

1. Calculate the altitude of the noon sun on the equinoxes and solstices.

<i>Fill in the empty cells using these formulas:</i>		$= 90^\circ - \text{Latitude}$	$= \text{Equinox} + 23.5^\circ$	$= 90^\circ - \text{Latitude}$	$= \text{Equinox} - 23.5^\circ$	$= \text{Latitude}$
Name of Location	Location's Latitude	Vernal Equinox March 20/21	Summer Solstice June 21/22	Autumnal Equinox September 22/23	Winter Solstice December 21/22	Altitude of Polaris
Katonah, NY	41° N	(NOON SUN TO SOUTH)	(NOON SUN TO SOUTH)	(NOON SUN TO SOUTH)	(NOON SUN TO SOUTH)	
North Pole	90° N	(SUN CIRCLES HORIZON)	(SUN CIRCLES SKY)	(SUN CIRCLES HORIZON)	(SUN BELOW HORIZON)	
Arctic Circle	66.5° N	(NOON SUN TO SOUTH)	(NOON SUN TO SOUTH)	(NOON SUN TO SOUTH)	(NOON SUN ON HORIZON, SOUTH)	
Tropic of Cancer	23.5° N	(NOON SUN TO SOUTH)	(NOON SUN AT ZENITH)	(NOON SUN TO SOUTH)	(NOON SUN TO SOUTH)	
Equator	0°	(NOON SUN AT ZENITH)	(NOON SUN TO ***NORTH)	(NOON SUN AT ZENITH)	(NOON SUN TO SOUTH)	
Tropic of Capricorn	23.5° S	(NOON SUN TO NORTH)	43° (NOON SUN TO NORTH)	(NOON SUN TO NORTH)	90° (NOON SUN AT ZENITH)	(BELOW HORIZON)
Antarctic Circle	66.5° S	(NOON SUN TO NORTH)	0° (NOON SUN ON HORIZON, NORTH)	(NOON SUN TO NORTH)	47° (NOON SUN TO NORTH)	(BELOW HORIZON)
South Pole	90° S	0° (SUN CIRCLES HORIZON)	-23.5° (SUN BELOW HORIZON)	0° (SUN CIRCLES HORIZON)	23.5° (SUN CIRCLES SKY)	(BELOW HORIZON)

***ALL ANSWERS SHOULD BE 90° OR LESS...

Direction of Sunrise/Sunset on the Equinoxes and Solstices

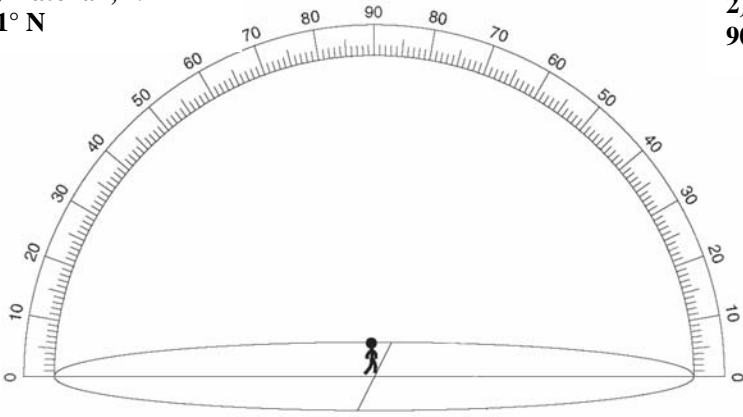
Name of Location	Location's Latitude	Vernal Equinox March 20/21	Summer Solstice June 21/22	Autumnal Equinox September 22/23	Winter Solstice December 21/22
Katonah, NY	41° N	Sunrise:EAST Sunset:WEST	Sunrise:NE Sunset:NW	Sunrise:EAST Sunset:WEST	Sunrise:SE Sunset:SW
North Pole	90° N	(Sun circles horizon)	(Sun circles sky)	(Sun circles horizon)	(Sun below horizon)
Arctic Circle	66.5° N	Sunrise:EAST Sunset:WEST	NORTH	Sunrise:EAST Sunset:WEST	(Sun below horizon)
Tropic of Cancer	23.5° N	Sunrise:EAST Sunset:WEST	Sunrise:NE Sunset:NW	Sunrise:EAST Sunset:WEST	Sunrise:SE Sunset:SW
Equator	0°	Sunrise:EAST Sunset:WEST	Sunrise:NE Sunset:NW	Sunrise:EAST Sunset:WEST	Sunrise:SE Sunset:SW
Tropic of Capricorn	23.5° S	Sunrise:EAST Sunset:WEST	Sunrise:NE Sunset:NW	Sunrise:EAST Sunset:WEST	Sunrise:SE Sunset:SW
Antarctic Circle	66.5° S	Sunrise:EAST Sunset:WEST	(Sun below horizon)	Sunrise:EAST Sunset:WEST	SOUTH
South Pole	90° S	(Sun circles horizon)	(Sun below horizon)	(Sun circles horizon)	(Sun circles sky)

2. Use the two tables above, and this key to draw the paths of the sun on the equinoxes and solstices at each of the eight locations. (Add compass directions to each diagram first, including NE, NW, SE, and SW. Be careful at the poles...)

