Chemistry 122 | Winter 2006 | Oregon State University
Exam 2 | March 2, 2006 | 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
M = mol/L
$\Pi V = nRT$

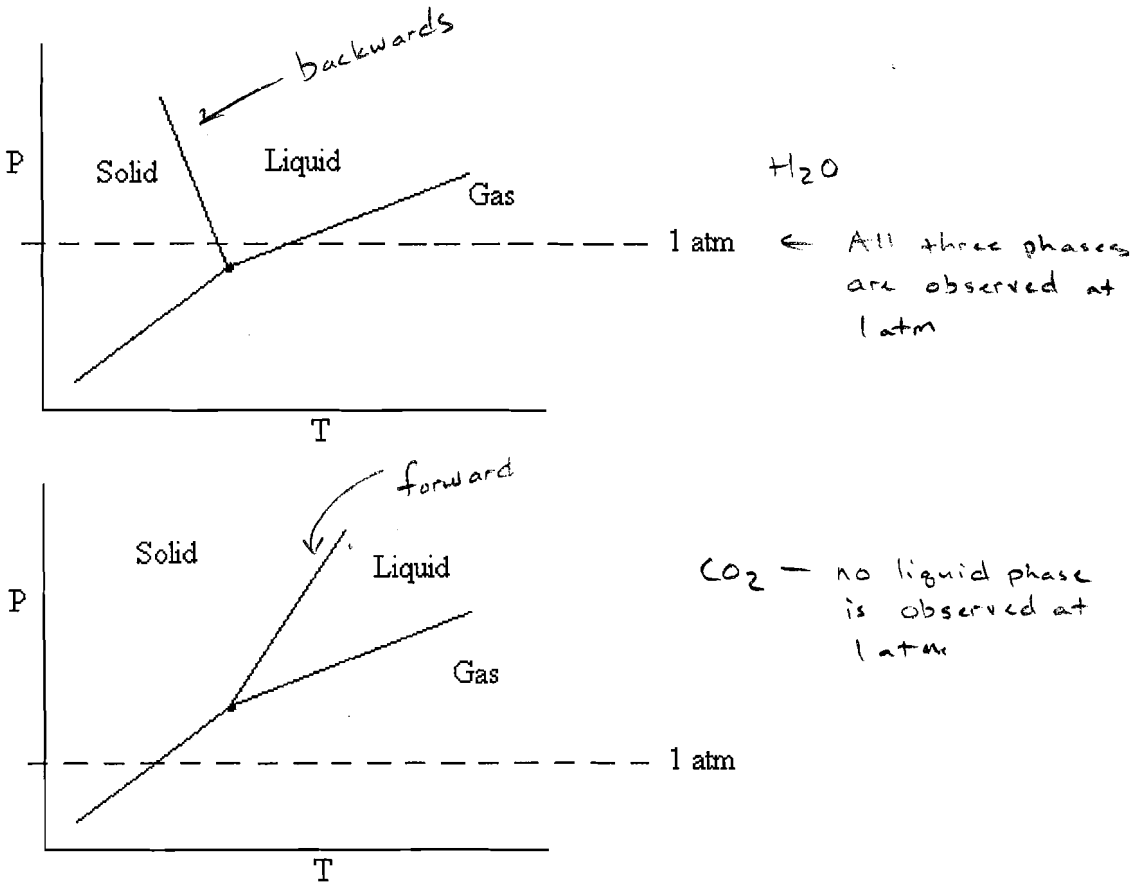
760 mm Hg = 760 torr = 1 atm
$\Delta T_f = imk_f$
$k_f(H_2O) = 1.86$ °C/m

$$\ln[\frac{A}{A_o}] = -kt$$

m = mol/kg
$\Delta T_b = imk_b$
$k_b(H_2O) = 0.512$ °C/m

IA												IIIA	IVA	VA	VIA	VIIA	VIIIA
1 H Hydrogen 1.0079	IIA							VII		IB	IIB						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						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				

