EXPRESSWALA ACADEMY

Maths 1B: Change of Axes

MCQ Test, Set 01

Time: 30 minutes | Maximum marks: 25

Name: _____ Class: _____ Date: _____

1. There are 25 questions. Each has exactly one correct answer: choose A, B, C or D.
2. Each correct answer carries 1 mark. There is no negative marking.
3. The key sheet and worked solutions are at the end of this test.

1. After the origin is shifted to $(-6, 1)$, a point has new coordinates $(-5, 4)$. Its original coordinates are

A. $(-11, 5)$ **B.** $(-4, -2)$ **C.** $(1, 3)$ **D.** $(-1, -3)$

2. When the origin is shifted to $(4, 7)$, the new coordinates of $(2, -2)$ are

A. $(6, 5)$ **B.** $(-5, -6)$ **C.** $(2, 9)$ **D.** $(-2, -9)$

3. When the origin is shifted to $(-3, -1)$, the equation $-x^2 + 3xy - 4y^2 - 7x - 5y + 1 = 0$ becomes

A. $-X^2 + 3XY - 4Y^2 - 4X - 6Y + 25 = 0$ **B.** $-X^2 + 3XY - 4Y^2 - 4X - 6Y + 23 = 0$

C. $-X^2 + 3XY - 4Y^2 - 10X - 4Y - 29 = 0$ **D.** $-X^2 + 3XY - 4Y^2 - 14X + 16Y - 5 = 0$

4. When the origin is shifted to $(-3, 3)$, the equation $x^2 + y^2 + 6x - 6y + 2 = 0$ becomes

A. $X^2 + Y^2 + 2 = 0$ **B.** $X^2 + Y^2 - 14 = 0$

C. $X^2 + Y^2 + 12X - 12Y + 56 = 0$ **D.** $X^2 + Y^2 - 16 = 0$

5. To remove the first degree terms from $6x^2 - 4xy + y^2 - 20x + 4y + 4 = 0$, the origin must be shifted to

A. $(-4, -3)$ **B.** $(4, 3)$ **C.** $(3, 4)$ **D.** $(-3, -4)$

6. When the first degree terms of $6x^2 - 6xy + 6y^2 + 18x + 18y + 9 = 0$ are removed by a translation, the constant term of the new equation is

A. 9 **B.** 45 **C.** -45 **D.** -36

7. To remove the first degree terms from $-2x^2 - 2xy + 4y^2 - 10x + 4y - 11 = 0$, the origin must be shifted to

A. $(2, 1)$ **B.** $(-2, -1)$ **C.** $(-1, -2)$ **D.** $(1, 2)$

8. When the origin is shifted to $(3, 2)$, the constant term of $4x^2 + xy + 5y^2 - 8x - y - 9 = 0$ becomes

A. 27 **B.** 9 **C.** -9 **D.** -27

9. When the origin is shifted to $(2, 1)$, the constant term of $x^2 - 2xy - 2y^2 + 5x + 2y + 6 = 0$ becomes

A. 6 **B.** -16 **C.** 16 **D.** 28

10. The equation $5x^2 - 2xy - y^2 - 14x - 2y + k = 0$ can be reduced to the form $aX^2 + 2hXY + bY^2 = 0$ by a translation when $k =$

A. 6 **B.** 10 **C.** 5 **D.** -5

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11. The equation $4x^2 + 6xy - y^2 - 6x - 24y + k = 0$ can be reduced to the form $aX^2 + 2hXY + bY^2 = 0$ by a translation when $k =$

A. -27 **B.** -26 **C.** -54 **D.** 27

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12. After the axes are rotated through an angle θ with $\cos\theta = \frac{4}{5}$, $\sin\theta = \frac{3}{5}$, a point has new coordinates $(6, 6)$. Its original coordinates are

A. $(-\frac{6}{5}, -\frac{42}{5})$ **B.** $(\frac{42}{5}, \frac{6}{5})$
C. $(\frac{6}{5}, \frac{42}{5})$ **D.** $(\frac{6}{5}, -\frac{42}{5})$

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13. After the axes are rotated through $45°$, a point has new coordinates $(7, -3)$. Its original coordinates are

A. $(2\sqrt{2}, 5\sqrt{2})$ **B.** $(5\sqrt{2}, 2\sqrt{2})$
C. $(2\sqrt{2}, -5\sqrt{2})$ **D.** $(-5\sqrt{2}, -2\sqrt{2})$

