EXPRESSWALA ACADEMY

Maths 1B: Change of Axes

MCQ Test, Set 05

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 $(-1, -3)$, a point has new coordinates $(-2, 2)$. Its original coordinates are

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

2. After the origin is shifted to $(2, 5)$, a point has new coordinates $(-5, 0)$. Its original coordinates are

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

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

A. $Y^2 - 4X + 3 = 0$ **B.** $Y^2 - 4X + 4Y - 1 = 0$ **C.** $Y^2 - 4X + 5 = 0$ **D.** $Y^2 - 4X = 0$

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

A. $-X^2 + 2XY + 2Y^2 + X + 24Y + 63 = 0$ **B.** $-X^2 + 2XY + 2Y^2 + 5X - 28Y + 47 = 0$

C. $-X^2 + 2XY + 2Y^2 + 5X + 26Y + 83 = 0$ **D.** $-X^2 + 2XY + 2Y^2 + X + 24Y + 61 = 0$

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

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

6. To remove the first degree terms from $5x^2 - 4xy - y^2 - 14x + 20y + 2 = 0$, the origin must be shifted to

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

7. To remove the first degree terms from $5x^2 - 2xy + 2y^2 + 28x - 2y - 12 = 0$, the origin must be shifted to

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

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

A. 9 **B.** 42 **C.** -42 **D.** 60

9. When the origin is shifted to $(4, 4)$, the coefficient of Y in the new form of $3x^2 + 4xy + 5y^2 + 6x - 8y + 4 = 0$ is

A. 48 **B.** -8 **C.** 24 **D.** -48

10. The equation $-2x^2 + 4xy - y^2 + 4x - 10y + k = 0$ can be reduced to the form $aX^2 + 2hXY + bY^2 = 0$ by a translation when $k =$

A. 14 **B.** -7 **C.** 7 **D.** 8

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11. The equation $-x^2 + 4xy + 4y^2 + 18x + 12y + k = 0$ can be reduced to the form $aX^2 + 2hXY + bY^2 = 0$ by a translation when $k =$

A. -8 **B.** -9 **C.** -18 **D.** 9

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12. After the axes are rotated through $150°$, a point has new coordinates $(-3, -4)$. Its original coordinates are

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

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

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13. The axes are rotated through $30°$ in the clockwise direction. The new coordinates of $(-5, 4)$ are

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

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

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14. When the axes are rotated through $45°$, the equation $x^2 + y^2 + x - 5y + 8 = 0$ becomes

A. $X^2 + Y^2 - 2\sqrt{2}X - 3\sqrt{2}Y - 8 = 0$ **B.** $X^2 + Y^2 - 2\sqrt{2}X - 3\sqrt{2}Y + 8 = 0$

C. $X^2 + Y^2 + 3\sqrt{2}X - 2\sqrt{2}Y + 8 = 0$ **D.** $X^2 + Y^2 - 3\sqrt{2}X - 2\sqrt{2}Y + 8 = 0$

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15. When the axes are rotated through $90°$, the equation $2x - 2y - 6 = 0$ becomes

A. $-X - Y + 3 = 0$ **B.** $-X + Y + 3 = 0$ **C.** $X + Y - 3 = 0$ **D.** $X + Y + 3 = 0$

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16. The angle of rotation that removes the xy term from $4x^2 - 4xy + 7y^2 = 3$ is

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

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 $8x^2 - 2xy + 8y^2 = 4$ is

A. $\frac{\pi}{3}$ **B.** $\frac{\pi}{4}$

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

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18. To reduce the line $6x + 8y + 1 = 0$ 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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19. To reduce the line $5x + 12y - 10 = 0$ to the form $Y = \text{constant}$, the axes must be rotated through

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

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

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

A. 6 **B.** -4 **C.** -5 **D.** 1

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21. The axes are rotated through 45° and $-3x^2 + 2xy - y^2 - 8x + 5y + 6 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $H^2 - AB =$

A. 2 **B.** -2 **C.** 1 **D.** 4

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22. The origin is shifted to $(-4, 4)$ and the axes are then rotated through 180°. The new coordinates of $(5, 4)$ are

A. $(9, 0)$ **B.** $(0, -9)$ **C.** $(-9, 0)$ **D.** $(-5, -4)$

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

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

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24. When the origin is shifted to $(2, 2)$ and the axes are then rotated through 45°, the equation $2x^2 - 10xy + 2y^2 + 12x + 12y - 44 = 0$ becomes

A. $2X^2 + 2Y^2 = 20$ **B.** $-3X^2 + 7Y^2 = -20$ **C.** $7X^2 - 3Y^2 = 20$ **D.** $-3X^2 + 7Y^2 = 20$

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25. When the origin is shifted to $(4, 4)$ and the axes are then rotated through $\tan^{-1}\frac{1}{2}$, the equation $7x^2 + 12xy - 2y^2 - 104x - 32y + 271 = 0$ becomes

A. $-5X^2 + 10Y^2 = 1$ **B.** $10X^2 - 5Y^2 = -1$ **C.** $10X^2 - 5Y^2 = 1$ **D.** $7X^2 - 2Y^2 = 1$

Key sheet

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

Solutions

1. After the origin is shifted to $(-1, -3)$, a point has new coordinates $(-2, 2)$. Its original coordinates are

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

$x = -2 + (-1) = -3,\ y = 2 + (-3) = -1$

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

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2. After the origin is shifted to $(2, 5)$, a point has new coordinates $(-5, 0)$. Its original coordinates are

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

$x = -5 + (2) = -3,\ y = 0 + (5) = 5$

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

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

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

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

Ans: (A) $Y^2 - 4X + 3 = 0$

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

Put $x = X + 5,\ y = Y + 4$ in the equation.

