Chemistry 122 | Winter 2005 | Oregon State University
Exam 2 | February 24, 2005 | Dr. Richard Nafshun

DO NOT OPEN THIS EXAM UNTIL INSTRUCTED. CALCULATORS ARE NOT TO BE SHARED.

Test Form 3

Instructions: You should have with you several number two pencils, an eraser, your 3" x 5" note card, a calculator, and your University ID Card. If you have notes with you, place them in a sealed backpack and place the backpack OUT OF SIGHT or place the notes directly on the table at the front of the room.

Fill in the front page of the Scantron answer sheet with your test form number (listed above), last name, first name, middle initial, and student identification number. **Leave the class section number blank.**

This exam consists of 25 multiple-choice questions. Each question has four points associated with it. Select the best multiple-choice answer by filling in the corresponding circle on the rear page of the answer sheet. If you have any questions before the exam, please ask. If you have any questions during the exam, please ask the proctor. Open and start this exam when instructed. When finished, place your Scantron form and note card in the appropriate stacks. You may keep the exam packet, so please show your work and mark the answers you selected on it.

$R = 0.0821$ L•atm/mol•K
$k_f (H_2O) = 1.86$ °C/m
m = mol/kg

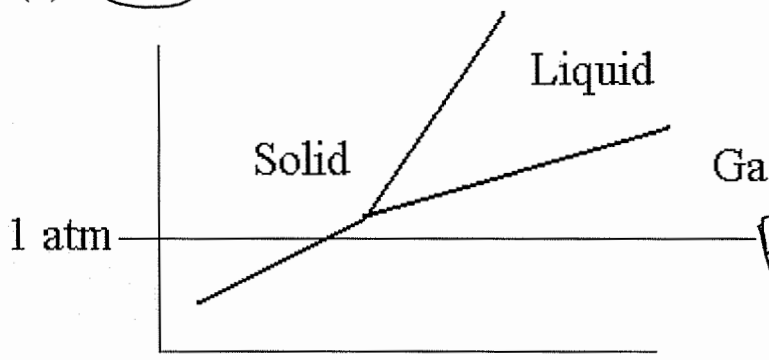
760 mm Hg = 760 torr = 1 atm
M = mol/L

IA												IIIA	IVA	VA	VIA	VIIA	VIIIA
1 H Hydrogen 1.0079	IIA																2 He Helium 4.0026
3 Li Lithium 6.941	4 Be Beryllium 9.01218											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984	10 Ne Neon 20.179
11 Na Sodium 22.98977	12 Mg Magnesium 24.305	IIIB	IVB	VB	VIB	VIIB	VII			IB	IIB	13 Al Aluminum 26.9815	14 Si Silicon 28.0855	15 P Phosphorus 30.97376	16 S Sulfur 32.06	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.08	21 Sc Scandium 44.9559	22 Ti Titanium 47.88	23 V Vanadium 50.9415	24 Cr Chromium 51.996	25 Mn Manganese 54.9380	26 Fe Iron 55.847	27 Co Cobalt 58.9332	28 Ni Nickel 58.70	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.72	32 Ge Germanium 72.59	33 As Arsenic 74.9216	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.9059	40 Zr Zirconium 91.22	41 Nb Niobium 92.9064	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055	46 Pd Palladium 106.4	47 Ag Silver 107.868	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.69	51 Sb Antimony 121.75	52 Te Tellurium 127.60	53 I Iodine 126.9045	54 Xe Xenon 131.30
55 Cs Cesium 132.9054	56 Ba Barium 137.33	57–71 *Rare earths	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.2	77 Ir Iridium 192.22	78 Pt Platinum 195.09	79 Au Gold 196.9665	80 Hg Mercury 200.59	81 Tl Thallium 204.37	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium 226.0254	89–103 †Actinides	104 Rf Rutherfordium (261)	105 Ha Hahnium (262)	106 Sg Seaborgium (263)	107 Ns Neilsbohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 ‡ (269)	111 ‡			114				

→ Stable region?