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14. When the axes are rotated through $45°$, the equation $2x + 3y - 6 = 0$ becomes

A. $-\sqrt{2}X + 5\sqrt{2}Y - 12 = 0$ **B.** $5\sqrt{2}X + \sqrt{2}Y + 12 = 0$
C. $\sqrt{2}X + 5\sqrt{2}Y - 12 = 0$ **D.** $5\sqrt{2}X + \sqrt{2}Y - 12 = 0$

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15. When the axes are rotated through $90°$, the equation $-5x - 2y - 2 = 0$ becomes

A. $5X + 2Y + 2 = 0$ **B.** $-2X + 5Y + 2 = 0$ **C.** $2X - 5Y - 2 = 0$ **D.** $2X - 5Y + 2 = 0$

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16. The angle of rotation that removes the xy term from $2x^2 + 10xy + 2y^2 = 2$ is

A. $\frac{\pi}{3}$ **B.** $\frac{\pi}{8}$
C. $\frac{\pi}{4}$ **D.** $\tan^{-1}\frac{1}{2}$

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17. The angle of rotation that removes the xy term from $-x^2 - 8xy - y^2 = -6$ is

A. $\tan^{-1}\frac{1}{2}$ **B.** $\frac{\pi}{4}$
C. $\frac{\pi}{3}$ **D.** $\frac{\pi}{8}$

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18. To reduce the line $12x + 5y + 1 = 0$ to the form $X = \text{constant}$, the axes must be rotated through

A. $\tan^{-1}\left(-\frac{5}{12}\right)$ **B.** $\tan^{-1}\left(-\frac{12}{5}\right)$
C. $\tan^{-1}\left(\frac{12}{5}\right)$ **D.** $\tan^{-1}\left(\frac{5}{12}\right)$

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19. To reduce the line $3x - 4y - 10 = 0$ to the form $X = \text{constant}$, the axes must be rotated through

A. $\tan^{-1}\left(\frac{4}{3}\right)$ **B.** $\tan^{-1}\left(\frac{3}{4}\right)$
C. $\tan^{-1}\left(-\frac{3}{4}\right)$ **D.** $\tan^{-1}\left(-\frac{4}{3}\right)$

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20. The axes are rotated through $60°$ and $3x^2 + 4xy - 4y^2 - x + y - 3 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $H^2 - AB =$

A. -16 **B.** 16 **C.** -8 **D.** 14

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21. The axes are rotated through 30° and $5x^2 - xy + 5y^2 - 8x - 6y + 5 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $C =$

A. 5 **B.** -5 **C.** 10 **D.** 15

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22. The origin is shifted to $(-3, -4)$ and the axes are then rotated through an angle θ with $\cos\theta = \frac{4}{5}$, $\sin\theta = \frac{3}{5}$. The new coordinates of $(-2, -3)$ are

A. $(-\frac{7}{5}, -\frac{1}{5})$ **B.** $(\frac{7}{5}, \frac{1}{5})$
C. $(-\frac{17}{5}, -\frac{6}{5})$ **D.** $(\frac{1}{5}, \frac{7}{5})$

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23. The origin is shifted to $(3, 4)$ and the axes are then rotated through 90°. The new coordinates of $(-5, 2)$ are

A. $(-2, 8)$ **B.** $(2, 5)$ **C.** $(2, -8)$ **D.** $(8, -2)$

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24. When the origin is shifted to $(3, 3)$ and the axes are then rotated through 45°, the equation $-x^2 + 4xy - y^2 - 6x - 6y + 42 = 0$ becomes

A. $X^2 - 3Y^2 = -24$ **B.** $-3X^2 + Y^2 = -24$ **C.** $X^2 - 3Y^2 = 24$ **D.** $-X^2 - Y^2 = -24$

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25. When the origin is shifted to $(2, -2)$ and the axes are then rotated through $\tan^{-1}\frac{1}{2}$, the equation $-5x^2 - 4xy - 2y^2 + 12x - 18 = 0$ becomes

A. $-6X^2 - Y^2 = -6$ **B.** $-6X^2 - Y^2 = 6$ **C.** $-X^2 - 6Y^2 = 6$ **D.** $-5X^2 - 2Y^2 = 6$

Key sheet

1. A	**2.** D	**3.** B	**4.** D	**5.** C
6. C	**7.** B	**8.** A	**9.** C	**10.** C
11. A	**12.** C	**13.** B	**14.** D	**15.** D
16. C	**17.** B	**18.** D	**19.** D	**20.** B
21. A	**22.** B	**23.** A	**24.** A	**25.** B

