

# Math Document Template

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**Abstract**—This is a document explaining for a question on the concept of area of triangles.

Download all python codes from

```
svn co https://github.com/Ashuwin/summer_20/
trunk/linalg_triangle/codes
```

and latex-tikz codes from

```
svn co https://github.com/Ashuwin/summer_20/
trunk/linalg_triangle/figs
```

## 1 PROBLEM

Find the area of triangle whose vertices are

a)  $\begin{pmatrix} 2 \\ 3 \end{pmatrix}, \begin{pmatrix} -1 \\ 0 \end{pmatrix}, \begin{pmatrix} 2 \\ -4 \end{pmatrix}$

b)  $\begin{pmatrix} -5 \\ -1 \end{pmatrix}, \begin{pmatrix} 3 \\ -5 \end{pmatrix}, \begin{pmatrix} 5 \\ 2 \end{pmatrix}$

## 2 CONSTRUCTION

2.1. The design parameters used for construction solution See Table. 2.1.

Design Parameters	
Parameters	Value
<b>A</b>	$\begin{pmatrix} 2 \\ 3 \end{pmatrix}$
<b>B</b>	$\begin{pmatrix} -1 \\ 0 \end{pmatrix}$
<b>C</b>	$\begin{pmatrix} 2 \\ -4 \end{pmatrix}$
<b>P</b>	$\begin{pmatrix} -5 \\ -1 \end{pmatrix}$
<b>Q</b>	$\begin{pmatrix} 3 \\ -5 \end{pmatrix}$
<b>R</b>	$\begin{pmatrix} 5 \\ 2 \end{pmatrix}$

