1. False. All differentiable function are continuous, and all continuous functions have antiderivatives.

2. True. Since the function is increasing, the value at the right endpoint will be greater than all previous points. Thus the rectangles will all overestimate the function, so will overestimate the area.

3. $F(x) = e^{\sin(x^2)} + \ln(|\cos(x)|) + C$ (I did not take off points for forgetting the absolute value.)

4. The area is $f(\frac{\pi}{2})\frac{2\pi}{4} + f(\pi)\frac{2\pi}{4} + f(\frac{3\pi}{2})\frac{2\pi}{4} + f(2\pi)\frac{2\pi}{4} = \frac{2\pi}{4} + 0 + \frac{2\pi}{4} + 0 = \pi$