UNIT 1 – Limits and Continuity

1. What does it mean to take the **limit of a function**? Explain the different cases and how each is approached. Give an example of each.
2. Give two examples in which the **limit does not exist –** one example must be algebraic, the other, graphical
3. State the **Squeeze Theorem**.
4. What does it mean for a function to be **discontinuous**?.
5. Discuss the **types of discontinuity** and give an example of each.
6. What does it mean for a function to be **continuous at a point**? What does it mean for a function to be **continuous**?
7. Explain how to find **vertical and horizontal asymptotes**.
8. State the **Intermediate Value Theorem.**

UNIT 2 – Differentiation: Definition and Basic Derivative Rules

1. The **average rate of change** of f(x) on the interval [a, b] is:_____. Another name for this is the slope of the _____.

2. What is one way to **approximate the slope of a tangent** at a point on the graph of a function? Draw a visual.

3. What is the meaning of the derivative of a function? Give the **limit definition of the derivative** and draw a visual.

4. Write the limit definition of the **derivative** of a function **at a particular x-value**.

5. Does the **derivative** at a point **always exist**? Thoroughly explain and include examples.

6. How do you find the equations of **vertical and horizontal tangent lines** to a graph? Give an example of each.

7. Does **differentiability imply continuity**? Explain and include an example.

8. Does **continuity imply differentiability**? Explain and include an example.

9. What are the **power, product and quotient rules** for derivatives? Write the formula for each and given an example of each.

10. How do we find the **derivative of a piecewise function**? Give an example.

11. Fill in the chart with the derivatives of the given functions:

$f(x)$	a^x	$ln(x)$	$\sqrt{x}$
$f'(x)$			

12. Fill in the chart with the **derivatives** of the given functions:

$f(x)$	$sin(x)$	$cos(x)$	$tan(x)$	$csc(x)$	$sec(x)$	$cot(x)$
$f'(x)$						

UNIT 3 – Differentiation: Composite, Implicit, and Inverse Functions

1. What is the **chain rule for** derivatives? Give two examples.

2. What is **implicit differentiation** and how do you know when to apply it? Give an example.

3. Fill in the chart with the derivatives of the given functions:

$f(x)$	$a^{f(x)}$	$ln(f(x))$	$\sqrt{f(x)}$
$f'(x)$			

4. Write the formula for the **derivative of the inverse** of a function and give an example.

5. Fill in the chart with the **derivatives** of the given functions:

$f(x)$	$sin^{-1}(x)$	$cos^{-1}(x)$	$tan^{-1}(x)$	$csc^{-1}(x)$	$sec^{-1}(x)$	$cot^{-1}(x)$
$f'(x)$						

6. What is a **higher order derivative**? Write some examples, including proper notation.

UNIT 4 – Contextual Applications of Differentiation

1. In **Cartesian coordinates**, given that the position of an object is given by s(t), define the object's a. **displacement** on [a, b] b. **velocity** at $t = t_1$ c. **speed** at $t = t_1$ d. **acceleration** at $t = t_1$
2. How do you recognize a **Related Rates problem**? What are the general steps to solve such a problem?
3. To solve Related Rates problems, what **formulas from Geometry** must you remember?
4. Explain how one can **approximate the value of a function at a point using a tangent line**. Also, give an example.
5. What is **L'H*o*pital's rule** and when does it apply? Give two examples.

UNIT 5 – Analytical Applications of Differentiation

1. State the **Mean Value Theorem** and show a graphical example.
2. State **Rolle's Theorem** and show a graphical example.
3. State the **Extreme Value Theorem** and show a graphical example.
4. Define an **absolute maximum (minimum)** of a function and give a graphical example.
5. Define a **relative maximum (minimum)** of a function and give a graphical example.
6. Define a **critical point** of a function and give a graphical example.
7. What does the **sign of f'(x)** imply about the graph of f(x)? Explain and show a graphical example.
8. What does the **First Derivative Test** do? Explain and show an example.
9. What does the **sign of f"(x)** imply about the graph of f(x)? Explain and show a graphical example.
10. Define an **inflection point** of a function and give a graphical example.
11. What does the **Second Derivative Test** do? Explain and show an example.
12. How do you recognize an **Optimization problem**? What are the general steps to solve such a problem?

UNIT 6 – Integration and Accumulation of Change

1. What is a **Riemann Sum**? Give a graphical example of each **RRAM, LRAM and MRAM**.
2. What is the **Trapezoid rule** for approximating area? Give a graphical example.
3. How do we find **exact area** between a positive function and the x axis on a given interval? Give an example.
4. What is the **First Fundamental Theorem of Calculus**? Given an example.
5. What is the **Second Fundamental Theorem of Calculus**? Give an example.
6. The **area** between a positive function and the x-axis can have many **interpretations** – give an example of one such problem.
7. List the **properties of definite integrals** and give an example of each.
8. What is an **indefinite integral**? Give an example and work it out. Show how you can check your answer.
9. What is the **Power Rule for Integrals**? Give an example.
10. What is **u-substitution** and how do we use it? Give an example.
11. Give an example (and work it out) which requires **Integration using Long Division**.
12. Give an example (and work it out) which requires **Integration using Completing the Square**.
13. Write the formula for **Integration by Parts** and give one example. Work out the example.
14. Give an example (and work it out) which requires **Integration by Partial Fractions**.
15. What is an **Improper Integral**? How is it evaluated? Give an example of each type and work them out.
16. What does it mean for an **integral** to **converge** or **diverge**? Give an example of each and work it out.

