CHAPTER 4

Term-I

DETERMINANTS

Syllabus

- *Determinant of a square matrix (up to 3 × 3 matrices), minors, co-factors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.*

STAND ALONE MCQs (1 Mark each)

Q. 1. If A is a square matrix of order 3, such that $A(adj\ A) = 10I$, then $|adj\ A|$ is equal to

(A) 1 (B) 10

(C) 100 (D) 101

[CBSE Delhi Set-I 2020]

Ans. Option (C) is correct.

Explanation: Consider the equation

$$A\,(adj\ A) = |A|\,I$$

Here, $A\,(adj\ A) = 10\,I$

Then, $|A| = 10$

Since, $|adj\ A| = |A|^{n-1}$

Where n is order of matrix

Here, $= |A|^{3-1}$

$= 10^2$

$= 100$

Q. 2. If A is a 3 × 3 matrix such that $|A| = 8$, then $|3A|$ equals

(A) 8 (B) 24

(C) 72 (D) 216

[CBSE Delhi Set-I 2020]

Ans. Option (D) is correct.

Explanation:

Here $|A| = 8$

Then $|3A| = 3^3|A| = 27 \times 8 = 216$

Q. 3. If A is skew symmetric matrix of order 3, then the value of $|A|$ is

(A) 3 (B) 0

(C) 9 (D) 27

[CBSE Delhi Set-III 2020]

Ans. Option (B) is correct.

Explanation: Determinant value of skew symmetric matrix is always '0'.

Q. 4. If $\begin{vmatrix} 2 & 3 & 2 \\ x & x & x \\ 4 & 9 & 1 \end{vmatrix} + 3 = 0$, then the value of x is

(A) 3 (B) 0

(C) – 1 (D) 1

[CBSE OD Set-I 2020]

Ans. Option (C) is correct.

Explanation:

$$\begin{vmatrix} 2 & 3 & 2 \\ x & x & x \\ 4 & 9 & 1 \end{vmatrix} + 3 = 0$$

On expanding along R_1

$$2(x-9x) - 3(x-4x) + 2(9x-4x) + 3 = 0$$

$$2(-8x) - 3(-3x) + 2(5x) + 3 = 0$$

$$-16x + 9x + 10x + 3 = 0$$

$$3x + 3 = 0$$

$$3x = -3$$
$$x = -\frac{3}{3}$$
$$x = -1$$

Q. 5. Let $A = \begin{bmatrix} 200 & 50 \\ 10 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 50 & 40 \\ 2 & 3 \end{bmatrix}$, then $|AB|$ is equal to

(A) 460 (B) 2000
(C) 3000 (D) – 7000

[CBSE OD Set-I 2020]

Ans. Option (D) is correct.

Explanation:

$$A = \begin{bmatrix} 200 & 50 \\ 10 & 2 \end{bmatrix}$$
$$B = \begin{bmatrix} 50 & 40 \\ 2 & 3 \end{bmatrix}$$
$$AB = \begin{bmatrix} 200 & 50 \\ 10 & 2 \end{bmatrix}\begin{bmatrix} 50 & 40 \\ 2 & 3 \end{bmatrix}$$
$$= \begin{bmatrix} 10000+100 & 8000+150 \\ 500+4 & 400+6 \end{bmatrix}$$
$$AB = \begin{bmatrix} 10100 & 8150 \\ 504 & 406 \end{bmatrix}$$
$$|AB| = (10100)(406) - (504)(8150)$$
$$= 4100600 - 4107600$$
$$= -7000$$

Q. 6. If $A = \begin{bmatrix} a & 0 & 0 \\ 0 & a & 0 \\ 0 & 0 & a \end{bmatrix}$, then det $(adj\ A)$ equals

(A) a^{27} (B) a^9
(C) a^6 (D) a^2

[CBSE OD Set-III 2020]

Ans. Option (C) is correct.

Explanation:

$$A = \begin{bmatrix} a & 0 & 0 \\ 0 & a & 0 \\ 0 & 0 & a \end{bmatrix}$$
$$\text{Det}(A) = a(a \times a - 0 \times 0) - 0 + 0$$
$$= a^3$$
$$\text{Det}(adj\ A) = (a^3)^2$$
$$= a^6$$

Q. 7. If A is any square matrix of order 3×3 such that $|A| = 3$, then the value of $|adj\ A|$ is?

(A) 3 (B) $\frac{1}{3}$
(C) 9 (D) 27

[CBSE SQP 2019-20]

Ans. Option (C) is correct.

