

# Math 22a Review Sheet for Exam #1

Below you will find the list of what you are supposed to know. References are made to the corresponding pages in the book. The exam problems will be modelled over homeworks and quizzes.

## 1. You need to understand what is:

a vector in  $\mathbb{R}^n$  (2), its geometric interpretation (4), sum of two vectors and product of a vector by a number (7), a linear combination of vectors (10), the span of a set of vectors (14);

the norm of a vector (21), the dot product of two vectors (24), orthogonality (27);

a matrix (36), product of matrices (38), sum of matrices and product of a matrix by a number (42), the transpose of a matrix (43);

the augmented matrix of a linear system (54), an elementary row operation (55-56), a pivot (57), row-echelon (57) and reduced row-echelon (63) form of a matrix, an elementary matrix (65);

an invertible matrix and the inverse of a matrix (75);

a subspace of  $\mathbb{R}^n$  (89), column space, row space, null space of a matrix (91), a basis for a subspace (93);

linear dependence and independence (127), dimension of a subspace (131), rank and nullity of a matrix (137, 139).

## 2. You need to be able to:

compute norms and dot products of vectors (21-24)

find the angle between two vectors (24)

reduce matrices to row-echelon (60) and reduced row-echelon (62) form

solve linear systems by Gauss method with back substitution (57-59) and by Gauss-Jordan method (61-62)

decide whether a matrix is invertible and find the inverse if it is (80-81)

express invertible matrices as products of elementary matrices (82-83)

check whether a subset of  $\mathbb{R}^n$  is a subspace (88-90)

find the general solution of  $A\mathbf{x} = \mathbf{b}$  given a particular solution of  $A\mathbf{x} = \mathbf{b}$  and the general solution of  $A\mathbf{x} = \mathbf{0}$  (97-98)

check whether a given set of vectors is dependent or independent (129-130)

find a basis for a nullspace (91), column space (129), row space (137-138) of a matrix

enlarge an independent set of vectors to a basis of  $\mathbb{R}^n$  (133)

calculate the rank and the nullity of a matrix (138)