

All 9 problems are worth 11 points each. That is: 4 points for setting the problem up correctly, 4 points for doing the calculus correctly, and the last 3 points for finding each exact answer (like $\sqrt{11}$) instead of a decimal approximation (like 3.31662479)

1. Use a “U-Substitution” to integrate $\int e^{2x} \sec(e^{2x}) dx$.
2. Use “Integration by Parts” to integrate $\int \sin \sqrt[3]{x} dx$.
3. Use $1 + \tan^2 x = \sec^2 x$ to integrate $\int \frac{\tan^3 x}{\sqrt{\sec x}} dx$.
4. Use a trigonometric substitution to find the *exact* value of $\int_{\sqrt{3}}^2 \frac{\sqrt{x^2 - 3}}{x} dx$. (NO DECIMALS!)
5. Use Partial Fraction Decomposition to find $\int \frac{5x^2 + 20x + 6}{x^3 + 2x^2 + x} dx$.
6. Use the formula $\int \frac{u du}{a + bu} = \frac{1}{b^2} (bu - a \ln |a + bu|) + C$ to find $\int \frac{\sin 2x}{2 + \cos x} dx$.
7. Use L’Hopital’s Rule to find the *exact* value of $\int_1^\infty e^3(1 - x)e^{-x} dx$. (NO DECIMALS!)
8. Differential Equations: If the half-life of a radioactive material is 3 hours, what percentage of the material will be present after 11 hours? (Round your answer to 3 digits.)
9. Separation of Variables: Solve the following IVP:

$$y' = x + xy^2, \quad y(0) = 1$$