1. Phase diagrams for H_2O and CO_2 are shown below:



H_2O ← All three phases are observed at 1 atm

CO_2 — no liquid phase is observed at 1 atm

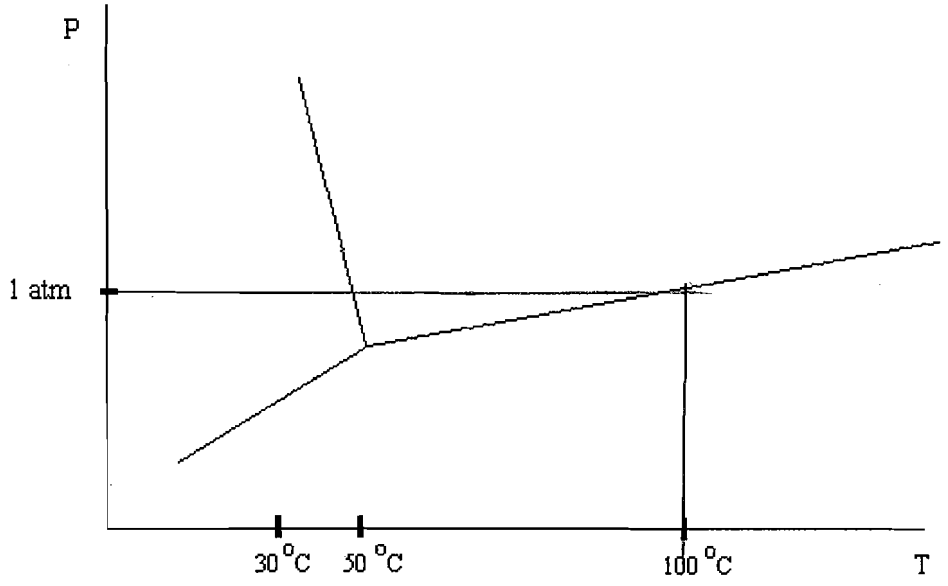
(A) The top phase diagram is associated with H_2O and the bottom phase diagram is associated with CO_2.

(B) The bottom phase diagram is associated with H_2O and the top phase diagram is associated with CO_2.

2. Consider the phase diagram below for compound WinterOlympide. The normal boiling point is:

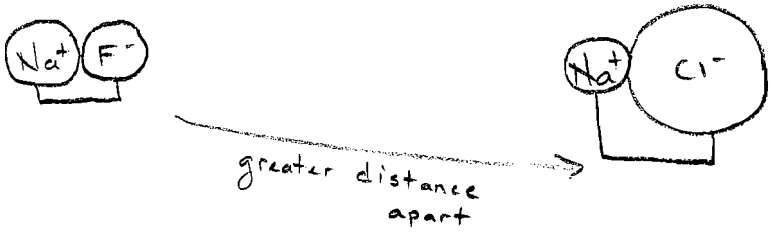
at 1 atm

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



3. Sodium fluoride melts near 993 °C. Sodium chloride melts near 804 °C. The difference in melting points can be attributed to:

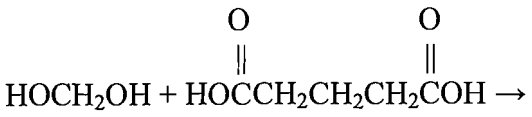
(A) Different intermolecular forces (dispersion, dipole-dipole, hydrogen bonding)
(B) Different ionic charges (+1, +2, +3, -1, -2, -3…)
(C) Different distances between nuclei (ionic size)
(D) The sheet-like structure
(E) Network covalent compounds



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

(A) Quartz, graphite, and diamond are ionic compounds.
(B) Ethanol (CH_3CH_2OH) is a polar molecule which exhibits hydrogen bonding.
(C) Sodium oxide is an ionic compound.
(D) Sodium oxide melts at a higher temperature than ethanol.
(E) Network covalent compounds melt at higher temperatures than molecules.

5. The reaction below will produce:



(A) Quartz
(B) A network covalent compound
(C) An ionic compound
(D) Soap
(E) A polymer

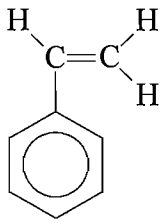
6. Which of the following compounds **cannot** undergo free radical polymerization?

(A) CF_2CF_2

(B) CCl_2CCl_2

(C) CH_2CH_2

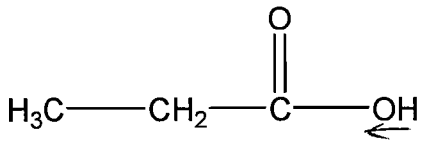
(D)



(E) CH_3CH_3 ← No π-bond

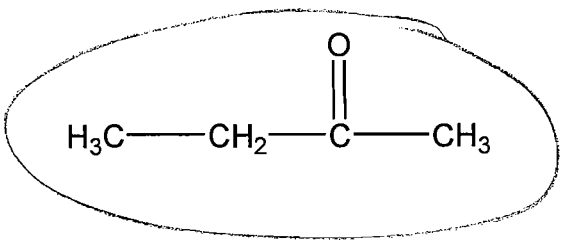
7. Which of the following molecules will not form hydrogen bonds?

