EXPRESSWALA ACADEMY

Maths 1B: Change of Axes

MCQ Test, Set 04

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. When the origin is shifted to $(-4, -3)$, the new coordinates of $(9, 6)$ are

A. $(-13, -9)$ **B.** $(5, 3)$ **C.** $(12, 10)$ **D.** $(13, 9)$

2. When the origin is shifted to $(6, -1)$, the new coordinates of $(6, 4)$ are

A. $(7, -2)$ **B.** $(12, 3)$ **C.** $(0, 5)$ **D.** $(0, -5)$

3. When the origin is shifted to $(-2, 4)$, the equation $x^2 + y^2 + 4x - 8y + 10 = 0$ becomes

A. $X^2 + Y^2 - 10 = 0$ **B.** $X^2 + Y^2 - 8 = 0$

C. $X^2 + Y^2 + 8X - 16Y + 70 = 0$ **D.** $X^2 + Y^2 + 12X - 12Y + 62 = 0$

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

A. $X^2 + 3XY + 3Y^2 - 5X - 10Y + 11 = 0$ **B.** $X^2 + 3XY + 3Y^2 + 3X + 14Y + 37 = 0$

C. $X^2 + 3XY + 3Y^2 + 3X + 14Y + 7 = 0$ **D.** $X^2 + 3XY + 3Y^2 + 3X + 14Y + 35 = 0$

5. To remove the first degree terms from $-2x^2 + 4xy + 2y^2 - 20x - 12y - 4 = 0$, the origin must be shifted to

A. $(4, -1)$ **B.** $(-1, 4)$ **C.** $(-4, 1)$ **D.** $(1, -4)$

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

A. $(1, -3)$ **B.** $(-1, 3)$ **C.** $(-3, 1)$ **D.** $(3, -1)$

7. When the first degree terms of $6x^2 + 2xy - 2y^2 - 18x - 16y + 6 = 0$ are removed by a translation, the constant term of the new equation is

A. -12 **B.** 18 **C.** 6 **D.** 12

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

A. -13 **B.** 0 **C.** 13 **D.** 14

9. When the origin is shifted to $(-1, -1)$, the coefficient of X in the new form of $x^2 + 2xy - 2y^2 - 5x + 6y + 1 = 0$ is

A. -9 **B.** -8 **C.** 9 **D.** -5

10. For $-2x^2 + 2y^2 - 12x + 8y + 6 = 0$, the value of $abc + 2fgh - af^2 - bg^2 - ch^2$ is

A. -24 **B.** -40 **C.** 64 **D.** -64

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11. The equation $3x^2 - 3y^2 - 6x - 24y + k = 0$ can be reduced to the form $aX^2 + 2hXY + bY^2 = 0$ by a translation when $k =$

A. 45 **B.** -45 **C.** -90 **D.** -44

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12. After the axes are rotated through $150°$, a point has new coordinates $(7, 1)$. Its original coordinates are

A. $(\frac{7}{2} - \frac{\sqrt{3}}{2}, -\frac{7\sqrt{3}}{2} - \frac{1}{2})$
B. $(\frac{1}{2} - \frac{7\sqrt{3}}{2}, -\frac{7}{2} - \frac{\sqrt{3}}{2})$
C. $(-\frac{7\sqrt{3}}{2} - \frac{1}{2}, \frac{7}{2} - \frac{\sqrt{3}}{2})$
D. $(\frac{1}{2} + \frac{7\sqrt{3}}{2}, -\frac{7}{2} + \frac{\sqrt{3}}{2})$

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13. The axes are rotated through $135°$. The new coordinates of $(1, -4)$ are

A. $(\frac{5\sqrt{2}}{2}, -\frac{3\sqrt{2}}{2})$ **B.** $(-\frac{5\sqrt{2}}{2}, \frac{3\sqrt{2}}{2})$
C. $(\frac{3\sqrt{2}}{2}, -\frac{5\sqrt{2}}{2})$ **D.** $(\frac{3\sqrt{2}}{2}, \frac{5\sqrt{2}}{2})$

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14. When the axes are rotated through $60°$, the equation $6x - 2y + 7 = 0$ becomes

A. $-1 + 3\sqrt{3}X - \sqrt{3} + 3Y + 7 = 0$ **B.** $\sqrt{3} + 3X + -1 + 3\sqrt{3}Y + 7 = 0$
C. $3 - \sqrt{3}X - 1 + 3\sqrt{3}Y - 7 = 0$ **D.** $3 - \sqrt{3}X - 1 + 3\sqrt{3}Y + 7 = 0$

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15. When the axes are rotated through $45°$, the equation $3x^2 + 2xy + 2y^2 = 8$ becomes

A. $3X^2 + 2XY + 7Y^2 = 16$ **B.** $7X^2 - 2XY + 3Y^2 = -16$ **C.** $7X^2 - 2XY + 3Y^2 = 16$ **D.** $3X^2 - 2XY + 7Y^2 = 16$

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16. The angle of rotation that removes the xy term from $-5x^2 - 6xy + 3y^2 = 3$ is

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

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17. The angle of rotation that removes the xy term from $-5x^2 - 4xy - 2y^2 = 6$ is

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

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

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

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19. To reduce the line $3x - 4y - 1 = 0$ to the form $X = \text{constant}$, the axes must be rotated through

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

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20. When the axes are rotated, which of the following is NOT an invariant of $-x^2 - 4xy + 3y^2 - 4x - 4y + 1 = 0$?

