

ASSERTION REASON TYPE QUESTIONS

For CBSE 2027 Exams - Mathematics (041) - Class 12

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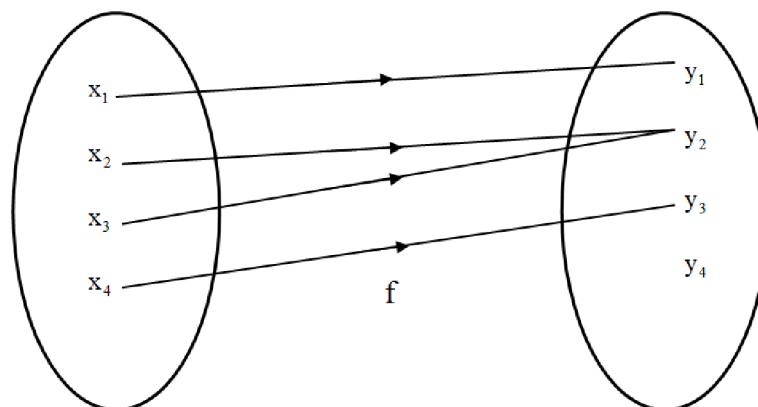
In the following questions, a statement of **Assertion (A)** is followed by a statement of **Reason (R)**. Choose the correct answer out of the following choices.

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true and R is not the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false but R is true.

Unit 1 (Relations & Functions)

Relations & Functions, Inverse Trig. Functions

- Q01. **Assertion (A)** : The relation $R = \{(a, b) : a \leq b^2\}$ on the set \mathbb{R} of real nos. is not reflexive.
Reason (R) : A relation on a set A is reflexive if $(a, a) \in R \forall a \in A$.
- Q07. **Assertion (A)** : Let $f : \mathbb{R} \rightarrow \mathbb{R}$ defined as $f(x) = [x]$, here $[\cdot]$ represents the greatest integer function. Then f is not one-one.
Reason (R) : A function is one-one if $f(\alpha) = f(\beta)$ implies $\alpha = \beta$.
- Q11. **Assertion (A)** : Number of all onto functions from the set $\{1, 2, 3, 4\}$ to itself is 24.
Reason (R) : Onto functions from the set $\{1, 2, 3, \dots, n\}$ to itself is simply a **permutation** on n symbols namely $1, 2, 3, \dots, n$.
- Q27. **Assertion (A)** : Inverse of $\sin x$ does not exist in $x \in \mathbb{R}$.
Reason (R) : All trigonometric functions are many-one in their respective domain.
- Q30. **Assertion (A)** : A function f shown below by the arrow diagram, is one-one.



Reason (R) : A function $f : A \rightarrow B$ is one-one if $f(\alpha) = f(\beta)$ implies $\alpha = \beta$ for all $\alpha, \beta \in A$.

- Q38. $X = \{0, 2, 4, 6, 8\}$.

P is a relation on X defined by $P = \{(0, 2), (4, 2), (4, 6), (8, 6), (2, 4), (0, 4)\}$.

Assertion (A) : The relation P on set X is a transitive relation.

Reason (R) : The relation P has a subset of the form $\{(a, b), (b, c), (a, c)\}$, where $a, b, c \in X$.

Q40. **Assertion (A)** : Domain of $y = \cos^{-1}(x)$ is $[-1, 1]$.

Reason (R) : The range of the principal value branch of $y = \cos^{-1}(x)$ is $[0, \pi] - \left\{\frac{\pi}{2}\right\}$.

Unit 2 (Algebra)

Matrices, Determinants

Q01. Let A and B be two symmetric matrices of order 3.

Assertion (A) : $A(BA)$ and $(AB)A$ are symmetric matrices.

Reason (R) : AB is symmetric matrix if matrix multiplication of A with B is commutative.

Q06. **Assertion (A)** : The inverse of $A = \begin{pmatrix} 5 & 1 \\ 2 & 2 \end{pmatrix}$ does not exist.

Reason (R) : Matrix A is non-singular.

Q30. **Assertion (A)** : If $A = \begin{pmatrix} -2 & 3 \\ 4 & 9 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 4 & 5 \\ 6 & 7 & 8 \end{pmatrix}$ then the product AB is of order 2×3 .

