

**Directions:** Read all questions and instructions carefully. Check to make sure that this exams contains **13** pages. Please budget your time across the entire exam and attempt all questions.

**Good Luck!**

*Happy Thanksgiving!!*

Exam Total	/100
------------	------

**1. (2 points)** Do you understand SRJCs academic integrity policy and agree to follow all exam procedures during this exam? If you have any question about what is and is not allowed, you agree that you must email me during the exam time where I will gladly clarify.

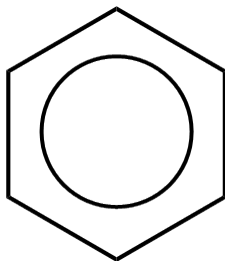
(a) Yes

(b) No

---

**(a) (2 points)** YES! Please don't cheat!

2. (2 points) In class we discussed that benzene rings are common because they are stable. We also discussed that the electrons of the double bond constantly move and can be represented by the following structure.



This structure was proposed when August Kekulé had a day-dream in which he visualized an alchemical symbol. Which symbol provided the inspiration?



1



2



3



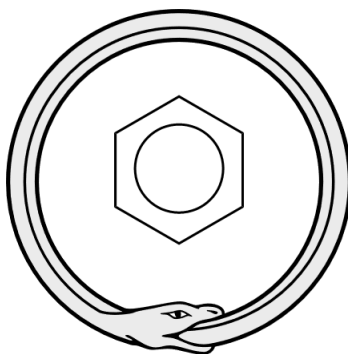
4



5

- (a) 1
- (b) 2
- (c) 3
- (d) 4
- (e) 5

(e) (2 points) The ouroboros (dragon/snake eating its own tail) provided the inspiration.



1 is the Hylian crest (*The Legend of Zelda*), 2 is copper (an actual alchemy symbol), 3 is the Mandalorian symbol (*Star Wars*), 4 is The Deathly Hallows (*Harry Potter*), and 5 is the ouroboros (an actual alchemy symbol).

**3. (2 points)** In class we learned that transmutation of base metals such as lead and mercury into gold is indeed possible. However, we also learned that the cost to produce one ounce of gold by this method is  $1 \times 10^{15}$  dollars. Calculate the mass of gold that can be produced by this method so the cost of gold amounts to 1 dollar. Note, 1 oz = 28.35 g.

- (a)  $3 \times 10^{-14}$  g
- (b)  $3 \times 10^{-13}$  g
- (c)  $3 \times 10^{-12}$  g
- (d)  $4 \times 10^{12}$  g
- (e)  $4 \times 10^{13}$  g

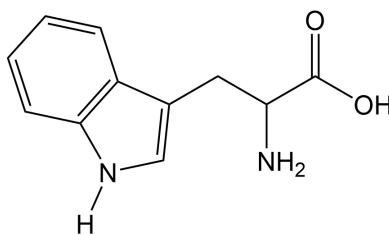
**(2 points) (a)**

$$m_{\text{Au}} = 1 \text{ dollar} \times \frac{1 \text{ oz Au}}{1 \times 10^{15} \text{ dollars}} \times \frac{28.35 \text{ g Au}}{1 \text{ oz Au}}$$

$$m_{\text{Au}} = 2.835 \times 10^{-14} \text{ g}$$

$$m_{\text{Au}} = 3 \times 10^{-14} \text{ g}$$

4. (12 points) Tryptophan is an amino acid present in turkey. Shown below is the molecular structure of tryptophan.



(a) (2 points)

State the number of carbon atoms in tryptophan.

- (a) 8
- (b) 9
- (c) 10
- (d) 11
- (e) 12

(b) (2 points)

State the number of hydrogen atoms in tryptophan.

- (a) 8
- (b) 9
- (c) 10
- (d) 11
- (e) 12

(c) (2 points)

Which of the following functional groups does tryptophan have?

- (a) Alcohol
- (b) Aldehyde
- (c) Amide
- (d) Carboxylic Acid
- (e) Ester

(d) (2 points)

Does tryptophan have a benzene ring as part of its structure?

- (a) True
- (b) False

(e) (2 points)

Is tryptophan an organic compound?

- (a) True
- (b) False

**(f) (2 points)** In 1989 over 1,500 cases of esinophilia-myalgia syndrome (EMS) were reported, which resulted in at least 37 deaths. Later, it was found that EMS was linked to tryptophan and the FDA subsequently recalled tryptophan supplements in 1989 and banned sales in 1990. Eosinophilia-myalgia syndrome is accompanied by eosinophilia and myalgia (muscle pain).

