# Homework #6 - Solutions

Released: 12/1/2014 (Mon) - Due: 12/8/2014 (Mon), in class

The homework will NOT be graded, but we will check for MISSING ANSWERS and CHEATING. Note that a cheated homework will get 80% of the lowest score in the class. You can give the answers **either** in English **or** Korean.

1. [Hazardous waste management] Dioxins and dioxin-like compounds include polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs). The backbone structures including carbon numberings for each group of chemicals are shown below:
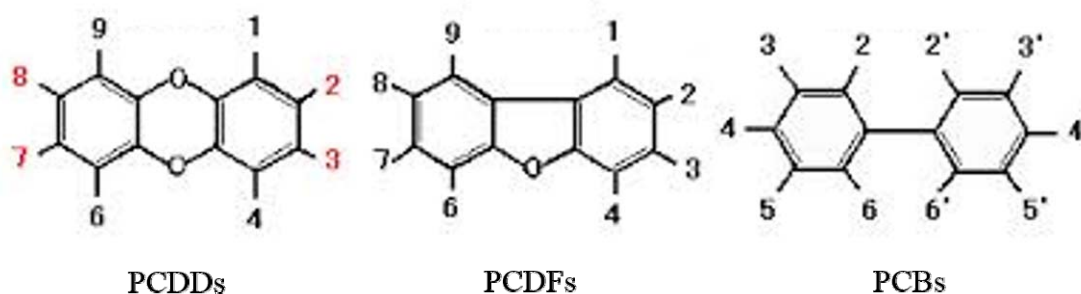
Based on the structure and the carbon numbering, draw the chemical structures of: i) 2,3,7,8-tetrachlorodibenzo-*p*-dioxin, ii) octachlorodibenzo-*p*-dioxin, iii) 2,3,7-trichlorodibenzo-furan, and iv) 2,2',4,5,5'-pentachlorobiphenyl.

Note: mono=1; di=2; tri=3; tetra=4; penta=5; hexa=6; hepta=7; octa=8; nona=9; deca=10

Answer)

i)

ii)

iii)

iv)
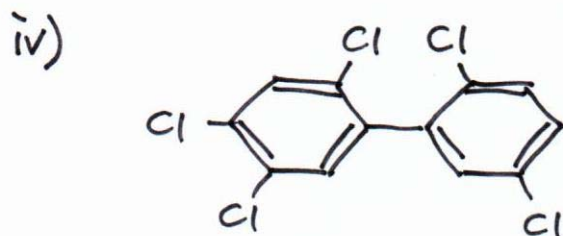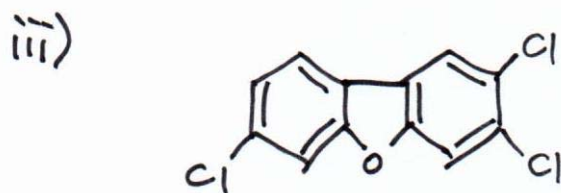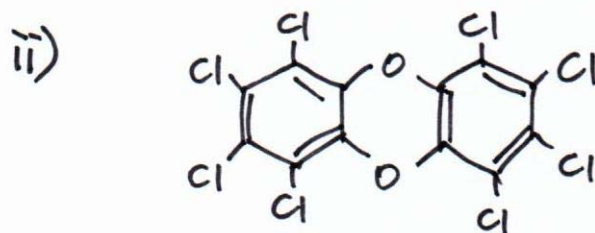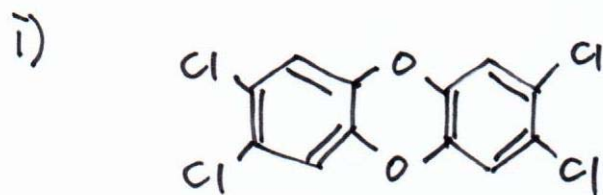
* Note that octachlorodibenzo-p-dioxin is fully saturated with chlorine so that there is no need to specify the carbon numbers for naming this chemical.

