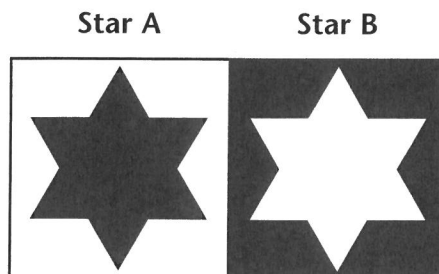




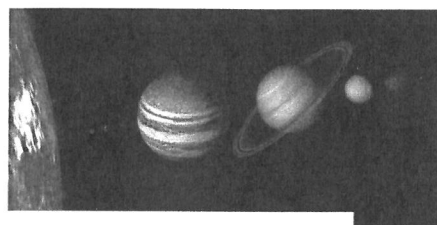
**OPTICAL ILLUSION** The brain sometimes makes interpretation errors that produce optical illusions or perceptions that differ from reality.

- What optical illusion do the adjacent illustrations produce?
- The perimeter of Star A is 120 cm. The vertices of the star are all formed by isometric equilateral triangles. Superimpose a Cartesian plane on Star A in such a way that the coordinates of the lowest vertex is aligned with the point (0, 0). Find the coordinates of the other vertices of the star.



The air temperature on Mars varies greatly. On a given day, the temperature at 8 a.m. was  $-42^{\circ}\text{C}$ . In each of the following cases, indicate the current temperature if since 8 a.m. the following occurred:

- The temperature increased by  $50^{\circ}\text{C}$ .
- The temperature decreased by  $50^{\circ}\text{C}$ .
- The temperature varied by  $-50^{\circ}\text{C}$ .
- The recorded temperatures showed a difference of  $50^{\circ}\text{C}$ .



The maximum temperature on the planets in our solar system varies between  $-219^{\circ}\text{C}$  on Neptune and  $482^{\circ}\text{C}$  on Venus. The hottest temperature recorded on Earth was  $58^{\circ}\text{C}$  (in El Azyzia, Libya, on September 13, 1922).



To find the length of a segment whose endpoints are  $A(2, 3)$  and  $B(5, 7)$ , Aglaé does the following calculation:  $\sqrt{(5-2)^2 + (7-3)^2}$ , while Marlene does this calculation:  $\sqrt{(2-5)^2 + (3-7)^2}$ . Explain why the results are the same.



Using the coordinates provided, find:

- $m \overline{AB}$
- $m \overline{CD}$
- $m \overline{EF}$

$A(3, 4)$	$B(-3, 8)$
$C(-5, 6)$	$D(-10, -12)$
$E(-100, -25)$	$F(40, 35)$



In each case, identify the type of quadrilateral that has the following coordinates for its four vertices.

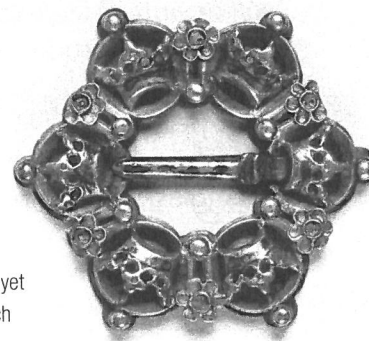
- $A(3, -2), B(4, -1), C(7, 0), D(6, -1)$
- $E(6, 1), F(3, -4), G(-2, -7), H(1, -2)$
- $I(6, 10), J(5, 13), K(11, 15), L(12, 12)$
- $M(-2, -1), N(-1, 1), O(3, 1), P(4, -1)$

- 6** A seamstress sews buttons on a shirt. Below is the distance between each button and the collar.

1 <sup>st</sup> button	2 <sup>nd</sup> button	3 <sup>rd</sup> button	4 <sup>th</sup> button	5 <sup>th</sup> button
2 cm	12 cm	22 cm	32 cm	42 cm

If the first button corresponds to point A and the fifth button to point B:

- into what ratio does the second button divide segment AB?
- into what ratio does the fourth button divide segment BA?
- state the position of the 3rd button by using a fraction of  $\overline{AB}$ .



In the Middle Ages, the button had not yet been invented. A buckle or metal brooch called a "fermail" was used to hold or fasten together two sides of garments.

- 7** Identify the type of triangle defined by the following vertices:

- $A(10, 20), B(10, 60), C(40, 20)$
- $D(0, 0), E(1, \sqrt{3}), F(2, 0)$
- $G(0, -3), H(-1, 1), I(3, 2)$
- $J(2, 1), K(1, -1), L(-2, -1)$

- 8** Determine if the slope of a segment whose endpoints are  $A(x_1, y_1)$  and  $B(x_2, y_2)$  is greater, less than or equal to 0, given that from A to B, the following occur:

- The change in x-values is greater than 0 and the change in y-values is less than 0.
- $\Delta x < 0$  and  $\Delta y > 0$ .
- $\Delta x < 0$  and  $\Delta y < 0$ .
- The change in x-values is less than 0, and  $\Delta y = 0$ .