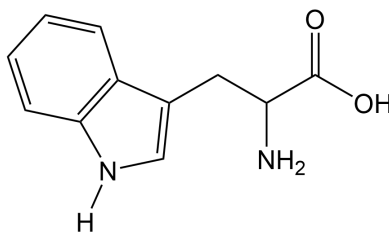
You may recall from Exam #1 that an eosinophil is a type of blood cell!



Eosinophilia is a condition where the concentration of eosinophils in venous (de-oxygenated) blood exceeds 500. eosinophils per microliter of blood. Convert 500. eosinophils per microliter of blood to eosinophils per nanoliter of blood.

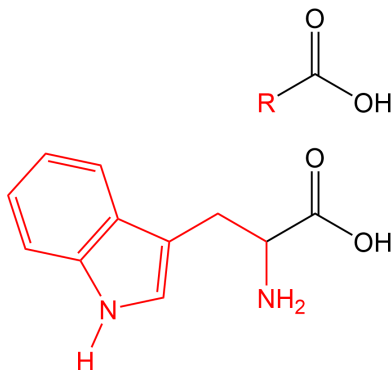
- (a)  $500. \frac{\text{eosinophils}}{\text{nL blood}}$
- (b)  $50.0 \frac{\text{eosinophils}}{\text{nL blood}}$
- (c)  $5.00 \frac{\text{eosinophils}}{\text{nL blood}}$
- (d)  $0.500 \frac{\text{eosinophils}}{\text{nL blood}}$
- (e)  $0.0500 \frac{\text{eosinophils}}{\text{nL blood}}$

**(a) and (b) (4 points)** Tryptophan has 11 carbon atoms and 12 hydrogen atoms.



(c) (2 points) (b)

Tryptophan has a carboxylic acid functional group.



(d) (2 points) (a)

Tryptophan does have a benzene ring as part of its structure.

(e) (2 points) (a)

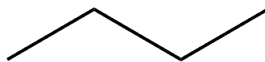
Tryptophan is an organic compound.

(f) (2 points) (d)

$$C_{\text{eosinophils}} = \frac{500. \text{ eosinophils}}{1 \times 10^{-6} \text{ L blood}} \times \frac{1 \times 10^{-9} \text{ L}}{1 \text{ nL}}$$

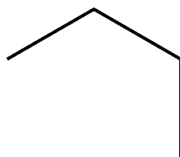
$$C_{\text{eosinophils}} = \frac{0.500 \text{ eosinophils}}{1 \text{ nL blood}}$$

**5. (10 points)** You have a BBQ that uses *n*-butane as a fuel source and decide to BBQ a Thanksgiving turkey! The fuel for the BBQ is *n*-butane is shown below.

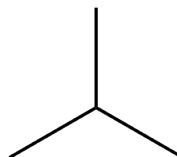


*n*-butane

Shown below are a couple structures.



1

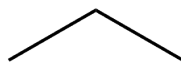


2

**(a) (4 points)** Fill in the blanks.

Compared to *n*-butane, Structure 1 is **the same molecule/an isomer/a different structure**. Compared to *n*-butane, Structure 2 is **the same molecule/an isomer/a different structure**.

**(b) (2 points)** Most BBQs use *n*-propane as a fuel source. Shown below is the structure of *n*-propane.



*n*-propane

Which BBQ fuel has a greater boiling point?

- (a) *n*-propane
- (b) *n*-butane

**(c) (4 points)**

Explain your answer/support your reasoning for your answer above (with regards to boiling point ranking).

---

**(a) (4 points)**

Compared to *n*-butane, Structure 1 is **the same molecule**. Compared to *n*-butane, Structure 2 is **an isomer**.

**(b) and (c) (6 points)**

*n*-butane has a greater molecular weight so it will have more London dispersion forces. With more intermolecular forces than *n*-propane, *n*-butane will have the greater boiling point.



6. (6 points) Shown below is a turkey baster.



(a) (2 points)

Chemically speaking, what is a plastic?

