y+16)=0$

Possible soln: $y=2^{x-1}=2^1$ ∴ $x-1=1$ or, $\underline{x=2}$

20. If a,b,c,d are the roots of the equation $x^4+2x^3+3x^2+4x+5=0$, then $1+a^2+b^2+c^2+d^2$ is equal to

a) -2
b) -1
c) 2
d) 1

(b)

$1+(a^2+b^2+c^2+d^2)=1+(a+b+c+d)^2-2(ab+ac+ad+bc+bd+cd)$

$=1+(\text{sum of roots})^2-2(\text{sum of multiplication of roots})$

$=1+2^2-2\times3=5-6=\underline{-1}$ Ans

21. If $C_0, C_1, C_2, \cdots, C_n$ are binomial coefficients of order n, then the value of $\frac{C_1}{2}+\frac{C_3}{4}+\frac{C_5}{6}+\cdots=$

a) $\frac{2^n+1}{n+1}$

b) $\frac{2^n-1}{n+1}$

c) $\frac{2^n+1}{n-1}$

d) $\frac{2^n}{n+1}$

(b)

$(1+x)^n=C_0+C_1x+C_2x^2+\ldots+C_nx^n$

Integrate both side from 0 to 1 :-

$\frac{2^n-1}{n+1}=C_0+C_1/2+C_2/3+\ldots+C_n/n+1$ — (1)

again $(1-x)^n=C_0-C_1x+C_2x^2+\ldots+(-1)^nC_nx^n$

Integrate both side 0 to 1 :-

$\frac{1}{n+1}=C_0-C_1/2+C_2/3-\ldots$ — (2)

Perform (1) − (2)

result ⇒ $\frac{2^n-1}{n+1}=C_1/2+\frac{C_3}{4}+\frac{C_5}{6}+\ldots$

22. The value of $(0.2)^{\log_{\sqrt5}\left(\frac14+\frac18+\frac1{16}+\cdots\text{ to }\infty\right)}$ is

a) 4

b) $\frac14$

c) 2

d) $\frac12$

(a)

$(0.2)^{\log_{\sqrt5}\left(\frac14+\frac14\cdot\frac12+\frac14\left(\frac12\right)^2+\ldots\infty\right)}$

$=(0.2)^{\log_{\sqrt5}(1/4)/1-1/2}=(0.2)^{\log_{\sqrt5}(1/2)}$

$=(0.2)^{-1\log_{\sqrt5}2}$

$=\left(\frac15\right)^{-\log_{\sqrt5}2}=\cancel{5\log_{\sqrt5}}\,5^{2\log_5 2}$

$=5^{\log_5 4}=\underline{4}$

24. If $n(A) = n(B) = m$, then the number of possible bijections from A to B is

a) m

b) m^2

c) $m!$

d) $2m$

c

$m!$

25. $\sin^{-1}\left[x\sqrt{1-x} - \sqrt{x}\sqrt{1-x^2}\right] =$

a) $\sin^{-1}x - \sin^{-1}\sqrt{1-x}$

b) $\sin^{-1}x + \sin^{-1}\sqrt{1-x}$

c) $\sin^{-1}x - \sin^{-1}\sqrt{x}$

d) $\sin^{-1}x + \sin^{-1}\sqrt{x}$

c

$\sin^{-1}\left[x\sqrt{1-x} - \sqrt{x}\sqrt{1-x^2}\right]$

$= \sin^{-1}\left[x\sqrt{1-(\sqrt{x})^2} - \sqrt{x}\sqrt{1-x^2}\right]$ — ①

W.K.T.

$\sin^{-1}(x+y) = \sin^{-1}\left[x\sqrt{1-y^2} - y\sqrt{1-x^2}\right]$ — ②

Compare ① & ② :

$\boxed{\sin^{-1}x - \sin^{-1}\sqrt{x}}$

25. If $\tan\theta + \tan 4\theta + \tan 7\theta = \tan\theta \tan 4\theta \tan 7\theta$, then the general solution is

a) $\theta = \dfrac{n\pi}{4}$

b) $\theta = \dfrac{n\pi}{12}$

c) $\theta = \dfrac{n\pi}{6}$

d) none of these

b

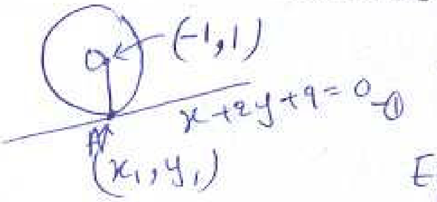
26. If a circle with the point $(-1, 1)$ as its center touches the straight line $x + 2y + 9 = 0$ then the coordinates of the points of contact is

a) $(-3, 3)$

b) $(-3, -3)$

c) $(0, 0)$

d) $\left(\dfrac{7}{3}, -\dfrac{17}{3}\right)$



$\perp^{ar}$ of equn of $x+2y+9=0$

is $y = 2x + c$ — ②

Equn of OA ⇒ $1 = -2 + c$;

