Sohcantoa

tcore 112: Quiz 4

Key

You may find the following table of approximations helpful if you did not bring a calculator for the quiz.

x	22.5°	30°	45°	60°	67.5°	135°
$\cos(x)$	$\frac{\sqrt{2+\sqrt{2}}}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	$\frac{\sqrt{2-\sqrt{2}}}{2}$	$-\frac{\sqrt{2}}{2}$
$\sin(x)$	$\frac{\sqrt{2-\sqrt{2}}}{2}$	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2+\sqrt{2}}}{2}$	$\frac{\sqrt{2}}{2}$
$\tan(x)$	$\sqrt{\frac{2-\sqrt{2}}{2+\sqrt{2}}}$	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	$\sqrt{\frac{2+\sqrt{2}}{2-\sqrt{2}}}$	-1

1. The crease pattern for the bird base is shown below. This bird base is the same as that presented in Lang and what you have worked with in class. Since you know how to make the bird base you know such things as $\overline{AB}$ bisects the $\angle GAF$. Let the side length of the square be 1 unit and find the following measures *exactly*.

   (a) [1] the measure of side $\overline{AF}$

   $\frac{1}{2}$

   (b) [2] the measure of $\angle DAF$

   $\frac{90^\circ}{4} = 22.5^\circ$

   (c) [3] the measure of side $\overline{AB}$

   Since $\overline{AB}$ bisected $\angle GAF$ and $\overline{AD}$ bisected $\angle DAF$

   Since $\triangle AFD$ is a right $\triangle$

   Sketch (.5) right $\angle$ (.5) trig (1) with angle (.5) $\Rightarrow \sin 67.5^\circ = \frac{.5}{AD}$

   $\Rightarrow AD = .5(\sin 67.5^\circ)^{-1} = \frac{1}{\frac{\sqrt{2+\sqrt{2}}}{2}} = \frac{2}{\sqrt{2+\sqrt{2}}}$

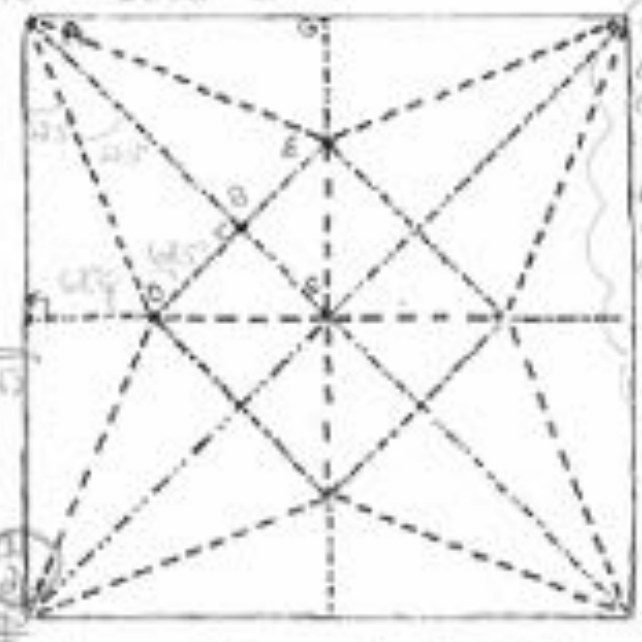
   Since $\triangle ABD$ is also a right $\triangle$

   $\Rightarrow \sin 67.5^\circ = \frac{AB}{AD}$

   $\Rightarrow AB = (AD)\cdot\sin 67.5^\circ = \left(\frac{1}{\sqrt{2+\sqrt{2}}}\right)\frac{\sqrt{2+\sqrt{2}}}{2}$

   $= (.5\sin 67.5^\circ)\sin 67.5^\circ$

   Note $\triangle DAF$ can be overlapped $\triangle DAB$ so $\overline{AF} = \overline{AB}$

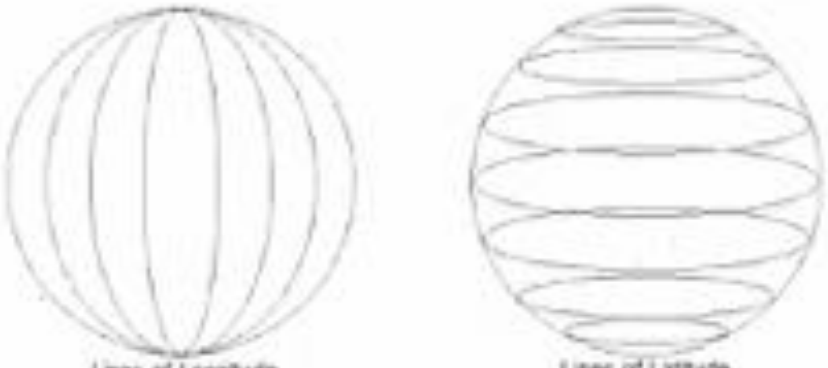


2. [1] Recall that the bird base has four flaps. Use your work from number 1 to find the length of the flaps in the bird base.

   Sketch (.5) Calculation (.5)

   The flap length is the length of $\overline{AB}$ which is calculated as $\frac{1}{2}$

3. [4] TRUE/FALSE: Refer to the diagram below when answering the following questions. If true, circle T and explain briefly why the statement is true. If false, circle F and explain briefly why the statement is false.



Lines of Longitude Lines of Latitude

(+.5) T (F) All of the 'lines' of latitude are geodesics on the sphere.

(+.5) only great circles are geodesics on the sphere and not all the lines of latitude are great circles

(+.5) (T) F The equator (the middle 'line' of latitude) is perpendicular to the 'lines' of longitude.

(+.5) the equator intersects the 'lines' of longitude and makes a 90° angle

(+.5) T (F) The 'lines' of latitude are parallel geodesics on the sphere.

(+.5) the lines of latitude are intersecting & thus not parallel

4. [2] How would you describe the style and/or content of mathematicians in the 17th and 18th centuries?

true (+1)
some (+.5)
stroke (+.5)

(*) Mathematicians of the 17th & 18th centuries were distinguished by their interest in: 1) creating the 1st of notations for math (calculus)
2) improving the rigor of their proofs

5. [2] What is it that Long calls "grafting"?

Long talks about book, simple & choice grafting. At this point you're only seeing about book grafting.
Book grafting involves a book or packet book-sewn the pages intended to be inserted after another page is located in the enclosing signature (see picture). For example, Long illustrates a cross pattern on the inner signature & uses the outer (grafted) pages to make folds to turn the cross into a swastika.

true (+1)
some (+.5)
stroke (+.5)