For each of the following problems, first find the answer by hand, and then use Mathematica to check your answer.

1) Find $f'(x)$ [space derivative] for

$$f(x) = A\sin^3\left[B\cos^2\left(Ce^{ax^2}\right)\right] \tag{1}$$

2) Find $\dot{f}(t)$ [time derivative] for

$$f(t) = (a+bt)^2\sin\left(ct^2\right) \tag{2}$$

3) Find $f'(x)$ [space derivative] for

$$f(x) = x\left(\ln(ax)\right)^3 \tag{3}$$

4) Find $\int f(x)dx$ for

$$f(x) = x\left(e^{\alpha x^2-1}\right) \tag{4}$$

5) Find $\int f(t)dt$ for

$$f(t) = \cos^2(\omega t)\sin(\omega t) \tag{5}$$

6) Find $\int f(x)dx$ for

$$f(x) = x^8\ln(\alpha x) \tag{5}$$

7) Find $\int_{-a}^{+a} f(x)dx$ for

$$f(x) = x\cos^2\left(\frac{\pi}{2a}x\right) \tag{6}$$

(**Hint**: plot the function *f*(*x*) first using Mathematica. How would the answer change if you replaced the cosine function with the sine function?)

8) Newton's 2nd Law (in one dimension) is sometimes written as $F_x^{net} = ma_x$, and sometimes written as $F_x^{net} = dp_x/dt$, where $p_x \equiv mv_x$ is the momentum. Are these the same equation? If not, which one is correct?