

# Assignment 1

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Download all python codes from

<https://github.com/grajanarsavva/Matrix-theory/codes>

and latex-tikz codes from

<https://github.com/grajanarsavva/Matrix-theory>

## 1 QUESTION No. 2.9

Draw a  $\triangle ABC$  in which  $\angle C = 90^\circ$ ,  $\angle B = 30^\circ$ ,  $\angle A = 60^\circ$  and  $a+b+c=11$

## 2 EXPLANATION

Given,

$$\angle C = 90^\circ, \angle B = 30^\circ, \angle A = 60^\circ \text{ and } a+b+c=11 \quad (2.0.1)$$

By using Sin Rule:

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} \quad (2.0.2)$$

$$\implies b \sin C = c \sin B \quad (2.0.3)$$

$$b \sin 90 = c \sin 30 \quad (2.0.4)$$

$$\implies c = 2b \quad (2.0.5)$$

$$a \sin B = b \sin A \quad (2.0.6)$$

$$a \sin 30 = b \sin 60 \quad (2.0.7)$$

$$\implies a = \sqrt{3}b \quad (2.0.8)$$

Then,  $AX=B$

which can be expressed as the matrix equation

$$\begin{pmatrix} 0 & -2 & 1 \\ 1 & -\sqrt{3} & 0 \\ 1 & 1 & 1 \end{pmatrix} \begin{pmatrix} a \\ b \\ c \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 11 \end{pmatrix} \quad (2.0.9)$$

By solving (2.0.8), we get values :

$$\implies a = 4.02627944; \quad (2.0.10)$$

$$\implies b = 2.32457352; \quad (2.0.11)$$

$$\implies c = 4.64914704 \quad (2.0.12)$$

The Vertices of  $\triangle ABC$  are

$$\mathbf{A} = \begin{pmatrix} 0 \\ c \end{pmatrix} = \begin{pmatrix} 0 \\ 4.64 \end{pmatrix} \quad (2.0.13)$$

$$\mathbf{B} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \quad (2.0.14)$$

$$\mathbf{C} = \begin{pmatrix} a \\ 0 \end{pmatrix} = \begin{pmatrix} 4.02 \\ 0 \end{pmatrix} \quad (2.0.15)$$

$$\mathbf{D} = \begin{pmatrix} p \\ 0 \end{pmatrix} = \begin{pmatrix} 4.02 \\ 0 \end{pmatrix} \quad (2.0.16)$$

Now,

$$AB = \|\mathbf{A} - \mathbf{B}\|^2 = \|\mathbf{A}\|^2 = c^2 = 21.61 \quad (2.0.17)$$

$$BC = \|\mathbf{C} - \mathbf{B}\|^2 = \|\mathbf{C}\|^2 = a^2 = 16.21 \quad (2.0.18)$$

$$AC = \|\mathbf{A} - \mathbf{C}\|^2 = b^2 = 5.4 \quad (2.0.19)$$

from AC

$$b^2 = \|\mathbf{A} - \mathbf{C}\|^2 = (\mathbf{A} - \mathbf{C})^T (\mathbf{A} - \mathbf{C}) \quad (2.0.20)$$

$$= \mathbf{A}^T \mathbf{A} + \mathbf{C}^T \mathbf{C} - \mathbf{A}^T \mathbf{C} - \mathbf{C}^T \mathbf{A} \quad (2.0.21)$$

$$= \|\mathbf{A}\|^2 + \|\mathbf{C}\|^2 - 2\mathbf{A}^T \mathbf{C} \quad (2.0.22)$$

$$= a^2 + b^2 - 2ap \quad (2.0.23)$$

yielding

$$p = \left( \frac{a^2 + c^2 - b^2}{2a} \right) = 4.026; \quad (2.0.24)$$

$$\|\mathbf{A}\|^2 = c^2 = p^2 + q^2 \quad (2.0.25)$$

$$\implies q = \pm \sqrt{c^2 - p^2} = \pm 2.324 \quad (2.0.26)$$

Plot the  $\triangle ABC$  is as follows:

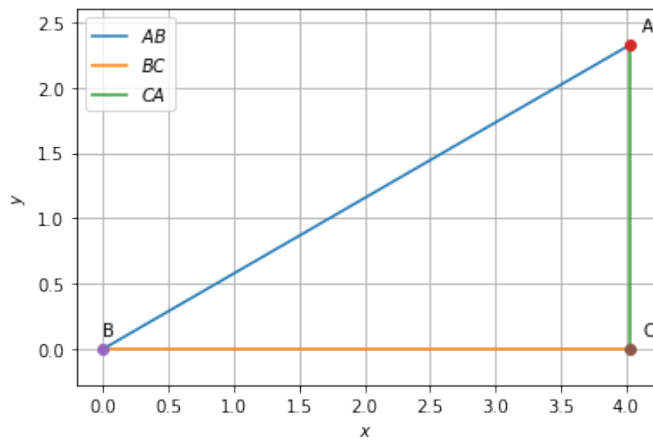


Fig. 2.1:  $\triangle ABC$