Survey of Materials
Homework 1, due date is set in Canvas LMS

***Notes**: In multiple choice problems explain your answer. Add references if needed. Your solution must be uploaded as a single file "YourName.pdf" or "YourName.zip".*

1. Elastic constants of a metal are primarily affected by material structure at: (A) atomistic scale (e.g. unit cell of a crystal); (B) mesoscale (beyond the size of single crystallites); (C) macroscale (size of the smallest geometrical features of the construction).

2. You would like to create a catalyst, what elements are most important for this: (A) halides; (B) fluorine; (C) hydrogen; (D) transition metals; (E) rare-earth elements; (F) radioactive elements.

3. Identify correct statement(s) about bulk metallic glasses: (A) Most of metals can be made glassy if cooled from melt very rapidly; (B) Most of metallic alloys can be made glassy upon mechanical alloying for a large enough number of cycles; (C) Most of multi-element alloys can be made glassy at some composition; (D) Only alloys with nonmetallic elements can be made glassy.

4. What materials are always poor conductors: (A) ionic solids; (B) wide-gap covalent solids; (C) organic materials; (D) liquids of identical wide-gap molecules; (E) ionic liquids; (F) molecular crystals; (G) crystals of noble gas elements.

5. Explain bonding in selenium crystal.

6. List all independent geometrical parameters of boroxine molecule. What is the point group and fundamental domain (asymmetric unit) of this molecule?

7. List all independent geometrical parameters of black-phosphorus crystal. What is the space group and fundamental domain (asymmetric unit) of this crystals?

8. For Si crystal determine the Wyckoff positions of voids, bonds, and centers of 6-fold rings. Determine Miller indexes for planes built by two parallel bonds in 6-fold rings. Use the origin choice in which the origin is occupied by Si atom.

9. From the band structure shown here http://zhugayevych.me/edu/Materials/images/bands.jpg, determine bandgap(s) and bandwidth(s). Speculate on possible chemical composition and crystal structure.

10. In five sentences review a contributed presentation from Industry Day including: 1) motivation; 2) approach; 3) results; 4) their significance; 5) outlook (your proposal of follow-up research).