2. (a) Use integration by parts to calculate the definite integral (5 pts)

$$I = \int_{-1}^{1} x^2 \sin x \, dx$$

$$\int uv' = uv - \int u'v$$

$u = x^2$, $v' = \sin(x) \Rightarrow v = -\cos(x)$, $u' = 2x$

$$I = -x^2\cos(x)\Big|_{-1}^{1} - \int_{-1}^{1} 2x\,(-\cos(x))\,dx$$

$$= \underbrace{[-1\cos(1)] - [-1\cos(-1)]}_{=0 \text{ since } \cos(a) = \cos(-a)} + \int_{-1}^{1} \underbrace{2x}_{u} \underbrace{\cos(x)}_{v'} dx$$

$u = 2x$, $v' = \cos(x) \Rightarrow u' = 2$, $v = \sin(x)$

$$I = 2x\sin(x)\Big|_{-1}^{1} - \int_{-1}^{1} 2\sin(x)\,dx.$$

$$= \underbrace{2\sin(1) - (-2\sin(-1))}_{=0 \text{ since } \sin(-1) = -\sin(1)} - \int_{-1}^{1} 2\sin(x)\,dx$$

$$= 2\cos(x)\Big|_{-1}^{1} = 2\cos(1) - 2\cos(-1)$$

$$= 0, \text{ since } \cos(1) = \cos(-1).$$