Calculating Sun Angles

Today you will calculate the angle of the sun at NOON (12:00) for different locations on Earth.

Calculating Sun Angles

You will be working with complementary angles.

Remember, complementary angles always add up to 90°.

Calculating Sun Angles

- High sun angles (45° to 90°) mean more intense sunlight.

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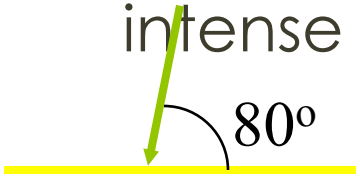

Calculating Sun Angles

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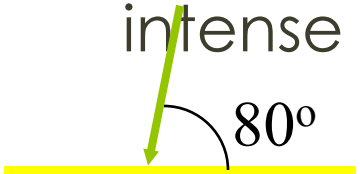
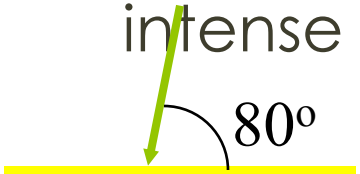


- Low sun angles (0° to 45°) mean less intense sunlight.

Calculating Sun Angles

- High sun angles (45° to 90°) mean more intense sunlight.



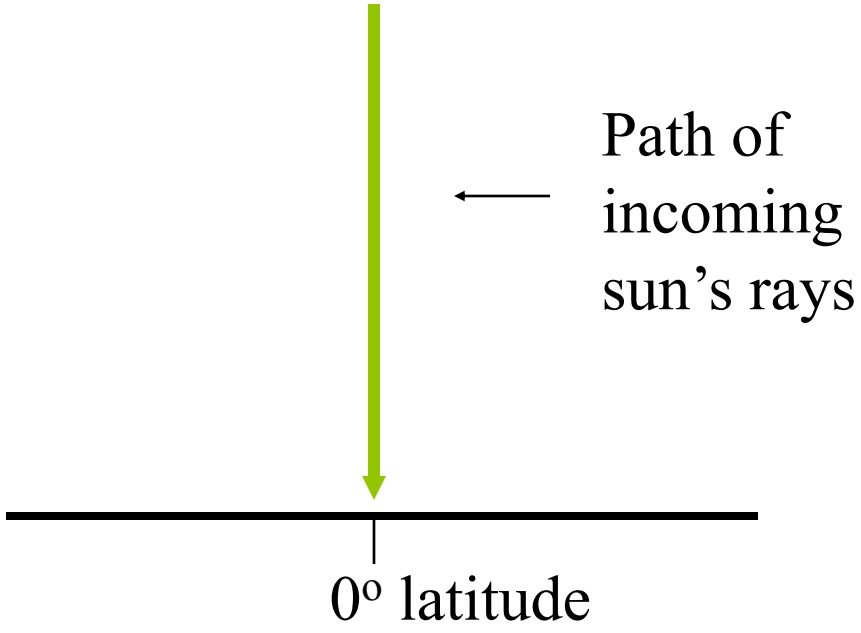
- Low sun angles (0° to 45°) mean less intense sunlight.

Latitude of 90° Sun Angle Changes

Over the year, the latitude where
the sun's rays form a 90° angle, at noon,
with the surface, moves slowly between the
Tropic of Cancer and
the Tropic of Capricorn.

Equinox

On March 22 and on September 22, the sun's rays form a 90° angle at noon at the equator.



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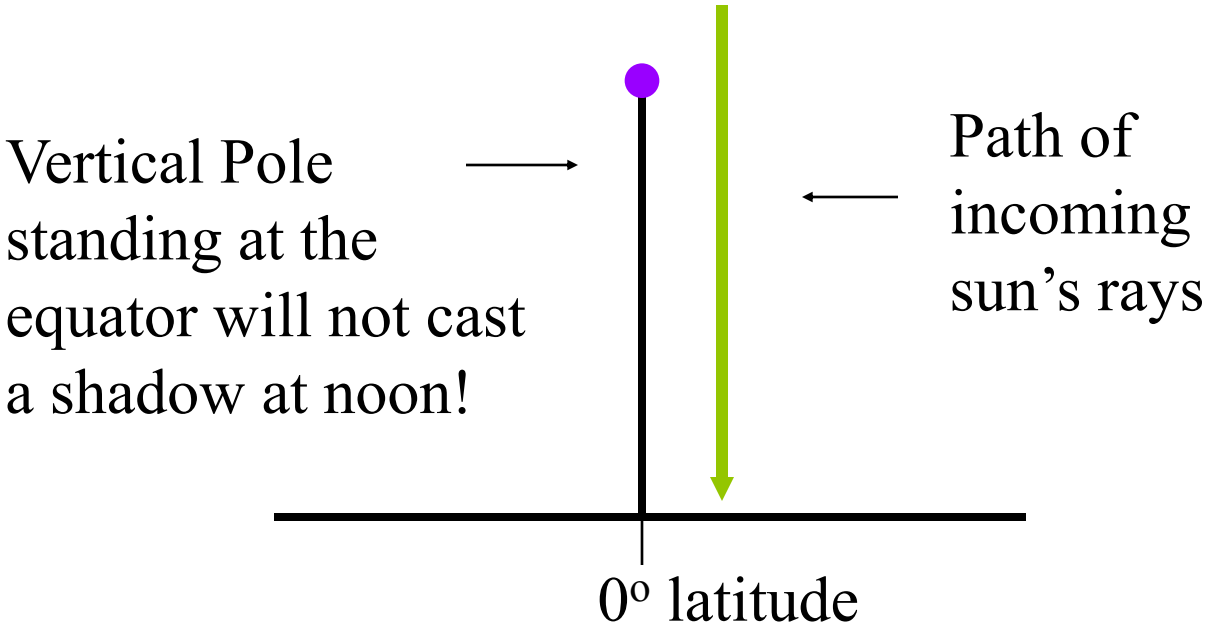

Equinox

At an Equinox, for every degree of latitude you move away from the equator, the sun angle at noon decreases by 1 degree.

