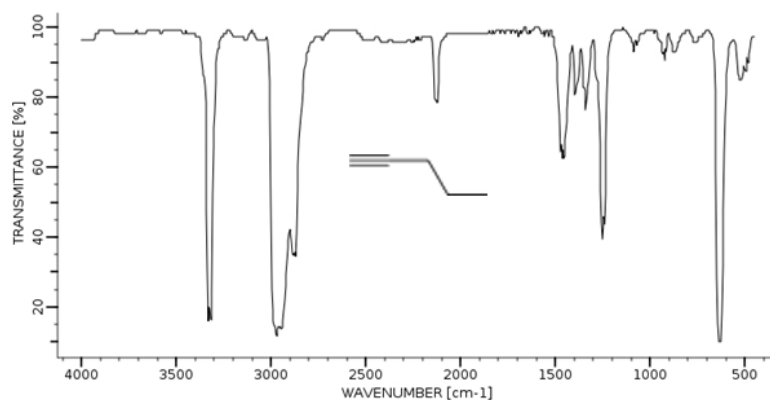
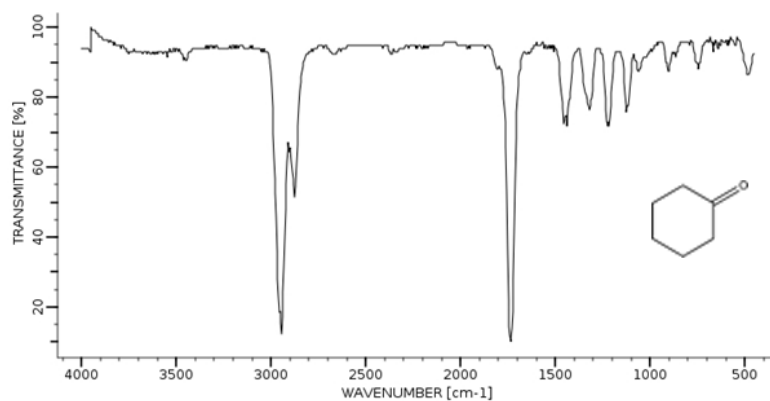
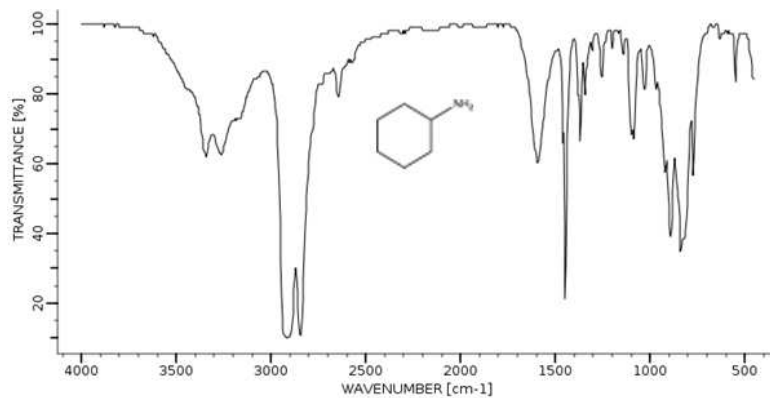
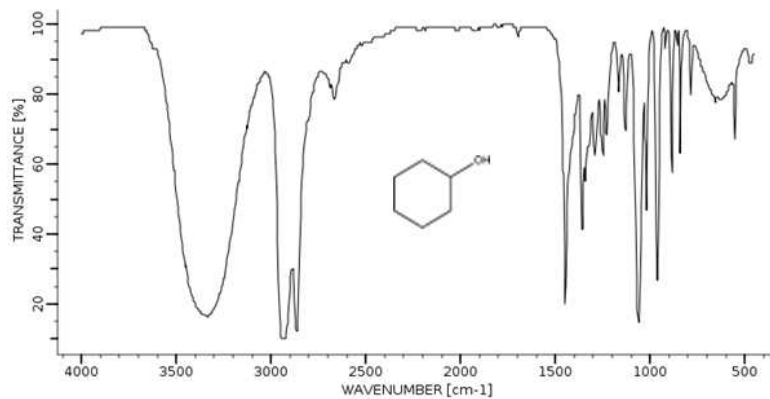


## CHEM1002 Worksheet 4 – Answers to Critical Thinking Questions

The worksheets are available in the tutorials and form an integral part of the learning outcomes and experience for this unit.

