Engineering Materials (MSE-220)

Assignment #2

1. Which of the following is a physical property? (Cht 3-P.1)

a. color
b. hardness
c. microstructure
d. valence
e. electronegativity
f. composition

2. List the chemical and physical properties that are important for a material to be used for a door knob. (Cht 3-P.4)

Chemical	Physical
Corrosion resistance	Color (nice appearance)
Ability to be plated	Feel (pleasing)
Non-toxic	Thermal conductivity (it would be nice if it was on insulation)
Chemical composition	Density (it would be nice to be light weight to reduce costs [wt/volume])

3. Which of the following is not a chemical property?

a. corrosivity
b. chemical reactivity
c. composition
d. solubility
e. moisture absorption
f. specific gravity

4. Which of the following does not play a role in chemical properties of a material? (Cht 3-P.5)

a. valence
b. melting point
c. composition
d. atomic number
e. corrosivity
f. friction

5. Calculate the energy required to heat a cast iron frying pan weighing 1kg to searing temperature of 200°C. (Assume no lost heat.) (Cht 3-P.9)

Ans: The specific heat of gray cast iron is 1 kg x 0.13 btu/lb F x 2.54 lb/kg x 320 F = 105.66 btu.

6. Which of the following is the best heat insulator? (Cht 3-P.13)

a. Fe
b. Ni
c. Ag
d. Ti
e. W
f. Mo

7. Calculate the ohmic resistance of 100 m of 1mm diameter copper wire, compared with the same length of nickel wire.(Cht 3-P.15)

Ans: Going to Table 2-1, the resistivity of copper is 1.69 cm; nickel has a resistivity of 7.8 ohm-centimeters, so the resistance of the nickel will be (7.8/1.69) or 4.6 times higher for the nickel.

8. Which of the following is the best electrical conductor? (Cht 3-P.16)

a. Cu
b. Ag
c. Pt
e. Hg
f. Ni
g. Au

9. A brick has dimensions of 60 x 80 x 400 mm and a weight of 3 kg. What is its apparent density? (Cht 3-P.19)

Ans:

$$60 \times 80 \times 400\text{mm} = 1920{,}000\text{mm}^3 \times \frac{\text{cm}^3}{1000\text{mm}^3}$$

$$\text{density} = \frac{3000\text{g}}{1920\text{cm}^3} = 1.56\text{g/cm}^3$$

10. What is the density of the alloy Monel (30% nickel, Cu remainder)? (Cht 3-P.20)

Ans: Using Table 2-1, the density of nickel is 7.85 lb/in^{-3}

X = .3 Ni + .7 Cu

X = (7.85 x .3) + (8.13 x .7) = 8.046

11. Calculate the spring constant for a one-inch cube of polystyrene. (Cht 3-P.21)

$$E = \text{stress/strain},\ \text{strain} = \frac{\text{stress}}{E}$$

Spring constant = force/unit deflection

$$\text{The strain on a one inch cube loaded with 1000 lb} = \frac{1000}{300{,}000} = .00333\text{in} \times 1\text{in} = .00333\text{in}$$

$$\text{So this can be the spring constant: } \frac{1000\text{lb}}{.00333\text{in}} = \boxed{\frac{300{,}000\text{lb}}{\text{in}}}$$

12. Explain the concept of tensile strain and how it is measured. (Cht 3-P.23)

Ans: Tensile strain is the stretch in a material that occurs from an applied axeal load. It is measured by applying a force (often by dead weight) and measuring the stretch. It is unitless in tabulations, but it really has units of length/length, for example, in/in or mm/mm.

13. What is the principle behind a wire strain sensor (gage)? (Cht 3-P.25)

Ans: When you stretch a round shape like a wire, its diameter decreases as does its cross section area. Electrical resistance is a function of the cross section area of a conductor. So when you stretch a wire, its resistance increases proportionally to its reduction in cross-section. If you glue thin wires to a test specimen in such a fashion that they will stretch when the specimen is loaded, they will change resistance. This can be measured as it is directly proportional to the strain on the specimen.

14. Which of the following is considered to be an electrical conductor? (Cht 3-P.28)

a. Hg
b. Cl
c. Na
d. O
e. N
f. B

15. What makes materials different colors? (Cht 3-P.30)

Ans: Color is caused by the differential absorption, reflections, and emission of white light and these differences are sensed by human vision. Different materials have different abilities to absorb, reflect, and emit electromagnetic radiation in the visible range.

16. What is the difference between electrical conductivity and resistivity? (Cht 3-P.31)

Ans: Resistivity is the reciprocal of conductivity. A high conductivity material or a material with low resistivity will carry more current than material with low conductivity or high resistivity.