

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

In the meantime, read this...

- Write your answers to Free-Response questions directly on the “Free-Response Answer Sheet.” Record your answers to multiple-choice questions on the Scantron card provided.
- 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, and
-  on the Scantron card.

Exams will be taken apart for processing, so it is important that you have your name on **every page**.

You may use your calculator, pens, and pencils. Please do not use green or red. Any other aids are prohibited.

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.

Problems marked ** are taken directly from the homework problems in the Text or in-class worksheets.

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! 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, you will be able to see later where mistakes happened.

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.

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

Periodic Table of the Elements

1A		2A												3A	4A	5A	6A	7A	8A						
1 H 1.008																		1 H 1.008	2 He 4.003						
3 Li 6.941	4 Be 9.012												5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00		9 F 19.00	10 Ne 20.18						
11 Na 22.99	12 Mg 24.31												13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06		17 Cl 35.45	18 Ar 39.95						
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96		35 Br 79.90	36 Kr 83.80							
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc [98]	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6		53 I 126.9	54 Xe 131.3							
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po [209]		85 At [210]	86 Rn [222]							
87 Fr [223]	88 Ra [226]	89 Ac [227]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [277]	109 Mt [268]	110 Ds [281]	111 Rg [272]	112 [285]	113 [284]	114 [289]	115 [288]	116 [292]										
		Lanthanides										58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm [145]	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
		Actinides										90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]	103 Lr [262]

You may remove this page and use it as scratch paper and a cover sheet. If you need more scratch paper, you may get it from the proctor.

Potentially useful information:

$$C_1V_1 = C_2V_2$$

$$1\% \text{ w/v} = 1\text{g}/100 \text{ mL} = 1 \text{ g/dL}$$

$$1\% \text{ v/v} = 1 \text{ mL}/100 \text{ mL} = 1 \text{ mL/dL}$$

$$1 \text{ ppm} = 1 \mu\text{g/mL}$$

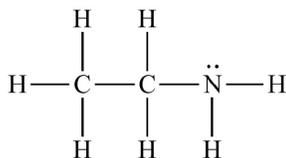
$$1 \text{ ppb} = 1 \text{ ng/mL}$$

$$1 \text{ mole} = 6.022 \times 10^{23}$$

Free-Response ANSWER SHEET

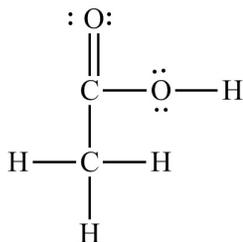
(MC score _____ FR score _____ Total raw _____ total % _____)

1. [6 pts] Sketch a hydrogen bonding interaction of the molecule below with a molecule of water.

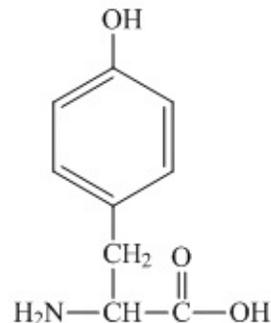


3. [3 pts] In the space below, sketch the interaction of a **chloride ion** with a water molecule. Represent charges accurately in the ion and in the water molecule.

2. [7 pts] In the molecule shown below, **circle all atoms that can participate in hydrogen bonding.**



4. [8 pts] The molecule shown below is an amino acid, a component of proteins. **Circle and name all functional groups** in this molecule.



5. [10 pts] Write a balanced equation, with **appropriate** phase labels, for the **combustion of ethane**.

(reminder--did you include phase labels?)

6. ******[8 pts] Write a balanced equation, with **appropriate** phase labels, for the following reaction:
Aluminum metal reacts with oxygen gas to form aluminum oxide

(reminder--did you include phase labels?)

Free-Response ANSWER SHEET

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

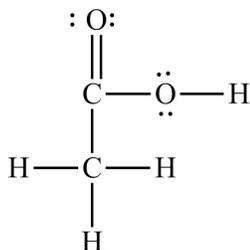
1. **[8 pts] Write a balanced equation, with **appropriate** phase labels, for the following reaction:
Aluminum metal reacts with oxygen gas to form aluminum oxide

(reminder--did you include phase labels?)