- 9** Calculate the slope of a segment whose endpoints are:

- $A(3, 5), B(5, 13)$
- $B(-2, 4), C(3, 19)$
- $C(-2, -3), D(24, -3)$
- $D(2, 3), E(-2, -8)$

- 10** Find the coordinates of a point:

- located in the middle of segment AB if the endpoints are  $A(2, 3)$  and  $B(4, -11)$
- situated  $\frac{3}{5}$  along segment CD if the endpoints are  $C(-3, -1)$  and  $D(2, 14)$
- situated  $\frac{2}{3}$  along segment EF if the endpoints are  $E(3, 4)$  and  $F(1, -5)$
- that divides segment BC if the endpoints are  $B(3, -2)$  and  $C(-2, 3)$ , in a ratio of 2:3

- 11** Find the circumference of a pool whose diameter has endpoints  $A(-1, -9)$  and  $B(-5, 5)$ .



*The Guinness Book of World Records* recognizes San Alfonso del Mar, in Algarrobo, Chile, as the largest swimming pool in the world. The lagoon has a length of more than 1 km and has a depth of 3.5 m. It holds approximately 250 million litres of salt water.

- 12** In the adjacent Cartesian plane, right trapezoid  $ABCD$  has been drawn and the coordinates of its vertices are provided.

a) Find the midpoints of  $\overline{AD}$  and  $\overline{BC}$  and label these points  $M_1$  and  $M_2$  respectively.

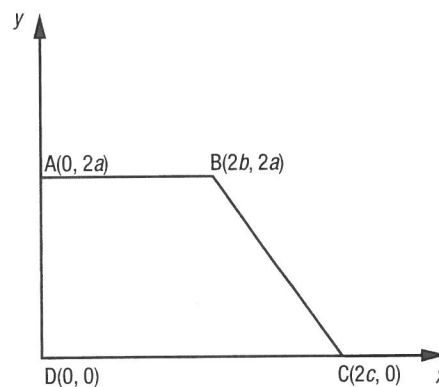
b) Calculate the slope of segment:

- 1)  $AB$
- 2)  $M_1M_2$
- 3)  $DC$

c) Using an algebraic expression, define the length of:

- 1)  $AB$
- 2)  $M_1M_2$
- 3)  $DC$

d) Is it correct to state that the segment connecting the midpoints of the non-parallel sides of a right trapezoid is parallel to the bases and that the length of this segment is equal to half the sum of the bases? Justify your answer.



- 13** Point  $P(5, 8)$  is situated  $\frac{3}{4}$  along segment  $EH$ . What are the coordinates of  $H$  if those of point  $E$  are  $(-1, -7)$ ?

- 14** Below is some information on two neighbouring cities:

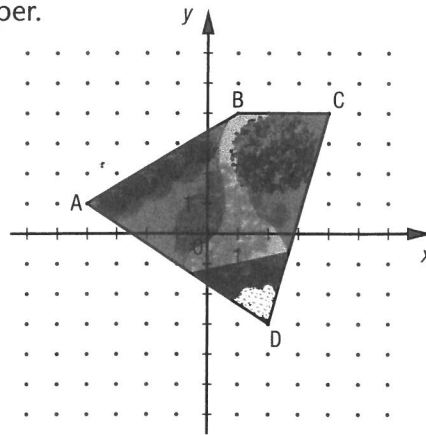
- City **A** is located at  $(15, 6)$ .
- City **B** is located on the  $y$ -axis.
- The distance between the two cities is 17 km.

Find the coordinates of City **B**.

15

The adjacent figure represents the work of a landscaper. The perimeter is edged with a decorative border that costs \$5.95/m. The scale is in metres. Find:

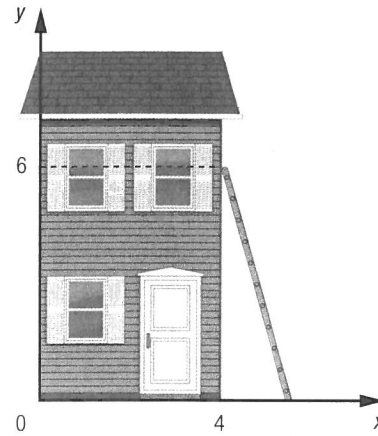
- the total cost of the decorative border
- the coordinates of an automatic sprinkler if it were situated at the midpoint of  $\overline{AB}$
- the coordinates of an automatic sprinkler if it were situated  $\frac{4}{7}$  along segment  $\overline{DC}$



16

The slope of the ladder leaning against this building is -4. The scale is in metres. Find:

- the coordinates corresponding to the foot of the ladder
- the distance between the foot of the ladder and the building
- the length of the ladder



**COLLEGE STUDIES** Enrollment in post-secondary schools varies according to various factors including those that are economic. Given that the situation from 2005 to 2009 can be graphically represented by a straight line, find the number of college students enrolled in 2007.

