

MATH 135 – Calculus 1
Practice on Combinations of Functions, Piecewise-defined functions
September 5, 2016

Background

In section 1.3, various ways of combining known functions to produce new ones are discussed. This also leads to some important classes of functions such as polynomial functions, rational functions, algebraic functions and transcendental functions, as well as piecewise-defined functions.

Questions

- 1) Give an *example* of a function in each of the classes of functions from the Background above.
- 2) For each of the following pairs of functions f, g , compute *both* compositions $f \circ g$ and $g \circ f$.
 - (a) $f(x) = x^2 + 4x + 5$, $g(x) = \sqrt{x}$
 - (b) $f(x) = \frac{1}{x^2+1}$, $g(x) = \cos(x)$
- 3) Express each of the following functions $F(x)$ as compositions $F = f \circ g$ for some functions f, g (Note: There is more than one correct answer here! Do you see why?)
 - (a) $F(x) = \frac{1}{\sqrt{1-x^2}}$
 - (b) $F(x) = (x^2 + 1)^{4/3}$.
- 4) From videos for last week, our “rule of thumb” on domains is: If $f(x)$ is given by a formula, then *unless stated otherwise* we take the domain to be the set of all real x that yield a well-defined result in the formula. What are the domains of the functions F in question 3?
- (5) For the upcoming tax season on income earned in 2016, for married couples filing joint returns, the Federal income tax due will be computed by something like the following tax bracket table. The *AGI* is the *adjusted gross income* (income minus exemptions, deductions for things like mortgage interest paid or medical care expenses, plus credits for various things, etc.¹) *In each case, to save space, only the upper limit of the tax bracket is given.* So for example the second entry 75.3 means all AGI values in the interval starting at the previous level 18.55 up to 75.3, i.e. $[18.55, 75.3)$ or $\$18550 \leq AGI < \75300 . The *tax rate* is the percentage of the AGI that is due as tax. (Of course, in almost all cases, most or all of this will have been withheld from paychecks through the year.)

<i>AGI (in \$1000)</i>	18.55	75.3	151.9	231.45	413.35	466.95	higher
<i>tax rate</i>	10%	15%	25%	28%	33%	35%	39.6%

Write the *tax due* as a function of the AGI using this information.

¹Computing this can get *very* involved – ask your parents or a tax accountant some time.