(A)

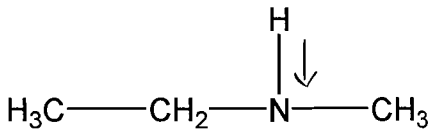


(B) HF →

(C)



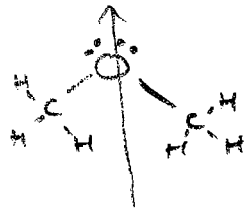
(D)



No H-F, or H-O, or H-N, or H-S bond

8. Consider CH_3OCH_3. The intermolecular forces present in CH_3OCH_3 are:

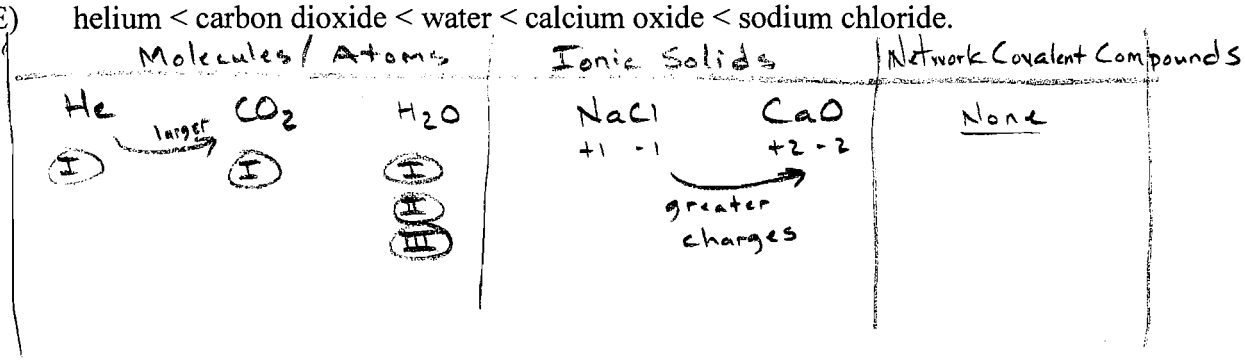
(A) Dispersion forces only
(B) Dispersion forces and dipole-dipole forces
(C) Dispersion forces, dipole-dipole forces, and hydrogen bonding
(D) Hydrogen bonding only
(E) Network covalent



dispersion
polar
no hydrogen bonding

9. 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.	

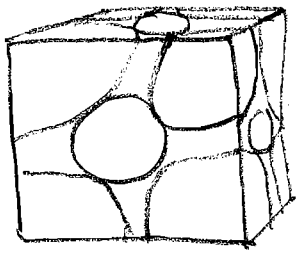


10. Which of the following has a hydrophilic end (polar, water-loving end) and a hydrophobic end (non-polar, water-fearing end)?

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

11. The equivalent number of atoms in the FCC unit cell is:

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

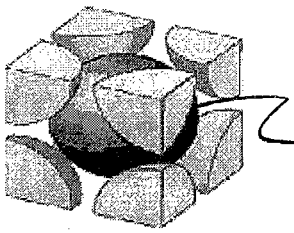


$8 \times \frac{1}{8} = 1$ ← corners

$6 \times \frac{1}{2} = 3$ ← sides

4

12. The structure below [from a *Course Worksheet*] represents:



Body Centered Cubic

(A) An SC unit cell
(B) A BCC unit cell
(C) A FCC unit cell
(D) A cell phone
(E) An iPOD unit cell

13. The freezing point of 3.20m aqueous NaCl is:

↑ i = 2 (Na^+) (Cl^-)

(A) 106 °C.
(B) -5.95 °C.
(C) +5.95 °C.
(D) -17.9 °C.
(E) -11.9 °C.

