Name: —————————————————————————————   ——————— / 10

There are 10 points possible on this quiz. No aids (book, calculator, etc.) are permitted. **This is a short-answer quiz.**

1. (2 points)

   (a) What is the null space of the differentiation transformation $d/dx : \mathscr{P}_n \to \mathscr{P}_n$?

   (b) What is the rank of the differentiation transformation $d/dx : \mathscr{P}_n \to \mathscr{P}_n$?

2. (4 points) Multiply the matrix $M = \begin{pmatrix} 1 & -1 \\ 2 & 0 \\ 0 & -3 \end{pmatrix}$ by each vector below or state that the operation is not defined.

   (a) $\vec{v} = \begin{pmatrix} 2 \\ -1 \\ 0 \end{pmatrix}$

   (b) $\vec{v} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

3. (4 points) Consider the linear map $h : V \to W$ represented with respect to some bases B, D by

the matrix $M = \begin{pmatrix} 1 & 1 & 0 & -2 \\ 2 & 3 & 1 & -1 \\ 1 & 2 & 1 & 1 \end{pmatrix}$. Observe that the reduced echelon form of M is $\begin{pmatrix} 1 & 0 & -1 & -5 \\ 0 & 1 & 1 & 3 \\ 0 & 0 & 0 & 0 \end{pmatrix}$.

(a) What is the dimension of the domain of h?

(b) What is the dimension of the codomain of h?

(c) What is the dimension of the range of h?

(d) What is the dimension of the nullity of h?