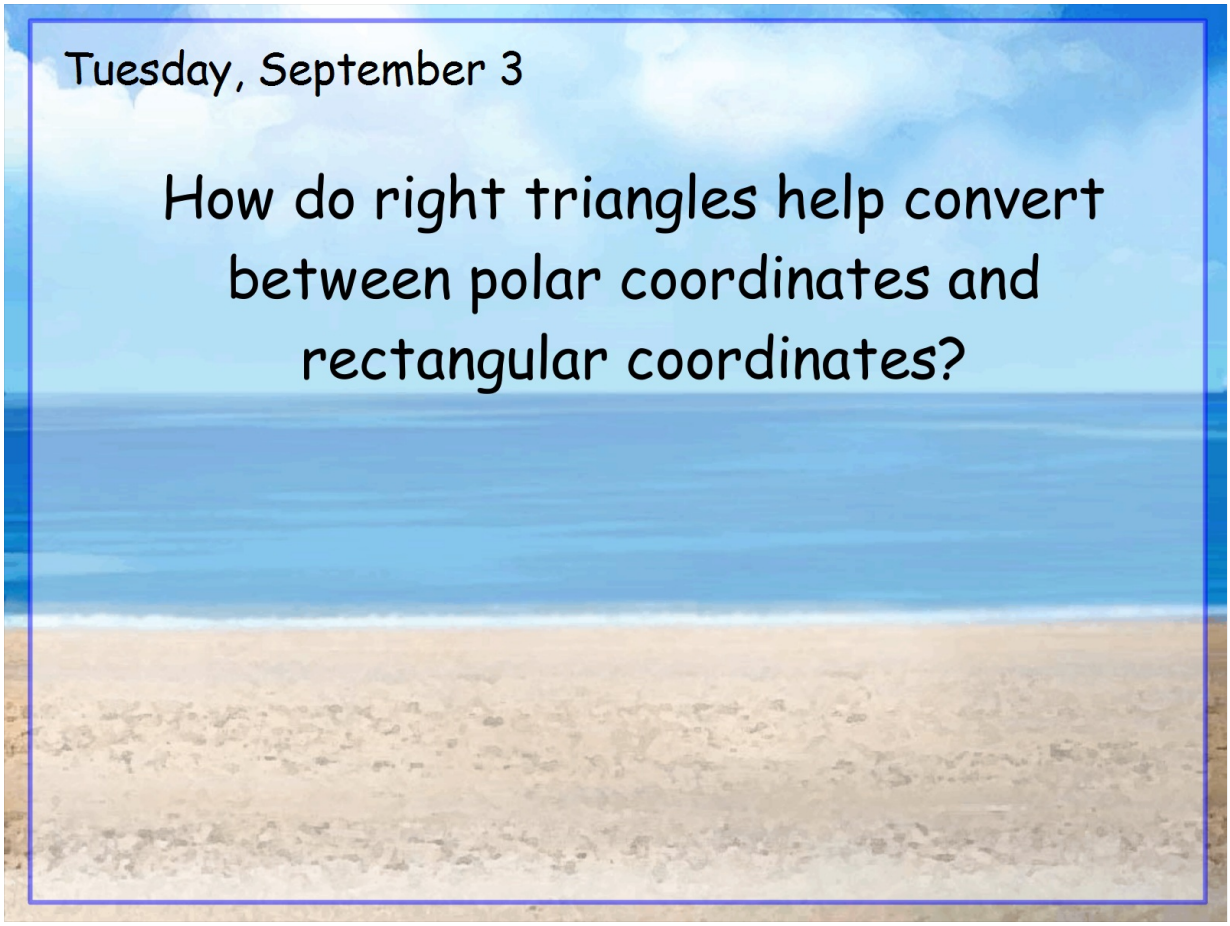


September 3 - Day 4

Students will verbally explain how to graph polar functions

(using the words:
angle, radius, terminal, initial...)