$c = -3$

$y = 2x - 3$ — ③

Solve equn ① & ③ :

Space for calculation/rough work

$x = -3$

$y = -3$

Answer – b

27. If the circles $x^2+y^2+2gx+2fy=0$, and $x^2+y^2+2g^1x+2f^1y=0$ touch each other, then For given condition :-

$$\frac{2g}{2g^1} = \frac{2f}{2f^1} \Rightarrow \boxed{f^1 g = g^1 f}$$

a) $fg = f^1g^1$ (b)
b) $f^1g = fg^1$
c) $ff^1 = gg^1$
d) none of these

28. The number of common tangents to the circles $x^2+y^2=4$ and $x^2+y^2-4x+2y-4=0$ is

a) 1
b) 2
c) 3
d) 4

(b)

Eqn are :- $x^2+y^2=(2)^2$; — (1)
$(x-2)^2+(y+1)^2=3^2$ — (2)

Cut each other at two places :-
So, no. common tangents $=2$

29. The length of the tangent drawn from any point on the circle $x^2+y^2-4x+6y-4=0$ to the circle $x^2+y^2-4x+6y=0$ is

a) 8
b) 4
c) 2
d) none of these

(c) Length of tangent from $x^2+y^2+2gx+2fy+c_1$ to circle $x^2+y^2+2gx+2fy+c_2=0$ is $\sqrt{c_2-c_1}$

here $c_2=4$, $c_1=0$

so, length $=\sqrt{4-0}=2$

30. If the foci of the ellipse $\frac{x^2}{25}+\frac{y^2}{b^2}=1$ and the hyperbola $\frac{x^2}{144}-\frac{y^2}{81}=\frac{1}{25}$ coincide, then the value of b^2 is

a) 25
b) 9
c) 16
d) 4

(c)

For hyperbola :- $\frac{x^2}{144}-\frac{y^2}{81}=\frac{1}{25}$; eccentricity $e=\frac{225}{144}=15/12$

foci $(\pm\frac{12}{5}\times\frac{15}{12},0)$
$=(\pm 3,0)$

Since focii of eclipse coincide :-
$\Rightarrow 5e=3$ or, $e=3/5$

Since $b^2=a^2(1-e^2)$ or $b^2=25(1-9/25)=\boxed{16}$ Ans

31. The latus rectum of the ellipse is half the minor axis. Then its eccentricity is

a) $\frac{1}{\sqrt{2}}$

b) $\frac{1}{\sqrt{3}}$

c) $\frac{\sqrt{3}}{2}$

d) none of these

(c)

latus Rectum $=2b^2/a$, L minor axis $=2b$

Given $\frac{2b}{2}=2b^2/a \Rightarrow a=2b$

W.K.T. $b^2=a^2(1-e^2)$

$1-e^2=1/4$ or, $e^2=3/4$

$\boxed{e=\sqrt{3}/2}$

Space for calculation / rough work

32. The ends of the latus rectum of the parabola $x^2+10x-16y+25=0$ are

$(x+5)^2=4(4)y$

$X^2=4aY$

vertex $\equiv(-5,0)$, focus $\equiv(-5,4)$

equ^n of axis $\Rightarrow x=4$

~~only (3,4~~ equ^n of a line $\perp^{ar}$ to axis and passing through focus is $y=4$; $(3,4),(-13,4)$ $\underline{4}$ satisfies the parabola and their y-coordinate is $\underline{4}$

a) (3,4),(−13,4)
b) (5,-8),(−5,8)
c) (3,-4),(13,4)
d) (-3,-4),(13,−4)

