Example:
A system consists of 10 identical components, all of which must work for system success. What is the system reliability if each component has a reliability of 0.95?

Component reliability, $R = 0.95$
Number of components, $n = 10$

Using Product Rule of Reliability,
System Reliability, $R_s = R^n$
\[= (0.95)^{10} = 0.5987\]

Example:
A system is to be designed with an overall reliability of 0.999 using components having individual reliabilities of 0.7. What is the minimum number of components that must be connected in parallel?

System Reliability, $R_s = 0.999$
Component reliability, $R = 0.7$
Number of components, $n = ?$

System Unreliability, $Q_s = 1 - R_s = 1 - 0.999 = 0.001$
Component Unreliability, $Q = 1 - R = 1 - 0.7 = 0.3$

Using Product Rule of Unreliability, $Q_s = Q^n$ i.e. $0.001 = (0.3)^n$
therefore, $n = \ln(0.001) / \ln(0.3) = 5.74$
since $n$ is an integer, $n = 6$
Example:

Derive a general expression for the unreliability of the model shown below, and hence evaluate the unreliability of the system if all components have a reliability of 0.8.

Reliability Network Model (Reliability Block Diagram) of the System
\[ R_i = 0.8 \text{ for } i = 1 \text{ to } 5 \]

\[ Q_8 = Q_7 \cdot Q_5 = (1 - R_7) \cdot Q_5 \]
\[ = (1 - R_1 \cdot R_2 \cdot R_6) \cdot Q_5 \]
\[ = [1 - R_1 \cdot R_2 \cdot (1 - Q_6)] \cdot Q_5 \]
\[ = [1 - R_1 \cdot R_2 \cdot (1 - Q_3 \cdot Q_4)] \cdot Q_5 \]

\[ Q_8 = [1 - 0.8 \times 0.8 \times (1 - 0.2 \times 0.2)] \times 0.2 = 0.07712 \]

**Example:**

Derive a general expression for the unreliability of the system whose reliability model is shown below.

Reliability Network Model (Reliability Block Diagram) of the System
If Components 4, 5 and 6 are identical, each with reliability $R$, 

$$R_9 = R^3 + 3R^2Q$$

Otherwise

$$R_9 = R_4 R_5 R_6 + R_4 R_5 Q_6 + R_4 Q_5 R_6 + Q_4 R_5 R_6$$

$$Q_8 = Q_2 \cdot Q_3$$

$$R_{10} = R_1 R_8 R_9$$

$$Q_4 = Q_{10} \cdot Q_7$$

$$= (1 - R_{10}) \cdot Q_7$$

$$= (1 - R_1 R_5 R_6) \cdot Q_7$$

$$= [1 - R_1 (1 - Q_8) R_6] \cdot Q_7$$

$$= [1 - R_1 (1 - Q_2 Q_3) R_6] \cdot Q_7$$