Explanation:

$$|A| = 3, n = 3$$
$$|adj\ A| = |A|^2 = 3^2 = 9$$

Q. 8. If $\begin{vmatrix} 2x & 5 \\ 8 & x \end{vmatrix} = \begin{vmatrix} 6 & -2 \\ 7 & 3 \end{vmatrix}$, then the value of x is

(A) 3 (B) ±3
(C) ±6 (D) 6

Ans. Option (C) is correct.

Explanation: Given that

$$\therefore \begin{vmatrix} 2x & 5 \\ 8 & x \end{vmatrix} = \begin{vmatrix} 6 & -2 \\ 7 & 3 \end{vmatrix},$$
$$\Rightarrow 2x^2 - 40 = 18 + 14$$
$$\Rightarrow 2x^2 = 32 + 40$$
$$\Rightarrow x^2 = \frac{72}{2}$$
$$x^2 = 36$$
$$\therefore x = \pm 6$$

Q. 9. The value of determinant $\begin{vmatrix} a-b & b+c & a \\ b-a & c+a & b \\ c-a & a+b & c \end{vmatrix}$ is

(A) $a^3 + b^3 + c^3$ (B) $3bc$
(C) $a^3 + b^3 + c^3 - 3abc$ (D) None of these

Ans. Option (D) is correct.

Explanation: We have

$$\begin{vmatrix} a-b & b+c & a \\ b-a & c+a & b \\ c-a & a+b & c \end{vmatrix} = \begin{vmatrix} a+c & b+c+a & a \\ b+c & c+a+b & b \\ c+b & a+b+c & c \end{vmatrix}$$
$$[\because C_1 \to C_1 + C_2 \text{ and } C_2 \to C_2 + C_3]$$
$$= (a+b+c)\begin{vmatrix} a+c & 1 & a \\ b+c & 1 & b \\ c+b & 1 & c \end{vmatrix}$$
[Taking $(a+b+c)$ common from C_2]
$[\because R_2 \to R_2 - R_3$ and $R_1 \to R_1 - R_3]$
$$= (a+b+c)\begin{vmatrix} a-b & 0 & a-c \\ 0 & 0 & b-c \\ c+b & 1 & c \end{vmatrix}$$
[Expanding along R_2]
$$= (a+b+c)[(b-c)(a-b)]$$
$$= (a+b+c)(b-c)(a-b)$$

Q. 10. The area of a triangle with vertices (–3, 0), (3, 0) and (0, k) is 9 sq. units. Then, the value of k will be

(A) 9 (B) 3
(C) –9 (D) 6

Ans. Option (B) is correct.

Explanation: We know that, area of a triangle with vertices (x_1, y_1), (x_2, y_2) and (x_3, y_3) is given by

$$\Delta = \frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

$$\therefore \Delta = \frac{1}{2}\begin{vmatrix} -3 & 0 & 1 \\ 3 & 0 & 1 \\ 0 & k & 1 \end{vmatrix}$$

[Expanding along R_1]

$$9 = \frac{1}{2}[-3(-k) - 0 + 1(3k)]$$

$$\Rightarrow 18 = 3k + 3k$$

$$18 = 6k$$

$$\therefore k = \frac{18}{6} = 3$$

Q. 11. The determinant $\begin{vmatrix} b^2 - ab & b - c & bc - ac \\ ab - a^2 & a - b & b^2 - ab \\ bc - ac & c - a & ab - a^2 \end{vmatrix}$ is equal to

(A) $abc(b-c)(c-a)(a-b)$

(B) $(b-c)(c-a)(a-b)$

(C) $(a+b+c)(b-c)(c-a)(a-b)$

(D) None of these

Ans. Option (D) is correct.