$\Delta T_f = i\, m\, k_f$

$= (2)(3.20\ m)(1.86\ ^\circ C/m)$

$= 11.9\ ^\circ C$

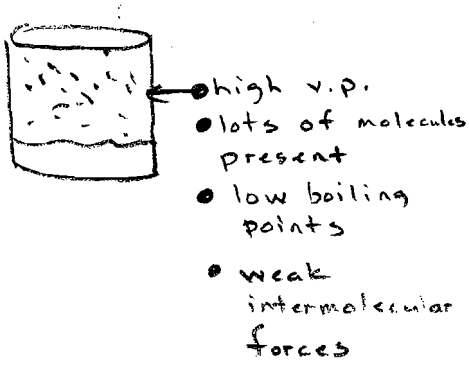
$T_f = 0^\circ C - 11.9^\circ C = -11.9^\circ C$

14. Consider 1.00 m NaCl (aq), 1.00 m $HOCH_2CH_2OH$ (aq), 1.00 m $CaCl_2$ (aq), 1.00 m LiBr (aq). The solution with the highest boiling point is:

(A) 1.00 m NaCl (aq) $i = 2$
(B) 1.00 m $HOCH_2CH_2OH$ (aq) $i = 1$
(C) 1.00 m $CaCl_2$ (aq) $i = 3$
(D) 1.00 m LiBr (aq) $i = 2$

15. 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



16. A student dissolves 7.8000 g of an unknown protein in 1500 mL of water at 287 K. She measures the osmotic pressure to be 0.302 mm Hg. What is the molar mass of the protein?

1.500 L

$0.302 \text{ mm Hg} \left(\frac{1 \text{ atm}}{760 \text{ mm Hg}}\right) = 3.97 \times 10^{-4} \text{ atm}$

(A) 2.57×10^{-6} g/mol.
(B) 5.83×10^{6} g/mol.
(C) 3.08×10^{5} g/mol.
(D) 8.44×10^{6} g/mol.
(E) 8.44×10^{-6} g/mol.

$\Pi V = nRT$

$n = \frac{\Pi V}{RT} = \frac{(3.97 \times 10^{-4} \text{ atm})(1.500 \text{ L})}{\left(0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}\right)(287 \text{ K})} = 2.53 \times 10^{-5} \text{ mol}$

$\text{Molar Mass} = \frac{g}{\text{mol}} = \frac{7.800 \text{ g}}{2.53 \times 10^{-5} \text{ mol}} = 3.08 \times 10^{5} \text{ g/mol}$

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.

18. A student places 0.040 moles of lithium fluoride into 800 g of water. Determine the **molality** of the solution.

(A) 20.0 m
(B) 0.020 m
(C) 0.050 m
(D) 2.00×10^{4} m
(E) 5.00×10^{-5} m

$m = \frac{\text{mol}}{\text{kg of solvent}} = \frac{0.040 \text{ mol}}{0.800 \text{ g}} = 0.050 \text{ m}$

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

polar / ionic

(A) CH_4, CO_2, CF_4
(B) NaCl, CH_4, CH_3OCH_3
(C) NaCl, CH_3CH_2OH, NH_3
(D) NaCl, CCl_4, C_4H_{10}

20. Which has a higher melting point, sodium fluoride or aluminum fluoride? Why?

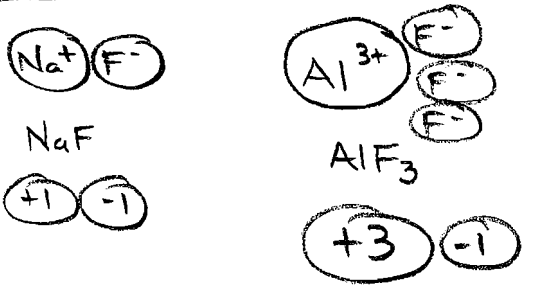
(A) sodium fluoride has a higher melting point because it has weaker dispersion forces than aluminum fluoride.

(B) sodium fluoride has a higher melting point because it has stronger dispersion forces than aluminum fluoride.

(C) aluminum fluoride has a higher melting point because it has stronger dispersion forces than sodium fluoride.

(D) aluminum fluoride has a higher melting point because it has a greater mass than sodium fluoride.

(E) aluminum fluoride has a higher melting point because it has greater ionic charges than sodium fluoride.