2. [10 pts] Write a balanced equation, with **appropriate** phase labels, for the **combustion of butane**.

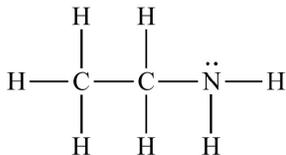
(reminder--did you include phase labels?)

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

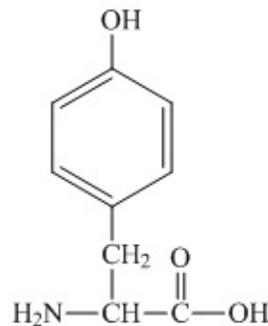


5. [3 pts] In the space below, sketch the interaction of a **sodium ion** with a water molecule. Represent charges accurately in the ion and in the water molecule.

4. [7 pts] In the molecule shown below, **circle all atoms that can participate in hydrogen bonding.**



6. [8 pts] The molecule shown below is an amino acid, a component of proteins. **Circle and name all functional groups** in this molecule.



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

- 1 Mark **A** on the Scantron card. (This item is a form identifier and will not be scored.)
- 2 Which option best describes the attraction **between the N and H atoms in a single ammonia molecule**?
A covalent bond B ionic bond C dispersion forces
D hydrogen bonding E both dispersion forces and hydrogen bonding
- 3 Which option best describes the attraction **between two separate ammonia molecules**?
A covalent bond B ionic bond C dispersion forces
D hydrogen bonding E both dispersion forces and hydrogen bonding

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

- A ethane B octane C methanol, CH₃OH
D 1-octanol, CH₃CH₂CH₂CH₂CH₂CH₂CH₂CH₂OH E more than one of these, or none of these
- 4 Which compound is expected to have the strongest dispersion forces?
 - 5 Which compound is expected to have the strongest total attractions between molecules?
 - 6 Which compound has the lowest boiling point?
 - 7 Which compound is a gas at room temperature?
 - 8 Which substance is likely to be most soluble in water?
 - 9 Which compound, as a pure substance, has hydrogen bonds between its molecules?
 - 10 Which of the following ionic compounds is likely to be **insoluble** in water?
A Na₂SO₄ B K₃PO₄ C Ca(NO₃)₂ D LiCl E FeCO₃

11 **Calcium chloride** dissolves in water. Which statement best describes how calcium chloride behaves when it dissolves in water?

- A The calcium chloride molecules have dispersion force interactions with the water molecules.
B The calcium chloride molecules form hydrogen-bonding interactions with the water molecules.
C Calcium chloride dissociates into Ca atoms and Cl atoms.
D Calcium chloride dissociates into Ca atoms and Cl₂ molecules.
E Calcium chloride dissociates into Ca²⁺ ions and Cl⁻ ions.

12 ******Which of these is the best representation of the formula of **magnesium phosphate**?

- A MgP B Mg₃P₂ C Mg₂P D MgPO₄ E Mg₃(PO₄)₂

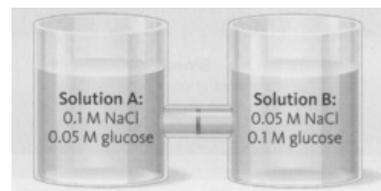
13 ******If some magnesium phosphate is placed in water, which of these is the most appropriate phase label for the magnesium phosphate in the resulting mixture?

- A (s) B (l) C (g) D (aq)

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

Consider the osmosis apparatus shown. Solution A is 0.10 M NaCl + 0.05 M glucose, $C_6H_{12}O_6$. Solution B is 0.05 M NaCl + 0.10 M glucose.

The two tanks containing solutions A and B are separated by a semipermeable membrane that allows molecular compounds to pass, but not ions.



