MCS 121
Powers and Polynomials

1. *A formidable polynomial:*

$$f(x) = x^{10} + \frac{7}{9}x^9 + \frac{1}{2}x^8 - 5x^7 + \pi x^5 - \sqrt{2}x^4 - 42$$

Its derivative:

$$f'(x) =$$

2. *All kinds of functions:*

Find the derivatives of the following functions:

(a) $f(x) = \sqrt[3]{x} + \sqrt[5]{2}$

(b) $g(x) = \dfrac{1}{x^3} - \dfrac{1}{\sqrt[4]{x^3}}$

(c) $h(x) = \dfrac{x^5 - 3\sqrt{x} + 2}{\sqrt{x}}$

3. *Some deceptive functions:*

$f(x) = (2x)^4$ $\qquad$ $f'(x) =$

$g(x) = (x^3)^5$ $\qquad$ $g'(x) =$

4. Determine if the derivative rules from Section 3.1 apply.

   (a) $f(x) = (x+5)^{1/2}$

   (b) $f(x) = (x+5)^2$

   (c) $f(x) = \frac{1}{2x^3+7}$

   (d) $f(x) = \frac{1}{2x^3} + \frac{1}{7}$

   (e) $f(x) = 5^x$

   (f) $f(x) = 5^\pi$

5. Challenge Problem

   (a) Use the formula for the area of a circle of radius r, $A = \pi r^2$, to find $\dfrac{dA}{dr}$.

   (b) The result from part (a) should look familiar. What does $\dfrac{dA}{dr}$ represent geometrically?

   (c) Use the definition of the derivative to explain the observation you made in part (b).