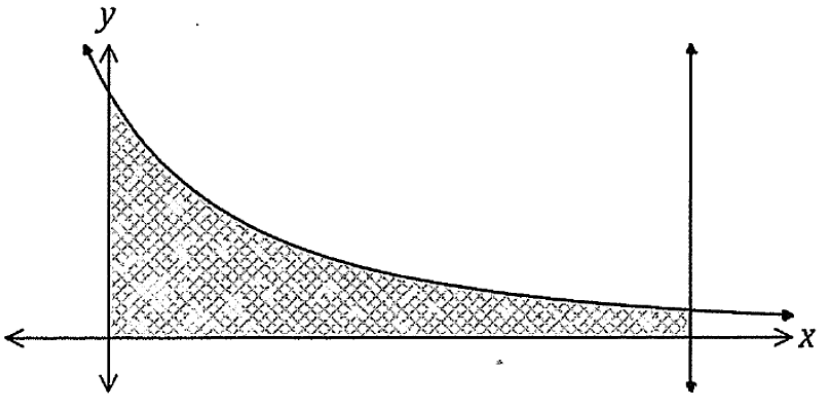
Question 1 **(5 marks)**

The graph below shows the curve $y = \frac{180}{(2x+5)^2}$ and the line $x = 5$.

Determine the area of the shaded region, enclosed by the $x -$ axis, the $y -$ axis, the line $x = 5$ and the curve.



Question 2 **(8 marks)**

A small body, initially at the origin, moves in a straight line with acceleration $a(t) = 6t - 10$ ms^{-2}, where t is the time in seconds, $t \geq 0$. When $t = 5$, it was observed to have a velocity of 31 ms^{-1}.

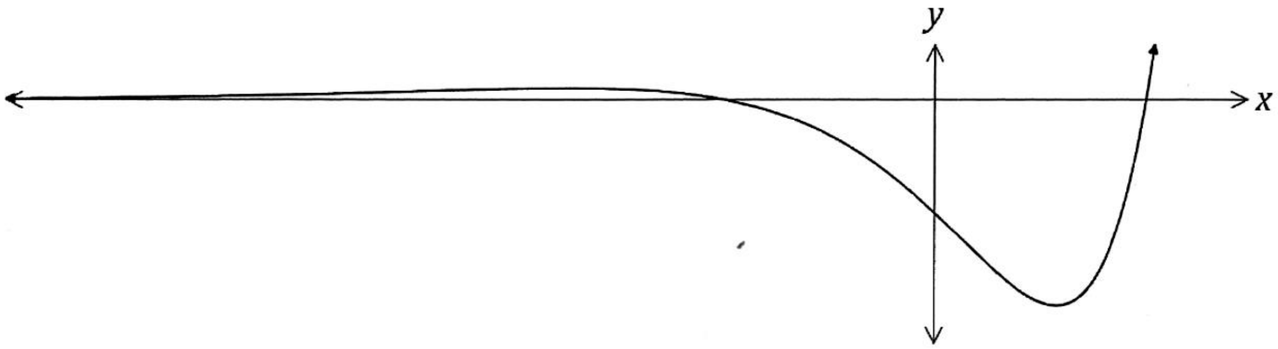
(a) Determine an expression for $v(t)$, the velocity of the body. (2 marks)

(b) Determine the acceleration of the body when $v = 19$. (3 marks)

(c) Determine the velocity of the body as it passes through the origin for the last time. (3 marks)

Question 3 **(6 marks)**

The graph of $y = f(x)$ is shown below, where $f(x) = e^x(x^2 - 3)$.



(a) Show that $f'(x) = e^x(x^2 + 2x - 3)$. (1 mark)

(b) Determine the $x -$ coordinates of the stationary points of $f(x)$. (2 marks)

(c) Given that $f''(x) = e^x(x^2 + 4x - 1)$, use the second derivative to justify that one of the stationary points is a local minimum and that the other is a local maximum. (3 marks)

Question 4 **(7 marks)**

(a) Use the quotient rule to differentiate $y = \dfrac{\sin^2 4x}{\cos x^2}$. (Do not simplify your answer.) (2 marks)

(b) Determine $\dfrac{d}{dx}(2x\sin(3x))$. (2 marks)

(c) Use your answer from (b) to determine $\int 6x\cos(3x)\,dx$. (3 marks)

Question 6 **(7 marks)**

(a) The function f is such that $f(1) = -2$ and $f'(x) = \sqrt{3 + x^2}$. Use the increments formula to determine an approximate value for $f(1.05)$. (3 marks)