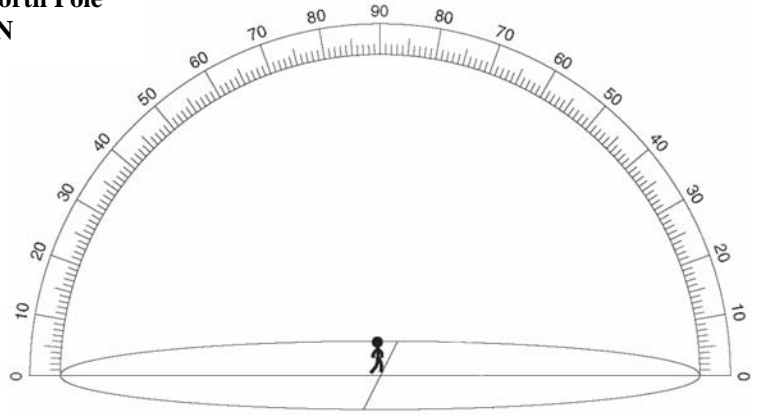
KEY:

<u>SYMBOL</u>	<u>MEANING</u>
EQ	EQUINOX
JS	JUNE SOLSTICE
DS	DECEMBER SOLSTICE
*	POLARIS (NORTH STAR)

