# 1 Properties of Legendre Polynomials

*(4 pts each)*

(a) Use technology such as *Mathematica* or *Maple* or *Python* to find the first 5 Legendre polynomials. This question is simply asking you to find the command in your preferred computer algebra system and learn the syntax to call the polynomials.

(b) Use Rodrigues' formula to calculate the first 5 Legendre polynomials. (You may use computer technology like *Mathematica* or *Maple* or *Python* to help with the derivatives. This question is asking you to find Rodrigues' formula (Googling it is fine) and learn how to use it to generate the Legendre polynomials. It is pretty straightforward to do this part by hand, but, if you use technology to help with messy derivatives, make sure to explain what you are doing.)

# 2 Legendre Polynomial Series for the Sine Function

*(8 pts)* Use your favorite technology tool (*e.g.* Maple, Mathematica, Matlab, Python, pencil) to generate the Legendre polynomial expansion to the function $f(z) = \sin(\pi z)$. How many terms do you need to include in a partial sum to get a "good" approximation to $f(z)$ for $-1 < z < 1$? What do you mean by a "good" approximation? How about the interval $-2 < z < 2$? How good is your approximation? Discuss your answers. Answer the same set of questions for the function $g(z) = \sin(3\pi z)$

# 3 Laplace's Equation in Polar Coordinates

*(2 pts each)*

(a) Write down Laplace's equation in two dimensions in polar coordinates.

(b) Use the separation of variables procedure to separate this partial differential equation into two ordinary differential equations.

(c) Write down a complete set of eigenstates of the $\phi$ equation. Justify your answer. You do not NEED to calculate anything here, but if you quote some answer that you already know, say how/where you know the answer. DO NOT TRY TO SOLVE THE $r$ EQUATION!

# 4 Confidence Rating

*1 point* After solving each problem on the assignment, indicate your answers to the following questions for each problem. Answer for the problem as a whole, even if the problem has multiple parts.

(a) **Question Confidence** How confident are you that you are interpreting the problem the way the instructor intends?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not confident at all | | | Somewhat confident | | | Extremely confident |

For the rest of the questions, assume you have interpreted the problem correctly

(b) **Problem Confidence** How confident are you that you could independently come up with a correct solution process to a similar problem on a future problem set?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not confident at all | | | Somewhat confident | | | Extremely confident |

(c) **Answer Confidence** How confident are you that your final answer to this question is correct (not solution process)?

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Not confident at all | | | Somewhat confident | | | Extremely confident |

(d) **Makes Sense** To what degree do you understand how your answer fits (or does not fit) the physical or mathematical situation of the problem?

| VN | N | LN | IDK | LF | F | VF |
|---|---|---|---|---|---|---|
| Very confident answer does NOT fit | Somewhat confident answer does NOT fit | Leaning toward the answer does NOT fit | Don't know if answer fits or not | Leaning toward the answer fits | Somewhat confident the answer fits | Very confident answer fits |