Explanation: We have

$$\begin{vmatrix} b^2 - ab & b - c & bc - ac \\ ab - a^2 & a - b & b^2 - ab \\ bc - ac & c - a & ab - a^2 \end{vmatrix} = \begin{vmatrix} b(b-a) & b-c & c(b-a) \\ a(b-a) & a-b & b(b-a) \\ c(b-a) & c-a & a(b-a) \end{vmatrix}$$

$$= (b-a)^2\begin{vmatrix} b & b-c & c \\ a & a-b & b \\ c & c-a & a \end{vmatrix}$$

[On taking $(b - a)$ common from C_1 and C_3 each]

$$= (b-a)^2\begin{vmatrix} b-c & b-c & c \\ a-b & a-b & b \\ c-a & c-a & a \end{vmatrix}$$

$[\because C_1 \to C_1 - C_3]$

$$= 0$$

[Since, two columns C_1 and C_2 are identical, so the value of determinant is zero.]

Q. 12. If $A = \begin{vmatrix} 2 & \lambda & -3 \\ 0 & 2 & 5 \\ 1 & 1 & 3 \end{vmatrix}$. Then A^{-1} exist if

(A) $\lambda = 2$ **(B)** $\lambda \neq 2$

(C) $\lambda \neq -2$ **(D)** None of these

Ans. Option (D) is correct.

Explanation: Given that,

$$A = \begin{vmatrix} 2 & \lambda & -3 \\ 0 & 2 & 5 \\ 1 & 1 & 3 \end{vmatrix}$$

Expanding along R_1,

$$|A| = 2(6-5) - \lambda(-5) - 3(-2)$$

$$= 2 + 5\lambda + 6$$

We know that A^{-1} exists, if A is non-singular matrix, *i.e.*, $|A| \neq 0$

$\therefore \quad 2 + 5\lambda + 6 \neq 0$

$\Rightarrow \quad 5\lambda \neq -8$

$\therefore \quad \lambda \neq \frac{-8}{5}$

So, A^{-1} exists if and only if $\lambda \neq \frac{-8}{5}$.

Q. 13. If A and B are invertible matrices, then which of the following is not correct?

(A) $adj\ A = |A|.A^{-1}$ **(B)** $\det(A^{-1}) = [\det(A)]^{-1}$

(C) $(AB)^{-1} = B^{-1}A^{-1}$ **(D)** $(A+B)^{-1} = B^{-1} + A^{-1}$

Ans. Option (D) is correct.

Explanation: Since, A and B are invertible matrices, so, we can say that

$$(AB)^{-1} = B^{-1}A^{-1} \quad \text{...(i)}$$

Also, $A^{-1} = \frac{1}{|A|}(adj\ A)$

$\Rightarrow \quad adj\ A = A^{-1}.|A| \quad$ ...(ii)

Also, $\det (A)^{-1} = [\det (A)]^{-1}$

$\Rightarrow \quad \det (A)^{-1} = \frac{1}{[\det (A)]}$

$\Rightarrow \det (A).\det (A)^{-1} = 1 \quad$ ...(iii)

From equation (iii), we conclude that it is true.

Again, $(A+B)^{-1} = \frac{1}{|(A+B)|} adj\ (A+B)$

$\Rightarrow \quad (A+B)^{-1} = B^{-1} + A^{-1} \quad$ ...(iv)

Q. 14. If $\begin{vmatrix} x & 2 \\ 18 & x \end{vmatrix} = \begin{vmatrix} 6 & 2 \\ 18 & 6 \end{vmatrix}$ then x is equal to

(A) 6 **(B)** ± 6

(C) -6 **(D)** 0

Ans. Option (B) is correct.

Explanation: Given that,

$$\begin{vmatrix} x & 2 \\ 18 & x \end{vmatrix} = \begin{vmatrix} 6 & 2 \\ 18 & 6 \end{vmatrix}$$

$\Rightarrow \quad x^2 - 36 = 36 - 36$

$\Rightarrow \quad x^2 - 36 = 0$

$\Rightarrow \quad x = \pm 6$

Q. 15. Let A be a non-singular square matrix of order 3×3. Then $|adj\,A|$ is equal to

(A) $|A|$ (B) $|A|^2$

(C) $|A|^3$ (D) $3|A|$

Ans. Option (B) is correct.

