

54-1=53
17x3=51
~~108~~
108

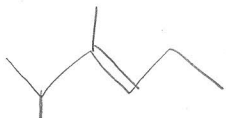
KEY

Read questions carefully to understand what is being asked. If you have doubt, do ask your instructor. Use the reverse side of your answer paper as scratch. Use attached periodic table and important constants chart. On your scantron, please start from same bubble number as the number of the multiple choice question. (Total pts. = 54 + (18 x 3 =) 54= 108)

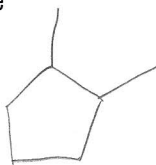
SHORT ANSWER: Show all your calculations using appropriate set up and units.

- 1) Draw skeletal or condensed structures of (2x5 = 10pts.):
 (a) trans-2,3-dimethyl-3-hexene

1) _____



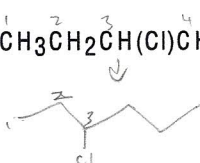
- (b) 1,2-Dimethylcyclopentane



- 2) What is the IUPAC name of the compound $\overset{1}{\text{CH}_3}\overset{2}{\text{CH}_2}\overset{3}{\text{CH}}(\text{Cl})\overset{4}{\text{CH}_2}\overset{5}{\text{CH}_2}\overset{6}{\text{CH}_3}$? (4 pts.)

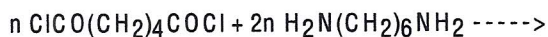
2) _____

3-chlorohexane

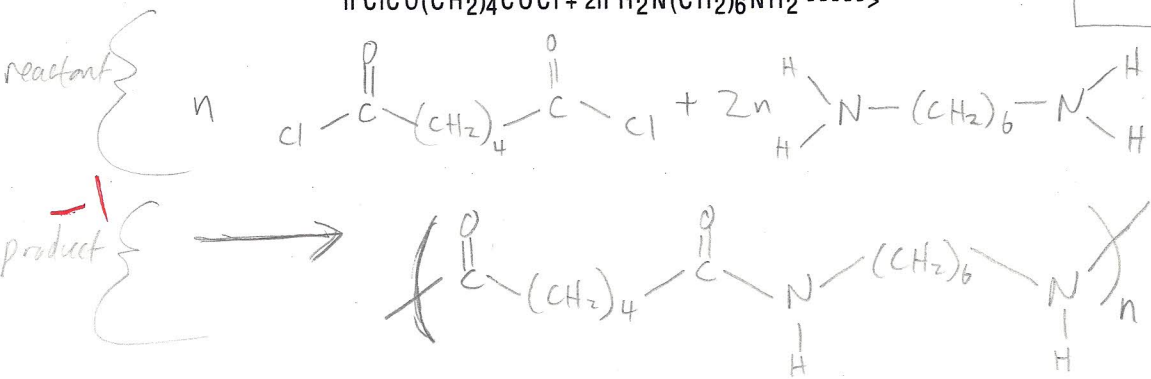


- 3) Show the products of the following reaction (4 pts) and name what kind of reaction is this (2 pts):

3) _____



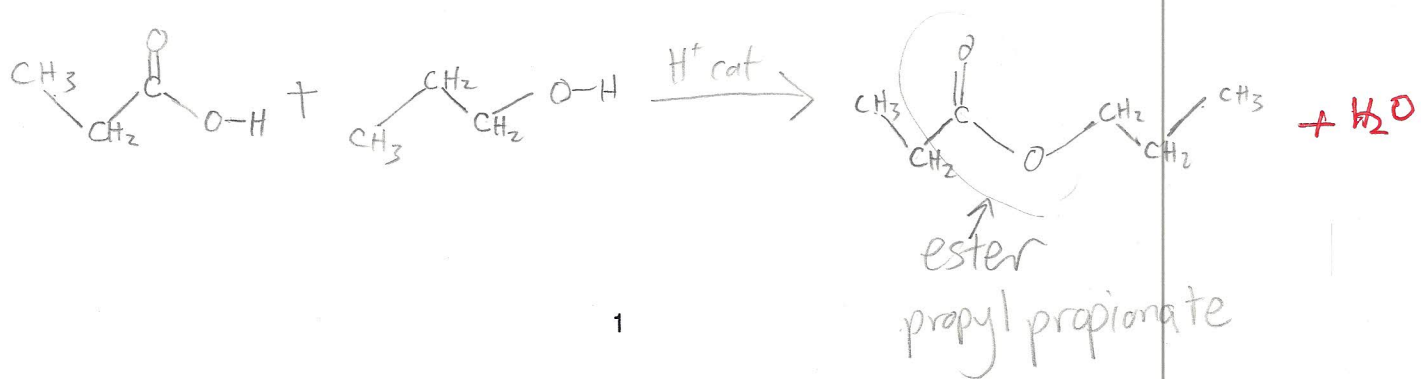
condensation polymerization



+ 2n HCl

- 4) Draw the condensed structures of the reactants and product(s) of the reaction between propionic acid and 1-propanol (8 pts.) and name the major product (2 pts.) and the functional group it contains (2 pts.).

