

Multiple Choice [3 points each]. Choose the **best** answer and record it on your Scantron card.

1 Mark **both B and D** on your Scantron card. (This item is a form identifier and will not be scored.)

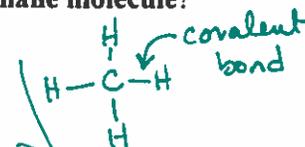
2 Which statement below best describes a bond between N and O?

- A N and O form an ionic bond, with charges N^{3-} and O^{2-} .
 B N and O form an ionic bond, with charges N^{5+} and O^{2-} .
 C N and O form a covalent bond, in which both atoms have neutral charge.
 D N and O form a covalent bond, in which N has a $\delta+$ charge.
 E N and O form a covalent bond, in which O has a $\delta+$ charge.

both nonmetals \rightarrow covalent
 O is more electronegative than N
 δ^- δ^+
 O - N

3 Which option best describes the attraction between the C and H atoms in a single methane molecule?

- A covalent bond B ionic bond C dispersion forces
 D hydrogen bonding E both dispersion forces and hydrogen bonding



4 Which option best describes the attraction between two separate methane molecules?

- A covalent bond B ionic bond C dispersion forces
 D hydrogen bonding E both dispersion forces and hydrogen bonding

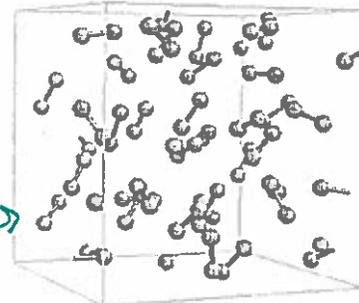


5 The sample pictured is best classified as:

- A an element.
 B a covalent/molecular compound.
 C an ionic compound.
 D a mixture.

all atoms alike \rightarrow

molecules close together but not ordered \rightarrow



6 The state or phase of the sample shown is best classified as:

- A solid. B liquid. C gas. D aqueous.

The next few questions refer to the following atoms or elements:

- A H B C C N D O E S

7 Which element's atoms typically form three bonds and a lone pair? C

8 Which element does not form monatomic ions? B

9 Which element has the highest electronegativity? D

10 Which element has about the same electronegativity as Cl? C



11 Which element can form both a +1 and a -1 ion? A

**12 Intravenous sodium lactate contains 1.72 % (w/v) sodium lactate in water. If you have $\frac{V_1}{C_1}$ of 100 mL of 5.00 % (w/v) sodium lactate, and you need to dilute it to 1.72 %, what must the final volume be? (Problem 5.63 in text)

- A 0.00344 mL B 2.91 mL C 8.6 mL D 34.4 mL E 291 mL

$$V_2 = \frac{C_1 V_1}{C_2} = \frac{(100 \text{ mL})(5.00\%)}{1.72\%}$$

**13 A solution is prepared by dissolving 2.31 g of sucrose in enough water to make 25.0 mL of solution. Calculate the percent concentration of this solution. (Problem 5.3 in text)

- A 0.0924 % B 0.578 % C 8.46 % D 9.24 % E 10.8 %

$$\frac{2.31 \text{ g}}{25.0 \text{ mL}} \times 100 = 9.24\% \text{ (w/v)}$$

14 The "amp" or ampere is a unit of electrical current (equivalent to one coulomb per second). A typical cell phone charger draws approximately 80 milliamps. What is this value in amps?

- A 0.000080 amps B 0.080 amps C 80 amps D 8000 amps E 80,000 amps

$$80 \text{ mA} \times \frac{1 \text{ A}}{1000 \text{ mA}} = 0.080 \text{ A}$$

15 Which of the following sets of values could apply to a substance that is a gas at room temperature?

| | melting point | boiling point |
|---|---------------|---------------|
| A | -23 °C | 77 °C |
| B | -20 °C | 0 °C |
| C | 35 °C | 150 °C |
| D | 37 °C | 150 °C |
| E | 77 °C | 0 °C |

↑ 20-25 °C
over boiling point

← boiling point is below room temp

16 Consider the same options from the previous question. Which set of melting and boiling point temperatures is actually impossible for any substance?

| | melting point | boiling point |
|---|---------------|---------------|
| A | -23 °C | 77 °C |
| B | -20 °C | 0 °C |
| C | 35 °C | 150 °C |
| D | 37 °C | 150 °C |
| E | 77 °C | 0 °C |

boiling point can't be lower than melting point

17 Which statement best describes what happens when MgCl_2 is mixed with water?

- A MgCl_2 is insoluble (does not dissolve).
 B MgCl_2 molecules disperse into the solution and mix with water molecules.
 C MgCl_2 dissociates into Mg^{2+} and Cl^- .
 D MgCl_2 dissociates into Mg and Cl_2 .
 E MgCl_2 dissociates into Mg^{2+} and Cl_2 .