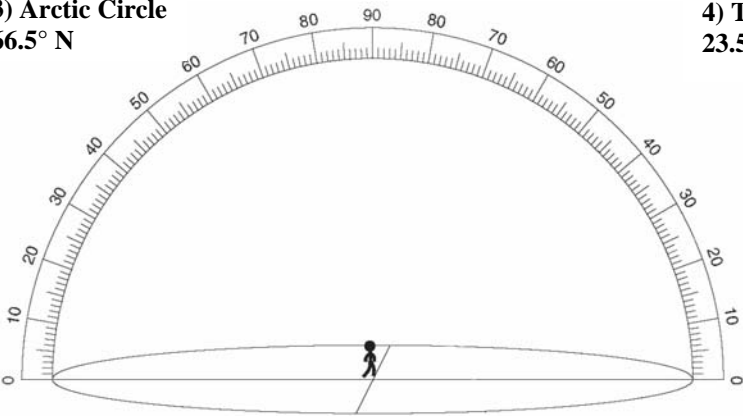
1) Katonah, NY
41° N



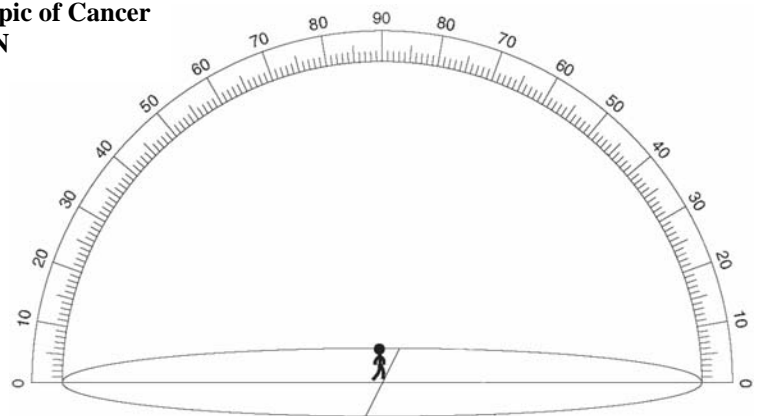
2) North Pole
90° N



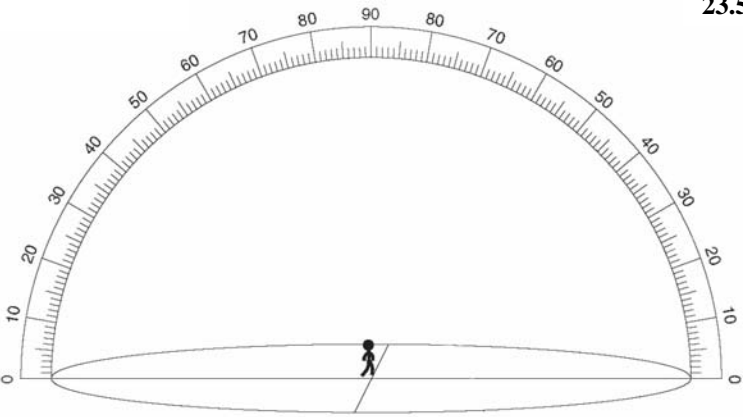
3) Arctic Circle
66.5° N



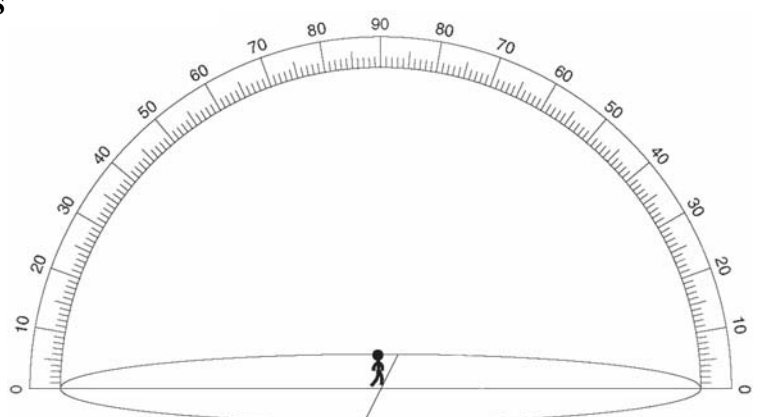
4) Tropic of Cancer
23.5° N



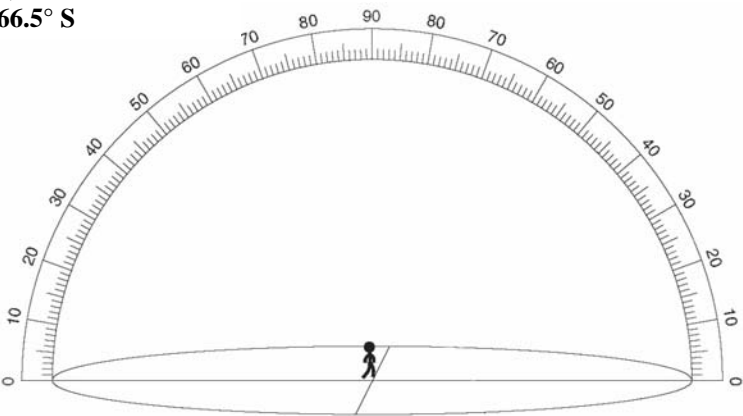
5) Equator 0°



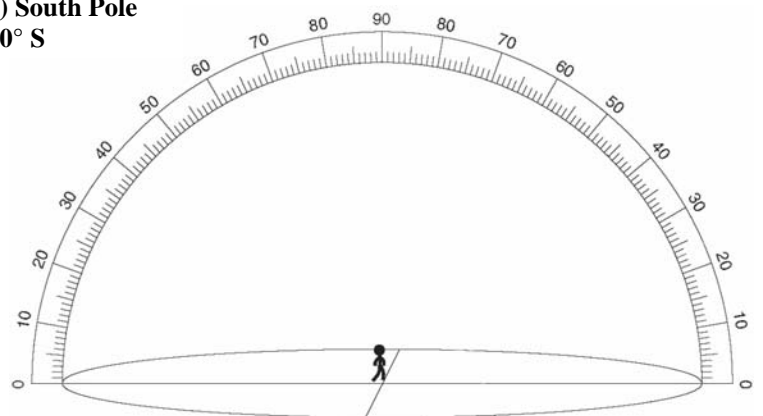
6) Tropic of Capricorn
23.5° S



7) Antarctic Circle
66.5° S



8) South Pole
90° S



1. ON EACH DATE, WHERE IS THE NOON SUN AT THE ZENITH?

- a) VERNAL EQUINOX _____
- b) SUMMER SOLSTICE _____
- c) AUTUMNAL EQUINOX _____
- d) WINTER SOLSTICE _____

2. ON EACH DATE, WHERE IS THE NOON SUN ON THE HORIZON?

- a) VERNAL EQUINOX _____
- b) SUMMER SOLSTICE _____
- c) AUTUMNAL EQUINOX _____
- d) WINTER SOLSTICE _____

3. ON EACH DATE, WHERE IS THE NOON SUN BELOW THE HORIZON?

- a) VERNAL EQUINOX _____
- b) SUMMER SOLSTICE _____
- c) AUTUMNAL EQUINOX _____
- d) WINTER SOLSTICE _____

4. IS THE SUN EVER AT THE ZENITH IN NEW YORK? _____

5. WHAT IS THE MAXIMUM ALTITUDE OF THE NOON SUN AT EACH LOCATION?

- a) KATONAH, NY _____
- b) NORTH POLE _____
- c) ARCTIC CIRCLE _____
- d) TROPIC OF CANCER _____
- e) EQUATOR _____
- f) TROPIC OF CAPRICORN _____
- g) ANTARCTIC CIRCLE _____
- h) SOUTH POLE _____

6. ON THE SUMMER SOLSTICE, WHERE ON EARTH WOULD YOU HAVE THE LONGEST SHADOW AT NOON? EXPLAIN YOUR ANSWER.