Air Traffic Controller

STUDENT ACTIVITY (continued)

Part IV Polar Curves $r = f(\theta)$

Pilots have a radar screen in the cockpit of their airplanes. When landing in overcast weather conditions, the radar screen becomes their eyes, guiding them to the runway for landing their aircraft. The cockpit radar screen is also a polar grid, with the pole on the radar screen giving the location of the Instrument Landing System (ILS) transmitting tower and the polar axis denoting due east from the ILS. The brightened point on the cockpit radar screen shows the location of the aircraft relative to the ILS transmitting system.

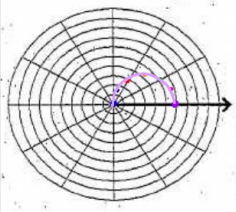
Typically, the ILS transmitting system is positioned at the ends of a runway. This positioning shows the pilot exactly where the beginning and end of the runway is located. From the ILS transmission, the pilot uses the cockpit radar screen to maneuver the airplane toward the pole, which locates the beginning of the runway. These maneuvers are referred to as landing approaches. Airports have strict landing approach procedures that must be followed to keep air traffic orderly and safe. These landing approach procedures are similar to traffic lane usage for cars.

Polar curves of the form $r = f(\theta)$ can be used to describe landing approaches for aircraft pilots. In the following questions, you are asked to investigate two such landing approaches. For the polar grids in these questions, the scale along the polar axis is one.

18. The ILS signal indicates that the landing approach is toward the south. The aircraft initially is at the point $(r, \theta) = (6, 0°)$. The scope on the airplane uses concentric circles with radii in steps of 1 mile from the ILS runway signal.

a. Use the polar grid given below to sketch the landing approach that is described by the polar function $r = 6\cdot\cos(\theta)$ for $0° \le \theta \le 90°$.

r	θ
6	0°
5.795	15°
5.196	30°
4.243	45°
3	60°
1.553	75°
0	90°



$8\cdot\sin(2\cdot0) = 0$
$8\cdot\sin(2\cdot15) = 4$
$8\cdot\sin(2\cdot30) = 6.928$
$8\cdot\sin(2\cdot45)$

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STUDENT ACTIVITY (continued)

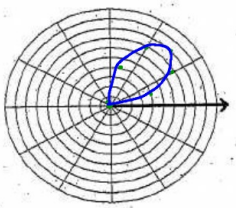
b. Describe the type of landing approach that is sketched in Part (a).

c. Transform the polar function $r = 6\cdot\cos(\theta)$ into rectangular variables x and y using your results in Question 11.

d. Does this transformation confirm your answer to Part (b)? Explain below.

19. The ILS signal once again indicates that the landing approach is toward the south. The aircraft initially is at the point $(r, \theta) = (0, 0°)$. Use the polar grid shown below to sketch the landing approach that is described by the polar function $r = 8\cdot\sin(2\theta)$ for $0° \le \theta \le 90°$.

r	θ
0	0°
4	15°
6.928	30°
8	45°
6.928	60°
4	75°
0	90°



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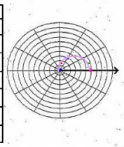
STUDENT ACTIVITY (continued)

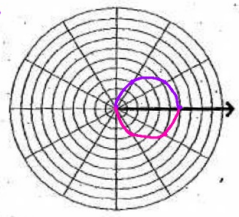
20: In Questions 18 and 19, you graphed polar functions of the form $r = f(\theta)$ on the interval $0° \le \theta \le 90°$. These graphs represent landing approaches for aircraft. However, the graphs of these landing approaches are only parts of the complete graph for these polar functions in the xy-coordinate plane.

a. Use the polar grid shown below to give a complete graph of $r = 6\cdot\cos(\theta)$ in the xy-coordinate plane. Indicate the interval of values for θ that gives the complete graph.

r	θ
6	0°
5.796	15°
5.196	30°
4.243	45°
3	60°
1.553	75°
0	90°



r	θ
	105°
-3	120°
	135°
-5.192	150°
	165°
-6	180°



$0° \le \theta \le 180°$

when the graph starts repeating

b. Use the polar grid shown below to give a complete graph of $r = 8\cdot\sin(2\theta)$ in the xy-coordinate plane. Indicate the interval of values for θ that gives the complete graph.

more than 180°