

## Dynamics

### Jerk in a String

If two particles are connected by a light inextensible string and one of the particles is projected away from the other then at some point there will be a jerk in the string. At the instant before the jerk one of the particles will have momentum. As soon as the string becomes taut the particles will move onwards with the same velocity. The overall momentum must be conserved so therefore the velocity after the jerk must be lower than the initial velocity. This idea is best explained through an example.

#### Example 19

Two particles P and Q of masses 4kg and 7.5kg respectively are connected by a light inextensible string which is initially slack. Q is projected away from P with velocity  $5\text{ms}^{-1}$ . When the string becomes taut the two particles move on together with a common speed. Find the common speed and the impulse exerted on P by the string.

Using the conservation of momentum where  $v_1 = v_2$  :

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_1$$

$$4 \times 0 + 7.5 \times 5 = 4 \times v_1 + 7.5 \times v_1$$

$$37.5 = 11.5v_1$$

$$v_1 = 3.26\text{ms}^{-1}$$

So the common speed is  $3.26\text{ms}^{-1}$

Impulse is the change in momentum so considering particle P:

$$\text{Impulse} = m(v - u)$$

$$= 4(3.26 - 0)$$

$$= 13.0\text{Ns}$$