EXPRESSWALA ACADEMY

Maths 1B: Change of Axes

MCQ Test, Set 09

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 $(4, 7)$, a point has new coordinates $(-1, 7)$. Its original coordinates are

A. $(5, 0)$ **B.** $(6, 11)$ **C.** $(3, 14)$ **D.** $(-5, 0)$

2. When the origin is shifted to $(3, 1)$, the new coordinates of $(-7, -5)$ are

A. $(-10, -6)$ **B.** $(-8, -8)$ **C.** $(10, 6)$ **D.** $(-4, -4)$

3. When the origin is shifted to $(5, 5)$, the equation $x^2 + y^2 - 10x - 10y + 46 = 0$ becomes

A. $X^2 + Y^2 + 46 = 0$ **B.** $X^2 + Y^2 - 4 = 0$

C. $X^2 + Y^2 - 2 = 0$ **D.** $X^2 + Y^2 - 20X - 20Y + 196 = 0$

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

A. $-2X^2 + 3Y^2 - X - 14Y + 11 = 0$ **B.** $-2X^2 + 3Y^2 - X - 14Y + 9 = 0$

C. $-2X^2 + 3Y^2 + 15X + 10Y - 27 = 0$ **D.** $-2X^2 + 3Y^2 + 7X + 22Y + 27 = 0$

5. To remove the first degree terms from $-3x^2 + 4xy - 2y^2 + 18x - 8y - 4 = 0$, the origin must be shifted to

A. $(5, 3)$ **B.** $(3, 5)$ **C.** $(-5, -3)$ **D.** $(-3, -5)$

6. When the first degree terms of $3x^2 - 2xy + 3y^2 + 22x - 2y + 9 = 0$ are removed by a translation, the constant term of the new equation is

A. 9 **B.** 34 **C.** -25 **D.** -34

7. When the first degree terms of $6x^2 - 6xy + 5y^2 - 30x - 6y + 11 = 0$ are removed by a translation, the constant term of the new equation is

A. 11 **B.** -47 **C.** -58 **D.** 58

8. When the origin is shifted to $(3, 3)$, the coefficient of X in the new form of $-3x^2 + 4y^2 - 5x + 8y = 0$ is

A. -22 **B.** -23 **C.** -5 **D.** 23

9. When the origin is shifted to $(2, -2)$, the coefficient of X in the new form of $3x^2 + 3xy + 4y^2 + x - y + 8 = 0$ is

A. 1 **B.** -7 **C.** 7 **D.** 8

10. For $4x^2 - 6xy + y^2 + 18x - 16y + 1 = 0$, the value of $abc + 2fgh - af^2 - bg^2 - ch^2$ is

A. 522 **B.** -90 **C.** 4 **D.** 90

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11. The equation $x^2 + 4xy - 2y^2 - 22x + 16y + k = 0$ can be reduced to the form $aX^2 + 2hXY + bY^2 = 0$ by a translation when $k =$

A. 29 **B.** -28 **C.** -29 **D.** -58

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12. After the axes are rotated through $120°$, a point has new coordinates $(3, -6)$. Its original coordinates are

A. $(-\frac{3}{2} + 3\sqrt{3}, \frac{3\sqrt{3}}{2} + 3)$ **B.** $(\frac{3}{2} - 3\sqrt{3}, -3 - \frac{3\sqrt{3}}{2})$
C. $(-3\sqrt{3} - \frac{3}{2}, 3 - \frac{3\sqrt{3}}{2})$ **D.** $(\frac{3\sqrt{3}}{2} + 3, -\frac{3}{2} + 3\sqrt{3})$

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13. The axes are rotated through $30°$. The new coordinates of $(-2, -6)$ are

A. $(1 - 3\sqrt{3}, -3 - \sqrt{3})$ **B.** $(\sqrt{3} + 3, -1 + 3\sqrt{3})$
C. $(-3 - \sqrt{3}, 1 - 3\sqrt{3})$ **D.** $(3 - \sqrt{3}, -3\sqrt{3} - 1)$

