**In-Lab Group Activity for Week 4: Matrix Inverse, Span, Stoichiometry Example**

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**Problem 1: Find the inverse of a matrix *A* using the super augmented matrix .**Given the matrix A below, find the inverse of the matrix () by concatenating *A* with the identity matrix, i.e. . Show all elementary row operation steps.

**a.** Write out the super matrix .

**b.** Start row reducing. First add row 2 to row 3 and show the result. The matrix is now in **echelon form**.

**c.** Continue row reducing. Use the third pivot to eliminate all non-zero entrees above it. Two steps.

**d.** Record the inverse here:

**e.** Verify by performing the multiplication explicitly. *I* denotes the identity matrix.

**f.** Find the unique solution to using your inverse matrix. Here **.**

**Problem 2: Span of Vectors and Independence**

Consider the following two vectors from the vector space over the reals.

**a.** Determine whether the vector is a linear combination of and .

If it is, give one such expansion.

**Tip**: Form the augmented matrix and row reduce.

If the system is consistent, give as a linear combination of the two vectors.

In fact,

-3

**b.** Determine whether the vector is a linear combination of and .

Form the augmented matrix and row reduce. Circle the poison pivot if there is one.

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**Below, a, b and c are arbitrary real numbers.**

**c.** The span of the vectors and is the set of all vectors of the form:

**i.** **ii.** **iii.** **iv.**

**d.** Are the three vectors , and **linearly independent**? We can use the row reduction in part **b** to help. Are there non-trivial solutions to the homogeneous equation ?

Are the vectors independent? Circle 🡪 **Yes No**

***1***

**Problem 3: Stoichiometry Example – See Section 1.6 in your text**

Ferric sulfide, aka iron(+3) sulfide reacts with hydrochloric acid (HCl) to produce various products. Under certain conditions, stinky hydrogen sulfide and ferric chloride are produced. Ferric chloride is used to treat sewage, industrial waste, to purify water, as an etching agent for engraving circuit boards, and in the manufacture of other chemicals.

**Challenge**: Balance the chemical reaction:

Assume the coefficient of is 3. Our goal is to find and to balance this equation:

**a.** Represent each molecular species as a vector of the atomic counts:

**Atomic Count Vectors**

First is given for free.

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**b.** This translates our stoichiometric problem:

into the **vector equation**:

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**c.** Now write the augmented matrix *AM* for this vector equation being sure to move all unknowns to the LHS.

Then completely row reduce.

**d.** Fill in the boxes of the balanced equation using the unique solution revealed by your fully reduced augmented matrix.