1. The purpose of this problem is to show you parallels and contrasts between differentiating and differencing. Evaluate the following derivatives and differences. In these problems, the derivative operator is denoted by $D$, and the forward difference operator is denoted by $\Delta$. Compile your answers in a table on one page, and attach your neatly written supporting work.

$$
Df(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}
$$

$$
De^x = e^x
$$

$$
D2^x = (\ln 2)2^x
$$

$$
Dx^3 = 3x^2
$$

$$
Dx^3 = 3x^2 - 3x^1 + 2x^0 = 3x^2 - 6x + 2
$$

$$
D \ln x = \frac{1}{x} = x^{-1}
$$

$$
D \frac{1}{x} = -x^{-2}
$$

$$
\Delta f(x) = f(x + 1) - f(x)
$$

$$
\Delta e^x = (e - 1)e^x
$$

$$
\Delta 2^x = 2^x
$$

$$
\Delta x^3 = 3x^2 + 3x + 1
$$

$$
\Delta H_x = \frac{1}{x + 1} = x^{-1}
$$

$$
\Delta \frac{1}{x + 1} = \Delta x^{-1} = -x^{-2}
$$

2. The purpose of this problem is to show you parallels and contrasts between integration and summation. Evaluate the following definite integrals and sums. Assume that $a$ and $b$ are integers and $n$ is a positive integer. Compile your answers in a table on one page, and attach your neatly written supporting work.

$$
\int_a^b Df(x) \, dx = f(x) \big|_a^b = f(b) - f(a)
$$

$$
\sum_{a \leq k < b} \Delta f(k) = f(x) \big|_a^b = f(b) - f(a)
$$

$$
\int_a^b e^x \, dx = e^b - e^a
$$

$$
\sum_{a \leq k < b} 2^k = 2^b - 2^a
$$

$$
\int_a^b 2^x \, dx = \frac{2^b - 2^a}{\ln 2}
$$

$$
\sum_{a \leq k < b} e^k = \frac{e^b - e^a}{e - 1}
$$

$$
\int_0^n x^4 \, dx = \frac{n^5}{5}
$$

$$
\sum_{0 \leq k < n} k^4 = \frac{n^5}{5}
$$

$$
\int_0^n x^4 \, dx = \frac{1}{5}n^5 - \frac{3}{2}n^4 + \frac{11}{3}n^3 - 3n^2
$$

$$
\sum_{0 \leq k < n} k^4 = \frac{1}{5}n^5 + \frac{3}{2}n^4 + \frac{7}{3}n^3 + \frac{1}{2}n^2
$$

$$
= \frac{1}{5}n^5 - \frac{1}{2}n^4 + \frac{1}{3}n^3 - \frac{1}{30}n
$$

$$
\int_0^n x^2e^x \, dx = (n^2 - 2n + 2)e^n - 2
$$

$$
\sum_{0 \leq k < n} k^22^k = (n^2 - 4n + 6)2^n - 6
$$