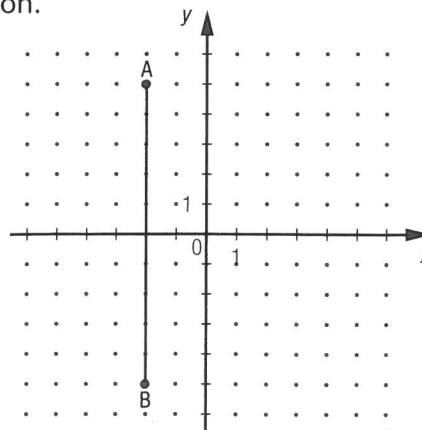
College enrollment

Year	Number of students
2000	159 617
2004	154 026
2005	153 290
2009	176 473

18

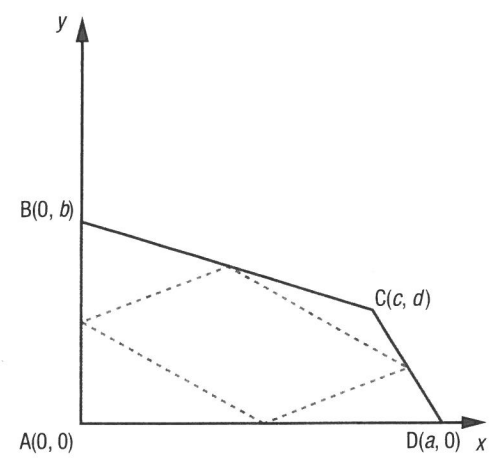
The slope of a line is a value that defines its inclination.

- What is the angle formed by line  $\overline{AB}$  and the  $x$ -axis?
- What is the change in  $x$ -values from  $A$  to  $B$ ?
- What is the change in  $y$ -values from  $A$  to  $B$ ?
- What do you notice when creating a ratio between the change of  $y$ -values to  $x$ -values?
- What is your conclusion about the slope of a vertical line?



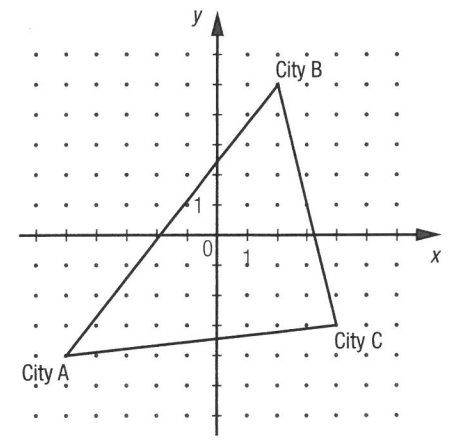
**19**

Show that the midpoints of the sides of the adjacent quadrilateral ABCD are the vertices of a parallelogram.



**20**

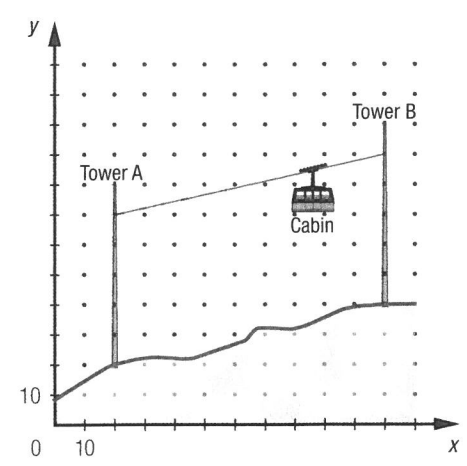
In the adjacent Cartesian plane, Cities A, B and C are joined to show the roads connecting these cities. To free up the roads during rush hour, a secondary road is constructed equivalent to the median stemming from City C. The scale is in kilometres.



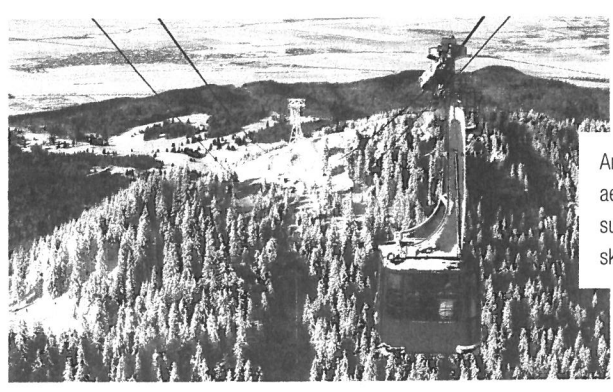
- a) What are the coordinates of the intersection point where the new road meets road AB?
- b) What is the length of the new road?

**21**

This graph shows two towers, a cable that joins them, and a cable car. The graph scale is in metres.



- a) What is the slope of the cable?
- b) What is the length of the cable?
- c) What is the distance between the cable car and Tower B, if the tram's position on the cable divides the cable in a ratio of 5:2?



An aerial tramway or cable car is a type of aerial lift in which one or two cabins are suspended from a cable. It is often used at ski resorts.