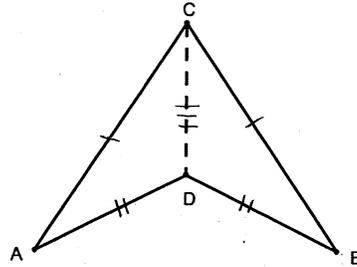


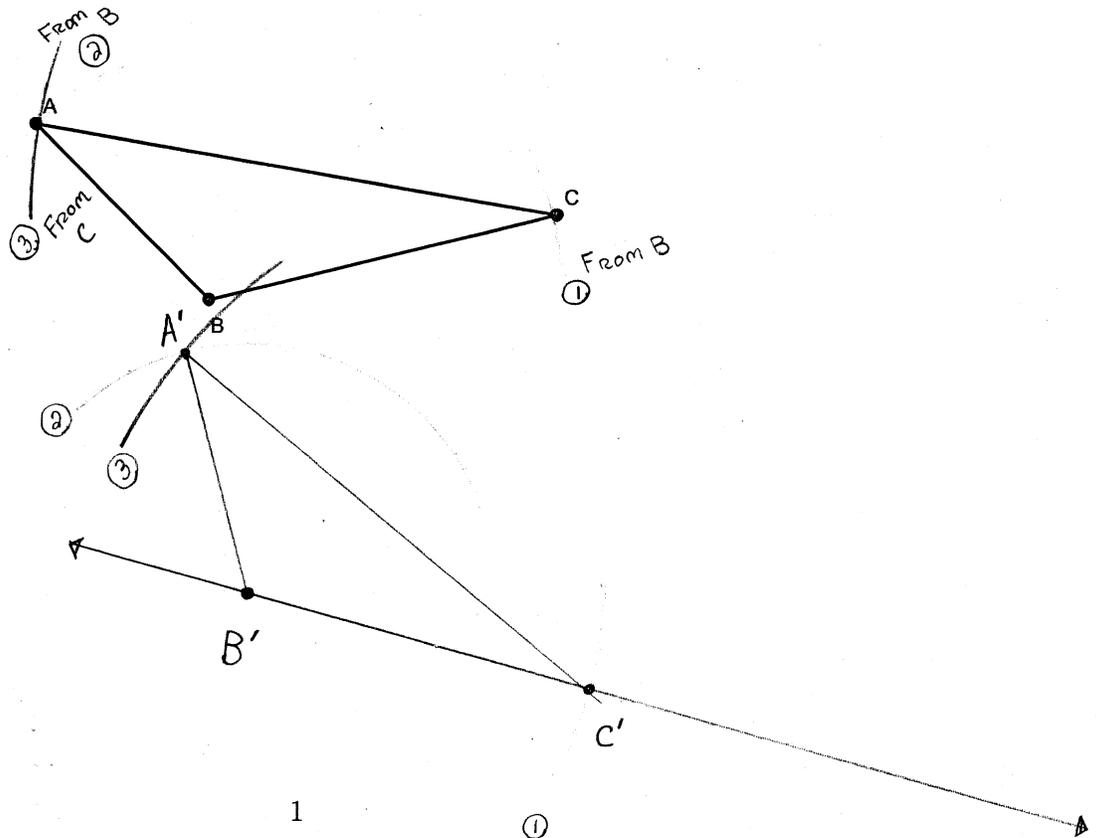
Show all work. Supply explanations when necessary.

1. (3 points) The figure shown below is a kite. Carefully explain how we can be sure that  $\triangle ACD \cong \triangle BCD$ .



THIS FIGURE IS A KITE, SO  
 BY DEFINITION  
 $\overline{AC} \cong \overline{BC}$   
 AND  $\overline{AD} \cong \overline{BD}$  AS MARKED.  
 CLEARLY  $\overline{CD} \cong \overline{CD}$ .  
 BY SSS,  
 $\triangle ACD \cong \triangle BCD$ .  
 (CORRESPONDING SIDES  
 AS MARKED)

2. (4 points) With only your compass and straightedge, use the SSS property or the SAS property to construct a triangle congruent to the one shown below.



3. (4 points) What is the measure of each interior angle of a regular nonagon? What is the measure of each exterior angle?

NONAGON HAS NINE SIDES.

EACH INTERIOR ANGLE MEASURES

$$\frac{(9-2) \cdot 180^\circ}{9} = 7 \cdot 20^\circ = \boxed{140^\circ}$$

EACH EXTERIOR ANGLE MEASURES

$$\boxed{40^\circ}$$

$$\text{INTERIOR ANGLE} + \text{EXTERIOR ANGLE} = \text{STRAIGHT ANGLE}$$

4. (3 points) If the measure of an angle is  $33^\circ 25' 48''$ , what is the measure of its complement? Write your answer in degrees in decimal form.

