1 Lesson 2: The Basics of Scientific Workplace

1.1 An introduction to environments.

Exercise 1 *This is an exercise environment. It will continue until I use the enter key. This is an exercise environment. It will continue until I use the enter key.(backspace)*

Exercise 2 *... type the exercise here ...*

Solution 3 *... type the solution here ...*

```
\begin{exercise}
 ...
 type the exercise here
 ...
  \begin{solution}
   ...
    type the solution here
   ...
  \end{solution}
\end{exercise}
```

An alternate approach...

Exercise 4 *... type the exercise here ...*

Solution 5 *... type the solution here ...*

```
\begin{exercise}
 ...
 type the exercise here
 ...
\end{exercise}
\begin{solution}
 ...
 type the solution here
 ...
\end{solution}
```

1.2 More on displayed equations

Theorem 6 *Let a be any real number. Then* $\lim_{x\to a}\frac{x^2-a^2}{x-a}$

$$\lim_{x\to a}\frac{x^2-a^2}{x-a}=2a$$

Proof. *Consider*

$$\begin{aligned}
\lim_{x\to a}\frac{x^2-a^2}{x-a} &= \lim_{x\to a}\frac{-(a-x)(a+x)}{x-a}\\
&= \lim_{x\to a}(a+x)\\
&= 2a.
\end{aligned}$$

■

This completes Lesson 2.

2 Project 2

Instructions: Create a file containing the items contained in this document. Submit your file to teprice@uakron.edu. The name of your file should be of the form **yourlastname02.tex**. All calculations should be done using the CAS in SWP.

3 Derivatives

Differential calculus is concerned with how one quantity changes in relation to another quantity. The central concept of differential calculus is the derivative.

3.1 Derivative

Definition 7 *The* derivative of a function f at a number a*, denoted by* $f'(a)$*, is*

$$f'(a)=\lim_{h\to 0}\frac{f(a+h)-f(a)}{h}$$

if this limit exists.

Exercise 8 *Use the above definition to compute* $f'(2)$ *if* $f(x)=3x+2$*.*

Solution 9 *(*SPECIAL INSTRUCTIONS: *This solution environment should be at*

Level 2.) Consider

$$\begin{aligned} f'(2) &= \lim_{h\to 0} \frac{f(2+h)-f(2)}{h} \\ &= \lim_{h\to 0} \frac{3(2+h)+2-8}{h} \\ &= \lim_{h\to 0} \frac{3h}{h} \\ &= 3. \end{aligned}$$

3.2 Equation of Tangent Line

Theorem 10 *If $f'(a)$ exists, then an equation of the tangent line to the curve $y = f(x)$ at the point $(a, f(a))$ is*

$$y - f(a) = f'(a)(x - a)$$

3.3 Differentiable Functions

Definition 11 *A function f is* differentiable at a *if $f'(a)$ exists. It is* differentiable on an open interval (a, b) *[or (a, ∞) or $(-\infty, a)$ or $(-\infty, \infty)$] if it is differentiable at every number in the interval.*

3.4 Differentiable Implies Continuous

Theorem 12 *If a function f is differentiable at a, then f is continuous at a.*
Proof. *(*SPECIAL INSTRUCTIONS: *You should complete the proof of this theorem. Recall that a function f is continuous at a if*

$$\lim_{x\to a} f(x) = f(a).$$

If you have trouble proving this, look for the proof in your calculus book.) ■