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14. When the axes are rotated through $45°$, the equation $-x - 4y + 9 = 0$ becomes

A. $-3\sqrt{2}X + 5\sqrt{2}Y - 18 = 0$ **B.** $3\sqrt{2}X + 5\sqrt{2}Y - 18 = 0$
C. $5\sqrt{2}X + 3\sqrt{2}Y + 18 = 0$ **D.** $5\sqrt{2}X + 3\sqrt{2}Y - 18 = 0$

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15. When the axes are rotated through $45°$, the equation $6x + 2y + 1 = 0$ becomes

A. $2\sqrt{2}X + 4\sqrt{2}Y + 1 = 0$ **B.** $4\sqrt{2}X - 2\sqrt{2}Y + 1 = 0$
C. $4\sqrt{2}X - 2\sqrt{2}Y - 1 = 0$ **D.** $-2\sqrt{2}X + 4\sqrt{2}Y + 1 = 0$

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16. The angle of rotation that removes the xy term from $-x^2 - 4\sqrt{3}xy + 3y^2 = 16$ is

A. $\frac{\pi}{6}$ **B.** $\frac{\pi}{4}$
C. $\tan^{-1}\frac{1}{2}$ **D.** $\frac{\pi}{3}$

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17. The angle of rotation that removes the xy term from $x^2 - 8xy + 7y^2 = -8$ is

A. $\frac{\pi}{4}$ **B.** $\frac{\pi}{6}$
C. $\tan^{-1}\frac{1}{2}$ **D.** $\frac{\pi}{3}$

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

A. $30°$ **B.** $-60°$ **C.** $60°$ **D.** $-30°$

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19. To reduce the line $3x + 4y - 9 = 0$ to the form $X = \text{constant}$, the axes must be rotated through

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

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20. The axes are rotated through $45°$ and $3x^2 - 2xy + 5y^2 - 2x + 7y + 4 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $A + B =$

A. 8 **B.** 15 **C.** -2 **D.** 9

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21. The axes are rotated through 60° and $x^2 + 2xy + 6y^2 + 5x + 2y + 7 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $A + B =$

A. 7 **B.** 6 **C.** 8 **D.** -5

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22. The origin is shifted to $(-3, 2)$ and the axes are then rotated through 90°. The new coordinates of $(-1, 7)$ are

A. $(7, 1)$ **B.** $(-2, 5)$ **C.** $(-5, 2)$ **D.** $(5, -2)$

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23. The origin is shifted to $(-4, -1)$ and the axes are then rotated through an angle θ with $\cos\theta = \frac{3}{5}$, $\sin\theta = \frac{4}{5}$. The new coordinates of $(-6, 6)$ are

A. $(-\frac{34}{5}, \frac{13}{5})$ **B.** $(\frac{22}{5}, \frac{29}{5})$
C. $(\frac{6}{5}, \frac{42}{5})$ **D.** $(\frac{29}{5}, \frac{22}{5})$

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24. When the origin is shifted to $(-1, 1)$ and the axes are then rotated through 45°, the equation $-x^2 - 8xy - y^2 + 6x - 6y - 6 = 0$ becomes

A. $-X^2 - Y^2 = 12$ **B.** $-5X^2 + 3Y^2 = 12$ **C.** $-5X^2 + 3Y^2 = -12$ **D.** $3X^2 - 5Y^2 = 12$

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25. When the origin is shifted to $(3, 3)$ and the axes are then rotated through $\tan^{-1}\frac{1}{3}$, the equation $7x^2 + 6xy - y^2 - 60x - 12y + 105 = 0$ becomes

A. $7X^2 - Y^2 = 3$ **B.** $-2X^2 + 8Y^2 = 3$ **C.** $8X^2 - 2Y^2 = -3$ **D.** $8X^2 - 2Y^2 = 3$

Key sheet

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

Solutions

1. After the origin is shifted to $(4, 7)$, a point has new coordinates $(-1, 7)$. Its original coordinates are

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

$x = -1 + (4) = 3,\ y = 7 + (7) = 14$

Ans: (C) $(3, 14)$

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2. When the origin is shifted to $(3, 1)$, the new coordinates of $(-7, -5)$ are

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

$X = -7 - (3) = -10,\ Y = -5 - (1) = -6$

Ans: (A) $(-10, -6)$

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3. When the origin is shifted to $(5, 5)$, the equation $x^2 + y^2 - 10x - 10y + 46 = 0$ becomes

Put $x = X + 5,\ y = Y + 5$ in the equation.

