The Cosine Rule
Teacher Notes

7   8   9   **10**   11   12

TI-Nspire CAS   Investigation   Student   30min

Aim

The aim of this investigation is to confirm the Cosine Rule.

Equipment

For this activity you will need:

- TI-Nspire CAS (or TI-Nspire)
- TI-Nspire file – Cosine Rule
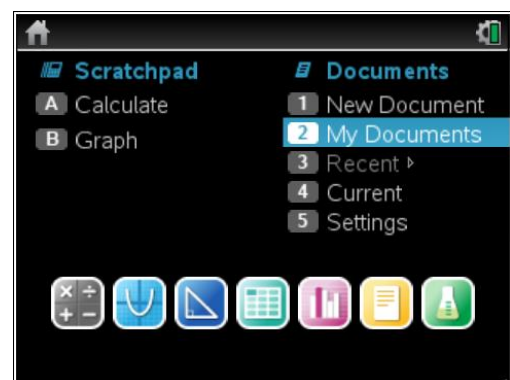
National Curriculum Statement:
Establish the sine, cosine and area rules for any triangle and solve related problems (ACMMG273)

Introduction – Setting up the calculations

During this activity, students will need to use the TI-Nspire file: "Cosine Rule". This file can be distributed using TI-Navigator, the TI-Nspire docking station or the teacher/student software. To distribute the file using the Teacher software, use the **Tools** menu and select the **Transfer Tool.** Locate the TI-Nspire file on your computer and then start the transfer. Once the file is transferred to the first handheld, unplug the handheld and continue plugging in each student's handheld device. Once all the students have the file, stop the transfer. Note that students can also transfer files from one handheld device to another from within the **My Documents** folder. Note also that multi-port USB connectors can be used to transfer files to several computers at the one time.

This activity requires access to the "Cosine Rule" TI-Nspire file. This file should be loaded on your device before proceeding.

Once the file is on your handheld, press **home** and select **My Documents**. Locate the "Cosine Rule" file and press **enter** to open.

The location of the file depends on the selected location during the file transfer.

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The Cosine Rule is $\mathbf{c^2 = a^2 + b^2 - 2 \cdot a \cdot b \cdot \cos(C)}$

Navigate to page 1.2, then grab and drag any of the vertices of the triangle. Observe that even though the measurements change, the Cosine Rule remains true.
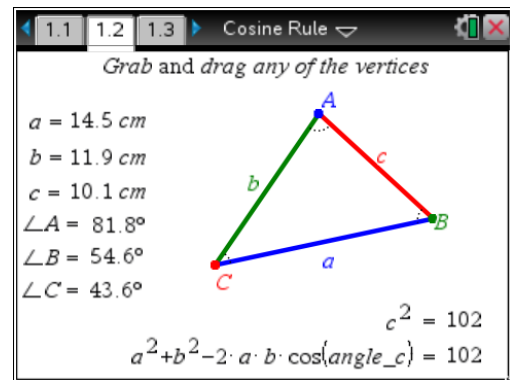
Navigate to page 1.4, then grab and drag any of the vertices of the triangle. Again, observe that even though the measurements change, the Cosine Rule ratios remain equal.
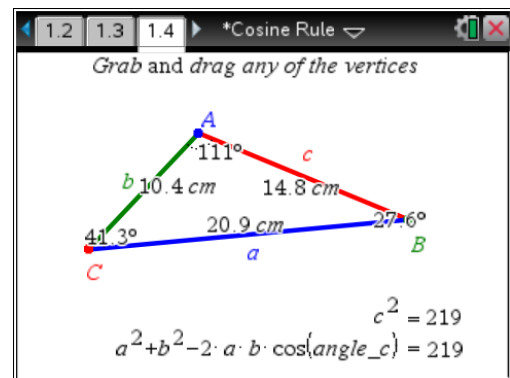
✎ Part of in this investigation requires calculations to be performed. The Scratchpad is a place where calculations can be computed and then discarded. To access the Scratchpad press **home** and select **Scratchpad** (or press **A**). Alternatively, press the ⌨ key (this key is not available on a Clickpad).

