Name: _____

- **Please hand in the lab as ONE PDF document on Moodle.**
- **Please make sure the pages are in order**
- **Please make sure it's legible (open your PDF file to double check 😊)**
- **Thank you**

CRANDALL UNIVERSITY
GEOGRAPHY 1023
Lab 1: Solar Energy

Reference: *Chapter 2, text and notes*

This lab reviews some of the key topics in Chapter 2, "Solar Energy." You will find the text and your notes essential. It may look complicated … it's really not! If you follow the instructions and use the diagrams in your text, you'll be just fine! Feel free to work with other students from the class. Just remember that they may not be right! So please do think for yourself!

I. Energy at the Top of the Atmosphere

A. Solar Radiation Intensity

For this question you will need to use ***4CE (4th Canadian Edition) Figure 2.8, "Insolation receipts and the Earth's curved surface" p.50*** *(Figure 2.9 3CE (3rd Canadian Edition))*

This figure shows five equal "parcels" of solar energy (the five yellow bands) striking the earth. Each band represents the same amount of energy from the sun. Notice, however, that the band at the equator heats a relatively narrow section of the Earth. The bands at the poles heat much wider sections of the Earth's surface.

What does that mean? If the same amount of solar energy heats a smaller area (at the Equator), the solar energy is more concentrated. Like being under a spotlight, you will have more intense sunshine and hotter weather! If the same amount of solar energy heats a larger area (at the poles), the solar energy is more diffuse. Like being under an ordinary light bulb, you will have less intense sunshine and cooler weather!

Note the Earth is straight up and down in this Figure. This Figure represents the Earth during the ***Spring and Autumnal Equinoxes****,* ***March 21 and September 21****. See 4CE "Geosystems in Action 2" pp. 56-57 (3CE Figure 2.15, "Annual March of the seasons," p.53).*

In your text there are yellow bars (inside the picture of the Earth, beside the words "more diffuse" and "more concentrated") that represent the amount of the Earth's surface heated by each parcel. Note that the polar bars are longer than the bar at the equator. The same amount of solar energy at the poles is heating a larger area than at the equator! The poles will be cooler! ***I have measured the <u>length</u> of these bars (so you don't have to do anything on THIS page):***

a. at the equator: 8 mm

b. at the tropics (halfway toward the poles): 12 mm

c. at the poles: 17 mm

1. ***For the equinoxes,*** compare the intensity of the solar radiation at each point. Do this by calculating:

   a. intensity at the equator: length at the equator / length at the equator = __1__

   multiply by (X) 100% = _100%

   b. intensity at the tropics: length at the equator / length at the tropics = _____

   multiply by (X) 100% = _____%

   c. intensity at the poles: length at the equator / length at the poles = _____

   multiply by (X) 100% = _____%

   d. intensity at approximately 45°N (Moncton): at this latitude, the intensity will be about 75% as intense as at the Tropic of Cancer.

   Multiply the intensity at tropics (in %) by 0.75 = _____%

2. *During the **Summer Solstice (June 21)** (choose one):*

   a. The Earth's position is:
   __ the Earth is straight up and down
   __ the Northern Hemisphere is tilted toward the sun
   __ the Southern Hemisphere is tilted toward the sun

   b. At this time (the **Summer Solstice (June 21))** (choose one):
   __ the sun is directly over the Equator
   __ the sun is directly over the Tropic of Capricorn (23½°S)
   __ the sun is directly over the Tropic of Cancer (23½°N)

   c. June 21, the intensity at the equator will be the same as that *at the tropics during the equinox (March 21/September 21)* (same as 1b):

   _____%

   d. June 21, the intensity at the Tropic of Cancer (23½°N) will be the same as that *at the equator during the equinox* (1a)*:*

   _____%

   e. June 21, the intensity at 45°N (Moncton – you – more or less) will be the same as that *at the Tropic of Cancer (23½°N) during the equinox (March 21/September 21)* (1b)*:*

   _____%

   f. June 21, the intensity at the North Pole will be about 60% of that *at the Tropic of Cancer (23½°N) during the equinox (March 21/September 21)* (1b X 0.6):

   _____%

   g. June 21, the intensity at the Tropic of Capricorn (23½°S) will be the same as that *at 45°N during the Equinox (March 21/September 21)* (1d)*:*

   _____%

   h. June 21, the intensity at the South Pole (90°S) will be ***0*** – complete darkness 24 hours per day.

3. *During the **Winter Solstice (December 21)** (choose one):*

   a. The Earth's position is:
      __ the Earth is straight up and down
      __ the Northern Hemisphere is tilted toward the sun
      __ the Southern Hemisphere is tilted toward the sun

   b. At this time (the **Winter Solstice (December 21))** (choose one):
      __ the sun is directly over the Equator
      __ the sun is directly over the Tropic of Capricorn (23½°S)
      __ the sun is directly over the Tropic of Cancer (23½°N)

   c. December 21, the intensity at the equator will be the same as that *at the tropics during the equinox (March 21/September 21)* (1b):

      _____%

   d. December 21, the intensity at the Tropic of Capricorn (23½°S) will be the same as that *at the equator during the Equinox (March 21/September 21)* (1a)*:*

      _____%

   e. December 21, the intensity at the South Pole will be about 60% of that *at the Tropic of Capricorn (23½°S) during the equinox (March 21/September 21)* (1b X 0.6):

      _____%

   f. December 21, the intensity at the Tropic of Cancer *(23½°N)* will be the same as that *at* 45°N *during the equinox (March 21/September 21)* (1d)*:*

      _____%

   g. December 21, the intensity at approximately 45°N (Moncton – you – more or less) will be 75% of that *at the Tropic of Cancer (23½°N) on December 21* (previous question, 3f X 0.75):

      _____%

   h. December 21, the intensity at the North Pole (90°N) will be ***0*** – complete darkness 24 hours per day.