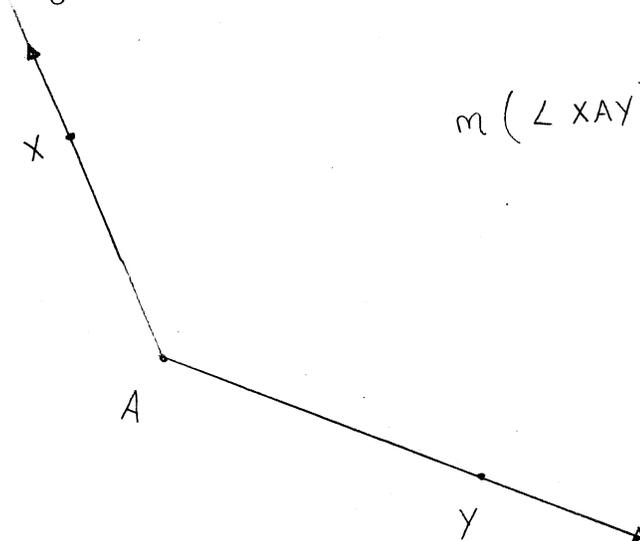
$$33^\circ 25' 48'' = 33^\circ + \frac{25'}{1} \cdot \frac{1^\circ}{60'} + \frac{48''}{1} \cdot \frac{1^\circ}{3600''}$$

$$= 33^\circ + 0.4166\bar{6}^\circ + 0.0133\bar{3}^\circ = 33.43^\circ$$

Complement measures

$$90^\circ - 33.43^\circ = \boxed{56.57^\circ}$$

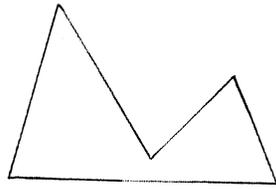
5. (3 points) Use a straightedge to sketch an obtuse angle. Then use your protractor to find the measure of the angle.



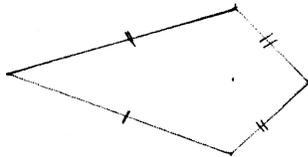
$$m(\angle XAY) \approx 134^\circ$$

6. (6 points) Sketch each of the following or explain why it is not possible.

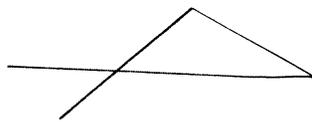
(a) A concave pentagon



(b) A kite that is not a rhombus



(c) A polygonal curve that is neither simple nor closed



(d) A scalene, isosceles triangle

NOT POSSIBLE BECAUSE A SCALENE  $\triangle$   
HAS NO CONGRUENT SIDES AND AN ISOSCELES  $\triangle$   
HAS AT LEAST TWO CONGRUENT SIDES

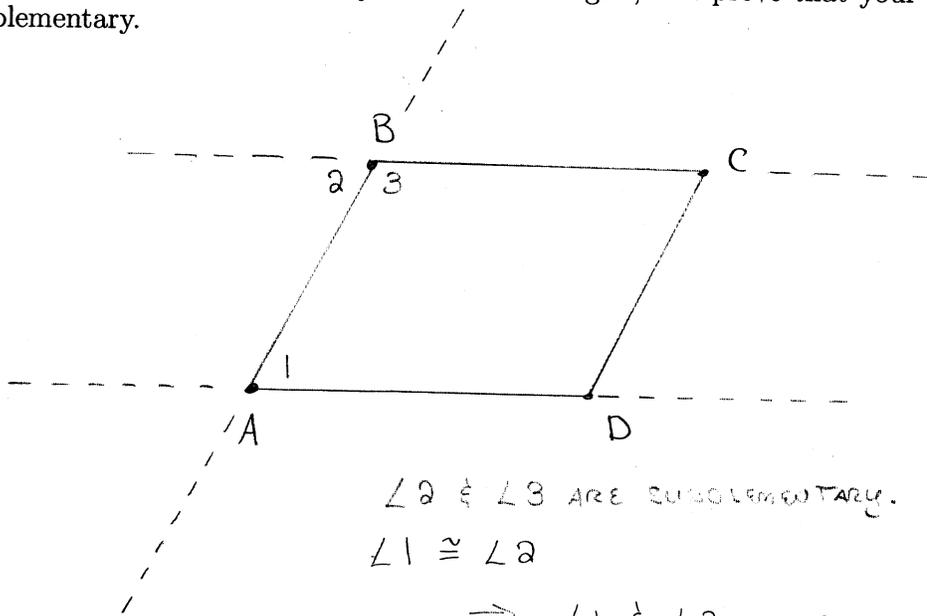
(e) A parallelogram with exactly one right angle

NOT POSSIBLE. IF A PARALLELOGRAM HAS  
ONE RIGHT, ANGLE IT MUST HAVE FOUR.

