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THIRUVALLUR DISTRICT

COMMON QUARTERLY EXAMINATION - 2024

23.9.2024 Standard XII Reg.No.

MATHEMATICS

Part - I

Time : 3.00 hrs Marks : 90

$20 \times 1 = 20$

I. Choose the correct answer:

1. If $A=\begin{bmatrix}2 & 0\\1 & 5\end{bmatrix}$ and $B=\begin{bmatrix}1 & 4\\2 & 0\end{bmatrix}$ then $|adj(AB)|=$
   a) −40 b) −80 c) −60 d) −20

2. If A, B and C are invertible matrices of some order, then which one of the following is not true?
   a) $adj\,A=|A|A^{-1}$ b) $adj(AB)=(adj\,A)(adj\,B)$
   c) $\det A^{-1}=(\det A)^{-1}$ d) $(ABC)^{-1}=C^{-1}B^{-1}A^{-1}$

3. If $A=\begin{bmatrix}2 & 3\\5 & -2\end{bmatrix}$ be such that $\lambda A^{-1}=A$, then λ is
   a) 17 b) 14 c) 19 d) 21

4. The value of $\sum_{n=1}^{13}(i^n+i^{n-1})$ is
   a) $1+i$ b) i c) 1 d) 0

5. If $|z_1|=1$, $|z_2|=2$, $|z_3|=3$ and $|9z_1z_2+4z_1z_3+z_2z_3|=12$, then the value of $|z_1+z_2+z_3|$ is
   a) 1 b) 2 c) 3 d) 4

6. The principal argument of $(\sin 40^\circ+i\cos 40^\circ)^5$ is
   a) -110° b) -70° c) 70° d) 110°

7. According to the rational root theorem, which number is not possible rational zero of $4x^7+2x^4-10x^3-5$?
   a) −1 b) $\frac{5}{4}$ c) $\frac{4}{5}$ d) 5

8. The polynomial x^3-kx^2+9x has three real zeros if and only if, k satisfies
   a) $|k|\le 6$ b) $k=0$ c) $|k|>6$ d) $|k|\ge 6$

9. The polynomial x^3+2x+3 has
   a) one negative and two imaginary zeros b) one positive and two imaginary zeros
   c) three real zeros d) no zeros

10. $\sin^{-1}(\cos x)=\frac{\pi-x}{2}$ is valid for
    a) $-\pi\le x\le 0$ b) $0\le x\le\pi$ c) $-\frac{\pi}{2}\le x\le\frac{\pi}{2}$ d) $-\frac{\pi}{4}\le x\le\frac{3\pi}{4}$

11. $\tan^{-1}\left(\frac{1}{4}\right)+\tan^{-1}\left(\frac{2}{9}\right)$ is equal to
    a) $\frac{1}{2}\cos^{-1}\left(\frac{3}{5}\right)$ b) $\frac{1}{2}\sin^{-1}\left(\frac{3}{5}\right)$ c) $\frac{1}{2}\tan^{-1}\left(\frac{3}{5}\right)$ d) $\tan^{-1}\left(\frac{1}{2}\right)$

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12. If $\cot^{-1}(\sqrt{\sin\alpha})+\tan^{-1}(\sqrt{\sin\alpha})=u$ then, cos2u is equal to
a) $\tan^2\alpha$ b) 0 c) -1 d) $\tan 2\alpha$

13. The circle $x^2 + y^2 = 4x + 8y + 5$ intersects the line $3x - 4y = m$ at two distinct points if
a) $15 < m < 65$ b) $35 < m < 85$ c) $-85 < m < -35$ d) $-35 < m < 15$

14. Area of the greatest rectangle inscribed in the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is
a) 2ab b) ab c) $\sqrt{ab}$ d) $\frac{a}{b}$

15. The locus of a point whose distance from (–2,0) is $\frac{2}{3}$ times its distance from the line $x=\frac{-9}{2}$ is
a) a parabola b) a hyperbola c) an ellipse d) a circle

16. If $\vec{a}$ and $\vec{b}$ are parallel vectors, then $[\vec{a}, \vec{c}, \vec{b}]$ is equal to
a) 2 b) -1 c) 1 d) 0

17. If $\vec{a}.\vec{b}=\vec{b}.\vec{c}=\vec{c}.\vec{a}=0$, then the value of $[\vec{a},\vec{b},\vec{c}]$ is
a) $|\vec{a}||\vec{b}||\vec{c}|$ b) $\frac{1}{3}|\vec{a}||\vec{b}||\vec{c}|$ c) 1 d) -1

