

Answer the problems on separate paper. You do not need to rewrite the problem statements on your answer sheets. Do your own work. Show all relevant steps which lead to your solutions. Retain this question sheet for your records.

Instructions:

- A. Problems which ask you to compute an integral and which specify a method, require you to demonstrate the use of that method.
- B. Problems which ask you to compute an integral but which do not specify a method, allow you to use any available method subject to the following:
 - i) If you use a substitution in your solution, you need to explicitly identify the substitution including the differential of the substitution
 - ii) If you use a table in your solution, you need to explicitly identify the item number and the choice of constants
 - iii) If you use a calculator in your solution, you need to explicitly identify the type of calculator and the instructions (keystrokes, functions, commands, etc.) you use to compute the result.
- C. Do **10 and only 10** of the following 11 problems.

1. Evaluate the following integral using integration by parts $\int x^2 \sin x \, dx$

2. Evaluate the following integral using integration by parts $\int_1^2 x \ln(2x) \, dx$

3. Evaluate the following integral $\int \sin x \cos^2 x \, dx$

4. Evaluate the following integral using the method of partial fractions $\int \frac{4 \, dx}{2x^2 + x}$

5. Evaluate the following integral using the method of partial fractions
$$\int \frac{2x - 7}{(x - 1)(x^2 + 9)} \, dx$$

6. Evaluate the following integral using the method of partial fractions
$$\int \frac{x + 3}{(x - 1)(x - 2)^2} \, dx$$

7. Solve the initial value problem
$$\begin{cases} \frac{dy}{dx} + \frac{3y}{x} = \frac{e^{x^2}}{x^2} \\ y(-1) = 1 \end{cases}$$
8. Either show that the following improper integral converges and find its value or show that it diverges $\int_2^{\infty} \frac{\ln x}{x} dx$
9. Either show that the following improper integral converges and find its value or show that it diverges $\int_2^{\infty} \frac{dx}{x\sqrt{\ln x}}$
10. For $y = 2 \tanh^{-1}(\sqrt{x}) + \ln(1 - x)$ find and simplify y' .
11. Evaluate the following integral $\int_0^1 \frac{t^5}{\sqrt{1 + t^{12}}} dt$