Spectroscopy Scrabble

This game is designed to test students’ knowledge for predicting the spectra of molecules.

Each game set consists of the following:

-A game board

-2048 tiles

--There are 256 hydrogen, carbon, oxygen, nitrogen, halogen, single bond and double bond tiles. --There are 192 triple bond and 64 blank (wild) tiles

-32 cards

-One six-sided die

Students will draw 20 tiles from the bag and any leftover tiles will be a “pool”. .

The player with the highest die roll goes first and play continues to the left. A student may use a turn to exchange tiles from the pool without playing (exchanged tiles are removed from the game). If a student is unable to play and there are no available tiles leftover in the pool, the student will have to “pass” and the game moves to the next student.

**Game play:**

-Player draws/replenishes up to 20 tiles at the beginning of their turn.

-Player rolls the die and places up to that number of tiles +2 to form a molecule (3-8 tiles). Hydrogen tiles are mainly used for showing OH and NH bonds. Players can make C-H bonds but carbon-carbon chains can be lengthy, so molecules created are considered to have skeletal structure (with carbons shown) meaning that hydrogens are implied to be on carbons without hydrogen or other attachments only. The first molecule must be played in the center of the board. Bond tiles may be placed at an angle to help make cyclic structures.

-Players may branch off any point (if room is available) or override sections on the existing molecule as long as these changes make sense. Hydrogens would not double bond with anything; halogens would not override an α-carbon next to a β-carbon, etc. Branching may also occur within the tiles being placed. Example: molecule – CBr3

-Blank (wild) tiles may be used as any tile including making sections of a molecule disappear similar to whiteout. Example: A blank tile may be used to override a bond and break up a cyclic section or a long chain into two molecules.

-After placing/changing the molecule, the player draws a card from the top of the deck. In order to receive full points for the tiles placed, the player must correctly predict the majority of all major peaks pertaining to the spectrum(a) listed on the card. Specific cards are listed in the cards/scoring section after this game turn section.

-The first molecule player must predict the entire spectrum(a) for the molecule played, other players predict the appearance and disappearance of spectrum(a) peaks for the branching/ overridden sections.

-The card drawn is placed in a discard pile for reshuffling when all cards are used.

-Play moves to the next person on the left and continues until a predetermined number of rounds, time or points have been reached.

**Cards / Scoring:**

-1 point: Hydrogen, Single bond, Double bond and Blank (wild) tiles

-2 points: Carbon, Oxygen, and Triple bond tiles

-3 points: Nitrogen and Halogen tiles

-Players receive 25% of the points for incorrect predictions for each spectrum (min. 1 point). Implicit hydrogens not shown and tiles that override the same atom are worth no points.

-The different types of cards out of the 32 card deck are given below:

-8 Cards with a single spec: MS, IR, H NMR, and C13 NMR (two of each).

-12 Cards with 2 specs: Combination of two of them (two of each). This is considered the double word score. Players receive points separately for each spectrum for a maximum total of double the tile points.

-6 Cards with 3 specs: Combination of three of them (two of each). This is considered the triple word score. Players receive points separately for each spectrum for a maximum total of triple the tile points.

-1 Card with no spec required: No spectroscopy predictions are required and the player receives full points.

-1 Card with all spec required: All four spectra are required; player does not receive extra points for each spectrum for a maximum total of the tile points.

-Cards with polymerization (spec): Polymerized spectra are difficult to interpret and not required at this point in time. Player predicts the branched/overridden spectrum as usual and has the option of doing the entire molecule for separate bonus points. The spectrum for the molecule bonus option must be predicted prior to rolling the die. The bonus points rewarded for a correct spectrum is a die roll \* 5 (for +5 to +30 pts). Incorrect bonus spectra still receive 25%

--Polymerization (with or without the attempted bonus) results in the removal of the entire molecule from the board and the next player places a new first molecule. Tiles polymerized are removed from the game. There are a total of 4 polymerization cards, one for each type of spectroscopy.

**Spectra predictions:**

*-Mass spec should answer the following questions:*

--What is the m/z value of M+ for the whole molecule and does the nitrogen rule take effect?

--What are the m/z values and signal heights of M+2/+4/etc. (if applicable)?

--What are the m/z values and structures of main peaks appearing / disappearing and what are the groups lost if this section is removed?

*-IR spec should answer the following questions:*

--What are the approximate wavenumbers along with the specific functional groups for appearing and disappearing peaks. Note: carbonyl is too general, ketone is more specific and only halogens are required in the fingerprint region.

*-H NMR spec should answer the following questions:*

--What are the splitting, type and integration of hydrogens appearing and disappearing?

*-C13 NMR should answer the following questions:*

--What are the splitting, type and integration of carbons appearing and disappearing?

-Spectra data tables are available on Blackboard and should only be used to check answers.