18. If $\vec{a},\vec{b},\vec{c}$ are three non-coplanar unit vectors such that $\vec{a}\times(\vec{b}\times\vec{c})=\frac{\vec{b}+\vec{c}}{\sqrt{2}}$, then the angle between $\vec{a}$ and $\vec{b}$ is
a) $\frac{\pi}{2}$ b) $\frac{3\pi}{4}$ c) $\frac{\pi}{4}$ d) π

19. Find the $|d_1 - d_2|$ between the parallel plane $x + 2y - 2z + 1 = 0$ and $2x + 4y - 4z + 5 = 0$
a) 2 b) -1 c) 1 d) -2

20. If $5x + 2y = 3$ and $3x + 2y = 5$ are the system of linear equations, then |A| =
a) 1 b) 2 c) 3 d) 4

Part - II

II. Answer any 7 questions. (Q.No.30 is compulsory) **7 x 2 = 14**

21. If A is a non-singular matrix of odd order, prove that |adj A| is positive.

22. Prove that $\begin{bmatrix}\cos\theta & -\sin\theta\\ \sin\theta & \cos\theta\end{bmatrix}$ is orthogonal.

23. Simplifying the following : $i^{59}+\frac{1}{i^{59}}$

24. If |z| = 2, show that $3 \le |z + 3 + 4i| \le 7$

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25. Find a polynomial equation of minimum degree with rational coefficients having $2-\sqrt{3}$ as a root.

26. Discuss the nature of the roots of the following polynomial :
$x^{2018} + 1947x^{1950} + 15x^{8} + 26x^{6} + 2019$

27. Find the principal value of $\cos^{-1}\left(\frac{1}{2}\right)$

28. The maximum and minimum distances of the Earth from the Sun respectively are 152×10^{6} km and 94.5×10^{6} km. The sun is at one focus of the elliptical orbit. Find the distance from the sun to the other focus.

29. If $2\hat{i}-\hat{j}+3\hat{k}$, $3\hat{i}+2\hat{j}+\hat{k}$, $\hat{i}+m\hat{j}+4\hat{k}$ are coplanar, find the value of m.

30. Prove that $[\vec{a}-\vec{b}, \vec{b}-\vec{c}, \vec{c}-\vec{a}] = 0$

Part - III

III. Answer any 7 questions. (Q.No.40 is compulsory) **7 x 3 = 21**

31. Find the adjoint of the following : $\begin{bmatrix} -3 & 4 \\ 6 & 2 \end{bmatrix}$

32. Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 4 \\ 3 & 0 & 5 \end{bmatrix}$ by reducing it to a row-echelon form.

33. Write the following in the rectangular form : $\frac{10-5i}{6+2i}$

34. Show that the equation $z^2 = \bar{z}$ has four solutions.

35. If α and β are the roots of the quadratic equation $2x^2 - 7x + 13 = 0$, construct a quadratic equation whose roots are α^2 and β^2.

36. If p is real, discuss the nature of the roots of the equation $4x^2 + 4px + p + 2 = 0$ in terms of p.

37. Find the value of $\sin^{-1}(-1) + \cos^{-1}\left(\frac{1}{2}\right) + \cot^{-1}(2)$

38. Find the general equation of the circle whose diameter is the line segment joining the points (–4,–2) and (1,1)

39. If $\vec{a} = \hat{i}-\hat{j}$, $\vec{b} = \hat{i}-\hat{j}-4\hat{k}$, $\vec{c} = 3\hat{i}-\hat{k}$ and $\vec{d} = 2\hat{i}+5\hat{j}+\hat{k}$, verify that
$(\vec{a}\times\vec{b})\times(\vec{c}\times\vec{d}) = [\vec{a}\,\vec{b}\,\vec{d}]\vec{c} - [\vec{a}\,\vec{b}\,\vec{c}]\vec{d}$

40. Show that the points (2,3,4), (–1,4,5) and (8,1,2) are collinear.

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Part - IV

IV. Answer all the questions. **7 x 5 = 35**

41. a) By using Gaussian elimination method, balance the chemical reaction equation $C_2H_6 + O_2 \rightarrow H_2O + CO_2$ *(OR)*

b) Investigate for what values of λ and μ the system of linear equations $x + 2y + z = 7,\ x + y + \lambda z = \mu,\ x + 3y - 5z = 5$ has
(i) no solution (ii) a unique solution (iii) an infinite number of solutions

