A. Lesson Context

BIG PICTURE of this UNIT:	• How do we measure "change" in a function or function model? • Why do we measure "change" in a function? • How do we analytically analyze a function or function model – beyond a simple preCalculus & visual/graphic level?		
CONTEXT of this LESSON:	Where we've been We understand how to differentiate and work with polynomial , sinusoidal, exponential & log functions & we understanding new differentiation techniques	Where we are Can we now consolidate our skills in differentiating and working with variety of functions?	Where we are heading Working with more complicated functions that are variations of polynomials, sinusoidal and exp/log

B. Review – Differentiation Techniques: Summary

Rule	"formula"
Chain Rule	
Product Rule	
Quotient Rule	
Derivative of trig fcns:	
Derivative of Exp & log fcns:	
Derivative of power fcns:	

C. Applying Calculus: Working with Rates of Change & Tangents & Normals

1. (**CI**) Given the function $f(x) = \ln(2x-1)$, determine:
   i. The equation of the derivative.
   ii. The exact value of the instantaneous rate of change at $x = 2$.
   iii. At what point(s) does the function have an instantaneous rate of change of $\frac{1}{3}$?

2. (**CI**) Given the function $f(x) = (3x+1)\ln(x)$, determine:
   i. The equation of the derivative
   ii. The exact value of the instantaneous rate of change at *x* = *e*.

3. (**CI**) Determine the equation of the line tangent to $y = (6x+3)^{\frac{5}{3}}$ at $x = 4$.

4. (**CI**) Find $\frac{dy}{dx}$ for $y = \frac{x^2-1}{2x^2+1}$. Determine the values of *x* for which $\frac{dy}{dx} > 0$.

5. (**CI**) Determine the interval(s) in which the curve of $g(x) = \sin^2(x)$ is concave down.

6. (**CI**) Find the equation of the line normal to the curve of $y = 4xe^{x^2-4}$ at the point $(2,8)$

7. (CI) Determine the equation of the line tangent to $y = x^3\ln(x)$ at $x = 1$.

8. (CI) Determine the equation of the tangent to $y = \cos(\pi - 2x)$ at the point where $x = \frac{\pi}{4}$.

9. (CI) Find the point(s) where the tangent line to the curve of $f(x) = e^{2x-3x^2}$ is horizontal.

10. (CI) Find the point(s) where the tangent line to the curve of $f(x) = \frac{x^2-2x+4}{x^2+4}$ is horizontal.

11. (**CI**) Find the minimal value of $g(x) = \frac{e^x}{x}; x > 0$.

12. (CI) Determine the equation of the tangent to $y = (2x^3 - 4x + 2)(x^2 - 3x + 1)$ at the point (2,-10).

13. (CI) For the curve defined by $g(x) = (\sin(x) + \cos(x))^2$ on the domain of $[0, 2\pi]$, determine:

    i. the x- and y-intercept(s);
    ii. Show that $g'(x) = 2\cos(2x)$
    iii. the first three stationary points;
    iv. the "nature" of these stationary points (max/min/neither);
    v. hence, sketch the function $g(x) = (\sin(x) + \cos(x))^2$.

14. (**CI**) Given the function $y = \sqrt{6x - 5}$.
    i. State the domain for the function $y = \sqrt{6x - 5}$.
    ii. Find $\frac{dy}{dx}$ for $y = \sqrt{6x - 5}$.
    iii. HENCE, explain why $\frac{dy}{dx} > 0$ for all values of *x* of the domain.
    iv. What does this mean about the function?

15. (CI) For the curve defined by $g(x) = e^{-x}\cos(x)$ on the domain of $\left[0, \frac{5\pi}{2}\right]$, determine:
    i. the x- and y-intercept(s);
    ii. the first two stationary points;
    iii. the "nature" of these stationary points (max/min/neither);
    iv. hence, sketch the function $g(x) = e^{-x}\cos(x)$.

16. (**CI**) Given the function $g(x) = \cos(x) + \frac{1}{2}\cos(2x),\ x \in [0, 2\pi]$, sketch the graph, identifying all important features including maximum(s), minimum(s) and inflection points.

17. (**CI**) For the curve of $g(x) = e^x \sin(x)$,

i. Find the equations of $g'(x)$ and $g''(x)$.

ii. Find the values of *x* for which $g'(x) = 0$ and $g''(x) = 0$.

iii. Given your work in Qi. and Qii., determine the intervals of increase and decrease and classify the extrema.

iv. Sketch the function, given your work in Qiii.

18. (**CI**) Given the function $g(x) = xe^x - e^x$,

i. Evaluate the exact values of: $(a)\ g(1)$ $(b)\ g(0)$

ii. Show that $\frac{d}{dx}g(x) = e^x + g(x)$.

iii. Detemine the intervals of increase/decrease of $y = g(x)$.

iv. Show that $y = g(x)$ has an inflection point at x = -1

v. Determine the interval in which $y = g(x)$ is concave up.

vi. Determine the equation of the tangent to the curve at *x* = 1.

19. (**CI**) Given the function $y = \frac{x}{3-2x}$;

i. Determine the equation of the aymptotes of this rational function.

ii. Hence or otherwise, evaluate $\lim_{x \to -\infty} \frac{x}{3-2x}$

iii. Determine the x- and y-intercepts.

iv. Find the equation of the line that is normal to the curve $y = \frac{x}{3-2x}$ at the point where *x* = 1.