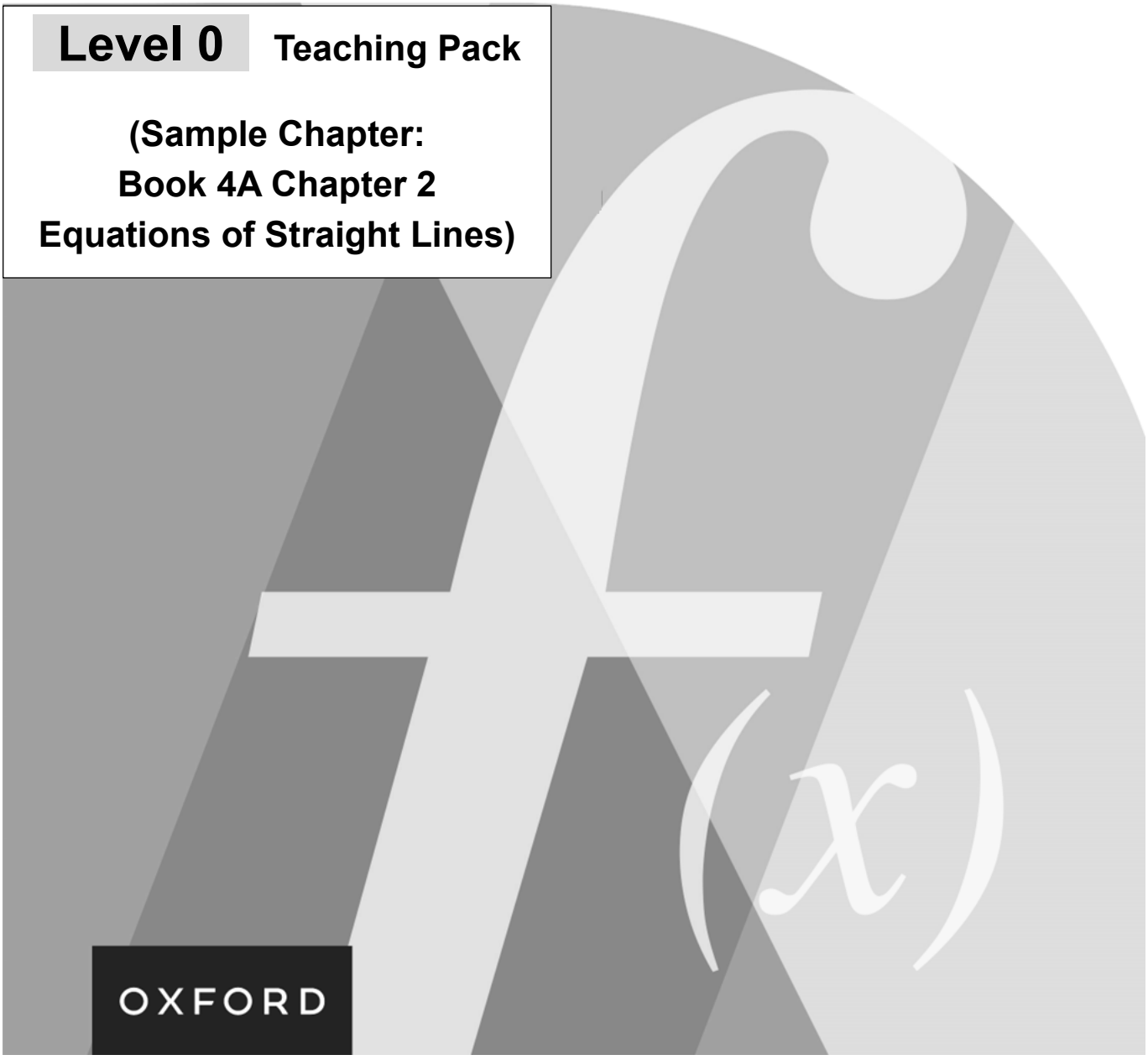
Senior Secondary

COMPULSORY PART

Oxford Mathematics for the New Century 4A

Level 0 **Teaching Pack**

(Sample Chapter:
Book 4A Chapter 2
Equations of Straight Lines)



OXFORD

Contents

Name: _____ Class: _____( )

Vertical Worksheet (Geometry)

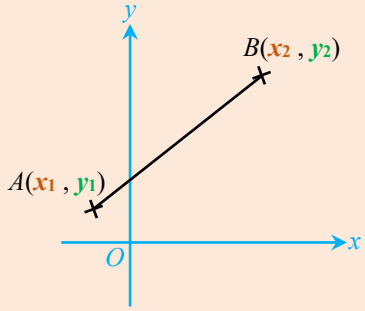
G12 Distance between Two Points

»» G12-1 Distance Formula

(Ref: 3B Ch.13 Rectangular Coordinate System (II))

Notes

For points $A(x_1 , y_1)$ and $B(x_2 , y_2)$,

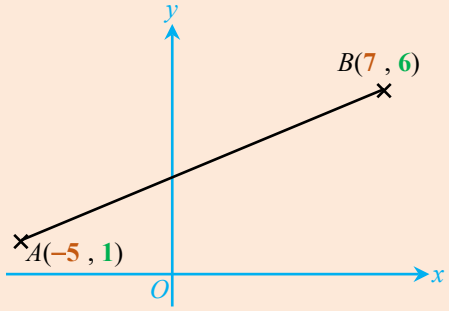


the distance between A and B is given by:

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Quick Example

For $A(-5 , 1)$ and $B(7 , 6)$,



$AB = \sqrt{[7-(-5)^2] + (6-1)^2}$ units ◄ Take $x_1 = -5$, $y_1 = 1$, $x_2 = 7$, $y_2 = 6$.

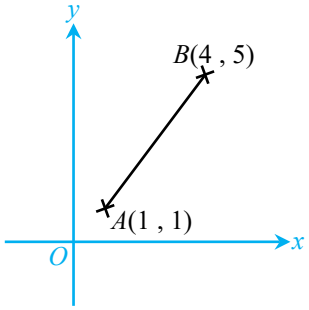
$= \sqrt{12^2 + 5^2}$ units

$= \sqrt{169}$ units

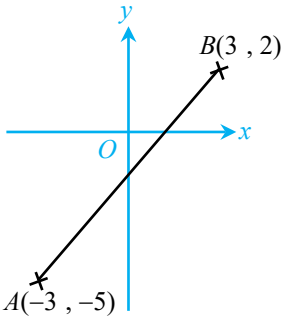
$= \underline{13 \text{ units}}$

In each of the following, find the distance between A and B. **[Nos. 1–2]**
(*Leave the radical sign '√' in the answers if necessary.*)

1. $AB = \sqrt{[(\quad)-(\quad)]^2 + [(\quad)-(\quad)]^2}$ units ◄ Take $x_1 = 1$, $y_1 = 1$, $x_2 = 4$, $y_2 = 5$.



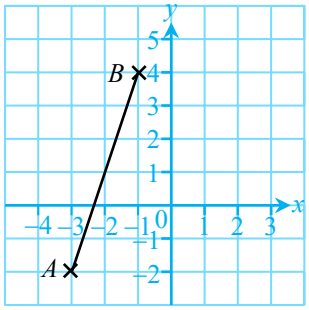
2. $AB =$



3. The coordinates of X and Y are $(-5, 6)$ and $(2, -3)$ respectively. Find the length of the line segment XY, correct to 3 significant figures.

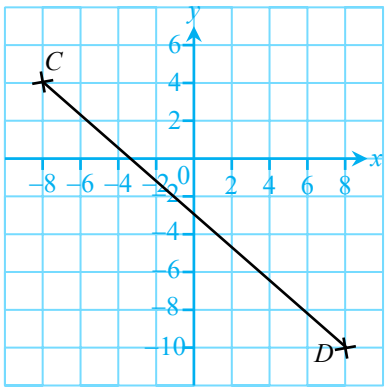
$XY = \sqrt{[(\quad)-(\quad)]^2+[(\quad)-(\quad)]^2}$ units

4. Find the length of the line segment AB, correct to 2 decimal places.

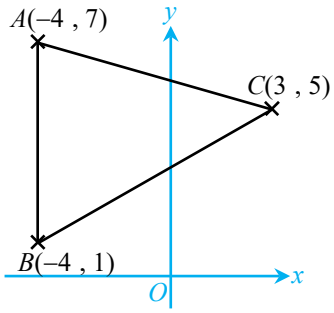


$AB = \sqrt{[(\quad)-(\quad)]^2+[(\quad)-(\quad)]^2}$ units ◀ Take $x_1 = -3$, $y_1 = -2$, $x_2 = -1$, $y_2 = 4$.

5. Find the length of the line segment CD, correct to 3 significant figures.



6. In the figure, $A(-4, 7)$, $B(-4, 1)$ and $C(3, 5)$ are the three vertices of $\triangle ABC$. Find the perimeter of $\triangle ABC$, correct to 2 decimal places.



$AB = [(\quad) - (\quad)]$ units ◀ AB is a vertical line.

$=$

$BC = \sqrt{[(\quad)-(\quad)]^2+[(\quad)-(\quad)]^2}$ units

$=$

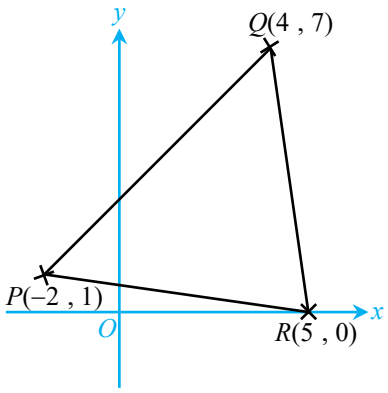
$=$

$AC =$

$\therefore$ Perimeter of $\triangle ABC = AB + BC + AC$

$=$

7. In the figure, $P(-2\ ,\ 1)$, $Q(4\ ,\ 7)$ and $R(5\ ,\ 0)$ are the three vertices of $\triangle PQR$. Is $\triangle PQR$ an isosceles triangle? Explain your answer.



8. In the figure, $L(-1\ ,\ 0)$, $M(-2\ ,\ -3)$ and $N(a\ ,\ -3)$ are the three vertices of $\triangle LMN$. If $MN = LN$, find the value of a.

$MN = [(\quad) - (\quad)]$ units ◄ MN is a horizontal line.

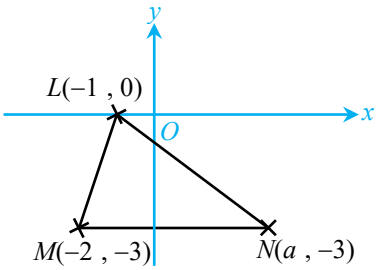
$=$

$LN = \sqrt{[(\quad)-(\quad)]^2 + [(\quad)-(\quad)]^2}$ units

$=$

$=$

$\because MN = LN$



9. $A(-1\ ,\ -4)$, $B(7\ ,\ 0)$ and $C(4\ ,\ 4)$ are the three vertices of $\triangle ABC$. Arrange the three sides of $\triangle ABC$ in ascending order of lengths.

Name: _____ Class: _____( )

Vertical Worksheet (Geometry)

G13 Slope of a Straight Line

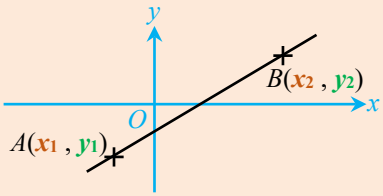
G13-1 Slope Formula

G13-2 Parallel and Perpendicular Lines

(Ref: 3B Ch.13 Rectangular Coordinate System (II))

Notes

For the straight line passing through $A(x_1 , y_1)$ and $B(x_2 , y_2)$ (where $x_1 \neq x_2$),

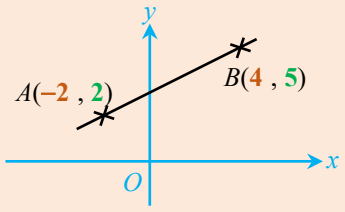


$$\text{slope of } AB = \frac{y_2 - y_1}{x_2 - x_1}$$

Note: The slope of a horizontal line is 0 while the slope of a vertical line is undefined.

Quick Example

For $A(-2 , 2)$ and $B(4 , 5)$,



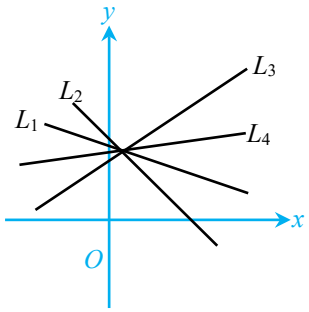
$$\text{Slope of } AB = \frac{5 - 2}{4 - (-2)}$$ ◀ Take $x_1 = -2, y_1 = 2, x_2 = 4, y_2 = 5$.

$$= \frac{3}{6}$$

$$= \frac{1}{2}$$

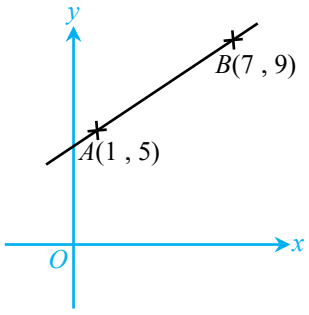
1. In the figure, the slopes of the lines L_1, L_2, L_3 and L_4 are m_1, m_2, m_3 and m_4 respectively. Arrange the values of m_1, m_2, m_3 and m_4 in ascending order.

