1. (a) Two roots must be at 1 and third root between 1 and infinity.

2. (a) \( N_2 = \frac{4mn^2}{r^3} \)

3. (c) scleronomic

4. (a) In any virtual displacement, the total work done by the force of constraint is zero.

5. (b) A single, coupled equation of motion

6. (d) A set of generalised co-ordinates is a unique set of co-ordinates to describe the configuration of the system.

7. (c) 0

8. (a) \((x_1, y_1) = (l_1 \cos \theta_1, l_1 \sin \theta_1)\)

   \((x_2, y_2) = (l_1 \cos \theta_2 + l_2 \cos \theta_2, l_1 \sin \theta_1 + l_2 \sin \theta_2)\)

9. From the principle of virtual work, we can write,
   
   \[ m_1 \ddot{x_1} + m_2 \ddot{x_2} = 0 \]

   \[ = m_1 g \sin \theta_1 \delta x_1 + m_2 g \sin \theta_2 \delta x_2 = 0 \]

   Here, \( \delta x_1 \) and \( \delta x_2 \) are two virtual displacement of \( m_1 \) and \( m_2 \) along the inclined plane in the downward directions respectively.

   \[ \therefore \delta x_1 = -\delta x_2 \]

   \[ \therefore m_1 \sin \theta_1 = m_2 \sin \theta_2 \]

   2) Cond. of equ.
The body is accelerating \((\ddot{a})\) horizontally towards left w.r.t incline, w.r.t an observer on earth. The virtual displacement \(\delta \vec{r}\) can only be along the incline.

\[ (m\ddot{g} - ma) \cdot \delta \vec{r} = 0 \]

\[ \Rightarrow \quad mg \sin \alpha \delta r - ma \cos \alpha \delta r = 0 \]

\[ \Rightarrow \quad a = \frac{g \tan \alpha}{1} \]