

You should work on the following problems in groups of 3. Try to get through as many as you can, but you aren't expected to finish everything. Instead, you should make sure everyone in your group knows **how** to solve all the problems, and not just the answers.

Feel free to skip around and spend your time on things your group feels sketchy about. Also, you should focus not just on the answers to each problem, but also on how you would actually write up the solution on the midterm.

Integrals

$$1. \int \frac{1}{4\sqrt[3]{x^2} - 4\sqrt[3]{x} - 3} dx$$

$$2. \int_0^4 \frac{\ln x}{\sqrt{x}} dx$$

$$3. \int \frac{4x^2 - 3x + 5}{(x-1)^2(x^2+x+1)} dx$$

$$4. \int \ln(x^2 - 1) dx$$

$$5. \int e^{\sqrt[3]{x+1}} dx$$

$$6. \int \sin \sqrt{x-1} dx$$

$$7. \int_{\pi/4}^{\pi/3} \frac{\sqrt{\tan \theta}}{\sin 2\theta} d\theta$$

$$8. \int \frac{dx}{\sqrt{x+x^{3/2}}}$$

$$9. \int \frac{x}{\sqrt{x^2+x+\frac{5}{4}}} dx$$

$$10. \int \tan^3 x \sqrt{\sec x} dx$$

$$11. \int_1^{\infty} \frac{\tan^{-1} x}{x^2} dx$$

$$12. \int x \tan^2 x dx$$

Convergence Problems Determine whether each of the following converges or diverges.

$$1. \int_0^{\infty} x e^{-x} dx$$

$$2. \int_0^1 \frac{e^x}{1-\sqrt{x}} dx$$

$$3. \int_3^{\infty} \frac{x^2 - \sqrt[3]{x^4+3}}{\sqrt[3]{x^7+4x^5-x}} dx$$

$$4. \int_0^{\pi/2} \frac{1}{x \sin x} dx$$

$$5. \int_1^{\infty} x - x \cos \frac{1}{x^2} dx$$

$$6. \int_2^{\infty} \ln \left(\frac{x+1}{x-1} \right) \sin \frac{1}{x-1} dx$$

$$7. \int_0^1 \csc((x-1)^3) \ln x dx$$

$$8. \int_1^{\infty} \frac{\sqrt[3]{\sin \frac{1}{x}}}{x} dx$$

$$9. \int_1^{\infty} \frac{\ln x}{\sqrt[4]{x^3+x^2+1}} dx$$

$$10. \int_0^1 \frac{(e^x-1)}{\ln(1+x) \sin x^2} dx$$

Differential Equations

Solve each of the following differential equations/initial value problems:

$$1. y' - 2xy = x^2 e^{x^2}$$

$$2. y' = e^{\sqrt{x}}(y^2 - y - 2)$$

$$3. (\cos^6 x)y' = y^2$$

$$4. y' = 2 + 2y + x + xy; y(0) = 1$$

$$5. y' = (e^y - 1) \tan^{-1} x$$

$$6. y' + (\tan x)y = \tan^5 x$$

$$7. y' = e^{x+y} \sqrt{e^x + 1}$$

$$8. y' = y + \sin x; y(0) = 1$$

$$9. y' + 2xy = x^3; y(0) = 5$$