1. The phase diagram below is for:

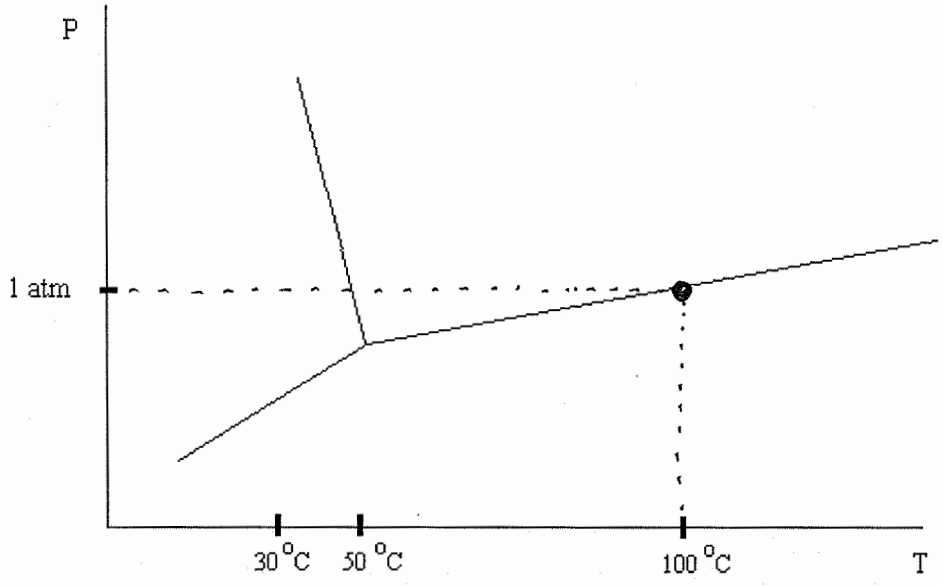
(A) H_2O.
(B) CO_2.



Can not be for water because H_2O exists as a solid, liquid, and gas at 1 atm — this 1 atm line is below the triple point

2. Consider the phase diagram below for compound Z-26. The normal boiling point is:

(A) 0 °C.
(B) 30 °C
(C) 50 °C
(D) 100 °C



3. Lithium fluoride melts at 848 °C. Lithium oxide melts at 1570 °C. The difference in melting points can be attributed to:

(A) Different intermolecular forces (dispersion, dipole-dipole, hydrogen bonding).
(B) Different ionic charges (q_+, q_-).
(C) Different distances between nuclei (d).
(D) The sheet-like structure.
(E) Network covalent compounds.

LiF
+1 -1

Li_2O

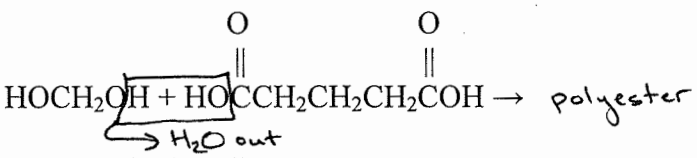
Li^+ O^{2-}

Stronger magnets

4. Which of the following is **false**?

(A) Carbon dioxide is a non-polar molecule. True
(B) Cesium oxide is a non-polar molecule. Cs_2O is an ionic compound
(C) Water is a polar molecule which exhibits hydrogen bonding. True
(D) Quartz is a network covalent compound. True
(E) Network covalent compounds typically melt at higher temperatures than molecules. True

5. The reaction below will produce:



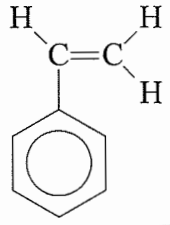
(A) an ionic solid.
(B) a polyester.
(C) a network covalent compound.
(D) quartz.
(E) graphite.

6. Which of the following compounds **cannot** undergo free radical polymerization?

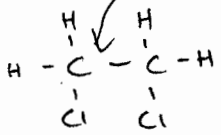
(A) CF_2CF_2

(B) CCl_2CCl_2

(C) CH_2CH_2

(D) 