Change the document setting to **Degree** or use the degree symbol (°). This can be found in the symbol palette or by pressing π▸ or ?▸ to access one of the mini-palettes. On a Clickpad, press ctrl + ⟨·⟩.

It is recommended that the setting be changed to Degree.

Calculate some of the cosine values from page 1.2.

Because you are inputting decimal values, you will get decimal answers. If you happen to get an exact answer, press **ctrl + enter** for the decimal answer.

To return to the current document, press **esc**. If you are on the **home** page, select **Current** (or press **4**).
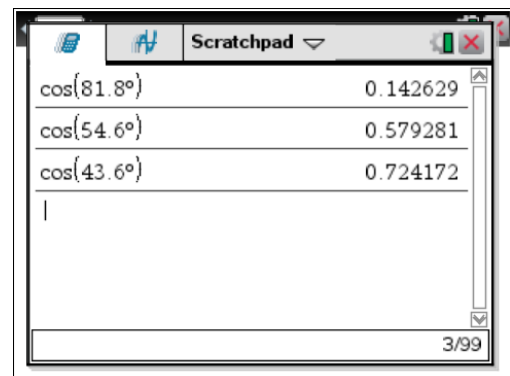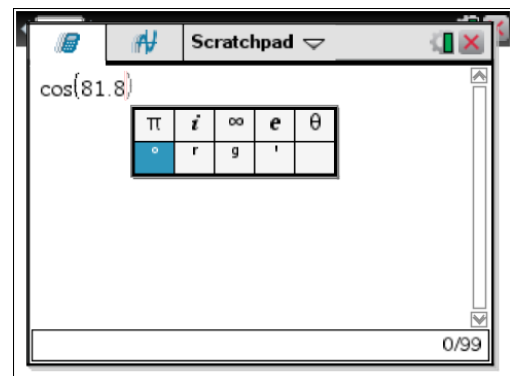
1. Alter the triangle on page 1.2 then complete the table below using a new set of values. Compare these to your own calculations using the Scratchpad.

   Several values are possible for the following table. Encourage students to adjust the triangle and use their own values. Students are also encouraged to share their results with others. Ideally, each student will use different values but they will all reach the same conclusion.

Side/Angle	Value	Cosine Rule	Page 1.2	Scratchpad
a	14.5	c^2	102	102.01
b	11.9			
c	10.1			
$\angle A$	81.8°	$a^2 + b^2 - 2 \times a \times b \times \cos(C°)$	102	101.948
$\angle B$	54.6°			
$\angle C$	43.6°			

2. Are the results on page 1.2 and the Scratchpad the same? In not, why do you think they are different?

   Any discrepancies will be due to rounding errors. The values shown on page 1.2 are rounded values. Consequently, the Scratchpad results may vary.

3. The other two forms of the Cosine Rule are:

   $$a^2 = b^2 + c^2 - 2 \cdot b \cdot c \cdot \cos(A) \text{ and}$$

   $$b^2 = a^2 + c^2 - 2 \cdot a \cdot c \cdot \cos(B)$$

   Using the values from the table in question 1, copy and complete this table to verify these two forms of the Cosine Rule. Use the Scratchpad for your calculations.

   Several values are possible for the following table.

a^2	210.25
$b^2 + c^2 - 2 \times b \times c \times \cos(A°)$	209.335
b^2	141.61
$a^2 + c^2 - 2 \times a \times c \times \cos(B°)$	142.589

4. Do you believe your answers verify the Cosine Rule? Why or why not?

   Yes, although this is not a proof. The results verify the Cosine Rule as these results are very close. Any discrepancies will be due to rounding errors. Emphasise to students that rounding errors can occur early in a solution, not just at the end.

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