

DO NOT OPEN THE EXAM UNTIL YOU ARE TOLD TO DO SO.

In the meantime, read this...

You will write all of your answers on the answer sheets, on the next two pages. At the end of the exam, turn in **your entire test booklet, with Answer Sheet, and your Scantron card.**

 Write your name:

-  on every PAGE of the exam (both sides of every sheet), and
-  on the Scantron card.

You may use your calculator and a pen or pencil. Please do not use green or red. Please use a pencil on the Scantron card; ink does not score reliably.

Problems marked ** come straight from the assigned homework or from worksheets in class.

Put all notes, books, etc away and out of sight. Turn off the ringers of electronic devices and put them away and out of sight. **Electronic devices (other than calculators) must be silenced and put away. Use of calculator functions on communication devices is not permitted. Sharing calculators is not permitted.** Points will be deducted for electronic devices in view or making noise, and devices will be confiscated.

No outside paper is allowed. If you need more scratch paper, ask one of the proctors.

Strategy hint: take a quick look over the whole exam before you start. If you see something that looks easy for you, go for it! It's good to get a few points in the bag right away.

Strategy hints for multiple choice:

- when you have determined that an option is not correct, mark it off so you don't have to check it again!
- even if you think you have found the right answer, look at the remaining answers to see if any of them are a better match.
- on calculation problems, show your work somewhere on the page. Even if you miss the problem, it certainly will be easier to see later where mistakes were made.

Looking at another student's work, intentionally or accidentally, will not be tolerated. Students who seem to have trouble keeping their eyes on their own papers will be moved to the front of the room. Students who cheat earn a failing grade.

DO NOT OPEN THE EXAM UNTIL YOU ARE TOLD TO DO SO.

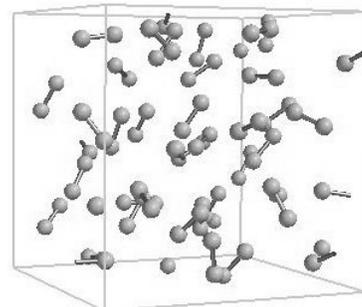
Check back over your exam and make sure you have completed all parts before turning in your paper!

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

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

2 The sample pictured is best classified as:

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



3 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

4 Which element has the highest electronegativity?

5 Which element has about the same electronegativity as Cl?

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

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

8 Which element does not form monatomic ions?

9 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 δ^+ charge.
- E N and O form a covalent bond, in which O has a δ^+ charge.

10 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

11 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

12 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	37 °C	150°C
C	77 °C	0 °C
D	-20 °C	0 °C
E	35 °C	150°C

13 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	37 °C	150°C
C	77 °C	0 °C
D	-20 °C	0 °C
E	35 °C	150°C

14 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 .

15 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

16 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 0.000 080 amps B 0.080 amps C 80 amps D 8000 amps E 80,000 amps

**17 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 %

**18 Intravenous sodium lactate contains 1.72 % (w/v) sodium lactate in water. If you have 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

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

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

- A ethane B 2-octene C methanol, CH₃OH
D sodium hydroxide, NaOH E more than one of these, or none of these

20 An ionic compound

21 A molecular compound with hydrogen bonding interactions between its molecules

22 An alcohol

23 An organic compound that is not a hydrocarbon

24 An electrolyte

25 A solid at room temperature

The next few questions refer to the following substances.

- A propane B ethanol, CH₃-CH₂-O-H
C pentane D 1-hexanol, CH₃-CH₂-CH₂-CH₂-CH₂-O-H

26 Which substance has the strongest dispersion forces?

27 Which substance has the highest boiling point?

28 Which substance is most soluble in water?

29 Which substance is an isomer of 2,2-dimethylpropane?

30 Which substance has the weakest total attractions?

31 Which substance is a gas at room temperature?

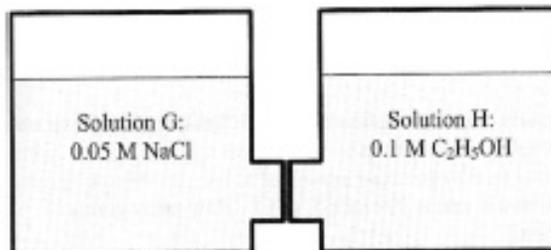
32 **Skip** the rest of the spaces on the front of your Scantron card. You will start the next section with Item #51 on the back of your Scantron card.

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, C₂H₅OH.

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.
- 52 Sodium chloride dialyzes from Solution G to Solution H.
- 53 Ethanol, C₂H₅OH, dialyzes from Solution H to Solution G.
- 54 Over time, both solutions will come to have the same composition.
- 55 As the experiment progresses, the level of the solution on the left will increase.
- 56 At the start of the experiment, Solution G conducts electricity, but Solution H does not.

(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]

_____ sodium carbonate

_____ ethane

_____ magnesium nitrate

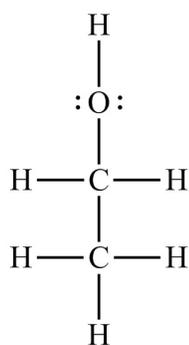
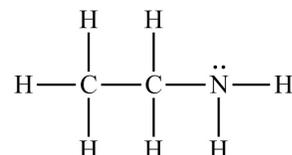
_____ ammonia

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

[2 each]

_____ S_2F_6 _____ Fe_2O_3 _____ KH _____ $CaSO_4$

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

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.