UNIT 7 – Differential Equations

1. What is a **differential equation**? How do you verify a solution to a differential equation?
2. What are **Slope Fields** and what are they used for? Give an example and work it out.
3. What is **Euler's method** and what is it used for? Give an example and work it out.
4. What is a **separable differential equation** and how is it solved? Give an example and work it out.
5. Describe how to use **initial conditions** to find **particular solutions** to differential equations.
6. Write the **Exponential Differential Equation and its solution**. For each, write a legend explaining what the variables mean.
7. Write the **Logistic Differential Equation and its solution**. For each, write a legend explaining what the variables mean.

UNIT 8 – Applications of Integration

1. What is the **Mean Value Theorem for Integrals**? Give an example.
2. What is the **Average Value of a Function**? Give an example.
3. What is the formula in **Cartesian form for total displacement** from x=a to x=b, given the velocity function?
4. What is the formula in **Cartesian form for total distance** from x=a to x=b, given the velocity function?
5. Write the formula for the **area between a curve and the x-axis** in terms of x and give an example.
6. Write the formula for the **area between a curve and the y-axis** in terms of y and give an example.
7. Write the formula for the **area between two curves in terms of x** and give an example.
8. Write the formula for the **area between two curves in terms of y** and give an example.
9. Write the formula for the **volume of a solid with the cross sections** below and with base given by a region bounded by y = f(x) [where $f(x) \geq 0$] and the x-axis from x = a to x = b. a. **squares** b. **semicircles** c. **equilateral triangles**
10. What is the **Disk Method**? When and how is this method used? Give an example and work it out. Include a diagram.
11. What is the **Washer Method**? When and how is this method used? Give an example and work it out. Include a diagram.
12. Write the **Cartesian formula for the arc length of a curve**. Give an example and work it out.

UNIT 9 – Parametric Equations, Polar Coordinates, and Vector-Valued Functions

1. Write the formulas for the **first and second derivatives of parametric equations** and give an example of each.
2. Write the formula for **slope of a tangent line using parametric equations** and give an example.
3. Write the **Parametric formula for the arc length of a curve**. Give an example and work it out.
4. What is the **vector form of a parametric equation**?
5. In **Parametric coordinates**, given that the position of an object is given by x=f(t), y = g(t), define the object's a. **velocity** at $t = t_1$ b. **speed** at $t=t_1$ c. **acceleration** at $t = t_1$
6. In **Parametric form**, what is the formula for the **speed** of a particle given its position <x(t), y(t)>?
7. In **Parametric form,** what is the formula for the **velocity** of a particle given its position <x(t), y(t)>?
8. In **Parametric form**, what is the formula for the **acceleration** of a particle given its position <x(t), y(t)>?
9. Write the formula for the **derivative of a polar equation**. Give a numerical example.
10. Write the formula for the **area inside a polar** curve and give an example.

UNIT 10 – Infinite Sequences and Series

1. What is the difference between a **sequence** and a **series**?

2. Fill in the blank: A **series conveverges** if the sequence of _____converges.

3. Give an example of each of type of series and where possible, state if it converges or not:

***geometric series:**

***p-series:**

***harmonic series:**

***alternating harmonic series:**

***telescoping series:**

***power series**

4. State the **Divergence Test** and give an example.

5. State the **Ratio Test** and state when it is mainly used. Give an example.

6. State the **Comparison Test** and explain how to find a series for comparison. Give an example.

7. State the **Limit Comparison Test** and give an example.

8. State the **Alternating Series Test** and give an example.

9. State the **Integral Test** (don't forget the premise!) and give an example.

10. What does it mean for a series to **converge absolutely**? What does it mean for a series to **converge conditionally**?

11. Name and state the two tests which are used to prove **absolute convergence**.

12. What does the **Interval of Convergence** of a power series mean and how do we find it? Give an example and work it out. If the power series is not geometric, we must not forget to also test the _____ of the interval!!!

13. What is the **Radius of Convergence** of a power series and how do we find it? Give an example and work it out.

14. Write the formula for the **Taylor Series** about x = a.

15. What is a **Maclaurin Series**? Write the formula.

16. Write the first 3 terms and the general term for the Maclaurin Polynomial for each of the functions below:

$\frac{1}{1-x}$, e^x , sin(x) , cos(x) , ln(x+1) , $\tan^{-1}(x)$

17. When **building new series from known series** we must remember that the interval of convergence might change at the _____.

18. What is the **error** when approximating a function with an **alternating series**?

19. Write the **Lagrange Error Bound formula** and write a legend explaining the meaning of each variable.