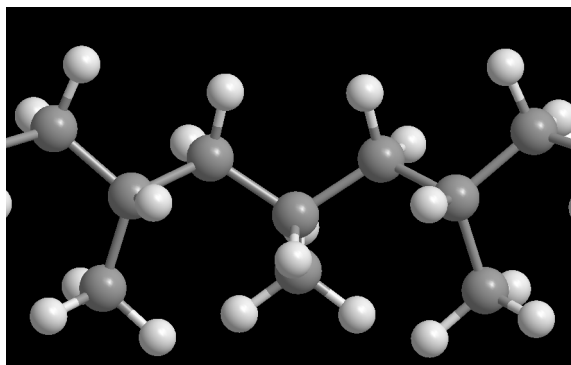
- (a) Alkahest
- (b) Amalgam
- (c) Argillaceous Earth
- (d) Polymer
- (e) Soda

(b) (4 points)

Being future health-care professional, you decide to use a (NEW) polypropylene syringe to baste your turkey! Shown below is the syringe you decide to use.



Shown below is the monomer unit for polypropylene. Note, the gray atoms are carbon atoms and the white atoms are hydrogen atoms.



Explain why using a polypropylene syringe is not dissolved by water from the basting juices of the turkey.

(2 points) (d) Plastics are polymers.

(4 points) Water is strongly polar and polypropylene is a very nonpolar (hydrophobic) polymer. Thus, there are little attractive intermolecular forces between water and polypropylene.

7. (2 point) After basting the turkey, you clean you hands with hand sanitizer and realize it is one of those brands that contains methanol. If methanol is consumed, what harmful chemical is generated that causes blindness?

- (a) Formaldehyde
- (b) Formic Acid
- (c) Sodium Fluoride
- (d) Tetracyanoethylene
- (e) Thiophene

(2 points) (b)

Formic acid causes blindness

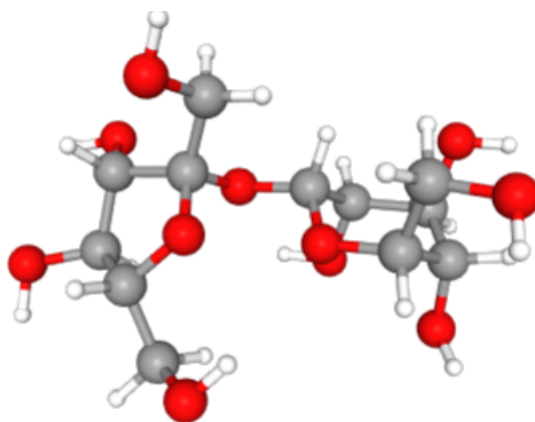
8. (16 points) While the turkey is grilling you decide it is time for you and your family to enjoy cocktail hour. Earlier in the week you found a recipe by editor Jim Meehan of Tasting Table Drinks called Cranberry "Sauce".<sup>a</sup>



(a) (4 points)

You decide to make the simple syrup from scratch. To prepare the simple syrup, you add 1 cup of sugar (sucrose) to one part water in a saucepan and heat until the sugar dissolves.

Shown below is the 3-D molecular model of sucrose. Grey atoms are carbon, red atoms are oxygen, and white atoms are hydrogen.



Explain, chemically, why sugar dissolves in water.

<sup>a</sup><https://www.tastingtable.com/cook/recipes/cranberry-sauce-cocktail-thanksgiving-cocktail-ideas-whiskey-beer-cocktail>

**(b) (4 points)**

Next, to prepare the cranberry simple syrup, you add 8 oz (1 bag) of cranberries and heat to a gentle simmer. Cook until the cranberries begin to split. This prepares 4 cups of cranberry simple syrup!

Shown below is the cross-section of a cranberry.



As you can see, the cranberry has little air pockets! This explains why cranberry bogs are flooded during harvest since the air pockets make the cranberries buoyant and float!!

Knowing that cranberries have air pockets, explain why the cranberries split during heating.

**(c) (2 points)**

To prepare the cocktail, add 2 oz of rye whiskey (Wild Turkey is befitting for the occasion), 0.5 oz of cranberry simple syrup, and 2 dashes of Angostura Bitters to a cocktail shaker. Fill with ice and prepare the drink shaken, not stirred. Garnish with a few simmered cranberries (this is the best part!).

The solvent for the whiskey and bitters is a water-ethanol solvent blend. What type of mixture is the drink (consider *only* the liquid ingredients in your answer)?

- (a) Heterogeneous Mixture
- (b) Homogeneous Mixture

**(d) (4 points)**

Explain your answer for the type of mixture you selected.

