2. In each of the following, if the given statement is true for all functions f that are continuous on the entire real line, then mark the ☐ to the left of TRUE with a ✗; otherwise, mark the ☐ to the left of FALSE with a ✗ and give a counterexample.

a. $\int_0^1 |f(x)|\,dx = \left|\int_0^1 f(x)\,dx\right|$

☐ TRUE

☒ FALSE, because it does not hold for $f(x) =$ $x - \frac{1}{2}$

b. $\frac{d}{dx}\int_0^x f(t)\,dt = f(x) - f(0)$ for all x

☐ TRUE

☒ FALSE, because it does not hold for $f(x) =$ 1

c. $\frac{d}{dx}\int_0^1 f(t)\,dt = f(1) - f(0)$

☐ TRUE

☒ FALSE, because it does not hold for $f(x) =$ x

d. $\frac{d}{dt}\int_0^x f(t)\,dt = f(x) - f(0)$ for all x

☐ TRUE

☒ FALSE, because it does not hold for $f(x) =$ x

e. $\int_0^1 f(x)^2\,dx = \frac{f(1)^3 - f(0)^3}{3}$

☐ TRUE

☒ FALSE, because it does not hold for $f(x) =$ 1

f. $\int f(x)^2\,dx = \frac{f(x)^3}{3f'(x)} + C$ for all x for which $f'(x) \neq 0$

☐ TRUE

☒ FALSE, because it does not hold for $f(x) =$ x^2