0. Complete the Pre-Course Survey (see Piazza for link).

1. Consider the following system of equations:

$$2x + 2y - z = 6$$
$$4x - y + 4z = 2$$
$$6x - 2y - 5z = -27$$

   a. Solve the system of equations by hand.
   b. Rewrite the system of equations as a matrix equation.
   c. *Bonus*: Solve the system by Gaussian elimination (see Murphy Appx. A)

2. Solve the following system of equations by using MATLAB. Submit your MATLAB script and the answer for the vector **v**. (Your script should be a set of commands that can be run from a ".m" file.)

$$\begin{bmatrix} -2 & 5 & 1 & 1 \\ 1 & 4 & 2 & -3 \\ -3 & 3 & 2 & 4 \\ 4 & 2 & 2 & 5 \end{bmatrix} \cdot \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \end{bmatrix} = \begin{bmatrix} -14 \\ -1 \\ -8 \\ 11 \end{bmatrix}$$

3. A famous demonstrative experiment is called "elephant's toothpaste" (see Science Bob demonstrate at https://www.youtube.com/watch?v=p1eG2y2mn54). For the experiment, we use a 5L flask and put inside a volume of 0.5 L of 30% hydrogen peroxide in the bottom. After this, we add 50 mL of liquid dishwashing soap. Finally, we add 50 g of potassium iodine and wait. A foam will form and rise quickly within the flask. The reaction is:

$$H_2O_2\ (aq) \rightarrow O_2\ (g) + H_2O\ (aq)$$

   a. Balance the reaction.
   b. How many moles of oxygen will be generated for the scenario described?
   c. *Bonus*: Estimate the volume of the foam.

4. Polyvinyl chloride (PVC) is used to make products like plastic pipe. PVC is a polymer of vinyl chloride, C_2H_3Cl. One way to produce vinyl chloride requires two reaction steps. In the first reaction, ethylene (C_2H_4) reacts with HCl and oxygen to make dichloroethane ($C_2H_4Cl_2$). In the second reaction, dichloroethane reacts with sodium hydroxide (NaOH) to make vinyl chloride. Both reactions have byproducts. Write both stoichiometrically balanced reactions, including their byproducts.

5. Glycerol ($C_3H_8O_3$) is a byproduct of biodiesel manufacture, and researchers are trying to come up with new uses for the compound. One idea is to react glycerol with water to make CO_2 and H_2, and then use the hydrogen in fuel cells to generate electricity. Write the stoichiometrically balanced chemical reaction. Calculate the pounds of hydrogen produced per pound of glycerol consumed. What do you think about this idea?

6. Murphy P1.11 [sulfuric acid]

7. Polycarbonates are transparent impact-resistant polymers used to make a variety of products including contact lenses, baby bottles, and compact discs. Polycarbonates are currently made from the highly toxic gas phosgene ($COCl_2$), in a process with poor atom economy. You are interested in developing a "greener" process for synthesis of polycarbonates by using dimethyl carbonate (DMC, $C_3H_6O_3$) instead of phosgene. You are searching for an economical and environmentally friendly method to make DMC. The following set of reactions is of interest:

   Syngas (mixture of CO and H_2) production from methane (CH_4) and steam (H_2O):

   $$CH_4 + H_2O \rightarrow CO + H_2$$

   Methanol (CH_3OH) production from CO and H_2:

   $$CO + H_2 \rightarrow CH_3OH$$

   Dimethyl carbonate production from methanol, CO, and O_2:

   $$CH_3OH + CO + O_2 \rightarrow C_3H_6O_3 + H_2O$$

   a. Balance the reactions. Use a generation-consumption analysis to come up with a reaction pathway that makes DMC from methane, water, and oxygen, with no net generation or consumption of CO or methanol.
   b. Calculate the atom economy of your pathway.

8. **Protein molecular mass**. Build an Excel spreadsheet to determine the mass of a protein from data on amino acid composition. The spreadsheet should take full advantage of formula and other features to minimize the amount of hand calculations. Test the spreadsheet with the data given below for insulin (see next page). In insulin, there are two disulfide bonds between chain A and chain B, and a third disulfide bond between two cysteine residues on chain A.