4. Using the information from Questions 1-3 above:

   a. If you wanted to receive the most intense solar radiation on March 21, where should you go?
      __ the North Pole
      __ 45-50°N
      __ the Tropic of Cancer
      __ the Equator
      __ the Tropic of Capricorn
      __ the South Pole

   b. If you wanted to receive the most intense solar radiation on June 21, where should you go?
      __ the North Pole
      __ 45-50°N
      __ the Tropic of Cancer
      __ the Equator
      __ the Tropic of Capricorn
      __ the South Pole

c. If you wanted to receive the least intense solar radiation on Sept 21, where should you go?
__ the North Pole
__ 45-50°N
__ the Tropic of Cancer
__ the Equator
__ the Tropic of Capricorn
__ the South Pole

d. If you wanted to receive the least intense solar radiation on Dec 21, where should you go?
__ the North Pole
__ 45-50°N
__ the Tropic of Cancer
__ the Equator
__ the Tropic of Capricorn
__ the South Pole

The point? Solar radiation can be MUCH more intense in tropical areas than less tropical areas (like Moncton or places further north). Therefore, you can get sunburned VERY QUICKLY on your March break in Florida (just north of the Tropic of Cancer, Cuba or Mexico (on the Tropic of Cancer), or Hawaii (just south of the Tropic of Cancer).

Even though day length may not be very different at different latitudes, solar intensity can be very different. Use sun screen! 😊

B. Insolation

*For this question you will need to use **4CE Figure 2.9, "Daily insolation received at the top of the atmosphere," p. 50 (3CE, Figure 2-10, p. 48).***

The dashed vertical lines represent Sept 21, June 21, Mar 21 and Dec 21.

1. Which location receives the most insolation on Sept 21? **(give a latitude range)**

   FROM _____**°**_____ **(indicate N or S) TO** _____**°**_____ **(indicate N or S)**

   This location receives the most insolation because … (check the best answer)

   ___ it receives the same intensity of insolation as other regions, but more hours of daylight
   ___ it receives more intense insolation during the same (12) hours of daylight as other regions
   ___ it receives more intense insolation and more hours of daylight than other regions

2. Which two locations receives the least insolation on Sept 21?

   1: _____

   2: _____

   This location(s) receive the least insolation because … (check the best answer)

   ___ it/they receive the same intensity of insolation as other regions, but less hours of daylight
   ___ it/they receive less intense insolation during the same (12) hours of daylight as other regions
   ___ it/they receive less intense insolation and less hours of daylight than other regions

3. Which location receives the most insolation on December 21? **(give a latitude range)**

   FROM _____°_____ (indicate N or S) TO _____°_____ (indicate N or S)

   This location receives the most insolation because … (check the best answer)

   ___ it receives the same intensity of insolation as other regions, but more hours of daylight
   ___ it receives more intense insolation during the same (12) hours of daylight as other regions
   ___ it receives more intense insolation and more hours of daylight than other regions
   ___ the insolation it receives is not very intense, but it gets more hours of daylight

4. Which location receives the least insolation on December 21? **(give a latitude range)**

   FROM _____°_____ (indicate N or S) TO _____°_____ (indicate N or S)

   This location receives the least insolation because … (check the best answer)

   ___ it receives the same intensity of insolation as other regions, but less hours of daylight
   ___ it does not receive any daylight, thus no insolation
   ___ it receives less intense insolation during the same (12) hours of daylight as other regions
   ___ it receives less intense insolation and less hours of daylight than other regions

5. Which location receives the most insolation on June 21? **(give a latitude range)**

   FROM _____°_____ (indicate N or S) TO _____°_____ (indicate N or S)

   This location receives the most insolation because … (check the best answer)

   ___ it receives the same intensity of insolation as other regions, but more hours of daylight
   ___ it receives more intense insolation during the same (12) hours of daylight as other regions
   ___ it receives more intense insolation and more hours of daylight than other regions
   ___ the insolation it receives is not very intense, but it gets more hours of daylight

6. Which location receives the least insolation on June 21? **(give a latitude range)**

FROM _____°_____ (indicate N or S) TO _____°_____ (indicate N or S)

   This location receives the least insolation because … (check the best answer)

   ___ it receives the same intensity of insolation as other regions, but less hours of daylight
   ___ it does not receive any daylight, thus no insolation
   ___ it receives less intense insolation during the same (12) hours of daylight as other regions
   ___ it receives less intense insolation and less hours of daylight than other regions

The point? Polar regions receive 24 hours of daylight in their summer, but it's not too intense. More tropical and equatorial areas receive less hours of daylight, but again, it can be VERY intense. So be careful. Don't be "white toast at breakfast and a lobster by noon" – a Caribbean joke about lighter-skinned northern vacationers who don't use adequate sunscreen.