42. a) Suppose z_1, z_2 and z_3 are the vertices of an equilateral triangle inscribed in the circle $|z| = 2$ If $z_1 = 1 + i\sqrt{3}$, then find z_2 and z_3. *(OR)*

b) If $z = x + iy$ and $\arg\left(\dfrac{z-i}{z+2}\right) = \dfrac{\pi}{4}$, show that $x^2 + y^2 + 3x - 3y + 2 = 0$

43. a) Solve the equation $6x^4 - 35x^3 + 62x^2 - 35x + 6 = 0$ *(OR)*

b) Solve the equation : $(x-2)(x-7)(x-3)(x+2) + 19 = 0$

44. a) Find the value of $\cos^{-1}\left(\cos\left(\dfrac{4\pi}{3}\right)\right) + \cos^{-1}\left(\cos\left(\dfrac{5\pi}{4}\right)\right)$ *(OR)*

b) Solve : $\tan^{-1}\left(\dfrac{x-1}{x-2}\right) + \tan^{-1}\left(\dfrac{x+1}{x+2}\right) = \dfrac{\pi}{4}$

45. a) Identify the type of conic and find centre, foci, vertices and directrices. $18x^2 + 12y^2 - 144x + 48y + 120 = 0$ *(OR)*

b) Find the equations of tangent and normal to the parabola $x^2 + 6x + 4y + 5 = 0$ at $(1, -3)$

46. a) Prove by vector method that the perpendiculars (attitudes) from the vertices to the opposite sides of a triangle are concurrent. *(OR)*

b) Find the non-parametric form of vector equation and cartesian equation of the plane passing through the point $(1,-2,4)$ and perpendicular to the plane $x + 2y - 3z = 11$ and parallel to the line $\dfrac{x+7}{3} = \dfrac{y+3}{-1} = \dfrac{z}{1}$

47. a) If the equation of the ellipse is $\dfrac{(x-11)^2}{484} + \dfrac{y^2}{64} = 1$ (x and y are measured in centimetres) where to the nearest centimetres, should the patient's kidney stone be placed so that the reflected sound hits the kidney stone? *(OR)*

b) A fish tank can be filled in 10 minutes using both pumps A and B simultaneously. However, pump B can pump water in or out at the same rate. If pump B is inadvertently run in reverse, then the tank will be filled in 30 minutes. How long would it take each pump to fill the tank by itself? (Use Cramer's rule to solve the problem)

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COMMON QUARTERLY EXAMINATION – 2024

CLASS : XII SUBJECTS :- MATHEMATICS

Part - I

Choose the correct Answer

1. (B) Chapter (I – 6 Question)
2. (B) (I – 7)
3. (C) (I – 16)
4. (A) (II – 2)
5. (B) (II – 14)
6. (A) (II – 17)
7. (C) (III – 5)
8. (D) (III – 6)
9. (A) (III – 9)
10. (B) (IV – 5)
11. (D) IV Chapter – 10 question
12. (C) (IV – 15)
13. (D) (V – 3)
14. (A) (V – 18)
15. (C) (V – 23)
16. (D) (VI – 1)
17. (A) (VI – 3)
18. (B) (VI – 10)
19. option wrong (Example 6.5)
20. (d) (own)

Part - II

(21) **Example 1.4**

non-singular Matrix of order $2m+1$

where $m = 0, 1, 2 \ldots$

$|A| \neq 0$

$|\text{adj } A| = |A|^{(2m+1)-1}$

$= |A|^{2m}$ is always positive,

$|\text{adj } A|$ is positive

(22) **Example 1.11**

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

$$A^T = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

$AA^T = I$ is orthogonal

$$AA^T = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \times \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

$$= \begin{bmatrix} \sin^2\theta + \cos^2\theta & 0 \\ 0 & \sin^2\theta + \cos^2\theta \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$ ∴ A is orthogonal

(23) **EX 2.1 ⇒ 4**

$$i^{59} + \frac{1}{i^{59}} = i^{59} + i^{-59}$$

$$= i^{56+3} + i^{56-3}$$

$$= i^3 + i^{-3}$$

$$= -i + i$$

$$= 0.$$

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(2)

Example 2.16

(24) $z^2 = \bar{z}$ Take Modul both side

$|z^2| = |\bar{z}|$

$|z|^2 - |z| = 0$

$|z|(|z|-1) = 0$

$|z| = 0$ | $|z| - 1 = 0$, $|z| = 1$

$z = 0$ is a solution

Take $|z| = 1$ | given $z^2 = \bar{z}$

$z\bar{z} = 1$ | $z^2 = 1/z$

$\bar{z} = 1/z$ | $z^3 = 1$

It has 3 non-zero solution.

Hence 4 Solutions.