Explanation: We know that,

$$(adj\,A)A = |A|I = \begin{bmatrix} |A| & 0 & 0 \\ 0 & |A| & 0 \\ 0 & 0 & |A| \end{bmatrix}$$

$$\Rightarrow \quad |(adj\,A)A| = \begin{vmatrix} |A| & 0 & 0 \\ 0 & |A| & 0 \\ 0 & 0 & |A| \end{vmatrix}$$

$$\Rightarrow |adj\,A||A| = |A|^3 \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} = |A|^3\,(I)$$

$$\therefore \quad |adj\,A| = |A|^2$$

Q. 16. If A is an invertible matrix of order 2, then det (A^{-1}) is equal to

(A) det (A) (B) $\dfrac{1}{\det(A)}$

(C) 1 (D) 0

Ans. Option (B) is correct.

Explanation: Given that A is an invertible matrix, A^{-1} exists and $A^{-1} = \dfrac{1}{|A|}\,adj.\,A$.

As matrix A is of order 2, let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

Then, $|A| = ad - bc$ and $adj\,A = \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

Now

$$A^{-1} = \frac{1}{|A|}adj.A = \begin{bmatrix} \frac{d}{|A|} & \frac{-b}{|A|} \\ \frac{-c}{|A|} & \frac{a}{|A|} \end{bmatrix}$$

$$\therefore \quad |A^{-1}| = \begin{vmatrix} \frac{d}{|A|} & \frac{-b}{|A|} \\ \frac{-c}{|A|} & \frac{a}{|A|} \end{vmatrix}$$

$$= \frac{1}{|A|^2}\begin{vmatrix} d & -b \\ -c & a \end{vmatrix}$$

$$= \frac{1}{|A|^2}.|A|$$

$$= \frac{1}{|A|}$$

$$\therefore \quad \det(A^{-1}) = \frac{1}{\det(A)}$$

ASSERTION AND REASON BASED MCQs (1 Mark each)

Directions: In the following questions, A statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as.

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is NOT the correct explanation of A

(C) A is true but R is false

(D) A is false and R is True

Q. 1. Let A be a 2×2 matrix.

Assertion (A): $adj\,(adj\,A) = A$

Reason (R): $|adj\,A| = |A|$

Ans. Option (B) is correct.

Explanation:

$adj\,(adj\,A) = |A|^{n-2}A$

Here $n = 2 \Rightarrow adj\,(adj\,A) = A$

Hence A is true.

$|adj\,A| = |A|^{n-1}$

$n = 2 \Rightarrow |adj\,A| = |A|$

Hence R is true.

R is not the correct explanation for A.

Q. 2. Assertion (A): If $A = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, then

$$A^{-1} = \begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{4} \end{bmatrix}.$$

Reason (R): The inverse of an invertible diagonal matrix is a diagonal matrix.

Ans. Option (B) is correct.

Explanation:

$|A| = 24$

$$Adj\,A = \begin{bmatrix} 12 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 6 \end{bmatrix}$$

$$A^{-1} = \frac{1}{|A|}(adj\,A) = \begin{bmatrix} \frac{1}{2} & 0 & 0 \\ 0 & \frac{1}{3} & 0 \\ 0 & 0 & \frac{1}{4} \end{bmatrix}$$

Hence A is true.

A is a diagonal matrix and its inverse is also a diagonal matrix. Hence R is true.

But R is not the correct explanation of A.

Q. 3. Assertion (A): If every element of a third order determinant of value Δ is multiplied by 5, then the value of the new determinant is 125Δ.

Reason (R): If k is a scalar and A is an $n \times n$ matrix, then $|kA| = k^n |A|$

Ans. Option (A) is correct.

Explanation: If k is a scalar and A is an $n \times n$ matrix, then $|kA| = k^n |A|$.

This is a property of the determinant. Hence R is true.

Using this property, $|5\Delta| = 5^3 \Delta = 125\Delta$

Hence A is true.

R is the correct explanation of A.

Q. 4. Assertion (A): If the matrix A = $\begin{bmatrix} 1 & 3 & \lambda+2 \\ 2 & 4 & 8 \\ 3 & 5 & 10 \end{bmatrix}$ is singular, then $\lambda = 4$.

Reason (R): If A is a singular matrix, then $|A| = 0$.

Ans. Option (A) is correct.

Explanation: A matrix is said to be singular if

$$|A| = 0.$$

Hence R is true.

$$\begin{vmatrix} 1 & 3 & \lambda+2 \\ 2 & 4 & 8 \\ 3 & 5 & 10 \end{vmatrix} = 0$$

$$\Rightarrow \quad 1(40-40) - 3(20-24) + (\lambda+2)(10-12) = 0$$

$$0 + 12 - 2\lambda - 4 = 0$$

$$\Rightarrow \quad \lambda = 4.$$

Hence A is true.

