9. Straight Line

Section A - Revision Section

This section will help you revise previous learning which is required in this topic.

R1   **I have revised National 5 straight line.**

1.   Find the gradient of the line joining each pair of points

     (a) $T(3, 2)$ and $R(4, 4)$ **(b)** $A(-1, 3)$ and $Q(4, 8)$

     (c) $C(-3, -2)$ and $S(7, 3)$ **(d)** $V(0, 3)$ and $L(-3, 9)$

     (e) $B(1, 4)$ and $H(-1, -2)$ **(f)** $G(-3, 4)$ and $W(-1, 8)$

     (g) $K(9, -2)$ and $N(5, -12)$ **(h)** $X(-7, -4)$ and $E(-3, -2)$

2.   Write down the gradient and y-intercept of each the line.

     (a) $y = 3x + 2$ **(b)** $y = \frac{5}{8}x - 7$

     (c) $y = 2 - 3x$ **(d)** $y = 4 - \frac{3}{4}x$

     (e) $y = x - 3$ **(f)** $y = \frac{1}{2}x + 9$

3.   Rearrange the equation of each line so that it is in the form $y = mx + c$ and write down its gradient and y-intercept.

     (a) $3y - 5x = 3$ **(b)** $4x + 3y = 9$

     (c) $2x - y = -12$ **(d)** $5y + 2x = 0$

     (e) $2y - 6x + 15 = 0$ **(f)** $4x - 3y - 7 = 0$

     (g) $5x + 2y + 6 = 0$ **(h)** $8y + 4x - 11 = 0$

Straight Line

4. Write down the equation, in the form $y = mx + c$ where possible, of each straight line described.

    (a) The straight line with gradient of -2 and passing through the point $(3, -2)$.

    (b) A straight line passes through the point $(0, 7)$, with a gradient of 6.

    (c) A straight line parallel to the x-axis and passes through $(-2, 4)$.

    (d) A straight line passes through the point $(0, 11)$, with a gradient of -2.

    (e) A straight line parallel to the y-axis and passes through $(5, 1)$.

    (f) A straight line has a gradient of $\frac{1}{2}$ and passes through the point $(-1, 4)$.

    (g) A straight line passes through the point $(0, -3)$, with a gradient of 2.

R2   **I can find the point of intersection of straight lines.**

Find the point of intersection between each pair of lines

(1) $3x + 4y = -7;$ and $2x + y = -3$

(2) $y = -x + 12;$ and $y = x - 4$

(3) $y = -x;$ and $4x + 3y = 3$

(4) $x + y = 5;$ and $x - y = 2$

Straight Line

Section B - Assessment Standard Section

This section will help you practise for your Assessment Standard Test for Straight Line (Applications 1.1)

1. Find the equation of the line passing through $(-1, 5)$, parallel to the line with equation $y = -2x + 1$.

2. Find the equation of the line passing through $(1, -6)$, parallel to the line with equation $2y + 6x = 4$.

3. ABCD is a kite.
    Diagonal AC has equation $y = -2x + 3$.
    B has the co-ordinates $(4, 3)$.

    Find the equation of the diagonal BD.
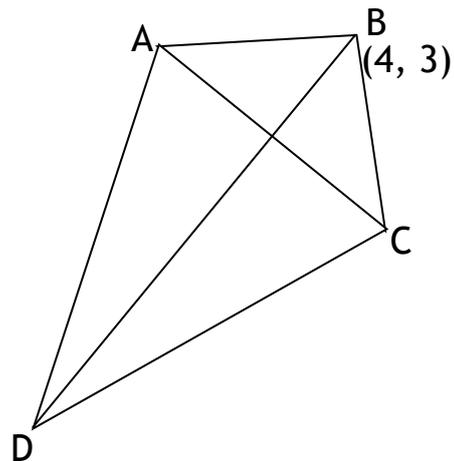
4. GH is a perpendicular bisector of EF.
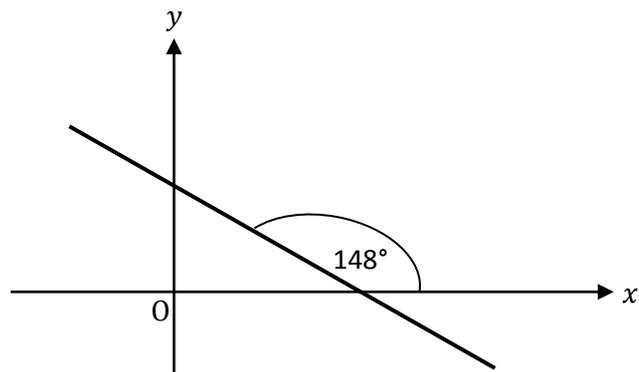   The equation of EF is $y = 3x + 11$.
    The midpoint of EF is (-2, 5).
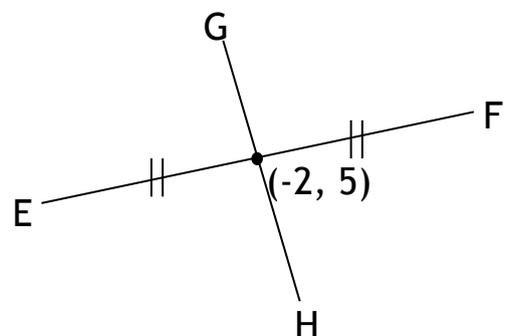
    Find the equation of GH.

