Name:_____ Period:_____

# Insolation Lab

In this lab, you will investigate how the angle at which sun strikes a solar panel can affect the amount of energy it absorbs. The amount of energy the surface of the Earth can absorb depends on its *angle of insolation* in very much the same way.

Lab materials:

- 1 solar panel
- 1 multimeter
- 1 protractor
- 1 textbook (for mounting your solar panel)
- 1 lamp attached to ring stand
- Poster putty

Lab Setup:

1. Attach your solar panel to the textbook using poster putty. Make sure the edge of the solar panel is touching the binding of the textbook.
2. Connect your solar panel to the multimeter; black clip to black probe and red clip to red probe.
3. Set your multimeter to the A (200m) setting
4. Make sure the lamp is pointing in a direction that is parallel to the table with the shade touching the table.
5. Place the textbook 30cm away from the lamp with the binding facing the lamp.

**Step 1: Looking at the effect of angles**

Use your protractor to set the solar panel at each angle. When the book is flat, it is at 0°. Record what the output is in milliamps (mA). Graph your data.

0° = _____

15°=_____

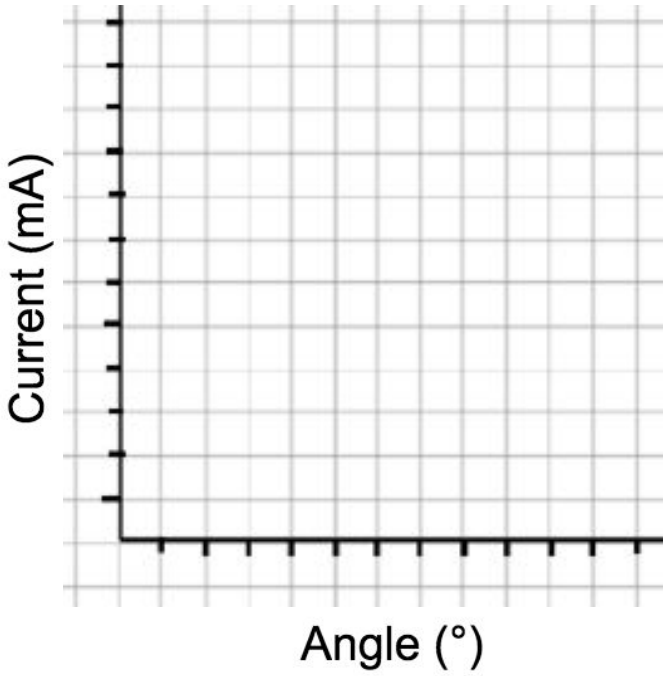
30°=_____

45°=_____

60°=_____

75°=_____

90°=_____




***Analysis:***

1. Which angle produced the highest output of energy to the voltmeter?

_____

_____

2. How might this angle affect the amount of heat Earth receives from the sun?

_____

_____

**Step 2: Applying angle of insolation to your life**

Research what size the battery is in your cell phone (if you don't have one, look up the battery size in another device you have) in mAh.

3. What is the size of your device battery?_____ mAh (milliamp-hours)

> *This value indicates that if you put that many milliamps into your device, it would take 1 hour to fully charge the battery. If you put **half** that many milliamps into your device, it will take **twice** as long to charge. If your device uses that many mA, the battery will last 1 hour before it dies.*

4. If you wanted to charge your phone the fastest, which angle to the sun would you want to set your solar panel? (Use a complete sentence for this answer.)

_____

_____

5. How many mA did this angle produce? (Look back at what you wrote in your data collection.) _____ mA

6. How many hours would this solar panel take to charge your phone?
*Scratch space for calculating:*

_____

7. Think about how long your phone takes to die when you use it. How long would you estimate that time to be?_____

8. Take your battery size from question 3, and divide by how many hours you estimated your phone to last. Write your value here._____mA

9. Question 8 gives you how many milliamp hours (mAh) your phone uses. Will your battery charge when you have it plugged into the solar panel, or will the battery still drain?

_____

10. You can find out how many mA a charger will put out. Look at the back of the charger. Find one and write down what the charger says for mA output. _____

11. How many solar panels would you need to use in order to charge your phone as fast as this charger?

_____

_____

12. Many students have found that using a regular iPhone charger will charge their iPad very slowly. What does this tell you about that charger, versus the charger that comes with your iPad?

_____

_____

## Step 3: How long will it take to charge your device in different locations?

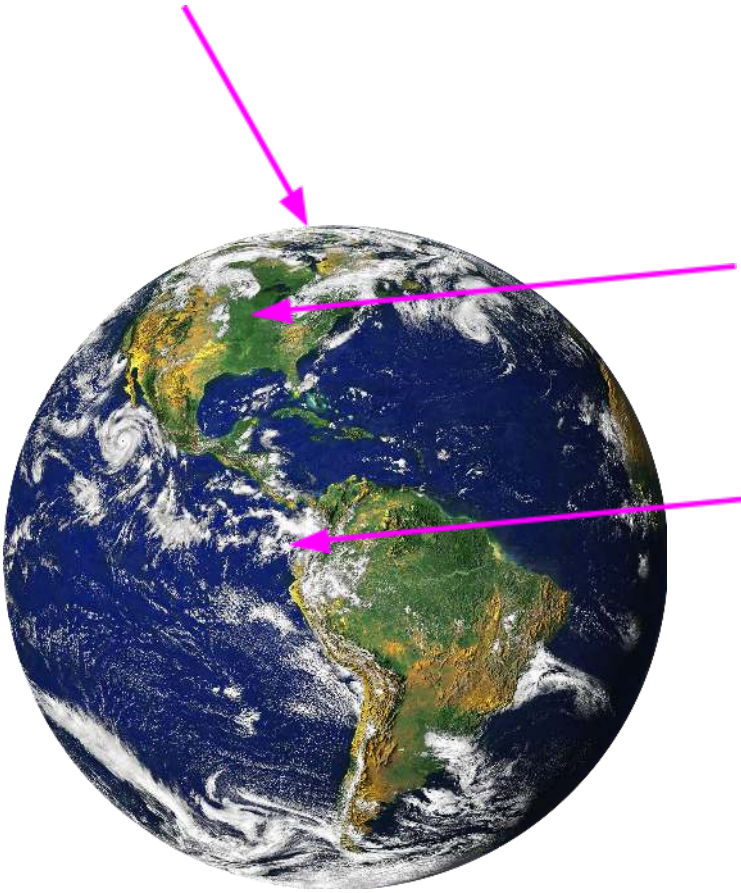
Calculate how long it would take your device to charge with the solar panel at different latitudes, if your solar panel was flat on the ground.  Assume Earth is at an equinox.

**North Pole**

*90°N Latitude*

*0° Angle of Insolation*

**_____ hours**



**Minneapolis, MN**

*45°N Latitude*

*45° Angle of insolation*

**_____ hours**

**Quito, Equador**

*0° Latitude*

*90° Angle of insolation*

**_____ hours**

14. If you were at the north pole and you needed to charge your device, what could you do to your solar panel to make it charge faster?

_____

_____