1 Vertical Angles

In the diagram below, the pairs of angles directly across from each other are called “vertical angles”.

\[ a = c \quad \text{and} \quad b = d \]

**Problem 1.** Using the fact that the measures of adjacent angles add, prove that vertical angles have the same measure. In other words, show that \( a = c \) and \( b = d \). Make sure you justify every step of your argument.
2 Clock Problems

Note: You should NOT use a calculator for any of these problems. You need to be comfortable working with the fractions that appear in these exercises.

Problem 2.  
1. How many degrees does the hour hand of a clock move in an hour?
2. How many degrees does the minute hand of a clock move in a minute?
3. How many degrees does the minute hand of a clock move in a second?

Problem 3. Find the angle between the minute hand and the hour hand of a clock at 6:20.

Problem 4. Find the reflex angle between the minute hand and the hour hand of a clock at 4:33.
Problem 5. How would you explain a general strategy for solving these “clock problems” to a middle school student? How should you adjust this strategy if we are also given the position of the second hand, e.g. what is the angle between the minute hand and the hour hand of a clock at 2:17:34? (Note: Assume that the student understands the basic properties of angles and knows that adjacent angles add.)

3 Definitions

Study the following definitions from Section 2.1 of your textbook before the next class:

1. Perpendicular
2. Parallel
3. Circle
4. Radius (Make sure you can distinguish between the two different meanings.)

You should also make sure you understand the following angle properties:

1. $\angle$s at a pt.
2. $\angle$s on a line
3. $\angle$s in a rt. $\angle$
4. Vert. $\angle$s