All have π-bonds

(E) CH_2ClCH_2Cl → 

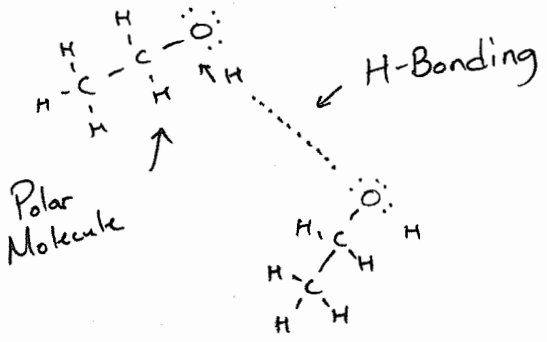
no π-bond

7. Which is not a polymer?

(A) polyethylene PE
(B) polypropylene PP
(C) polystyrene PS
(D) polynomials

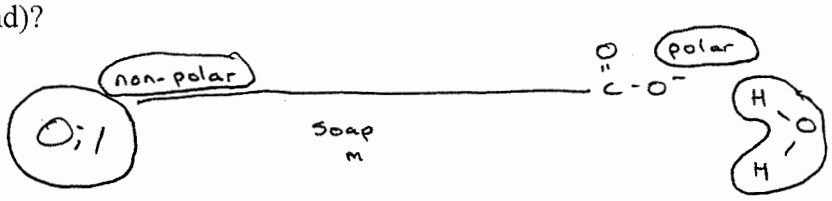
8. Consider CH_3CH_2OH. The intermolecular forces present in CH_3CH_2OH are:

(A) dispersion forces only.
(B) dispersion forces and dipole-dipole forces.
(C) dispersion forces, dipole-dipole forces, and hydrogen bonding.
(D) hydrogen bonding only.
(E) network covalent.



9. Which of the following has a hydrophilic end (polar, water-loving end) and a hydrophobic end (non-polar, water-fearing end)?

(A) methane (CH_4).
(B) soap.
(C) lithium chloride.
(D) helium.
(E) diamond.



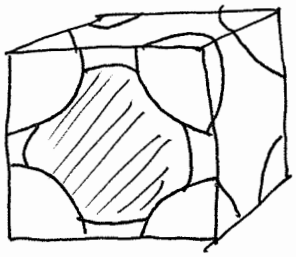
10. The equivalent number of atoms in the BCC unit cell is:

(A) 1.
(B) 2.
(C) 3.
(D) 4.
(E) 6.

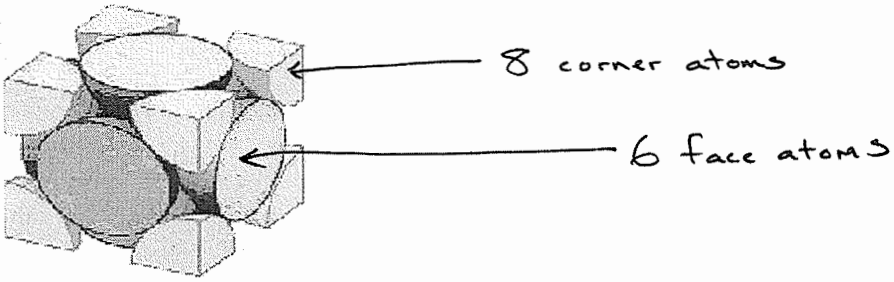
corners: $8 \times \frac{1}{8} = 1$

inside: $1 \times 1 = 1$

$\frac{2}{2}$



11. The structure below [from *Worksheet 6 During Recitation*] represents:



(A) an SC unit cell.
(B) a BCC unit cell.
(C) a FCC unit cell. Face centered cubic
(D) a FBC unit cell.
(E) an MTV unit cell.

12. The freezing point of 5.00m aqueous $MgCl_2$ is:

(A) 118.6 °C.
(B) -9.30 °C.
(C) 18.6 °C.
(D) -18.6 °C.
(E) -27.9 °C.

$i = 3$

$\Delta T_f = i\, m\, k_f = (3)(5.00\,m)\left(1.86\,\frac{^\circ C}{m}\right) = 27.9^\circ C$

$T_f = 0^\circ C - 27.9^\circ C = -27.9^\circ C$

13. A student dissolves 15.000 g of an unknown protein in 1200 mL of water at 308 K. She measures the osmotic pressure to be 0.0412 mm Hg. What is the molar mass of the?