   Your spreadsheet should have cells for entering the number of each type of amino acids in the protein (alanine, arginine, etc.) and the number of disulfide bonds.

   The molecular mass can be found by summing the masses of all N amino acids, subtracting $(N_{\text{residues}} - N_{\text{chains}}) * 18$ to account for the loss of one water molecule in forming a peptide bond, and subtracting $2W$ for the hydrogens removed for each of the W disulfide bonds.

   Bonus: Use special functions in Excel to automatically count the number of amino acids of each type in the sequence. Thus, the input will simply be the sequence of amino acids (using the one-letter code may simplify the lookup).

   For full credit, upload your Excel spreadsheet directly to Piazza.

Molecular Weight	Chain A	Chain B
Ala: 89	1. GLY	1. PHE
Arg: 174	2. ILE	2. VAL
Asn: 132	3. VAL	3. ASN
Asp: 133	4. GLU	4. GLN
Cys: 121	5. GLN	5. HIS
Gln: 146	6. CYS	6. LEU
Glu: 147	7. CYS	7. CYS
Gly: 75	8. THR	8. GLY
His: 155	9. SER	9. ASP
Ile: 131	10. ILE	10. HIS
Leu: 131	11. CYS	11. LYS
Lys: 146	12. SER	12. VAL
Met: 149	13. LEU	13. GLU
Phe: 165	14. TYR	14. ALA
Pro: 115	15. GLN	15. LEU
Ser: 105	16. LEU	16. TYR
Thr: 119	17. GLU	17. LEU
Trp: 204	18. ASN	18. VAL
Tyr: 181	19. TYR	19. CYS
Val: 117	20. CYS	20. GLY
	21. ASN	21. GLU
		22. ARG
		23. GLY
		24. PHE
		25. PHE
		26. TYR
		27. THR
		28. PRO
		29. LYS
		30. THR

9. **Reflection assignment based on the Johns Hopkins University Ethics Policies**.

    a. Read the Academic Integrity section of the syllabus (on Piazza), and the Violations of Academic Integrity portion of the Hopkins Ethics Policy and the procedures of the Ethics Board (http://e-catalog.jhu.edu/undergrad-students/student-life-policies/#Violations_of_acad). You may also want to review the Academic Integrity Training module on Blackboard (click My Institution, then look for the My Organization box).

    b. Give a short answer (1-4 sentences) to your choice of any two of the following four questions

        i. State why you think it is important for faculty to enforce the Code of Student Conduct. List some benefits that you receive as a student when this is enforced.

        ii. List some of the potential negative consequences that you would experience for being found guilty of academically dishonest behavior in this class, including your academic standing or delay in taking subsequent courses should you not make a C-; relationships with faculty, peers, family, and potential employers or professional schools; and your own self-image.

        iii. Give an example of a public figure who made a faulty decision that resulted in a loss of position or status. Discuss how one poor decision can have significant consequences.

        iv. There are many factors that contribute to circumstances that encourage academically dishonest behaviors including poor time management, lack of preparation, inappropriate ranking of priorities, and lack of general personal care (including getting enough rest, exercising, and eating well), among others. List some of things that you can do to prevent circumstances that might encourage academic dishonesty.

    c. After completing this assignment, do you have a good understanding of the academic integrity expectations for this course and in this department? List any lingering issues about which you're unsure or want clarification.

10. On this and every class assignment, inscribe this pledge: "I attest that I have completed this assignment without unauthorized assistance from any person, materials or device. All consultants, collaborators, and sources are cited. [Signed and dated]"

11. *Optional*: To help the teaching staff and your fellow students to get to know you, please upload a profile picture to Piazza and post a brief message introducing yourself (hometown, interests, student activities and leadership, research lab or interests, etc.)

12. *Optional:* Johns Hopkins directory and email setup:
    a. If you often use a name other than your government name (for example, “Jeff” instead of “Jeffrey,” please sign in to SIS and set your “Preferred Name.”
    b. To set an email alias, (for example, to make *jeffrey.gray@jhu.edu* forward mail to *jgray21@jhu.edu*), go to http://my.jhu.edu, select JHED from the left panel, then select Email Alias.