_____( ) < ( ) < ( ) < ( )_____

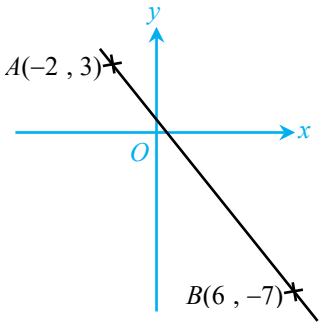


2. Find the slope of the line AB in each of the following figures.

(a) Slope of $AB = \dfrac{(\quad) - (\quad)}{(\quad) - (\quad)}$



(b) Slope of AB =



3. In each of the following, find the slope of the straight line passing through the two given points.

(a) $A(12 , 4)$, $O(0 , 0)$

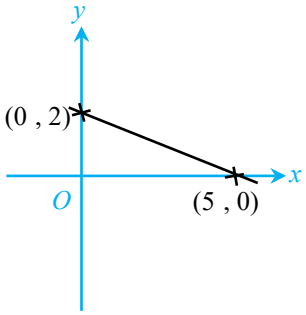
Slope of OA = $\dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

(b) $C(4 , 8)$, $D(-2 , 5)$

4. In each of the following, find the slope of the straight line with the given x-intercept and y-intercept.

(a) x-intercept = 5, y-intercept = 2

Slope of the straight line = $\dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$



(b) x-intercept = −8, y-intercept = 14

Slope of the straight line = $\dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

5. Given that the slope of the line passing through $X(a + 2 , 3)$ and $Y(-a , -9)$ is 2, find the value of a.

Slope of $XY = 2$

$$\frac{(\quad)-(\quad)}{(\quad)-(\quad)} = 2$$

6. In each of the following, determine whether the three given points lie on the same straight line.

(a) $A(2 , 1)$, $B(-4 , 4)$, $C(6 , -1)$

$$\text{Slope of } AB = \frac{(\quad)-(\quad)}{(\quad)-(\quad)}$$

$$\text{Slope of } AC = \frac{(\quad)-(\quad)}{(\quad)-(\quad)}$$

$\because$ Slope of AB (= / ≠) Slope of AC

$\therefore$ The three points A, B and C (lie / do not lie) on the same straight line.

(b) $X(5 , -5)$, $Y(7 , -11)$, $Z(-7 , -1)$

7. L is a straight line passing through the points $A(6\ ,\ 5)$ and $B(2\ ,\ -5)$.

(a) Find the slope of L.

(b) Find the x-intercept and y-intercept of L.

Name: _____ Class: _____( )

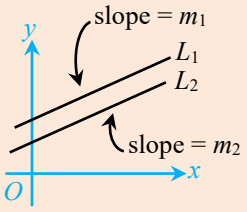
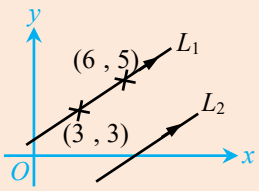
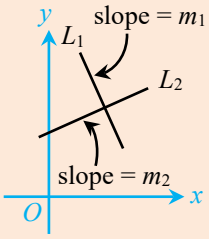
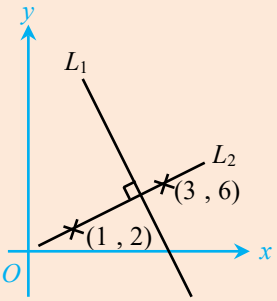
Vertical Worksheet (Geometry)

G13 Slope of a Straight Line

G13-1 Slope Formula

»» G13-2 Parallel and Perpendicular Lines

(Ref: 3B Ch.13 Rectangular Coordinate System (II))

Notes	Quick Example
(a) Parallel Lines  **(i)** If $L_1 \parallel L_2$, then $m_1 = m_2$. **(ii)** If $m_1 = m_2$, then $L_1 \parallel L_2$.	Refer to the figure.  $\because L_1 \parallel L_2$ $\therefore$ Slope of L_2 = slope of L_1 $= \frac{5-3}{6-3}$ $= \underline{\underline{\frac{2}{3}}}$
(b) Perpendicular Lines  **(i)** If $L_1 \perp L_2$, then $m_1 \times m_2 = -1$. **(ii)** If $m_1 \times m_2 = -1$, then $L_1 \perp L_2$.	Refer to the figure.  Slope of $L_2 = \frac{6-2}{3-1} = \frac{4}{2} = 2$ $\because L_1 \perp L_2$ $\therefore$ Slope of $L_1 \times$ slope of $L_2 = -1$ Slope of $L_1 \times 2 = -1$ Slope of $L_1 = \underline{\underline{-\frac{1}{2}}}$

1. In each of the following, L_1 and L_2 are two straight lines. Find the slope of L_2.

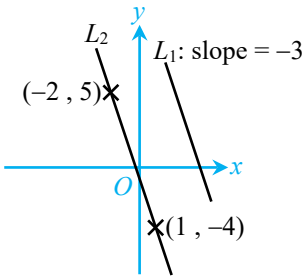
(a) $L_1 \parallel L_2$, slope of $L_1 = 5$

$\because L_1 \parallel L_2$

$\therefore$ Slope of $L_2 =$

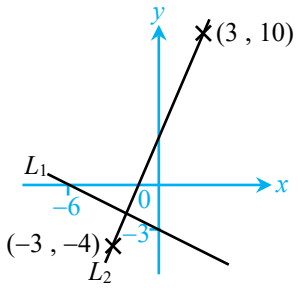
(b) $L_1 \perp L_2$, slope of $L_1 = -2$

2. **(a)** Determine whether L_1 and L_2 are parallel.



Slope of L_2 = $\dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

(b) Determine whether L_1 and L_2 are perpendicular.



Slope of L_1 = $\dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

$\because$ Slope of L_1 (= / ≠) slope of L_2

$\therefore$

3. Consider four points $A(2 , 3)$, $B(-5 , -4)$, $C(7 , 2)$ and $D(-1 , -6)$.

(a) Find the slopes of AB and CD.

Slope of AB = $\dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

=

Slope of CD = $\dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

=

(b) What is the relationship between AB and CD?

4. Consider four points $P(9 , 3)$, $Q(-8 , -2)$, $R(3 , -5)$ and $S(-2 , 12)$.

(a) Find the slopes of PQ and RS.

Slope of PQ =

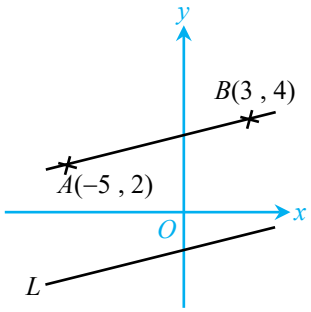
=

Slope of RS =

=

(b) What is the relationship between PQ and RS?

5. It is given that the coordinates of A and B are $(-5\ ,\ 2)$ and $(3\ ,\ 4)$ respectively. If L is a straight line parallel to AB, find the slope of L.



Slope of $L = \dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

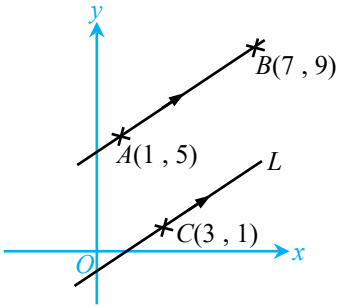
6. It is given that the coordinates of C and D are $(3\ ,\ 5)$ and $(-2\ ,\ -4)$ respectively. If L is a straight line perpendicular to CD, find the slope of L.

Slope of $CD = \dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

$\because L \perp CD$

$\therefore$

7. In the figure, L is parallel to the line passing through $A(1\ ,\ 5)$ and $B(7\ ,\ 9)$. $C(3\ ,\ 1)$ is a point on L.



(a) Find the slope of AB.

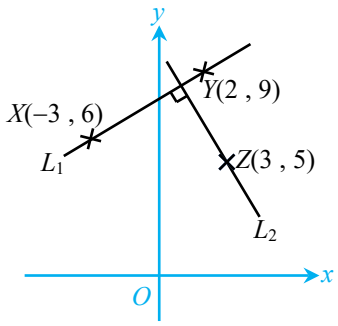
Slope of $AB = \dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

(b) If L cuts the x-axis at P, find the coordinates of P.

Let $(\quad,\quad)$ be the coordinates of P.

$\because L \perp AB$

8. In the figure, L_1 and L_2 are perpendicular to each other. L_1 passes through $X(-3\ ,\ 6)$ and $Y(2\ ,\ 9)$ while L_2 passes through $Z(3\ ,\ 5)$.



(a) Find the slope of L_2.

$\because\ L_1 \perp L_2$

$\therefore$ Slope of $L_1 \times$ slope of $L_2 =$

(b) Does the point $(7\ ,\ -2)$ lie on L_2? Explain your answer.

Slope of the line passing through $(7\ ,\ -2)$ and Z

$=$

(= / ≠) Slope of L_2

$\therefore$

Name: _____ Class: _____( )

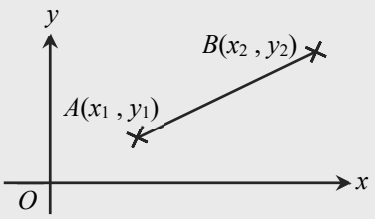
Lesson Worksheet 2.0 (*Lite*)

(Refer to Book 4A P.2.2)

Review

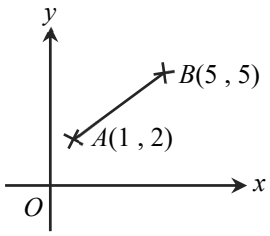
Distance Formula

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$



In each of the following, find AB. **[Nos. 1–4]**

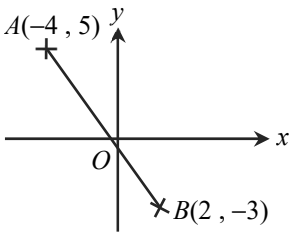
1.



$AB = \sqrt{[(\quad) - (\quad)]^2 + [(\quad) - (\quad)]^2}$

$=$

2.



$AB = \sqrt{\qquad\qquad\qquad\qquad\qquad\qquad}$

3. $A(0 , 2)$, $B(4 , 5)$

4. $A(3 , 1)$, $B(8 , 13)$

In each of the following, find AB. **[Nos. 5–6]**

(*Leave the radical sign '$\sqrt{\ }$' in the answers.*)

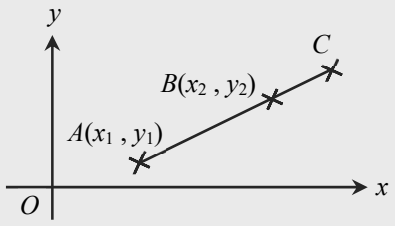
5. $A(2 , –1)$, $B(3 , 3)$

6. $A(1 , –5)$, $B(–4 , –7)$

Slope of a Straight Line

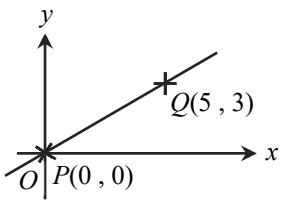
(a) Slope of $AB = \dfrac{y_2 - y_1}{x_2 - x_1}$ (where $x_1 \neq x_2$)

(b) For three collinear points A, B and C (i.e. A, B and C lie on the same straight line), slope of AB = slope of BC = slope of AC.



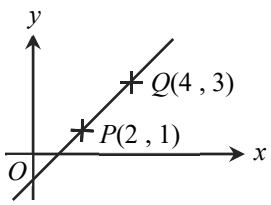
In each of the following, find the slope of PQ. **[Nos. 7–12]**

7.



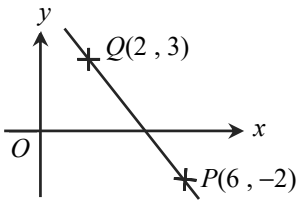
Slope of $PQ = \dfrac{(\quad) - (\quad)}{(\quad) - (\quad)}$

8.

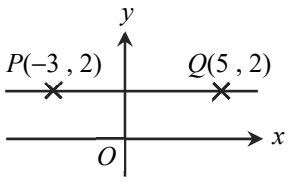


Slope of $PQ =$ _____

9.



10.



11. $P(-1 , 3)$, $Q(5 , 7)$

12. $P(-3 , -2)$, $Q(7 , -6)$

13. Consider $A(2 , 0)$ and $B(4 , r)$. If the slope of AB is 3, find r.

In each of the following, determine whether A, B and C are collinear. Explain your answer. **[Nos. 14–15]**

14. $A(2 , 2)$, $B(3 , 5)$, $C(4 , 8)$

Slope of AB =

Slope of BC =

$\because$ Slope of AB (= / $\neq$) slope of BC

$\therefore$ A, B and C (are / are not) collinear.

15. $A(-4 , 2)$, $B(3 , 5)$, $C(4 , 8)$

16. If $P(-3 , 1)$, $Q(0 , 3)$ and $R(6 , r)$ are collinear, find r.

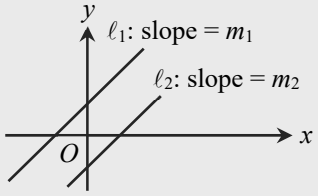
$\because$ P, Q and R are collinear.

$\therefore$ Slope of PQ (= / $\neq$) slope of QR

Parallel Lines

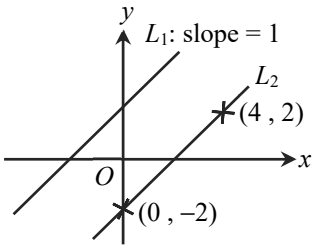
(i) If $\ell_1 // \ell_2$, then $m_1 = m_2$.

(ii) If $m_1 = m_2$, then $\ell_1 // \ell_2$.



In each of the following, determine whether L_1 is parallel to L_2. **[Nos. 17–18]**

17.



Slope of L_1 = ( )

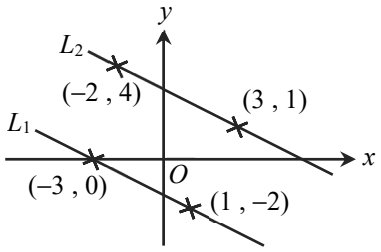
Slope of $L_2 = \dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

$=$

$\because$ Slope of L_1 (= / ≠) slope of L_2

$\therefore$

18.