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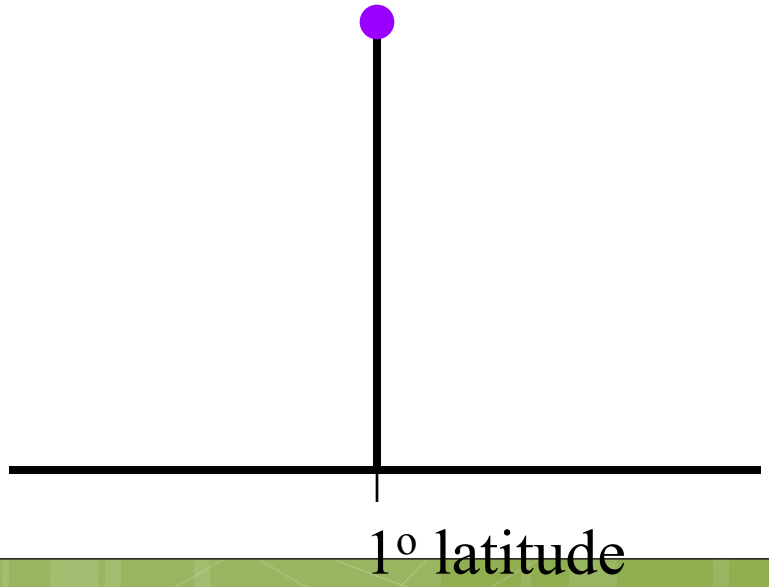

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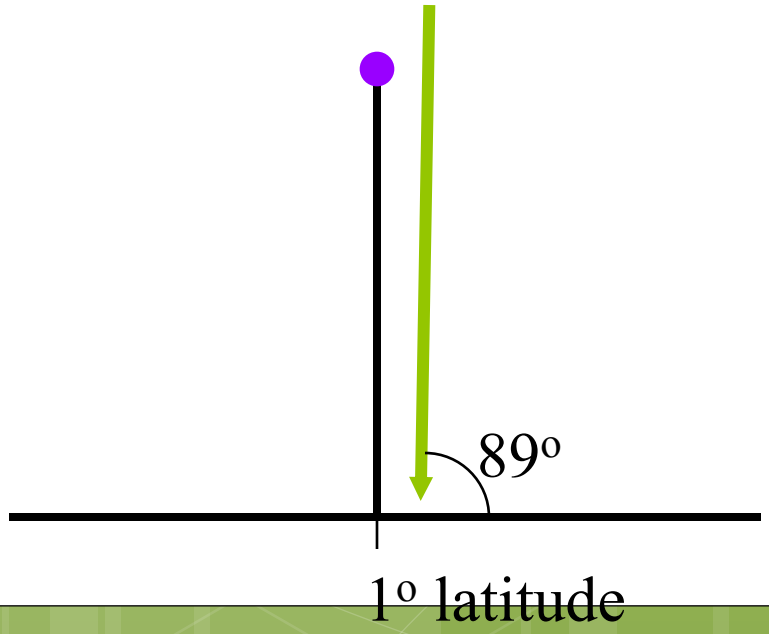

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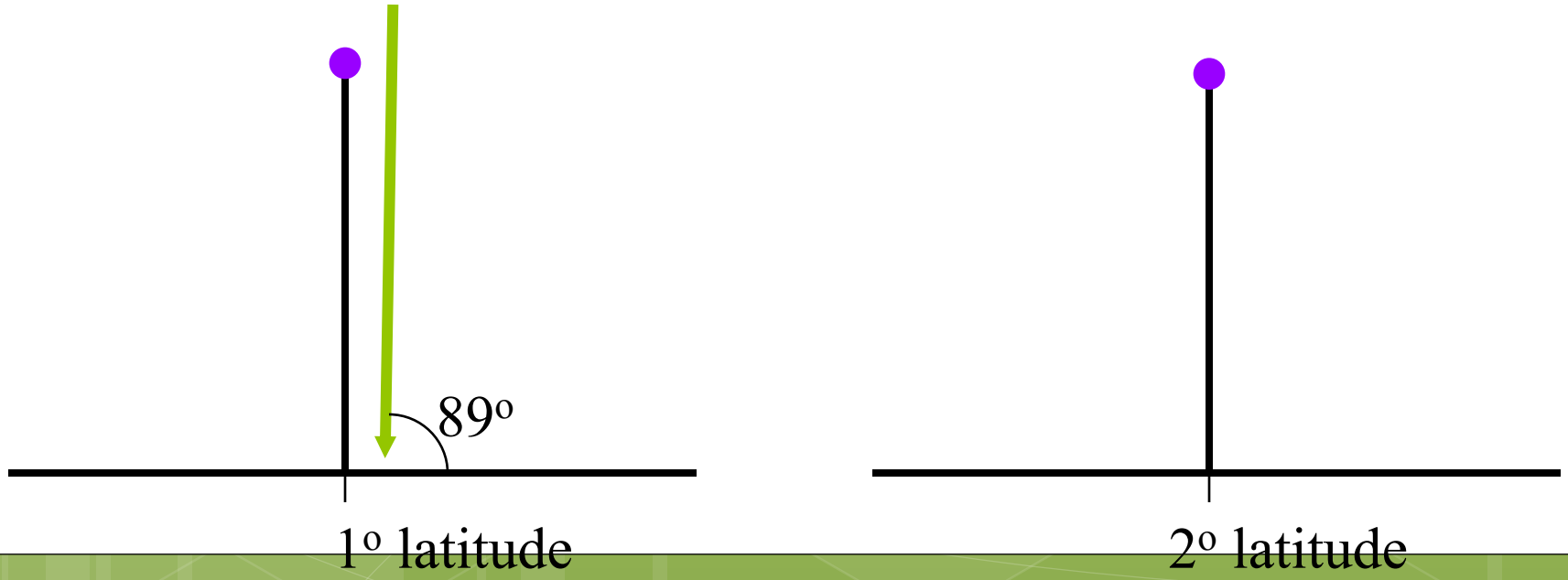