Example 3.9

(25) $2-\sqrt{3}$ is a roots

$2+\sqrt{3}$ are another roots

$Sum = 2-\sqrt{3}+2+\sqrt{3} = 4$

$Product = (2-\sqrt{3})(2+\sqrt{3}) = (2)^2-(\sqrt{3})^2$

$= 4-3 = 1$

equation

$x^2 - (sum)x + Product = 0$

$x^2 - 4x + 1 = 0$

Example 3.31

(26) $P(x) = x^{2018} + 1947x^{1950} + 15x^8 + 26x^6 + 2019$

$P(-x) = x^{2018} + 1947x^{1950} + 15x^8 + 26x^6 + 2019$

$P(-x)$ has No Positive roots and No Negative roots.

∴ Has No Real roots and all roots are Imaginary roots.

Ex 4.2 ⇒ 4

(27) $\theta = \cos^{-1}(1/2)$

$\cos\theta = 1/2$

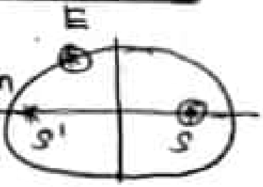
$\cos \pi/3 = 1/2$

$\therefore \pi/3 \in [0, \pi]$

Example 5.32

(28) $AS = 94.5 \times 10^6$ km

$SA' = 152 \times 10^6$ km



$a+c = 152 \times 10^6 \longrightarrow (1)$

$a-c = 94.5 \times 10^6 \longrightarrow (2)$

(1) − (2)

$2c = 57.5 \times 10^6$

$SS' = 57.5 \times 10^1 \times 10^5$

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$SS' = 575 \times 10^5$ km

Distance

(29) Example 6.15

Coplanar $\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} = 0$

$2\vec{i} - \vec{j} + 3\vec{k}$ $\quad a_1 = 2,\ b_1 = -1,\ c_1 = 3$

$3\vec{i} + 2\vec{j} + \vec{k}$ $\quad a_2 = 3,\ b_2 = 2,\ c_2 = 1$

$\vec{i} + m\vec{j} + 4\vec{k}$ $\quad a_3 = 1,\ b_3 = m,\ c_3 = 4$

$$\begin{vmatrix} 2 & -1 & 3 \\ 3 & 2 & 1 \\ 1 & m & 4 \end{vmatrix} = 0$$

$2(6-m) + 1(12-1) + 3(3m-2) = 0$

$12 - 2m + 11 + 9m - 6 = 0$

$7m + 21 = 0$

$7m = -21$

$m = -\frac{21}{7} = -3$

$\boxed{m = -3}$

(30) Ex 6.3 ⇒ 3

$[\vec{a}-\vec{b}, \vec{b}-\vec{c}, \vec{c}-\vec{a}] =$

$(\vec{a}-\vec{b}) \cdot [(\vec{b}-\vec{c}) \times (\vec{c}-\vec{a})]$

$= (\vec{a}\cdot\vec{b}) \cdot (\vec{b}\times\vec{c} - \vec{b}\times\vec{a} - \vec{c}\times\vec{c} + \vec{c}\times\vec{a})$

$= \vec{a}(\vec{b}\times\vec{c}) - \vec{b}(\vec{c}\times\vec{a})$

$= 0.$

Part - III

(31) Ex 1.1 ⇒ 1

$A = \begin{bmatrix} -3 & 4 \\ 6 & 2 \end{bmatrix}$

$\operatorname{adj} A = \begin{bmatrix} 2 & -4 \\ -6 & -3 \end{bmatrix}$

(32) Example 1.17

$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 1 & 4 \\ 3 & 0 & 5 \end{bmatrix}$

$\sim \begin{bmatrix} 1 & 2 & 3 \\ 0 & -3 & -2 \\ 0 & -6 & -4 \end{bmatrix}$ $\quad R_2 \to R_2 - 2R_1$, $R_3 \to R_3 - 3R_1$

$\sim \begin{bmatrix} 1 & 2 & 3 \\ 0 & -3 & -2 \\ 0 & 0 & 0 \end{bmatrix}$ $\quad R_3 \to R_3 - 2R_2$

$\rho(A) = 2$ (non - zero rows)

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(4)

(33) **Ex 2.4 → 1(ii)**

$= \frac{10-5i}{6+2i} \times \frac{6-2i}{6-2i} = \frac{(60-10)+i(-30-10)}{36+4}$

$= \frac{50-50i}{40} = \frac{5}{4}(1-i)$

(34) **Example 2.13**

given $|z| = 2$

$|z+3+4i| \le |z| + |3+4i|$

$= 2+5 = 7$

$|z+3+4i| \le 7 \longrightarrow (1)$

$|z+3+4i| \ge |z| - |3+4i|$

$= 2-5 = 3$

$|z+3+4i| \ge 3 \longrightarrow (2)$

Form (1) & (2)