a

33. Which of the following functions is differentiable at $x=0$?

a) $\cos(|x|)+|x|$
b) $\cos(|x|)-|x|$
c) $\sin(|x|)+|x|$
d) $\sin(|x|)-|x|$

d

34. If $x=a\left(\cos t+\log\tan\frac{t}{2}\right), y=a\sin t$, then $\frac{dy}{dx}=$

a) $\tan t$
b) $\cot t$
c) $-\cot t$
d) $-\tan t$

a

Find $\frac{dy}{dt}$ and $\frac{dx}{dt}$

$\frac{(dy/dt)}{(dx/dt)}=\frac{\cos t\sin t}{\cos^2 t}=\tan t$

35. If $\begin{bmatrix}1 & -\tan\theta\\ \tan\theta & 1\end{bmatrix}\begin{bmatrix}1 & \tan\theta\\ -\tan\theta & 1\end{bmatrix}^{-1}=\begin{bmatrix}a & -b\\ b & a\end{bmatrix}$, then

a) $a=1=b$
b) $a=\cos 2\theta, b=\sin 2\theta$
c) $a=\sin 2\theta, b=\cos 2\theta$
d) $a=\cos\theta, b=\sin\theta$

b

$\begin{bmatrix}1 & -\tan\theta\\ \tan\theta & 1\end{bmatrix}\begin{bmatrix}1 & -\tan\theta\\ \tan\theta & 1\end{bmatrix}\frac{1}{\sec^2\theta}$

$=\begin{bmatrix}1-\tan^2\theta & -2\tan\theta\\ 2\tan\theta & 1-\tan^2\theta\end{bmatrix}\frac{1}{\sec^2\theta}$

$=\begin{bmatrix}\cos^2\theta-\sin^2\theta & -2\sin\theta\cos\theta\\ +2\sin\theta\cos\theta & \cos^2\theta-\sin^2\theta\end{bmatrix}$

$=\begin{bmatrix}\cos 2\theta & -\sin 2\theta\\ \sin 2\theta & \cos 2\theta\end{bmatrix}$

So, $a=\cos 2\theta$, $b=\sin 2\theta$

Space for calculation / rough work

$1-\tan\theta \quad -\tan\theta$

$1+\tan^2\theta \quad \tan\theta-\tan\theta \quad -\tan\theta-\tan\theta \quad 1+\tan^2\theta$

36. If $A=\begin{bmatrix}1 & 2\\0 & 1\end{bmatrix}$, then A^n is

(C) $\begin{bmatrix}1 & 2n\\0 & 1\end{bmatrix}$

a) $\begin{bmatrix}1 & 2^n-2\\0 & 1\end{bmatrix}$

b) $\begin{bmatrix}1 & n^2\\0 & 1\end{bmatrix}$

c) $\begin{bmatrix}1 & 2n\\0 & 1\end{bmatrix}$

d) $\begin{bmatrix}1 & n^2\\1 & 1\end{bmatrix}$

37. If α,β,v are the roots of the equation $x^3+px+q=0$ then the value of the determinant $\begin{vmatrix}\alpha & \beta & v\\ \beta & v & \alpha\\ v & \alpha & \beta\end{vmatrix}$ is

a) q (b)

b) 0

c) p

d) p^2-2q

38. The number of distinct real roots of $\begin{vmatrix}\sin x & \cos x & \cos x\\ \cos x & \sin x & \cos x\\ \cos x & \cos x & \sin x\end{vmatrix}$ in the interval $\left[\frac{-\pi}{4},\frac{\pi}{4}\right]$ is

a) 0

b) 1 (b)

c) 2

d) 3

Space for calculation / rough work

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39. The sum of non-prime positive divisors of 450 is

a) 1209
b) 1299
c) 1199
d) 1099

c

40. The last digit of $\sum_{\substack{1<p<100 \\ p\text{ - prime}}} p! - \sum_{n=1}^{50} (2n)!$ is

a) 2
b) 4
c) 6
d) 8

d

41. The interval I such that $\int_0^1 \frac{dx}{\sqrt{1+x^4}} \in$ I is given by

a) $\left(0, \frac{1}{\sqrt{2}}\right)$
b) $\left[\frac{1}{\sqrt{2}}, 1\right]$
c) $\left[\sqrt{2}, 2\right]$
d) $\left[\sqrt{2}, \frac{7}{4}\right]$

$(1+x^4) < (1+x^2)^2 \Rightarrow \sqrt{1+x^4} < 1+x^2$

or, $\frac{1}{\sqrt{1+x^4}} > \frac{1}{1+x^2}$ or, $\frac{1}{1+x^2} < \frac{1}{\sqrt{1+x^4}}$