soluble ionic compound - will dissociate into ions

18 Which of the following ionic compounds is likely to be soluble in water?

- A BaSO_4 B K_3PO_4 C MgCO_3 D AgBr E FeS

compounds of K^+ are always soluble

19 Convert 0.250 mol of NaOH into grams.

A 0.00625 g

B 0.250 g

C 1.00 g

D 10.0 g

E 40.0 g



$$0.250 \text{ mol} \times \frac{40.00 \text{ g}}{\text{mol}} = 10.0 \text{ g}$$

The next few descriptions refer to the following substances. Choose the option that best fits each description:

A sodium hydroxide, NaOH

B methanol, CH₃OH

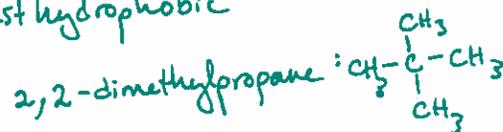
C ethane

D 2-octene

E more than one of these, or none of these

20 An ionic compound *A only*21 A molecular compound with hydrogen bonding interactions between its molecules *B only*22 An alcohol *B only*23 An organic compound that is not a hydrocarbon *B*
contains C & H *must have other elements too*24 An electrolyte *A*25 A solid at room temperature *A*

The next few questions refer to the following substances.

A ethanol, CH₃-CH₂-O-HB propane *CH₃-CH₂-CH₃*C 1-hexanol, CH₃-CH₂-CH₂-CH₂-CH₂-O-HD pentane *CH₃-CH₂-CH₂-CH₂-CH₃*26 Which substance has the strongest dispersion forces? *C is the biggest molecule.*27 Which substance has the highest boiling point? *C has strongest dispersion forces + hydrogen bonding*28 Which substance is most soluble in water? *A most hydrophilic, least hydrophobic*29 Which substance is an isomer of 2,2-dimethylpropane? *D*30 Which substance has the weakest total attractions? *B small, no H-bonding*31 Which substance is a gas at room temperature? *B hydrocarbon with 1-4 C*

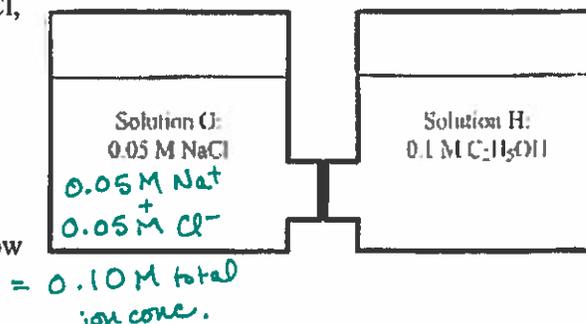
32 **Skip** the rest of the spaces on the front of your Scantron card. You will start the next section with Item #51 on the back of your Scantron card.

Turn your Scantron card over and answer the remaining questions starting with #51. The true-false questions on this page earn 1 point for each correct answer.

Consider the osmosis apparatus shown. Solution G is 0.05 M NaCl, and Solution H is 0.10 M ethanol, C_2H_5OH .

The two tanks containing solutions G and H are separated by a semipermeable membrane that allows both ions and molecular compounds to pass.

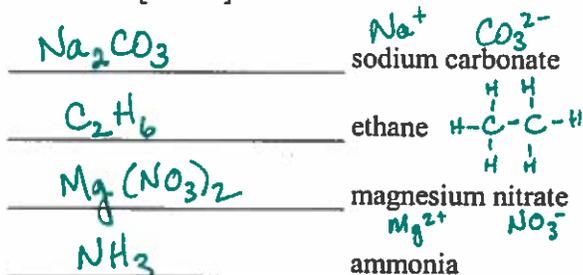
On your Scantron card, record whether each of the statements below is TRUE or FALSE as follows:



