1. Integrate the following expressions using substitution.

$$\int b\ e^{ax}dx \qquad \int a\sin(bx+c)dx$$
$$\int \frac{dx}{x\ln x} \qquad \int x\sqrt{ax^2+b}dx$$
$$\int x^2e^{x^3}dx \qquad \int x(x^2+1)^5dx$$
$$\int \frac{2x+1}{x^2+x-1}dx \qquad \int x^2\sin(2x^3+8)dx$$

Here $a, b, c$ are constants.

2. Integrate the following expressions using integration by parts.

$$\int x\sqrt{x+1}dx \qquad \int x^3e^{-2x}dx$$
$$\int x\sec^2 x dx \qquad \int (\ln x)^2dx$$
$$\int x^2\ln x dx \qquad \int x\ln(x^2)dx$$
$$\int \ln(x+5)dx \qquad \int (x-2)\cos x dx$$

3. State the relationship between differentiation and integration.

4. State two parts of Fundamental Theorem of Calculus.

5. Derive formula of integration by parts.

6. Derive formula of substitution.

7. Write from memory the following table of integration.

1. $\int k\ dx = kx + C \qquad (k \text{ is a constant })$

2. $\int x^r\ dx = \dfrac{x^{r+1}}{r+1} + C,$ provided $r \neq -1$

(To integrate a power of $x$ other than $-1$, increase the power by 1 and divide by the incresed power.)

3. $\int x^{-1}\ dx = \int \dfrac{1}{x}\ dx = \int \dfrac{dx}{x} = \ln|x| + C, x \neq 0$

(When $x < 0$, $\ln x$ is not defined. In order to handle the cases when $x > 0$ and when $x < 0$ in one formula, we use $|x|$.)

4. $\int e^{ax}\ dx = \dfrac{1}{a} e^{ax} + C$

5. $\int \sin ax\ dx = -\dfrac{1}{a} \cos ax + C$

6. $\int \cos ax\ dx = \dfrac{1}{a} \sin ax + C$

7. $\int \sec^2 ax\ dx = \dfrac{1}{a} \tan ax + C$

8. $\int \csc^2 as\ dx = -\dfrac{1}{a} \cot ax + C$

9. $\int \sec ax \tan ax\ dx = \dfrac{1}{a} \sec ax + C$

10. $\int \csc ax \cot ax\ dx = -\dfrac{1}{a} \csc ax + C$