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Worksheet week 10 - MAC 2312, Spring 2017

1. Write the general form of the partial fraction decomposition for  $\frac{2x+5}{(x^3+x^2)(x^2+1)^2}$ . You **do not** have to determine the constants involved.

2. Use partial fractions to compute the integrals

(a)  $\int \frac{x^3}{x^2 - 4} dx$

(b)  $\int \frac{1}{x^3 + 4x} dx$

*Note:* Each integral can be also done with an appropriate trig substitution. You will receive one additional point (and check your previous work) if you compute them both ways.

3. You are the treasurer of the new island kingdom Polar Koordinatea where no calculators are allowed. The Queen summons you and gives you 24h to design a coin for the kingdom. After a sleepless night, you come up with two proposals:

(i) The coin is the circle  $r = 1$ , having inside the rose  $r = \cos(3\theta)$  whose petals are plated in gold;

(ii) The coin is circle  $r = 1$ , having inside the rose  $r = \sin(5\theta)$  whose petals are plated in gold.

(a) Draw the two designs you submit to the Queen.

(b) Seeing the designs, the Queen decides: "Make the one that has more gold. Bring it tomorrow!" You go and spend one more sleepless night lost in polar computations. What do you tell the Queen?

(c) After your answer next day, the Queen decides again: "You modify the design (i) as follows. Inside the coin  $r = 1$ , draw also the circle  $r = 1/2$ . The part of the rose  $r = \cos(3\theta)$  which is inside  $r = 1/2$  shall be covered with platinum, the rest of the rose shall be covered with gold. And this shall forever be the coin of Polar Koordinatea!"

Just when you are about to leave happy, the Queen says: "I would like to know by tomorrow if more platinum or more gold is needed for the new coin. Tell me please the exact difference between the two areas." Can you answer this?