R is the correct explanation for A.

Q. 5. Given $A = \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$.

Assertion (A): $2A^{-1} = 9I - A$

Reason (R): $A^{-1} = \frac{1}{|A|}(adj\,A)$

Ans. Option (A) is correct.

Explanation: $A^{-1} = \frac{1}{|A|}(adj\,A)$ is true.

Hence R is true

$$|A| = 2,$$

$$A^{-1} = \frac{1}{2}\begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix}$$

$$\text{LHS} = 2A^{-1} = \begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix},$$

$$\text{RHS} = 9\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$$

$$= \begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix}$$

$\therefore \quad 2A^{-1} = 9I - A$ is true.

R is the correct explanation for A.

Q. 6. Assertion (A): If $A = \begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix}$ and $A^{-1} = kA$, then $k = \frac{1}{9}$

Reason (R): $|A^{-1}| = \frac{1}{|A|}$

Ans. Option (D) is correct.

Explanation:

$$|A| = -4 - 15$$

$$= -19$$

$$A^{-1} = \frac{-1}{19}\begin{bmatrix} -2 & -3 \\ -5 & 2 \end{bmatrix}$$

$$\Rightarrow \quad \frac{-1}{19}\begin{bmatrix} -2 & -3 \\ -5 & 2 \end{bmatrix} = \begin{bmatrix} 2k & 3k \\ 5k & -2k \end{bmatrix}$$

$$\Rightarrow \quad k = \frac{1}{19}$$

A is false

$$|A^{-1}| = \frac{1}{|A|} \text{ is true.}$$

R is true.

CASE-BASED MCQs

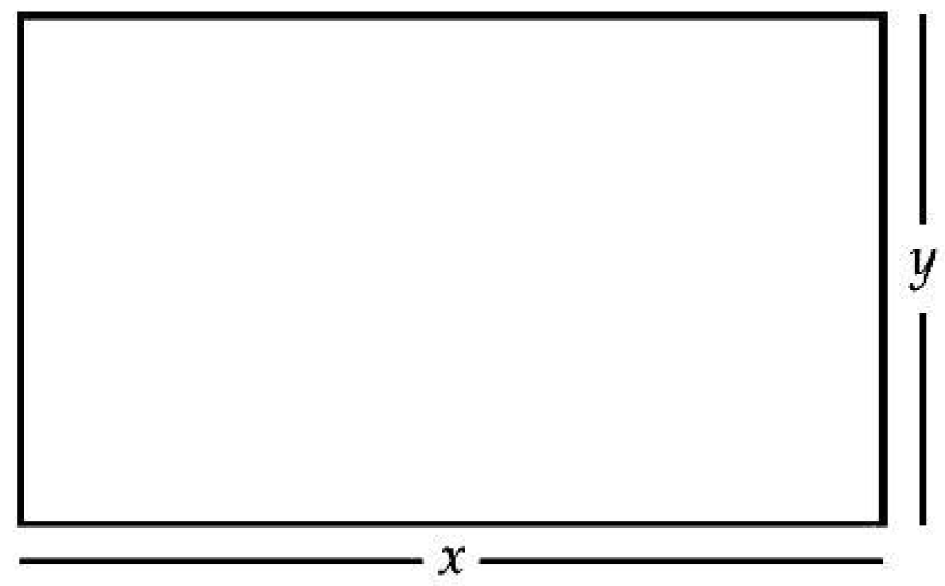
Attempt any four sub-parts from each question. Each sub-part carries 1 mark.

I. Read the following text and answer the following questions on the basis of the same:

Manjit wants to donate a rectangular plot of land for a school in his village. When he was asked to give dimensions of the plot, he told that if its length is decreased by 50 m and breadth is increased by

50 m, then its area will remain same, but if length is decreased by 10 m and breadth is decreased by 20 m, then its area will decrease by 5300 m^2

[CBSE QB 2021]



Q. 1. The equations in terms of X and Y are

(A) $x - y = 50, 2x - y = 550$

(B) $x - y = 50, 2x + y = 550$

(C) $x + y = 50, 2x + y = 550$

(D) $x + y = 50, 2x + y = 550$

Ans. Option (B) is correct.

