Final

## **Formulae and Theorems**

**Fundamental Theorem of Calculus**: If F'(x) = f(x) then

$$\int_{a}^{b} f(x) \, dx = F(b) - F(a)$$

Integrals of common functions

$$\int x^n dx = \frac{1}{n+1} x^{n+1} + C \quad , \quad n \neq -1$$
$$\int e^x dx = e^x + C$$
$$\int \frac{1}{x} dx = \ln x + C$$

## Second Derivative Test

Let (x, y) be a critical point of a smooth function f(x, y). Define the Discriminant D(x, y) by

$$D = f_{xx}f_{yy} - f_{xy}^2$$

Then

 $\begin{array}{rcl} D < 0 & \Rightarrow & (x,y) \mbox{ is a saddle} \\ D > 0 \mbox{ and } f_{xx} > 0 & \Rightarrow & (x,y) \mbox{ is a relative minima} \\ D > 0 \mbox{ and } f_{xx} < 0 & \Rightarrow & (x,y) \mbox{ is a relative maxima} \end{array}$ 

If D = 0 the test fails and no conclusion can be made.