Occidental College
Math Comps Part 1 Study Guide

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This is a list of topics you might want to use to orient your studying for the Part I comprehensive exam. This is *not* intended to be an exhaustive list; the complete list of topics for each course is available at `https://www.oxy.edu/mathematics/students/topics-fundamental-courses`. But you should certainly ensure that you are comfortable with all of the topics on the list below, and can use it as a starting point for your studying.

Calc 1

1. Finite limits

2. Infinite limits

3. Continuity and IVT

4. Definition of derivative

5. Computing Derivatives

6. Implicit Derivatives

7. Tangent lines

8. Linear approximation

9. Maxima and minima

10. Concavity and Graphing

Calc 2

1. Riemann sums

2. Fundamental Theorem of Calculus

3. Integration by substitution

4. Integration by parts

5. Applications of integrals (e.g. work), relation to Riemann Sums

6. Sequences

7. Positive series convergence

8. Absolute and conditional convergence

9. Power series

10. Taylor series

Multivariable

1. Equations of lines and planes, curves and surfaces

2. Tangent planes and linear approximations

3. Gradients and Directional Derivatives

4. Max / Min problems via critical points and second derivatives

5. Double Integrals over general regions: swapping limits

6. Line Integrals, Conservative Vector Fields

7. Contour Maps; first derivative approximation, 2nd derivative sign

Linear Algebra

1. Geometry of vectors

2. Dot product and norms

3. Orthonormality and Gram-Schmidt

4. Lines and Planes

5. Distances and projections

6. Systems of linear equations

7. Spanning, linear independence, bases

8. Matrices and matrix operations

9. Row, column, and nullspaces; rank and nullity

10. Determinants

11. Eigenvalues and eigenvectors

12. Orthogonal projections

Discrete Mathematics

1. Logic: Operators, Quantifiers

2. Sets: subsets, power sets, Cartesian Products

3. Mathematical Induction

4. Number Theory: divisibility, gcd and lcm, modular arithmetic

5. Equivalence relations and equivalence classes, partitions

6. Functions: One-to-one, Onto, Bijections, Composition

7. Counting Techniques