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) $8y + 4x - 11 = 0$

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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 Distance between 2 points using the Distance Formula.

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$(-1, -2)$

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R3 I can use the Midpoint Formula.

1. 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$(-4, -2)$

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

Find the coordinates of D.

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

Find the coordinates of E.

R4 I can calculate the gradient of perpendicular lines.

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

(a) $m = 3$ **(b)** $m = -2$ **(c)** $m = 6$

(d) $m = \frac{1}{3}$ **(e)** $m = -\frac{1}{4}$ **(f)** $m = \frac{1}{5}$

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

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

(a) $y = 5x + 2$

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

(c) $y = 2 - 3x$

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

(e) $y = 3x - 3$

(f) $y = x + 9$

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

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

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

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

R5 **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

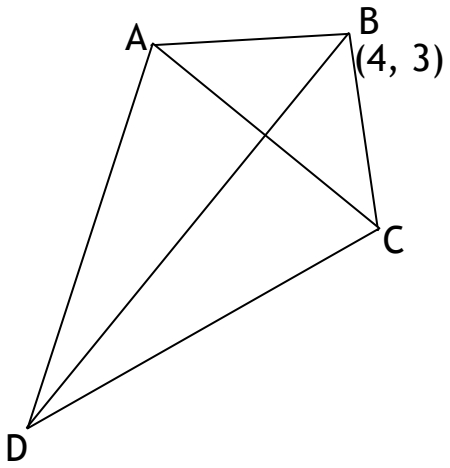
This section will help you practise for your Assessment Standard Test for Straight Line (Applications 1.1)

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 $2y + 6x = 4$.

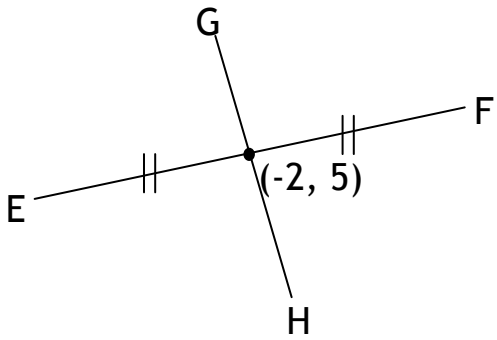
3. ABCD is a kite.
Diagonal AC has equation $y = -2x + 3$.
B has the co-ordinates $(4, 3)$.

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.



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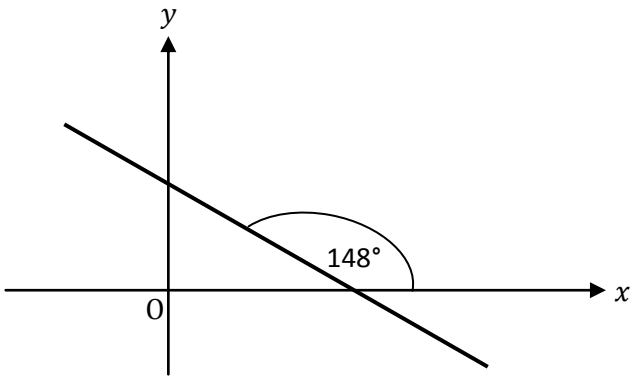
5. Children's play chutes are categorised by their gradient as shown in the table.

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?

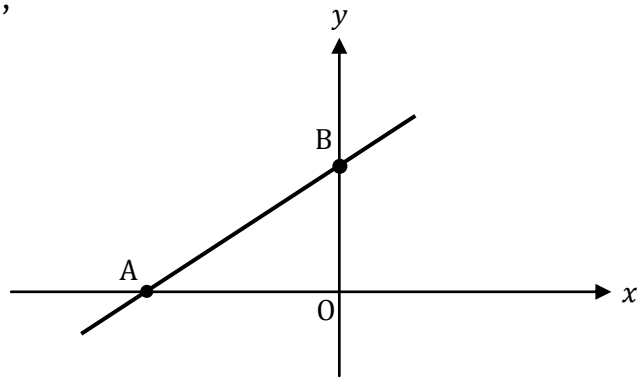
Straight Line

Section C – Operational Skills Section

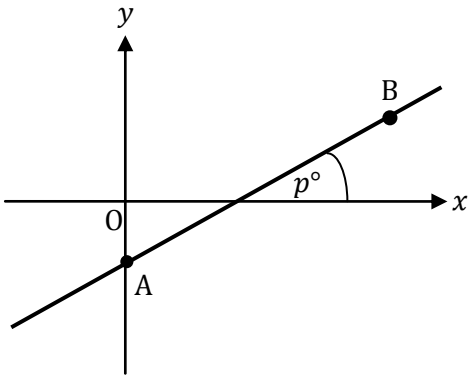
This section provides problems with the operational skills associated with The Straight Line

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 $3x + 2y - 1 = 0$.