Slope of L_1 = _____

19. L_1 and L_2 are straight lines. The slope of L_2 is –5. If $L_1 // L_2$, find the slope of L_1.

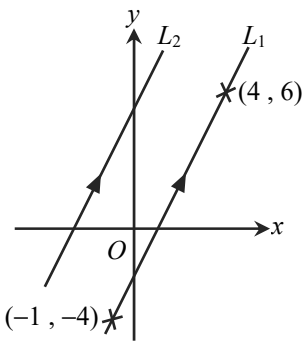
$\because$ $L_1 // L_2$

$\therefore$ Slope of L_1 = slope of L_2

$=$

20. In the figure, $L_1 // L_2$.

(a) Find the slope of L_1.

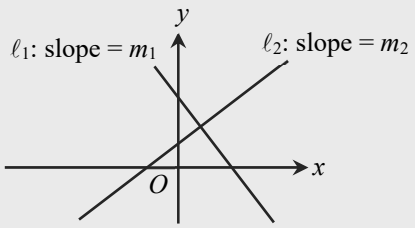


(b) Find the slope of L_2.

Perpendicular Lines

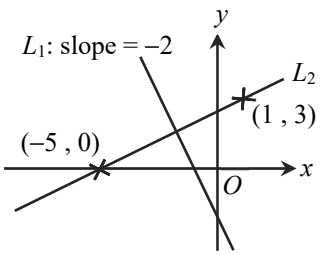
(i) If $\ell_1 \perp \ell_2$, then $m_1 \times m_2 = -1$.

(ii) If $m_1 \times m_2 = -1$, then $\ell_1 \perp \ell_2$.



In each of the following, determine whether L_1 is perpendicular to L_2. **[Nos. 21–22]**

21.



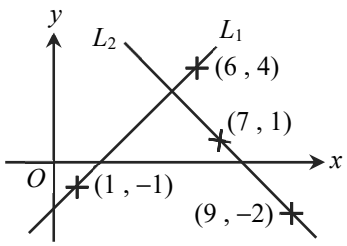
Slope of L_1 =

Slope of L_2 =

∵ Slope of L_1 × slope of L_2

=

22.



Slope of L_1 = _____

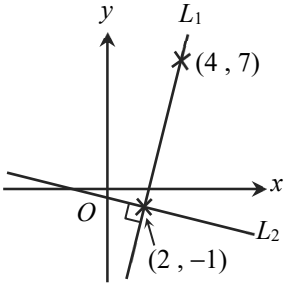
23. The slope of a straight line L_1 is –2. If a straight line L_2 is perpendicular to L_1, find the slope of L_2.

∵ $L_1 \perp L_2$

∴ Slope of L_1 × slope of L_2 = –1

24. In the figure, L_1 is perpendicular to L_2.

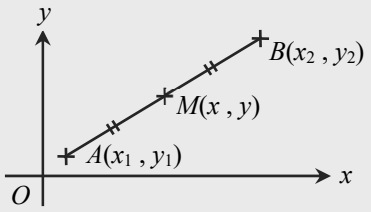
(a) Find the slope of L_1.



(b) Find the slope of L_2.

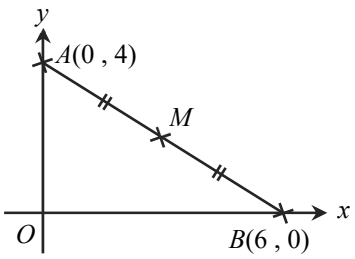
Mid-point Formula

$$x = \frac{x_1 + x_2}{2},\ y = \frac{y_1 + y_2}{2}$$



In each of the following, find the coordinates of M. **[Nos. 25–26]**

25.

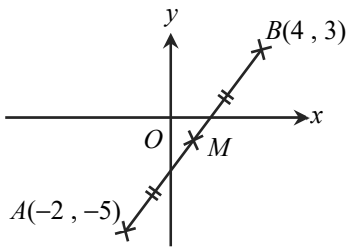


Coordinates of M

$= \left(\frac{(\quad)+(\quad)}{(\quad)}, \frac{(\quad)+(\quad)}{(\quad)} \right)$

$=$

26.



Coordinates of M

$= \left(\underline{\qquad\qquad}, \underline{\qquad\qquad} \right)$

In each of the following, find the coordinates of the mid-point of the line segment AB. **[Nos. 27–30]**

27. $A(-10 , 0)$, $B(0 , 8)$

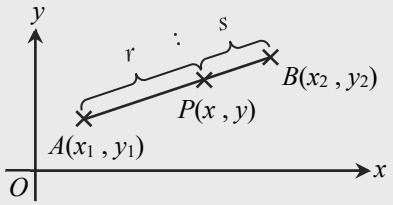
28. $A(13 , 6)$, $B(3 , 4)$

29. $A(7 , -2)$, $B(-3 , 10)$

30. $A(-2 , -5)$, $B(4 , 3)$

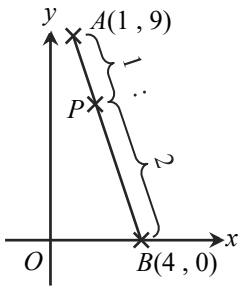
✂ Formula for the Internal Point of Division

$$x = \frac{sx_1 + rx_2}{r+s},\ y = \frac{sy_1 + ry_2}{r+s}$$



In each of the following, find the coordinates of P. **[Nos. 31–32]**

✂ 31.

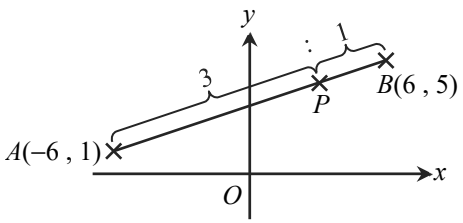


Coordinates of P

$= \left(\frac{(\quad)(\quad)+(\quad)(\quad)}{(\quad)+(\quad)}, \frac{(\quad)(\quad)+(\quad)(\quad)}{(\quad)+(\quad)} \right)$

$=$

✂ 32.



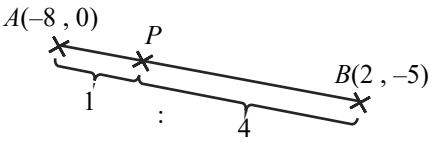
Coordinates of P

$= \left(\underline{\qquad\qquad}, \underline{\qquad\qquad} \right)$

In each of the following, find the coordinates of the point P that divides the line segment AB internally in the given ratio. **[Nos. 33–34]**

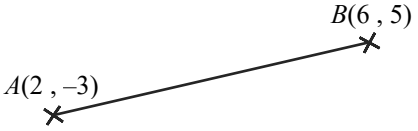
✂ 33. $A(-8 , 0)$, $B(2 , -5)$, $AP : PB = 1 : 4$

Sketch:



✂ 34. $A(2 , -3)$, $B(6 , 5)$, $AP : PB = 1 : 3$

Sketch:



Name: _____ Class: _____( )

Consolidation Exercise 2 (Review)

1. In each of the following, find the distance between the points A and B.

(a) $A(0 , 0)$, $B(8 , 6)$

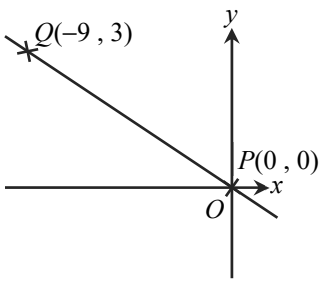
(b) $A(0 , 5)$, $B(-12 , 0)$

(c) $A(-1 , 2)$, $B(3 , -1)$

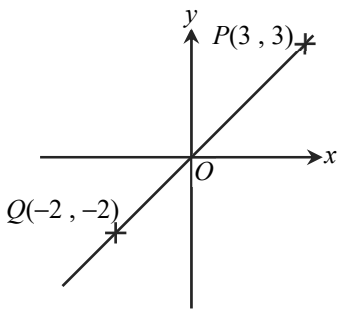
(d) $A(-10 , -5)$, $B(14 , 2)$

2. In each of the following, find the slope of the straight line passing through the points P and Q.

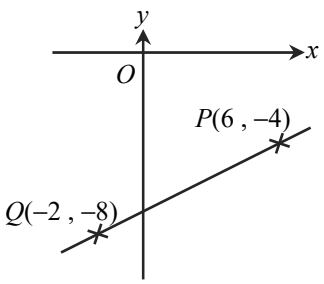
(a)



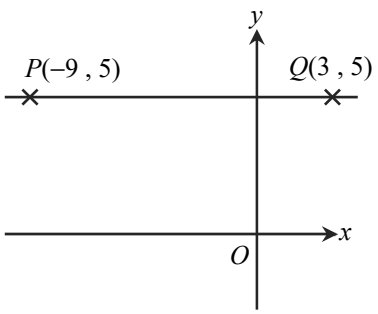
(b)



(c)



(d)



Explain **3.** In each of the following, determine whether the three points are collinear. Explain your answers.

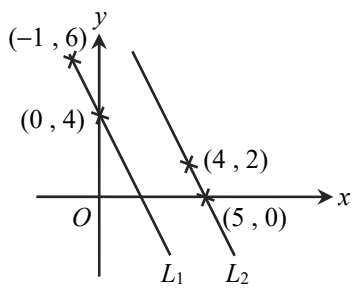
(a) $P(6 , 4)$, $Q(-2 , -3)$, $R(4 , 1)$

(b) $P(-6 , 8)$, $Q(-2 , 11)$, $R(2 , 14)$

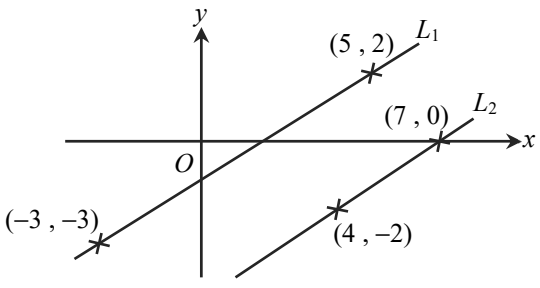
4. If $A(-8 , 1)$, $B(4 , 10)$ and $C(a , 13)$ are collinear, find the value of a.

5. In each of the following, determine whether L_1 and L_2 are parallel.

(a)

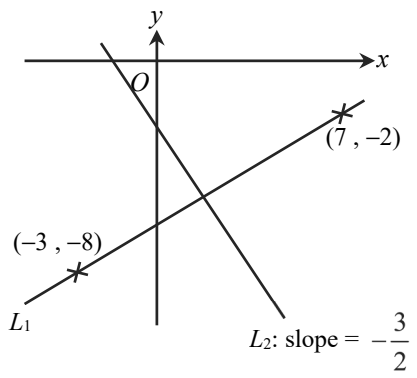


(b)

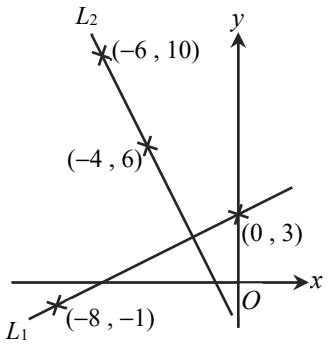


6. In each of the following, determine whether L_1 and L_2 are perpendicular.

(a)



(b)



7. It is given that the coordinates of P and Q are (1 , 6) and (–5 , 3) respectively.

(a) If L_1 is a straight line parallel to PQ, find the slope of L_1.

(b) If L_2 is a straight line perpendicular to PQ, find the slope of L_2.

8. L_1 is a straight line with slope 3. L_2 is a straight line passing through $A(k\ ,\ -9)$ and $B(-2\ ,\ 3)$. Find the value of k in each of the following cases.

(a) $L_1 \parallel L_2$

(b) $L_1 \perp L_2$

9. In each of the following, find the coordinates of the mid-point of the line segment AB.

(a) $A(2\ ,\ 11)$, $B(8\ ,\ 11)$

(b) $A(3\ ,\ 9)$, $B(-7\ ,\ 5)$

(c) $A(-5\ ,\ -2)$, $B(-3\ ,\ -6)$

(d) $A(9\ ,\ -16)$, $B(13\ ,\ -8)$

✂**10.** In each of the following, find the coordinates of the point P which divides the line segment AB internally in the given ratio.

(a) $A(1\ ,\ 0)$, $B(-2\ ,\ 6)$, $AP : PB = 2 : 1$

(b) $A(-9\ ,\ 6)$, $B(1\ ,\ -9)$, $AP : PB = 1 : 4$

(c) $A(8\ ,\ 7)$, $B(-7\ ,\ -3)$, $AP : PB = 2 : 3$

✂**11.** Q is a point lying on the line segment joining $A(-6\ ,\ -1)$ and $B(6\ ,\ 5)$. If $AB = 6QB$, find the coordinates of Q.

Name: _____ Class: _____( )

Lesson Worksheet 2.1 (*Lite*)

(Refer to Book 4A P.2.6)

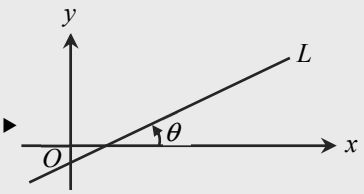
Slope and Inclination

Inclination

For a straight line L with inclination θ (where $\theta \neq 90°$):

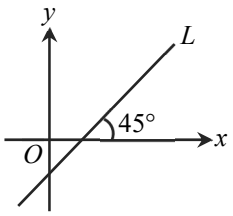
slope of $L = \tan\theta$

θ is the angle measured anticlockwise from the positive x-axis to L.



Example 1 Level 1

Find the slope of L.



Solution

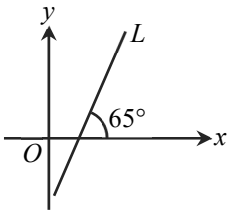
Slope of $L = \tan 45°$

$= 1$

Calculator:
tan 45 EXE

Instant Drill 1.1

Find the slope of L, correct to 3 significant figures.