4) _____



- 5) At 318 mmHg of oxygen pressure in the atmosphere, the solubility of oxygen in the blood is 0.88 g per 0.1 L. Calculate the solubility of oxygen in the blood (per 0.1L) when the oxygen pressure is 112 mmHg (6 pts.)

$$S_g = K \cdot P_g \rightarrow K = \frac{S_g}{P_g}$$

$$K_x = K_y$$

$$\frac{S_{gx}}{P_{gx}} = \frac{S_{gy}}{P_{gy}} \rightarrow \frac{0.88 \text{ g}/0.1 \text{ L}}{318 \text{ mmHg}} = \frac{S_{gy}}{112 \text{ mmHg}}$$

5) 0.31 g/0.1 L

$$S_{gy} = \frac{0.88 \text{ g}/0.1 \text{ L}}{318 \text{ mmHg}} \cdot 112 \text{ mmHg}$$

$$S_{gy} = 0.31 \text{ g}/0.1 \text{ L}$$

- 6) One kilogram of water is cooled from 50°C to ice at 0°C. Calculate the amount of heat released. Given specific heat of water is 4.18 J · g⁻¹ · K⁻¹ and heat of fusion of ice = 6.01 kJ · mol⁻¹. (8 pts.)

$$1 \text{ kg} = 1000 \text{ g H}_2\text{O}$$

$$\Delta T = 0 - 50 = -50^\circ \text{K}$$

6) 542.89 kJ released

temp chg = $MC\Delta T$

$$1000 \text{ g} \cdot \frac{4.18 \text{ J}}{\text{gK}} \cdot (-50^\circ \text{K}) = -209000 \text{ J} \Rightarrow 209 \text{ kJ released}$$

↑
amt of heat absorbed, so it's negative, ✓

phase chg = $m\Delta H$

$$1000 \text{ g} \cdot \frac{1 \text{ mol}}{18 \text{ g}} \cdot \frac{6.01 \text{ kJ}}{\text{mol}} \Rightarrow 333.89 \text{ kJ released}$$

$$209 + 333.89 = \boxed{542.89 \text{ kJ}}$$

- 7) What mass (in kilogram) of CaCl₂ is needed to decrease FP of 11000.0 g of water to -5.5 °C. (Assume CaCl₂ dissolves completely and it has an ideal van't Hoff factor. K_{fp} for water is -1.86 °C/m.) $\Delta T_f = i m K_{fp}$ (8pts.)

7) 1.314 kg CaCl₂

$$\Delta T_f = i K_f m$$

↑ ↑ ↑
-5.5 3 -1.86

$$m = \frac{\Delta T_f}{i K_f} = \frac{-5.5}{3 \cdot (-1.86)} = 0.9857$$

$$m = \frac{\text{mol solute}}{\text{kg solvent}}$$

$$0.9857 = \frac{\text{mol CaCl}_2}{11 \text{ kg H}_2\text{O}}$$

$$\text{mol CaCl}_2 = 0.9857 \cdot 11 = 10.84$$

$$10.84 \text{ mol CaCl}_2 \cdot \frac{40.08 \text{ g} + 2 \cdot 35.45 \text{ g}}{1 \text{ mol CaCl}_2} = 1203 \text{ g CaCl}_2$$

2

$$= \boxed{1.203 \text{ kg CaCl}_2}$$

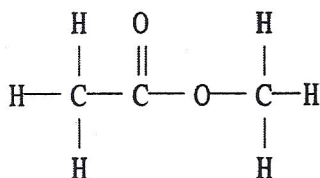
MULTIPLE CHOICE. On scantron start from the same bubble number as the multiple choice question number. Select the one alternative that best completes the statement or answers the question (3 pts each).

8) Hydrocarbons containing carbon-carbon triple bonds are called _____.

