BASIC Tasks you should be able to do on a Math 241 midterm:

1. Find the distance between two given points.
2. Find magnitude of a given vector, add vectors, take the dot product of vectors.
3. Given the sign of the dot product of two vectors (positive, negative or zero), decide whether the angle between them is acute, obtuse or right.
4. Realize when the cross product of two vectors is zero just looking at the vectors.
5. Use cross product to find the area of a parallelogram spanned by two vectors
6. Given three vectors, find the volume of the parallelepiped they span.
7. Given a vector find it's unit vector (one which has the same direction but magnitude 1).
8. Decide which operations are meaningful (Can you "multiply" two vectors? Can you take the dot product of a vector and a number? Can you add a vector and a scalar? etc)
9. Write down the projection formula without mistakes. Orthogonal component?
10. Pick two vectors (that aren't super simple) in 3D and compute their cross product. Check that your answer is correct by computing it's dot product with the original two and seeing that this is zero.
11. Find the distance from a point to a plane. (Hint: Projection)
12. What does the equation of a plane look like? What important vector is associated to the plane? How can we figure this out from the equation?
13. What does the equation of a line look like? What's the direction vector in this formula? Why is this significant geometrically?
14. Find the distance between two parallel lines given parametrically in 3D.
15. Find the distance from a line to a plane.
16. Given a point and a normal vector, give the equation of a plane containing the point and having that normal vector.
17. Given a point and two lines, find a plane containing the point and parallel to the two lines.
18. Given a line, find a plane containing the line. (Many answers)
19. Given two lines, decide if there is a plane containing both of them and if so, find it's equation.
20. Given a point and two planes, find the equation of a plane perpendicular to both and containing the given point.
21. LOOK AT THE PROBLEMS FROM THE PRACTICE MIDTERMS HAVING TO DO WITH MATCHING GRAPHS WITH THEIR EQUATIONS. DO ALL OF THESE.
22. Given a limit problem in two variables, be able to check along various curves and lines to try and show the the limit does not exist.
23. Given a 3D surface, what are it's level sets. Can you draw them? Can you guess the name of a quadric (degree 2) surface based on it's level sets?
24. Once you've tried everything you can in problem 18 and all the directions are showing you the same limit and you're now convinced that the limit does exist, what method do you use to show it's existence (Leave this question for last).
25. Given a function in either two or three variables, be able to take their partial derivatives with respect to any variables. Review product and chain rule in one dimension.
26. Explain the difference between a linear approximation and the equation of the tangent plane? Pick your favorite function $z=f(x,y)$ and a point (a,b) and compute both the linear approximation and the equation of the tangent plane for this.
27. Given the equation of the tangent plane to $z=f(x,y)$ at (a,b), what do the coefficients of x and y in this equation represent in terms of the function?
28. What is Clairaut's theorem? Make sure to include hypotheses.
29. Is differentiability the same as both partial derivatives existing? Why, why not?

BASIC Tasks you should be able to do on a Math 241 midterm:

30. Given a table of values of the function, use the limit definition of partial derivatives to compute them. Also be ready to read these off a graph and not a table (Eg: Practice Exam 2011, Problem 5c).
31. Given a contour graph of a function, be able to determine the signs of the first partial derivatives by considering growth or decrease in the relevant direction.
32. Given a contour graph of a function, be able to determine the signs of the second partial derivatives by considering growth or decrease in the relevant direction.
33. Given a function of two variables f(x,y) and if x and y are themselves x(u,v), y(u,v), be able to find the partial derivatives of f with respect to u and v using the chain rule. (DO THIS FOR AN EXAMPLE OF YOUR CHOOSING!)
34. Same setting as 27, but now you're only given a table of values of f(x,y), x, y and and various partial derivatives, be able to keep calm and carry out the same calculation as in 27 above. (See Practice Exam 2010, problem 4 if you don't know what I'm talking about).