Ongoing Skill List for Adv. Precalculus

Skill 1: Do you understand *what* the graphs of the form $r = \cos(\theta) + k$ and $r = \sin(\theta) + k$ look like (for various values of *k*), and *why* they look the way they do? Given an equation and a blank graph, can you draw what these graphs would look like?

Skill 2: In terms of graphing in polar, can you explain what certain transformations to the polar equations do? (For example, if you had the graph of $r = \cos(\theta)$, what do the graphs of like $r = \cos(\theta - \pi/6)$, $r = -\cos(\theta)$, and $r = 7\cos(\theta)$ would look like?)

Skill 3: Can you add and subtract vectors graphically? Can you multiply vectors by a scalar and understand what happens graphically?

Skill 4: Can you algebraically add and subtract vectors? Can you algebraically multiply vectors by a scalar? Given the coordinate points that represent the head and tail of a vector, can you calculate what the vector is? Given a vector, can you calculate the magnitude and direction that the vector is pointing? Given a vector, can you come up with another vector that has the same direction but unit magnitude?

Skill 5: Do you know the formula for the dot product between two vectors? Can you use that formula to find the angle between the two vectors? Do you understand what a dot product of 1, 0, and -1 mean in terms of what the two vectors might be? Do you understand what the dot product is conceptually?

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Skill 6: Can you add, subtract, multiply, and divide complex numbers given in rectangular form? Can you plot complex numbers given in rectangular form on a complex plane? Can you show the addition of two complex numbers on a complex plane, and relate it to our work with vectors? [resource(s): Desmos activity "Complex Numbers 1" and delta math]

Skill 7: Can you articulate what multiplying a complex number by a scalar does visually? Can you articulate what multiplying a complex number by an imaginary number does visually? Can you explain visually how multiplication of two complex numbers in rectangular form work? (This is Screen #29 in the desmos activity "Complex Numbers 1.") [resource(s): Desmos activity "Complex Numbers 1" and delta math]

Skill 8: Given a complex number in rectangular form, can you write it in polar form? Given a complex number in polar form, can you write it in rectangular form? Can you multiply and divide two complex numbers in polar form? [resource(s): Desmos activity "Complex Numbers 2" and delta math]

Skill 9: Can you use DeMoivre's theorem to raise complex numbers to various powers? Can you identify all solutions to $z^n = 1$ visually and in algebraic form (in both rectangular and polar forms)? Can you relate DeMoivre's theorem to these solutions to "roots of unity"? [resource(s): Desmos activity "Complex Numbers 2" and delta math]

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Skill 10: Can you explain conceptually *why* a hole appears in a graph (e.g. why a hole appears in $y = \dfrac{x+2}{x+2}$)? Can you explain conceptually *why* a vertical asymptote appears in a graph (e.g. why a vertical asymptote appears in $y = \dfrac{1}{x}$)? Given a rational equation, can you identify all the x-intercepts, holes, and vertical asymptotes? Can you find the exact location (x- and y-coordinates) of holes? Can you explain how you found the y-coordinate of any holes, and why that approach works? [resource(s): Desmos activity "Rational Functions #1," Desmos activity "Rational Functions 3," and delta math]

Skill 11: Given a rational equation, can you identify the end behavior? Given the end-behavior of a rational function and some information about the rational function (e.g. the degree of the numerator, the leading term of the denominator), can you come up with a rational function that would fit the end behavior and information given? Can you explain conceptually why that end behavior results? [resource(s): Desmos activity "Rational Functions #2]

Skill 12: Given a rational function, can you perform a sign analysis for it? Given a rational function, can you identify all the relevant features of the graph, and then use that information to draw a sketch of the rational function? [resource(s): Desmos activity "Rational Functions #3," Desmos Activity "Rational Functions #4," and delta math]

Skill 13: Given an equation for an ellipse that isn't in standard form, can you write it in standard form? Can you identify the x- and y- intercepts for an ellipse given an equation for an ellipse? Can you identify the foci for an ellipse given the equation for an ellipse? Can you explain *why* the "string length" for an ellipse is the length of the major axis?