Solutions

1. After the origin is shifted to $(-6, 1)$, a point has new coordinates $(-5, 4)$. Its original coordinates are

$x = X + h,\ y = Y + k$

$x = -5 + (-6) = -11,\ y = 4 + (1) = 5$

Ans: (A) $(-11, 5)$

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2. When the origin is shifted to $(4, 7)$, the new coordinates of $(2, -2)$ are

$X = x - h,\ Y = y - k$

$X = 2 - (4) = -2,\ Y = -2 - (7) = -9$

Ans: (D) $(-2, -9)$

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3. When the origin is shifted to $(-3, -1)$, the equation $-x^2 + 3xy - 4y^2 - 7x - 5y + 1 = 0$ becomes

Put $x = X - 3,\ y = Y - 1$ in the equation.

Expanding and collecting terms: $-X^2 + 3XY - 4Y^2 - 4X - 6Y + 23 = 0$

Ans: (B) $-X^2 + 3XY - 4Y^2 - 4X - 6Y + 23 = 0$

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4. When the origin is shifted to $(-3, 3)$, the equation $x^2 + y^2 + 6x - 6y + 2 = 0$ becomes

Put $x = X - 3,\ y = Y + 3$ in the equation.

Expanding and collecting terms: $X^2 + Y^2 - 16 = 0$

Ans: (D) $X^2 + Y^2 - 16 = 0$

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5. To remove the first degree terms from $6x^2 - 4xy + y^2 - 20x + 4y + 4 = 0$, the origin must be shifted to

$a = 6,\ h = -2,\ b = 1,\ g = -10,\ f = 2,\ c = 4$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $6x - 2y - 10 = 0$, $-2x + y + 2 = 0$

So $(x_1, y_1) = (3, 4)$.

Ans: (C) $(3, 4)$

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6. When the first degree terms of $6x^2 - 6xy + 6y^2 + 18x + 18y + 9 = 0$ are removed by a translation, the constant term of the new equation is

$a = 6,\ h = -3,\ b = 6,\ g = 9,\ f = 9,\ c = 9$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $6x - 3y + 9 = 0$, $-3x + 6y + 9 = 0$

So $(x_1, y_1) = (-3, -3)$.

Constant $= gx_1 + fy_1 + c = (9)(-3) + (9)(-3) + (9) = -45$

Ans: (C) -45

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7. To remove the first degree terms from $-2x^2 - 2xy + 4y^2 - 10x + 4y - 11 = 0$, the origin must be shifted to

$a = -2,\ h = -1,\ b = 4,\ g = -5,\ f = 2,\ c = -11$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $-2x - y - 5 = 0$, $-x + 4y + 2 = 0$

So $(x_1, y_1) = (-2, -1)$.

Ans: (B) $(-2, -1)$

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8. When the origin is shifted to $(3, 2)$, the constant term of $4x^2 + xy + 5y^2 - 8x - y - 9 = 0$ becomes

$C = S(3, 2) = 27$

Ans: (A) 27

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9. When the origin is shifted to $(2, 1)$, the constant term of $x^2 - 2xy - 2y^2 + 5x + 2y + 6 = 0$ becomes

$C = S(2, 1) = 16$

Ans: (C) 16

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10. The equation $5x^2 - 2xy - y^2 - 14x - 2y + k = 0$ can be reduced to the form $aX^2 + 2hXY + bY^2 = 0$ by a translation when $k =$

Need $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$ with $c = k$: $-6k + 30 = 0$

$k = 5$

Ans: (C) 5

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11. The equation $4x^2 + 6xy - y^2 - 6x - 24y + k = 0$ can be reduced to the form $aX^2 + 2hXY + bY^2 = 0$ by a translation when $k =$

Need $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$ with $c = k$: $-13k - 351 = 0$

$k = -27$

Ans: (A) -27

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12. After the axes are rotated through an angle θ with $\cos\theta = \frac{4}{5}$, $\sin\theta = \frac{3}{5}$, a point has new coordinates $(6, 6)$. Its original coordinates are

$x = X\cos\theta - Y\sin\theta = \frac{6}{5},\ y = X\sin\theta + Y\cos\theta = \frac{42}{5}$

Ans: (C) $(\frac{6}{5}, \frac{42}{5})$

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13. After the axes are rotated through $45°$, a point has new coordinates $(7, -3)$. Its original coordinates are

