A graph of the function $f(x) = x^2 \sin(2x)$ is shown below

1) (Circle the correct choice.) By just looking at this graph, it appears that
$\int_0^\pi x^2 \sin(2x) \, dx$ (is a positive number, is a negative number, is zero). Explain your answer. (A one or two sentence explanation is sufficient.)

2) Use integration by parts and the Fundamental Theorem of Calculus (Part 2) to show that

$$\int_0^\pi x^2 \sin(2x) \, dx = -\frac{1}{2} \pi^2.$$ 

(You must include all details of how you use integration by parts in order to get credit.)