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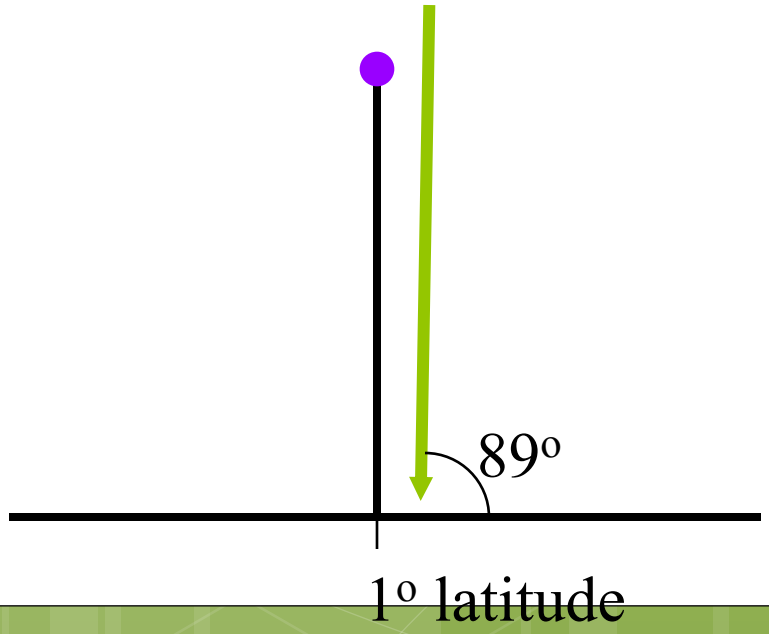

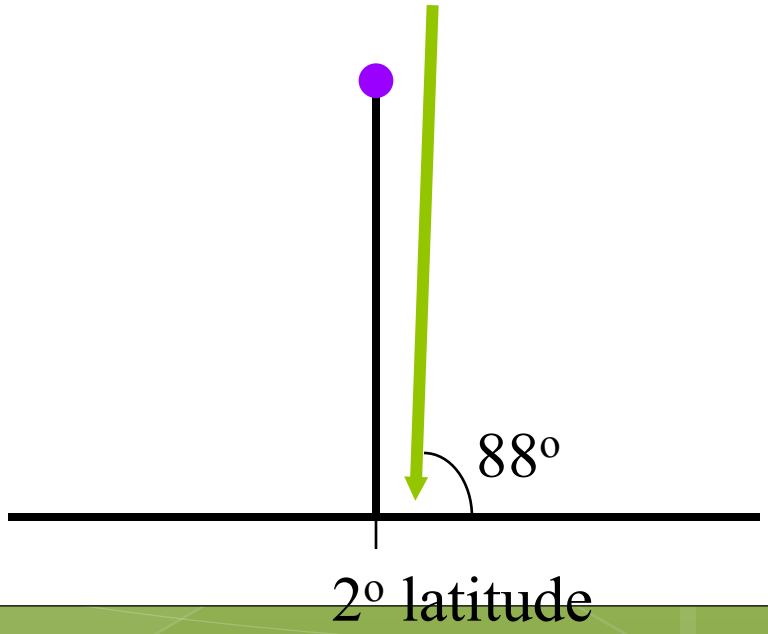

Solstices

Solstices

June 22

Solstices

June 22

- The sun forms a 90° angle at noon at 23.5° N

Solstices

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- The sun forms a 90° angle at noon at 23.5° N
  - This latitude is called the Tropic of Cancer.

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  - This is the summer solstice for the Northern Hemisphere.

Solstices

June 22

- The sun forms a 90° angle at noon at 23.5° N
  - This latitude is called the Tropic of Cancer.
  - This is the summer solstice for the Northern Hemisphere.
  - This is the winter solstice for the Southern Hemisphere.

Solstices

December 22

Solstices

December 22

- The sun forms a 90° angle at noon at 23.5° S

Solstices

December 22

- The sun forms a 90° angle at noon at 23.5° S
- This latitude is called the Tropic of Capricorn

Solstices

December 22

- The sun forms a 90° angle at noon at 23.5° S
- This latitude is called the Tropic of Capricorn
- This is winter solstice for the Northern Hemisphere.

