Hydrogen Bonding

New Regents original practice • Name: _____ Date: _____
Show your work for written answers.

In these examples, a hydrogen-bond donor has H covalently bonded to O, N, or F. An acceptor has an available lone pair on an electronegative atom.

1 Which attraction between two water molecules represents a hydrogen bond?

(1) Between the O atom and an H atom within one molecule

(2) Between an O atom of one molecule and an H atom bonded to O in another molecule

(3) Between two H atoms in one molecule

(4) Between two protons in an O nucleus

2 Explain why methane, CH_4, lacks the donor needed to form hydrogen bonds with other methane molecules. [1]

Answer and work

_____

_____

3 As water boils, which attractions are overcome to separate the molecules?

(1) The covalent O–H bonds within each molecule

(2) The forces holding each oxygen nucleus together

(3) Attractions between different water molecules

(4) The bonds between hydrogen atoms within each molecule

4 Dimethyl ether has the structure CH_3–O–CH_3. Explain how its oxygen can accept a hydrogen bond from a water molecule. [1]

Answer and work

_____

_____

Same Formula, Different Boiling Points

Use the information below to answer the questions.

Ethanol and dimethyl ether both have molecular formula C_2H_6O. The table shows their structures and approximate normal boiling points.

Substance	**Structural formula**	**Boiling point (°C)**
Ethanol	$CH_3–CH_2–OH$	78
Dimethyl ether	$CH_3–O–CH_3$	−25

5 Which substance can form hydrogen bonds between its own molecules?

(1) Ethanol only

(2) Dimethyl ether only

(3) Both substances

(4) Neither substance

6 Use the structures and boiling points to support the claim that ethanol molecules experience stronger intermolecular attractions than dimethyl ether molecules. [1]

Answer and work

7 How many degrees Celsius higher is ethanol’s normal boiling point in the table? Show your calculation. [1]

Answer and work

8 Which feature is the same for both substances because they share a molecular formula?

(1) Boiling point

(2) Ability to donate a hydrogen bond

(3) Molar mass

(4) Order in which the atoms are joined