ST. ANNE'S ACADEMY

(MATHS & PHYSICS TUITION CENTRE)

I FLOOR, JAFRO DENTAL CLINIC, HOLY CROSS COLLEGE ROAD, PUNNAI NAGAR, NAGERCOIL – 629004

2M Question Bank (2022 – 23)

CLASS – XII - MATHEMATICS

2 MARK QUESTION BANK

1) **Example 1.4**

If A is a non-singular matrix of odd order, prove that $|\text{adj } A|$ is positive.

2) **Example1.7**

If A is symmetric, prove that adj A is also symmetric.

3) **Example 1.11**

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

4) **EXERCISE 1.2**

1.Find the rank of the following matrices by minor method:

$$\begin{bmatrix} 1 & -2 & 3 \\ 2 & 4 & -6 \\ 5 & 1 & -1 \end{bmatrix}$$

5) **EXERCISE 1.2**

2.Find the rank of the following matrices by row reduction method:

(iii) $\begin{bmatrix} 3 & -8 & 5 & 2 \\ 2 & -5 & 1 & 4 \\ -1 & 2 & 3 & -2 \end{bmatrix}$

6) **EXERCISE 1.2**

3. Find the inverse of each of the following by Gauss-Jordan method:

(i) $\begin{bmatrix} 2 & -1 \\ 5 & -2 \end{bmatrix}$

7) **Example 2.1**

Simplify the following

(iv) $\sum_{n=1}^{102} i^n$ (v) $i\, i^2\, i^3 \cdots i^{40}$

8) **Example 2.6**

If $z_1 = 3-2i$ and $z_2 = 6+4i$, find $\frac{z_1}{z_2}$ in the rectangular form

9) **Example 2.10**

Find the following (i) $\left|\frac{2+i}{-1+2i}\right|$

10) **Example 2.17**

Find the square root of $6-8i$.

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11) **Example 2.20**
Show that $|z+2-i|<2$ represents interior points of a circle. Find its centre and radius.

12) **EXERCISE 2.6**
4. Show that the following equations represent a circle, and, find its centre and radius.

(ii) $|2z+2-4i|=2$

13) **Example 2.23**
Represent the complex number (i) $-1-i$

14) **Example 2.24**
Find the principal argument Arg z, when $z=\frac{-2}{1+i\sqrt{3}}$.

15) **EXERCISE 2.8**
8. If $\omega \neq 1$ is a cube root of unity, show that

(i) $(1-\omega+\omega^2)^6+(1+\omega-\omega^2)^6=128$. (ii) $(1+\omega)(1+\omega^2)(1+\omega^4)(1+\omega^8)\cdots(1+\omega^{2^{11}})=1$.

16) **EXERCISE 2.8**
9. If $z=2-2i$, find the rotation of z by θ radians in the counter clockwise direction about the origin when (ii) $\theta=\frac{2\pi}{3}$

17) **Example 3.3**
If α, β, and γ are the roots of the equation $x^3+px^2+qx+r=0$, find the value of $\sum\frac{1}{\beta\gamma}$ in terms of the coefficients.

18) **EXERCISE 3.1**
5. Find the sum of squares of roots of the equation $2x^4-8x^3+6x^2-3=0$.

19) **EXERCISE 3.1**
11. A 12 metre tall tree was broken into two parts. It was found that the height of the part which was left standing was the cube root of the length of the part that was cut away. Formulate this into a mathematical problem to find the height of the part which was left standing.

20) **Example 3.8**
Find the monic polynomial equation of minimum degree with real coefficients having $2-\sqrt{3}\,i$ as a root.

21) **Example 3.9**
Find a polynomial equation of minimum degree with rational coefficients, having $2-\sqrt{3}$ as a root.

22) **Example 3.11**
Show that the equation $2x^2-6x+7=0$ cannot be satisfied by any real values of x.

23) **Example 3.12**
If $x^2+2(k+2)x+9k=0$ has equal roots, find k.

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24) **EXERCISE 3.2**

5. Prove that a straight line and parabola cannot intersect at more than two points

25) **EXERCISE 3.3**

7. Solve the equation : $x^4 - 14x^2 + 45 = 0$.

26) **EXERCISE 3.6**

1. Discuss the maximum possible number of positive and negative roots of the polynomial equation $9x^9 - 4x^8 + 4x^7 - 3x^6 + 2x^5 + x^3 + 7x^2 + 7x + 2 = 0$.

27) **EXERCISE 3.6**

4. Determine the number of positive and negative roots of the equation $x^9 - 5x^8 - 14x^7 = 0$

28) **Example 4.1**

Find the principal value of $\sin^{-1}\left(-\frac{1}{2}\right)$ (in radians and degrees).

