13 In this question the unit vectors **i** and **j** are in the directions east and north respectively.

At time t seconds, where $t \geqslant 0$, a particle P of mass 2 kg is moving on a smooth horizontal surface under the action of a constant horizontal force $(-8\mathbf{i} - 54\mathbf{j})$N and a variable horizontal force $(4t\mathbf{i} + 6(2t-1)^2\mathbf{j})$N.

(a) Determine the value of t when the forces acting on P are in equilibrium. **[2]**

It is given that P is at rest when $t = 0$.

(b) Determine the speed of P at the instant when P is moving due north. **[6]**

(c) Determine the distance between the positions of P when $t = 0$ and $t = 3$. **[5]**