1. Define the following:
   a. Mobile phase
   - **Solvent** moves through **stationary phase** - carries solutes
   b. Stationary phase
   - Particles, gel or film - does not move, retains or slows some solutes more than others
   c. General elution problem
   - Sample mixtures w/ widely varied solute retention. Strong eluent does not separate poorly retained solutes. Weak eluent allows too much broadening. $\Delta$ too much time, $\Delta$ too much elution required to elute.

2. Name 5 things that can lead to band broadening in HPLC:
   a. Solute spends too long on column, requires slow gradient and is not separated.
   b. Solute spends too much time, gets broadened.
   c. Stationary phase interactions kinetically slow or high (aka resistance to mass transfer).
   d. Non-uniform SP particles - col too long.
   e. Overloading of solutes - col too short.
$A = \varepsilon b c = -\log \left( \frac{P}{P_0} \right)$  $T = \frac{1}{P_0}$

3. A 1.000 cm cuvette filled with water (blank) was placed in a spectrophotometer set to 640 nm. The detector signal was 1509 µA. With a sample of 1.06x10$^{-3}$ M sample of magnesium phthalocyanine (MgPC) the detector signal read 1312 µA. What is the molar extinction coefficient of MgPC?

$$b = 1.000 \quad P_0 = 1509 \quad c = 1.06 \times 10^{-3}$$

$$P = 1312$$

$$A = \varepsilon b c = -\log \left( \frac{P}{P_0} \right)$$

$$\varepsilon = \frac{-\log \left( \frac{1312}{1509} \right)}{1.06 \times 10^{-3}}$$

$$\varepsilon = 5.73 \times 10^3 \text{ M}^{-1} \text{ cm}^{-1}$$

4. If the transmittance of a 1.5x10$^{-3}$ M solution of Fe(phen)$_2$Cl$_2$ is 0.95, what is the transmittance of a solution that is 1.5x10$^{-2}$ M?

$$-\log T_1 = \varepsilon b c_1 = A_1 \quad A_2 = A_1 \cdot \frac{c_2}{c_1}$$

$$-\log T_2 = \varepsilon b c_2 = A_2 \quad A_2 = -\log \left( \frac{15 \times 10^{-2}}{15 \times 10^{-3}} \right) \cdot 0.95$$

$$A_2 = 0.22$$

$$\frac{A_2}{A_1} = \frac{\varepsilon b c_2}{\varepsilon b c_1} = \frac{c_2}{c_1}$$

$$T_2 = 0.60$$

5. Circle the correct answer. In comparison to double-beam scanning spectrophotometers, diode array spectrophotometers are:

a. more accurate  

b. much faster  

c. higher resolution  

d. more complex  

e. more expensive