Reason (R) : For a null matrix, all of its elements are zero.

Q33. **Assertion (A)** : Matrix $M = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ is a diagonal matrix.

Reason (R) : A diagonal matrix is a square matrix, in which all the non-diagonal elements are zero.

Q34. **Assertion (A)** : For matrix $M = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 2 \end{bmatrix}$, determinant value $|M| = 24$.

Reason (R) : For a diagonal matrix $\text{diag.}(a \ b \ c)$, the det. value is given by 'abc'.

Q40. **Assertion (A)** : A system of three linear equations in three variables always has a unique solution if the determinant of the coefficient matrix is non-zero.

Reason (R) : For a diagonal matrix $X = \begin{pmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & c \end{pmatrix}$, $\det.(X) = 0$.

Unit 3 (Calculus)

Continuity & Differentiability, Applications of Derivatives, Integrals, Application of Integrals, Differential Equations

Q01. **Assertion (A)** : $f(x) = \log|x|$ is always continuous for all real values of x.

Reason (R) : A function is always continuous at all the points of its domain.

Q19. **Assertion (A)** : If $y = x e^x$, then $\frac{dy}{dx} = x e^x + e^x$.

Reason (R) : $\frac{d}{dx}(u v) = u \frac{dv}{dx} + v \frac{du}{dx}$.

Q25. **Assertion (A)** : $f(x) = \sin 2x + 3$ is defined for all real values of x .

Reason (R) : Maximum value of $f(x)$ is 4 and minimum value is 2.

Q42. **Assertion (A)** : Order of differential equation $\log\left(\frac{d^2y}{dx^2}\right) = \left(\frac{dy}{dx}\right)^3 + x$ is 2.

Reason (R) : Order of a differential equation is the order of the highest order derivative appearing in the differential equation.

Q52. **Assertion (A)** : For $y = 9x^2$, $x = 0$, $y = 1$ and $y = 4$, the area of the closed region in the first quadrant is $\frac{14}{9}$ Sq. units.

Reason (R) : For the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$, the area enclosed in first quadrant is 6π Sq. units.

Q60. **Assertion (A)** : $\int_2^8 \frac{\sqrt{10-x}}{\sqrt{x} + \sqrt{10-x}} dx = 3$.

Reason (R) : $\int_a^b f(x) dx = \int_a^b f(a+b-x) dx$.

Q62. **Assertion (A)** : The maximum value of the function $f(x) = x^5$, where $x \in [-1, 1]$ is attained at its critical point, $x = 0$.

Reason (R) : The maximum of a function can only occur at points where derivative is zero.

Unit 4 (Vectors & 3 D Geometry)

Vector Algebra, Three Dimensional Geometry

Q01. **Assertion (A)** : Value of $\lambda = 2$, if $\vec{a} \parallel \vec{b}$, where $\vec{a} = 2\hat{i} + 4\hat{j} + 3\lambda\hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} + 3\hat{k}$.

Reason (R) : $\vec{a} \cdot \vec{b} = 0$ implies, $\vec{a} \perp \vec{b}$, if \vec{a} and \vec{b} are non-zero vectors.

Q16. **Assertion (A)** : If $\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ then, $\vec{a} \cdot \vec{a} = 29$.

Reason (R) : $\vec{a} \cdot \vec{a} = |\vec{a}|^2$.

Q25. **Assertion (A)** : $\vec{r} = \hat{i} + \lambda(2\hat{i} + 3\hat{k})$ and $\vec{r} = 2\hat{i} - \hat{j} + \hat{k} + \lambda(3\hat{i} + \hat{j} - 2\hat{k})$ are perpendicular lines.

Reason (R) : For two perpendicular lines whose d.r.'s are a_1, b_1, c_1 and a_2, b_2, c_2 , we must have $a_1 a_2 + b_1 b_2 + c_1 c_2 = 0$.

