

3.5.17 Differentiate $f(x) = x^3 \sin(x) \cos(x)$.

Solution

Well, we have $f(x) = x^3 (\sin(x) \cos(x))$.
Then, by the Product Rule (Theorem 3.3.6)
we have

$$f'(x) = [3x^2] (\sin(x) \cos(x)) +$$
$$(x^3) \left[[\cos(x)] (\cos(x)) + (\sin(x)) [-\sin(x)] \right]$$

$$= [3x^2] (\sin(x)) (\cos(x))$$

$$+ (x^3) [\cos(x)] (\cos(x))$$

$$+ (x^3) (\sin(x)) [-\sin(x)]$$

(notice the pattern in the square brackets;
see the Class Notes for Section 3.3 and
Exercise 3.3.77). \square