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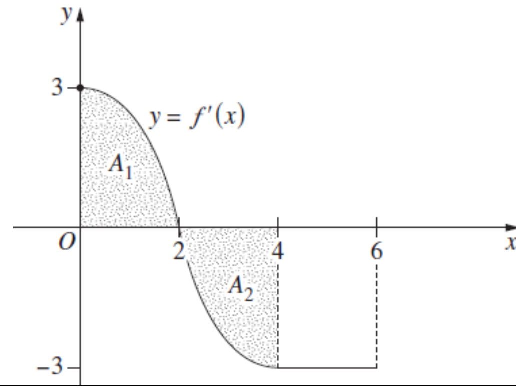
10	**9b**	Let $y = f(x)$ be a function defined for $0 \le x \le 6$, with $f(0) = 0$. The diagram shows the graph of the derivative of f, $y = f'(x)$. The shaded region A_1 has area 4 square units. The shaded region A_2 has area 4 square units. (i) For which values of x is $f(x)$ increasing? (ii) What is the maximum value of $f(x)$? (iii) Find the value of $f(6)$. (iv) Draw a graph of $y = f(x)$ for $0 \le x \le 6$.	**1** **1** **1** **2**



(i) $f(x)$ increasing when $f'(x) > 0$.

From graph, $0 < x < 2$.

(ii) Maximum value of $f(x)$ when $f'(x) = 0$.

$\therefore$ when x = 2.

Now, $\int_0^2 f'(x)\ dx = 4$

$[f(x)]_0^2 = 4$

$f(2) - f(0) = 4$

But $f(0) = 0$,

$\therefore f(2) - 0 = 4$

$f(2) = 4$

$\therefore$ maximum value of $f(x)$ is 4.

(iii) *METHOD 1*:

As $f(0) = 0$ and $A_1 = A_2$, then $f(4) = 0$.

From $x = 4$ to $x = 6$, the gradient is −3.

As $m = -3$, then $f(6) = -6$

METHOD 2:

Now, $\int_2^4 f'(x)\ dx = -4$

$[f(x)]_2^4 = -4$

$f(4) - f(2) = -4$

But $f(2) = 4$, (from ii)

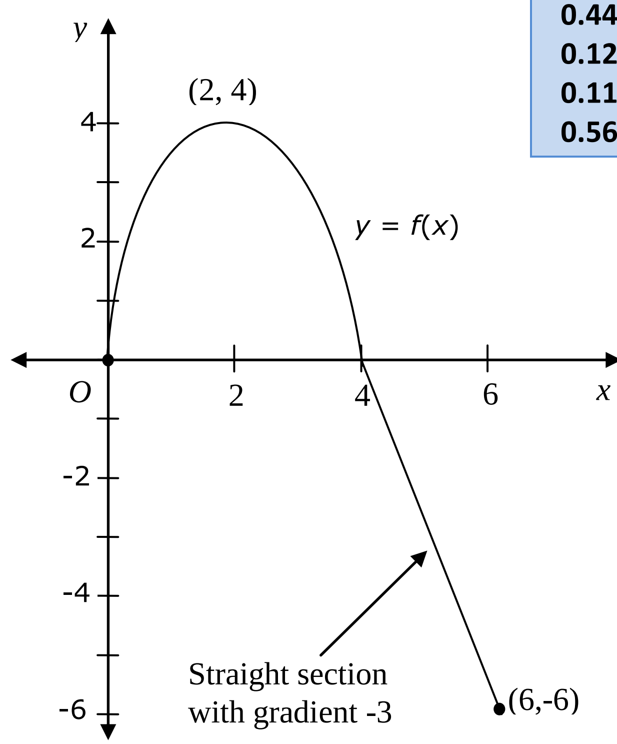
$\therefore f(4) - 4 = -4$

$f(4) = 0$

From $x = 4$ to $x = 6$, the gradient is −3.

As $m = -3$, then $f(6) = -6$.

State Mean:
0.44/1
0.12/1
0.11/1
0.56/2



* 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

(i) Most candidates attempted this part, presenting a solution involving an inequality. Commonly, errors resulted from the misuse of inequality signs, for example $x > 0$ or $x < 2$ or $0 > x > 2$. A notable percentage of candidates correctly stated the solution in words.

(ii) Many candidates correctly stated that the maximum value was at $x = 2$ but then failed to use the fact that $A_1 = 4$ and $f(0) = 0$ to find the corresponding y value.

(iii) This part was very poorly done and many candidates did not attempt it. Some candidates realised that the solution involved using the area under the curve for $4 \le x \le 6$. Only a small number of candidates interpreted their findings and used $\int_4^6 f'(x)dx = -6$ to arrive at the correct answer. This meant that the most common incorrect answer was $(6) = 6$.

(iv) Most candidates did not use the connection between this part and the earlier parts of this section. For some, a perfectly drawn graph was their only attempt. Graphs were generally not well sketched. Candidates are reminded that care should be taken with diagrams and that they should be clearly drawn using a scale on both axes. Most candidates attempting this part correctly interpreted the concave-down section of the graph, but unfortunately many failed to join this section properly to the rest of their graph at $x = 0$ and $x = 4$. There was limited recognition of the need to sketch a straight line section with a negative gradient for $x \le 4$. Other incorrect responses included a graph showing more than one turning point, graphs sketched beyond the given domain and failing to indicate $f(0) = 0$ as stated in the question.

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