14 What is the concentration of **chloride ions** in Solution A?

- A 0.025 M B 0.05 M C 0.10 M D 0.15 M E 0.20 M

15 Before the experiment begins, the two solutions are tested for electrical conductivity. Which statement best predicts the result of this test?

- A Both solutions are electrically conductive. B Solution A conducts electricity, but solution B does not.
C Solution B conducts electricity, but solution A does not. D Neither solution conducts electricity.

16 What **mass** of NaCl is required to make 1.0 L of 0.10 M NaCl?

- A 0.10 g B 1.0 g C 5.8 g D 58 g E 100 g

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

- A TRUE B FALSE

17 At the beginning of the experiment, osmosis does not occur.

18 Sodium chloride dialyzes from Solution A to Solution B.

19 Glucose, $C_6H_{12}O_6$, dialyzes from Solution B to Solution A.

20 Over time, the concentration of solute in Solution A will increase.

21 As the experiment progresses, the level of the solution on the left will increase.

22 Blood plasma has a total solute concentration of about 0.28 M. Which of the following solutions is **hypertonic in comparison with blood plasma? (Problem 5.35 in text)

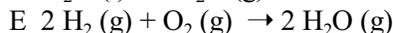
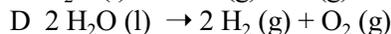
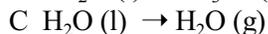
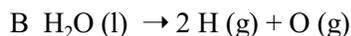
- A 0.14 M lactose ($C_{12}H_{22}O_{11}$) B 0.14 M potassium chloride
C 0.14 M magnesium chloride
D more than one of these E none of these

**23 In which of the solutions listed in Problem #22 will a cell be able to keep its proper shape, without undergoing crenation or hemolysis? (Problem 5.37 in text)

**24 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)

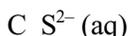
- A 0.00344 mL B 2.91 mL C 8.6 mL D 34.4 mL E 291 mL

25 Which of the following represents a **physical** change, rather than a chemical reaction?



26 Which reaction in #25 represents a **combustion** reaction?

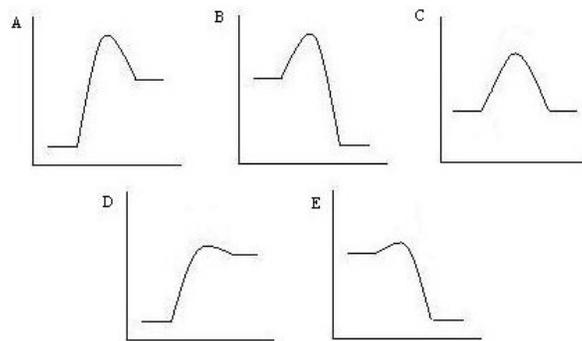
27 Imagine that you are writing a chemical reaction equation that includes **elemental sulfur** (under standard laboratory conditions). Which of these is the best representation of the formula of **elemental sulfur**?



28 A certain reaction takes place in aqueous solution. As the reaction progresses, the solution is observed to become cold. Which of the following assignments are correct for this reaction?

	<u>endo/exothermic</u>	<u>sign of ΔH</u>
A	endothermic	+
B	exothermic	+
C	endothermic	-
D	exothermic	-

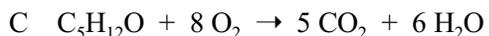
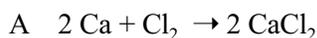
29 In the graphs at right, which curve shows the **smallest** value of activation energy for the forward reaction?



30 Which graph shows an **endothermic** reaction with a **high** activation energy?

31 Consider the reaction represented by graph A at right. Which of the **other** choices (**B, C, D or E**) represents a reaction with the same value for ΔH as the reaction in choice A?

32 Which of these reactions is correctly balanced?



33** Iron reacts with sulfuric acid (H_2SO_4) according to the following equation:



Which of the following changes will **increase** the rate of this reaction?