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

Find the size of angle $a°$.

Straight Line

O2 I can solve straight line problems involving parallel and perpendicular lines.

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

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

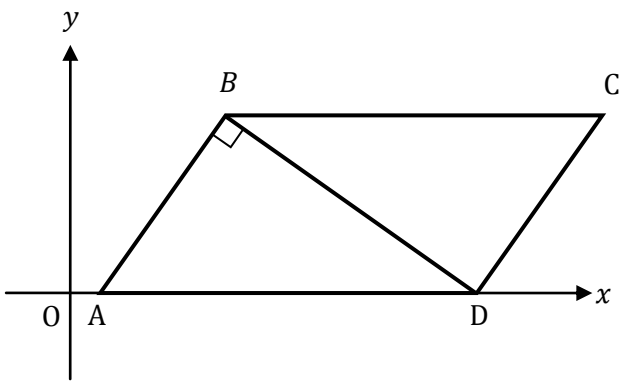
3. The point P has coordinates $(1, 12)$. The straight lines with equations $x + 3y - 7 = 0$ and $2x + 5y = 11$ intersect at Q.

(a) Find the gradient of PQ.

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

4. 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.



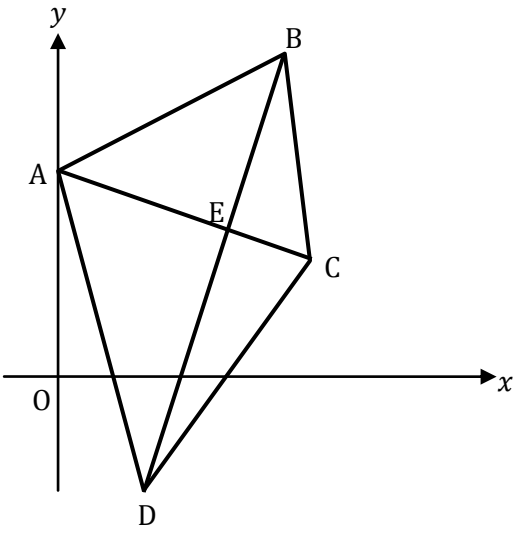
(a) Show that the equation of BD is $x + 3y - 23 = 0$.

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

Straight Line

O3	**I know the properties of: midpoints; altitudes; medians; perpendicular bisectors and can apply these in problems (including points of intersection).**

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



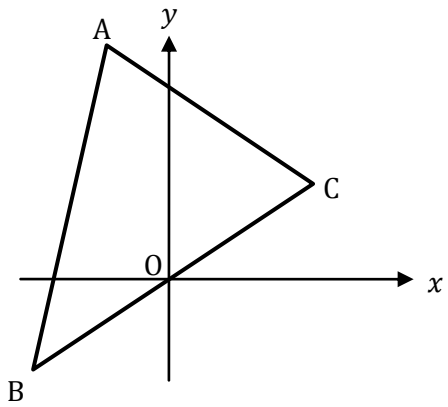
(a) Find the equation of diagonal BD.

(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.

2. Triangle ABC has vertices A$(-2,6)$, B$(-4,-2)$ and C$(4,2)$ as shown. Find



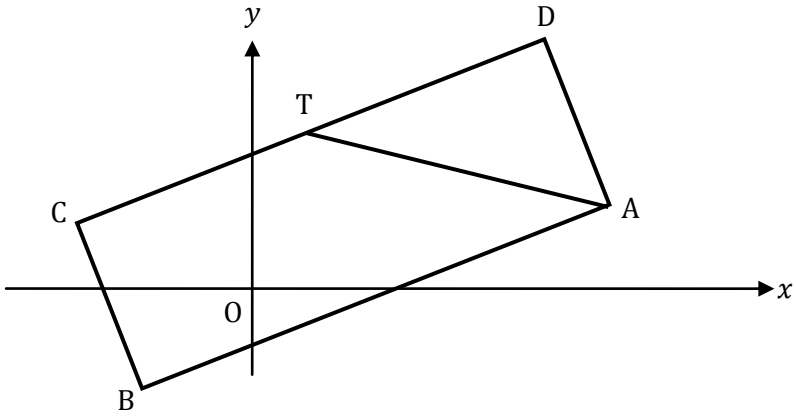
(a) the equation of the line p, the median from C of triangle ABC.

(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

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



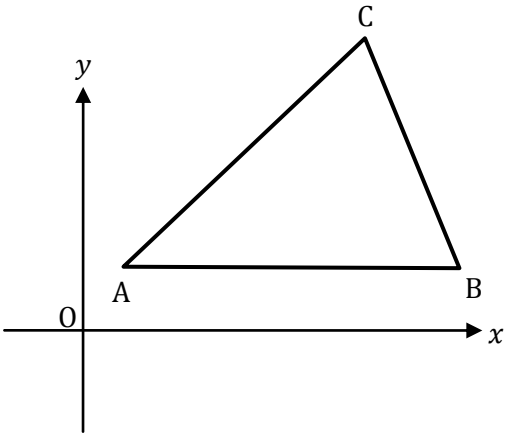
(a) Find the equation of AD.