Straight Line

5. Children's play chutes are categorised by their gradient as shown in the table.

Chute category	Gradient (m) of slope
Safe	$0 \cdot 5 < m \leq 1 \cdot 2$
Unsafe	$m > 1 \cdot 2$

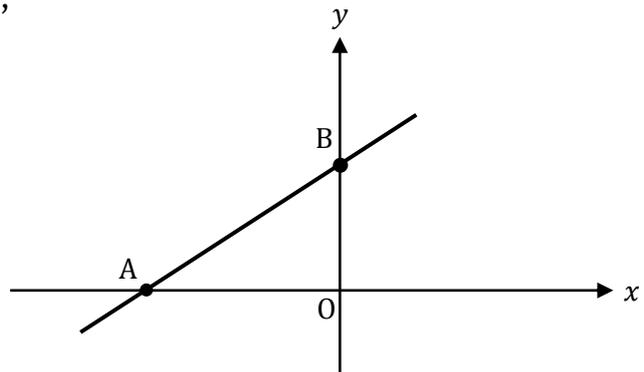To which category does the chute represented in the diagram above belong?

Straight Line

## Section C – Operational Skills Section

This section provides problems with the operational skills associated with The Straight Line

> **O1**   I can apply $m = tan\theta$ in the context of a problem.

1.   Find the equation of the line AB, where A is the point $(-3, 0)$ and the angle BAO is $30°$.

2.   Find the size of the angle $p°$ that the line joining the points $A(0, -2)$ and $B(4\sqrt{3}, \ 2)$ makes with the positive direction of the x-axis.
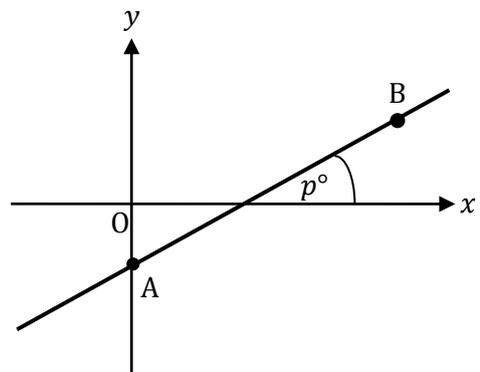
3.   A straight line has equation $3x + 2y - 1 = 0$.

Find the size of angle $a°$.

This line is inclined to the x-axis by an angle of $a°$.

Find the size of angle $a°$.

Straight Line

1. Write down the gradient of the line perpendicular to the gradient given

   (a) $m = 3$

   (b) $m = -2$

   (c) $m = 6$

   (d) $m = \dfrac{1}{3}$

   (e) $m = -\dfrac{1}{4}$

   (f) $m = \dfrac{1}{5}$

   (g) $m = -\dfrac{2}{3}$

   (h) $m = \dfrac{5}{4}$

   (i) $m = -\dfrac{3}{5}$

2. Write down the gradient of the line perpendicular to the given line

   (a) $y = 5x + 2$

   (b) $y = \dfrac{2}{3}x - 7$

   (c) $y = 2 - 3x$

   (d) $y = 4 - \dfrac{1}{2}x$

   (e) $y = 3x - 3$

   (f) $y = x + 9$

   (g) $y - 4x + 12 = 0$

   (h) $3x - y - 8 = 0$

   (i) $3x - 2y + 7 = 0$

   (j) $8y + 4x - 2 = 0$

3. Find the equation of the straight line through the point $(-1, 5)$ which is parallel to the line with equation $3x - y + 1 = 0$.

4. Find the equation of the straight line which passes through the point $(-1, 4)$ and is perpendicular to the line with equation $4x + y - 3 = 0$.