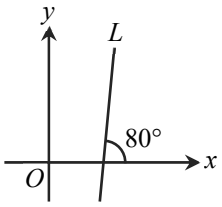
Solution

Slope of $L = \tan$ ( )

=

Instant Drill 1.2

Find the slope of L, correct to 3 significant figures.



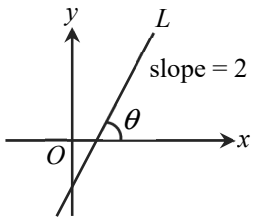
Solution

Slope of L =

➥ **Exercise 2A (P.2.21)** 1(a), (b)

Example 2 Level 1

Find the inclination θ of L, correct to 3 significant figures.



Solution

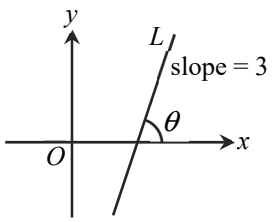
$\tan\theta = 2$

$\theta = \underline{63.4°}$, *cor. to 3 sig. fig.*

Calculator:
SHIFT tan 2 EXE

Instant Drill 2.1

Find the inclination θ of L, correct to 3 significant figures.



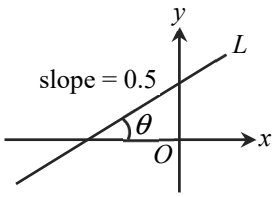
Solution

$\tan\theta = (\quad)$

$\theta =$

Instant Drill 2.2

Find the inclination θ of L, correct to 3 significant figures.



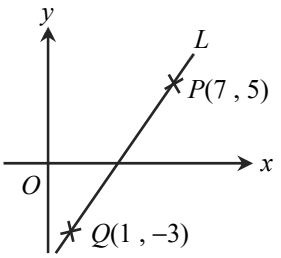
Solution

$\tan\theta =$

➥ **Exercise 2A (P.2.21)** 1(c), (d)

Example 3 Level 1

In the figure, L passes through $P(7 , 5)$ and $Q(1 , -3)$.



(a) Find the slope of L.

(b) Find the inclination of L, correct to the nearest degree.

Solution

(a) Slope of $L = \dfrac{5-(-3)}{7-1}$

$= \dfrac{8}{6}$

$= \dfrac{4}{3}$

(b) Let θ be the inclination of L.

$\tan\theta =$ slope of L

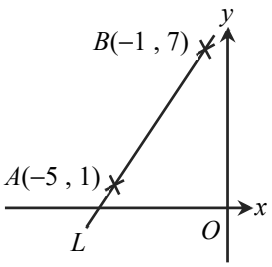
$= \dfrac{4}{3}$

$\theta = 53°$, *cor. to the nearest degree*

$\therefore$ The inclination of L is $53°$.

Instant Drill 3.1

In the figure, L passes through $A(-5 , 1)$ and $B(-1 , 7)$.



(a) Find the slope of L.

(b) Find the inclination of L, correct to the nearest degree.

Solution

(a) Slope of $L = \dfrac{(\quad)-(\quad)}{(\quad)-(\quad)}$

$=$

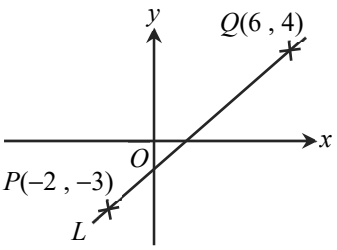
(b) Let θ be the inclination of L.

$\tan\theta = (\quad)$

$\theta =$

Instant Drill 3.2

In the figure, L passes through $P(-2 , -3)$ and $Q(6 , 4)$.



(a) Find the slope of L.

(b) Find the inclination of L, correct to the nearest degree.

Solution

(a) Slope of L = ————————

(b) Let θ be the inclination of L.

Instant Drill 3.3

A straight line L passes through $A(1 , 4)$ and $B(3 , 9)$.

(a) Find the slope of L.

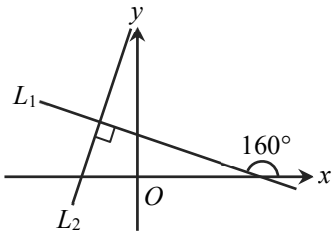
(b) Find the inclination of L, correct to the nearest degree.

Solution

➥ **Exercise 2A (P.2.21)** 2, 3

Example 4 Level 1

In the figure, $L_1 \perp L_2$.

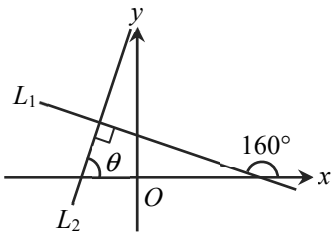


(a) Find the inclination of L_2.

(b) Find the slope of L_2, correct to 3 significant figures.

Solution

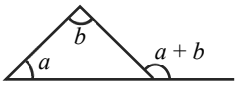
(a) With the notations in the figure,



$\theta + 90° = 160°$ ◄ *ext. ∠ of △*

$\theta = 70°$

$\therefore$ The inclination of L_2 is 70°.



ext. ∠ of △

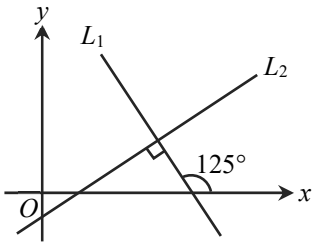
(b) Slope of L_2 = tan θ

= tan 70°

= 2.75, *cor. to 3 sig. fig.*

Instant Drill 4.1

In the figure, $L_1 \perp L_2$.

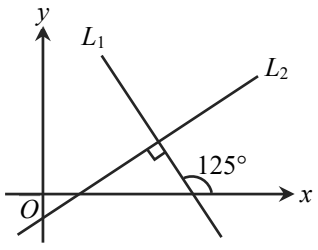


(a) Find the inclination of L_2.

(b) Find the slope of L_2, correct to 3 significant figures.

Solution

(a) With the notations in the figure,



Mark the inclination θ of L_2 in the figure.

$\theta + (\quad) = (\quad)$

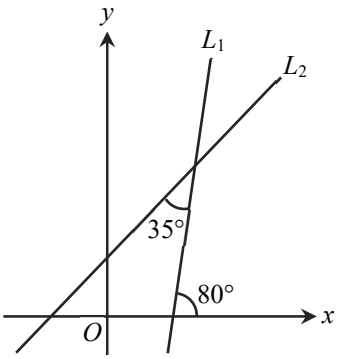
(b) Slope of L_2 = tan ( )

Instant Drill 4.2

Refer to the figure.

(a) Find the inclination of L_2.

(b) Find the slope of L_2.



Solution

(a) Mark the inclination θ of L_2 in the figure on the right.

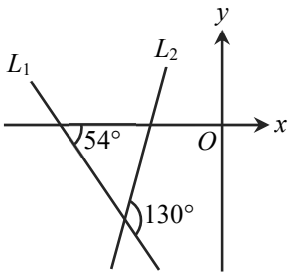
(b) Slope of L_2 =

Instant Drill 4.3

Refer to the figure.

(a) Find the inclination of L_2.

(b) Find the slope of L_2, correct to 3 significant figures.



Solution

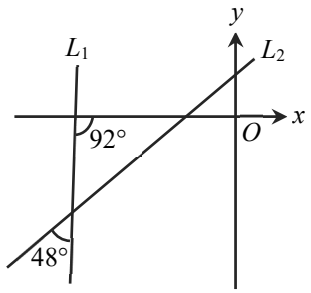
➥ **Exercise 2A (P.2.21)** 4, 5

★ *Challenging Question* ★

Refer to the figure.

(a) Find the inclination of L_2.

(b) Find the slope of L_2, correct to 3 significant figures.



Solution

Name: _____ Class: _____( )

Lesson Worksheet 2.2 (*Lite*)

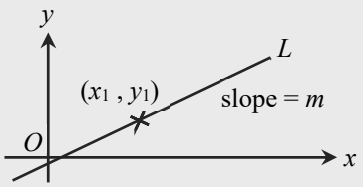
(Refer to Book 4A P.2.10)

Finding Equations of Straight Lines

Point-slope Form

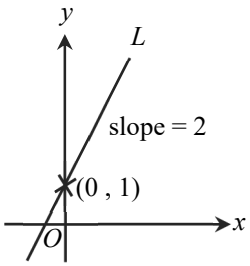
The equation of the straight line L with slope m and passing through (x_1 , y_1) is given by:

$$y - y_1 = m(x - x_1)$$



Example 1 Level 1

Refer to the figure. Find the equation of L.



Solution

The equation of L is

$y - 1 = 2(x - 0)$

$y - 1 = 2x$

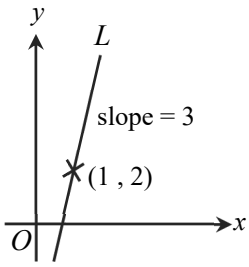
$2x - y + 1 = 0$

$y - y_1 = m(x - x_1)$
$\uparrow \quad \uparrow \quad \uparrow$
$1 \quad 2 \quad 0$

◄ Usually the equation contains 'x' and 'y'. Express the equation in the form $Ax + By + C = 0$.

Instant Drill 1.1

Refer to figure. Find the equation of L.



Solution

The equation of L is

$y - (\quad) = (\quad)(x - \_\_\_)$

$=$

$y - y_1 = m(x - x_1)$
$\uparrow \quad \uparrow \quad \uparrow$
$(\quad)(\quad) \quad (\quad)$

Instant Drill 1.2

Find the equation of the straight line L passing through (5 , 2) and with slope –4.

Solution

The equation of L is

$y - (\quad) =$

Instant Drill 1.3

Find the equation of the straight line L passing through (–3 , 1) and with slope $\frac{1}{3}$.

Solution

Instant Drill 1.4

Find the equation of the straight line L passing through (3 , –2) and with slope $-\frac{1}{2}$.

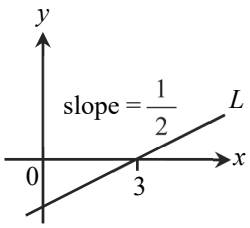
Solution

➥ **Exercise 2A (P.2.21)** 6, 10

Example 2 Level 1

In the figure, the x-intercept of L is 3 and the slope of L is $\frac{1}{2}$.

Find the equation of L.



Solution

The equation of L is

$$y - 0 = \frac{1}{2}(x - 3)$$

$$y = \frac{1}{2}(x - 3)$$

$$2y = x - 3$$

$$\underline{x - 2y - 3 = 0}$$

x-intercept of L is 3

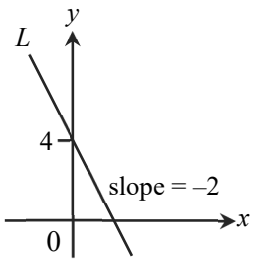
⇩

L passes through (3 , 0)

Instant Drill 2.1

In the figure, the y-intercept of L is 4 and the slope of L is –2.

Find the equation of L.



Solution

The equation of L is

$y - (\quad) = (\quad)(x - \_\_\_)$

$=$

y-intercept of L is 4

⇩

L passes through (___ , ___)

Instant Drill 2.2

Find the equation of the straight line L with x-intercept –4 and slope 2.

Solution

The equation of L is

$y - (\quad) =$

Instant Drill 2.3

Find the equation of the straight line L with y-intercept 2 and slope $-\frac{1}{4}$.

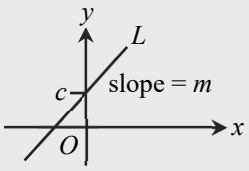
Solution

➥ **Exercise 2A (P.2.21)** 11

Slope-intercept Form

The equation of the straight line L with slope m and y-intercept c is given by:

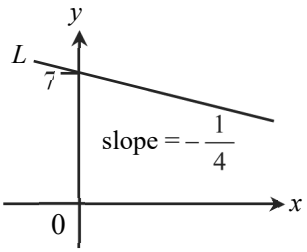
$$y = mx + c$$



Example 3 Level 1

In the figure, the slope of L is $-\frac{1}{4}$ and the y-intercept of L is 7.

Find the equation of L.



Solution

The equation of L is

$$y = -\frac{1}{4}x + 7$$

$$4y = -x + 28$$

$$x + 4y - 28 = 0$$

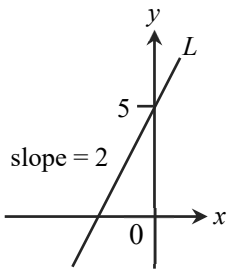
$y = mx + c$, with $m = -\frac{1}{4}$ and $c = 7$

◄ Express the answer in the form $Ax + By + C = 0$.

Instant Drill 3.1

In the figure, the slope of L is 2 and the y-intercept of L is 5.

Find the equation of L.



Solution

The equation of L is

$y = (\quad)x + (\quad)$

$y = mx + c$, with $m = (\quad)$ and $c = (\quad)$

Instant Drill 3.2

Find the equation of the straight line with slope 3 and y-intercept -7.

Solution

The equation of L is

$y =$

Instant Drill 3.3

Find the equation of the straight line with slope -4 and y-intercept 8.

Solution

Instant Drill 3.4

Find the equation of the straight line with slope $\frac{1}{5}$ and y-intercept 2.

Solution

Instant Drill 3.5

Find the equation of the straight line with slope $-\frac{4}{3}$ and y-intercept –1.

Solution

➥ **Exercise 2A (P.2.21)** 7, 11

Example 4 Level 1

In each of the following, find the slope and the y-intercept of the straight line from its equation.

(a) $2x + y = 6$

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

Solution

(a) $2x + y = 6$

$y = -2x + 6$ ◀ ① Express the equation in the form $y = mx + c$.

$\therefore$ The slope is –2 and the y-intercept is 6. ◀ ② Identify the slope and the y-intercept:

$y = mx + c$

slope y-intercept

$y = -2x + 6$

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

$x + 4 = 2y$

$y = \frac{1}{2}x + 2$

$\therefore$ The slope is $\frac{1}{2}$ and the y-intercept is 2.