Q. 2. Which of the following matrix equation is represented by the given information

(A) $\begin{bmatrix} 1 & -1 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 50 \\ 550 \end{bmatrix}$

(B) $\begin{bmatrix} 1 & 1 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 50 \\ 550 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 1 \\ 2 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 50 \\ 550 \end{bmatrix}$

(D) $\begin{bmatrix} 1 & 1 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -50 \\ -550 \end{bmatrix}$

Ans. Option (A) is correct.

Q. 3. The value of x (length of rectangular field) is

(A) 150 m **(B)** 400 m

(C) 200 m **(D)** 320 m

Ans. Option (C) is correct.

Explanation: We have,

$$\begin{bmatrix} 1 & -1 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 50 \\ 550 \end{bmatrix}$$

Let $A = \begin{bmatrix} 1 & -1 \\ 2 & 1 \end{bmatrix}$

$B = \begin{bmatrix} 50 \\ 550 \end{bmatrix}$,

$X = \begin{bmatrix} x \\ y \end{bmatrix}$

Now $AX = B$

$X = A^{-1}B$

$$Adj(A) = \begin{bmatrix} 1 & 1 \\ -2 & 1 \end{bmatrix}$$

$$|A| = 1 - [2 \times (-1)] = 1 + 2 = 3$$

$$A^{-1} = \frac{Adj(A)}{|A|} = \frac{1}{3}\begin{bmatrix} 1 & 1 \\ -2 & 1 \end{bmatrix}$$

$$X = \frac{1}{3}\begin{bmatrix} 1 & 1 \\ -2 & 1 \end{bmatrix}\begin{bmatrix} 50 \\ 550 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{1}{3} & \frac{1}{3} \\ \frac{-2}{3} & \frac{1}{3} \end{bmatrix}\begin{bmatrix} 50 \\ 550 \end{bmatrix}$$

$$= \begin{bmatrix} \frac{50}{3} + \frac{550}{3} \\ \frac{-100}{3} + \frac{550}{3} \end{bmatrix}$$

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 200 \\ 150 \end{bmatrix}$$

$\Rightarrow$ $x = 200$

$y = 150$

Q. 4. The value of y (breadth of rectangular field) is

(A) 150 m **(B)** 200 m

(C) 430 m. **(D)** 350 m

Ans. Option (A) is correct.

Q. 5. How much is the area of rectangular field?

(A) 60000 sq.m. **(B)** 30000 sq.m.

(C) 30000m **(D)** 3000m

Ans. Option (B) is correct.

Explanation: Area of rectangular field

$= xy$

$= 200 \times 150$

$= 30000$ sqm.

II. Read the following text and answer the following questions on the basis of the same:

The management committee of a residential colony decided to award some of its members (say x) for honesty, some (say y) for helping others and some others (say z) for supervising the workers to kept the colony neat and clean. The sum of all the awardees is 12. Three times the sum of awardees for cooperation and supervision added to two times the number of awardees for honesty is 33. The sum of the number of awardees for honesty and supervision is twice the number of awardees for helping.

Q. 1. $x + y + z =$ _______.

(A) 3 **(B)** 5

(C) 7 **(D)** 12

Ans. Option (D) is correct.

Explanation:

$$x + y + z = 12 \quad ...(i)$$

$$2x + 3y + 3z = 33 \quad ...(ii)$$

$$x - 2y + z = 0 \quad ...(iii)$$

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 3 & 3 \\ 1 & -2 & 1 \end{bmatrix}, B = \begin{bmatrix} 12 \\ 33 \\ 0 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$|A| = 1(3 + 6) - 1(2 - 3) + 1(-4 - 3)$$

$$= 9 + 1 - 7$$

$$= 3$$

$$A^{-1} = \frac{1}{|A|}(adj\ A)$$

$$= \frac{1}{3}\begin{bmatrix} 9 & -3 & 0 \\ 1 & 0 & -1 \\ -7 & 3 & 1 \end{bmatrix}$$

$$X = A^{-1}B$$

$$= \frac{1}{3}\begin{bmatrix} 9 & -3 & 0 \\ 1 & 0 & -1 \\ -7 & 3 & 1 \end{bmatrix}\begin{bmatrix} 12 \\ 33 \\ 0 \end{bmatrix}$$

$$= \frac{1}{3}\begin{bmatrix} 9 \\ 12 \\ 15 \end{bmatrix}$$

$$= \begin{bmatrix} 3 \\ 4 \\ 5 \end{bmatrix}$$

$\Rightarrow x = 3, y = 4, z = 5$

$x + y + z = 12$ [from (i)]

Q. 2. $x - 2y =$ _______.

(A) z **(B)** $-z$

(C) $2z$ **(D)** $-2z$

Ans. Option (B) is correct.

