Homework Questions for Unit 5

1. Assuming that charge in a polymer semiconductor is transported in a manner that is consistent with the variable range hopping (VRH) model, which of the following describes the change in the mobility of the charge in that polymer semiconductor if the site-to-site distance is increased by a factor of two (assuming all other parameters remain unaffected)?

   a. Increase by a factor of 7
   b. Decrease by a factor of 7
   c. Increase by a factor of 400
   d. Decrease by a factor of 400
   e. Remain unchanged

2. Water shows a Newtonian fluid response in many instances. Assuming that we are operating in this regime with a shear rate of 10 s\(^{-1}\), calculate the shear stress associated with the response.

   a. 0.01 Pa
   b. 0.10 Pa
   c. 1.0 Pa
   d. 10 Pa
   e. 100 Pa

3. The loss modulus of a material that resembles a Maxwell element can be expressed as:

   a) \( \mathcal{G}' = \hat{G}' \frac{\omega}{1 + \omega^2 \tau^2} \)
   b) \( \mathcal{G}' = \hat{G}' \frac{\omega^2 \tau^2}{1 + \omega^2 \tau^2} \)
   c) \( \mathcal{G}'' = \hat{G}'' \frac{\omega}{1 + \omega^2 \tau^2} \)
   d) \( \mathcal{G}'' = \hat{G}'' \frac{\omega^2 \tau^2}{1 + \omega^2 \tau^2} \)
   e) \( \mathcal{G}'' = \hat{G}'' \frac{1}{1 + \omega^2 \tau^2} \)

4. The mobility values of common semiconducting polymers, when they are stretched, depending on the stretching direction.

   a. True
   b. False

5. The tensile modulus of a poly(3-alkylthiophene) (P3AT) with the alkyl side chain length equaling 6, is approximately which of the following values?

   a. 5 MPa
   b. 1 MPa
   c. 5 GPa
   d. 1 GPa
   e. 0.1 GPa
6. The key difference between an organic field-effect transistor (OFET) operation and an organic electrochemical transistor (OECT) operation is which of the following?

   a. The OECT operates with a much shorter channel than an OFET.
   b. There is no gate in an OECT as opposed to an OFET.
   c. Ions modulate the OECT channel current as opposed to electrostatic effects in the OFET.
   d. In OECTs there is an electrolyte that serves as the gate, but there are no OFETs that have electrolyte gating.
   e. Both (c) and (d) are correct.

7. The chemical structure below is the chemical structure for which of the following (select all that apply)?

   ![Chemical Structure Image]

   a. 4,4’-bis(2,2’-diphenylvinyl)-1,1’-biphenyl
   b. Tris(8-hydroxyquinolato) aluminum(III)
   c. (Alq₃)
   d. Bis[2-(4,6-difluorophenyl)pyridinato-C²,N](picolinato)iridium(III)
   e. 4-(dicyanomethylene)-2-tert-butyl-6(1,1,7,7-tetramethyljulolidyl-9-enyl)-4H-pyran