$3 \le |z+3+4i| \le 7$

(35) **Example 3.2**

$2x^2-7x+13=0$

$a=2 \quad b=-7 \quad c=13$

Sum $(\alpha+\beta) = -\frac{b}{a} = 7/2$

product $(\alpha\beta) = \frac{c}{a} = \frac{13}{2}$

Sum $(\alpha^2+\beta^2) = (\alpha+\beta)^2 - 2(\alpha\beta)$

$= (7/2)^2 - 2(13/2)$

$= -3/4$

Product $(\alpha\beta)^2 = \alpha^2\beta^2$

$= \left(\frac{13}{2}\right)^2 = \frac{169}{4}$

equation

$x^2-(\alpha^2+\beta^2)x+(\alpha\beta)^2=0$

$x^2+\frac{3}{4}x+\frac{169}{4}=0$

(or)

$4x^2+3x+169=0$

(36) **Example 3.7**

$\Delta = b^2-4ac$

$4x^2+4px+p+2=0$

$a=4 \quad b=4p \quad c=p+2$

$\Delta = (4p)^2 - 4(4)(p+2)$

$= 16(p^2-p-2)$

$= 16(p+1)(p-2)$

Imaginary roots

$\Delta < 0$ if $-1<p<2$

equal roots

$\Delta = 0$ if $p=-1$ (or) $p=2$

distinct real roots

$\Delta > 0$ if $-\infty<p<-1$ (or) $2<p<\infty$

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(37) Ex 4.4 → 2 (ii) (5)

$\sin^{-1}(-1) = -\pi/2$

$\cos^{-1}(1/2) = \pi/3$

$\cot^{-1}(2) = \cot^{-1}(2)$

$\therefore = -\pi/2 + \pi/3 + \cot^{-1}(2)$

$= \frac{-3\pi+2\pi}{6} + \cot^{-1}(2)$

$= -\pi/6 + \cot^{-1}(2)$

(38) Example 5.4

given $(x_1, y_1) = (-4, -2)$

$(x_2, y_2) = (1, 1)$

$(x-x_1)(x-x_2) + (y-y_1)(y-y_2) = 0$

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

$x^2+y^2+3x+y-6 = 0$

(39) Example 6.22

LHS:

$\vec{a} \times \vec{b} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & -1 & 0 \\ 1 & -1 & 4 \end{vmatrix}$

$= \vec{i}(-4+0) - \vec{j}(4+0) + \vec{k}(-1+1)$

$= 4\vec{i} + 4\vec{j}$

$\vec{c} \times \vec{d} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 0 & 3 & -1 \\ 2 & 5 & 1 \end{vmatrix} = 8\vec{i} - 2\vec{j} - 6\vec{k}$

$(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d}) = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 4 & 4 & 0 \\ 8 & -2 & -6 \end{vmatrix}$

$= -24\vec{i} + 24\vec{j} - 40\vec{k}$

RHS

$[\vec{a}, \vec{b}, \vec{d}] = \begin{vmatrix} 1 & -1 & 0 \\ 1 & -1 & -4 \\ 2 & 5 & 1 \end{vmatrix}$

$= 1(-1+20) + 1(1+8) + 0$

$= 19 + 9$

$= 28$

$[\vec{a}, \vec{b}, \vec{c}] = 12$

$\therefore = [\vec{a}, \vec{b}, \vec{d}]\vec{c} - [\vec{a}, \vec{b}, \vec{c}]\vec{d}$

$= 28(3\vec{j} - \vec{k}) - 12(2\vec{i} + 5\vec{j} + \vec{k})$

$= -24\vec{i} + 24\vec{j} - 40\vec{k}$

LHS = RHS

Verify

(40)