Instant Drill 4.1

Find the slope and the y-intercept of the straight line $y = 5x + 1$.

Solution

Slope = (____)

y-intercept = (____)

Instant Drill 4.2

Find the slope and the y-intercept of the straight line $y + 5 = 3x$.

Solution

$y + 5 = 3x$

$y =$

Instant Drill 4.3

Find the slope and the y-intercept of the straight line $x + 2y + 2 = 0$.

Solution

Instant Drill 4.4

Find the slope and the y-intercept of the straight line $x - 5y = 0$.

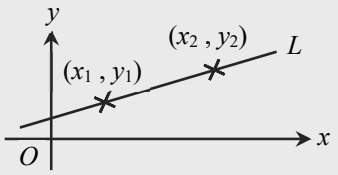
Solution

➥ **Exercise 2A (P.2.21)** 14–17

Two-point Form

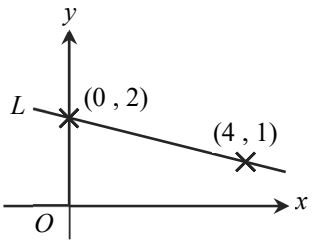
The equation of the straight line L passing through (x_1 , y_1) and (x_2 , y_2) is given by:

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1), \text{ where } x_1 \neq x_2$$



Example 5 Level 1

In the figure, L passes through (0 , 2) and (4 , 1). Find the equation of L.



Solution

The equation of L is

$$y - 2 = \frac{1-2}{4-0}(x - 0)$$

We may also write: $y - 1 = \frac{2-1}{0-4}(x - 4)$

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

$$4y - 8 = -x$$

$$\underline{x + 4y - 8 = 0}$$

◄ Express the equation in the form $Ax + By + C = 0$.

Alternative:

Slope of $L = \frac{1-2}{4-0} = -\frac{1}{4}$ ◄ Find the slope of L first.

The equation of L is

$$y - 2 = -\frac{1}{4}(x - 0)$$

◄ Point-slope form

We may also write: $y - 1 = -\frac{1}{4}(x - 4)$

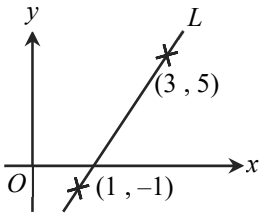
$$y - 2 = -\frac{1}{4}x$$

$$4y - 8 = -x$$

$$\underline{x + 4y - 8 = 0}$$

Instant Drill 5.1

In the figure, L passes through (1 , –1) and (3 , 5). Find the equation of L.



Solution

The equation of L is

$$y - (\quad) = \left(\qquad\qquad\right)[x - (\quad)]$$

Instant Drill 5.2

Find the equation of the straight line passing through $A(2 , 3)$ and $B(0 , 4)$.

Solution

The equation of L is

Instant Drill 5.3

Find the equation of the straight line passing through $A(-3 , -1)$ and with x-intercept 2.

Solution

x-intercept is 2

⇩

Passes through (___ , ___)

Instant Drill 5.4

Find the equation of the straight line with x-intercept -3 and y-intercept 2.

Solution

x-intercept is -3

⇩

Passes through (___ , ___)

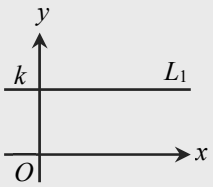
y-intercept is 2

⇩

Passes through (___ , ___)

➥ **Exercise 2A (P.2.21)** 8, 12

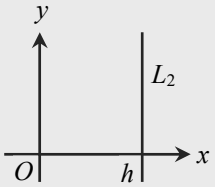
Horizontal Lines



The equation of the horizontal line L_1 is:

$y = k$

Vertical Lines



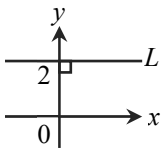
The equation of the vertical line L_2 is:

$x = h$

Example 6 Level 1

In each of the following, find the equation of L.

(a)

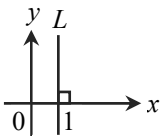


Solution

(a) The equation of L is $\underline{y = 2}$

A line perpendicular to the y-axis is a horizontal line.

(b)



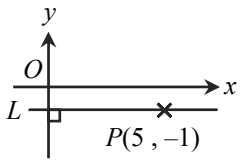
Solution

(b) The equation of L is $\underline{x = 1}$

A line perpendicular to the x-axis is a vertical line.

Instant Drill 6.1

Refer to the figure. Find the equation of L.



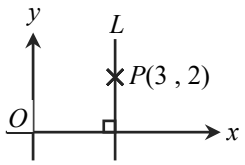
Solution

The equation of L is

The y-coordinate of any point on L is ( ).

Instant Drill 6.2

Refer to the figure. Find the equation of L.



Solution

The equation of L is

The x-coordinate of any point on L is ( ).

Instant Drill 6.3

Find the equation of the straight line L which passes through (1 , 3) and is parallel to the y-axis.

Solution

L is a (horizontal / vertical) line.

Instant Drill 6.4

Find the equation of the straight line L which passes through (–5 , –8) and is parallel to the x-axis.

Solution

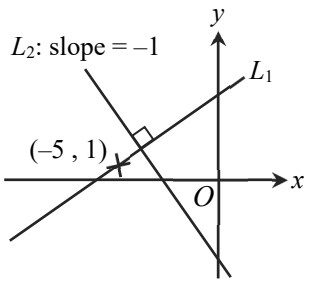
L is a (horizontal / vertical) line.

➥ **Exercise 2A (P.2.21)** 9, 13

Miscellaneous Questions about Finding Equations of Straight Lines

Example 7 Level 1

In the figure, L_1 passes through (–5 , 1). L_2 is perpendicular to L_1 and the slope of L_2 is –1. Find the equation of L_1.



Solution

$\because$ $L_1 \perp L_2$

$\therefore$ Slope of L_1 × slope of L_2 = –1

Slope of L_1 × (–1) = –1

Slope of L_1 = 1

The equation of L_1 is

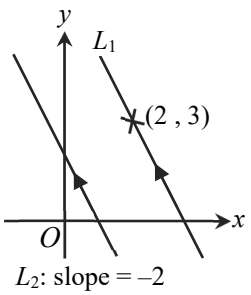
$y - 1 = 1[x - (-5)]$

$y - 1 = x + 5$

$\underline{x - y + 6 = 0}$

Instant Drill 7.1

In the figure, L_1 passes through (2 , 3). L_2 is parallel to L_1 and the slope of L_2 is –2. Find the equation of L_1.



Solution

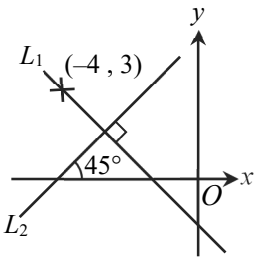
Slope of L_1 =

The equation of L_1 is

$\because$ $L_1 // L_2$
$\therefore$ Slope of L_1 = slope of L_2

Instant Drill 7.2

Refer to the figure. Find the equation of L_1.



Solution

Slope of L_2 = ( ) =

Slope of L_1 × ( ) = ( )

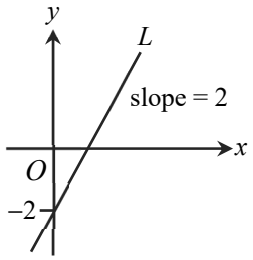
Find the slope of L_2 first.

The equation of L_1 is

➥ **Exercise 2A (P.2.21)** 19, 20

Example 8 Level 2

In the figure, the slope of L is 2 and the y-intercept of L is –2.



(a) Find the equation of L.

(b) If $A(a\ ,\ 0)$ lies on L, find a.

(c) Does $B(3\ ,\ 6)$ lie on L? Explain your answer.

Solution

(a) The equation of L is

$y = 2x - 2$ ◄ $y = mx + c$

$\underline{2x - y - 2 = 0}$

(b) Substitute $(a\ ,\ 0)$ into $2x - y - 2 = 0$.

If a point lies on a line, then the coordinates of the point satisfy the equation of the line.

$2a - 0 - 2 = 0$

$2a = 2$

$a = \underline{\underline{1}}$

(c) Substitute $(3\ ,\ 6)$ into $2x - y - 2 = 0$.

If the coordinates of a point satisfy the equation of the line, then the point lies on the line. Otherwise, the point does not lie on the line.

L.H.S. $= 2(3) - 6 - 2$

$= -2$

$\neq$ R.H.S.

The coordinates of B do not satisfy the equation of L.

$\therefore$ $\underline{B \text{ does not lie on } L.}$

Instant Drill 8.1

The slope of a straight line L is -3 and the y-intercept of L is 6.

(a) Find the equation of L.

(b) If $A(1 , a)$ lies on L, find a.

(c) Does $B(3 , 2)$ lie on L? Explain your answer.

Solution

(a) The equation of L is

(b) Substitute $(1 , a)$ into ( ).

(c) Substitute $(3 , 2)$ into ( ).

L.H.S. =

Instant Drill 8.2

The slope of a straight line L is $\frac{1}{3}$ and L passes through $(-2 , 1)$.

(a) Find the equation of L.

(b) If $A(a , 2)$ lies on L, find a.

(c) Does $B(-5 , 0)$ lie on L? Explain your answer.

Solution

(a) The equation of L is

(b) Substitute ( ) into ( ).

(c) Substitute ( ) into ( ).

➥ **Exercise 2A (P.2.21)** 21–23

★ *Challenging Question* ★

L_1 is a straight line passing through $P(2\ ,\ -3)$ and with slope -2.

(a) Find the equation of L_1.

(b) L_2 is another straight line passing through P and is perpendicular to L_1.

(i) Find the equation of L_2.

(ii) Find the y-intercept of L_2.

Solution

Name: _____ Class: _____( )

Consolidation Exercise 2A (Level 1)

1. Complete the following table.

(*Give the answers correct to 3 significant figures.*)

	Straight line	***Inclination***	***Slope***
(a)	L_1	36°	
(b)	L_2	85°	
(c)	L_3		3
(d)	L_4		0.8

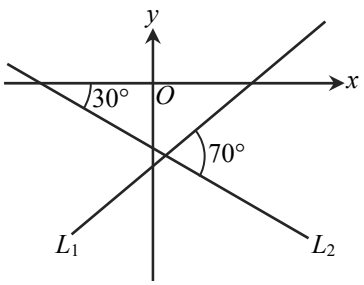
In each of the following, find the slope and the inclination of the straight line passing through the two given points. **[Nos. 2–3]**

(*Give the answers correct to 3 significant figures if necessary.*)

2. $A(-1 , 1)$, $B(4 , 3)$

3. $A(-1 , 3)$, $B(-2 , -2)$

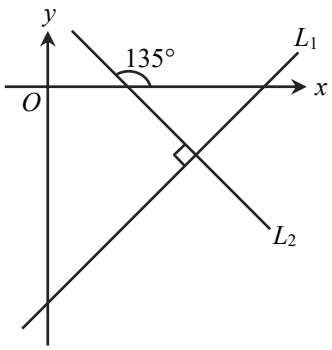
4. Refer to the figure.



(a) Find the inclination of L_1.

(b) Find the slope of L_1, correct to 1 decimal place.

5. In the figure, the straight lines L_1 and L_2 are perpendicular to each other.

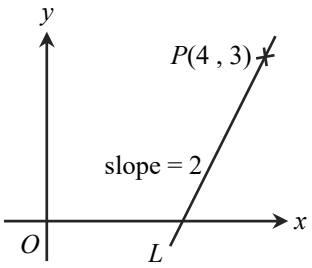


(a) Find the inclination of L_1.

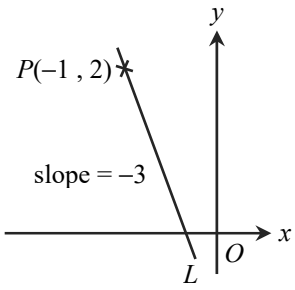
(b) Find the slope of L_1.

In each of the following, find the equation of the straight line L. **[Nos. 6–9]**

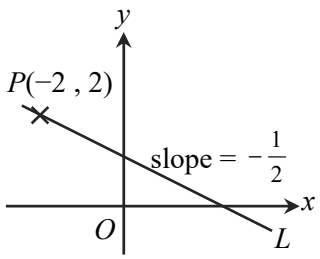
6. **(a)**



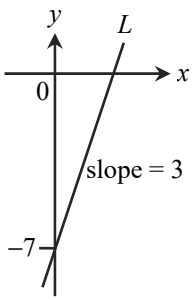
(b)



(c)



7. **(a)**



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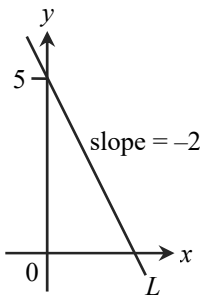
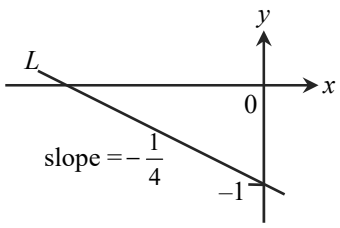
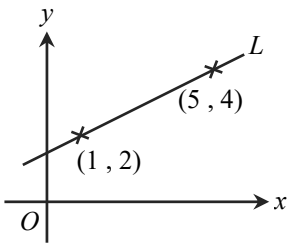


(c)



8. (a)



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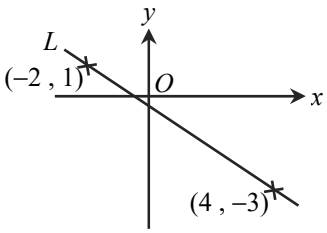

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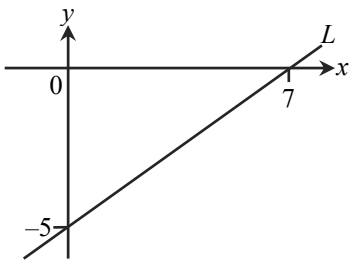
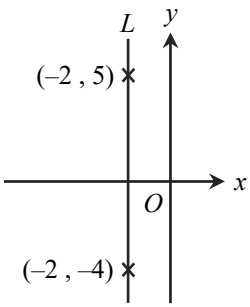


9. (a)



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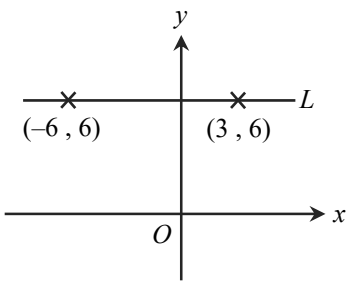
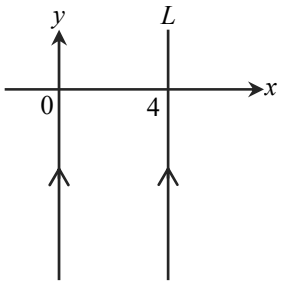


(c)



In each of the following, find the equation of the straight line L satisfying the given conditions.