$\frac{1}{\sqrt{1+x^4}} < 1$ always

So, $\int_0^1 \frac{1}{1+x^2} dx < \int_0^1 \frac{1}{\sqrt{1+x^4}} dx < \int_0^1 1\, dx$

b

42. $\int_0^{\frac{\pi}{2}} \log(\tan x)\ dx =$

a) $\frac{\pi}{2}$
b) 0
c) 1
d) $\frac{\pi}{4}$

b

$\int$ tan x

$\int_0^{\pi/2} \log(\tan x) = \int_0^{\pi/2} \log \sin x - \int_0^{\pi/2} \log \cos x$

$= 0$

$\Rightarrow \int_0^{\pi/2} \log(\sin x) = \int_0^{\pi/2} \log(\cos x)$

Space for calculation / rough work

43. The value of $\int_{-2}^{2}\left(ax^3+bx+c\right)\,dx$ depends on the

a) value of b
b) value of c
c) value of a
d) values of a and b

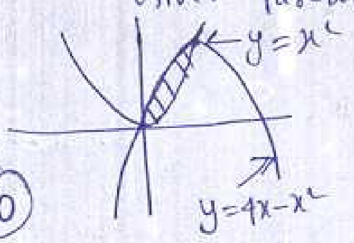
since ax^3+bx is an odd function $\int_{-2}^{2}(ax^3+bx)\,dx=0$

(b) then $\int_{-2}^{2}(ax^3+bx+c)\,dx=\int_{-2}^{2}c(dx)$; $\therefore$ integral depends upon the value of 'c'

44. The area of the region bound by the curves $y=x^2$ and $y=4x-x^2$ is

a) $\frac{16}{3}$ sq. units
b) $\frac{8}{3}$ sq. units
c) $\frac{4}{3}$ sq. units
d) $\frac{2}{3}$ sq. units

(b)



Given parabolas are $y=x^2$, $(y-4)=-(x-2)^2$

x - coordinates on intersect pt. = 0 or 2

area $=\int_0^2\{(4x-x^2)-x^2\}dx=\int_0^2(4x-2x^2)dx$

$\left[2x^2-\frac{2}{3}x^3\right]_0^2=8/3$

45. The particular solution of $\frac{y}{x}\frac{dy}{dx}=\frac{1+y^2}{1+x^2}$, when $x=1$, $y=2$ is

a) $5\left(1+y^2\right)=2\left(1+x^2\right)$
b) $2\left(1+y^2\right)=5\left(1+x^2\right)$
c) $5\left(1+y^2\right)=\left(1+x^2\right)$
d) $\left(1+y^2\right)=2\left(1+x^2\right)$

(b)

$\frac{1}{2}\int\frac{2y\,dy}{1+y^2}=\frac{1}{2}\int\frac{2x\,dx}{1+x^2}$; or, $\frac{1}{2}\log(1+x^2)=\frac{1}{2}\log(1+y^2)+c$ —①

or, $\log\frac{(1+x^2)}{(1+y^2)}=c$

Put $x=1, y=2$

$c=\log 2/5$

Put value of c in equⁿ ①: $2(1+y^2)=5(1+x^2)$

46. The solution of the differential equation $\frac{dy}{dx}=(x+y)^2$ is

a) $\frac{1}{x+y}=c$
b) $\sin^{-1}(x+y)=x+c$
c) $\tan^{-1}(x+y)=c$
d) $\tan^{-1}(x+y)=x+c$

(d)

Put $x+y=z \Rightarrow \frac{dy}{dx}+1=\frac{dz}{dx}$

Now given equⁿ

$\frac{dz}{dx}-1=z^2$ or, $\frac{dz}{dx}=1+z^2$

$\int dx=\int\frac{dz}{1+z^2}$

Space for calculation / rough work

$\boxed{c+x=\tan^{-1}(x+y)}$

47. The maximum value of $\left(\frac{1}{x}\right)^{2x^2}$ is

a) $e^{1/2}$ (b)

b) $\sqrt{e}$

c) 1

d) e^2

48. Let x be a number which exceeds its square by the greatest possible quantity, then x =

a) 1/2 (a)

b) 1/4

c) 3/4

d) 1/3

Go by option. For $x=\frac{1}{2}$: $\frac{1}{2}-\left(\frac{1}{2}\right)^2=\frac{1}{4}$