(f) An equilateral triangle that is not acute

NOT POSSIBLE.  
EVERY ANGLE OF AN EQUILATERAL  $\triangle$   
MEASURES  $60^\circ$ . EACH ANGLE IS ACUTE  
 $\Rightarrow \triangle$  IS ACUTE.

7. (3 points) Use a straightedge to roughly sketch (not construct) a parallelogram. Label the vertices, choose any two adjacent interior angles, and prove that your angles are supplementary.

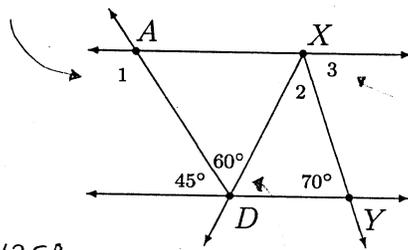


$\overleftrightarrow{BC} \parallel \overleftrightarrow{AD}$   
 cut by  
 TRANSVERSAL  
 $\overleftrightarrow{AB} \Rightarrow$   
 ALT INTERIOR  $\angle$ 'S  
 ARE CONGRUENT  
 $\Rightarrow \angle 1 \cong \angle 2$

$\angle 2$  &  $\angle 3$  ARE SUPPLEMENTARY.  
 $\angle 1 \cong \angle 2$   
 $\Rightarrow \angle 1$  &  $\angle 3$  ARE SUPP.

8. (4 points) Given the figure shown below with  $\overleftrightarrow{AX} \parallel \overleftrightarrow{DY}$ , find each of the following:

$\overleftrightarrow{AD}$  IS A TRANS  
 OF  $\overleftrightarrow{AX} \parallel \overleftrightarrow{DY}$ .  
 $\angle ADY$  AND  $\angle 1$  ARE  
 ALT. INTERIOR.  
 $\Rightarrow \angle 1$  MEASURES  $135^\circ$



FINALLY,  $\overleftrightarrow{AX} \parallel \overleftrightarrow{DY}$   
 CUT BY TRANS  $\overleftrightarrow{XY}$ ,  
 $\angle 3$  &  $\angle XYD$  ARE ALT  
 INTERIOR.  
 $\Rightarrow \angle 3$  MEASURES  
 $70^\circ$

1<sup>ST</sup>, THIS ANGLE MUST MEASURE  $75^\circ$   
 (THE 3  $\angle$ 'S MAKE A STRAIGHT ANGLE.)

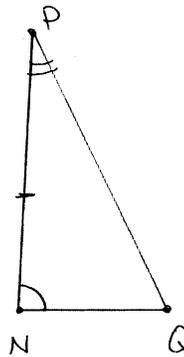
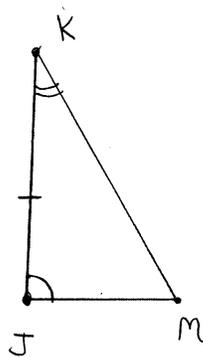
(a)  $m(\angle 1) = \boxed{135^\circ}$

(b)  $m(\angle 2) = 180^\circ - (75^\circ + 70^\circ) = \boxed{35^\circ}$

(c)  $m(\angle 3) = \boxed{70^\circ}$

9. (3 points) Is the following information sufficient to justify  $\triangle JKM \cong \triangle NPQ$ ? Justify your answer.

$$\overline{JK} \cong \overline{NP}, \quad \angle J \cong \angle N, \quad \angle K \cong \angle P$$



Yes, THE TRIANGLES ARE CONGRUENT BY ASA.

10. (3 points) You have two sticks that have lengths of 11 cm and 18 cm. Describe the possible lengths of a third stick if you are going to make a triangle from the sticks.