TABLE 2.1: Triangle  $ABC$  and Triangle  $PQR$

2.2. Draw fig. 2.2.

**Solution:** The following Python code generates Fig. 2.2

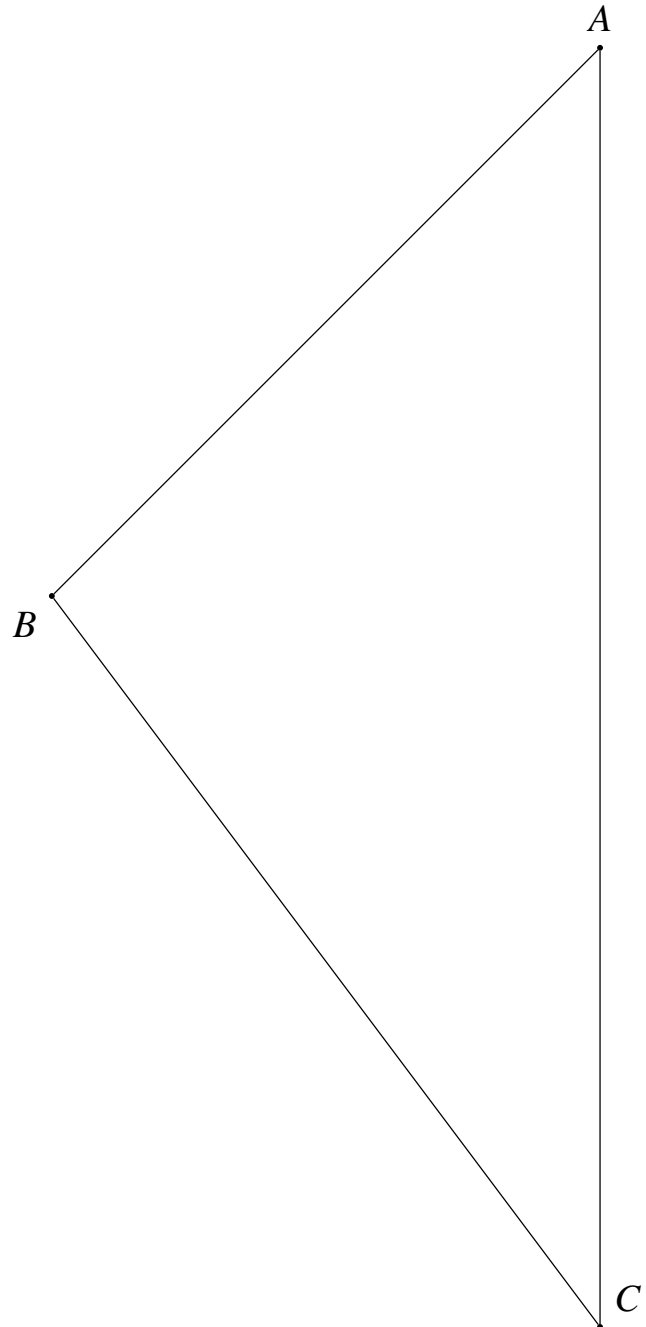


Fig. 2.0: Triangle  $ABC$  by Latex-tikz

```
codes/triangle1.py
```

and the equivalent latex-tikz code generating

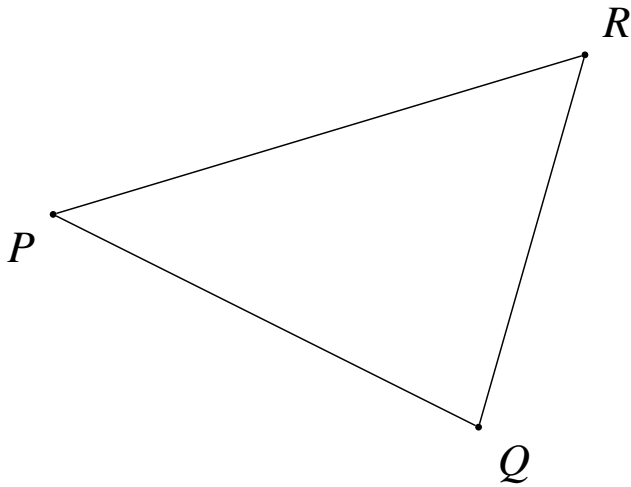


Fig. 2.0: Triangle  $PQR$  by Latex-tikz

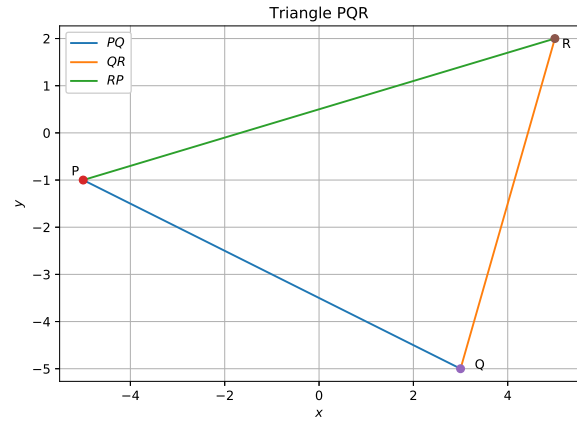


Fig. 2.3: Triangle  $PQR$  using python

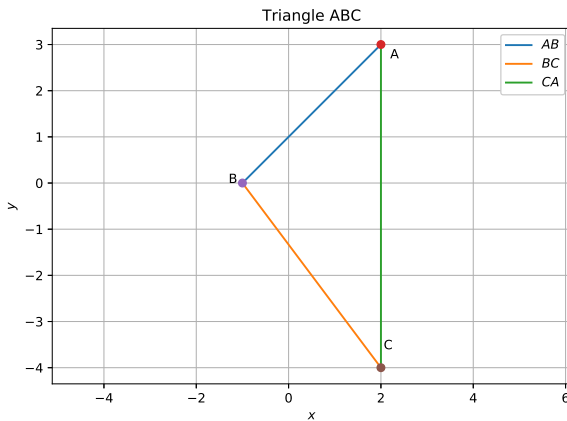


Fig. 2.2: Triangle  $ABC$  using python

Fig. 2.2 is

```
figs/triangle_ABC.tex
```

2.3. Draw fig. 2.3.

**Solution:** The following Python code generates Fig. 2.3

```
codes/triangle2.py
```

and the equivalent latex-tikz code generating Fig. 2.3 is

```
figs/triangle_PQR.tex
```

product is obtained as:

$$\frac{1}{2} \|(\mathbf{B} - \mathbf{A}) \times (\mathbf{C} - \mathbf{A})\|$$

and it is found in the following python code:

```
codes/tri_area_cp.py
```

Area of  $\triangle ABC = 10.5 \text{ units}^2$

3.2. The area of triangle  $PQR$ :

**Solution:** The area of triangle  $PQR$  using Heron's formula is obtained as:

$$\sqrt{s * (s - p) * (s - q) * (s - r)}$$

where

$$s = \frac{p + q + r}{2}$$

$$p = \|\mathbf{R} - \mathbf{Q}\|, q = \|\mathbf{P} - \mathbf{R}\|, r = \|\mathbf{Q} - \mathbf{P}\|$$

and it is found in the following python code:

```
codes/tri_area_heron.py
```

Area of  $\triangle PQR = 32 \text{ units}^2$

### 3 SOLUTION

3.1. The area of triangle  $ABC$ :

**Solution:** The area of triangle  $ABC$  using cross