10 Rory runs a distance of 45 m in 12.5 s. He starts from rest and accelerates to a speed of $4\,\mathrm{m\,s^{-1}}$. He runs the remaining distance at $4\,\mathrm{m\,s^{-1}}$.

Rory proposes a model in which the acceleration is constant until time T seconds.

(i) Sketch the velocity-time graph for Rory's run using this model. [2]

(ii) Calculate T. [2]

(iii) Find an expression for Rory's displacement at time t s for $0 \leqslant t \leqslant T$. [2]

(iv) Use this model to find the time taken for Rory to run the first 4 m. [1]

Rory proposes a refined model in which the velocity during the acceleration phase is a quadratic function of t. The graph of Rory's quadratic goes through $(0, 0)$ and has its maximum point at $(S, 4)$. In this model the acceleration phase lasts until time S seconds, after which the velocity is constant.

(v) Sketch a velocity-time graph that represents Rory's run using this refined model. [1]

(vi) State with a reason whether S is greater than T or less than T. (You are not required to calculate the value of S.) [1]