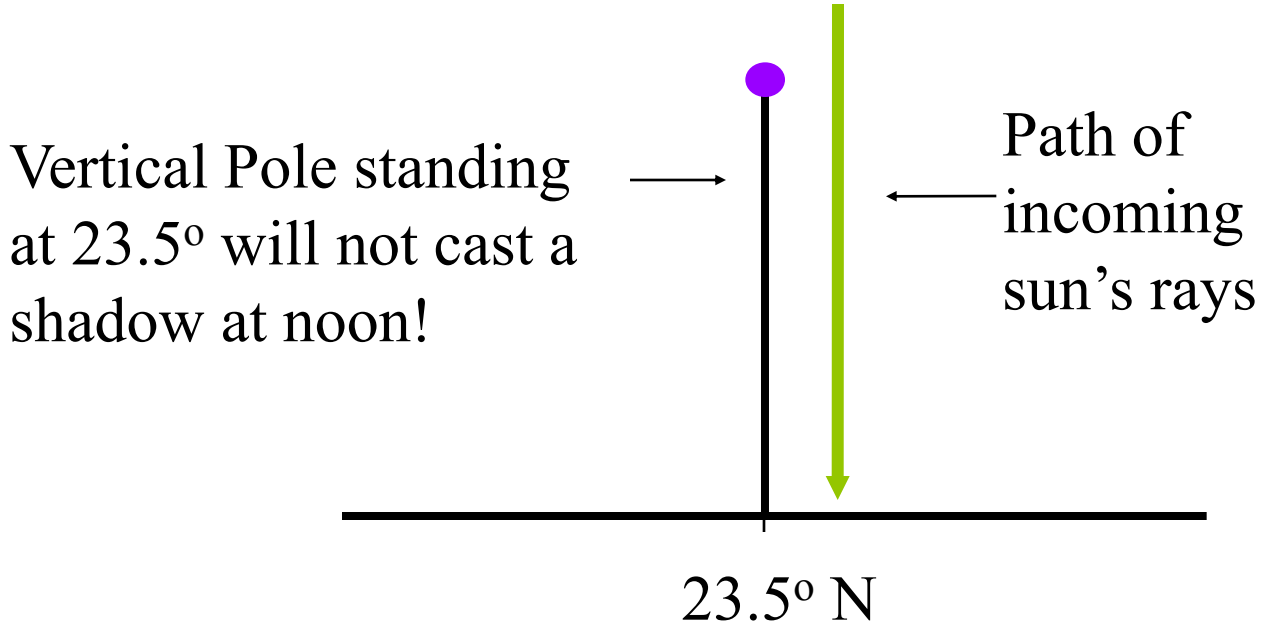
Solstices

December 22

- The sun forms a 90° angle at noon at 23.5° S
- This latitude is called the Tropic of Capricorn
- This is winter solstice for the Northern Hemisphere.
- This is the summer solstice for the Southern Hemisphere.

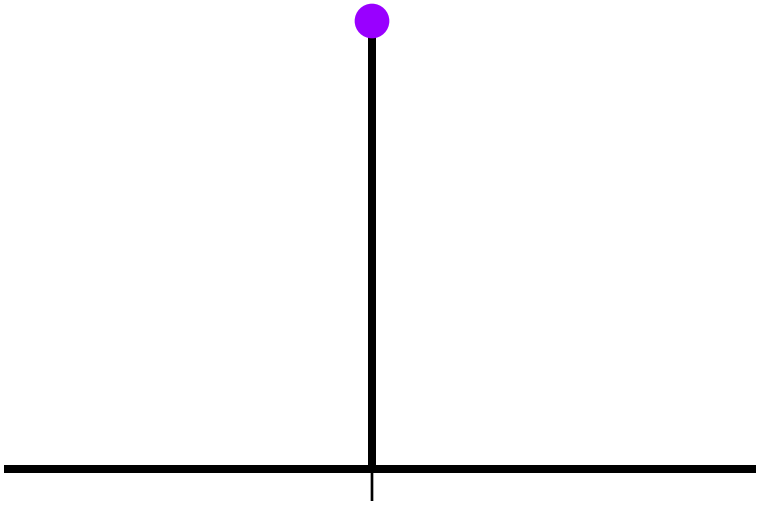
Solstices

On the summer solstice the sun's rays form a 90° angle at noon at 23.5° N



Solstices

On the summer solstice, for every degree of latitude you move away from 23.5°, the sun angle at noon decreases by 1 degree.



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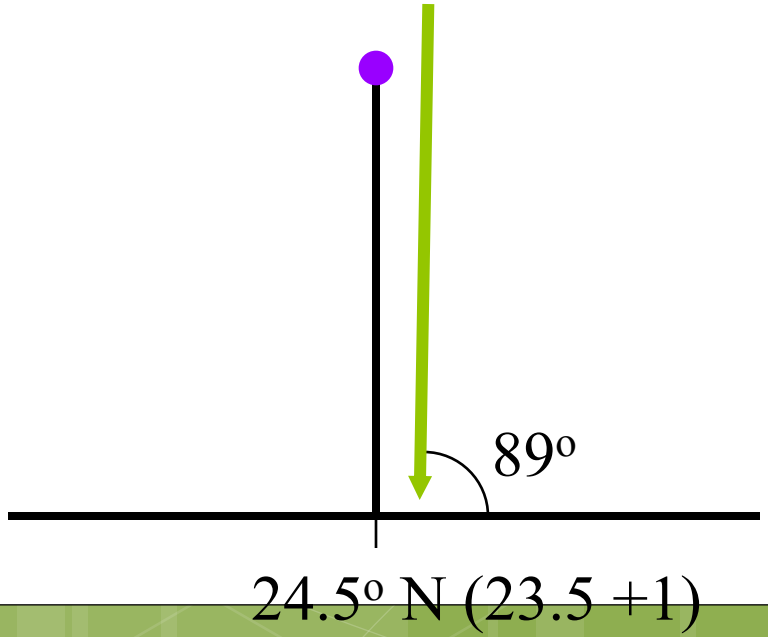