Q30. **Assertion (A)** : The shortest distance between the lines $\vec{r} = 8\hat{i} - 9\hat{j} + 10\hat{k} + \lambda(3\hat{i} - 16\hat{j} + 7\hat{k})$ and $\vec{r} = 15\hat{i} + 29\hat{j} + 5\hat{k} + \mu(3\hat{i} + 8\hat{j} - 5\hat{k})$ is given by 14 units.

Reason (R) : The shortest distance between the parallel lines $\vec{r} = \vec{a}_1 + \lambda \vec{b}$ and $\vec{r} = \vec{a}_2 + \mu \vec{b}$, is

given by S.D. =
$$\frac{|\vec{b} \times (\vec{a}_2 - \vec{a}_1)|}{|\vec{b}|}$$
.

Q32. **Assertion (A) :** The lines $\vec{r} = \vec{a}_1 + \lambda \vec{b}_1$ and $\vec{r} = \vec{a}_2 + \mu \vec{b}_2$ are perpendicular, when $\vec{b}_1 \cdot \vec{b}_2 = 0$.

Reason (R) : The angle θ between the lines $\vec{r} = \vec{a}_1 + \lambda \vec{b}_1$ and $\vec{r} = \vec{a}_2 + \mu \vec{b}_2$ is given by the

expression
$$\cos \theta = \frac{\vec{b}_1 \cdot \vec{b}_2}{|\vec{b}_1| |\vec{b}_2|}$$
.

Q36. **Assertion (A) :** The acute angle between the line $\vec{r} = \hat{i} + \hat{j} + 2\hat{k} + \lambda(\hat{i} - \hat{j})$ and the x-axis is 45° .

Reason (R) : The acute angle θ between the lines $\vec{r} = x_1\hat{i} + y_1\hat{j} + z_1\hat{k} + \lambda(a_1\hat{i} + b_1\hat{j} + c_1\hat{k})$ and

$\vec{r} = x_2\hat{i} + y_2\hat{j} + z_2\hat{k} + \mu(a_2\hat{i} + b_2\hat{j} + c_2\hat{k})$ is given by
$$\cos \theta = \frac{|a_1a_2 + b_1b_2 + c_1c_2|}{\sqrt{a_1^2 + b_1^2 + c_1^2} \sqrt{a_2^2 + b_2^2 + c_2^2}}$$
.

Q45. **Assertion (A) :** For a vector \vec{p} , we always have $\vec{p} \cdot \vec{p} = \vec{0}$.

Reason (R) : If $\vec{OA} = \vec{x}$ and $\vec{OB} = \vec{y}$, then $\vec{BA} = \vec{x} - \vec{y}$.

Unit 5 (Linear Programming)

Linear Programming Problems

Q01. **Assertion (A) :** In a particular LPP whose objective function is given as $Z = x + y$, the corner points of the feasible region are found to be (25, 0), (0, 40) and (0, 0) and so, $Z_{\max} = 40$.

Reason (R) : The maximum or minimum values of objective function occur at the corner point of the feasible region.

Q08. Corner points of a LPP are given as O(0, 0), A(7, 0), B(3, 4) and C(0, 2).

Assertion (A) : Let $Z = px + y$ and $Z_A = Z_C$ then, the value of $p = \frac{2}{7}$.

Reason (R) : If $Z = qx + y$ and $Z_A = 2Z_C$, then value of $q = \frac{3}{7}$.

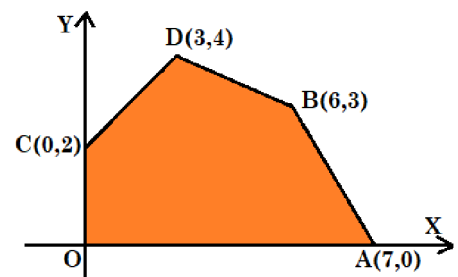
Q09. The corner points of the feasible region determined by the system of linear constraints are as shown below.

Assertion (A) : Let $Z = x + 2y$ be the objective function.

Then maximum value of Z occurs at B(6, 3).

Reason (R) : For the objective function $Z = x + 2y$,

$Z_{\max} = 11$.



Unit 6 (Probability)

Probability

Q01. **Assertion (A)** : If $P(A) = \frac{2}{5}$, $P(B) = \frac{1}{3}$, $P(A \cap B) = \frac{1}{5}$, then $P(\bar{A} | \bar{B}) = \frac{7}{10}$.

