The Robert Gillespie ACADEMIC SKILLS CENTRE

Differentiation Techniques

Assume that c and n are real numbers and $f(x)$, $g(x)$, and $u(x)$ are any differentiable functions of x:

1. $\frac{d}{dx}(c)=0$

2. $\frac{d}{dx}(x^n)=nx^{n-1}$ (power rule)

3. $\frac{d}{dx}(cf)=c\frac{df}{dx}$

4. $\frac{d}{dx}(f \pm g)=\frac{df}{dx}\pm\frac{dg}{dx}$

5. $\frac{d}{dx}(fg)=g\frac{df}{dx}+f\frac{dg}{dx}$ or $(fg)'=gf'+fg'$ (product rule)

6. $\frac{d(f/g)}{dx}=\frac{g\frac{df}{dx}-f\frac{dg}{dx}}{g^2}$ or $\left(\frac{f}{g}\right)'=\frac{gf'-fg'}{g^2}$ (quotient rule)

7. $\frac{d[u(x)]^n}{dx}=n[u(x)]^{n-1}\frac{d(u(x))}{dx}$ (general power rule – chain rule)

8. $\frac{d(e^x)}{dx}=e^x$

9. $\frac{d(\ln x)}{dx}=\frac{1}{x}$

10. $\frac{d(e^{u(x)})}{dx}=e^{u(x)}\frac{d(u(x))}{dx}$

11. $\frac{d[\ln(u(x))]}{dx}=\frac{1}{u(x)}\frac{d(u(x))}{dx}$

12. $\frac{d(a^x)}{dx}=a^x\ln a$

13. $\frac{d(\log_a x)}{dx}=\frac{1}{x\ln a}$

14. $\frac{d(a^{u(x)})}{dx}=a^{u(x)}\ln a\frac{d(u(x))}{dx}$

15. $$\frac{d(\log_a u(x))}{dx} = \frac{1}{u(x)\ln a}\frac{d(u(x))}{dx}$$