$x = X\cos\theta - Y\sin\theta = 5\sqrt{2},\ y = X\sin\theta + Y\cos\theta = 2\sqrt{2}$

Ans: (B) $(5\sqrt{2}, 2\sqrt{2})$

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14. When the axes are rotated through $45°$, the equation $2x + 3y - 6 = 0$ becomes

Put $x = X\cos\theta - Y\sin\theta = \frac{\sqrt{2}X}{2} - \frac{\sqrt{2}Y}{2},\ y = X\sin\theta + Y\cos\theta = \frac{\sqrt{2}X}{2} + \frac{\sqrt{2}Y}{2}$.

Simplifying: $5\sqrt{2}X + \sqrt{2}Y - 12 = 0$

Ans: (D) $5\sqrt{2}X + \sqrt{2}Y - 12 = 0$

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15. When the axes are rotated through $90°$, the equation $-5x - 2y - 2 = 0$ becomes

Put $x = X\cos\theta - Y\sin\theta = -Y,\ y = X\sin\theta + Y\cos\theta = X$.

Simplifying: $2X - 5Y + 2 = 0$

Ans: (D) $2X - 5Y + 2 = 0$

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16. The angle of rotation that removes the xy term from $2x^2 + 10xy + 2y^2 = 2$ is

Here $a = b = 2$, so $\theta = \frac{\pi}{4}$.

Ans: (C) $\frac{\pi}{4}$

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17. The angle of rotation that removes the xy term from $-x^2 - 8xy - y^2 = -6$ is

Here $a = b = -1$, so $\theta = \frac{\pi}{4}$.

Ans: (B) $\frac{\pi}{4}$

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18. To reduce the line $12x + 5y + 1 = 0$ to the form $X = \text{constant}$, the axes must be rotated through

Angle $= \tan^{-1}\left(\frac{b}{a}\right) = \tan^{-1}\left(\frac{5}{12}\right)$.

Ans: (D) $\tan^{-1}\left(\frac{5}{12}\right)$

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19. To reduce the line $3x - 4y - 10 = 0$ to the form $X = \text{constant}$, the axes must be rotated through

Angle $= \tan^{-1}\left(\frac{b}{a}\right) = \tan^{-1}\left(-\frac{4}{3}\right)$.

Ans: (D) $\tan^{-1}\left(-\frac{4}{3}\right)$

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20. The axes are rotated through 60° and $3x^2 + 4xy - 4y^2 - x + y - 3 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $H^2 - AB =$

$H^2 - AB = h^2 - ab$ (an invariant under rotation).

$= 16$

Ans: (B) 16

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21. The axes are rotated through 30° and $5x^2 - xy + 5y^2 - 8x - 6y + 5 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $C =$

$C = c$ (an invariant under rotation).

$= 5$

Ans: (A) 5

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22. The origin is shifted to $(-3, -4)$ and the axes are then rotated through an angle θ with $\cos\theta = \frac{4}{5}$, $\sin\theta = \frac{3}{5}$. The new coordinates of $(-2, -3)$ are

$x - h = 1,\ y - k = 1$

$X = (x-h)\cos\theta + (y-k)\sin\theta = \frac{7}{5}$

$Y = -(x-h)\sin\theta + (y-k)\cos\theta = \frac{1}{5}$

Ans: (B) $(\frac{7}{5}, \frac{1}{5})$

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23. The origin is shifted to $(3, 4)$ and the axes are then rotated through 90°. The new coordinates of $(-5, 2)$ are

$x - h = -8,\ y - k = -2$

$X = (x-h)\cos\theta + (y-k)\sin\theta = -2$

$Y = -(x-h)\sin\theta + (y-k)\cos\theta = 8$

Ans: (A) $(-2, 8)$

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24. When the origin is shifted to $(3, 3)$ and the axes are then rotated through 45°, the equation $-x^2 + 4xy - y^2 - 6x - 6y + 42 = 0$ becomes

The XY terms cancel: $X^2 - 3Y^2 = -24$

Ans: (A) $X^2 - 3Y^2 = -24$

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25. When the origin is shifted to $(2, -2)$ and the axes are then rotated through $\tan^{-1}\frac{1}{2}$, the equation $-5x^2 - 4xy - 2y^2 + 12x - 18 = 0$ becomes

The XY terms cancel: $-6X^2 - Y^2 = 6$

Ans: (B) $-6X^2 - Y^2 = 6$