5. The point P has coordinates $(1, 12)$. The straight lines with equations $x + 3y - 7 = 0$ and $2x + 5y = 11$ intersect at Q.
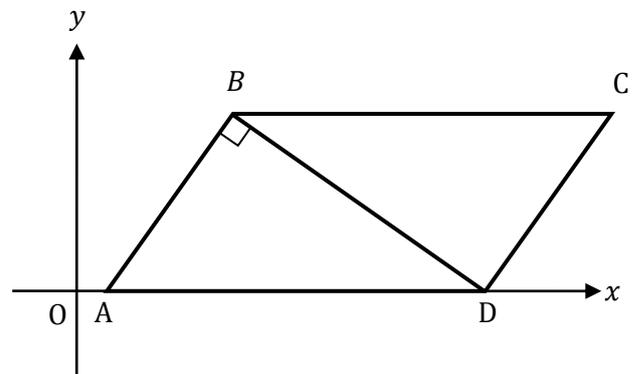
   (a) Find the gradient of PQ.

   (b) Hence show that PQ is perpendicular to only one of the lines.

Straight Line

6. ABCD is a parallelogram.

A is the point $(3, 0)$, B is the point $(5, 6)$ and D lies on the x-axis. The diagonal BD is perpendicular to side AB.

(a) Show that the equation of BD is $x + 3y - 23 = 0$.

(b) Hence find the coordinates of C and D.

Straight Line

Use the distance formula to calculate the length of the straight line joining each pair of points. Leave your answer as a surd.

(1) $A(1, 5)$ and $B(3, 3)$ **(2)** $P(-7, 1)$ and $Q(3, 8)$

(3) $C(-3, -5)$ and $D(7, 1)$ **(4)** $V(0, 3)$ and $W(-7, 9)$

(5) $G(7, 3)$ and $H(-1, -2)$ **(6)** $R(-2, 3)$ and $S(-1, 8)$

(7) $K(9, -5)$ and $L(2, -12)$ **(8)** $X(-7, -3)$ and $Y(-1, -2)$

9.   Find the midpoint of each pair of points

(a) $A(-3, 1)$ and $B(1, 3)$ **(b)** $P(1, 4)$ and $Q(9, 8)$

(c) $C(3, -3)$ and $D(-6, 1)$ **(d)** $V(-7, 1)$ and $W(3, 9)$

(e) $G(2, 4)$ and $H(-2, -2)$ **(f)** $R(-6, 2)$ and $S(-2, 8)$

(g) $K(-3, -3)$ and $L(3, -11)$ **(h)** $X(0, -4)$ and $Y(-4, -2)$

10.   The Line CD has the midpoint $(5, 3)$ and the point C has coordinates $(-3, 2)$.
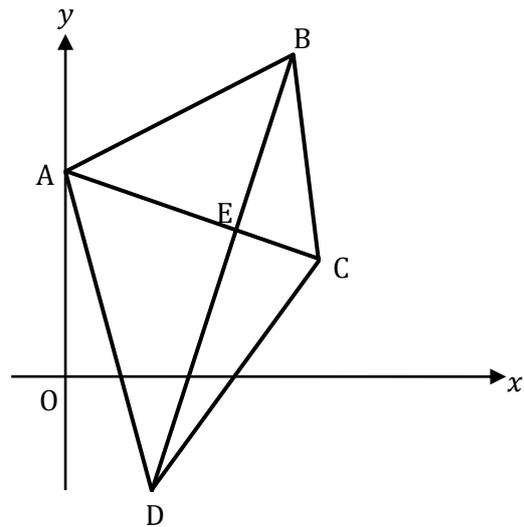
Find the coordinates of D.

11.   The Line EF has the midpoint $(-5, 3)$ and the point F has coordinates $(3, 11)$.
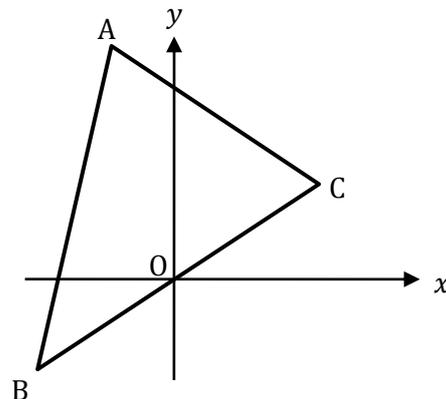
Find the coordinates of E.