Expanding and collecting terms: $X^2 + Y^2 - 4 = 0$

Ans: (B) $X^2 + Y^2 - 4 = 0$

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

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

Expanding and collecting terms: $-2X^2 + 3Y^2 - X - 14Y + 9 = 0$

Ans: (B) $-2X^2 + 3Y^2 - X - 14Y + 9 = 0$

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5. To remove the first degree terms from $-3x^2 + 4xy - 2y^2 + 18x - 8y - 4 = 0$, the origin must be shifted to

$a = -3,\ h = 2,\ b = -2,\ g = 9,\ f = -4,\ c = -4$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $-3x + 2y + 9 = 0$, $2x - 2y - 4 = 0$

So $(x_1, y_1) = (5, 3)$.

Ans: (A) $(5, 3)$

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6. When the first degree terms of $3x^2 - 2xy + 3y^2 + 22x - 2y + 9 = 0$ are removed by a translation, the constant term of the new equation is

$a = 3,\ h = -1,\ b = 3,\ g = 11,\ f = -1,\ c = 9$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $3x - y + 11 = 0$, $-x + 3y - 1 = 0$

So $(x_1, y_1) = (-4, -1)$.

Constant $= gx_1 + fy_1 + c = (11)(-4) + (-1)(-1) + (9) = -34$

Ans: (D) -34

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7. When the first degree terms of $6x^2 - 6xy + 5y^2 - 30x - 6y + 11 = 0$ are removed by a translation, the constant term of the new equation is

$a = 6,\ h = -3,\ b = 5,\ g = -15,\ f = -3,\ c = 11$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $6x - 3y - 15 = 0$, $-3x + 5y - 3 = 0$

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

Constant $= gx_1 + fy_1 + c = (-15)(4) + (-3)(3) + (11) = -58$

Ans: (C) -58

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8. When the origin is shifted to $(3, 3)$, the coefficient of X in the new form of $-3x^2 + 4y^2 - 5x + 8y = 0$ is

$2G = \left(\frac{\partial S}{\partial x}\right)_{(3,3)} = 2(-3)(3) + (0)(3) + (-5) = -23$

Ans: (B) -23

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9. When the origin is shifted to $(2, -2)$, the coefficient of X in the new form of $3x^2 + 3xy + 4y^2 + x - y + 8 = 0$ is

$2G = \left(\frac{\partial S}{\partial x}\right)_{(2,-2)} = 2(3)(2) + (3)(-2) + (1) = 7$

Ans: (C) 7

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10. For $4x^2 - 6xy + y^2 + 18x - 16y + 1 = 0$, the value of $abc + 2fgh - af^2 - bg^2 - ch^2$ is

$a = 4,\ h = -3,\ b = 1,\ g = 9,\ f = -8,\ c = 1$

$abc + 2fgh - af^2 - bg^2 - ch^2 = 90$

Ans: (D) 90

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11. The equation $x^2 + 4xy - 2y^2 - 22x + 16y + k = 0$ 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 $c = k$: $-6k - 174 = 0$

$k = -29$

Ans: (C) -29

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12. After the axes are rotated through $120°$, a point has new coordinates $(3, -6)$. Its original coordinates are

$x = X\cos\theta - Y\sin\theta = -\frac{3}{2} + 3\sqrt{3},\ y = X\sin\theta + Y\cos\theta = \frac{3\sqrt{3}}{2} + 3$

