

**Math 230, Fall 2006**  
**Review sheet for Exam 1**

Our first midterm exam will be given on October 5, 2006. It will cover the material from Chapters 13-14.

**Some important skills**

**Section 13.1: Three-dimensional Coordinate Systems**

- Find the distance from a point  $P$  to the coordinate planes (or the coordinate axes).
- Find the distance between two points in 3-space.
- Know the general equation of a plane in 3-space. Sketch the graph of a given plane.
- Find the equation of a given sphere.
- Find intersections of a surface  $S$  with coordinate planes (or coordinate axes).

**Section 13.2 - 13.3: Vectors - The dot product**

- Adding vectors, triangle law, parallelogram law, scalar multiplication.
- Find the dot product of two vectors.
- Given a vector  $\mathbf{v}$  in  $\mathbb{R}^3$ , find its magnitude (length or norm).
- Find a *unit vector* that has the same direction as a given one.
- Find the dot product of two vectors.
- Apply the cosine formula.
- Determine whether two vectors are parallel, perpendicular or neither.
- Scalar projection (and vector projection) of a vector  $\mathbf{b}$  onto  $\mathbf{a}$ .
- Find the work done by a force acting on an object.

**Section 13.4: The cross-product**

- Find the cross-product of two given vectors.
- Find the area of the parallelogram in 3-space.
- Find a vector orthogonal to a given plane.
- Find the volume of a parallelepiped determined by vectors (or points).

### **Section 13.5: Equations of lines and planes**

- Find a *vector, parametric or symmetric equations* of a given line  $L$ .
- Decide whether three given points lie in the same line.
- Find the equation of a given plane.
- Decide whether two lines are parallel, intersecting, or skew.
- Decide whether four points lie in the same plane.
- Find the distance from a point  $P$  to a given plane.
- Find the distance between two parallel planes.

### **Section 13.6: Cylindrical and Quadratic Surfaces**

- Find and identify the traces of a given quadric surface and give a rough sketch.
- Identify quadric surfaces (ellipsoids, paraboloids, cones, hyperboloids).

### **Section 13.7: Cylindrical and Spherical Coordinates**

- Convert from cylindrical to rectangular and spherical coordinates.
- Convert from rectangular to cylindrical and spherical coordinates.
- Convert from spherical to rectangular and cylindrical coordinates
- Write equations of surfaces in rectangular, cylindrical, or spherical coordinates.

### **Section 14.1: Vector Functions and Space Curves**

- Describe a curve given by a vector function.
- Find limits and derivatives of vector functions.
- Find the parametric equations of a line segment from  $P$  to  $Q$ .
- Find the *vector function* that represents the curve of intersection of two given surfaces.

### **Section 14.2: Derivatives and Integrals of Vector Functions**

- Find the derivative of a given vector function.
- Find parametric (or symmetric equation) of the *tangent line* to a curve  $C$  at a given point.
- Find the unit tangent vector of a vector function  $\mathbf{r}$  at a given point  $P$ .

### **Section 14.3: Arc Length and curvature**

- Find the length of a space curve.
- Parametrize a curve with respect to arc length.
- Find the curvature of a smooth space curve  $\mathbf{r}$ .
- Find the normal vector  $\mathbf{N}$  and binormal vector  $\mathbf{B}$  of  $\mathbf{r}$  at a given point.

### **Section 14.4: Velocity and acceleration**

- Find the velocity, speed, and acceleration of a moving particle  $P(t)$ .
- Find the *normal and tangential components of acceleration*.
- Given the acceleration, initial velocity and position of a particle, find its velocity and its position vector at time  $t$ .