The closeness centrality of a vertex v is defined as

$\boldsymbol{C_C(v_i) = \frac{n-1}{\sum_{i\neq j} d(v_i,v_j)}}$ **where** $\boldsymbol{d(v_i, v_j)}$ **is distance from** $\boldsymbol{v_i}$ **to** $\boldsymbol{v_j}$**.**

Cycle $\boldsymbol{C_n}$:

n even

$$\boldsymbol{CC(v) = \frac{n-1}{2.1 + 2.2 + 2.3 + \cdots + 2.\left(\frac{n}{2} - 1\right) + \frac{n}{2}}}$$

$$\boldsymbol{= \frac{n-1}{2\left(1 + 2 + \cdots + \left(\frac{n}{2} - 1\right) + \frac{n}{2}\right.} = \frac{4(n-1)}{n^2}}$$

n odd:

$$\boldsymbol{CC(v) = \frac{n-1}{2.1 + 2.2 + 2.3 + \cdots + 2.\left(\frac{n-1}{2}\right)}}$$

$$\boldsymbol{= \frac{n-1}{2\left(1+2+\cdots+\frac{n-1}{2}\right)} = \frac{4}{n+1}}$$

$\boldsymbol{K_{p,q}}$:

Let $\boldsymbol{|V_1| = p,\ |V_2| = q \text{ and } u \in V_1,\ v \in V_2}$.

$$\boldsymbol{CC(u) = \frac{n-1}{1.q + (p-1)2} = \frac{n-1}{n+p-2}}$$

$$\boldsymbol{CC(v) = \frac{n-1}{1.p+(q-1)2} = \frac{n-1}{n+q-2}}$$

Betweenness centrality $\boldsymbol{C_B(v)} = \sum_{s\neq v\neq t} \frac{\sigma_{st}(v)}{\sigma_{st}}$, where σ_{st} is the total number of shortest paths from vertex s to vertex t and $\sigma_{st}(v)$ is the number of shortest paths from vertex s to vertex t that pass through v.

In C_6 all the vertices will have same $C_B(v) = 2$

In a complete bipartite graph, $K_{1,n-1}$, all the pendant vertices have $C_B(v) = 0$ and the central vertex will have $C_B(v) = {}^{n-1}C_2$.

Obtain closeness centrality of all the vertices in $P_n, K_n\backslash e$.

Obtain betweenness centrality of all the vertices in $P_7, K_n\backslash e, K_{p,q}$.