Expanding and collecting terms: $-X^2 + 2XY + 2Y^2 + X + 24Y + 61 = 0$

Ans: (D) $-X^2 + 2XY + 2Y^2 + X + 24Y + 61 = 0$

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

$a = 2,\ h = 1,\ b = 1,\ g = -10,\ f = -6,\ c = 0$

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

So $(x_1, y_1) = (4, 2)$.

Ans: (A) $(4, 2)$

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6. To remove the first degree terms from $5x^2 - 4xy - y^2 - 14x + 20y + 2 = 0$, the origin must be shifted to

$a = 5,\ h = -2,\ b = -1,\ g = -7,\ f = 10,\ c = 2$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $5x - 2y - 7 = 0$, $-2x - y + 10 = 0$

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

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

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7. To remove the first degree terms from $5x^2 - 2xy + 2y^2 + 28x - 2y - 12 = 0$, the origin must be shifted to

$a = 5,\ h = -1,\ b = 2,\ g = 14,\ f = -1,\ c = -12$

Solve $ax + hy + g = 0$ and $hx + by + f = 0$: $5x - y + 14 = 0$, $-x + 2y - 1 = 0$

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

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

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

$C = S(3, 3) = 42$

Ans: (B) 42

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9. When the origin is shifted to $(4, 4)$, the coefficient of Y in the new form of $3x^2 + 4xy + 5y^2 + 6x - 8y + 4 = 0$ is

$2F = \left(\frac{\partial S}{\partial y}\right)_{(4,4)} = (4)(4) + 2(5)(4) + (-8) = 48$

Ans: (A) 48

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10. The equation $-2x^2 + 4xy - y^2 + 4x - 10y + k = 0$ 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 $c = k$: $-2k + 14 = 0$

$k = 7$

Ans: (C) 7

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11. The equation $-x^2 + 4xy + 4y^2 + 18x + 12y + k = 0$ 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 $c = k$: $-8k - 72 = 0$

$k = -9$

Ans: (B) -9

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12. After the axes are rotated through $150°$, a point has new coordinates $(-3, -4)$. Its original coordinates are

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

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

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13. The axes are rotated through $30°$ in the clockwise direction. The new coordinates of $(-5, 4)$ are

Clockwise: use $\theta = -30°$.

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

Ans: (C) $(-\frac{5\sqrt{3}}{2} - 2, -\frac{5}{2} + 2\sqrt{3})$

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14. When the axes are rotated through $45°$, the equation $x^2 + y^2 + x - 5y + 8 = 0$ 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: $X^2 + Y^2 - 2\sqrt{2}X - 3\sqrt{2}Y + 8 = 0$

Ans: (B) $X^2 + Y^2 - 2\sqrt{2}X - 3\sqrt{2}Y + 8 = 0$

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15. When the axes are rotated through $90°$, the equation $2x - 2y - 6 = 0$ becomes

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

Simplifying: $X + Y + 3 = 0$

Ans: (D) $X + Y + 3 = 0$

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16. The angle of rotation that removes the xy term from $4x^2 - 4xy + 7y^2 = 3$ is

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

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

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

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17. The angle of rotation that removes the xy term from $8x^2 - 2xy + 8y^2 = 4$ is

Here $a = b = 8$, so $\theta = \frac{\pi}{4}$.

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

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18. To reduce the line $6x + 8y + 1 = 0$ 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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19. To reduce the line $5x + 12y - 10 = 0$ to the form $Y = \text{constant}$, the axes must be rotated through

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

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

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

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

$= -5$

Ans: (C) -5

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21. The axes are rotated through 45° and $-3x^2 + 2xy - y^2 - 8x + 5y + 6 = 0$ becomes $AX^2 + 2HXY + BY^2 + 2GX + 2FY + C = 0$. Then $H^2 - AB =$

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

$= -2$

Ans: (B) -2

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22. The origin is shifted to $(-4, 4)$ and the axes are then rotated through 180°. The new coordinates of $(5, 4)$ are

$x - h = 9,\ y - k = 0$

$X = (x-h)\cos\theta + (y-k)\sin\theta = -9$

$Y = -(x-h)\sin\theta + (y-k)\cos\theta = 0$

Ans: (C) $(-9, 0)$

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

$x - h = -4,\ y - k = -2$

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

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

Ans: (D) $(4, 2)$

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24. When the origin is shifted to $(2, 2)$ and the axes are then rotated through 45°, the equation $2x^2 - 10xy + 2y^2 + 12x + 12y - 44 = 0$ becomes

The XY terms cancel: $-3X^2 + 7Y^2 = 20$

Ans: (D) $-3X^2 + 7Y^2 = 20$

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25. When the origin is shifted to $(4, 4)$ and the axes are then rotated through $\tan^{-1}\frac{1}{2}$, the equation $7x^2 + 12xy - 2y^2 - 104x - 32y + 271 = 0$ becomes

The XY terms cancel: $10X^2 - 5Y^2 = 1$

Ans: (C) $10X^2 - 5Y^2 = 1$