2. [Noise pollution] You are annoyed with your neighbor who watches TV around midnight every day with its volume turned up too loud. One night, you obtained a sound meter, set the level as "A", and measured the TV sound from your neighbor for 5 minutes. The result recorded in the sound meter is shown below.
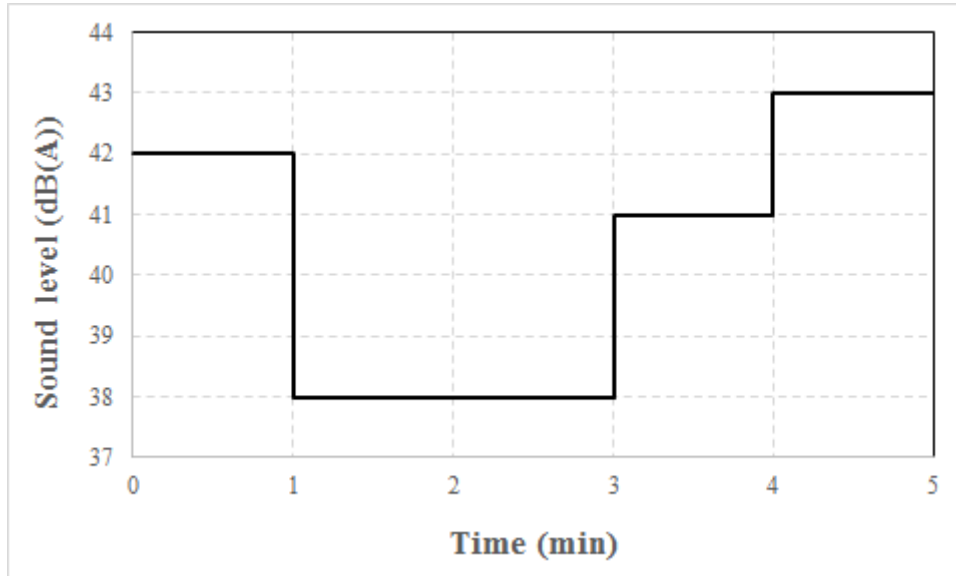
Did your neighbor exceed the Korean regulation level? Calculate the L_{eq} to answer.

Answer)

$$L_{eq} = 10\log_{10}\left[\sum_{i=1}^{n}10^{L_i/10} \cdot t_i\right]$$

$$\sum_{i=1}^{n}10^{L_i/10} \cdot t_i = 10^{42/10} \cdot \frac{1}{5} + 10^{38/10} \cdot \frac{2}{5} + 10^{41/10} \cdot \frac{1}{5} + 10^{43/10} \cdot \frac{1}{5} = 12202$$

$$\therefore L_{eq} = 10\log_{10}12202 = 40.86 \ dB(A)$$

Since the Korean regulation level for <u>nighttime, air-transmitted noise</u> is 40 dB(A) as L_{eq} for 5 min period, <u>your neighbor exceeded the regulation level</u>.

3. [Noise pollution] You went to a music festival and sat right in front of an amplifier. The sound from the amplifier was too loud that you felt uncomfortable and could not enjoy the festival at all. You asked the festival manager to reduce the volume and he said that the audiences at the far end would not be able to hear the sound well if the volume

was reduced. For this situation, answer the following (Neglect any reflection of the sound for calculations):

(i) If you sat 2 m from the amplifier getting the sound pressure level of 80 dB, what will be the sound pressure level for an audience sitting 100 m away from the amplifier?

Answer)

For a point source of sound,

$$L_{p2} = L_{p1} - 10\log_{10}\left(\frac{r_2}{r_1}\right)^2$$

$$L_{p2} = 80 - 10\log_{10}\left(\frac{100\ m}{2\ m}\right)^2 = 46.0\ dB$$

The audience sitting 100 m away got 46 dB as sound pressure level.

(ii) You then asked the manager to move the amplifier 3 m backwards and he accepted your suggestion. Now, you and the audience at the far end are 5 and 103 m away from the amplifier, respectively. How will the sound pressure levels change for you and the audience at the far end?

Answer)

For $r_2 = 5$ m,

$$L_{p2} = 80 - 10\log_{10}\left(\frac{5\ m}{2\ m}\right)^2 = 72.0\ dB$$

For $r_2 = 103$ m,

$$L_{p2} = 80 - 10\log_{10}\left(\frac{103\ m}{2\ m}\right)^2 = 45.8\ dB$$

So, moving the amplifier 3 m backwards looks like a good solution – it reduced the sound you get by 8 dB while not significantly changing the sound pressure level for the audience at the far end.