PATTUKKOTTAI-PALANIAPPAN-MATHS

+1MATHS EXPECTED QUESTIONS FOR MAY-2022

ONLY 5 MARKS

VOLUME-I

Chapter 1 Sets, Relations and Functions

1. If A and B are two sets so that $n(B-A) = 2n(A-B) = 4n(A \cap B)$ and if $n(A \cup B) = 14$, then find $n(\mathscr{P}(A))$.

2. In the set $\mathbb{Z}$ of integers, define mRn if $m-n$ is a multiple of 12. Prove that R is an equivalence relation.

3. Let $X = \{a, b, c, d\}$ and $R = \{(a, a), (b, b), (a, c)\}$. Write down the minimum number of ordered pairs to be included to R to make it
   (i) reflexive (ii) symmetric (iii) transitive (iv) equivalence

4. On the set of natural numbers let R be the relation defined by aRb if $2a + 3b = 30$. Write down the relation by listing all the pairs. Check whether it is
   (i) reflexive (ii) symmetric (iii) transitive (iv) equivalence

5. On the set of natural numbers let R be the relation defined by aRb if $a + b \leq 6$. Write down the relation by listing all the pairs. Check whether it is
   (i) reflexive (ii) symmetric (iii) transitive (iv) equivalence

6. In the set Z of integers, define mRn if $m-n$ is divisible by 7. Prove that R is an equivalence relation.

7. **If f : R → R is defined by f (x)=2 x − 3 prove that f is a bijection and find its inverse.**

8. **Write the values of f at − 4, 1, − 2, 7, 0 if**

$$f(x) = \begin{cases} -x+4 & \text{if } -\infty < x \leq -3 \\ x+4 & \text{if } -3 < x < -2 \\ x^2 - x & \text{if } -2 \leq x < 1 \\ x - x^2 & \text{if } 1 \leq x < 7 \\ 0 & \text{otherwise} \end{cases}$$

9. **Write the values of f at − 3, 5, 2, − 1, 0 if**

$$f(x) = \begin{cases} x^2 + x - 5 & \text{if } x \in (-\infty, 0) \\ x^2 + 3x - 2 & \text{if } x \in (3, \infty) \\ x^2 & \text{if } x \in (0, 2) \\ x^2 - 3 & \text{otherwise} \end{cases}$$

10. The function forex changing American dollars for Singapore Dollar on a given day is $f(x) = 1.23x$, where x represents the number of American dollars. On the same day the function for exchanging Singapore Dollar to Indian Rupee is $g(y) = 50.50y$, where y represents the number of Singapore dollars. Write a function which will give the exchange rate of American dollars in terms of Indian rupee.

11. If $f : \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = 3x - 5$, prove that f is a bijection and find its inverse.

12. The formula for converting from Fahrenheit to Celsius temperatures is $y = \frac{5x}{9} - \frac{160}{9}$. Find the inverse of this function and determine whether the inverse is also a function.

Chapter 2 Basic Algebra

13. A manufacturer has 600 litres of a 12 percent solution of acid. How many litres of a 30 percent acid solution must be added to it so that the acid content in the resulting mixture will be more than 15 percent but less than 18 percent?

14. A and B are working on similar jobs but their annual salaries differ by more than Rs 6000. If B earns rupees 27000 per month, then what are the possibilities of A's salary per month?

15. Find the number of solutions of $x^2 + |x - 1| = 1$.

16. If one root of $k(x-1)^2 = 5x - 7$ is double the other root, show that $k = 2$ or -25.

17. Solve the equation $\sqrt{6 - 4x - x^2} = x + 4$.

18. Solve $\frac{x+1}{x+3} < 3$.

19. Find all values of$x$ that satisfies the inequality $\frac{2x-3}{(x-2)(x-4)} < 0$.

20. Solve $\frac{x^2-4}{x^2-2x-15} \leq 0$.

21. **Partial Fractions** **PRACTICE EXAMPLE AND EXERCISE SUMS**

22. Find the square root of $7 - 4\sqrt{3}$.

23. Simplify $\frac{1}{3-\sqrt{8}} - \frac{1}{\sqrt{8}-\sqrt{7}} + \frac{1}{\sqrt{7}-\sqrt{6}} - \frac{1}{\sqrt{6}-\sqrt{5}} + \frac{1}{\sqrt{5}-2}$.