29) **EXERCISE 4.1**

2. Find the period and amplitude of

(ii) $y = -\sin\left(\frac{1}{3}x\right)$

30) Sketch the graph of inverse cosine function

31) **Example 4.6**

Find (i) $\cos^{-1}\left(-\frac{1}{\sqrt{2}}\right)$

32) **Example 4.9**

Find (i) $\tan^{-1}\left(-\sqrt{3}\right)$ (iii) $\tan\left(\tan^{-1}(2019)\right)$

33) **Example 4.13**

Find the value of $\sec^{-1}\left(-\frac{2\sqrt{3}}{3}\right)$.

34) **EXERCISE 4.4**

1. Find the principal value of

(ii) $\cot^{-1}\left(\sqrt{3}\right)$ (iii) $\operatorname{cosec}^{-1}\left(-\sqrt{2}\right)$

35) **Example 5.1**

Find the general equation of a circle with centre $(-3,-4)$ and radius 3 units.

36) **Example 5.4**

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

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37) **Example 5.5**
Examine the position of the point $(2,3)$ with respect to the circle $x^2+y^2-6x-8y+12=($

38) **Example 5.12**
If $y=4x+c$ is a tangent to the circle $x^2+y^2=9$, find c.

39) **EXERCISE 5.1**
8. If $y=2\sqrt{2}x+c$ is a tangent to the circle $x^2+y^2=16$, find the value of c.

40) **EXERCISE 5.1**
11. Find centre and radius of the following circles.
(i) $x^2+(y+2)^2=0$ (ii) $x^2+y^2+6x-4y+4=0$

41) **Example 5.16**
Find the equation of the parabola with focus $(-\sqrt{2},0)$ and directrix $x=\sqrt{2}$.

42) **EXERCISE 5.3**
Identify the type of conic section for each of the equations.
5. $11x^2-25y^2-44x+50y-256=0$

43) **Example 6.9**
A particle acted upon by constant forces $2\hat{i}+5\hat{j}+6\hat{k}$ and $-\hat{i}-2\hat{j}-\hat{k}$ is displaced from the point $(4,-3,-2)$ to the point $(6,1,-3)$. Find the total work done by the forces.

44) **Example 6.10**
A particle is acted upon by the forces $3\hat{i}-2\hat{j}+2\hat{k}$ and $2\hat{i}+\hat{j}-\hat{k}$ is displaced from the point $(1,3,-1)$ to the point $(4,-1,\lambda)$. If the work done by the forces is 16 units, find the value of λ.

45) **Example 6.11**
Find the magnitude and the direction cosines of the torque about the point $(2,0,-1)$ of a force $2\hat{i}+\hat{j}-\hat{k}$, whose line of action passes through the origin.

46) **Example 6.12**
If $\vec{a}=-3\hat{i}-\hat{j}+5\hat{k}$, $\vec{b}=\hat{i}-2\hat{j}+\hat{k}$, $\vec{c}=4\hat{j}-5\hat{k}$, find $\vec{a}\cdot(\vec{b}\times\vec{c})$.

47) **Example 6.13**
Find the volume of the parallelepiped whose coterminus edges are given by the vectors $2\hat{i}-3\hat{j}+4\hat{k}, \hat{i}+2\hat{j}-\hat{k}$ and $3\hat{i}-\hat{j}+2\hat{k}$.

48) **Example 6.14**
Show that the vectors $\hat{i}+2\hat{j}-3\hat{k}$, $2\hat{i}-\hat{j}+2\hat{k}$ and $3\hat{i}+\hat{j}-\hat{k}$ are coplanar.

49) **Example 6.15**
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

Ph: 948 99 00 886 E-mail: berkmansja@gmail.com

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50) **Example 6.16**
Show that the four points $(6,-7,0)$, $(16,-19,-4)$, $(0,3,-6)$, $(2,-5,10)$ lie on a same plane.

51) **EXERCISE 6.2**
3. The volume of the parallelepiped whose coterminus edges are $7\hat{i}+\lambda\hat{j}-3\hat{k}$, $\hat{i}+2\hat{j}-\hat{k}$, $-3\hat{i}+7\hat{j}+5\hat{k}$ is 90 cubic units. Find the value of λ.

52) **EXERCISE 6.2**
8. If $\vec{a}=\hat{i}-\hat{k}$, $\vec{b}=x\hat{i}+\hat{j}+(1-x)\hat{k}$, $\vec{c}=y\hat{i}+x\hat{j}+(1+x-y)\hat{k}$, show that $[\vec{a},\vec{b},\vec{c}]$ depends on neither x nor y.