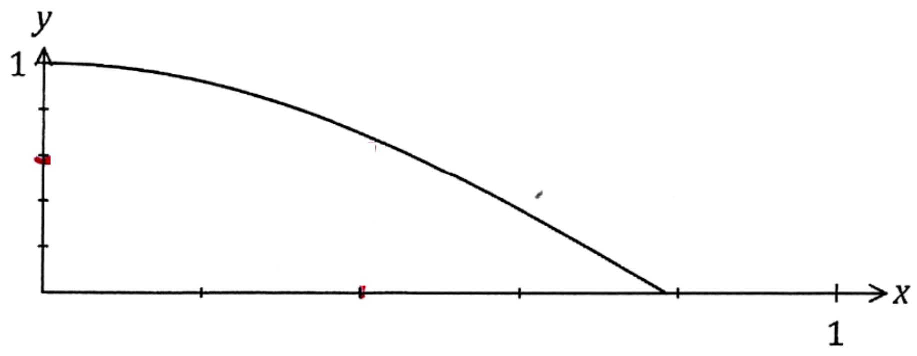
(b) The function C is such that $C(1) = 10$ and $C'(x) = 3\sqrt{x} + 3$.

(i) Explain why the increments formula would not yield an approximate value for $C(6)$. (1 mark)

(ii) Determine $C(6)$. (3 marks)

Question 7 **(7 marks)**

A rectangle has its base on the $x-$axis, its lower left corner at $(0, 0)$ and its upper right corner on the curve shown below, $y = \cos 2x$, $0 \le x \le \frac{\pi}{4}$.

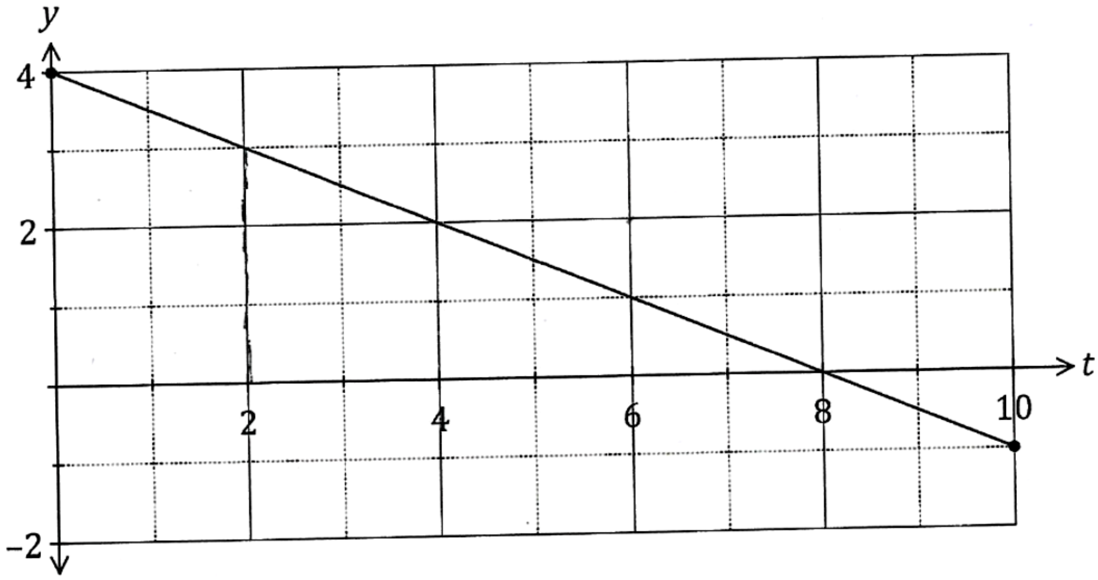


(a) Sketch a possible rectangle on the graph above and explain why the perimeter of the rectangle is given by the function $p(x) = 2x + 2\cos 2x$. (2 marks)

(b) Determine the largest perimeter of the rectangle. Justify your answer. (5 marks)

Question 8 **(6 marks)**

The graph of $y = f(t)$ is shown below over the interval $0 \leq t \leq 10$.



(a) Use the graph to determine an estimate for $\int_0^2 f(t)\,dt$. (2 marks)

(b) On the axes below, sketch the graph of $y = F(x)$ for $0 \leq x \leq 10$, where $F(x) = \int_0^x f(t)\,dt$. (4 marks)