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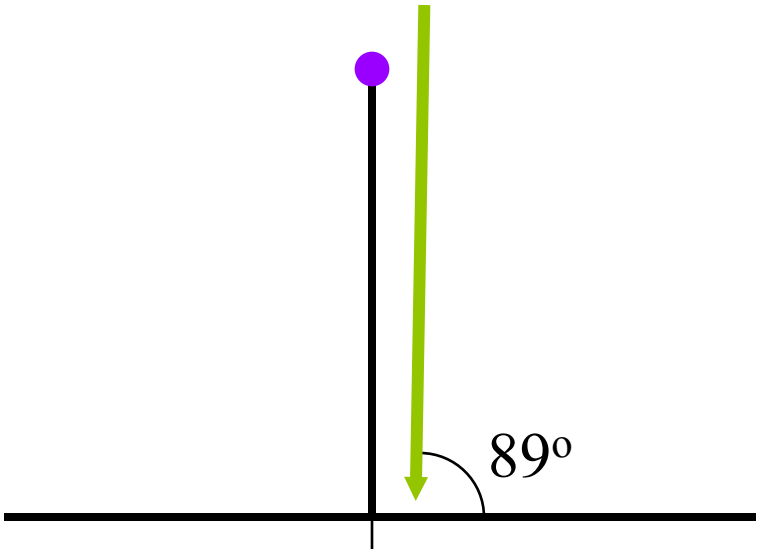

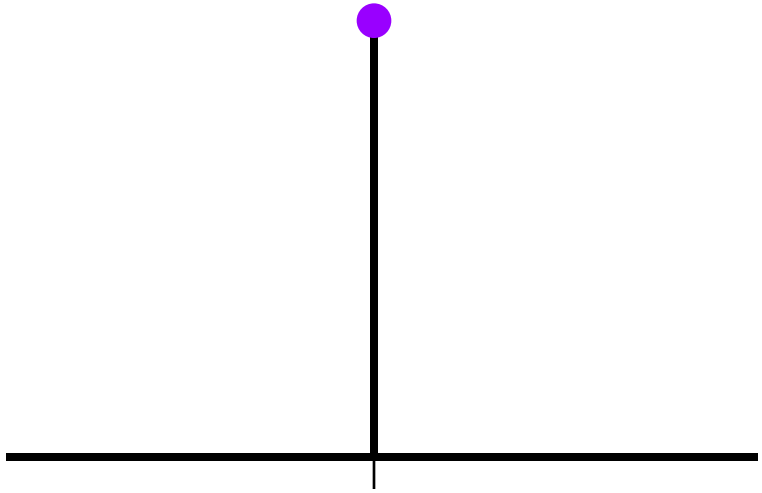

Solstices

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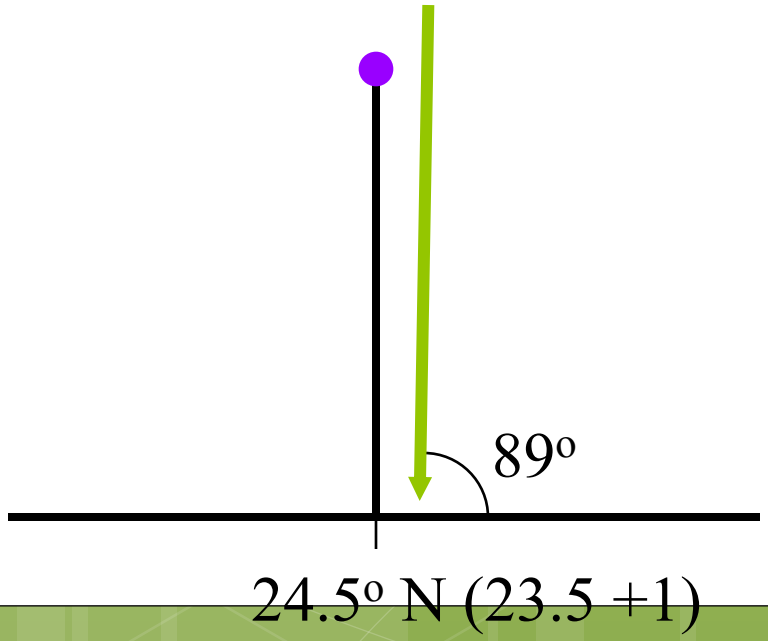

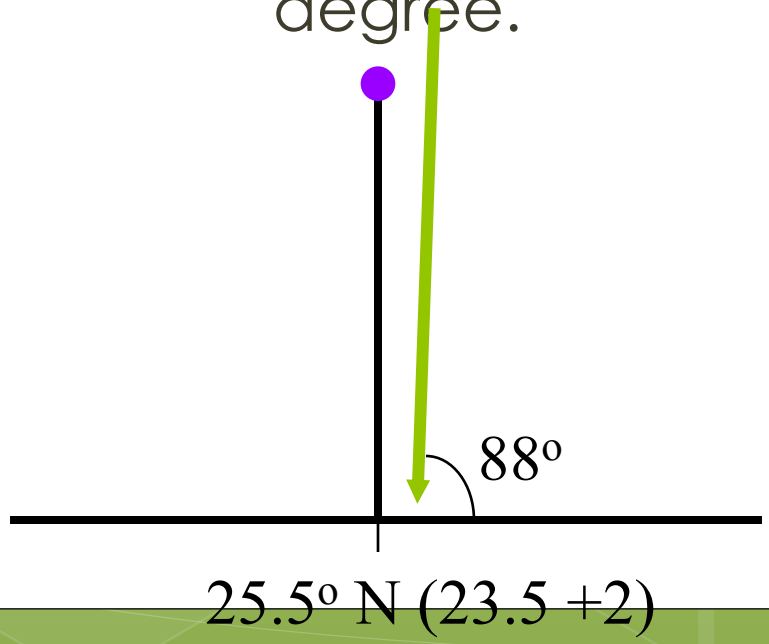

Noon Sun Angle Equation

Noon Sun Angle Equation

- You are about to find the angle of the sun at noon at different latitudes.