- A) olefins
- B) alkynes
- C) alkenes
- D) aromatic hydrocarbons
- E) alkanes

8) B

9) The compound below is a(n) _____.



- A) aldehyde
- B) amine
- C) ketone
- D) carboxylic acid
- E) ester

9) E

10) The addition of HBr to 2-butene produces _____.

- A) no reaction
- B) 2-bromobutane
- C) 2,3-dibromobutane
- D) 1-bromobutane
- E) 1,2-dibromobutane



10) B

11) When NaCl dissolves in water, aqueous Na^+ and Cl^- ions result. The force of attraction that exists between Na^+ and H_2O is called a(n) _____ interaction.

- A) hydrogen bonding
- B) dipole-dipole
- C) London dispersion force
- D) ion-ion
- E) ion-dipole

11) E

12) The intermolecular force(s) responsible for the fact that CH_4 has the lowest boiling point in the set $\text{CH}_4, \text{SiH}_4, \text{GeH}_4, \text{SnH}_4$ is/are _____.

- A) mainly hydrogen bonding but also dipole-dipole interactions
- B) hydrogen bonding
- C) mainly London-dispersion forces but also dipole-dipole interactions
- D) dipole-dipole interactions
- E) London dispersion forces

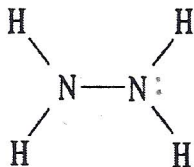


12) E

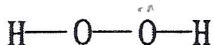
13) Which one of the following substances will not have hydrogen bonding as one of its intermolecular forces?

13) D

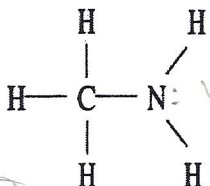
A)



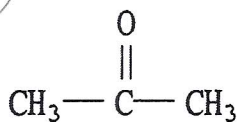
B)



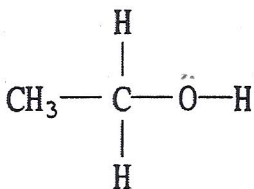
C)



D)



E)



14) How high a liquid will rise up a narrow tube as a result of capillary action depends on _____.

14) D

A) only the magnitude of adhesive forces between the liquid and the tube

B) only the magnitude of cohesive forces in the liquid

C) gravity alone

D) the magnitudes of cohesive forces in the liquid and adhesive forces between the liquid and the tube, and gravity

E) the viscosity of the liquid

15) Large intermolecular forces in a substance are manifested by _____.

15) E

A) high boiling point

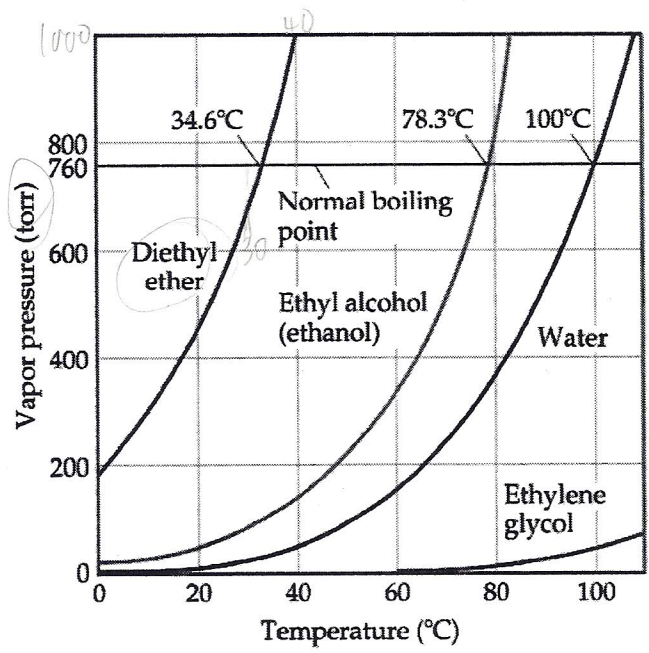
B) high critical temperatures and pressures