24. If $x = \sqrt{2} + \sqrt{3}$ find $\frac{x^2+1}{x^2-2}$.

25. If $a^2 + b^2 = 7ab$, show that $\log \frac{a+b}{3} = \frac{1}{2}(\log a + \log b)$

26. Solve $\log_{5-x}(x^2 - 6x + 65) = 2$.

27. Prove that $\log 2 + 16 \log \frac{16}{15} + 12 \log \frac{25}{24} + 7 \log \frac{81}{80} = 1$.

28. If $\frac{\log x}{y-z} = \frac{\log y}{z-x} = \frac{\log z}{x-y}$, then prove that $xyz = 1$.

Chapter 3 Trigonometry

29. Prove that $\tan 315^\circ \cot(-405^\circ) + \cot 495^\circ \tan(-585^\circ) = 2$

30. Prove that $\dfrac{\cot(180^\circ+\theta)\sin(90^\circ-\theta)\cos(-\theta)}{\sin(270^\circ+\theta)\tan(-\theta)\text{cosec}(360^\circ+\theta)} = \cos^2\theta\cot\theta.$

31. Show that $\sin^2\dfrac{\pi}{18} + \sin^2\dfrac{\pi}{9} + \sin^2\dfrac{7\pi}{18} + \sin^2\dfrac{4\pi}{9} = 2.$

32. Find $\cos(x-y)$, given that $\cos x = -\dfrac{4}{5}$ with $\pi < x < \dfrac{3\pi}{2}$ and $\sin y = -\dfrac{24}{25}$ with $\pi < y < \dfrac{3\pi}{2}$.

33. Find the values of $\tan(\alpha+\beta)$, given that $\cot\alpha = \dfrac{1}{2}, \alpha \in \quad \pi, \dfrac{3\pi}{2}$ and $\sec\beta = -\dfrac{5}{3}, \beta \in \left(\dfrac{\pi}{2}, \pi\right)$.

34. If $\theta + \phi = \alpha$ and $\tan\theta = k\tan\phi$, then prove that $\sin(\theta-\phi) = \dfrac{k-1}{k+1}\sin\alpha$.

35. Prove that $\sin x = 2^{10}\sin\left(\dfrac{x}{2^{10}}\right)\cos\left(\dfrac{x}{2}\right)\cos\left(\dfrac{x}{2^2}\right)\ldots\cos\left(\dfrac{x}{2^{10}}\right)$

36. Prove that $\cos A\cos 2A\cos 2^2A\cos 2^3A\ldots\cos 2^{n-1}A = \dfrac{\sin 2^nA}{2^n\sin A}$

37. Prove that $\sin 4\alpha = 4\tan\alpha\dfrac{1-\tan^2\alpha}{(1+\tan^2\alpha)^2}$.

38. If $A + B = 45^\circ$, show that $(1+\tan A)(1+\tan B) = 2$.

39. Prove that $(1+\tan 1^\circ)(1+\tan 2^\circ)(1+\tan 3^\circ)\ldots(1+\tan 44^\circ)$ is a multiple of 4.

40. Prove that $32(\sqrt{3})\sin\dfrac{\pi}{48}\cos\dfrac{\pi}{48}\cos\dfrac{\pi}{24}\cos\dfrac{\pi}{12}\cos\dfrac{\pi}{6} = 3.$

Chapter 4 Combinatorics and

41. If the letters of the word TABLE are permuted in all possible ways and the words thus formed are arranged in the dictionary order (alphabetical order), find the ranks of the words (i) TABLE, (ii) BLEAT

42. If the letters of the word IITJEE are permuted in all possible ways and the strings thus formed are arranged in the lexicographic order, find the rank of the word IITJEE

43. MATHEMATICAL INDUCTION ALL PROBLEMS ARE PRACTICED

Chapter 5 Binomial Theorem, Sequences and Series

44. If a, b, c are in geometric progression, and if $a^{\frac{1}{x}} = b^{\frac{1}{y}} = c^{\frac{1}{z}}$, then prove that x, y, z are in arithmetic progression.