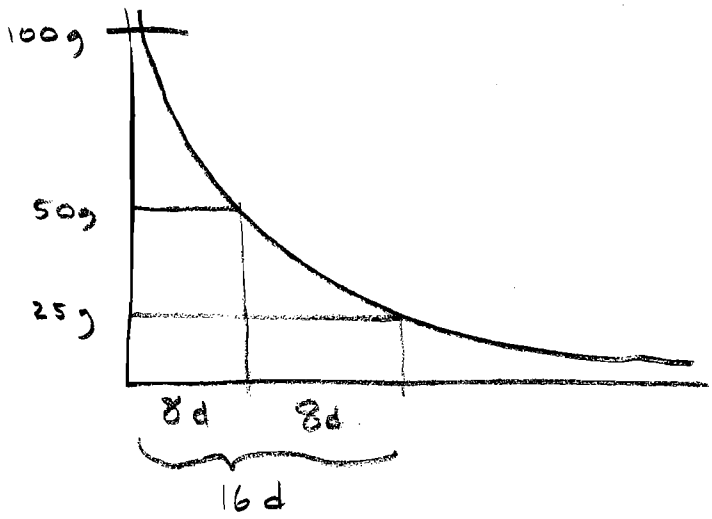


21. The half-life is:

(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.

22. A student ( ) obtains a 100.0 gram sample of ^{131}I ($t_{1/2}$ = 8.00 days). How many grams of ^{131}I will remain after 16.00 days?

(A) 8.0 grams
(B) 16.0 grams
(C) 25.0 grams
(D) 50.0 grams
(E) 75.0 grams



23. A student ( ) obtains a 100.0 gram sample of ^{131}I ($t_{1/2}$ = 8.00 days). How long will it take so that only 10.0 grams of ^{131}I remain?

(A) 8.2 days
(B) 16.4 days
(C) 25.0 days
(D) 26.6 days
(E) 50.0 days

Step 1

$\ln \frac{1}{2} = -k(8.00\,d)$

$k = 0.0866\ \frac{1}{d}$

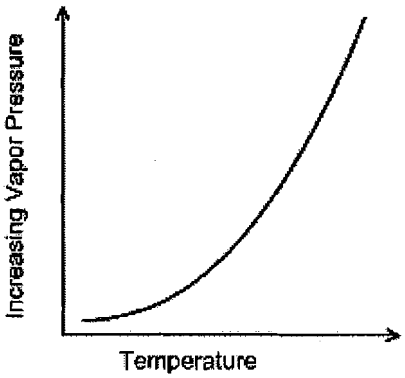
Step 2

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

$\ln\left[\frac{10\,g}{100\,g}\right] = -(0.0866)(t)$

$t = 26.6\,d$

24. The data below were obtained for ethyl acetate. Estimate by interpolation the temperature when the vapor pressure is 800 torr.

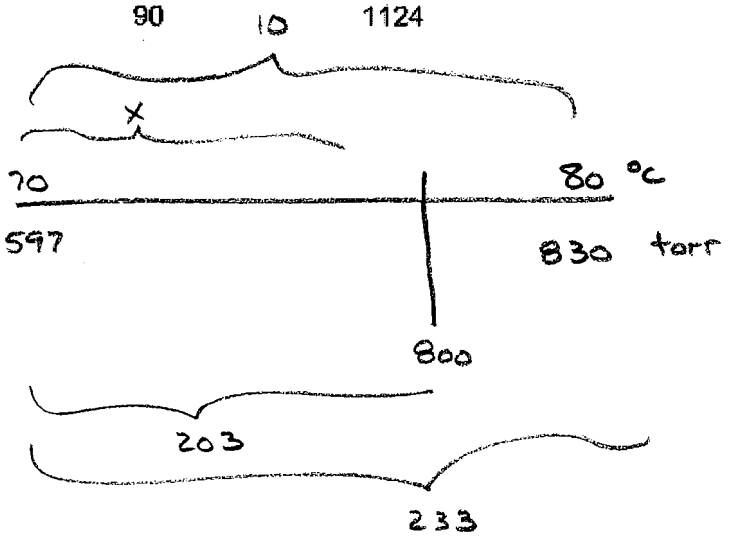


ethyl acetate

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

800 torr

(A) 77.1 °C.
(B) 77.4 °C.
(C) 78.1 °C.
(D) 78.4 °C.
(E) 78.7 °C.



$\frac{203}{233} = \frac{x}{10}$ $x = 8.7$

$T = 70°C + 8.7\ °C = 78.7\ °C$

25. The Chemistry 122 final exam is Wednesday, March 22, 2006 at 4:00pm. Later that evening I will be…

(A) Recovering from the full-body-discomfort brought on by Chemistry 122.
(B) Catching up on e-mail.
(C) Getting a head start on that CH 123 reading.
(D) Hangin' with friends.

(E) In Reno

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