

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

Our first midterm exam will be given on October 5, 2006 in 10 Sparks. It covers 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).
- Check whether two spheres intersect.
- Find the equation of a given sphere.
- Find the distance between two points in 3-space.

#### *Sections 13.2 - 13.3: Vectors - The dot product*

- Adding vectors, triangle law, parallelogram law, scalar multiplication.
- Find the dot product of two vectors in coordinates and by the cosine formula.
- Given a vector  $\mathbf{v}$  in  $\mathbf{R}^3$ , find its magnitude (length).
- Find a unit vector that has the same direction as a given nonzero vector (i.e. normalize).
- 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 a parallelogram and of a triangle in 3-space.
- Find a vector orthogonal to two given nonzero vectors, which are not parallel to each other.
- Find the volume of a parallelepiped determined by 3 vectors (or 4 points).

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

- Find the vector, parametric or symmetric equations of a given line L (i.e. convert from vector to parametric, etc.) “Find the line” means “find vector, parametric or symmetric equations of...” (any may be asked); same with planes.
- Convert between vector and scalar equations of a plane.
- Find the line passing through the two points.
- Find the line passing through a given point parallel to a given line.
- Find the line passing through a given point perpendicular to a given plane.
- Decide whether three given points lie in the same line.
- Decide whether two lines are parallel, intersecting, or skew.
- Find the intersection of two lines and of two line segments, if they intersect (you may not need the latter skill).
- Decide whether four (or more) given points lie in the same plane (are coplanar).
- Decide whether three (or more) given vectors are coplanar.
- Find the distance from a point P to a given plane.
- Find the distance between two parallel planes.
- Find the distance a plane and a line parallel to this plane.
- Find the line, which is the intersection of two planes (not parallel to each other).
- Find the plane passing through a given point parallel to a given plane.
- Find the plane passing through a given point perpendicular to a given line or vector.

*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) by their pictures and by equations in rectangular, cylindrical and spherical coordinates. (This is slightly more than you will need).

*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
- Convert equations of surfaces between all these 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 intersection of two space curves.
- 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 the 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 at a general point.
- Find the normal vector  $\mathbf{N}$  and binormal vector  $\mathbf{B}$  of  $\mathbf{r}$  at a given point or at a general 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  $t$ .
- Given the position vector of an object at each moment and the mass of the object. Find the force acting on the object at each time  $t$ . (Newton's Second Law of Motion).