49. The subtangent at $x=\pi/2$ on the curve $y = x \sin x$ is

a) 0 (c)

b) 1

c) $\pi/2$

d) none of these

slope $\left.\frac{dy}{dx}\right|_{x=\pi/2}=1$; $y=x+c$; $P(\pi/2, 0)$ lies on $y=x\sin x$; so $c=\pi/2$

equⁿ of line $\Rightarrow y=x+\pi/2$ (distance b/w origin and axis intersect pt $=\pi/2$)

50. The value of $\int \frac{10^{x/2}}{\sqrt{10^{-x}-10^{x}}}\,dx$ is

a) $\frac{1}{\log_e 10}\sin^{-1}(10^x)+c$ (a)

b) $2\sqrt{10^{-x}+10^x}+c$

c) $\frac{1}{\log_e 10}\sinh^{-1}(10^x)+c$

d) $\frac{-1}{\log_e 10}\sinh^{-1}(10^x)+c$

$$\int \frac{10^{x/2}\,dx}{\sqrt{10^{-x}-10^{x}}}=\int \frac{10^{x/2}\,10^{x/2}}{\sqrt{1-(10^x)^2}}\,dx$$

$$=\int \frac{10^x}{\sqrt{1-(10^x)^2}}\,dx\,;\quad y=10^x=e^{x\log_e 10}$$

$$\frac{dy}{dx}=(\log_e 10)\,e^{x\log_e 10}$$

$$=\int \frac{\log_e 10\,(e^{x\log 10})}{\log_e 10\,\sqrt{1-(10^x)^2}}\,dx$$

$$=\frac{1}{\log_e 10}\int \frac{dy}{\sqrt{1-y^2}}\,;\quad y=10^x=e^{x\log_e 10}$$

$$=\frac{1}{\log_e 10}\sin^{-1}(10^x)+c$$

Space for calculation / rough work

51. $\int e^x \left\{ \frac{1+\sin x \cos x}{\cos^2 x} \right\} dx =$

$$\int e^x \left\{ \frac{1}{\cos^2 x} + \frac{\sin x \cos x}{\cos^2} \right\} dx$$

$$\int e^x (\sec^2 x + \tan x)\, dx \equiv \int e^x (f'(x) + f(x))\, dx$$

$$= e^x \tan x + C$$

(c)

a) $e^x \cos x + c$

b) $e^x \sec x \tan x + c$

c) $e^x \tan x + c$

d) $e^x \cos^2 x - 1 + c$

52. $\int \frac{x^2+1}{x^4+1} dx$

(d)

a) $\frac{1}{\sqrt{2}} \log_e (x^2+1) + c$

b) $\frac{1}{\sqrt{2}} \tan^{-1}\left(\frac{x^2+1}{x\sqrt{2}}\right) + c$

c) $\frac{1}{\sqrt{2}} \tan^{-1}(x^2-1) + c$

d) $\frac{1}{\sqrt{2}} \tan^{-1}\left(\frac{x^2-1}{x\sqrt{2}}\right) + c$

53. The locus of the mid point of the intercept of the line $x \cos\alpha + y \sin\alpha = p$ between the coordinate axes is

(a)

a) $x^{-2} + y^{-2} = 4p^{-2}$

b) $x^{-2} + y^{-2} = p^{-2}$

c) $x^2 + y^2 = 4p^{-2}$

d) $x^2 + y^2 = p^2$

when $x = 0$, $y = p \operatorname{cosec}\alpha$

$y = 0$, $x = p \sec\alpha$

mid point $\equiv \left(\frac{p \sec\alpha}{2}, \frac{p \operatorname{cosec}\alpha}{2}\right)$

so, $x = \frac{p \sec\alpha}{2}$; $y = \frac{p \operatorname{cosec}\alpha}{2}$

or, $\cos\alpha = \frac{p}{2x}$; $\sin\alpha = \frac{p}{2y}$

W.K.T

$\cos^2\alpha + \sin^2\alpha = 1$

Space for calculation / rough work

$$\frac{p^2}{4x^2} + \frac{p^2}{4y^2} = 1$$

$$\boxed{x^{-2} + y^{-2} = 4p^{-2}}$$

54. If the line through $A = (4, -5)$ is inclined at an angle 45^0 with the positive direction of the x–axis, then the coordinates of the two points on opposite sides of A at a distance of $3\sqrt{2}$ units are

a) (7, 2), (1, 8)

b) (7, 2), (1, –8)

c) (7, –2), (1, –8)

d) (7, 2), (–1, 8)

