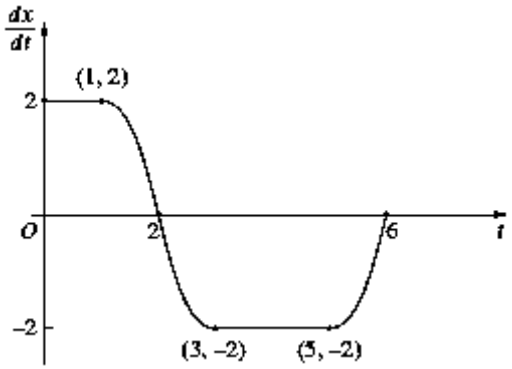
05 **7b**

The graph shows the velocity, $\frac{dx}{dt}$, of a particle as a function of time. Initially the particle is at the origin.

(i) At what time is the displacement, x, from the origin a maximum? **1**

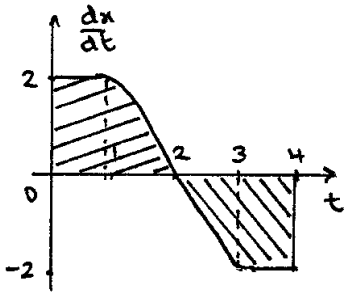
(ii) At what time does the particle return to the origin? Justify your answer. **2**

(iii) Draw a sketch of the acceleration, $\frac{d^2x}{dt^2}$, as a function of time for $0 \le t \le 6$. **2**



(i) Max displacement when $\frac{dx}{dt} = 0$ and sign change from + 0 – around stat pt.
From the graph, occurs when $x = 2$.
After 2 seconds.

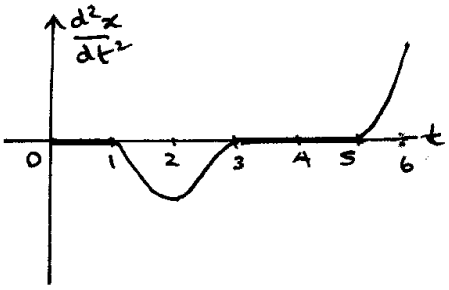
(ii) Occurs when area above x-axis equals area below x-axis.



Occurs when $t = 4$.

(iii) Consider the slope of the curve of $\frac{dx}{dt}$:

From 0 to 1: curve is flat: its der. = 0
From 1 to 3: curve is decreasing: its der. < 0
From 3 to 5: curve if flat: its der. = 0
From 5 onwards: curve is increasing: der. > 0



* These solutions have been provided by *projectmaths* and are not supplied or endorsed by the Board of Studies

Board of Studies: Notes from the Marking Centre

A reasonable percentage of candidates did not attempt this part of the question.

(i) Given there were so many '2s' in the question and that it was the answer, it was important for candidates to show how their response was obtained eg $\frac{dx}{dt} = 2$; (2, 0); (0, 2) and the maximum value of the given graph was also 2.

(ii) Most of those who attempted this part got the correct time of $t = 4$, but the reasoning behind their response did not recognise the area relationship under $\frac{dx}{dt}$. Many responses revolved around a description of the given graph in terms of velocity and time. Only the better responses related the use of integration to the desired justification.

(iii) Graphical techniques were obviously lacking for a large group of candidates. Errors included the omission of a scale on the horizontal axis, the horizontal portions of the solution being almost impossible to distinguish from the given horizontal axis, and concavity of the curved sections not relating to the original graph.

Source: http://www.boardofstudies.nsw.edu.au/hsc_exams/