53) **Example 6.19**
Prove that $[\vec{a}\times\vec{b}, \vec{b}\times\vec{c}, \vec{c}\times\vec{a}]=[\vec{a},\vec{b},\vec{c}]^2$.

54) **Example 6.20**
Prove that $(\vec{a}\cdot(\vec{b}\times\vec{c}))\vec{a}=(\vec{a}\times\vec{b})\times(\vec{a}\times\vec{c})$.

55) **EXERCISE 6.3**
3. Prove that $[\vec{a}-\vec{b}, \vec{b}-\vec{c}, \vec{c}-\vec{a}]=0$.

56) **EXERCISE 6.3**
6. If $\vec{a},\vec{b},\vec{c},\vec{d}$ are coplanar vectors, show that $(\vec{a}\times\vec{b})\times(\vec{c}\times\vec{d})=\vec{0}$.

57) **Example 6.26**
Find the vector equation in parametric form and Cartesian equations of the line passing through $(-4,2,-3)$ and is parallel to the line $\frac{-x-2}{4}=\frac{y+3}{-2}=\frac{2z-6}{3}$.

58) **Example 6.29**
Find the acute angle between the lines $\vec{r}=(\hat{i}+2\hat{j}+4\hat{k})+t(2\hat{i}+2\hat{j}+\hat{k})$ and the straight line passing through the points $(5,1,4)$ and $(9,2,12)$.

59) **Example 6.30**
Find the acute angle between the straight lines $\frac{x-4}{2}=\frac{y}{1}=\frac{z+1}{-2}$ and $\frac{x-1}{4}=\frac{y+1}{-4}=\frac{z-2}{2}$ and state whether they are parallel or perpendicular.

60) **Example 6.31**
Show that the straight line passing through the points $A(6,7,5)$ and $B(8,10,6)$ is perpendicular to the straight line passing through the points $C(10,2,-5)$ and $D(8,3,-4)$.

61) **EXERCISE 6.4**
9. Show that the points $(2,3,4)$, $(-1,4,5)$ and $(8,1,2)$ are collinear.

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62) **Example 6.36**
Find the shortest distance between the two given straight lines $\vec{r} = (2\hat{i} + 3\hat{j} + 4\hat{k}) + t(-2\hat{i} + \hat{j} - 2\hat{k})$ and $\frac{x-3}{2} = \frac{y}{-1} = \frac{z+2}{2}$.

63) **Example 6.39**
If the Cartesian equation of a plane is $3x - 4y + 3z = -8$, find the vector equation of the plane in the standard form.

64) **Example 6.47**
Find the acute angle between the planes $\vec{r} \cdot \left(2\hat{i} + 2\hat{j} + 2\hat{k}\right) = 11$ and $4x - 2y + 2z = 15$

65) **Example 6.48**
Find the angle between the straight line $\vec{r} = \left(2\hat{i} + 3\hat{j} + \hat{k}\right) + t\left(\hat{i} - \hat{j} + \hat{k}\right)$ and the plane $2x - y + z = 5$.

66) **Example 6.51**
Find the distance between the parallel planes $x + 2y - 2z + 1 = 0$ and $2x + 4y - 4z + 5 = 0$.

67) **Example 7.2**
The temperature T in celsius in a long rod of length 10 m, insulated at both ends, is a function of length x given by $T = x(10 - x)$. Prove that the rate of change of temperature at the midpoint of the

68) **Example 7.3**
A person learnt 100 words for an English test. The number of words the person remembers in t days after learning is given by $W(t) = 100 \times (1 - 0.1t)^2$, $0 \le t \le 10$. What is the rate at which the person forgets the words 2 days after learning?

69) **Example 7.4**
A particle moves so that the distance moved is according to the law $s(t) = \frac{t^3}{3} - t^2 + 3$. At what time the velocity and acceleration are zero.

70) **EXERCISE 7.1**
4. If the volume of a cube of side length x is $v = x^3$. Find the rate of change of the volume with respect to x when $x = 5$ units.

71) **EXERCISE 7.1**
5. If the mass $m(x)$ (in kilograms) of a thin rod of length x (in metres) is given by, $m(x) = \sqrt{3x}$ then what is the rate of change of mass with respect to the length when it is $x = 3$ and $x = 27$ metres.

72) **Example 7.19**
Compute the value of 'c' satisfied by the Rolle's theorem for the function $f(x) = x^2(1-x)^2, x \in [0,1]$.

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73) **Example 7.25**
Find the values in the interval $(1,2)$ of the mean value theorem satisfied by the function $f(x)=x-x^2$ for $1 \le x \le 2$.

