

## Module 14a: The Distance Formula

### **Math Practice(s):**

- Model with mathematics.
- Look for & make use of structure.

### **Learning Target(s):**

- Use coordinates to compute the perimeter & areas of polygons using the distance formula.

### **Homework:**

HW#1: 14a #1-2

**Warm-up**

1. Use the Distributive Property to rewrite each expression as a quadratic equation in standard form:

$$ax^2 + bx + c$$

A.  $(x + 4)(x + 9)$

$$x^2 + 9x + 4x + 36$$

$$x^2 + 13x + 36$$

B.  $(2x + 1)(x - 5)$

$$2x^2 - 10x + 1x - 5$$

$$2x^2 - 9x - 5$$

C.  $(4x - 9)(3x + 7)$

$$12x^2 + 28x - 27x - 63$$

$$12x^2 + x - 63$$

D.  $5(x - 8)(x + 3)$

$$x^2 + 3x - 8x - 24$$

$$5(x^2 - 5x - 24)$$

$$5x^2 - 25x - 120$$

E.  $(3x - 4)(x + 4)$

$$3x^2 + 12x - 4x - 16$$

$$3x^2 + 8x - 16$$

F.  $(x - 1)^2$

$$(x - 1)(x - 1)$$

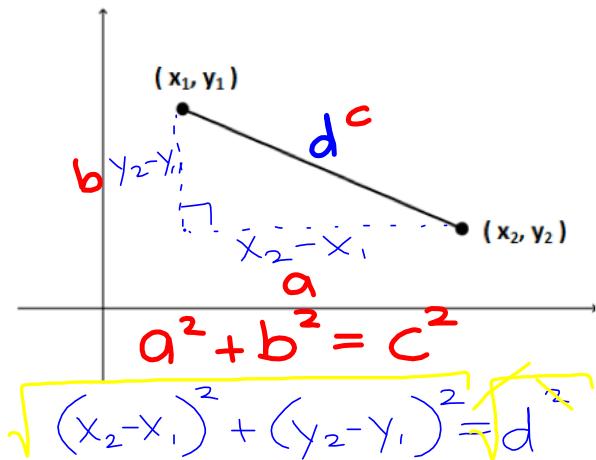
$$x^2 - x - x + 1$$

$$x^2 - 2x + 1$$

