## CALCULUS EXAMPLES

## A. STUDENT

1. DIFFERENTIATION

Let  $f(x) = \frac{e^x}{1-x}$ . Then  $f'(x) = \frac{(1-x)e^x - e^x(-1)}{(1-x)^2}$   $= \frac{e^x(2-x)}{(1-x)^2}.$ 

## 2. INTEGRATION

Because the derivative of  $\sin x$  is  $\cos x$ , it follows that

$$\int_0^\pi \cos x \, dx = [\sin x]_0^\pi$$
$$= \sin \pi - \sin 0$$
$$= 0.$$

## 3. Formulae

The three main differentiation formulae are the product rule,

$$\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx},$$

the quotient rule,

$$\frac{d}{dx}(u/v) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2},$$

and the chain rule,

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx},$$

where y = y(u) is a function of u, and u = u(x) is a function of x. The rule for integration by parts is given by the formula

$$\int u \frac{dv}{dx} \, dx = uv - \int v \frac{du}{dx} \, dx,$$

where u and v are both functions of x.

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