$\vec{OA} = 2\vec{i} + 3\vec{j} + 4\vec{k}$

$\vec{OB} = -\vec{i} + 4\vec{j} + 5\vec{k}$

$\vec{OC} = 8\vec{i} + \vec{j} + 2\vec{k}$

$\vec{AB} = \vec{OB} - \vec{OA}$

$= (-\vec{i} + 4\vec{j} + 5\vec{k}) - (2\vec{i} + 3\vec{j} + 4\vec{k})$

$= -3\vec{i} + \vec{j} + \vec{k}$

$\vec{CA} = \vec{OA} - \vec{OC}$

$= (2\vec{i} + 3\vec{j} + 4\vec{k}) - (8\vec{i} + \vec{j} + 2\vec{k})$

$= -6\vec{i} + 2\vec{j} + 2\vec{k}$

$= 2(-3\vec{i} + \vec{j} + \vec{k})$

$= 2\vec{AB}$

$\therefore$ Points are collinear

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Part – IV

41 **Ex 1.7 ⇒ 3**

(a) $C_2H_6 + O_2 \rightarrow H_2O + CO_2$

$x_1 C_2H_6 + x_2 O_2 \rightarrow x_3 H_2O + x_4 CO_2$

$2x_1 - x_4 = 0$

$2x_2 - x_3 - 2x_4 = 0$

$-2x_3 + 3x_4$

$$(A,B) = \begin{bmatrix} 2 & 0 & 0 & -1 \\ 0 & 2 & -1 & -2 \\ 3 & 0 & -2 & 0 \end{bmatrix}$$

$$\sim \begin{bmatrix} 2 & 0 & 0 & -1 \\ 0 & 2 & -1 & -2 \\ 0 & 0 & -2 & 3 \end{bmatrix} R_3 \rightarrow 2R_3 - 3R_1$$

$\rho(A) = \rho(A,B) = 3 <$ No of unknowns

$x_1 = 2 \quad x_2 = 7 \quad x_3 = 6 \quad x_4 = 4$

Balanced equation

$2C_2H_6 + 7O_2 \rightarrow 6H_2O + 4CO_2$

(b) **Example 1.34**

$AX = B$

$$\begin{bmatrix} 1 & 2 & 1 \\ 1 & 1 & \lambda \\ 1 & 3 & -5 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 7 \\ \mu \\ 5 \end{bmatrix}$$

$$[A|B] = \begin{bmatrix} 1 & 2 & 1 & 7 \\ 1 & 1 & \lambda & \mu \\ 1 & 3 & -5 & 5 \end{bmatrix}$$

$$\sim \begin{bmatrix} 1 & 2 & 1 & 7 \\ 0 & 1 & -6 & -2 \\ 0 & -1 & \lambda-1 & \mu-7 \end{bmatrix} \begin{matrix} R_2 \leftrightarrow R_3 \\ R_2 \rightarrow R_2 - R_1 \\ R_3 \rightarrow R_3 - R_1 \end{matrix}$$

(4)

$$\sim \begin{bmatrix} 1 & 2 & 1 & 7 \\ 0 & 1 & -6 & -2 \\ 0 & 0 & \lambda-7 & \mu-9 \end{bmatrix} R_3 \rightarrow R_3 + R_2$$

(i) $\lambda = 7, \mu \neq 9$

$\rho(A) \neq \rho(A|B) \Rightarrow$ $\rho(A) = 2$, $\rho(A|B) = 3$

No solutions

(ii) $\lambda \neq 7$ $\rho(A) = 3$

$\rho(A|B) = 3$

$\rho(A) = \rho(A|B) = 3$

Unique solutions

(iii) $\lambda = 7, \mu = 9$

$\rho(A) = 2, \rho(A/B) = 2$

$\rho(A) = \rho(A|B) = 2 < 3$

Infinite No. of Solutions

(42) **Example 2.36**

(a)

$|z| = 2$

centre $(0,0)$

radius $= 2$

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

$\vec{OA} = z_1 = 1 + i\sqrt{3}$

$\vec{OB} = (1 + i\sqrt{3}) e^{i\frac{2\pi}{3}}$

$= (1 + i\sqrt{3})\left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right)$

$= -2$

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$\vec{OC} = -2e^{i2\pi/3}$

$= -2\left(\cos\frac{2\pi}{3} + i\sin\frac{2\pi}{3}\right)$

$= -2\left(-\frac{1}{2} + i\frac{\sqrt{3}}{2}\right)$

$= 1 - i\sqrt{3}$

$\therefore Z_2 = -2, \; Z_3 = 1 - i\sqrt{3}$

(b) Ex 2.7 → 6

$\arg\left(\frac{z-i}{z+2}\right) = \pi/4$

$z = x + iy$

$\pi/4 = \arg[x + i(y-1)] - \arg[(x+2) + iy]$

$\pi/4 = \tan^{-1}\left(\frac{y-1}{x}\right) - \tan^{-1}\left(\frac{y}{x+2}\right)$

$\pi/4 = \tan^{-1}\left[\frac{(x+2)(y-2) - yx}{x(x+2) + y(y-1)}\right]$

$\tan \pi/4 = 1$

$(x+2)(y-2) - yx = x(x+2) + y(y-1)$

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

Hence proved

(43)

