Law of Cosines

Let $\triangle ABC$ be any triangle with a, b, and c representing the measures of sides included angles with measurements A, B, & C, respectively.

Sides:

$c^2 = a^2 + b^2 - 2ab\cos C$

$b^2 = a^2 + c^2 - 2ac\cos B$

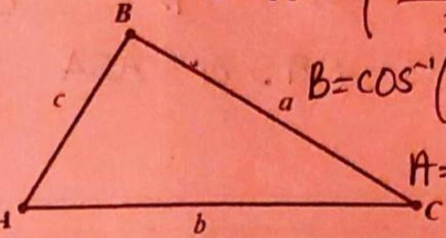
$a^2 = b^2 + c^2 - 2bc\cos A$

Angles:

$C = \cos^{-1}\left(\frac{a^2+b^2-c^2}{2ab}\right)$

$B = \cos^{-1}\left(\frac{a^2+c^2-b^2}{2ac}\right)$

$A = \cos^{-1}\left(\frac{b^2+c^2-a^2}{2bc}\right)$



**2 conditions:

SSS, SAS

* start with largest angle ~~across from longest side~~, then with next biggest side

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Example. Solve $\triangle ABC$. Round the angle measures to the nearest degree.

1. **a = 4, b = 7, c = 9.**

① $C = \cos^{-1}\left(\frac{4^2+7^2-9^2}{2\cdot 4\cdot 7}\right)$

$C = 107°$

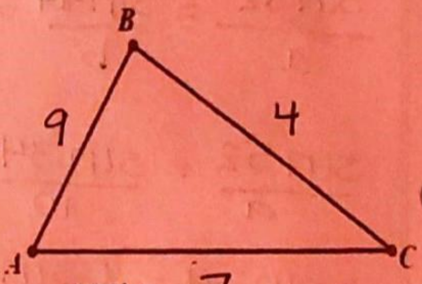
② $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

$\frac{\sin A}{4} = \frac{\sin B}{7} = \frac{\sin 107}{9}$

$\frac{9\sin B}{9} = \frac{7\sin 107}{9}$ $B = \sin^{-1}\left(\frac{7\sin 107}{9}\right)$

$B = 48°$

③ $\angle A = 180 - (107 + 48) = 25°$



A = 25° a = 4

B = 48° b = 7

C = 107° c = 9

2. **a = 25, b = 30, ∠C = 160°.**

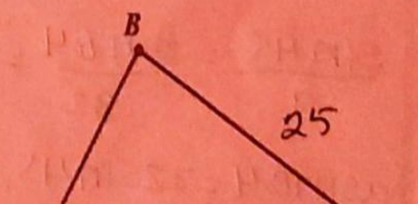
① $c^2 = \sqrt{25^2 + 30^2 - 2(25)(30)\cos 160}$

$c = 54.2$

② $\frac{\sin A}{25} = \frac{\sin B}{30} = \frac{\sin 160}{54.2}$

$\angle B = \sin^{-1}\left(\frac{30\sin 160}{54.2}\right) = 11°$

③ $\angle A = 180 - (160 + 11) = 9°$



A = 9° a = 25

B = 11° b = 30

C = 160° c = 54.2