(A) 2.57×10^{-6} g/mol.
(B) 5.83×10^{6} g/mol.
(C) 3.64×10^{-5} g/mol.
(D) 8.44×10^{6} g/mol.
(E) 8.44×10^{-6} g/mol.

$PV = nRT$ or $\pi V = nRT \Rightarrow n = \frac{\pi V}{RT}$

$$n = \frac{\pi V}{RT} = \frac{\left[(0.0412\ mm\,Hg)\left(\frac{1\ atm}{760\ mm\,Hg}\right)\right](1.200\,L)}{\left(0.0821\,\frac{L \cdot atm}{mol \cdot K}\right)(308\,K)}$$

$n = 2.573 \times 10^{-6}\ mol$

$$\text{Molar mass} = \frac{g}{mol} = \frac{15.000\,g}{2.573 \times 10^{-6}\,mol} = 5.83 \times 10^{6}\ \frac{g}{mol}$$

14. Which of the following sets of compounds are expected to be soluble in water?

(A) CH_4, CO_2, CF_4 – All non-polar
(B) NaCl, CH_4, CH_3OCH_3 – CH_4 is non-polar
(C) NaCl, CH_3CH_2OH, NH_3 – Polar and ionic
(D) NaCl, CCl_4, C_4H_{10} – non-polar

Polar & ionic

15. Which has a higher boiling point, He or Kr? Why?

(A) He has a higher boiling point because it has weaker dispersion forces than Kr.
(B) He has a higher boiling point because it has stronger dispersion forces than Kr.
(C) Kr has a higher boiling point because it has weaker dispersion forces than He.
(D) Kr has a higher boiling point because it has stronger dispersion forces than He.

Kr has more electrons than He. This results in stronger dispersion forces. The stronger forces result in higher boiling point.

16. A student places 14.00 grams of lithium fluoride into 400 g of water. Determine the molality of the solution.

LiF = 25.941 g/mol

(A) 35.0 m
(B) 0.0350 m
(C) 2.86 m
(D) 1.35 m
(E) 0.741 m

$$m = \frac{\text{mol}}{\text{kg}} = \frac{14.00\text{ g}\left(\frac{1\text{ mol}}{25.941\text{ g}}\right)}{0.400\text{ kg}} = 1.35\text{ m}$$

17. Why is molality used as the unit of concentration rather than molarity for colligative property calculations?

(A) Molarity is not temperature dependent; molality is
(B) Molality is not temperature dependent; molarity is.
(C) Molality calculations are easier to perform in lab.
(D) Molarity can only be used with network covalent compounds.
(E) Molarity can only be used with hydrophobic molecules.

Front Page

$m = \frac{\text{mol}}{\text{kg}}$ – not temp dependent

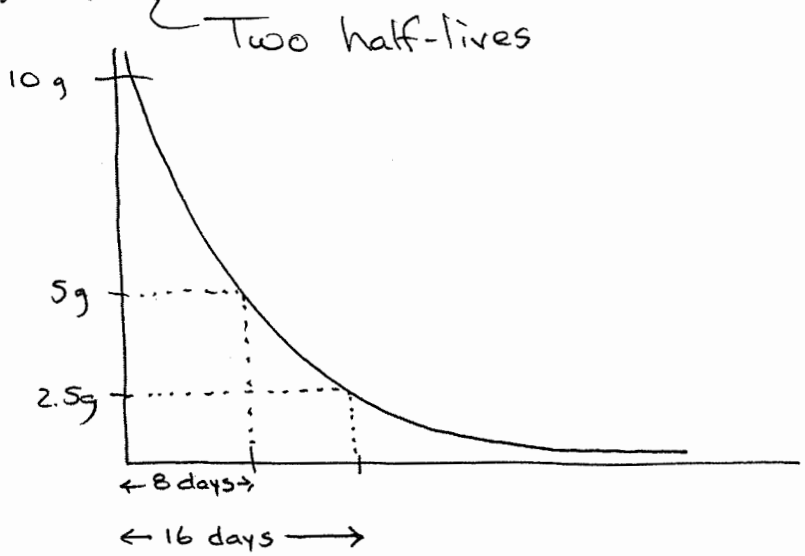
$M = \frac{\text{mol}}{\text{L}}$ – temp dependent because with a change in temperature the volume changes.