Explanation: $x - 2y = -z$ [from (iii)]

Q. 3. The value of z is _______.

(A) 3 **(B)** 4

(C) 5 **(D)** 6

Ans. Option (C) is correct.

Explanation: $z = 5$

Q. 4. The value of $x + 2y =$ _______.

(A) 9 **(B)** 10

(C) 11 **(D)** 12

Ans. Option (C) is correct.

Explanation: $x + 2y = 3 + 8 = 11$

Q. 5. The value of $2x + 3y + 5z =$ _______.

(A) 40 **(B)** 43

(C) 50 **(D)** 53

Ans. Option (B) is correct.

Explanation:

$$2x + 3y + 5z = 6 + 12 + 25$$
$$= 43$$

III. Read the following text and answer the following questions. On the basis of the same:

Two schools Oxford and Navdeep want to award their selected students on the values of sincerity, truthfulness and helpfulness. Oxford wants to award ₹x each, ₹y each and ₹z each for the three respective values to 3, 2 and 1 students respectively with a total award money of ₹1600. Navdeep wants to spend ₹2300 to award its 4, 1 and 3 students on the respective values (by giving the same amount to the three values as before). The total amount of the award for one prize on each is ₹900.

Q. 1. $x + y + z =$ _______.

(A) 800 **(B)** 900

(C) 1000 **(D)** 1200

Ans. Option (B) is correct.

Explanation:
From the above information, we have

$$3x + 2y + z = 1600 \quad ...(i)$$
$$4x + y + 3z = 2300 \quad ...(ii)$$
$$x + y + z = 900 \quad ...(iii)$$

$$A = \begin{bmatrix} 3 & 2 & 1 \\ 4 & 1 & 3 \\ 1 & 1 & 1 \end{bmatrix}, B = \begin{bmatrix} 1600 \\ 2300 \\ 900 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$$

$$|A| = 3(1-3) - 2(4-3) + 1(4-1)$$
$$= -6 - 2 + 3$$
$$= -5$$

$$A^{-1} = \frac{1}{|A|}(adj\,A)$$

$$= \frac{1}{-5}\begin{bmatrix} -2 & -1 & 5 \\ -1 & 2 & -5 \\ 3 & -1 & -5 \end{bmatrix}$$

$$X = A^{-1}B$$

$$= \frac{-1}{5}\begin{bmatrix} -2 & -1 & 5 \\ -1 & 2 & -5 \\ 3 & -1 & -5 \end{bmatrix}\begin{bmatrix} 1600 \\ 2300 \\ 900 \end{bmatrix}$$

$$= \frac{-1}{5}\begin{bmatrix} -1000 \\ -1500 \\ -2000 \end{bmatrix}$$

$$= \begin{bmatrix} 200 \\ 300 \\ 400 \end{bmatrix}$$

$$\therefore x = 200, y = 300, z = 400$$

$x + y + z = 900$ [from (iii)]

Q. 2. $4x + y + 3z =$ _______.

(A) 1600 **(B)** 2300

(C) 900 **(D)** 1200

Ans. Option (B) is correct.

Explanation: $4x + y + 3z = 2300$

Q. 3. The value of y is _______.

(A) 200 **(B)** 250

(C) 300 **(D)** 350

Ans. Option (C) is correct.

Explanation: $4x + y + 3z = 2300$ [from (ii)]
$y = 300$

Q. 4. The value of $2x + 3y$ is _______.

(A) 1000 **(B)** 1100

(C) 1200 **(D)** 1300

Ans. Option (D) is correct.

Explanation: $2x + 3y = 400 + 900$
$= 1300$

Q. 5. $y - x =$ _______.

(A) 100 **(B)** 200

(C) 300 **(D)** 400

Ans. Option (A) is correct.

Explanation:
$$y - x = 300 - 200$$
$$= 100$$