45. If the roots of the equation $(q-r)x^2 + (r-p)x + p - q = 0$ are equal, then show that p, q and r are in AP.

46. If a, b, c are respectively the p^{th}, q^{th} and r^{th} terms of a GP, show that $(q-r)\log a + (r-p)\log b + (p-q)\log c = 0$.

47. Find $\sqrt[3]{65}$.

48. Prove that $\sqrt[3]{x^3+7} - \sqrt[3]{x^3+4}$ is approximately equal to $\frac{1}{x^2}$ when x is large.

49. Find $\sqrt[3]{1001}$ approximately (two decimal places).

50. Prove that $\sqrt[3]{x^3+6} - \sqrt[3]{x^3+3}$ is approximately equal to $\frac{1}{x^2}$ when x is sufficiently large.

51. Prove that $\sqrt{\frac{1-x}{1+x}}$ is approximately equal to $1 - x + \frac{x^2}{2}$ when x is very small.

Chapter 6 Two Dimensional Analytical Geometry

52. Find the equation of the locus of a point such that the sum of the squares of the distance from the points $(3, 5)$, $(1, -1)$ is equal to 20

53. The sum of the distance of a moving point from the points $(4, 0)$ and $(-4, 0)$ is always 10 units. Find the equation of the locus of the moving point.

54. Find the equations of a parallel line and a perpendicular line passing through the point (1, 2) to the line $3x + 4y = 7$.

55. Find the nearest point on the line $2x + y = 5$ from the origin.

56. Find the equation of the line passing through the point of intersection lines $4x - y + 3 = 0$ and $5x + 2y + 7 = 0$, and (i) through the point $(-1, 2)$ (ii) Parallel to $x - y + 5 = 0$ (iii) Perpendicular to $x - 2y + 1 = 0$

57. If p_1 and p_2 are the lengths of the perpendiculars from the origin to the straight lines $x \sec\theta + y \operatorname{cosec}\theta = 2a$ and $x\cos\theta - y\sin\theta = a\cos 2\theta$, then prove that $p_1^2 + p_2^2 = a^2$.

59. If the equation $\lambda x^2 - 10xy + 12y^2 + 5x - 16y - 3 = 0$ represents a pair of straight lines, find (i) the value of λ and the separate equations of the lines (ii) point of intersection of the lines (iii) angle between the lines

60. Show that the equation $2x^2 - xy - 3y^2 - 6x + 19y - 20 = 0$ represents a pair of intersecting lines. Show further that the angle between them is $\tan^{-1}(5)$.

61.. The slope of one of the straight lines $ax^2 + 2hxy + by^2 = 0$ is twice that of the other, show that $8h^2 = 9ab$.

62. The slope of one of the straight lines $ax^2 + 2hxy + by^2 = 0$ is three times the other, show that $3h^2 = 4ab$.

ALL THE BEST

Chapter 7 Matrices and Determinants

1. Find the matrix A such that $\begin{bmatrix} 2 & 1 \\ 1 & 0 \\ -3 & 4 \end{bmatrix} A^T = \begin{bmatrix} 1 & 8 & 10 \\ 1 & 2 & -5 \\ 9 & 22 & 15 \end{bmatrix}$.

2. If $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ x & 2 & y \end{bmatrix}$ is a matrix such that $AA^T = 9I$, find the values of x and y.

3. Prove that $\begin{vmatrix} a^2 & bc & ac+c^2 \\ a^2+ab & b^2 & ac \\ ab & b^2+bc & c^2 \end{vmatrix} = 4a^2b^2c^2$.

4. Prove that $\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = abc\left(1+\frac{1}{a}+\frac{1}{b}+\frac{1}{c}\right)$.

5. If $\begin{vmatrix} a & b & a\alpha+b \\ b & c & b\alpha+c \\ a\alpha+b & b\alpha+c & 0 \end{vmatrix} = 0$,

prove that a, b, c are in $G.P.$ or α is a root of $ax^2 + 2bx + c = 0$.

