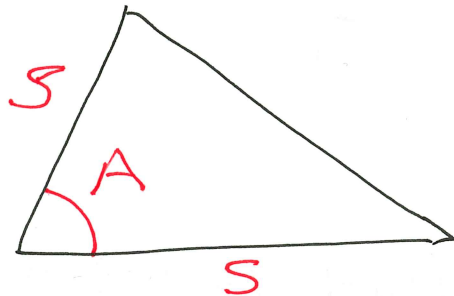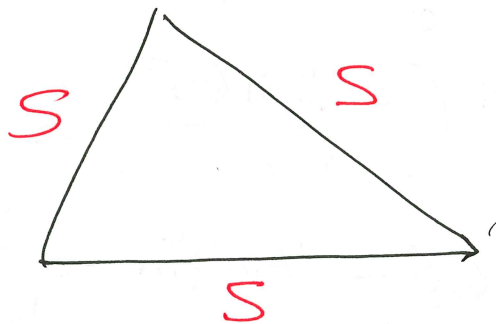# 4.3 Law of Cosines

In 4.2 we stated that the Law of Sines applied to Cases 1 and 2 triangles. To solve triangles for Cases 3 and 4 we need something else.

- ### Case 3

  Two sides and included angle, SAS.

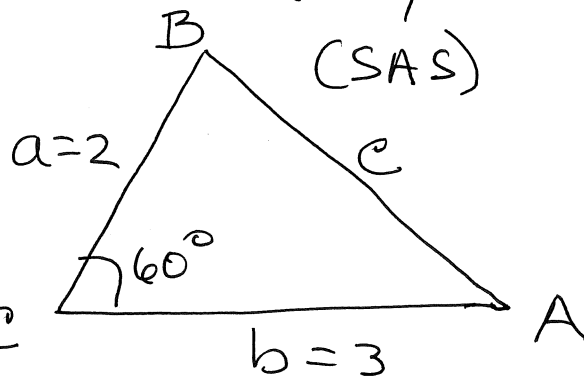- ### Case 4

  Three sides are given, SSS.

To solve these two triangles we use the Law of Cosines:

$$a^2 = b^2 + c^2 - 2bc \cos A$$
$$b^2 = a^2 + c^2 - 2ac \cos B$$
$$c^2 = a^2 + b^2 - 2ab \cos C$$

EX: Solve the triangle with $a=2$, $b=3$, and $C=60°$. (SAS)

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

$$= 4 + 9 - 2(2)(3) \cos 60°$$

$$= 13 - 6 = 7$$

$$\underline{c = \sqrt{7}}$$

Choose to find A with

$$\frac{\sin A}{a} = \frac{\sin C}{c} \implies \sin A = \frac{2 \sin 60°}{\sqrt{7}}$$

$$A = \sin^{-1}\left(\frac{2 \sin 60°}{\sqrt{7}}\right) = \underline{40.9°}$$

$$B = 180° - 60° - 40.9\mathring{.}.. = \underline{79.1°}$$