MULTIPLE CHOICE QUESTIONS   Select the one best answer for each question.
Due Date: Wednesday, July 7, by 8:00 am

1. A mixture of benzene, toluene, and methane was injected into a gas chromatograph. Methane gave a sharp spike at 32.0 s, whereas benzene required 257 s and toluene was eluted in 337 s.
   The adjusted retention times of benzene and toluene are
   a) 289 s and 369 s
   b) 257 s and 337 s
   c) 225 s and 305 s

2. In the above problem, the capacity factors for benzene and toluene are
   a) 9.03 and 11.5
   b) 8.03 and 10.5
   c) 7.03 and 9.53

3. In the above problem, the relative retention of toluene to benzene is
   a) 1.36
   b) 1.27
   c) 2.53

4. In the above problem, if the partition coefficient of benzene is 312 the partition coefficient of toluene
   a) 423
   b) 396
   c) 789

5. The fluid exiting a chromatographic column is called the
   a) eluent
   b) eluate.
   c) analyte

6. Retention time is defined as
   a) the time needed for an individual band of analyte to be eluted.
   b) the time needed for all solutes in a sample to be eluted.
   c) the time needed after injection for an individual solute to be eluted.

7. Listed below are retention times and peak widths for an HPLC chromatographic separation on a 10 cm C18 column. Calculate the capacity factors for pyrene and coronene.
### Table

<table>
<thead>
<tr>
<th>Compound</th>
<th>Time (min)</th>
<th>Baseline Width (min)</th>
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<tbody>
<tr>
<td>Unretained</td>
<td>0.9</td>
<td>—</td>
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<tr>
<td>Benzene</td>
<td>10.9</td>
<td>0.40</td>
</tr>
<tr>
<td>Benzo[e]pyrene</td>
<td>13.3</td>
<td>0.40</td>
</tr>
<tr>
<td>Pyrene</td>
<td>16.7</td>
<td>0.45</td>
</tr>
<tr>
<td>Coronene</td>
<td>26.1</td>
<td>0.50</td>
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a) Pyrene $k' = 35.1$ and coronene $k' = 50.4$

b) Pyrene $k' = 17.6$ and coronene $k' = 28.0$

c) Pyrene $k' = 18.6$ and coronene $k' = 29.0$

8. Listed below are retention times and peak widths for an HPLC chromatographic separation on a 10 cm C18 column. Calculate the theoretical number of plates for benzo[e]pyrene.

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a) 532  
b) 15,376  
c) 17,689

9. A peak with a retention time of 407 s shows a poorly resolved second peak which appeared 10 s after it. The calculated resolution was 0.74. The first peak had a width of 16 s. The width of the second peak is

a) 11 s  
b) 22 s  
c) 3 s

10. HPLC stands for

a) High Pressure or High Performance Liquid Chromatography  
b) High Priority Liquid Chromatography  
c) Highly Placed Liquid Chromatography
11. Normal-phase liquid chromatography refers to
   a) the use of a nonpolar solvent as the eluent in HPLC.
   b) the use of a polar material as the stationary phase in a chromatographic column.
   c) the use of a nonpolar material as the stationary phase in a chromatographic column.

12. Two nonpolar aromatic compounds could be hardly separated by HPLC on an octadecyl (C18) bonded phase using 90 vol% methanol in water. If 65% methanol were used
   a) Both will come out fast because the solvent is polar.
   b) The overall polarity of the eluent is increased and therefore their separation will increase compared to 90% methanol.
   c) The two compounds will never come out off the column.

13. Octanoic acid (CH₃CH₂CH₂CH₂CH₂CH₂COOH) and 1-aminooctane (CH₃CH₂CH₂CH₂CH₂CH₂CH₂NH₂) were passed through an octadecyl (C₁₈) bonded phase column, using an eluent of 20 % methanol/80% buffer (pH 3.0). Mark is the correct statement
   a) Being polar, octanoic acid will be retained more in the column and will come out after 1-aminooctane.
   b) Being nonpolar, 1-aminooctane will be retained more in the column and will come out after octanoic acid.
   c) At pH 3.0, octanoic acid will not dissociate and act as nonpolar molecule, while 1-aminooctane being protonated will act as a polar molecule and therefore will come out first.
   d) The column will be unable to distinguish the two chemicals and both will come out roughly at the same time.

14. A 10.5 cm column with an inner diameter 4.7 mm is packed with a stationary phase that occupies a 64% volume. The void volume is
   a) 0.66 cm³.
   b) 1.83 cm³.
   c) 1.17 cm³.

15. To improve a chromatographic separation, you must
   a) increase the number of theoretical plates on the column.
   b) increase the height of the theoretical plates on the column.
   c) increase both the number and the height of the theoretical plates on the column.

**ANSWER LIST – List your answers here**

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