Reason (R) : $P(\bar{A} | \bar{B}) = \frac{P(\bar{A} \cap \bar{B})}{P(\bar{B})}$, $P(\overline{A \cup B}) = P(\bar{A} \cap \bar{B})$ and $P(\bar{E}) = 1 - P(E)$.

Q17. **Assertion (A)** : Two coins are tossed simultaneously. The probability of getting two heads, if it is known that at least one head comes up, is $\frac{1}{3}$.

Reason (R) : Let E and F be two events with a random experiment, then $P(F | E) = \frac{P(E \cap F)}{P(E)}$.

Q20. If each element of a second order determinant is either 0 or 1, then the probability that the value of the determinant is positive is given by P. Assume that the individual entries of the determinant are chosen independently, each value being assumed with probability $\frac{1}{2}$.

Assertion (A) : $P = \frac{3}{16}$.

Reason (R) : For $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, the value of det. (A) is given by expression $ad + bc$.

Q23. **Assertion (A)** : Suppose a function $f : \mathbb{R} \rightarrow \mathbb{R}$ is defined by

$$f(x) = \begin{cases} x^2, & \text{if } x \leq 1 \\ 2x - 1, & \text{if } x > 1 \end{cases}$$

Then, the probability that f is continuous at $x = 1$ is zero.

Reason (R) : For a function to be continuous at a point, its left-hand limit, right-hand limit, and value at that point must be equal.

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Matrices



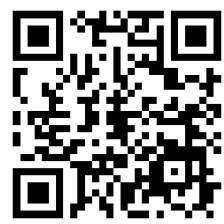
Determinants



Relations & Functions



Inverse Trig. Functions



Continuity & Diff.



Application of Derivatives



Indefinite Integrals



Definite Integrals



Application of Integrals



Differential Equations



Vector Algebra



3 D Geometry



Linear Programming



Probability

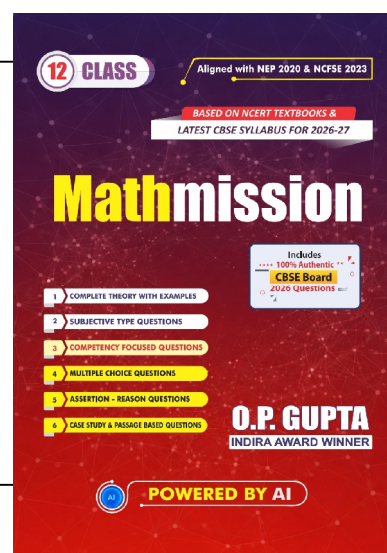
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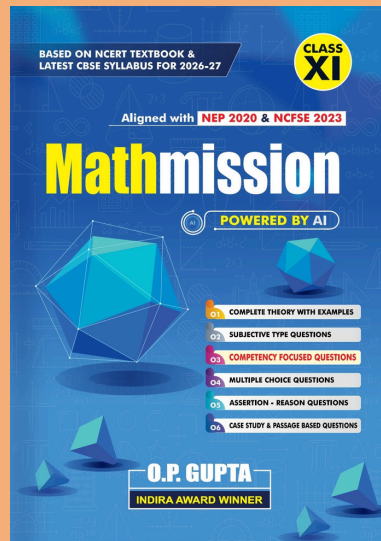
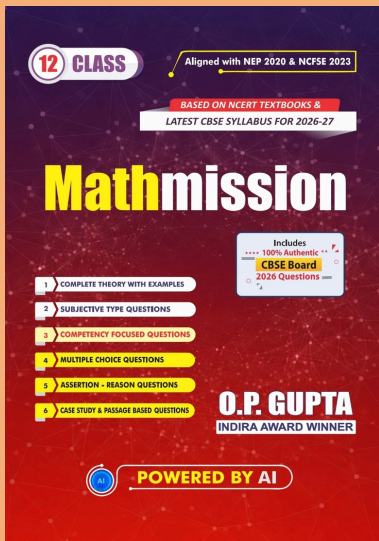
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