(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.

4. 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.

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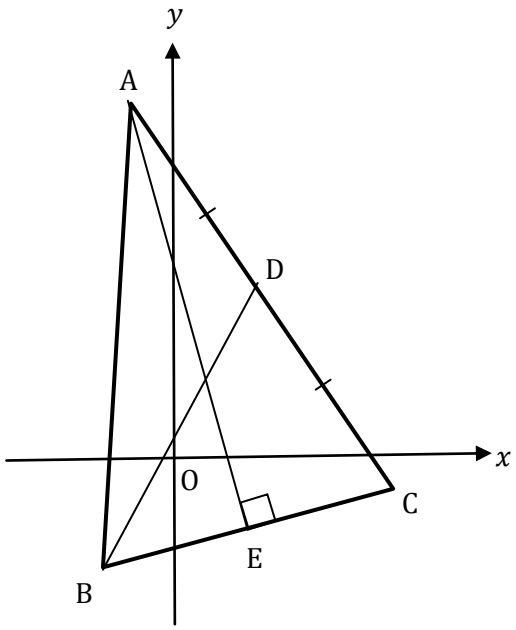
5. Triangle ABC has vertices A$(-2, 12)$, B$(-3, -5)$ and C$(6, -2)$ as shown.



(a) Find the equation of the median BD.

(b) Find the equation of the altitude AE.

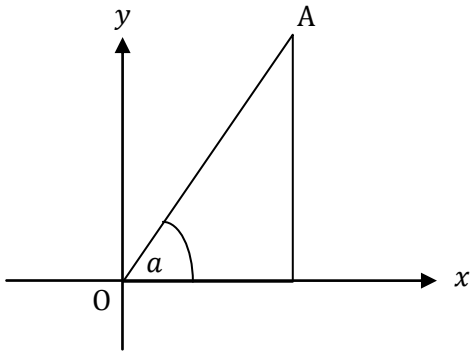
(c) Find the coordinates of the point of intersection of BD and AE.

Straight Line

Cross Topic Questions

Straight line and trigonometry

1. **(a)** The diagram below show a right angled triangle, where the line OA has equation $5x - 3y = 0$.

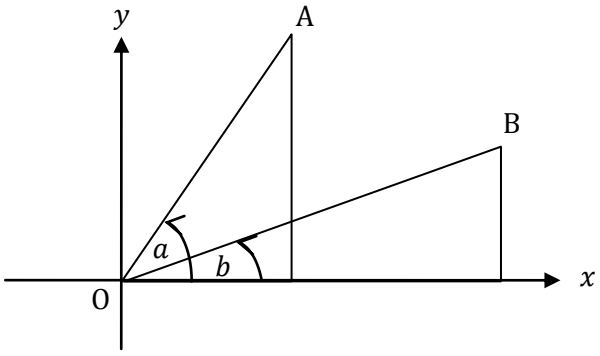


(i) Show that $\tan a = \frac{5}{3}$.

(ii) Find the value of $\sin a$ and $\cos a$.

(b) A second right angled triangle is added as shown.

The line OB has equation $x - 2y = 0$.



Find values of $\sin b$ and $\cos b$.

(c) **(i)** Find the value of $\sin(a - b)$.

(ii) Find the value of $\cos(a + b)$.

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) $2\sqrt{2}$ **(2)** $\sqrt{149}$ **(3)** $2\sqrt{34}$

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

(7) $7\sqrt{2}$ **(8)** $\sqrt{37}$

R3

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

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

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

2. $(13, 4)$

3. $(-13, -5)$

Straight Line

R4

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

R5

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. $m=-0\cdot62$ as chute is downhill then $m=0\cdot62$ which falls between $0\cdot5<m\leq1\cdot2$ $\therefore$ chute is categorised as **safe**.

Section C

01

1. $y=\frac{1}{\sqrt{3}}(x+3)$ **2.** $30°$ **3.** $123\cdot7°$

02

1. $y=3x+8$ **2.** $4y=x+17$

3 **(a)** 3

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

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

03

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

(c)ii $Proof$

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

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

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

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

Section D

Cross Topic Questions

1. **(a) i** $Proof$ **(a) ii** $\sin a = \frac{5}{\sqrt{34}}$ and $\cos a = \frac{3}{\sqrt{34}}$

(b) $\sin a = \frac{1}{\sqrt{5}}$ and $\cos a = \frac{2}{\sqrt{5}}$

(c) i $\frac{7}{\sqrt{170}}$ **ii** $\frac{1}{\sqrt{170}}$