**(e) (2 points)** The recipe requires 2 dashes of bitters. A dash is 10 drops, when delivered from a 1-mL dropper. The volume of a dash is 0.20 t, where t is the symbol for a teaspoon. Given that 1 teaspoon equals 4.92 mL, how many milliliters of bitters does the recipe require?

- (a) 0.50 mL
- (b) 1 mL
- (c) 2 mL
- (d) 3 mL
- (e) 4 mL

**(a) (4 points)**

Water dissolves sucrose really well since water and sucrose can hydrogen bond with each other.

**(b) (4 points)**

As the air pockets heat, the pressure increases until the cranberry splits.

**(c) and (d) (6 points)**

The drink is a homogeneous mixture since it is a blend of water, ethanol, and dissolved sucrose. All of these molecules are highly polar and mix well.

**(e) (2 points) (c)**

$$V = 2 \text{ dashes} \times \frac{0.20 \text{ t}}{1 \text{ dash}} \times \frac{4.92 \text{ mL}}{1 \text{ t}}$$

$$V = 1.968 \text{ mL}$$

$$V = 2 \text{ mL}$$

**9. (6 points)** At the cocktail hour you encourage responsible consumption of alcohol by preparing one drink per person. Knowing your chemistry for the following chemical equation, you decide to hand out breathalyzer tests.



Ethanol

Potassium  
DichromateSulfuric  
AcidChromium (III)  
SulfateAcetic  
AcidPotassium  
Sulfate

Water

**(a) (2 points)** What color needs to be observed by the test to indicate the presence of ethanol?

(a) Orange

(b) Green

**(b) (4 points)** Explain your reasoning, chemically, in two sentences or less

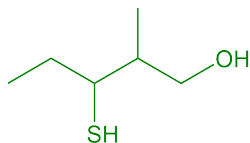
**(a) and (b) (6 points)**

For the chemical reaction to proceed, products are produced and reactants are consumed. Thus, the orange potassium dichromate is depleted as the green chromium(III) sulfate is produced.

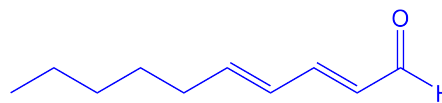
**10. (16 points)** The turkey comes out of the oven and you start preparing beef-and-vegetable gravy. With your expert nose and chemistry expertise you identify three volatile compounds as the principle contributors to the gravy's smell. These molecules with the associated scent profile are shown below.



3-(Methylthio)propanal  
Cooked Potato



3-Mercapto-2-methylpentan-1-ol  
Sulfur (Onion) Compounds



2,4-Decadienal  
Deep-Fried Foods

**(a) (10 points)** Fill in the blanks.

*3-(methylthio)propanal has/does not have an aldehyde functional group. 3-mercapto-2-methylpentan-1-ol has/does not have an alkane functional group; 3-mercapto-2-methylpentan-1-ol has/does not have an alcohol functional group. 2,4-decadienal has/does not have an ester functional group; 2,4-decadienal has/does not have an alkene functional group.*

**(b) (2 points)** R-SH is the thiol functional group. When naming molecules based on the IUPAC system, do alcohols or thiols take priority in naming the molecule? Hint, I have listed the IUPAC names of the three molecules in the above structures.

- (a) Alcohols
- (b) Thiols

**(c) (4 points)** Explain your answer above.

**(a) (10 points)**

*3-(methylthio)propanal has an aldehyde functional group. 3-mercapto-2-methylpentan-1-ol has an alkane functional group; 3-mercapto-2-methylpentan-1-ol has an alcohol functional group. 2,4-decadienal does not have an ester functional group; 2,4-decadienal has an alkene functional group.*

**(b) and (c) (6 points)**

Alcohols take priority since 3-mercapto-2-methylpentan-1-ol has both an alcohol and thiol functional group, yet has -ol as the suffix for the IUPAC name.

**11. (5 points)** A family member is on the keto diet and decides to eat the turkey and states they are “in a metabolic state of ketosis”. Your 10-year-old cousin says “what?”, looks clueless, and then proceeds to eat the marshmallows off the yams. What do you say to your cousin to help better explain what ketosis is? (Note, don't be too hard on yourself for this question! There are many ways to answer this question well and what matters most is writing it in your own authentic voice).

Ketosis is when you get your energy from different sources (the fancy name is ketone bodies) when you don't eat sweets.