(a) ~~$P(x) = 6x^4 - 3$~~

(43) Ex 3.5 → 5

(a) $P(x) = 6x^4 - 35x^3 + 62x^2 - 35x + 6$

	6	-35	62	-35	6
1/3	0	2	-11	17	-6
	6	-33	51	-18	0
3	0	18	-45	18	
	6	-15	6	0	

$6x^2 - 15x + 6 = 0$

$(\div 3)$

$2x^2 - 5x + 2 = 0$

$(x-2)(2x-1) = 0$ $2\times2 = 4$, -5: $-\frac{4}{2}, -\frac{1}{2}$

$x - 2 = 0$ | $2x - 1 = 0$

$x = 2$ | $2x = 1$

$x = \frac{1}{2}$

Solution are $3, \frac{1}{3}, 2, \frac{1}{2}$

(b) Example 3.23

$(x-2)(x-7)(x-3)(x+2) + 19 = 0$

Rewriting

$(x-2)(x-3)(x-7)(x+2) + 19 = 0$

$(x^2 - 5x + 6)(x^2 - 5x - 14) + 19 = 0$

$y = x^2 - 5x$

$(y+6)(y-14) + 19 = 0$

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$y^2-8y-65=0$

$y=13$ and $y=-5$

$x^2-5x-13=0$

$a=1 \quad b=-5 \quad c=-13$

$x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$

$x=\dfrac{+5\pm\sqrt{77}}{2}$

$x^2-5x+5=0$

$a=1 \quad b=-5 \quad c=5$

$x=\dfrac{5\pm\sqrt{5}}{2}$

Solutions as $\dfrac{5\pm\sqrt{77}}{2}, \dfrac{5\pm\sqrt{5}}{2}$

---

44 EX 4.2 ⇒ 8

(a)

$=\cos^{-1}\left(\cos\left(\frac{4\pi}{3}\right)\right)+\cos^{-1}\left(\cos\left(\frac{5\pi}{4}\right)\right)$

$=\cos^{-1}\left(\cos(\pi+\pi/3)\right)+\cos^{-1}\left(\cos(\pi+\pi/4)\right)$

$=\cos^{-1}\left(-\cos(\pi/3)\right)+\cos^{-1}\left(-\cos(\pi/4)\right)$

$=\cos^{-1}\left(\cos(\pi-\pi/3)\right)+\cos^{-1}\left(\cos(\pi-\pi/4)\right)$

$=\cos^{-1}\left(\cos\left(\frac{2\pi}{3}\right)\right)+\cos^{-1}\left(\cos\left(\frac{3\pi}{4}\right)\right)$

$=\dfrac{2\pi}{3}+\dfrac{3\pi}{4}$

$=\dfrac{17\pi}{12}$

(8) Example 4.28

(b)

$\tan^{-1}\left(\frac{x-1}{x-2}\right)+\tan^{-1}\left(\frac{x+1}{x+2}\right)=\pi/4$