74) **EXERCISE 7.4**
1. Write the Maclaurin series expansion of the following functions:

(i) e^x

75) **Example 7.40**
Evaluate : $\lim\limits_{x \to 0^+} x \log x$.

76) **Example 7.42**
Evaluate : $\lim\limits_{x \to \infty} \left(\frac{e^x}{x^m} \right), m \in N$.

77) **EXERCISE 7.5**
Evaluate the following limits, if necessary use l'Hôpital Rule :
3. $\lim\limits_{x \to \infty} \frac{x}{\log x}$ 8. $\lim\limits_{x \to 0^+} x^x$

78) **Example 7.47**
Prove that the function $f(x)=x^2-2x-3$ is strictly increasing in $(2,\infty)$.

79) **EXERCISE 7.6**
1. Find the absolute extrema of the following functions on the given closed interval.

(i) $f(x)=x^2-12x+10$; $[1,2]$

80) **Example 7.59**
Find the local extremum of the function $f(x)=x^4+32x$.

81) **EXERCISE 8.1**
1. Let $f(x)=\sqrt[3]{x}$. Find the linear approximation at $x=27$. Use the linear approximation to approximate $\sqrt[3]{27.2}$.

82) **EXERCISE 8.1**
7. Show that the percentage error in the n^{th} root of a number is approximately $\frac{1}{n}$ times the percentage error in the number

83) **Example 8.6**
Let $g(x)=x^2+\sin x$. Calculate the differential dg.

84) **Example 8.7**
If the radius of a sphere, with radius 10 cm, has to decrease by 0.1 cm, approximately how much will its volume decrease?

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85) **EXERCISE 8.2**
1. Find differential dy for the following function :
(ii) $y=(3+\sin(2x))^{2/3}$

86) 2. Find df for $f(x)=x^2+3x$ and evaluate it for
(i) $x=2$ and $dx=0.1$

87) **Example 8.12**
Let $F(x,y)=x^3y+y^2x+7$ for all $(x,y)\in\mathbb{R}^2$. Calculate $\frac{\partial F}{\partial x}(-1,3)$

88) **EXERCISE 8.5**
1. If $w(x,y)=x^3-3xy+2y^2,\ x,y\in\mathbb{R}$, find the linear approximation for w at $(1,-1)$.

89) **Example 8.21**
Show that $F(x,y)=\dfrac{x^2+5xy-10y^2}{3x+7y}$ is a homogeneous function of degree 1.

90) **EXERCISE 9.1**
1. Find an approximate value of $\int_1^{1.5} x\,dx$ by applying the left-end rule with the partition $\{1.1, 1.2, 1.3, 1.4, 1.5\}$.

91) **EXERCISE 9.1**
2. Find an approximate value of $\int_1^{1.5} x^2 dx$ by applying the right-end rule with the partition $\{1.1, 1.2, 1.3, 1.4, 1.5\}$.

92) **Example 9.2**
Evaluate $\int_0^1 x\,dx$, as the limit of a sum.

93) **Example 9.24**
Evaluate : $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} x\cos x\,dx.$

94) **EXERCISE 9.3**
1. Evaluate the following definite integrals
(i) $\int_3^4 \frac{dx}{x^2-4}$

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95) **EXERCISE 9.4**

Evaluate the following:

1. $\int_0^1 x^3 e^{-2x}\,dx$

96) **Example 9.42**

Evaluate $\int_0^1 x^3(1-x)^4 dx$.

97) **EXERCISE 9.6**

1. Evaluate the following:

(iv) $\int_0^{\frac{\pi}{6}} \sin^5 3x\,dx$

98) (vi) $\int_0^{2\pi} \sin^7 \frac{x}{4}\,dx$

99) **EXERCISE 9.7**

Evaluate the following

1. (i) $\int_0^{\infty} x^5 e^{-3x}\,dx$

100) **Example 10.1**

Determine the order and degree (if exists) of the following differential equations:

$$3\left(\frac{d^2y}{dx^2}\right)=\left[4+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}$$

101) **EXERCISE 10.1**

1. For the following differential equations, determine its order, degree (if exists)

(iii) $\left(\frac{d^2y}{dx^2}\right)^2+\left(\frac{dy}{dx}\right)^2=x\sin\left(\frac{d^2y}{dx^2}\right)$ (iv) $\sqrt{\frac{dy}{dx}}-4\frac{dy}{dx}-7x=0$

102) **EXERCISE 10.2**

1. (iii) For a certain substance, the rate of change of vapor pressure P with respect to temperature T is proportional to the vapor pressure and inversely proportional to the square of the temperature.