A. $g + f$ **B.** $h^2 - ab$

C. $(a - b)^2 + 4h^2$ **D.** $abc + 2fgh - af^2 - bg^2 - ch^2$

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21. The axes are rotated through an angle θ with $\cos\theta = \frac{4}{5}$, $\sin\theta = \frac{3}{5}$ and $4x^2 - xy - 3y^2 - 7x - 4y + 3 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $H^2 - AB =$

A. $\frac{49}{4}$ **B.** $-\frac{47}{4}$ **C.** $\frac{23}{2}$ **D.** $-\frac{49}{4}$

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22. The origin is shifted to $(-3, -1)$ and the axes are then rotated through 180°. The new coordinates of $(2, 3)$ are

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

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23. The origin is shifted to $(-3, -1)$ 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 $(-5, -2)$ are

A. $(-\frac{2}{5}, -\frac{11}{5})$ **B.** $(-2, 1)$

C. $(1, -2)$ **D.** $(-\frac{23}{5}, \frac{14}{5})$

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24. When the origin is shifted to $(-2, -2)$ and the axes are then rotated through $\tan^{-1}\frac{1}{2}$, the equation $4x^2 + 8xy - 2y^2 + 32x + 8y + 37 = 0$ becomes

A. $-4X^2 + 6Y^2 = 3$ **B.** $6X^2 - 4Y^2 = -3$ **C.** $6X^2 - 4Y^2 = 3$ **D.** $4X^2 - 2Y^2 = 3$

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25. When the origin is shifted to $(4, 2)$ and the axes are then rotated through 45°, the equation $8x^2 + 2xy + 8y^2 - 68x - 40y + 152 = 0$ becomes

A. $7X^2 + 9Y^2 = 24$ **B.** $9X^2 + 7Y^2 = 24$ **C.** $8X^2 + 8Y^2 = 24$ **D.** $9X^2 + 7Y^2 = -24$

Key sheet

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

Solutions

1. When the origin is shifted to $(-4, -3)$, the new coordinates of $(9, 6)$ are

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

$X = 9 - (-4) = 13,\ Y = 6 - (-3) = 9$

Ans: (D) $(13, 9)$

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2. When the origin is shifted to $(6, -1)$, the new coordinates of $(6, 4)$ are

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

$X = 6 - (6) = 0,\ Y = 4 - (-1) = 5$

Ans: (C) $(0, 5)$

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3. When the origin is shifted to $(-2, 4)$, the equation $x^2 + y^2 + 4x - 8y + 10 = 0$ becomes

Put $x = X - 2,\ y = Y + 4$ in the equation.

Expanding and collecting terms: $X^2 + Y^2 - 10 = 0$

Ans: (A) $X^2 + Y^2 - 10 = 0$

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

Put $x = X - 4,\ y = Y + 4$ in the equation.

Expanding and collecting terms: $X^2 + 3XY + 3Y^2 + 3X + 14Y + 35 = 0$

Ans: (D) $X^2 + 3XY + 3Y^2 + 3X + 14Y + 35 = 0$

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5. To remove the first degree terms from $-2x^2 + 4xy + 2y^2 - 20x - 12y - 4 = 0$, the origin must be shifted to

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

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

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

Ans: (B) $(-1, 4)$

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

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

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $2x + y + 1 = 0$, $x - y - 4 = 0$

So $(x_1, y_1) = (1, -3)$.

Ans: (A) $(1, -3)$

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7. When the first degree terms of $6x^2 + 2xy - 2y^2 - 18x - 16y + 6 = 0$ are removed by a translation, the constant term of the new equation is

$a = 6,\ h = 1,\ b = -2,\ g = -9,\ f = -8,\ c = 6$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $6x + y - 9 = 0$, $x - 2y - 8 = 0$

So $(x_1, y_1) = (2, -3)$.