18. The half-life is:

(A) the amount of time required for the entire sample to decay.
(B) 0.5 years.
(C) the amount of time required for half the sample to decay.
(D) the amount of time required for the sample to decay so that only a few atoms or molecules remain.

19. A student ( ) obtains a 10.0 gram sample of ^{131}I ($t_{1/2}$ = 8.0 days). How many grams of ^{131}I will remain after 16.0 days?

(A) 2.5 grams
(B) 5.0 grams
(C) 10.0 grams
(D) 20.0 grams
(E) 80.0 grams



20. A student ( ) obtains a 10.0 gram sample of ^{131}I ($t_{1/2}$ = 8.0 days). How long will it take so that only 3.0 grams of ^{131}I remain?

(A) 13.9 days
(B) 14.7 days
(C) 2.40 days
(D) 1.52 days
(E) 15.2 days

Step 1: Calc k

$\ln\left[\frac{1}{2}\right] = -k t_{1/2}$ $\quad \ln\left[\frac{1}{2}\right] = -0.6931$

$-0.6931 = -k(8\ \text{days})$

$k = 0.0866\ \frac{1}{\text{days}}$

Step 2: Calc t

$\ln\left[\frac{A_t}{A_0}\right] = -kt$

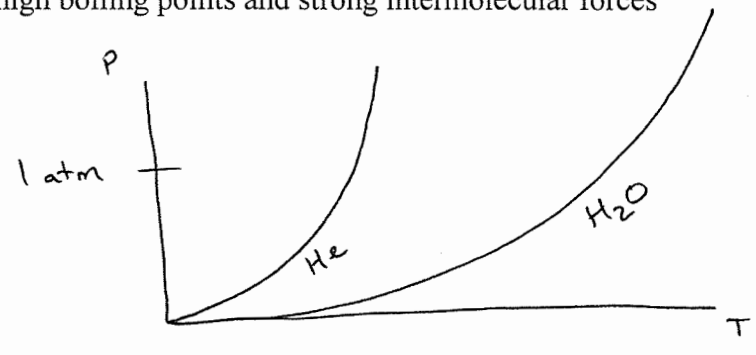
$\ln\left[\frac{3\ g}{10\ g}\right] = -(0.0866\ \frac{1}{\text{days}})(t)$

$t = 13.9\ \text{days}$

21. Compounds with relatively high vapor pressure have:

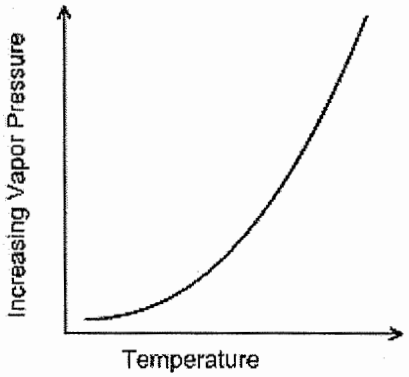
(A) high boiling points and weak intermolecular forces
(B) low boiling points and weak intermolecular forces
(C) high boiling points and strong intermolecular forces
(D) high boiling points and strong intermolecular forces

See Worksheet 7 for Recitation Question # 11



Helium has a high vapor pressure – certainly no solid or liquid at room temp. It has a low boiling point and weak intermolecular forces.

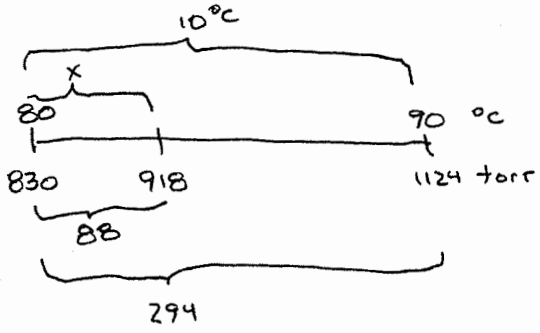
22. The data below were obtained for ethyl acetate. Estimate by interpolation the temperature when the vapor pressure is 918 torr.



ethyl acetate

Temp. (°C)	V.P. (torr)
10	45
20	74
30	118
40	185
50	282
60	417
70	597
80	830 ← 918
90	1124

(A) 91.8 °C.
(B) 81 °C.
(C) 82 °C.
(D) 83 °C.
(E) 84 °C.

