Calculus 3 Final Exam Study Guide

For the final exam, you should be able to:

1. Apply basic skills such as graphing polynomial, exponential, natural log, sine, cosine and tangent functions, finding where functions intersect, finding the distance between two points, etc.
2. Be ready to calculate dot products and cross products. Understand and apply properties of dot products and cross products. Know and use formulas for scalar and vector projections. Know and use the formulas $\mathbf{a} \cdot \mathbf{b} = \|\mathbf{a}\| \cdot \|\mathbf{b}\| \cos\theta$ and $\|\mathbf{a} \times \mathbf{b}\| = \|\mathbf{a}\| \|\mathbf{b}\| \sin\theta$ where θ is the angle between $\mathbf{a}$ and $\mathbf{b}$ so that θ is in $[0, \pi]$.
3. Recognize and use equations of lines, planes, spheres, cylinders, paraboloids, ellipsoids, cones and hyperboloids.
4. Sketch surfaces using traces/cross sections and contour curves.
5. Know and use the formulas for arc length, curvature, the unit tangent vector, the unit normal vector, the velocity vector, and the acceleration vector.
6. Find partial derivatives for functions. This includes the chain rule.
7. Know and use formulas for tangent planes and linear approximations.
8. Know and use formulas for the directional derivative and gradient.
9. Know and use the second derivative test for finding local extrema.
10. Know and use the method of Lagrange multipliers for finding maximum and minimum values of a function subject to a constraint.
11. Calculate double integrals in rectangular and polar coordinates. Convert integrals from rectangular to polar coordinates. Use double integrals to find areas and volumes. You *might* just be asked to <u>set up but not evaluate</u> an integral. Be ready to change the order of integration. Know the formulas for converting from rectangular to polar and cylindrical coordinates.
12. Calculate triple integrals in rectangular, cylindrical, and spherical coordinates. Convert integrals from rectangular to cylindrical or spherical coordinates. Use triple integrals to find volumes. You *might* just be asked to <u>set up but not evaluate</u> an integral. Know the formulas for converting from rectangular to spherical coordinates.
13. Be ready to parameterize a curve C.
14. Know and use the Fundamental Theorem for Line Integrals. Know how to determine whether a vector field is conservative. Find a potential function for a vector field (i.e., a function that has a given vector field as its gradient).
15. Know and use Green's Theorem for calculating line integrals.
16. Know and use the formulas for curl and divergence.
17. Know and use Stoke's Theorem to calculate an integral.

Here are some problems that you could use for practice:

1. Section 12.1: 21
2. Section 12.2: 5, 7, 21
3. Section 12.3: 5, 19, 23, 41
4. Section 12.4: 9, 11, 14, 19, 29
5. Section 12.5: 5, 10, 12, 26, 27, 31, 45, 57
6. Section 12.6: 21, 23, 25, 27
7. Section 13.1: 21, 23, 25, 29
8. Section 13.2: 7, 17 ,23, 37, 41
9. Section 13.3: 3, 19, 23, 49
10. Section 13.4: 11, 15, 23
11. Section 14.1: 32, 43, 59, 63
12. Section 14.3: 17, 21, 33, 65, 67
13. Section 14.4: 5, 11, 19
14. Section 14.5: 5, 9, 13, 17, 23
15. Section 14.6: 7, 13, 17, 19, 21
16. Section 14.7: 5, 11, 13, 16
17. Section 14.8: 5, 7, 9
18. Section 15.1: 3(a),9
19. Section 15.2: 9,17, 29
20. Section 15.3: 15, 17, 23, 43, 47, 53
21. Section 15.4: 9, 25, 31
22. Section 15.6: 3, 6, 9
23. Section 15.7: 13, 16, 20, 30
24. Section 15.8: 17, 21, 30
25. Section 15.9: 23, 35, 39
26. Section 15.10: 15, 16, 17
27. Section 16.2: 7, 9, 19
28. Section 16.3: 3, 9, 13
29. Section 16.4: 1, 4, 7, 11
30. Section 16.5: 3, 5
31. Section 16.7: 9, 11, 13, 23, 25
32. Section 16.8: 7, 9
33. Section 16.9: 5, 7, 9