[Nos. 10–13]

10. (a) L passes through (3 , 1) and the slope of L is 1.

(b) L passes through (–1 , 5) and the slope of L is –2.

11. (a) Slope of $L = -\frac{5}{2}$, y-intercept of $L = 3$

(b) Slope of $L = 4$, x-intercept of $L = -\frac{1}{2}$

12. (a) L passes through $A(5\ ,\ 7)$ and $B(-4\ ,\ -5)$.

(b) x-intercept of $L = 6$, y-intercept of $L = 9$

13. (a) L passes through $A(-8\ ,\ -1)$ and is perpendicular to the y-axis.

(b) L passes through $B(5\ ,\ -4)$ and is parallel to the y-axis.

In each of the following, find the slope and the y-intercept of the straight line from its equation.

[Nos. 14–17]

14. $y = 2x + 1$

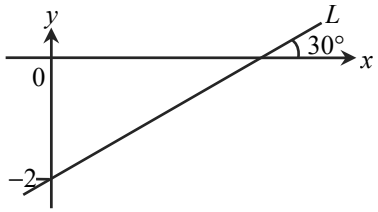
15. $x + 4y = 2$

16. $x - 4y - 28 = 0$

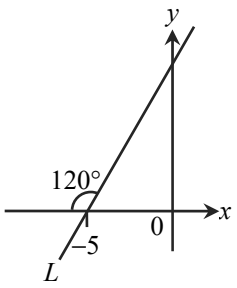
17. $8x + 5y - 40 = 0$

18. In each of the following, find the equation of the straight line L.
(*Leave the radical sign '$\sqrt{\ }$' in the answers if neccessary.*)

(a)



(b)



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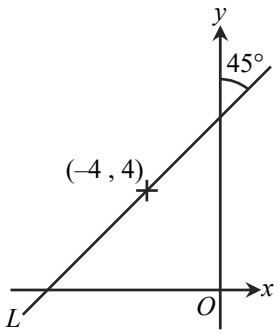
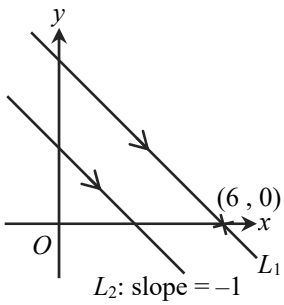
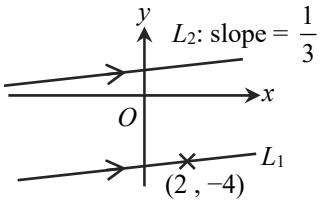


19. In each of the following, find the equation of the straight line L_1.

(a)



(b)



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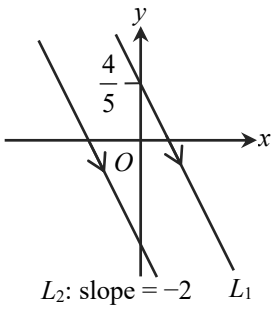
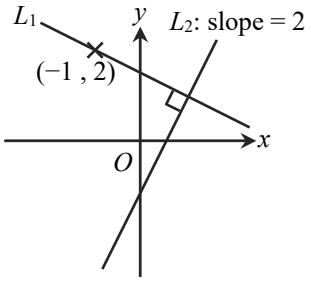
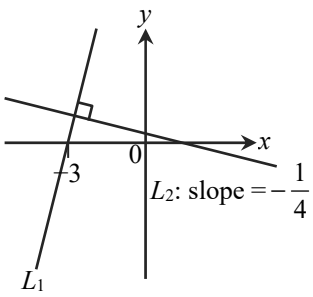


20. In each of the following, find the equation of the straight line L_1.

(a)



(b)



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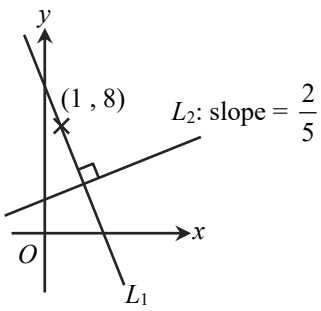


Name: _____ Class: _____( )

Lesson Worksheet 2.3 (*Lite*)

(Refer to Book 4A P.2.27)

General Form of Equations of Straight Lines

Finding the Slope, *x*-intercept and *y*-intercept of a Straight Line

For the straight line $Ax + By + C = 0$,

(i) slope $= -\frac{A}{B}$ $(B \neq 0)$,

(ii) x-intercept $= -\frac{C}{A}$ $(A \neq 0)$,

(iii) y-intercept $= -\frac{C}{B}$ $(B \neq 0)$.

Example 1 Level 1

Find the slope, the x-intercept and the y-intercept of the straight line $3x + 2y + 6 = 0$.

Solution

Slope $= -\frac{3}{2}$

x-intercept $= -\frac{6}{3} = -2$

y-intercept $= -\frac{6}{2} = -3$

$3x + 2y + 6 = 0$
$\uparrow \quad \uparrow \quad \uparrow$
$A \quad B \quad C$

In each of the following, find the slope, the x-intercept and the y-intercept of the straight line.

[Instant Drills 1.1–1.4]

Instant Drill 1.1

$2x + 3y + 7 = 0$

Solution

Slope $= -\frac{(\quad)}{(\quad)}$

x-intercept $= -\frac{(\quad)}{(\quad)}$

y-intercept $= -\frac{(\quad)}{(\quad)}$

For $2x + 3y + 7 = 0$,
$A = (\quad)$, $B = (\quad)$, $C = (\quad)$

Instant Drill 1.2

$4x - 5y - 10 = 0$

Solution

Slope =

x-intercept =

y-intercept =

Instant Drill 1.3

$-x + 4y - 8 = 0$

Solution

Instant Drill 1.4

$5x - y = 0$

Solution

➥ **Exercise 2B (P.2.35)** 1–4

Example 2 Level 1

The slope of the straight line L: $6x + ky - 1 = 0$ is 3, where k is a constant.

(a) Find k.

(b) Find the y-intercept of L.

Solution

(a) Slope of $L = 3$

$$-\frac{6}{k} = 3$$

$$k = \underline{\underline{-2}}$$

$A = 6$, $B = k$, $C = -1$

Slope $= -\frac{A}{B}$

(b) y-intercept $= -\frac{-1}{k}$

$$= \frac{1}{-2}$$

$$= \underline{\underline{-\frac{1}{2}}}$$

y-intercept $= -\frac{C}{B}$

Instant Drill 2.1

The slope of the straight line L: $2x + ky - 3 = 0$ is -1, where k is a constant.

(a) Find k.

(b) Find the y-intercept of L.

Solution

(a) Slope $= -1$

$$\frac{(\quad)}{(\quad)} = -1$$

For $2x + ky - 3 = 0$,

$A = (\quad)$, $B = (\quad)$, $C = (\quad)$

(b) y-intercept $= -\frac{(\quad)}{(\quad)}$

Instant Drill 2.2

The x-intercept of the straight line L: $kx + 4y - 9 = 0$ is 3, where k is a constant.

(a) Find k.

(b) Find the slope of L.

Solution

(a) x-intercept =

(b) Slope =

Instant Drill 2.3

The y-intercept of the straight line L: $3x - y + k = 0$ is -2, where k is a constant.

(a) Find k.

(b) Find the x-intercept of L.

Solution

➥ **Exercise 2B (P.2.35)** 5, 6

Example 3 Level 1

Is the straight line L_1: $2x - y + 1 = 0$ perpendicular to the straight line L_2: $4x + 2y - 3 = 0$? Explain your answer.

Solution

Slope of $L_1 = -\dfrac{2}{-1} = 2$

Slope of $L_2 = -\dfrac{4}{2} = -2$

If slope of $L_1 \times$ slope of $L_2 = -1$, then $L_1 \perp L_2$.
Otherwise, L_1 is not perpendicular to L_2.

$\because$ Slope of $L_1 \times$ slope of $L_2 = 2 \times (-2)$

$= -4$

$\neq -1$

$\therefore$ L_1 is not perpendicular to L_2.

Instant Drill 3.1

Is the straight line L_1: $4x - 3y + 2 = 0$ perpendicular to the straight line L_2: $3x + 4y - 5 = 0$? Explain your answer.

Solution

Slope of $L_1 = -\dfrac{(\quad)}{(\quad)}$

Slope of $L_2 = -\dfrac{(\quad)}{(\quad)}$

Instant Drill 3.2

Is the straight line L_1: $3x - 2y + 1 = 0$ perpendicular to the straight line L_2: $2x + 4y - 3 = 0$? Explain your answer.

Solution

Slope of L_1 =

Slope of L_2 =

Instant Drill 3.3

Is the straight line L_1: $x - 2y - 5 = 0$ parallel to the straight line L_2: $3x - 6y + 1 = 0$? Explain your answer.

Solution

If slope of L_1 = slope of L_2, then $L_1 \parallel L_2$.
Otherwise, L_1 is not parallel to L_2.

➥ **Exercise 2B (P.2.35)** 13, 14

Example 4 Level 1

The straight lines L_1: $kx - 2y + 3 = 0$ and L_2: $x + 2y + 5 = 0$ are perpendicular to each other.

(a) Find k.

(b) Find the x-intercept of L_1.

Solution

(a) Slope of $L_1 = -\dfrac{k}{-2} = \dfrac{k}{2}$

Slope of $L_2 = -\dfrac{1}{2}$

$\because$ $L_1 \perp L_2$

$\therefore$ Slope of $L_1 \times$ slope of $L_2 = -1$

$$\frac{k}{2} \times \left(-\frac{1}{2}\right) = -1$$

$$k = \underline{\underline{4}}$$

$L_1 \perp L_2$

⇓

Slope of $L_1 \times$ slope of $L_2 = -1$

(b) x-intercept of $L_1 = -\dfrac{3}{k}$

$$= \underline{\underline{-\frac{3}{4}}}$$

Instant Drill 4.1

The straight lines L_1: $kx - 3y + 5 = 0$ and L_2: $3x + y - 4 = 0$ are perpendicular to each other.

(a) Find k.

(b) Find the x-intercept of L_1.

Solution

(a) Slope of $L_1 = -\dfrac{(\quad)}{(\quad)}$

Slope of $L_2 = -\dfrac{(\quad)}{(\quad)}$

$\because$ $L_1 \perp L_2$

$\therefore$ Slope of $L_1 \times$ slope of $L_2 = (\quad)$

Instant Drill 4.2

The straight lines L_1: $2x + ky + 9 = 0$ and L_2: $x + 3y - 4 = 0$ are parallel to each other.

(a) Find k.

(b) Find the y-intercept of L_1.

Solution

(a) Slope of L_1 =

$L_1 \parallel L_2$

⇓

Slope of L_1 = slope of L_2

Slope of L_2 =

$\because$ $L_1 \parallel L_2$

$\therefore$

Instant Drill 4.3

The straight lines L_1: $4x - 3y + 12 = 0$ and L_2: $3x + ky - 16 = 0$ have the same y-intercept.

(a) Find k.

(b) Find the slope of L_2.

Solution

Find the y-intercepts of L_1 and L_2 first.

➥ **Exercise 2B (P.2.35)** 9, 10

Example 5 Level 1

The straight line L_1 is perpendicular to the straight line L_2: $2x - y + 3 = 0$. If the y-intercept of L_1 is 1, find the equation of L_1.

Solution

Slope of $L_2 = -\dfrac{2}{-1} = 2$

$\because$ $L_1 \perp L_2$

$\therefore$ Slope of $L_1 \times$ slope of $L_2 = -1$

Slope of $L_1 \times 2 = -1$

Slope of $L_1 = -\dfrac{1}{2}$

The equation of L_1 is

$$y = -\frac{1}{2}x + 1$$

$$2y = -x + 2$$

$$\underline{x + 2y - 2 = 0}$$

Equation of the line with slope m and y-intercept c is:
$y = mx + c$

Instant Drill 5.1

The straight line L_1 is perpendicular to the straight line L_2: $x - 4y + 3 = 0$. If the y-intercept of L_1 is 5, find the equation of L_1.

Solution

Slope of $L_2 = -\dfrac{(\quad)}{(\quad)}$

$\because$ $L_1 \perp L_2$

$\therefore$ Slope of $L_1 \times$ slope of $L_2 = (\quad)$

Instant Drill 5.2

The straight line L_1 is parallel to the straight line L_2: $x + 3y + 2 = 0$. If the y-intercept of L_1 is -3, find the equation of L_1.

Solution

Slope of L_2 =

$\because$ $L_1 // L_2$

$\therefore$

Instant Drill 5.3

The straight line L_1 passes through $(2 , -4)$ and is parallel to the straight line L_2: $3x + 5y + 1 = 0$. Find the equation of L_1.