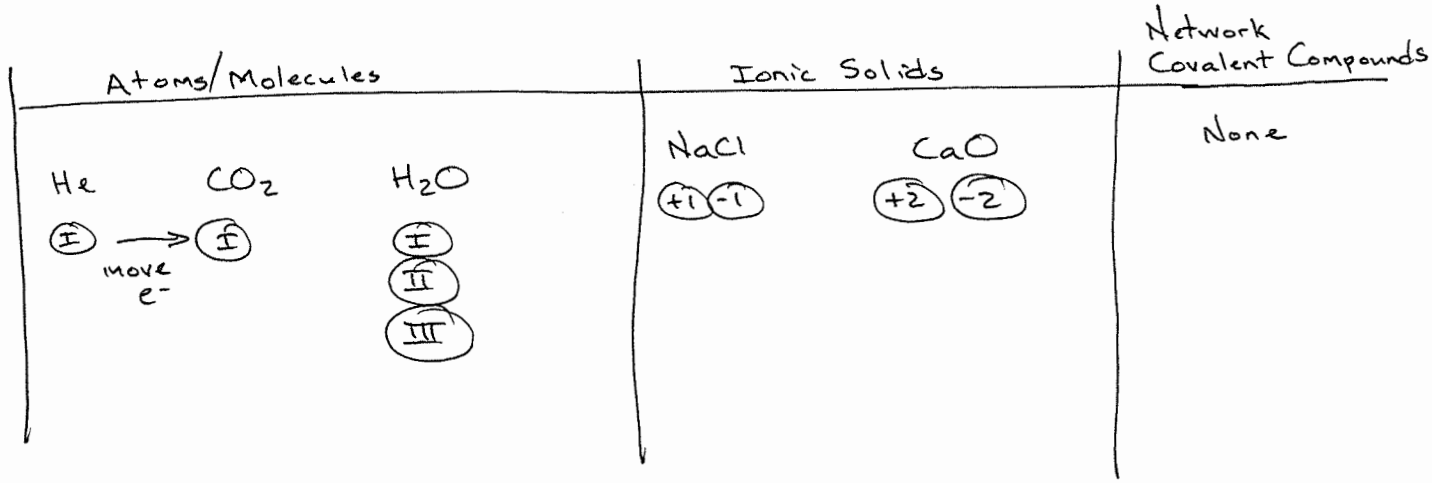


$$\frac{88 \text{ torr}}{294 \text{ torr}} = \frac{x}{10^\circ C}$$

$$x = 3^\circ C$$

23. Consider carbon dioxide, sodium chloride, water, calcium oxide, and helium. Arranged in **increasing** melting point, these are:

	Lowest mp	**Highest mp**
(A)	helium < sodium chloride < carbon dioxide < water < calcium oxide.	
(B)	helium < sodium chloride < carbon dioxide < calcium oxide < water.	
(C)	helium < carbon dioxide < water < sodium chloride < calcium oxide.	
(D)	carbon dioxide < calcium oxide < water < helium < sodium chloride.	
(E)	helium < carbon dioxide < water < calcium oxide < sodium chloride.	



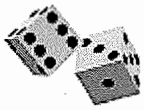
24. Please consider Question 23 above. How sure were you of your answer?

(A) Basically guessed.
(B) Not sure.
(C) Fairly sure.
(D) Very sure.

[Any response will receive full credit; even no response. Responses will be analyzed as a group, not individually.]

25. So, the Chemistry 122 final exam is Wednesday, March 16, 2005 at 7:30 A.M. (Good Morning!) Later that day...

(A) I will be sleeping.



(B) Vegas

(C) I will be at the registrar's office enrolling in six chemistry courses for the Spring term.

(D) Experimentation with munchies.

(E) I will be laying out on the grass. Looking up at the sky. Trying to envision each cloud as a piece of chemistry glassware.
[Understand this... since this notion in your psyche, every time you look at a cloud you will smile and see an Erlenmeyer flask.]

[Any response will receive full credit; even no response.]