Ans: (A) $(-\frac{3}{2} + 3\sqrt{3}, \frac{3\sqrt{3}}{2} + 3)$

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13. The axes are rotated through $30°$. The new coordinates of $(-2, -6)$ are

$X = x\cos\theta + y\sin\theta = -3 - \sqrt{3},\ Y = -x\sin\theta + y\cos\theta = 1 - 3\sqrt{3}$

Ans: (C) $(-3 - \sqrt{3}, 1 - 3\sqrt{3})$

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14. When the axes are rotated through $45°$, the equation $-x - 4y + 9 = 0$ 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: $5\sqrt{2}X + 3\sqrt{2}Y - 18 = 0$

Ans: (D) $5\sqrt{2}X + 3\sqrt{2}Y - 18 = 0$

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15. When the axes are rotated through $45°$, the equation $6x + 2y + 1 = 0$ 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: $4\sqrt{2}X - 2\sqrt{2}Y + 1 = 0$

Ans: (B) $4\sqrt{2}X - 2\sqrt{2}Y + 1 = 0$

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16. The angle of rotation that removes the xy term from $-x^2 - 4\sqrt{3}xy + 3y^2 = 16$ is

$\tan 2\theta = \frac{2h}{a-b} = \frac{-4\sqrt{3}}{-1-(3)} = \sqrt{3}$

$\theta = \frac{\pi}{6} = \frac{\pi}{6}$

Ans: (A) $\frac{\pi}{6}$

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17. The angle of rotation that removes the xy term from $x^2 - 8xy + 7y^2 = -8$ is

$\tan 2\theta = \frac{2h}{a-b} = \frac{-8}{1-(7)} = \frac{4}{3}$

$\theta = \frac{1}{2}\tan^{-1}\left(\frac{4}{3}\right) = \tan^{-1}\frac{1}{2}$

Ans: (C) $\tan^{-1}\frac{1}{2}$

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

Angle $= \tan^{-1}\left(\frac{b}{a}\right) = -30^\circ$.

Ans: (D) -30°

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19. To reduce the line $3x + 4y - 9 = 0$ 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: (C) $\tan^{-1}\left(\frac{4}{3}\right)$

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20. The axes are rotated through 45° and $3x^2 - 2xy + 5y^2 - 2x + 7y + 4 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $A + B =$

$A + B = a + b$ (an invariant under rotation).

$= 8$

Ans: (A) 8

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21. The axes are rotated through 60° and $x^2 + 2xy + 6y^2 + 5x + 2y + 7 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $A + B =$

$A + B = a + b$ (an invariant under rotation).

$= 7$

Ans: (A) 7

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22. The origin is shifted to $(-3, 2)$ and the axes are then rotated through 90°. The new coordinates of $(-1, 7)$ are

$x - h = 2,\ y - k = 5$

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

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

Ans: (D) $(5, -2)$

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23. The origin is shifted to $(-4, -1)$ and the axes are then rotated through an angle θ with $\cos\theta = \frac{3}{5}$, $\sin\theta = \frac{4}{5}$. The new coordinates of $(-6, 6)$ are

$x - h = -2,\ y - k = 7$

$X = (x-h)\cos\theta + (y-k)\sin\theta = \frac{22}{5}$

$Y = -(x-h)\sin\theta + (y-k)\cos\theta = \frac{29}{5}$

Ans: (B) $(\frac{22}{5}, \frac{29}{5})$

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24. When the origin is shifted to $(-1, 1)$ and the axes are then rotated through 45°, the equation $-x^2 - 8xy - y^2 + 6x - 6y - 6 = 0$ becomes

The XY terms cancel: $-5X^2 + 3Y^2 = 12$

Ans: (B) $-5X^2 + 3Y^2 = 12$

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25. When the origin is shifted to $(3, 3)$ and the axes are then rotated through $\tan^{-1}\frac{1}{3}$, the equation $7x^2 + 6xy - y^2 - 60x - 12y + 105 = 0$ becomes

The XY terms cancel: $8X^2 - 2Y^2 = 3$

Ans: (D) $8X^2 - 2Y^2 = 3$