Straight Line

12. A quadrilateral has vertices A($-2, 8$), B($6, 12$), C($7, 5$) and D($1, -3$) as shown in the diagram.

(a) Find the equation of diagonal BD.

(b) The equation of diagonal AC is $x + 3y = 22$. Find the coordinates of E, the point of intersection of the diagonals.

(c) **(i)** Find the equation of the perpendicular bisector of AB.

(ii) Show that this line passes through E.
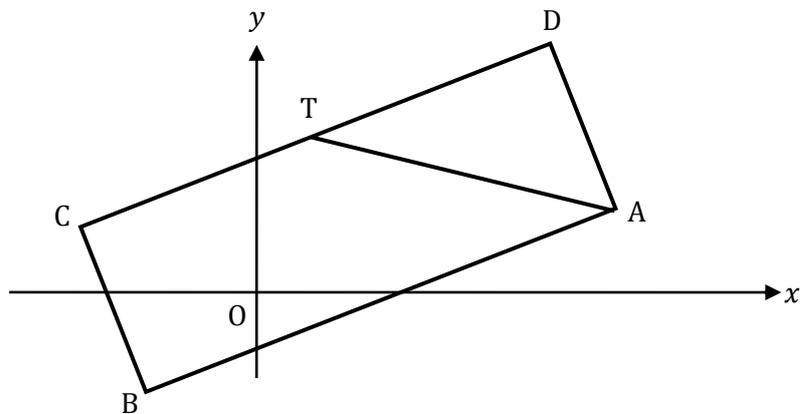
13. Triangle ABC has vertices A($-2, 6$), B($-4, -2$) and C($4, 2$) as shown. Find

(a) the equation of the line p, the median from C of triangle ABC.

(b) the equation of the line q, the perpendicular bisector of BC.

(c) the coordinates of the point of intersection of the lines p and q.

Straight Line

14. The diagram shows rectangle ABCD with $A(7, 1)$ and $D(5, 5)$.

(a) Find the equation of AD.

(b) The line from A with equation $x + 3y = 10$ intersects with CD at T.

Find the coordinates of T.

(c) Given that T is the midpoint of CD, find the coordinates of C and B.

15. Triangle ABC has vertices $A(1, 2)$, $B(11, 2)$ and $C(7, 6)$ as shown.
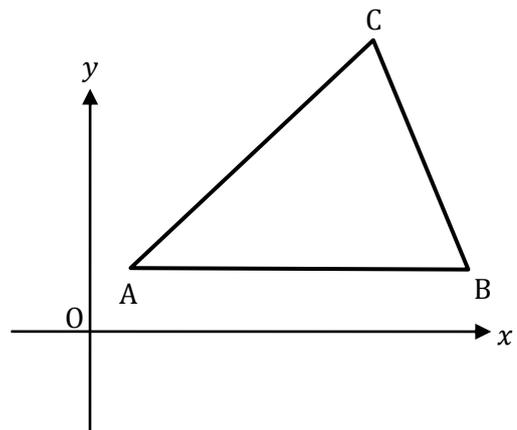
(a) Write down the equation of l_1, the perpendicular bisector of AB.

(b) Find the equation of l_2, the perpendicular bisector of AC.

(c) Find the point of intersection of the lines l_1 and l_2.

Straight Line

16. Triangle ABC has vertices A$(-2, 12)$, B$(-3, -5)$ and C$(6, -2)$ as shown.

    (a) Find the equation of the median BD.

    (b) Find the equation of the altitude AE.

    (c) Find the coordinates of the point of intersection of BD and AE.
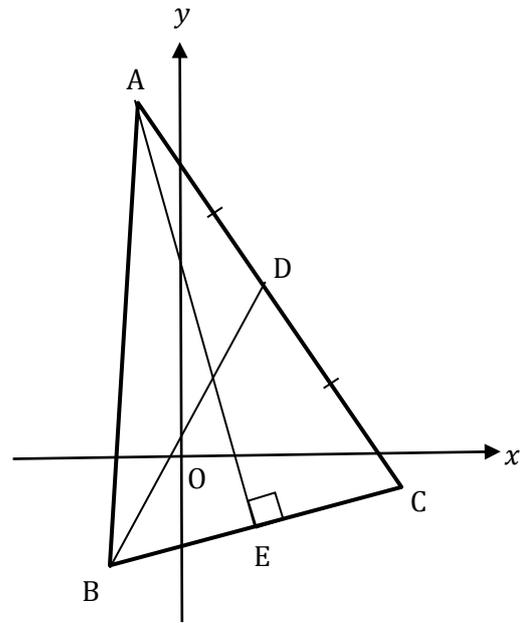
Straight Line

