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# Online HW 2: Proof by Picture

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# Set Theory Problems

*Extra problems about sets.*

## Reminders

- Sets are collections of objects such as numbers or points. The objects are called *elements* of the set, and the order elements are listed is not important.
- The notation  $\{7, 3\}$  means “The set containing 7 and 3.”
- Note that  $\{8\}$  is not the same as the number 8 but rather is a set that contains one element that happens to be a number.
- The set containing zero elements, sometimes call the *empty set* is denoted  $\{\}$  or  $\emptyset$ .
- The elements of a set can themselves be sets.

**Problem 1** *Indicate the number of elements in each set:*

- (a) The set  $\{3, 5, 6, 9, 10\}$  has  element(s).
- (b) The set  $\{\{3, 2, 7\}, \{4, 5\}, \{2\}, \emptyset\}$  has  element(s).
- (c) The set  $\{\{\}\}$  has  element(s).
- (d) The set  $\{\}$  has  element(s).
- (e) The set  $\emptyset$  has  element(s).
- (f) The set  $\{\emptyset\}$  has  element(s).

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**Problem 2** *Indicate whether each statement is true or false:*

- (a)  $2 \in \{3, 2, 5\}$ . (True/ False)
- (b)  $2 \subseteq \{3, 2, 5\}$ . (True/ False)

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- (c)  $\{2\} \in \{3, 2, 5\}$ . (True/ False)
- (d)  $\{2\} \subseteq \{3, 2, 5\}$ . (True/ False)
- (e)  $\emptyset = \{\}$ . (True/ False)
- (f)  $\emptyset = \{\emptyset\}$ . (True/ False)
- (g)  $\{\emptyset\} = \{\{\}\}$ . (True/ False)
- (h)  $\emptyset \in \{\emptyset\}$ . (True/ False)
- (i)  $\emptyset \subseteq \{\emptyset\}$ . (True/ False)
- (j)  $2 \in \{\{3, 2, 7\}, \{4, 5\}, \{2\}, \emptyset\}$ . (True/ False)
- (k)  $2 \subseteq \{\{3, 2, 7\}, \{4, 5\}, \{2\}, \emptyset\}$ . (True/ False)
- (l)  $\{2\} \in \{\{3, 2, 7\}, \{4, 5\}, \{2\}, \emptyset\}$ . (True/ False)
- (m)  $\{2\} \subseteq \{\{3, 2, 7\}, \{4, 5\}, \{2\}, \emptyset\}$ . (True/ False)
- (n)  $\{\{2\}\} \in \{\{3, 2, 7\}, \{4, 5\}, \{2\}, \emptyset\}$ . (True/ False)
- (o)  $\{\{2\}\} \subseteq \{\{3, 2, 7\}, \{4, 5\}, \{2\}, \emptyset\}$ . (True/ False)

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**Problem 3** Explain the difference between the symbols  $\in$  and  $\subseteq$ .

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**Problem 4** How is  $\{\emptyset\}$  different from  $\emptyset$ ?

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# Polygon Measurement

Short-answer questions involving length, angle, and area.

## Careful Measurement with Eyeballs

Adjust the figures to fit the given conditions within **eyeball accuracy**. Enter the requested measurements.

Geogebra link: <https://tube.geogebra.org/m/gjf28er6>

**Problem 5** In figure above, when point  $C$  is adjusted so that  $BC$  is perpendicular to  $AC$ ,  $AC = \boxed{?}$ .

Geogebra link: <https://tube.geogebra.org/m/q32gyaud>

**Problem 6** In  $\triangle ABC$  above, move point  $D$  to make the following measurements. **Enter -1 if it is not possible.**

- (a) When  $\overline{BD}$  is a median,  $AD = \boxed{?}$ .
- (b) When  $\overline{BD}$  is a angle bisector,  $AD = \boxed{?}$ .
- (c) When  $\overline{BD}$  is a perpendicular bisector,  $AD = \boxed{?}$ .
- (d) When  $\overline{BD}$  is a altitude,  $AD = \boxed{?}$ .

Geogebra link: <https://tube.geogebra.org/m/a888zyw2>

**Problem 7** In  $\triangle ABC$  above, the height to base  $\overline{AC}$  is  $\boxed{?}$ .

Geogebra link: <https://tube.geogebra.org/m/hta9hbuf>

**Problem 8** In  $\triangle ABC$  above, the height to base  $\overline{AC}$  is  $\boxed{?}$ .

# Interior Angles Measurement

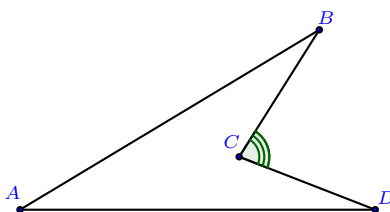
Short-answer questions involving length, angle, and area.

Geogebra link: <https://tube.geogebra.org/m/zrapvzpz>

**Problem 9** Measure the interior angles of quadrilateral  $ABCD$  above.

- (a)  $m\angle A = \boxed{?}$  degrees.
- (b)  $m\angle B = \boxed{?}$  degrees.
- (c)  $m\angle C = \boxed{?}$  degrees.
- (d)  $m\angle D = \boxed{?}$  degrees.
- (e)  $m\angle A + m\angle B + m\angle C + m\angle D = \boxed{?}$ .

**Problem 10** Use the measurements from the previous problem, to compute the measure of the marked angle below.

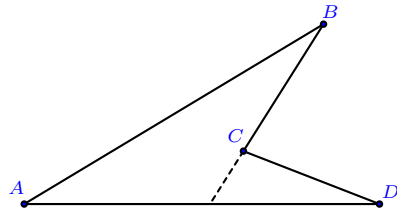


The marked angle should measure  $\boxed{?}$  degrees.

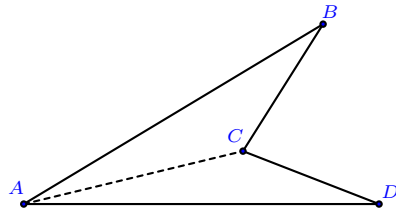
**Problem 11** In order to explain why the sum of the interior angles should be  $360^\circ$ , Bart and Brad each triangulated the figure as shown below.

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Interior Angles Measurement



Brad's figure



Bart's figure

**Multiple Choice:**

- (a) *They are both correct.*
- (b) *Only Brad is correct.*
- (c) *Only Bart is correct.*
- (d) *Neither of them are correct.*

*Explain your reasoning.*

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