6. If $A = \begin{bmatrix} \frac{1}{2} & \alpha \\ 0 & \frac{1}{2} \end{bmatrix}$, prove that $\sum_{k=1}^{n} \det(A^k) = \frac{1}{3}\left(1-\frac{1}{4^n}\right)$.

7. Prove that $\begin{vmatrix} 1 & x^2 & x^3 \\ 1 & y^2 & y^3 \\ 1 & z^2 & z^3 \end{vmatrix} = (x-y)\,(y-z)\,(z-x)\,(xy+yz+zx)$.

8. Prove that $|A| = \begin{vmatrix} (q+r)^2 & p^2 & p^2 \\ q^2 & (r+p)^2 & q^2 \\ r^2 & r^2 & (p+q)^2 \end{vmatrix} = 2pqr\,(p+q+r)^3$.

9. Show that $\begin{vmatrix} b+c & a-c & a-b \\ b-c & c+a & b-a \\ c-b & c-a & a+b \end{vmatrix} = 8abc$.

10. Show that $\begin{vmatrix} b+c & a & a^2 \\ c+a & b & b^2 \\ a+b & c & c^2 \end{vmatrix} = (a+b+c)\,(a-b)\,(b-c)\,(c-a)$.

11. Show that $\begin{vmatrix} 2bc-a^2 & c^2 & b^2 \\ c^2 & 2ca-b^2 & a^2 \\ b^2 & a^2 & 2ab-c^2 \end{vmatrix} = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}^2$.

12. Prove that $\begin{vmatrix} 1 & x & x \\ x & 1 & x \\ x & x & 1 \end{vmatrix}^2 = \begin{vmatrix} 1-2x^2 & -x^2 & -x^2 \\ -x^2 & -1 & x^2-2x \\ -x^2 & x^2-2x & -1 \end{vmatrix}$.

13. If A_i, B_i, C_i are the cofactors of a_i, b_i, c_i, respectively, $i = 1$ to 3 in

$$|A| = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}, \text{ show that } \begin{vmatrix} A_1 & B_1 & C_1 \\ A_2 & B_2 & C_2 \\ A_3 & B_3 & C_3 \end{vmatrix} = |A|^2 .$$

14. If $\cos 2\theta = 0$, determine $\begin{vmatrix} 0 & \cos\theta & \sin\theta \\ \cos\theta & \sin\theta & 0 \\ \sin\theta & 0 & \cos\theta \end{vmatrix}^2$.

15. Find the value of the product ; $\begin{vmatrix} \log_3 64 & \log_4 3 \\ \log_3 8 & \log_4 9 \end{vmatrix} \times \begin{vmatrix} \log_2 3 & \log_8 3 \\ \log_3 4 & \log_3 4 \end{vmatrix}$.

Chapter 8 Vector Algebra - I

16. The medians of a triangle are concurrent.

17. If $ABCD$ is a quadrilateral and E and F are the midpoints of AC and BD respectively, then prove that $\overrightarrow{AB} + \overrightarrow{AD} + \overrightarrow{CB} + \overrightarrow{CD} = 4\overrightarrow{EF}$.

18. Prove that the points whose position vectors $2\hat{i} + 4\hat{j} + 3\hat{k}$, $4\hat{i} + \hat{j} + 9\hat{k}$ and $10\hat{i} - \hat{j} + 6\hat{k}$ form a right angled triangle.

19. Show that the vectors $5\hat{i} + 6\hat{j} + 7\hat{k}$, $7\hat{i} - 8\hat{j} + 9\hat{k}$, $3\hat{i} + 20\hat{j} + 5\hat{k}$ are coplanar.

20. Show that the following vectors are coplanar

(i) $\hat{i} - 2\hat{j} + 3\hat{k}$, $-2\hat{i} + 3\hat{j} - 4\hat{k}$, $-\hat{j} + 2\hat{k}$

(ii) $5\hat{i} + 6\hat{j} + 7\hat{k}$, $7\hat{i} - 8\hat{j} + 9\hat{k}$, $3\hat{i} + 20\hat{j} + 5\hat{k}$.