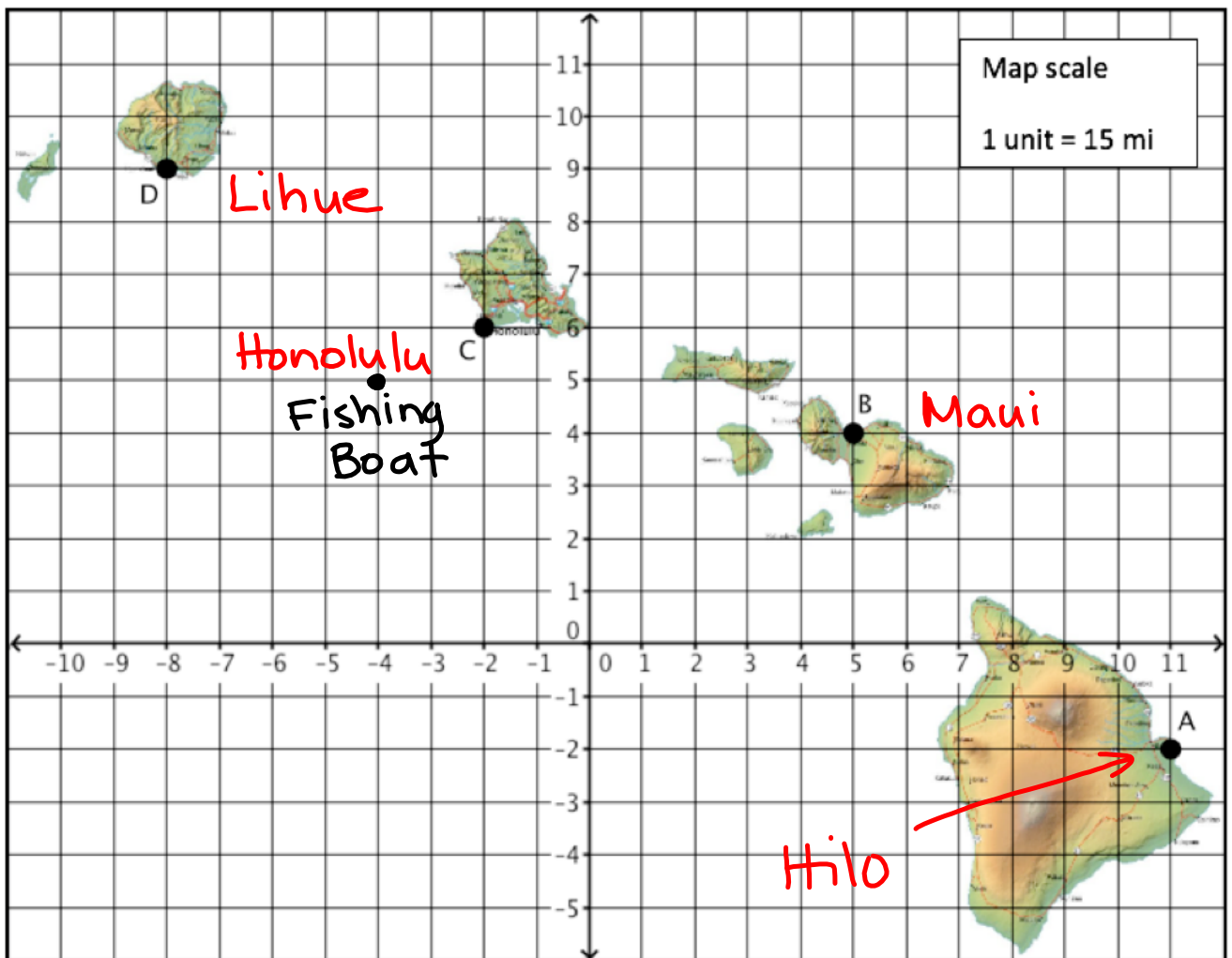
**The DISTANCE (between two points) FORMULA**

Given two points  
 $(x_1, y_1)$  &  $(x_2, y_2)$

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



**Example 1:** Cecile's dad asks her to make roundtrip airline reservations for him to fly from Honolulu to Hilo and back. The flight from Honolulu to Hilo is booked solid, since it's Merry Monarch week, but luckily, she finds a flight that stops first in Maui. The return flight from Hilo to Honolulu is available. When Cecile tells her dad about the stop in Maui he responds, "I guess I'll get more miles on my frequent flyer plan." Use the map below to help Cecile determine how many more miles Dad should get on his trip from Honolulu to Hilo than on his return flight.



A. How many more miles did Dad earn on the flights Cecile reserved than if he'd flown direct to Hilo (A) and back to Honolulu (C)?