Solution

Equation of the line with slope m and passing through (x_1 , y_1) is:

$$y - y_1 = m(x - x_1)$$

➥ **Exercise 2B (P.2.35)** 15–18

★ *Challenging Question* ★

The straight line L_1: $2x - y + 4 = 0$ cuts the x-axis and the y-axis at A and B respectively. The straight line L_2 is perpendicular to L_1. L_2 intersects L_1 at B and cuts the x-axis at C.

(a) Find the coordinates of A and B.

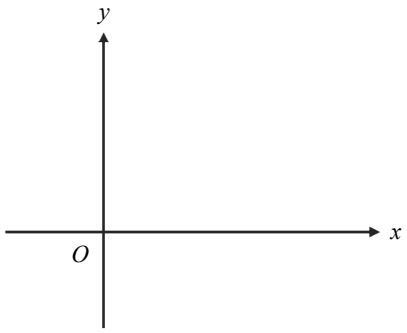
(b) **(i)** Find the equation of L_2.

(ii) Find the coordinates of C.

(c) Find the area of $\triangle ABC$.

Solution

Find the coordinates of A and B first.
Then sketch L_1 and L_2.



Name: _____ Class: _____( )

Consolidation Exercise 2B (Level 1)

Find the slope, the x-intercept and the y-intercept of each of the following straight lines. **[Nos. 1–4]**

1. $3x + 4y + 2 = 0$

2. $5x - 3y + 1 = 0$

3. $y - 7 = 6(x + 1)$

4. $y - 2 = \frac{4}{5}(x + 10)$

5. The slope of the straight line L: $2x + ky + 6 = 0$ is 1.

(a) Find the value of k.

(b) Find the x-intercept and the y-intercept of L.

6. The x-intercept of the straight line L: $7x + 2y - k = 0$ is -4.

(a) Find the value of k.

(b) Find the slope and the y-intercept of L.

7. The straight lines L_1: $5x + 8y - 16 = 0$ and L_2: $6x - ky - 12 = 0$ have the same y-intercept. Find the value of k.

8. The straight lines L_1: $kx - 9y - 18 = 0$ and L_2: $x + ky - 2 = 0$ intersect at a point lying on the x-axis. Find the value of k.

9. The straight lines L_1: $kx + 6y - 10 = 0$ and L_2: $4x + 12y - 9 = 0$ are parallel to each other.

(a) Find the value of k.

(b) Find the x-intercept of L_1.

10. The straight line L_1: $8x - ky + 7 = 0$ is perpendicular to the straight line L_2: $5x + 10y - 4k = 0$.

(a) Find the value of k.

(b) Find the y-intercept of L_2.

11. The equation of the straight line L is $8x + 6y - 9 = 0$.

(a) Find the y-intercept of L.

(b) The slope of the straight line L_1 is $-\frac{7}{2}$. If the y-intercepts of L_1 and L are the same, find the equation of L_1.

12. The equation of the straight line L_1 is $8x - 5y - 7 = 0$. The x-intercept of the straight line L_2 is 3. If L_1 intersects L_2 at a point lying on the y-axis, find the equation of L_2.

Explain **13.** In each of the following, is the straight line L_1 parallel to the straight line L_2? Explain your answers.

(a) L_1: $8x - 2y - 3 = 0$, L_2: $4x - y + 7 = 0$

(b) L_1: $5x - 4y + 2 = 0$, L_2: $10x + 8y - 11 = 0$

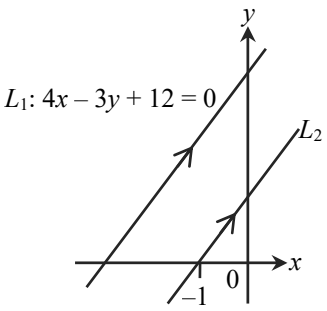
Explain **14.** In each of the following, is the straight line L_1 perpendicular to the straight line L_2? Explain your answers.

(a) L_1: $9x + 2y - 6 = 0$, L_2: $2x + 9y - 1 = 0$

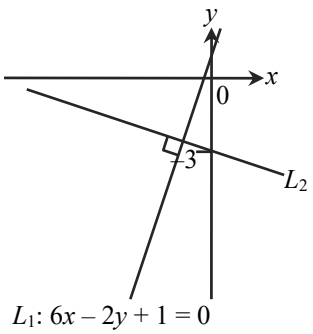
(b) L_1: $3x - 8y + 5 = 0$, L_2: $24x + 9y - 4 = 0$

In each of the following, find the equation of the straight line L_2. **[Nos. 15–17]**

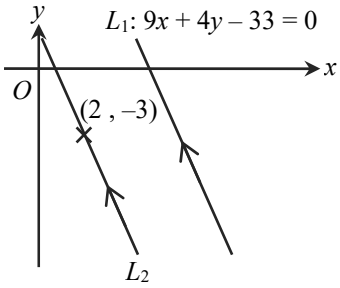
15.



16.



17.



18. The equation of the straight line L is $x + 3y - 9 = 0$.

(a) L_1 is a straight line passing through $(-6 , -5)$. If the x-intercepts of L_1 and L are the same, find the equation of L_1.

(b) L_2 is a straight line passing through $(7 , -6)$. If the y-intercepts of L_2 and L are the same, find the equation of L_2.

19. The equation of the straight line L is $3x - y + 4 = 0$.

(a) Find the equation of the straight line L_1 passing through $(-5 , -3)$ and parallel to L.

(b) Find the equation of the straight line L_2 passing through $(5 , -2)$ and perpendicular to L.

Name: _____ Class: _____( )

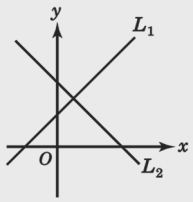
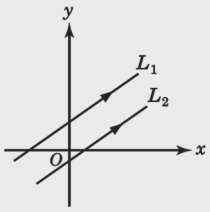
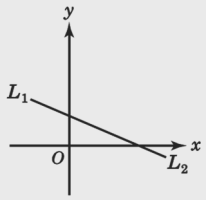
Lesson Worksheet 2.4 (*Lite*)

(Refer to Book 4A P.2.39)

Possible Intersection of Two Straight Lines

Number of Points of Intersection of Two Straight Lines

For two non-vertical lines L_1: $y = m_1x + c_1$ and L_2: $y = m_2x + c_2$, we have the following three cases.

Case 1: Different slopes	**Case 2: Same slope and different *y*-intercepts**	**Case 3: Same slope and same *y*-intercept**
$m_1 \neq m_2$	$m_1 = m_2$ and $c_1 \neq c_2$	$m_1 = m_2$ and $c_1 = c_2$
		
1 point of intersection	**0** points of intersection	**infinitely many** points of intersection

Example 1 Level 1

In each of the following, find the number of points of intersection of the straight lines L_1 and L_2.

(a) L_1: $y = x + 2$, L_2: $y = 2x + 4$

(b) L_1: $y = -3x + 7$, L_2: $3x + y + 5 = 0$

(c) L_1: $y = 2x + 1$, L_2: $4x - 2y + 2 = 0$

Solution

(a) Slope of $L_1 = 1$

Slope of $L_2 = 2$

Slope of $L_1 \neq$ slope of L_2

$\therefore$ L_1 and L_2 have 1 point of intersection. ◄ $m_1 \neq m_2$: **Case 1**

(b) Slope of $L_1 = -3$

Slope of $L_2 = -\dfrac{3}{1} = -3$

Slope of L_1 = slope of L_2 ◄ $m_1 = m_2$: **Case 2** or **3**

y-intercept of $L_1 = 7$

y-intercept of $L_2 = -\dfrac{5}{1} = -5$

y-intercept of $L_1 \neq y$-intercept of L_2

$\therefore$ L_1 and L_2 have 0 points of intersection. ◄ $c_1 \neq c_2$: **Case 2**

(c) Slope of $L_1 = 2$

Slope of $L_2 = -\dfrac{4}{-2} = 2$

Slope of L_1 = slope of L_2 ◄ $m_1 = m_2$: **Case 2** or **3**

y-intercept of $L_1 = 1$

y-intercept of $L_2 = -\dfrac{2}{-2} = 1$

y-intercept of L_1 = y-intercept of L_2

$\therefore$ L_1 and L_2 have infinitely many points of intersection. ◄ $c_1 = c_2$: **Case 3**

Instant Drill 1.1

Find the number of points of intersection of the straight lines L_1: $y = 2x$ and L_2: $y = 4x + 1$.

Solution

Slope of L_1 = ( )

Slope of L_2 = ( )

Slope of L_1 (= / ≠) slope of L_2

Step 1: Compare the slopes.
Step 2: If the slopes are the same, compare the y-intercepts.

Instant Drill 1.2

Find the number of points of intersection of the straight lines L_1: $y = -2x + 1$ and L_2: $4x + 2y + 3 = 0$.

Solution

Slope of L_1 =

Slope of L_2 =

Instant Drill 1.3

Find the number of points of intersection of the straight lines L_1: $5x + y - 1 = 0$ and L_2: $10x + 2y - 2 = 0$.

Solution

➥ **Exercise 2C (P.2.46)** 1–8

Example 2 Level 1

Two straight lines L_1: $y = ax + 16$ and L_2: $5x - y + 11 = 0$ have no points of intersection. Find a.

Solution

Slope of L_1 = slope of L_2

If L_1 and L_2 have no points of intersection, slope of L_1 = slope of L_2 (i.e. **Case 2**).

$$a = -\frac{5}{-1}$$

$$= \underline{5}$$

Instant Drill 2.1

Two straight lines L_1: $kx - y + 9 = 0$ and L_2: $9x + 3y + 7 = 0$ have no points of intersection. Find k.

Solution

Slope of L_1 = slope of L_2

=

Instant Drill 2.2

Two straight lines L_1: $2kx + y + 5 = 0$ and L_2: $8x - y - 2 = 0$ have no points of intersection. Find k.

Solution

Slope of L_1 (= / ≠) slope of L_2

➥ **Exercise 2C (P.2.46)** 18

Coordinates of the Point of Intersection of Two Intersecting Lines

To find the coordinates of the point of intersection of two straight lines L_1: $A_1x + B_1y + C_1 = 0$ and L_2: $A_2x + B_2y + C_2 = 0$, we can solve

$$\begin{cases} A_1x + B_1y + C_1 = 0 \\ A_2x + B_2y + C_2 = 0 \end{cases}.$$

Example 3 Level 1

Two straight lines L_1: $x + y = 3$ and L_2: $x - y = 1$ intersect at the point P. Find the coordinates of P.

Solution

Method of Substitution	Method of Elimination
$\begin{cases} x + y = 3 \text{ .....} \textbf{(1)} \\ x - y = 1 \text{ .....} \textbf{(2)} \end{cases}$	$\begin{cases} x + y = 3 \text{ .....} \textbf{(4)} \\ x - y = 1 \text{ .....} \textbf{(5)} \end{cases}$
From **(1)**, $x = 3 - y$ ..... **(3)**	**(4)** + **(5)**: $2x = 4$
Substitute **(3)** into **(2)**.	$x = 2$
$(3 - y) - y = 1$	Substitute $x = 2$ into **(4)**.
$-2y = -2$	$2 + y = 3$
$y = 1$	$y = 1$
Substitute $y = 1$ into **(3)**.	$\therefore$ The coordinates of P are (2 , 1).
$x = 3 - 1 = 2$	
$\therefore$ The coordinates of P are (2 , 1).	

Instant Drill 3.1

Two straight lines L_1: $x - 2y = -6$ and L_2: $y = 2x$ intersect at the point P. Find the coordinates of P.

Solution

$\begin{cases} x - 2y = -6 \text{ .....} \textbf{(1)} \\ y = 2x \text{ .....} \textbf{(2)} \end{cases}$

Substitute **( )** into **( )**.

In each of the following, the two given straight lines intersect at the point P. Find the coordinates of P.

[Instant Drills 3.2–3.5]

Instant Drill 3.2

L_1: $2x - y = 7$, L_2: $x - y = 2$

Solution

$\begin{cases} 2x - y = 7 \text{ ..... } (\quad) \\ x - y = 2 \text{ ..... } (\quad) \end{cases}$

Instant Drill 3.3

L_1: $3x + 4y = -20$, L_2: $3x - 2y = -8$

Solution

Instant Drill 3.4

L_1: $4x + 3y = 3$, L_2: $2x - 3y = -21$

Solution

Instant Drill 3.5

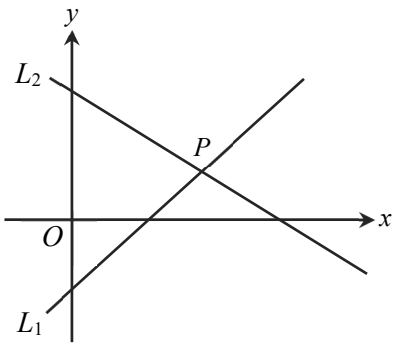
L_1: $x - 2y - 5 = 0$, L_2: $3x + 4y - 5 = 0$

Solution

➥ **Exercise 2C (P.2.46)** 9–12

Example 4 Level 1

In the figure, two straight lines L_1: $3x - 4y - 7 = 0$ and L_2: $x + 4y - 13 = 0$ intersect at the point P.



(a) Find the coordinates of P.

(b) Find the equation of the straight line L_3 passing through P and with slope -2.

Solution

(a) $\begin{cases} 3x - 4y - 7 = 0 \text{ ..... (1)} \\ x + 4y - 13 = 0 \text{ ..... (2)} \end{cases}$

(1) + **(2)**: $4x - 20 = 0$

$x = 5$

Substitute $x = 5$ into **(2)**.

$5 + 4y - 13 = 0$

$4y = 8$

$y = 2$

$\therefore$ The coordinates of P are $(5 , 2)$.

