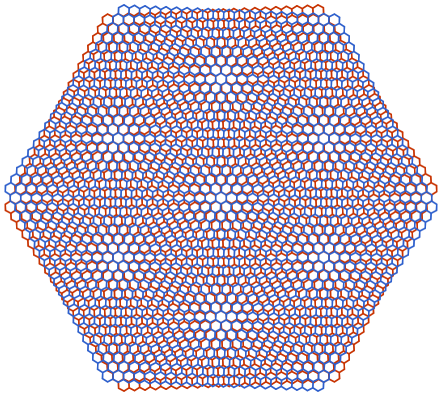
Student Name: _____ Date: _____

Observing Moiré Patterns

Background:
A moiré pattern is a two dimensional interference pattern produced by overlaying two periodic patterns with either slightly different periods or with the same period but placed at a small angle to one another. Solid state materials consist of atoms arranged in a periodic lattice. By fabricating thin films of solids, researchers can create two dimensional patterns at the nanoscale. Placing two thin films on top of one another weaves moiré patterns of atoms.



Part I

Aim
To create a moiré pattern, measure the moiré periods, and see how ***differences in lattice periods*** affect the moiré periods.

Materials	
Transparent paper with hexagon lattice with reference period	3 pieces of paper with hexagon lattice with periods 0.8, 1.1 and 1.2 times the reference period
Paper clip	Ruler

Method	
1	Place the transparent paper on top of the paper with scale 1.2, so that the reference lines are aligned. Use a paperclip to hold them together.

Student Name: _____ Date: _____

Question: Do you see the moiré patterns?	
2	Identify the repeating patterns and their centers (where it looks blankest). Mark the centers of two ***nearest*** patterns.
3	Remove the transparent paper from the scale 1.2 paper. On the transparent paper, count how many pink hexagons there are between the two marks. This is the ***ratio*** of moiré period to the original period. Record it in the table.
4	Repeat steps 1-3, but replace scale 1.2 with scale 1.1 and 0.8

Results Table			
Scale	**1.2**	**1.1**	**0.8**
Ratio			
Reference	6	11	4

Analysis:
Can you calculate the ratio using the same method in the beats activity? Does it agree with what you measure? [Hint: period = 1/frequency; *Ans*: ratio = scale/|scale-1|]

Student Name: _____ Date: _____

Part II

Aim
To create a moiré pattern, measure the moiré periods, and see how ***the relative angle*** affects the moiré periods.

Materials	
Transparent paper with pink hexagon lattice with a period of 1	Paper with blue hexagon lattice with a period of 1
Pin and cardboard	Ruler

Method	
1	Measure the blue line on the transparent paper in mm. Divide this length by 20. This is the ***original period***. Record it in the table.
2	On top of the cardboard, place the blue pattern paper with scale 1.0. Note the lines marking angles of 3°, 4°, 6°, 10° and 14°.
3	Place the pink pattern transparent paper on top of the paper so that the black dots at the center are aligned. Place the pin at the black dots.
4	Rotate the transparent paper so that its reference line aligns with 3° line on the bottom paper
Question: Do you see the moiré patterns?	
5	Identify the repeating patterns and their centers (where it looks blankest). Mark the centers of two ***nearest*** patterns. Measure the distance between the two marks in mm. This is the ***moiré period***. Record it in the table.
6	Repeat step 5 two more times, using the patterns at different locations on the paper.
7	Calculate the average moiré period, record in the "average" row. Divide the average period by the original period measured in step 1, record in the "ratio"

Student Name: _____ Date: _____

	row.
8	Repeat steps 4-7 but align the transparent paper at 4°, 6°, 10° and 14° lines. [Tips: when the moiré period is too small, measure the distance between 5 moiré patterns and divide by 5.]
9	Make a graph plotting the ratio (y-axis) vs. angle (x-axis).

Results Table	**Original Period (mm):**				
Angle	**3°**	**4°**	**6°**	**10°**	**14°**
moiré period 1 (mm)					
moiré period 2 (mm)					
moiré period 3 (mm)					
Average					
Ratio					
Reference	19.1	14.3	9.6	5.7	4.1

Analysis:
What do you notice about the relationship between the period and the angle θ?
Does your plot agree with the theory prediction below?

$$\text{ratio} = \frac{1}{2\sin(\theta/2)}$$