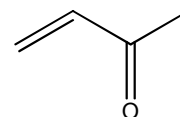
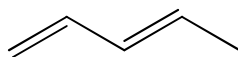
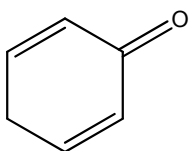
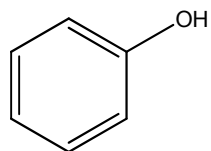
### Model 1: Infrared (IR) Spectroscopy

1. See below.



## Model 2: UV-Visible Spectroscopy

1. See below.

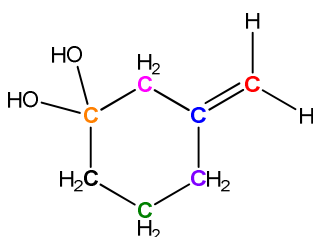
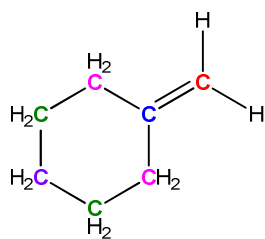


2. All of the above.

3. Restricted to the identification of conjugation.

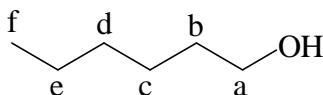
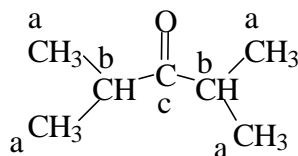
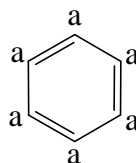
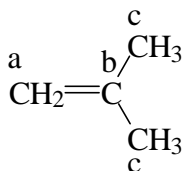
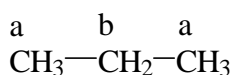
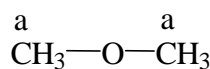
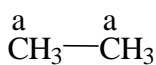
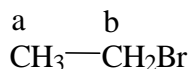
## Model 3: $^{13}\text{C}$ NMR Spectroscopy – Number of Signals

1. The molecule on the left has 5 types of C atom and the molecule on the right has 7 types of C atom\*.



2. The molecule on the left will give 5 signals and the molecule on the right will give 7 signals.

3. See below.



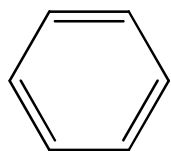
4. (a) 1    (b) 1    (c) 2    (d) 2    (e) 2    (f) 3    (g) 4  
 (h) 6    (i) 4    (j) 1    (k) 2    (l) 2    (m) 4    (n) 1  
 (o) 4    (p) 26

## Model 4: $^{13}\text{C}$ NMR Spectroscopy – Chemical Shifts

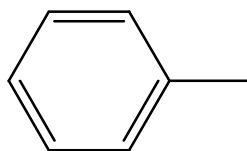
1. (a) 205 ppm    (b) 32 ppm

\* The ring in these two molecules is not planar. You might like to re-consider these answers taking into account the 3D structure

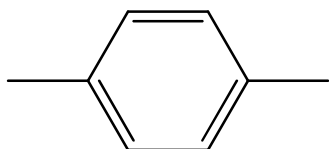
2. See below



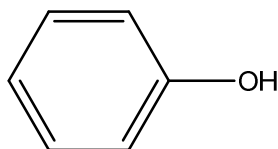
1 signal – between 120 – 150 ppm due to aromatic C.



5 signals – one between 0 – 30 ppm (-CH<sub>3</sub>) and four between 120 – 150 ppm (aromatic C).



3 signals – one at between 0 – 30 ppm (-CH<sub>3</sub>) and two between 120 – 150 ppm (aromatic C).



4 signals – all between 120 – 150 ppm (aromatic C)

3. See below.