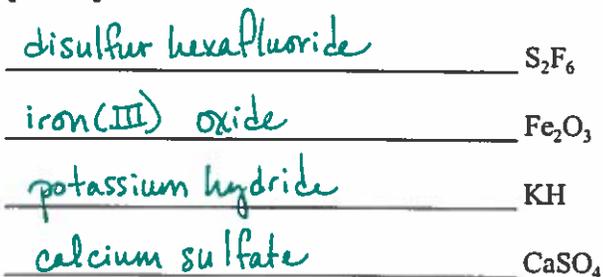
A TRUE B FALSE

- 51 At the beginning of the experiment, osmosis does not occur. *True - total conc is same in both.*
- 52 At the start of the experiment, Solution G conducts electricity, but Solution H does not. *True - NaCl is an electrolyte, C₂H₅OH is not*
- 53 As the experiment progresses, the level of the solution on the left will increase. *False*
- 54 Sodium chloride dialyzes from Solution G to Solution H. *True - ions can pass*
- 55 Ethanol, C_2H_5OH , dialyzes from Solution H to Solution G. *True - molecular compounds can pass*
- 56 Over time, both solutions will come to have the same composition. *True*

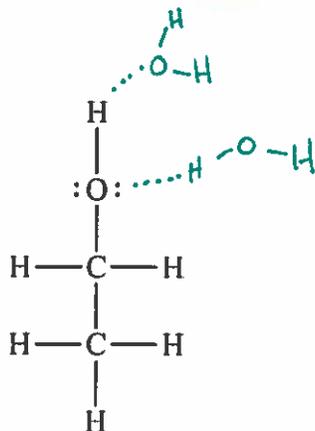
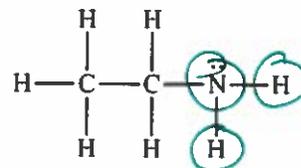
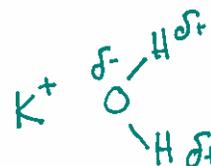
(MC score _____ FR score _____ Total raw _____ total % _____)

Free-Response ANSWER SHEET. Write your answers in the spaces provided.1. Give the correct **chemical formula** for each substance. [2 each]2. Give a correct **systematic name** for each formula.

[2 each]



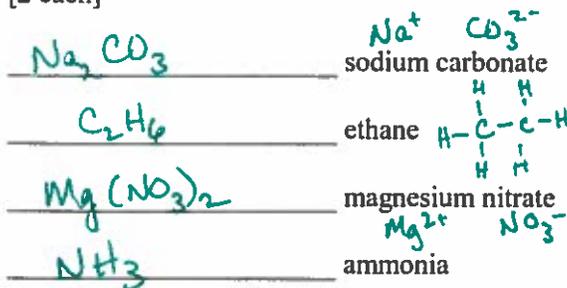
3. [6 pts] Sketch a hydrogen bonding interaction of the molecule below with a molecule of water.

Only one interaction needed.4. [6 pts] In the molecule shown below, **circle all atoms that can participate in hydrogen bonding.**5. [3 pts] Sketch the interaction of a **potassium ion** with a water molecule. Represent charges accurately in the ion and in the water molecule.

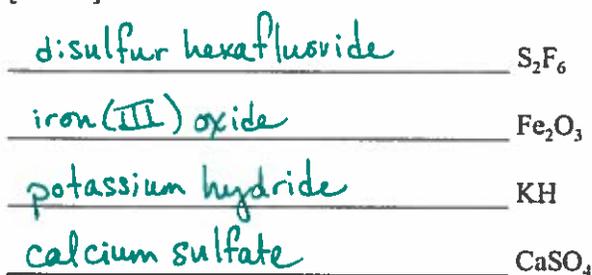
(MC score _____ FR score _____ Total raw _____ total % _____)

Free-Response ANSWER SHEET. Write your answers in the spaces provided.1. Give the correct **chemical formula** for each substance.

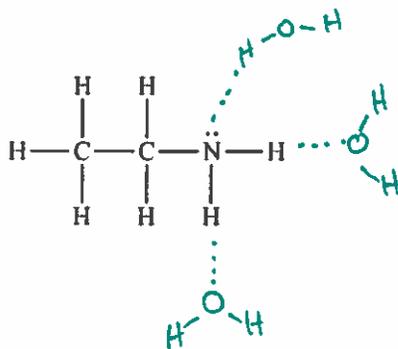
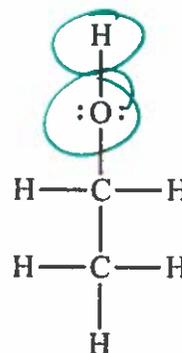
[2 each]

2. Give a correct **systematic name** for each formula.

[2 each]



3. [6 pts] Sketch a hydrogen bonding interaction of the molecule below with a molecule of water.

only one interaction needed.4. [6 pts] In the molecule shown below, **circle all atoms that can participate in hydrogen bonding.**5. [3 pts] Sketch the interaction of a **potassium ion** with a water molecule. Represent charges accurately in the ion and in the water molecule.