THE SUM OF THE LENGTHS OF ANY TWO SIDES MUST EXCEED THE LENGTH OF THE REMAINING SIDE.

$$\text{So, } 11 + \square > 18$$

$$\text{AND } 11 + 18 > \square$$

$\Rightarrow$

THE POSSIBLE LENGTHS ARE BETWEEN 7 cm AND 29 cm (EXCLUDING 7 cm & 29 cm)

11. (3 points) What are vertical angles? Give a convincing argument that vertical angles are congruent.

$$m(\angle a) + m(\angle b) = 180^\circ$$

$$m(\angle b) + m(\angle a) = 180^\circ$$

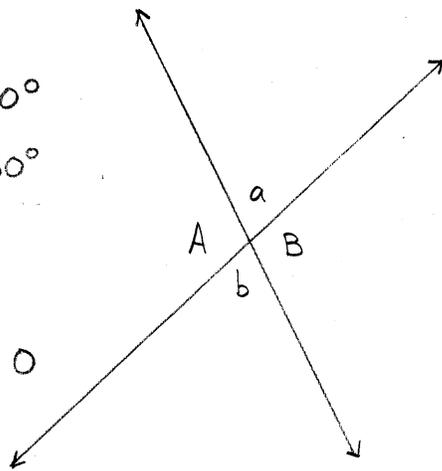
SUBTRACT TO GET

$$m(\angle a) - m(\angle b) = 0$$

OR

$$m(\angle a) = m(\angle b)$$

SAME IDEA FOR  $m(\angle A)$  AND  $m(\angle B)$

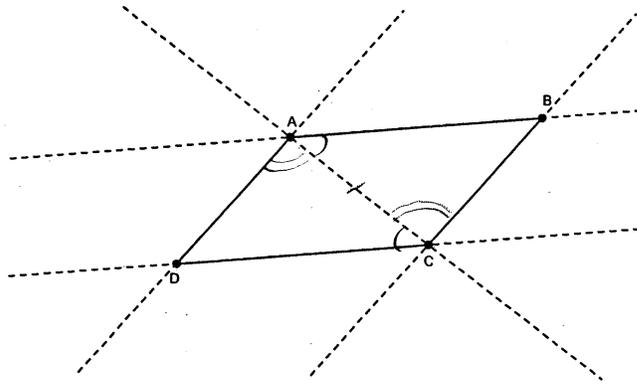


VERTICAL ANGLES ARE THE OPPOSITE ANGLES FORMED AT THE INTERSECTION OF TWO LINES.

$\angle a$  &  $\angle b$  ARE VERTICAL.

$\angle A$  &  $\angle B$  ARE VERTICAL.

12. (5 points) Parallelogram  $ABCD$  is shown here.



(a) According to the definition of parallelogram, what can be said about the  $ABCD$ ?

$$\overrightarrow{AB} \parallel \overrightarrow{DC} \quad \text{AND} \quad \overrightarrow{AD} \parallel \overrightarrow{BC}$$

(b) What can be said about  $\angle ACD$  and  $\angle CAB$ ? Explain your reasoning.

PARALLEL LINES  $\overrightarrow{AB}$  AND  $\overrightarrow{DC}$  ARE CUT BY  
TRANSVERSAL  $\overrightarrow{AC}$ .  $\angle ACD$  AND  $\angle CAB$  ARE  
CONGRUENT ALTERNATE INTERIOR ANGLES.

(c) What can be said about  $\angle DAC$  and  $\angle BCA$ ? Explain your reasoning.

PARALLEL LINES  $\overrightarrow{AD}$  AND  $\overrightarrow{BC}$  ARE CUT BY TRANSVERSAL  
 $\overrightarrow{AC}$ .  $\angle DAC$  AND  $\angle BCA$  ARE CONGRUENT  
ALTERNATE INTERIOR ANGLES

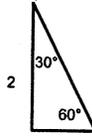
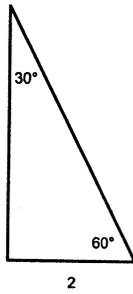
(d) Using parts (b) and (c), what triangle congruence property allows us to conclude that  $\triangle ADC \cong \triangle CBA$ ?

SINCE  $\overline{AC}$  IS SHARED,  $\triangle ADC \cong \triangle CBA$   
By ASA.

(e) Are opposite sides of a parallelogram congruent? Justify your answer.

YES, SINCE  $\triangle ADC \cong \triangle CBA$ ,  
WE MUST HAVE  $\overline{AD} \cong \overline{CB}$   
AND  $\overline{AB} \cong \overline{CD}$   
(CPCTC).

13. (3 points) The triangles shown here are clearly not congruent. Why doesn't the AAS congruence property apply?



AAS property

USE TWO ANGLES

AND A CORRESPONDING  
ADJACENT SIDE.

THE ADJACENT SIDE

IN THE 1ST  $\Delta$

(NEXT TO THE  $60^\circ$  ANGLE)

DOES NOT CORRESPOND TO

THE ADJACENT SIDE

(NEXT TO THE  $30^\circ$  ANGLE)

OF THE 2<sup>ND</sup>.

AAS DOES NOT APPLY.

14. (3 points) Use your straightedge to sketch a line segment. Then use only your compass and straightedge to construct the segment's perpendicular bisector.