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- To do this, you will use the following formula:

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- To do this, you will use the following formula:

Noon Sun Angle = 90 - Zenith Angle

Noon Sun Angle Equation

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Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

You need to subtract from 90 because the angles you are working with are complementary.

Noon Sun Angle Equation

Sun Angle = 90 - Zenith Angle

Noon Sun Angle Equation

Sun Angle = 90 - Zenith Angle

- The zenith angle is the distance between the subsolar point and the latitude you are "at".

Noon Sun Angle Equation

Sun Angle = 90 - Zenith Angle

- The zenith angle is the distance between the subsolar point and the latitude you are "at".
- The subsolar point is the latitude where the sun's rays form a 90° angle at noon.

Noon Sun Angle Equation

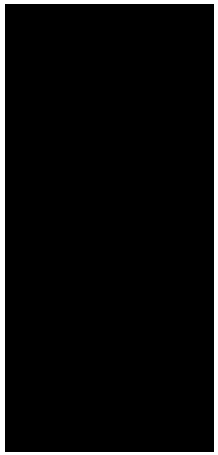
Sun Angle = 90 - Zenith Angle

- The zenith angle is the distance between the subsolar point and the latitude you are "at".
  - The subsolar point is the latitude where the sun's rays form a 90° angle at noon.

In other words: Noon Sun Angle = 90 - (latitude your are at ± latitude where sun is 90° at noon)

Noon Sun Angle Equation

- To calculate the zenith angle between the subsolar point and the latitude you are "at" requires a bit of thought….



Noon Sun Angle Equation

- If the subsolar point and your latitude are in the same hemisphere, subtract.

Noon Sun Angle Equation

If the subsolar point and your latitude are in the same hemisphere, subtract.

Example: Subsolar Point = 0°

Noon Sun Angle Equation

If the subsolar point and your latitude are in the same hemisphere, subtract.

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You are at 45°N.

Noon Sun Angle Equation

If the subsolar point and your latitude are in the same hemisphere, subtract.

Example: Subsolar Point = 0°

You are at 45°N.

Zenith Angle = (45 - 0) =

Noon Sun Angle Equation

If the subsolar point and your latitude are in the same hemisphere, subtract.

Example: Subsolar Point = 0°

You are at 45°N.

Zenith Angle = (45 - 0) = 45°

Noon Sun Angle Equation

- If the subsolar point and your latitude are in different hemispheres, add.

Noon Sun Angle Equation

- If the subsolar point and your latitude are in different hemispheres, add.
  - Example: Subsolar Point = 23.5° S

Noon Sun Angle Equation

- If the subsolar point and your latitude are in different hemispheres, add.
  - Example: Subsolar Point = 23.5° S
  - You are at 45°N.

Noon Sun Angle Equation

If the subsolar point and your latitude are in different hemispheres, add.

Example: Subsolar Point = 23.5° S

You are at 45°N.

Zenith Angle = (45 + 23.5) =

Noon Sun Angle Equation

If the subsolar point and your latitude are in different hemispheres, add.

Example: Subsolar Point = 23.5° S

You are at 45°N.

Zenith Angle = (45 + 23.5) = 68.5°

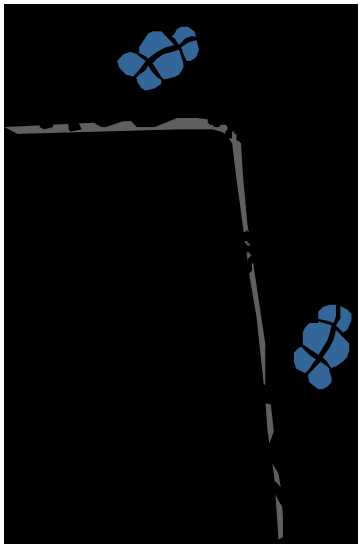
Noon Sun Angle Equation

- If the subsolar point and your latitude are in the same hemisphere, subtract.

- If the subsolar point and your latitude are in different hemispheres, add.

Noon Sun Angle Equation

- Let's do some problems together!



Noon Sun Angle Equation

- It is the June 22nd solstice (summer).

Noon Sun Angle Equation

- It is the June 22nd solstice (summer).
- The subsolar point is 23.5° N

Noon Sun Angle Equation

- It is the June 22nd solstice (summer).
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- You are visiting a friend in Brussels, Belgium