Answers

R1

1.   **(a)**   2   **(b)**   1   **(c)** $\frac{1}{2}$

       (d) -2 **(e)**   3   **(f)**   2

       (g) $\frac{5}{2}$ **(h)** $\frac{1}{2}$

2.   **(a)** $3, (0,2)$ **(b)** $\frac{5}{8}, (0,-7)$ **(c)** $-3, (0,2)$

       (d) $-\frac{3}{4}, (0,4)$ **(e)** $1, (0,-3)$ **(f)** $\frac{1}{2}, (0,9)$

3.   **(a)** $\frac{5}{3}, (0,1)$ **(b)** $-\frac{4}{3}, (0,3)$ **(c)** $2, (0,12)$

       (d) $-\frac{2}{5}, (0,0)$ **(e)** $3, (0,-\frac{15}{2})$ **(f)** $\frac{4}{3}, (0,-\frac{7}{3})$

       (g) $-\frac{5}{2}, (0,-3)$ **(h)** $-\frac{1}{2}, (0,\frac{11}{8})$

4.   **(a)** $y = -2x + 4$ **(b)** $y = 6x + 7$ **(c)** $y = 4$

       (d) $y = -2x + 11$ **(e)** $x = 5$ **(f)** $y = \frac{1}{2}x + \frac{9}{2}$

       (g) $y = 2x - 3$

R2

1. $(-1,-1)$ **2.** $(8,4)$ **3.** $(3,-3)$

4. $\left(\frac{7}{2},\frac{3}{2}\right)$

Section B

1. $2x + y = 3$ **2.** $3x + y = -3$

3. $x - 2y = -2$ **4.** $x + 3y = 13$

5. $m = -0 \cdot 62$ as chute is downhill then $m = 0 \cdot 62$ which falls between $0 \cdot 5 < m \leq 1 \cdot 2$ ∴ chute is categorised as **safe**.

Straight Line

Section C

1. $y = \frac{1}{\sqrt{3}}(x + 3)$ **2.** $30°$ **3.** $123 \cdot 7°$

02

1. **(a)** $-\frac{1}{3}$ **(b)** $\frac{1}{2}$ **(c)** $-\frac{1}{6}$

     (d) -3 **(e)** 4 **(f)** -5

     (g) $\frac{3}{2}$ **(h)** $-\frac{4}{5}$ **(i)** $\frac{5}{3}$

2. **(a)** $-\frac{1}{5}$ **(b)** $-\frac{3}{2}$ **(c)** $\frac{1}{3}$

     (d) 2 **(e)** $-\frac{1}{3}$ **(f)** -1

     (g) $-\frac{1}{4}$ **(h)** $-\frac{1}{3}$ **(i)** $-\frac{2}{3}$

     (j) 2

3. $y = 3x + 8$ **4.** $4y = x + 17$

5. **(a)** 3

     (b) PQ is perpendicular to $x + 3y - 7 = 0$ since $m_1 \times m_2 = -1$

6. **(a)** Proof   **(b)** $C(25, 6)$ and $D(23, 0)$

03

1. $2\sqrt{2}$ **2.** $\sqrt{149}$ **3.** $2\sqrt{34}$

4. $\sqrt{85}$ **5.** $\sqrt{89}$ **6.** $\sqrt{26}$

7. $7\sqrt{2}$ **8.** $\sqrt{37}$

9. **(a)** $(-1, 2)$ **(b)** $(5, 6)$ **(c)** $(-\frac{3}{2}, -1)$

     (d) $(-2, 5)$ **(e)** $(0, 1)$ **(f)** $(-4, 5)$

     (g) $(0, -7)$ **(h)** $(-2, -3)$

10. $(13, 4)$

Straight Line

11. $(-13, -5)$

12. **(a)** $y = 3x - 6$ **(b)** $E(4, 6)$ **(c)i** $y = -2x + 14$

(c)ii *Proof*

13. **(a)** $y = 2$ **(b)** $y = -2x$ **(c)** $(-1, 2)$

14. **(a)** $y = -2x + 15$ **(b)** $T(1, 3)$ **(c)** $B(-1, -3), C(-3, 1)$

15. **(a)** $x = 6$ **(b)** $2y + 3x = 20$ **(c)** $(6, 1)$

16. **(a)** $y = 2x + 1$ **(b)** $y = -3x + 6$ **(c)** $(1, 3)$