C) low vapor pressure

D) high heats of fusion and vaporization

E) all of the above

1 atm = 760 torr
 1.32 atm = 1003.2 torr

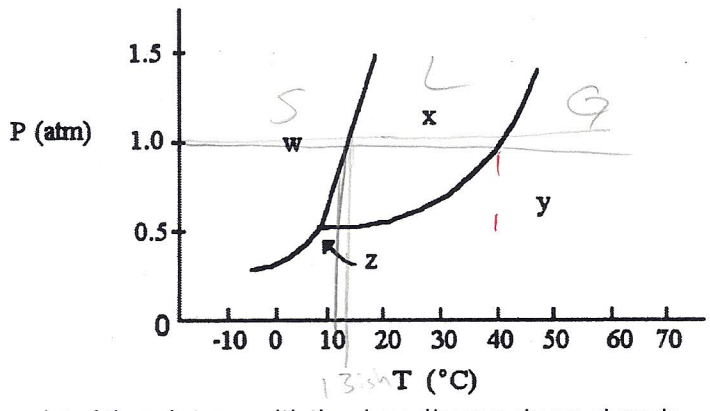


16) Based on the figure above, the boiling point of diethyl ether under an external pressure of 1.32 atm is _____ °C.
 A) 40 B) 10 C) 0 D) 20 E) 30

16) A

17) On a phase diagram, the critical temperature is _____.
 A) the temperature below which a gas cannot be liquefied
 B) the temperature above which a gas cannot be liquefied
 C) the temperature required to melt a solid
 D) the temperature required to cause sublimation of a solid
 E) the temperature at which all three states are in equilibrium

17) B



18) The normal boiling point of the substance with the phase diagram shown above is _____ °C.
 A) 10 B) 20 C) 30 D) 40 E) 50

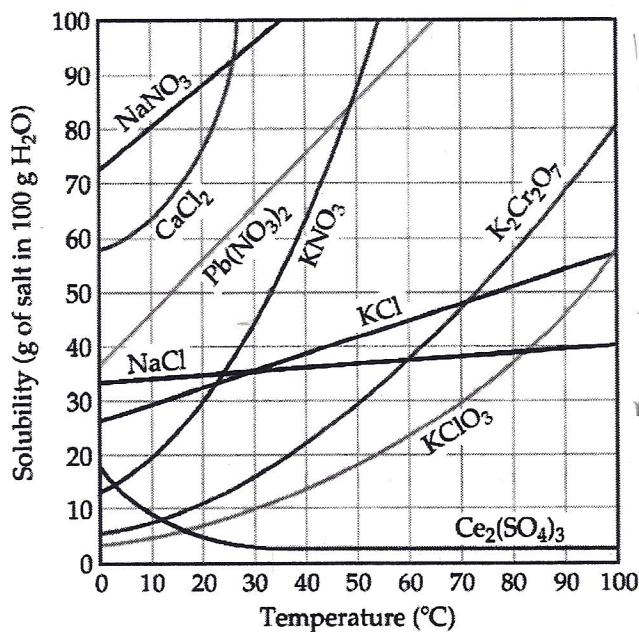
18) AD

- 19) The process of solute particles being surrounded by solvent particles is known as _____.
- A) agglutination
 - B) solvation
 - C) agglomeration
 - D) salutation
 - E) dehydration

19) B

- 20) A solution is prepared by dissolving 15.0 g of NH_3 in 250.0 g of water. The density of the resulting solution is 0.974 g/mL. The mole fraction of NH_3 in the solution is _____.
- A) 0.0597
 - B) 0.940
 - C) 0.0640
 - D) 0.922
 - E) 16.8

20) A



15g NH_3 $250\text{g H}_2\text{O}$
 density = 0.974g/mL
 $15\text{g NH}_3 \cdot \frac{1\text{mol NH}_3}{14+3} = \frac{15}{17} = 0.882\text{mol NH}_3$
 $250\text{g H}_2\text{O} \cdot \frac{1\text{mol H}_2\text{O}}{16+2} = 13.889\text{mol H}_2\text{O}$
 mol fraction = $\frac{0.882}{0.882 + 13.889} = 0.0597$

- 21) A sample of potassium nitrate (49.0 g) is dissolved in 101 g of water at 100°C , with precautions taken to avoid evaporation of any water. The solution is cooled to 30.0°C and no precipitate is observed. This solution is _____.
- A) placated
 - B) supersaturated
 - C) unsaturated
 - D) saturated
 - E) hydrated

21) B

TRUE/FALSE. In your scantron, fill up bubble A for true and bubble B for false answers (3 pts/question).

- 22) Carbon has six valence electrons.
- 23) The bond angles in a tetrahedral molecule are 90° .
- 24) Under ordinary conditions, a substance will sublime rather than melt if its triple point occurs at a pressure above atmospheric pressure.
- 25) A solution with a solute concentration greater than the solubility is called a supercritical solution.



22) F

23) F

24) T

25) F