Math 130 Homework: Day 4

Office Hours (LN 301/301.5): M 3:30-4:30, Tu 11:00-1:00, W 12:15-1:15, F 1:30-2:30. Other times by appointment. **Math Intern:** Sun through Thurs: 3:00–6:00, 7:00–10:00pm. **Website:** Use the links at the course homepage on **Canvas** or go to my course Webpage: `http://math.hws.edu/~mitchell/Math130F16/index.html`.

Reading and Practice

1. (*a*) Read/review all of Chapter 2.3. See on the online NOTES for lots more examples.

(*b*) Try page 77ff: #1, 3, 5, 7, 9, 11, 15–27 (odd), 31, 61. These should be easy and quick!

(*c*) These are more typical of the limits we will actually calculate most of the time. Use algebra to simplify the limits before evaluation: Try page 77ff: #39, 41, 43 (Hint: write $-x+b$ as $-(x-b)$ and factor!), 47(use conjugates), 49(conjugates again).

Answers to Day 2, Problems 3 (d) and 6 (b)

#3 (d) If $s(t) = -16t^2 + 128t$ is the position of an object in meters at time t seconds, find the average velocity of the object on the interval $[1, 1+h]$.

$$\frac{s(1+h)-s(1)}{1+h-1} = \frac{-16(1+h)^2+128(1+h)-112}{h} = \frac{-16(1+2h+h^2)+128+128h-112}{h}$$

$$= \frac{-\cancel{16}-32h-16h^2+\cancel{128}+128h-\cancel{112}}{h} = \frac{-16h^2+96h}{h} = \boxed{-16h+96} \text{ m/s}$$

6(b). The algebra is a little harder in this one. Let $f(x) = \frac{1}{x}$. The point $P = (5, \frac{1}{5})$ lies on the curve. Let $Q = (x, \frac{1}{x})$ be any other point on the graph of f. Find the slope of the secant line, m_{sec}, through P and Q. Simplify your answer. It will be a function of x.

$$\frac{f(x)-f(5)}{x-5} = \frac{\frac{1}{x}-\frac{1}{5}}{x-5} = \frac{\frac{5-x}{5x}}{x-5} = \frac{5-x}{5x(x-5)}$$

$$= \frac{-1\cancel{(x-5)}}{5x\cancel{(x-5)}}$$

$$= -\frac{1}{5x} \quad (x \neq 5)$$

5-Minute Review: Polynomial Functions

DEFINITION 0.0.1. A **polynomial** is a function of the form

$$y = p(x) = a_n x^n + a_{n-1}x^{n-1} + \cdots + a_1 x + a_0,$$

where n is a *non-negative integer* and each a_i is a real number (constant). If $a_n \neq 0$, then n is the **degree** (highest power) of the polynomial. The domain of a polynomial is $(-\infty, \infty)$.

NOTE: A polynomial cannot have any trig, log, exponential, or root functions, and no x's in the denominator. The powers must be non-negative, whole numbers.

Degree 1 polynomials: Have the form $y = a_1 x + a_0$ and are just equations of lines. The more familiar form is $y = mx + b$ (where $m = a_1$ is the slope and $b = a_0$ is the y-intercept).

Degree 2 polynomials: Have the form $y = f(x) = a_2 x^2 + a_1 x + a_0$ or $y = ax^2 + bx + c$. These are the familiar *quadratic functions* or *parabolas*.

Degree 0 polynomials: Are the constant functions: $y = f(x) = 9$ is a degree 0 polynomial. It can be written as $f(x) = 9x^0$, where the power 0 is a non-negative integer.

YOU TRY IT 0.1. Identify the polynomials. For those that are, what are their degrees?

(*a*) $p(x) = -4x^3 + 2x + 11$ (*b*) $q(x) = \dfrac{1}{5x^2} - \dfrac{7}{x}$ (*c*) $r(t) = \dfrac{t^2+1}{t^2-1}$

(*d*) $p(x) = \sin(x^2+1)$ (*e*) $s(x) = 2x^2 - x^{1/2} + 7$ (*f*) $q(t) = \sqrt{t^3 + t^2 + 1}$

(*g*) $r(x) = 11$ (*h*) $r(x) = 3^{1/2}x^4 - 2x + \pi$ (*i*) $f(x) = -\dfrac{2}{3}x^5 + 3x^4 + x^2 - 11$

(*j*) $p(x) = 5x^2 - x^{1/3} - 23$ (*k*) $g(x) = 6x^{-2} + 4x^{-1} + 2$ (*l*) $q(x) = 3x - 4x^2 + \dfrac{x^3}{6}$

ANSWER TO YOU TRY IT ??. Polynomials (degree): a (3), g (0), h (4), i (5), l (3).

5-Minute Review: Rational Functions

DEFINITION 0.0.2. A **rational function** is a function of the form

$$y = r(x) = \frac{p(x)}{q(x)},$$

where $p(x)$ and $q(x)$ are polynomials. The domain of a rational function consists of all values of x such that $q(x) \neq 0$.

Here the term 'rational' means 'ratio' as in the ratio of two polynomials.

YOU TRY IT 0.2. Which are of the following functions are polynomials (state the degree)? Rational (but not a polynomial)? Neither?

(*a*) $p(x) = -4x^2 + 2x^3$ (*b*) $r(x) = \dfrac{2x^2+3x+1}{4x^{11}+9x^2}$ (*c*) $q(x) = \dfrac{1}{5x^2} - \dfrac{7}{x}$

(*d*) $s(x) = \dfrac{1}{2x+7}$ (*e*) $r(t) = \dfrac{t^2+1}{t^2-1}$ (*f*) $p(x) = \tan(\frac{x}{x^2+1})$

(*g*) $s(x) = 2x^2 - x^{1/2} + 7$ (*h*) $q(t) = \sqrt{t^3+t^2+1}$ (*i*) $r(x) = 11$

(*j*) $r(x) = \dfrac{x^4}{3} - 2x + 6$ (*k*) $s(x) = \sqrt{\dfrac{3x}{2x+7}}$ (*l*) $t(x) = \dfrac{3x^{1/2}+1}{x^2+4}$

(*m*) $f(x) = -2x^2 + 3x^3 - \dfrac{2}{3}x^5$ (*n*) $p(x) = 5x^2 - x^{1/3} - 23$ (*o*) $g(x) = 6x^{-2} + 4x^{-1} + 2$

ANSWER TO YOU TRY IT ??. Polynomial: a (3), i (0), j (4), and m (5). Rational (but not a polynomial): b, c d, e, and o. Neither: f, g, h, k, l, and n.