Slope = tan 45° = 1 ; equⁿ y = x + c
P(4, 5) lies on line so, c = –9
Now, equⁿ ⟹ y = x – 9
only (7, –2) and (1, –8) lies on above st. line equⁿ, so no need for further calculation

C

55. If the line $px + qy = 0$ coincides with one of the lines given by $ax^2 + 2hxy + by^2 = 0$ then

a) $ap^2 + 2hpq + bq^2 = 0$

b) $aq^2 + 2hpq + bp^2 = 0$

c) $aq^2 - 2hpq + bp^2 = 0$

d) none of these

$y = \frac{-p}{q}x$; Put in given pair of lines

or, $ax^2 + 2hx\left(\frac{-px}{q}\right) + \frac{bp^2}{q^2}x^2 = 0$

or, $(aq^2 - 2hpq + bp^2)x^2 = 0$

Soln:- either $x = 0$ or $\boxed{aq^2 - 2hpq + bp^2 = 0}$

C

56. The function $f(x) = \left(\frac{\log_e(1+ax) - \log_e(1-bx)}{x}\right)$ is undefined at $x = 0$. The value which should be assigned to f at $x = 0$ so that it is continuous at $x = 0$ is

a) $\frac{a+b}{2}$

b) $a + b$

c) $\log_e(ab)$

d) $a - b$

b

57. lim

a)

b)

c)

d)

58. The n

a) 3

b) 2

c) 1

d) 6

59. The a

a) 17

b) 14

c) 13

d) 12

Space for calculation / rough work

coordi-

57. $\lim_{n\to\infty}\frac{(1^2+2^2+\cdots+n^2)\sqrt[n]{n}}{(n+1)(n+10)(n+100)}=$

a) 3

b) $\frac{1}{3}$

c) $\frac{2}{3}$

d) ∞

(b)

$$\left(\lim_{n\to\infty}\frac{n(n+1)(2n+1)}{6(n+1)(n+10)(n+100)}\right)\left(\lim_{n\to\infty}\sqrt[n]{n}\right)$$

$$=\lim_{n\to\infty}\frac{2n^2+n}{6(n+10)(n+100)}(1)=\lim_{n\to\infty}\frac{2+1/n}{6(1+10/n)(1+100/n)}$$

$$=\frac{2+0}{6(1+0)(1+0)}=\frac{2}{6}=1/3$$

58. The number of triangles in a complete graph with 10 non-collinear vertices is

a) 360

b) 240

c) 120

d) 60

(c)

$$\text{no. of triangle} = {}^{10}C_3 = \frac{10\times 9\times 8\times 7!}{7!\times 3!} = 120$$

59. The angle between hands of a clock when the time is 4.25 AM is

igned to

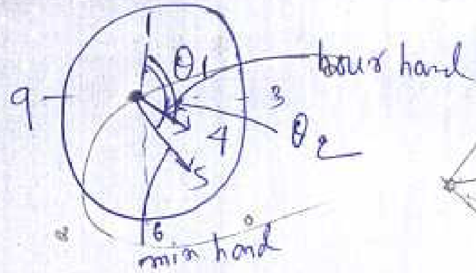
a) $17\frac{1}{2}^0$

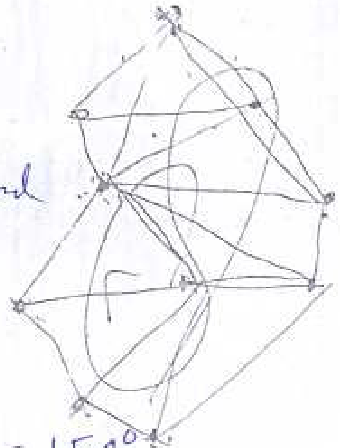
b) $14\frac{1}{2}^0$

c) $13\frac{1}{2}^0$

d) $12\frac{1}{2}^0$

(a)





$$\theta_{1\ \text{min hand}} = \frac{360^\circ}{12}\times 5 = 150^\circ$$

$$\theta_{2\ \text{hour hand}} = \frac{360^\circ}{12}\times 4 + \frac{30^\circ}{60\text{min}}\times 25\text{ min} = 132.5^\circ$$

$$\theta_1-\theta_2 = 150-132.5^\circ = 17\tfrac{1}{2}$$

Space for calculation / rough work