$C \rightarrow B \rightarrow A$

①  $(-2, 6)$   $(5, 4)$   
 $x_2, y_2$   $x_1, y_1$

$$d = \sqrt{(-2-5)^2 + (6-4)^2}$$

$$d = \sqrt{(-7)^2 + (2)^2}$$

$$d = \sqrt{49 + 4}$$

$$d = \sqrt{53} \cdot (15) \Rightarrow 109.2 \text{ miles}$$

VS

$C \rightarrow A$

$(-2, 6)$   $(11, -2)$   
 $x_1, y_1$   $x_2, y_2$

$$d = \sqrt{(11+2)^2 + (-2-6)^2}$$

$$d = \sqrt{(13)^2 + (-8)^2}$$

$$d = \sqrt{169 + 64}$$

$$d = \sqrt{233} \cdot (15) \Rightarrow 229 \text{ miles}$$

**229 miles**

②  $(5, 4)$   $(11, -2)$   
 $x_1, y_1$   $x_2, y_2$

$$d = \sqrt{(11-5)^2 + (-2-4)^2}$$

$$d = \sqrt{(6)^2 + (-6)^2}$$

$$d = \sqrt{36 + 36}$$

$$d = \sqrt{72} \cdot (15) \Rightarrow 127.3 \text{ miles}$$

**236.5 miles**

$$\begin{array}{r} 236.5 \\ - 229 \\ \hline 7.5 \end{array}$$

Dad earned 7.5 more miles on the route Cecile booked.

B. How much further is it to Hilo from Honolulu than from Lihue (D) to Honolulu? Round your answer off to the nearest mile.

$C \rightarrow A$

$(-2, 6)$   $(11, -2)$   
 $x_1, y_1$   $x_2, y_2$

$$d = \sqrt{(11-(-2))^2 + (-2-6)^2}$$

$$d = \sqrt{(13)^2 + (-8)^2}$$

$$d = \sqrt{169 + 64}$$

$$d = \sqrt{233} \cdot (15) \Rightarrow 229$$

VS

$D \rightarrow C$

$(-8, 9)$   $(-2, 6)$   
 $x_1, y_1$   $x_2, y_2$

$$d = \sqrt{(-2-(-8))^2 + (6-9)^2}$$

$$d = \sqrt{(6)^2 + (-3)^2}$$

$$d = \sqrt{36 + 9}$$

$$d = \sqrt{45} \cdot (15) \Rightarrow 100.6$$

Honolulu to Hilo is about 128.4 miles further than Lihue to Honolulu.

C. Which is closest to Honolulu, Kahului (B) or Lihue (D)? Explain how you know without computing the two distances.

Lihue is closest to Honolulu.

$B \rightarrow C$

109.2 miles  
 (from A)

VS

$D \rightarrow C$

100.6 miles  
 (from b)

- D. While Dad is in Hilo, Cecile decides to go out on her friend's fishing boat. At noon of the third day they are located at coordinates  $(-4, 5)$ . How far from Honolulu are they at that time? Her dad thinks she's in Honolulu. Is she closer or further away to him than what her dad thinks?

$$(-2, 6) \quad (-4, 5)$$

$$(11, -2) \quad (-4, 5)$$

$$d = \sqrt{(-4 - (-2))^2 + (5 - 6)^2}$$

$$d = \sqrt{(-2)^2 + (-1)^2}$$

$$d = \sqrt{4 + 1}$$

$$d = \sqrt{5} \cdot (15) \rightarrow$$

$$d = \sqrt{(-4 - 11)^2 + (5 - (-2))^2}$$

$$d = \sqrt{(-15)^2 + (7)^2}$$

$$d = \sqrt{225 + 49}$$

$$d = \sqrt{274} \cdot (5) \rightarrow 248.3 \text{ miles}$$

Hon to Hilo  $\rightarrow$  229 miles

• At noon of the third day, Cecile is 33.5 miles from Honolulu.

• Cecile is further than her dad thinks.

- E. Point E, which is East and North of Kahului, is 75 miles from Kahului. The x - coordinate of E on the map is 9. What is its y - coordinate?

$$\text{Kahului } (5, 4)$$

$x_1, y_1$

$\rightarrow$  75 miles away

$$\text{Point E } (9, ?)$$

$x_2, y_2$

(5 graphical units away)

$$5 = \sqrt{(9-5)^2 + (?-4)^2}$$

$$5^2 = \sqrt{(4)^2 + (y-4)^2}$$

$$25 = 16 + (y-4)^2$$

$$-16 \quad -16$$

$$\sqrt{9} = \sqrt{(y-4)^2}$$

$$3 = y - 4$$

$$+4 \quad +4$$

$$\boxed{y = 7}$$

The y-coordinate of Point E is 7.