Constant $= gx_1 + fy_1 + c = (-9)(2) + (-8)(-3) + (6) = 12$

Ans: (D) 12

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

$C = S(3, 2) = 13$

Ans: (C) 13

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9. When the origin is shifted to $(-1, -1)$, the coefficient of X in the new form of $x^2 + 2xy - 2y^2 - 5x + 6y + 1 = 0$ is

$2G = \left(\frac{\partial S}{\partial x}\right)_{(-1,-1)} = 2(1)(-1) + (2)(-1) + (-5) = -9$

Ans: (A) -9

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10. For $-2x^2 + 2y^2 - 12x + 8y + 6 = 0$, the value of $abc + 2fgh - af^2 - bg^2 - ch^2$ is

$a = -2,\ h = 0,\ b = 2,\ g = -6,\ f = 4,\ c = 6$

$abc + 2fgh - af^2 - bg^2 - ch^2 = -64$

Ans: (D) -64

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11. The equation $3x^2 - 3y^2 - 6x - 24y + k = 0$ 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 $c = k$: $-9k - 405 = 0$

$k = -45$

Ans: (B) -45

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12. After the axes are rotated through $150°$, a point has new coordinates $(7, 1)$. Its original coordinates are

$x = X\cos\theta - Y\sin\theta = -\frac{7\sqrt{3}}{2} - \frac{1}{2},\ y = X\sin\theta + Y\cos\theta = \frac{7}{2} - \frac{\sqrt{3}}{2}$

Ans: (C) $\left(-\frac{7\sqrt{3}}{2} - \frac{1}{2}, \frac{7}{2} - \frac{\sqrt{3}}{2}\right)$

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13. The axes are rotated through $135°$. The new coordinates of $(1, -4)$ are

$X = x\cos\theta + y\sin\theta = -\frac{5\sqrt{2}}{2},\ Y = -x\sin\theta + y\cos\theta = \frac{3\sqrt{2}}{2}$

Ans: (B) $\left(-\frac{5\sqrt{2}}{2}, \frac{3\sqrt{2}}{2}\right)$

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14. When the axes are rotated through $60°$, the equation $6x - 2y + 7 = 0$ becomes

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

Simplifying: $3 - \sqrt{3}X - 1 + 3\sqrt{3}Y + 7 = 0$

Ans: (D) $3 - \sqrt{3}X - 1 + 3\sqrt{3}Y + 7 = 0$

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15. When the axes are rotated through $45°$, the equation $3x^2 + 2xy + 2y^2 = 8$ 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: $7X^2 - 2XY + 3Y^2 = 16$

Ans: (C) $7X^2 - 2XY + 3Y^2 = 16$

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16. The angle of rotation that removes the xy term from $-5x^2 - 6xy + 3y^2 = 3$ is

$\tan 2\theta = \frac{2h}{a-b} = \frac{-6}{-5-(3)} = \frac{3}{4}$

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

Ans: (A) $\tan^{-1}\frac{1}{3}$

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17. The angle of rotation that removes the xy term from $-5x^2 - 4xy - 2y^2 = 6$ is

$\tan 2\theta = \frac{2h}{a-b} = \frac{-4}{-5-(-2)} = \frac{4}{3}$

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

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

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

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

Ans: (A) -30°

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19. To reduce the line $3x - 4y - 1 = 0$ to the form $X = \text{constant}$, the axes must be rotated through

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

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

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20. When the axes are rotated, which of the following is NOT an invariant of $-x^2 - 4xy + 3y^2 - 4x - 4y + 1 = 0$?

The invariants are $a + b$, $h^2 - ab$, c, $(a-b)^2 + 4h^2$, $2fgh - af^2 - bg^2$ and $abc + 2fgh - af^2 - bg^2 - ch^2$.

$g + f$ is not one of them.

Ans: (A) $g + f$

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21. The axes are rotated through an angle θ with $\cos\theta = \frac{4}{5}$, $\sin\theta = \frac{3}{5}$ and $4x^2 - xy - 3y^2 - 7x - 4y + 3 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $H^2 - AB =$

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

$= \frac{49}{4}$

Ans: (A) $\frac{49}{4}$

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22. The origin is shifted to $(-3, -1)$ and the axes are then rotated through 180°. The new coordinates of $(2, 3)$ are

$x - h = 5,\ y - k = 4$

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

$Y = -(x-h)\sin\theta + (y-k)\cos\theta = -4$

Ans: (C) $(-5, -4)$

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23. The origin is shifted to $(-3, -1)$ 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 $(-5, -2)$ are

$x - h = -2,\ y - k = -1$

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

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

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

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24. When the origin is shifted to $(-2, -2)$ and the axes are then rotated through $\tan^{-1}\frac{1}{2}$, the equation $4x^2 + 8xy - 2y^2 + 32x + 8y + 37 = 0$ becomes

The XY terms cancel: $6X^2 - 4Y^2 = 3$

Ans: (C) $6X^2 - 4Y^2 = 3$

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25. When the origin is shifted to $(4, 2)$ and the axes are then rotated through 45°, the equation $8x^2 + 2xy + 8y^2 - 68x - 40y + 152 = 0$ becomes

The XY terms cancel: $9X^2 + 7Y^2 = 24$

Ans: (B) $9X^2 + 7Y^2 = 24$