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

$\dfrac{2x^2-4}{-3}=1$

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

$x=\pm\frac{1}{\sqrt{2}}$

---

45 EX 5.2 ⇒ 8

(a) $18x^2+12y^2-144x+48y+120=0$

$18(x^2-8x)+12(y^2-4y)+120=0$

$\dfrac{(x-4)^2}{12}+\dfrac{(y+2)^2}{18}=1$

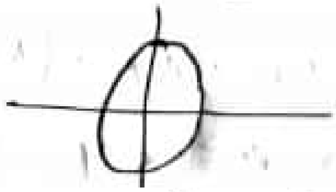
$X=x-4 \quad Y=y+2$

$\dfrac{X^2}{12}+\dfrac{Y^2}{18}=1$

$a^2=18, \quad b^2=12$

$e=\sqrt{1-\dfrac{b^2}{a^2}}=1/\sqrt{3}$

$ae=\sqrt{6} \quad \dfrac{a}{e}=3\sqrt{6}$



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Centre $(4, -2)$

Vertices $(0, \pm a)$

$A(4, -2+3\sqrt{2})$

$A'(4, -2-3\sqrt{2})$

foci $(0, \pm ae)$

$S(4, -2+\sqrt{6})$

$S'(4, -2-\sqrt{6})$

directrices $y = \pm \frac{a}{e}$

$y = \pm 3\sqrt{6}$

(b) Example 5.29

$x^2+6x+4y+5=0$ at $(1,-3)$

$x^2+6x+9-9+4y+5=0$

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

let $X = x+3$

$Y = y-1$

$X^2 = -4Y$

$X_1 = 1+3 = 4$

$Y_1 = -3-1 = -4$

tangent at $(1,-3)$

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

$2x+6 = -y+5$

$2x+y+1=0$

Slope of tangent at $(1,-3)$ is -2,

Slope of normal at $(1,-3)$ is $\frac{1}{2}$

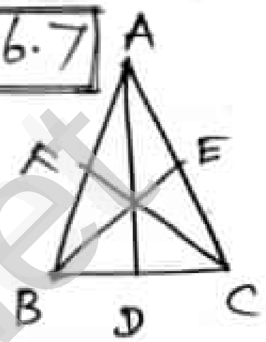
at $(1,-3)$ is given

$y+3 = \frac{1}{2}(x-1)$

$x-2y-7=0.$

(46) Example 6.7

(a)



$\vec{OA} = \vec{a}$

$\vec{OB} = \vec{b}$

$\vec{OC} = \vec{c}$

$AD \perp BC$

$\vec{OA}\cdot(\vec{OC}-\vec{OB})=0$

$\vec{a}\cdot\vec{c} - \vec{a}\cdot\vec{b} = 0 \longrightarrow (1)$

$\vec{BE} \perp CA$

$\vec{OB}\cdot(\vec{OA}-\vec{OC})=0$

$\vec{a}\cdot\vec{b} - \vec{b}\cdot\vec{c} = 0 \longrightarrow (2)$

From eqn (1)+(2)

$CF \perp BA$

are concurrent

(b) Ex 6.7 ⇒ 4

Non-parametric form

$(\vec{r}-\vec{a})\cdot(\vec{b}\times\vec{c})=0$

$\vec{r}\cdot(\vec{i}+10\vec{j}+7\vec{k})=9$

cartesian equation

$x+10y+7z-9=0.$

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(47) **Example 5.39**

(a)

$$\frac{(x-11)^2}{484} + \frac{y^2}{64} = 1$$

$a^2 = 484$ $b^2 = 64$

$c^2 = a^2 - b^2$

$= 484 - 64$

$c^2 = 420$

$c = \sqrt{420}$

$c = 20.5$

Patient's kidney stone should be placed 20.5 cm

(b) **Ex 1.4 → 4**

$$\frac{1}{A} + \frac{1}{B} = \frac{1}{10}$$

$$\frac{1}{A} - \frac{1}{B} = \frac{1}{30}$$

$x + y = 1/10$

$x - y = 1/30$

$$\Delta = \begin{vmatrix} 1 & 1 \\ 1 & -1 \end{vmatrix} = -2$$

$$\Delta_x = \begin{vmatrix} 1/10 & 1 \\ 1/30 & -1 \end{vmatrix} = \frac{-2}{15}$$

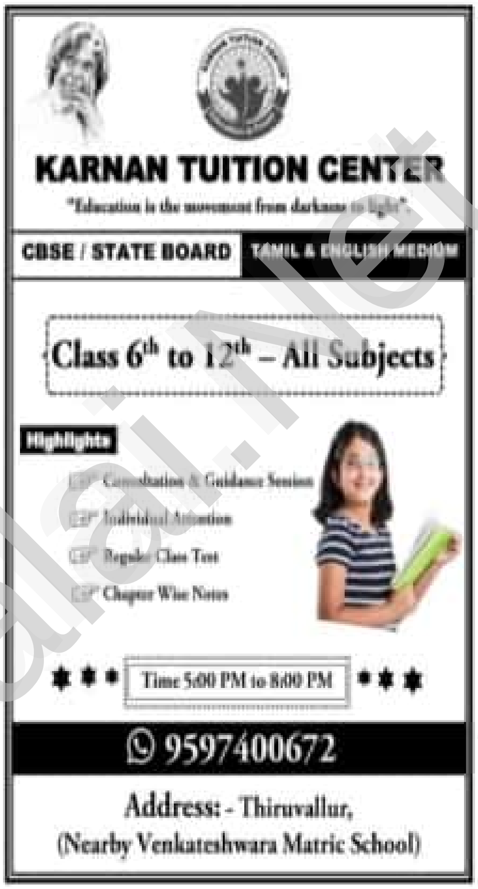
$$\Delta_y = \begin{vmatrix} 1 & 1/10 \\ 1 & 1/30 \end{vmatrix} = -\frac{1}{15}$$

$x = \frac{\Delta_x}{\Delta} = \frac{1}{15}$ $A = 15$ min

(10)

$y = \frac{\Delta_y}{\Delta} = \frac{1}{30}$

$B = 30$ min



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