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103) **EXERCISE 10.2**

2. Assume that a spherical rain drop evaporates at a rate proportional to its surface area. Form a differential equation involving the rate of change of the radius of the rain drop.

104) **Example 10.3**

Form the differential equation by eliminating the arbitrary constants A and B from $y = A\cos x + B\sin x$.

105) **Example 10.5**

Find the differential equation of the family of parabolas $y^2 = 4ax$, where a is an arbitrary constant.

106) **EXERCISE 10.4**

1. Show that the following expression is a solution of the corresponding given differential equation.

107) 2. Find value of m so that the function $y = e^{mx}$ is a solution of the given differential equation.

(i) $y' + 2y = 0$ (ii) $y'' - 5y' + 6y = 0$

108) **Example 10.11**

Solve $(1+x^2)\frac{dy}{dx} = 1 + y^2$.

109) **EXERCISE 10.5**

4. Solve the following differential equations:

(i) $\frac{dy}{dx} = \sqrt{\frac{1-y^2}{1-x^2}}$ (iii) $\sin\frac{dy}{dx} = a, \ y(0) = 1$

110) **Example 10.22**

Solve $\frac{dy}{dx} + 2y = e^{-x}$.

111) **Example 11.2**

Suppose a pair of unbiased dice is rolled once. If X denotes the total score of two dice, write down the number of elements in inverse image of X

112) **EXERCISE 11.1**

2. In a pack of 52 playing cards, two cards are drawn at random simultaneously. If the number of black cards drawn is a random variable, find the values of the random variable and number of points in its inverse images.

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113) **Example 11.10**

A random variable X has the following probability mass function. Find k.

x	1	2	3	4	5	6
$f(x)$	k	$2k$	$6k$	$5k$	$6k$	$10k$

114) **EXERCISE 11.2**

7. The cumulative distribution function of a discrete random variable is given by

$$F(x)=\begin{cases} 0 & \text{for } -\infty<x<0 \\ \frac{1}{2} & \text{for } 0\le x<1 \\ \frac{3}{5} & \text{for } 1\le x<2 \\ \frac{4}{5} & \text{for } 2\le x<3 \\ \frac{9}{10} & \text{for } 3\le x<4 \\ 1 & \text{for } 4\le x<\infty \end{cases}$$

Find the probability mass function

115) **Example 11.13**

If X is the random variable with distribution function $F(x)$ given by,

$$F(x)=\begin{cases} 0, & x<0 \\ x, & 0\le x<1 \\ 1, & 1\le x \end{cases}$$

then find the probability density function $f(x)$

116) **Example 11.15**

Let X be a random variable denoting the life time of an electrical equipment having probability density function

$$f(x)=\begin{cases} k e^{-2x} & \text{for } x>0 \\ 0 & \text{for } x\le 0. \end{cases}$$

Find the value of k

117) **EXERCISE 11.4**

3. If μ and σ^2 are the mean and variance of the discrete random variable X, and $E(X+3)=10$ and $E(X+3)^2=116$, find μ and σ^2.

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118) The time to failure in thousands of hours of an electronic equipment used in a manufactured computer has the density function

$$f(x) = \begin{cases} 3e^{-3x} & x > 0 \\ 0 & \text{elsewhere} \end{cases}.$$

Find the expected life of this electronic equipment.

119) **EXERCISE 11.5**

1. Compute $P(X = k)$ for the binomial distribution, $B(n, p)$ where
   (ii) $n = 10,\ p = \frac{1}{5},\ k = 4$

120) 4. The probability that a certain kind of component will survive a electrical test is $\frac{3}{4}$. Find th probability that exactly 3 of the 5 components tested survive.

121) Prove that, in an algebraic structure the identity element (if exists) is unique.

122) Prove that, in an algebraic structure the inverse of an element (if exists) is unique.

123) **Example 12.13**

How many rows are needed for following statement formulae?

(i) $p \vee \neg t \wedge (p \vee \neg s)$ (ii) $((p \wedge q) \vee (\neg r \vee \neg s)) \wedge (\neg t \wedge v)$

124) Write the dual of the following:

(i) The dual of $(p \vee q) \wedge (r \wedge s) \vee \mathbb{F}$

(ii) The dual of $p \wedge [\neg q \vee (p \wedge q) \vee \neg r$

125) Verify De-Morgans Laws by truth table.

126) **EXERCISE 12.2**

7. Verify whether the following compound propositions are tautologies or contradictions or contingency
   (iii) $(p \rightarrow q) \leftrightarrow (\neg p \rightarrow q)$

127) Verify Absorption Laws with truth table.

128) Verify Distributive Laws with truth table.