21. Show that the points whose position vectors $4\hat{i} + 5\hat{j} + \hat{k}$, $-\hat{j} - \hat{k}$, $3\hat{i} + 9\hat{j} + 4\hat{k}$ and $-4\hat{i} + 4\hat{j} + 4\hat{k}$ are coplanar.

22. If $\vec{a}, \vec{b}$, and $\vec{c}$ are three unit vectors satisfying $\vec{a} - \sqrt{3}\,\vec{b} + \vec{c} = \vec{0}$ then find the angle between $\vec{a}$ and $\vec{c}$.

23. Three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ are such that $|\vec{a}| = 2$, $|\vec{b}| = 3, |\vec{c}| = 4$, and $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. Find $4\vec{a}\cdot\vec{b} + 3\vec{b}\cdot\vec{c} + 3\vec{c}\cdot\vec{a}$.

24. Find the cosine and sine angle between the vectors $\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = 4\hat{i} - 2\hat{j} + 2\hat{k}$

25. Find the area of the triangle whose vertices are
$A(3, -1, 2)$, $B(1, -1, -3)$ and $C(4, -3, 1)$.

26. If $\vec{a}, \vec{b}, \vec{c}$ are position vectors of the vertices *A, B, C* of a triangle *ABC*, show that the area of the triangle *ABC* is $\frac{1}{2}|\vec{a}\times\vec{b} + \vec{b}\times\vec{c} + \vec{c}\times\vec{a}|$. Also deduce the condition for collinearity of the points *A, B,* and *C*.

27. For any vector $\vec{a}$ prove that $|\vec{a}\times\hat{i}|^2 + |\vec{a}\times\hat{j}|^2 + |\vec{a}\times\hat{k}|^2 = 2|\vec{a}|^2$.

28. Let $\vec{a}, \vec{b}, \vec{c}$ be unit vectors such that $\vec{a}\cdot\vec{b} = \vec{a}\cdot\vec{c} = 0$ and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$. Prove that $\vec{a} = \pm\frac{2}{\sqrt{3}}(\vec{b}\times\vec{c})$.

Chapter 9 Differential Calculus - Limits and Continuity

29. $\lim\limits_{x\to 1}\dfrac{\sqrt[3]{7+x^3} - \sqrt{3+x^2}}{x-1}$

30. $\lim\limits_{x\to a}\dfrac{\sqrt{x-b} - \sqrt{a-b}}{x^2 - a^2}(a > b)$

31. Show that $\lim\limits_{x\to 0^+} x\left[\left\lfloor\frac{1}{x}\right\rfloor + \left\lfloor\frac{2}{x}\right\rfloor + \cdots + \left\lfloor\frac{15}{x}\right\rfloor\right] = 120$.

32. $\lim\limits_{\theta\to 0}\dfrac{\sin\theta}{\theta} = 1$

33. Do the limits of following functions exist as $x \to 0$? State reasons for your answer.

(i) $\dfrac{\sin|x|}{x}$ (ii) $\dfrac{\sin x}{|x|}$ (iii) $\dfrac{x\lfloor x\rfloor}{\sin|x|}$ (iv) $\dfrac{\sin\left(x - \lfloor x\rfloor\right)}{x - \lfloor x\rfloor}$.

34. $\lim\limits_{x\to 0}\dfrac{\sqrt{1+\sin x}-\sqrt{1-\sin x}}{\tan x}$

35. A function f is defined as follows :

$$f(x)=\begin{cases}0 & \text{for } x<0;\\ x & \text{for } 0\le x<1;\\ -x^2+4x-2 & \text{for } 1\le x<3;\\ 4-x & \text{for } x\ge 3\end{cases}$$

Is the function continuous?

Chapter 10 Differential Calculus- Differentiability and Methods of Differentiation

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36. Find y'' if $x^4+y^4=16$.

37. Find $\dfrac{d^2y}{dx^2}$ if $x^2+y^2=4$.

38. If $y=e^{\tan^{-1}x}$, show that $(1+x^2)y''+(2x-1)y'=0$.

39. If $y=\dfrac{\sin^{-1}x}{\sqrt{1-x^2}}$, show that $(1-x^2)y_2-3xy_1-y=0.$

40. If $x = a\ (\theta + \sin\theta), y = a\ (1 - \cos\theta)$ then prove that at $\theta=\dfrac{\pi}{2}, y''=\dfrac{1}{a}$.