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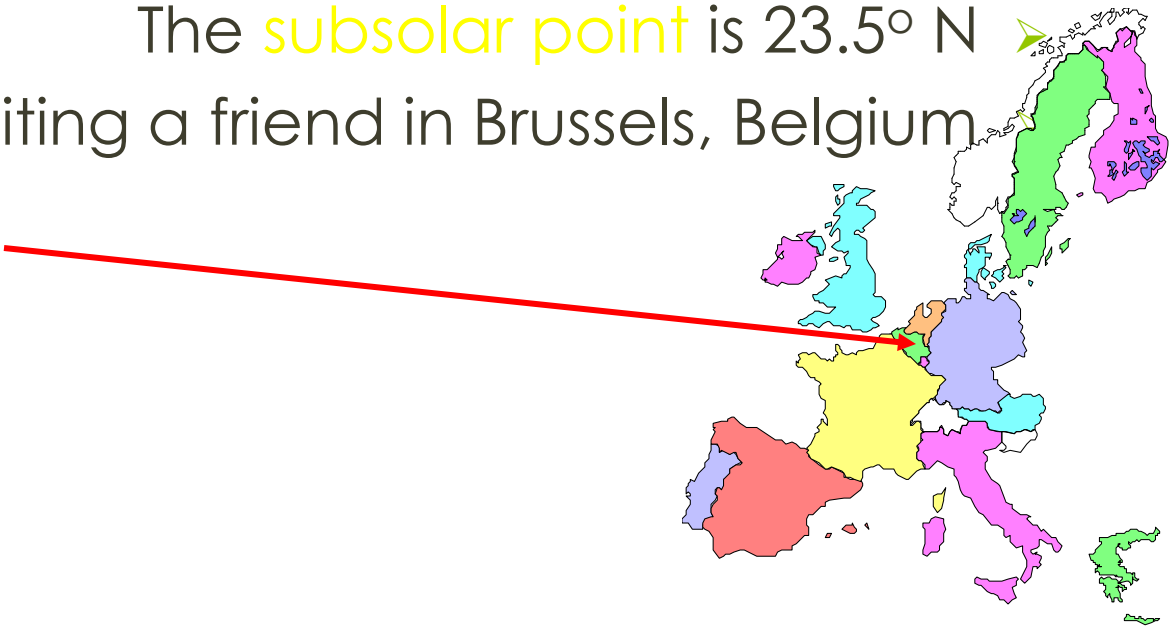
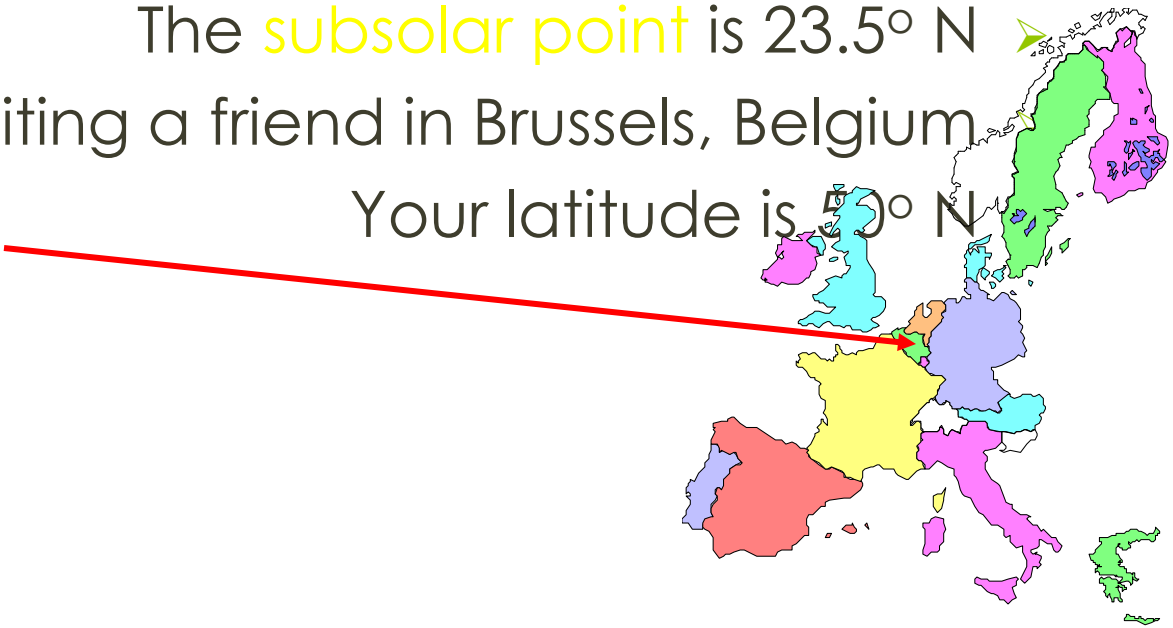


Noon Sun Angle Equation

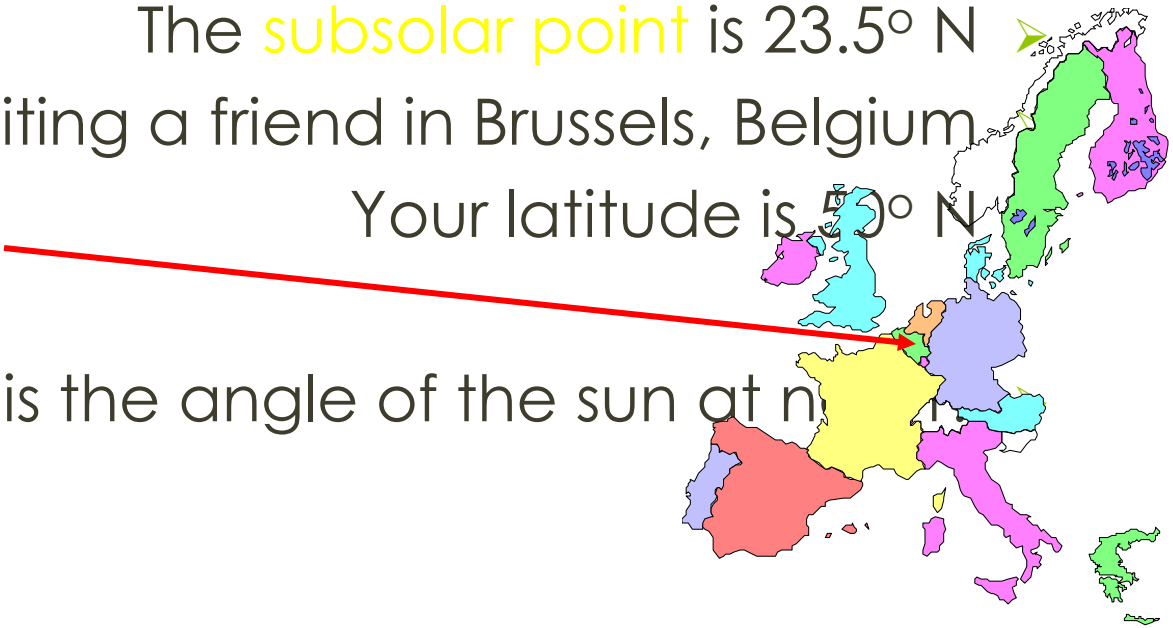
- It is the June 22nd solstice (summer).
- The subsolar point is 23.5° N
- You are visiting a friend in Brussels, Belgium
- Your latitude is 50° N



