9 In this question, all lengths are in metres, and time, t, is in seconds.

A particle P moves in a straight line such that, t seconds after leaving a fixed point O, its displacement, s, is given by $s = 4t - 4\cos 2t + 4$.

(a) Find the velocity, v, of P at time t. [2]

(b) On the axes, sketch the velocity–time graph for P for $0 \leqslant t \leqslant \pi$, stating the intercepts with the axes in exact form. [5]



(c) Find the acceleration of P at time t. [1]

(d) Find the times when the acceleration of P is zero for $0 \leqslant t \leqslant \pi$. Give your answers in terms of π. [2]