Class 11 Mathematics · Chapter 9: Straight Lines

Answer key and marking scheme · 20 marks · about 40 minutes · based on NCERT

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1. The slope of a line whose inclination with the positive direction of the x-axis is 150° is [1]

(a) $\sqrt{3}$ (b) $-\sqrt{3}$

(c) $-1/\sqrt{3}$ (d) $1/\sqrt{3}$

Answer: (c) $m = \tan 150° = \tan(180° - 30°) = -\tan 30° = -1/\sqrt{3}$.

2. Which of the following lines has a slope that is not defined? [1]

(a) $x = -3$ (b) $y = 4$

(c) $y = x$ (d) $x + y = 0$

Answer: (a) $x = -3$ is a vertical line: its inclination is 90°, and tan 90° is not defined. $y = 4$ has slope 0; $y = x$ has slope 1; $x + y = 0$ has slope −1.

3. The equation of the line through (−3, 1) whose inclination is 45° is [1]

(a) $x - y - 4 = 0$ (b) $x + y + 2 = 0$

(c) $x - y + 4 = 0$ (d) $x + y - 4 = 0$

Answer: (c) $m = \tan 45° = 1$. Point-slope form: $y - 1 = 1(x + 3)$, i.e. $x - y + 4 = 0$. $x + y + 2 = 0$ passes through (−3, 1) but has inclination 135°.

4. The line through (2, −1) and (5, a) is parallel to the line $2x - 3y + 7 = 0$. The value of a is [1]

(a) −3 (b) 1

(c) $-\frac{11}{2}$ (d) 3

Answer: (b) $2x - 3y + 7 = 0$ has slope $-A/B = 2/3$. Parallel lines have equal slopes: $(a + 1)/(5 - 2) = 2/3$, so $a + 1 = 2$ and $a = 1$.

5. The acute angle between the lines $y = 3x + 1$ and $y = -2x + 4$ is [1]

(a) 45° (b) 30°

(c) 60° (d) 135°

Answer: (a) $m_1 = 3$, $m_2 = -2$: $\tan\theta = |(-2 - 3)/(1 + (3)(-2))| = |-5/-5| = 1$, so $\theta = 45°$. 135° is the obtuse angle.

6. Find the points on the x-axis that are equidistant from the lines $3x + 4y - 12 = 0$ and $4x + 3y - 12 = 0$. [2]

For (h, 0): $|3h - 12|/5 = |4h - 12|/5$. Either $3h - 12 = 4h - 12$, giving $h = 0$, or $3h - 12 = -(4h - 12)$, giving $7h = 24$, $h = 24/7$. The points are (0, 0) and (24/7, 0).

- $|3h - 12| = |4h - 12|$ (1)
- (0, 0) and (24/7, 0) (1)

7. The lines L_1: $y = 2x$ and L_2: $y = -3x + 1$ have inclinations α_1 and α_2. Find $\tan\theta$, where $\theta = \alpha_2 - \alpha_1$, and say which of the two adjacent angles between the lines is acute. [2]

$\tan\theta = (m_2 - m_1)/(1 + m_1m_2) = (-3 - 2)/(1 - 6) = 1$. As this is positive, $\theta = 45°$ is acute and the adjacent angle $\phi = 180° - 45° = 135°$ is obtuse.

- $\tan\theta = 1$ (1)
- $\theta = 45°$ acute, $\phi = 135°$ obtuse (1)

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8. Show that the lines $x - 2y + 3 = 0$, $2x + y - 4 = 0$ and $3x - y - 1 = 0$ are concurrent, and find the common point. [2]

From the first, $x = 2y - 3$; in the second, $4y - 6 + y - 4 = 0$, so $y = 2$ and $x = 1$. In the third, $3(1) - 2 - 1 = 0$, so (1, 2) lies on all three lines: they are concurrent at (1, 2).

- intersection (1, 2) of two of the lines (1)
- verifies the third line passes through it (1)

9. The line $3x - 4y + 12 = 0$ meets the x-axis at P and the y-axis at Q. Find the area of the triangle OPQ, O being the origin, and the length of the perpendicular from O to the line. Check your answers against each other. [3]

At $y = 0$, $x = -4$: P(−4, 0). At $x = 0$, $y = 3$: Q(0, 3). Area $= (1/2) \times 4 \times 3 = 6$ square units. Perpendicular from O: $|0 - 0 + 12|/\sqrt{(9 + 16)} = 12/5$. Check: PQ = 5, and $(1/2) \times PQ \times 12/5 = 6$, the same area.

- P(−4, 0), Q(0, 3) and area 6 (1)
- perpendicular 12/5 (1)
- check $(1/2) \times 5 \times 12/5 = 6$ (1)

10. Using the inclinations of its sides, show that the triangle with vertices A(0, 0), B(3, $\sqrt{3}$) and C(0, $2\sqrt{3}$) is equilateral. [3]

AB has slope $\sqrt{3}/3 = 1/\sqrt{3}$, inclination 30°. AC lies on the y-axis, inclination 90°. BC has slope $(2\sqrt{3} - \sqrt{3})/(0 - 3) = -1/\sqrt{3}$, inclination 150°. Angle A = 90° − 30° = 60°; angle C, between inclinations 90° and 150°, is 60°. So angle B = 180° − 120° = 60° (check: $\tan B = |(-1/\sqrt{3} - 1/\sqrt{3})/(1 - 1/3)| = \sqrt{3}$). All angles are 60°: equilateral.

- inclinations 30°, 90°, 150° (1)
- angles A and C are 60° (1)
- angle B = 60°, so equilateral (1)

11. The vertices of a triangle are A(0, 0), B(6, 0) and C(0, 4). Find the equations of its three medians and show that they are concurrent. [3]

Mid-points: BC (3, 2), CA (0, 2), AB (3, 0). Median from A through (3, 2): $2x - 3y = 0$. Median from B through (0, 2): $x/6 + y/2 = 1$, i.e. $x + 3y = 6$. Median from C through (3, 0): $x/3 + y/4 = 1$, i.e. $4x + 3y = 12$. The first two meet where $3x = 6$: (2, 4/3). In the third, $4(2) + 3(4/3) = 12$, so all three pass through (2, 4/3).

- the three mid-points and median equations (1)
- intersection (2, 4/3) of two medians (1)
- third median passes through it (1)