1. Integrate the following

   a) $\int \tan^3\theta \sec\theta \; d\theta$ b) $\int \sin^2 x \cos^2 x \; dx$ c) $\int \dfrac{\sqrt{y^2-2}}{y} \; dy$ d) $\int \dfrac{x^2}{\sqrt{9-x^2}} \; dx$

2. Write the partial fraction decomposition for the rational function, but do not solve for the constants.
$$\frac{x^2+2}{x^2(x^2+1)^2(x-3)^3}$$

3. Find the partial fraction decomposition for the rational function (find the coefficients). Don't forget that PFD only applies to rational expressions where the degree of the denominator *strictly exceeds* the degree of the numerator.
$$\frac{x^2+1}{x^2-9x+20}$$

4. Integrate the following.

   a)
$$\int_4^8 \frac{y}{y^2-2y-3} \; dy$$
   b)
$$\int \frac{\sin(\theta)}{(\cos(\theta)-1)(\cos^2(\theta)+2\cos(\theta)+1)} \; d\theta$$

5. Approximate $\int_{-2}^{2}(x^2+1)dx$ using Trapezoid Rule with $n=4$, and then using Simpson's Rule with $n=4$. Compare both of these to the exact value of $\int_{-2}^{2}(x^2+1)dx$. Why do you think this is?

6. Find an upper bound for the error when one uses Trapezoid rule with $n=4$ to approximate $\int_{-1}^{1} e^{x^2} \; dx$. **Note: you do not need to find the approximation, only the upper bound for the estimate.**
$$|E_T| \leq \frac{K(b-a)^3}{12n^2}, \text{ where } |f''(x)| \leq K \text{ for all } x \text{ in } (a,b)$$

7. For the following integrals, evaluate or conclude divergence.

   a)
   $$\int_0^1 \frac{dx}{x^{3/2}}$$

   b)
   $$\int_{-\infty}^0 \theta e^\theta \, d\theta$$

8. For the following integrals, test for convergence or divergence. (Remember "p-integrals!")

   a)
   $$\int_3^\infty \frac{dx}{x^2-4}$$

   b)
   $$\int_1^\infty \frac{\arctan x}{x}$$

   c)
   $$\int_\pi^\infty \frac{1+\sin x}{x^2} \, dx$$

   d)
   $$\int_1^\infty \frac{\sqrt{x^4+1}}{x^3} \, dx$$

   e)
   $$\int_2^\infty \frac{dt}{t-\sqrt{t}}$$

   f)
   $$\int_{12}^\infty \frac{dx}{x^{100}-6x+7}$$