41. If $\sin y=x\sin(a+y)$, then prove that $\dfrac{dy}{dx}=\dfrac{\sin^2(a+y)}{\sin a}$, $a\neq n\pi.$

42. If $y=(\cos^{-1}x)^2$, prove that $(1-x^2)\dfrac{d^2y}{dx^2}-x\dfrac{dy}{dx}-2=0$. Hence find y_2 when $x=0$

Chapter 11 Integral Calculus

43. Evaluate the following integrals

(i) $\int \frac{3x+5}{x^2+4x+7}dx$ (ii) $\int \frac{5x-7}{\sqrt{3x-x^2-2}}dx$

Chapter 12 Introduction to Probability Theory

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44. Given that $P(A) = 0.52$, $P(B) = 0.43$, and $P(A \cap B) = 0.24$, find

(i) $P(A \cap \bar{B})$ (ii) $P(A \cup B)$ (iii) $P(\bar{A} \cap \bar{B})$ (iv) $P(\bar{A} \cup \bar{B})$.

45. If A and B are two events associated with a random experiment for which

$P(A) = 0.35$, $P(A \text{ or } B) = 0.85$, and $P(A \text{ and } B) = 0.15$.

Find (i) $P(\text{only } B)$ (ii) $P(\bar{B})$ (iii) $P(\text{only } A)$

46. If $P(A) = 0.6$, $P(B) = 0.5$, and $P(A \cap B) = 0.2$

Find (i) $P(A/B)$ (ii) $P(\bar{A}/B)$ (iii) $P(A/\bar{B})$.

47. A problem in Mathematics is given to three students whose chances of solving it are $\frac{1}{3}, \frac{1}{4}$, and $\frac{1}{5}$ (i) What is the probability that the problem is solved? (ii) What is the probability that exactly one of them will solve it?

48. Given $P(A) = 0.4$ and $P(A \cup B) = 0.7$. Find $P(B)$ if
(i) A and B are mutually exclusive (ii) A and B are independent events
(iii) $P(A / B) = 0.4$ (iv) $P(B / A) = 0.5$

49. A year is selected at random. What is the probability that
(i) it contains 53 Sundays (ii) it is a leap year which contains 53 Sundays

50. A factory has two machines I and II. Machine I produces 40% of items of the output and Machine II produces 60% of the items. Further 4% of items produced by Machine I are defective and 5% produced by Machine II are defective. An item is drawn at random. If the drawn item is defective, find the probability that it was produced by Machine II.

51. A construction company employs 2 executive engineers. Engineer-1 does the work for 60% of jobs of the company. Engineer-2 does the work for 40% of jobs of the company. It is known from the past experience that the probability of an error when engineer-1 does the work is 0.03, whereas the probability of an error in the work of engineer-2 is 0.04. Suppose a serious error occurs in the work, which engineer would you guess did the work?

52. A firm manufactures PVC pipes in three plants viz, X, Y and Z. The daily production volumes from the three firms X, Y and Z are respectively 2000 units, 3000 units and 5000 units. It is known from the past experience that 3% of the output from plant X, 4% from plant Y and 2% from plant Z are defective. A pipe is selected at random from a day's total production,

(i) find the probability that the selected pipe is a defective one.

(ii) if the selected pipe is a defective, then what is the probability that it was produced by plant Y ?

53. An advertising executive is studying television viewing habits of married men and women during prime time hours. Based on the past viewing records he has determined that during prime time wives are watching television 60% of the time. It has also been determined that when the wife is watching television, 40% of the time the husband is also watching. When the wife is not watching the television, 30% of the time the husband is watching the television. Find the probability that (i) the husband is watching the television during the prime time of television (ii) if the husband is watching the television, the wife is also watching the television.

54. A consulting firm rents car from three agencies such that 50% from agency L, 30% from agency M and 20% from agency N. If 90% of the cars from L, 70% of cars from M and 60% of the cars from N are in good conditions (i) what is the probability that the firm will get a car in good condition? (ii) if a car is in good condition, what is probability that it has come from agency N?

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