(b) The equation of L_3 is

$y - 2 = -2(x - 5)$

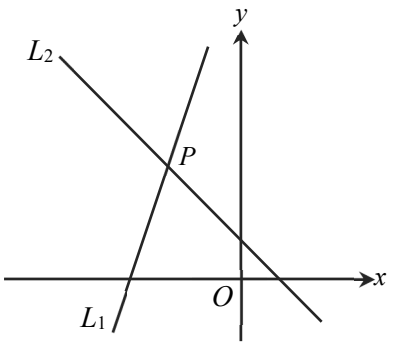
$y - 2 = -2x + 10$

$2x + y - 12 = 0$

Equation of the line passing through (x_1 , y_1) and with slope m:
$y - y_1 = m(x - x_1)$

Instant Drill 4.1

In the figure, two straight lines L_1: $3x - y + 9 = 0$ and L_2: $x + y - 1 = 0$ intersect at the point P.



(a) Find the coordinates of P.

(b) Find the equation of the straight line L_3 passing through P and with slope -3.

Solution

(a) $\begin{cases} 3x - y + 9 = 0 \text{ ..... (1)} \\ x + y - 1 = 0 \text{ ..... (2)} \end{cases}$

(b) The equation of L_3 is

$y - (\quad) = (\quad)[x - (\quad)]$

Instant Drill 4.2

It is given that two straight lines L_1: $x + 2y - 2 = 0$ and L_2: $4x - y - 17 = 0$ intersect at the point P.

(a) Find the coordinates of P.

(b) Find the equation of the straight line L_3 passing through P and $(0 , -3)$.

Solution

(a) $\begin{cases} x + 2y - 2 = 0 \text{ ..... ( )} \\ 4x - y - 17 = 0 \text{ ..... ( )} \end{cases}$

(b) The equation of L_3 is

➥ **Exercise 2C (P.2.46)** 14, 15

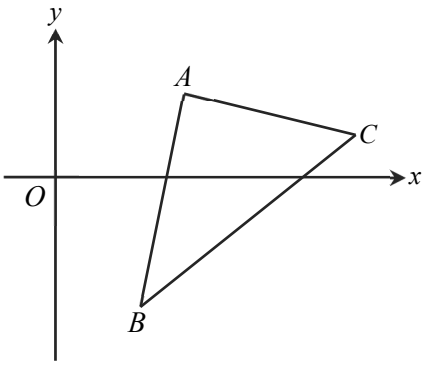
★ *Challenging Question* ★

$A(6\ ,\ 4)$, $B(4\ ,\ -6)$ and $C(14\ ,\ 2)$ are the vertices of $\triangle ABC$. M and N are the mid-points of AB and BC respectively.

(a) Find the coordinates of M and N.

(b) Find the equations of AN and CM.

(c) Find the coordinates of the point of intersection of AN and CM.



Solution

Name: _____ Class: _____( )

Consolidation Exercise 2C (Level 1)

In each of the following, find the number of points of intersection of the straight lines L_1 and L_2.

[Nos. 1–8]

1. L_1: $x + 3y = 5$, L_2: $2x + 5y + 1 = 0$

2. L_1: $2x + 2y + 7 = 0$, L_2: $3x + 3y - 8 = 0$

3. L_1: $y = -\frac{3}{2}x - 1$, L_2: $x = 4$

4. L_1: $5x - 7y + 5 = 0$, L_2: $5x - 7y - 3 = 0$

5. L_1: $2y = 4x - 3$, L_2: $12x - 6y - 9 = 0$

6. L_1: $y = -\frac{2}{3}x + 2$, L_2: $12x + 18y + 5 = 0$

7. L_1: $-4x + 3y + 4 = 0$, L_2: $8x - 6y - 8 = 0$

8. L_1: $8x - 8y + 9 = 0$, L_2: $6x + 6y + 7 = 0$

In each of the following, find the coordinates of the point of intersection of the straight lines L_1 and L_2.

[Nos. 9–12]

9. L_1: $y = 3x + 2$, L_2: $2x + 5y + 7 = 0$

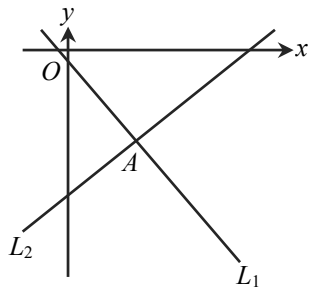
10. L_1: $x - y - 5 = 0$, L_2: $9x - y + 27 = 0$

11. L_1: $5x - 2y = 3$, L_2: $x + 3y = 4$

12. L_1: $4x + 3y - 6 = 0$, L_2: $9x + 5y - 3 = 0$

Explain **13.** Let k be a non-zero constant. Do L_1: $2kx + ky + 9 = 0$ and L_2: $y = -2x + 8k$ intersect? Explain your answer.

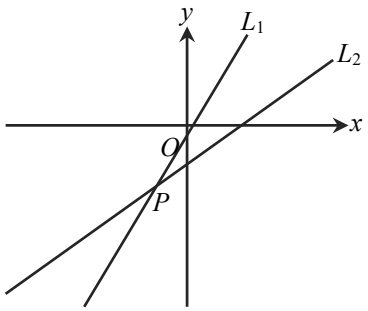
14. In the figure, two straight lines L_1: $7x + 6y + 3 = 0$ and L_2: $4x - 5y - 32 = 0$ intersect at the point A.



(a) Find the coordinates of A.

(b) Find the equation of the straight line passing through A and with y-intercept -6.

15. Two straight lines L_1: $5x - 3y - 1 = 0$ and L_2: $5x - 7y - 9 = 0$ intersect at the point P.



(a) Find the coordinates of P.

(b) Find the equation of the straight line which passes through P and is perpendicular to the straight line $4x + 3y + 17 = 0$.

16. The equation of the straight line L_1 is $x + 2y + 10 = 0$. The straight line L_2 passes through $(5 , 5)$ and $(-7 , -4)$.

(a) Find the equation of L_2.

(b) Find the coordinates of the point of intersection of L_1 and L_2.

17. The equation of the straight line L_1 is $2x + 3y + 20 = 0$. The straight line L_2 with y-intercept 2 is perpendicular to L_1.

(a) Find the equation of L_2.

(b) Find the coordinates of the point of intersection of L_1 and L_2.

Name	
Class	( )
Date	
Marks	

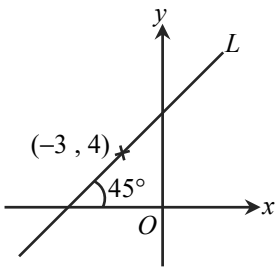
2 Equations of Straight Lines

Section Test 2A

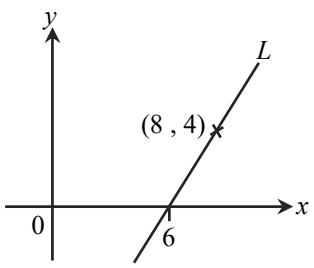
(§2.1 Slope and Inclination, §2.2 Finding Equations of Straight Lines)

1. Find the slope and the inclination of the straight line L passing through $A(5 , 2)$ and $B(-1 , 0)$. (*Give the answers correct to 3 significant figures if necessary.*) (4 marks)

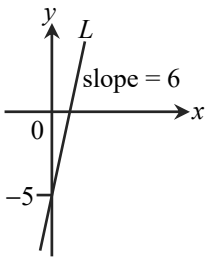
2. In the figure, the straight line L with inclination 45° passes through $(-3 , 4)$. Find the equation of L. (2 marks)



3. Refer to the figure. Find the equation of L. (2 marks)



4. In the figure, the slope and the y-intercept of the straight line L are 6 and -5 respectively. Find the equation of L. (2 marks)



END OF TEST

Name	
Class	( )
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Marks	

2 Equations of Straight Lines

Section Test 2B

(§2.3 General Form of Equations of Straight Lines)

1. The slope of the straight line L: $4x + ky + 24 = 0$ is $\frac{4}{3}$, where k is a non-zero constant.

(a) Find the value of k. (2 marks)

(b) Find the x-intercept of L. (1 mark)

2. The straight lines L_1: $3x + ky - 2 = 0$ and L_2: $2x - y + 3 = 0$ are perpendicular to each other.

(a) Find the value of k. (2 marks)

(b) Find the y-intercept of L_1. (1 mark)

3. The equation of the straight line L_1 is $x + 7y = 0$. The straight line L_2 cuts the y-axis at (0 , 6) and $L_2 // L_1$.

(a) Find the equation of L_2. (3 marks)

(b) If L_2 cuts the x-axis at the point B, find the equation of the vertical line passing through B. (2 marks)

END OF TEST

Name	
Class	( )
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Marks	

2 Equations of Straight Lines

Section Test 2C

(§2.4 Possible Intersection of Two Straight Lines)

1. Find the number of points of intersection of the straight lines L_1: $y = 4$ and L_2: $2x + y - 4 = 0$.

(2 marks)

2. If the straight lines L_1: $3x + 4y - 6 = 0$ and L_2: $6x + 8y + k = 0$ have infinitely many points of intersection, find the value of k. (2 marks)

3. If the straight lines L_1: $kx - 6y + 5 = 0$ and L_2: $7x + 2y - 1 = 0$ do not intersect, find the value of k.

(2 marks)

4. Explain The slope of the straight line L_1 is negative. Lillian claims that L_1 intersects the straight line L_2: $5x - 2y + 7 = 0$ at only one point. Do you agree? Explain your answer. (2 marks)

5. Find the coordinates of the point of intersection of the straight lines L_1: $7x - 9y + 11 = 0$ and L_2: $x + y - 3 = 0$. (3 marks)

END OF TEST

2 Equations of Straight Lines

Chapter Test 2 Lite

Name	
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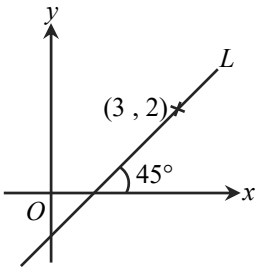
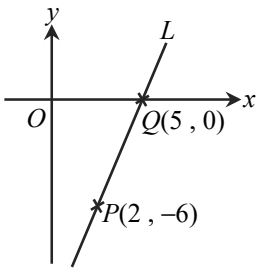
1. In each of the following, find the equation of the straight line L.

(a) (3 marks)



(b) (2 marks)



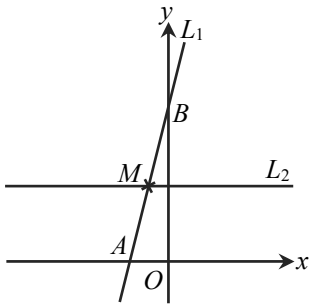
2. If the straight lines L_1: $y = 3x - 2$ and L_2: $kx - 2y + 4 = 0$ are parallel to each other, find the value of k. (2 marks)

3. The straight line L_1 passes through $(-5, -4)$ and $(1, -3)$. The straight line L_2 is perpendicular to L_1.

(a) Find the slope of L_2. (3 marks)

(b) If the y-intercept of L_2 is -12, find the equation of L_2. (2 marks)

4. In the figure, the straight line L_1: $4x - y + 8 = 0$ cuts the x-axis and the y-axis at A and B respectively. M is the mid-point of AB. The straight line L_2 is a horizontal line passing through M.



(a) Find the coordinates of A and B. (2 marks)

(b) Find the coordinates of M. (2 marks)

(c) Write down the equation of L_2. (1 mark)

5. Two straight lines L_1: $ax + y - b = 0$ and L_2: $bx + 2y - 12 = 0$ have infinitely many points of intersection. Find the values of a and b. (4 marks)

6. Two straight lines L_1: $4x - y - 5 = 0$ and L_2: $3x + y - 9 = 0$ intersect at the point A.

(a) Find the coordinates of A. (3 marks)

Explain **(b)** The straight line L_3 passes through A and its slope is -3. Do L_2 and L_3 intersect at only one point? Explain your answer. (3 marks)

Multiple-choice Questions

(*Each of the following questions carries 2 marks.*)

7. The straight line L_1 passing through $(-1\ ,\ 6)$ is parallel to the straight line L_2: $5x - 4y - 7 = 0$. Find the equation of L_1.

A. $4x + 5y - 26 = 0$

B. $4x + 5y - 29 = 0$

C. $5x - 4y + 26 = 0$

D. $5x - 4y + 29 = 0$

8. $P(2\ ,\ -5)$ is rotated clockwise about the origin through 90° to the point Q. The straight line L passes through P and Q. Find the equation of L.

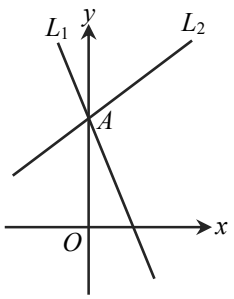
A. $x - y - 7 = 0$

B. $x + y + 3 = 0$

C. $3x + 7y + 29 = 0$

D. $7x - 3y - 29 = 0$

9. In the figure, the straight line L_1: $5x + 2y - 8 = 0$ cuts the y-axis at the point A. L_2 is a straight line passing through A and its slope is $\frac{3}{4}$. Find the equation of L_2.



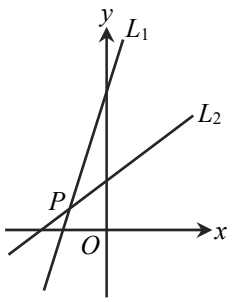
A. $3x - 4y - 12 = 0$

B. $3x - 4y + 16 = 0$

C. $15x - 20y - 24 = 0$

D. $15x - 20y + 32 = 0$

10. In the figure, the equations of the straight lines L_1 and L_2 are $ax - y + b = 0$ and $cx - y + d = 0$ respectively. P is the point of intersection of L_1 and L_2. Which of the following are true?



I. $a > c$

II. $b > d$

III. x-coordinate of $P = \frac{d-b}{a-c}$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

END OF TEST