# ASSIGNMENT 3

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Download all python codes from

https://github.com/CRAMYATULASI/ASSIGNMENT_3/tree/main/ASSIGNMENT3/CODES

and latex-tikz codes from

https://github.com/CRAMYATULASI/ASSIGNMENT_3/tree/main/ASSIGNMENT3

## 1 Question No 2.56

Construct a tangent to a circle of radius 4 units from a point on concentric circle of radius 6 units.

## 2 Solution

Data from the given question

| | Symbols | Circle1 | Circle2 |
|---|---|---|---|
| Centre | **O** | $\begin{pmatrix}0\\0\end{pmatrix}$ | $\begin{pmatrix}0\\0\end{pmatrix}$ |
| Radius | $r_1$,$r_2$ | 4 | 6 |

Let P be a point on circle with radius 6.

$$\therefore \mathbf{P} = \begin{pmatrix}6\\0\end{pmatrix} \tag{2.0.1}$$

Let $PQ$ and $PR$ be tangents from point P on circle with radius 6 to the points Q and R on circle with radius 4 .

We know a tangent is always perpendicular to the radius .

$$\therefore OQ \perp QP \tag{2.0.2}$$

Now,

$$(\mathbf{O}-\mathbf{Q})^T(\mathbf{Q}-\mathbf{P}) = 0 \quad (\because OQ \perp QP) \tag{2.0.3}$$

$$\mathbf{Q}^T(\mathbf{Q}-\mathbf{P}) = 0 \quad \left(\because \mathbf{O} = \begin{pmatrix}0\\0\end{pmatrix}\right) \tag{2.0.4}$$

$$\mathbf{Q}^T\mathbf{Q} - \mathbf{Q}^T\mathbf{P} = 0 \tag{2.0.5}$$

$$\|\mathbf{Q}\|^2 = \mathbf{Q}^T\mathbf{P} \tag{2.0.6}$$

$$\|\mathbf{Q}\|^2 = \mathbf{P}^T\mathbf{Q} \quad \left(\because \mathbf{Q}^T\mathbf{P} = \mathbf{P}^T\mathbf{Q}\right) \tag{2.0.7}$$

$$\mathbf{P}^T\mathbf{Q} = 16 \quad \left(\because \|\mathbf{Q}\|^2 = 16\right) \tag{2.0.8}$$

$$\begin{pmatrix}6 & 0\end{pmatrix}\mathbf{Q} = 16 \quad \left(\because \mathbf{P} = \begin{pmatrix}6\\0\end{pmatrix}\right) \tag{2.0.9}$$

$$\begin{pmatrix}1 & 0\end{pmatrix}\mathbf{Q} = \frac{8}{3} \tag{2.0.10}$$

$$\mathbf{Q} = \begin{pmatrix}\frac{8}{3}\\0\end{pmatrix} + \lambda\begin{pmatrix}0\\1\end{pmatrix} \tag{2.0.11}$$

$$\mathbf{Q} = \mathbf{q} + \lambda\mathbf{m} \tag{2.0.12}$$

$$\mathbf{q} = \begin{pmatrix}\frac{8}{3}\\0\end{pmatrix}, \mathbf{m} = \begin{pmatrix}0\\1\end{pmatrix} \tag{2.0.13}$$

We know,

$$\|\mathbf{q} + \lambda\mathbf{m}\|^2 = 9 \tag{2.0.14}$$

$$(\mathbf{q} + \lambda\mathbf{m})^T(\mathbf{q} + \lambda\mathbf{m}) = r^2 \tag{2.0.15}$$

$$\lambda^2 = \frac{r^2 - \|\mathbf{q}\|^2}{\|\mathbf{m}\|^2} \tag{2.0.16}$$

$$\lambda = \pm 2.95 \tag{2.0.17}$$

Substitute $\lambda$ value in (2.0.11) we get

$$\mathbf{Q} = \begin{pmatrix}\frac{8}{3}\\2.95\end{pmatrix}, \mathbf{R} = \begin{pmatrix}\frac{8}{3}\\-2.95\end{pmatrix} \tag{2.0.18}$$

Plot of Tangents PQ and PR :

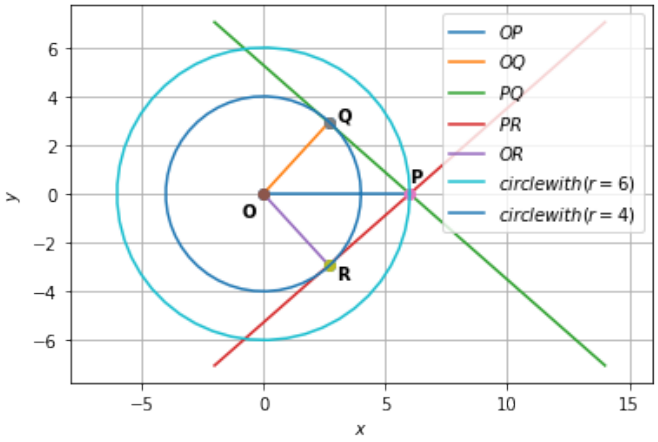


Fig. 2.1: Tangent lines to circle of radius 4 units.