Noon Sun Angle Equation

- It is the June 22nd solstice (summer).
- The subsolar point is 23.5° N
- You are visiting a friend in Brussels, Belgium
- Your latitude is 50° N

What is the angle of the sun at n[illegible]



Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Noon Sun Angle Equation

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Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

50 - 23.5 =

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

50 - 23.5 = 26.5

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

50 - 23.5 = 26.5

Noon Sun Angle = 90 - 26.5 =

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

50 - 23.5 = 26.5

Noon Sun Angle = 90 - 26.5 = 63.5°

Noon Sun Angle Equation

- A noon sun angle of 63.5° is considered a high angle.
- This answer makes sense because it is summer time where you are.

Noon Sun Angle Equation

Good Job!!!

Let's try another one!

Noon Sun Angle Equation

- It is the March 22nd.

Noon Sun Angle Equation

- It is the March 22nd.
- It is the Spring Equinox.

Noon Sun Angle Equation

- It is the March 22nd.
- It is the Spring Equinox.
- The subsolar point is 0°

Noon Sun Angle Equation

- It is the March 22nd.
- It is the Spring Equinox.
- The subsolar point is 0°
- You are going to go skiing in New Zealand.

Noon Sun Angle Equation

It is the

It is the Spr

The subsol

- You are going to go skiing in New Zealand.

Noon Sun Angle Equation

It is the

It is the Spr

The subsol

- You are going to go skiing in New Zealand.
- Your latitude is 43° S

Noon Sun Angle Equation

It is the

It is the Spr

The subsol

- You are going to go skiing in New Zealand.
- Your latitude is 43° S
- What is the angle of the sun at noon?

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

43 - 0 =

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

43 - 0 = 43

Noon Sun Angle Equation

Noon Sun Angle = 90 - Zenith Angle

Zenith Angle: Subsolar point & your location are in the same hemisphere, subtract!

43 - 0 = 43

Noon Sun Angle = 90 - 43 =

Noon Sun Angle Equation

Noon Sun Angle = 90 - Arc Distance

Arc Distance: Subsolar point & your location are in the same hemisphere, subtract!

43 - 0 = 43

Noon Sun Angle = 90 - 43 = 47°

Noon Sun Angle Equation

- A noon sun angle of is 47° a moderate angle.
- This answer makes sense because it is spring time where you are.
- The snow may be melting, but you can probably still get in a few runs!

Noon Sun Angle Equation

Excellent work!

Let's try one last problem together.

Noon Sun Angle Equation

- It is the December 22nd.

Noon Sun Angle Equation

- It is the December 22nd.
- It is the Winter Solstice.

Noon Sun Angle Equation

- It is the December 22nd.
- It is the Winter Solstice.
- The subsolar point is 23.5° S

Noon Sun Angle Equation

- It is the December 22nd.
- It is the Winter Solstice.
- The subsolar point is 23.5° S

- You just won a trip to Oulu, Finland

Noon Sun Angle Equation

- It is the December 22nd.
- It is the Winter Solstice.
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You just won a trip to Oulu, Finland.

Noon Sun Angle Equation

- It is the December 22nd.
- It is the Winter Solstice.
- The subsolar point is 23.5°.

You just won a trip to Oulu, Finland.

Noon Sun Angle Equation

- It is the December 22nd.
- It is the Winter Solstice.
- The subsolar point is 23.5°
- You just won a trip to Oulu, Finland.
- Your latitude is 64° N

Noon Sun Angle Equation

- It is the December 22nd.
- It is the Winter Solstice.
- The subsolar point is 23.5°
- You just won a trip to Oulu, Finland.
- Your latitude is 64° N
- What is the angle of the sun at noon?

Noon Sun Angle Equation

Noon Sun Angle = 90 - Arc Distance

Noon Sun Angle Equation

Noon Sun Angle = 90 - Arc Distance

Arc Distance: Subsolar point & your location are in different hemispheres, add!

Noon Sun Angle Equation

Noon Sun Angle = 90 - Arc Distance

Arc Distance: Subsolar point & your location are in different hemispheres, add!

64 + 23.5 =

Noon Sun Angle Equation

Noon Sun Angle = 90 - Arc Distance

Arc Distance: Subsolar point & your location are in different hemispheres, add!

64 + 23.5 = 87.5

Noon Sun Angle Equation

Noon Sun Angle = 90 - Arc Distance

Arc Distance: Subsolar point & your location are in different hemispheres, add!

64 + 23.5 = 87.5

Noon Sun Angle = 90 - 87.5 =

Noon Sun Angle Equation

Noon Sun Angle = 90 - Arc Distance

Arc Distance: Subsolar point & your location are in different hemispheres, add!

64 + 23.5 = 87.5

Noon Sun Angle = 90 - 87.5 = 2.5°

Noon Sun Angle Equation

- A noon sun angle of is 2.5° a VERY low angle.
- This answer makes sense because it is wintertime where you are.
- You will need to take a lot of warm clothes for this trip!

Noon Sun Angle Equation

Congratulations!

You get to try some of these problems on your own. All the hints you've been shown are on your worksheet!

Good Luck