Integration and the Fundamental Theorem of Calculus

1. Using the first part of the fundamental theorem of calculus, find the derivative of
$$f(x) = \int_{-52}^{x} \frac{x^3 + x^2}{\sin x + \cos x}\, dx$$

2. Find the general anti-derivative of the following functions:

   (a) $f(x) = -\sin x$

   (b) $f(x) = x^3 + x^2 + 3$

   (c) $f(x) = \dfrac{x^4 + x}{x^2}$

3. Evaluate the following integrals:

   (a) $\displaystyle\int_1^3 3x^2 + 6\, dx$

   (b) $\displaystyle\int_1^5 \frac{-2}{x}\, dx$

   (c) $\displaystyle\int_0^{\pi} \sec^2 x\, dx$