

Name: \_\_\_\_\_ Student ID \_\_\_\_\_

**Prince of Songkla University**  
**Faculty of Engineering**

**Final Exam, Semester II**

**Date: February 21, 2004**

**Subject: 230-476 – Safety**

**(Safety in Chemical Engineering Operations)**

**Academic Year: 2003 – 2004**

**Time: 9:00 – 12:00 PM**

**Room: R200**

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**Instructions: There are a total of 5 parts 10 pages not including the cover sheet. Place your name and the student ID number on every page. Students are allowed to use only a pen or pencil. After you finish the Closed Book Section, I will give you the Open Book Section. No exams are allowed to leave the room.**

<b>Points Distribution (For Grader Only)</b>		
<b>Part</b>	<b>Points Value</b>	<b>Score</b>
<b>I</b>	<b>25</b>	
<b>II</b>	<b>60</b>	
<b>III</b>	<b>35</b>	
<b>IV</b>	<b>45</b>	
<b>V</b>	<b>35</b>	
<b>Total</b>	<b>200</b>	

**Exam prepared by  
Ram Yamsaengsung  
February 16, 2004**

**PLEASE CHECK TO MAKE SURE THAT  
YOU HAVE ALL 10 PAGES OF THE EXAM BEFORE BEGINNING  
(not including the cover sheet).**

**PSU POLICY  
CHEATING RESULTS IN AN E IN ALL SUBJECTS!!!**

**GOOD LUCK!**

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**CLOSED BOOK SECTION (No books or notes allowed)**

**I. Fill in the blanks (25 points)**

1. The \_\_\_\_\_ should be designated in a safe place in the open air where workers evacuating can meet.
2. \_\_\_\_\_ should be worn when working with toxic and \_\_\_\_\_ chemicals.
3. \_\_\_\_\_ should leave the building immediately upon hearing the fire alarm.
4. The \_\_\_\_\_ will relieve the lab superintendent of the responsibility of main control and direct the shutting down and evacuation of the laboratory.
5. If organic solvents are used for cleaning equipment, the work (cleaning) should be done in a \_\_\_\_\_.
6. An \_\_\_\_\_ is used to prepare workers for emergencies such as the release of toxic gas.
7. If there are some workers trapped inside the building, the 3 main tasks of emergency services team are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
8. Fire fighters, rescuers, first-aid providers are all \_\_\_\_\_ and will work under the direction of the \_\_\_\_\_ and later the \_\_\_\_\_.
9. The first-aid box should be provided in laboratories and should be located near the \_\_\_\_\_ with a list of trained personnel alongside.
10. After spillages, areas should be cleaned and \_\_\_\_\_ for at least \_\_\_\_\_ minutes.
11. The \_\_\_\_\_ have the responsibility of assisting the orderly evacuation of the building.
12. Upon discovering a major vapor or liquid escape of a hazardous material, persons should \_\_\_\_\_ and leave immediately.
13. A communicating door must be able to provide fire resistance for at least \_\_\_\_\_.
14. For high pressure equipment, the safety devices that must be installed include \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

15. HAZOP is an abbreviation for \_\_\_\_\_ which is a safety check lists that should be carried out before authorizing work liable to have serious mechanical, flammable, or toxic hazard.
16. Experiments can be classified as \_\_\_\_\_ and \_\_\_\_\_.

## **II. Shorts Answers (60 points)**

1. Name 4 items that should be listed in the appendices of a Laboratory Safety Manual. **(5 points)**
2. For each rig, name 5 items that the operating instructions must cover. **(5 points)**
3. Name 4 purposes of experimentation on the pilot-scale. **(4 points)**
4. When working with machineries or moving parts, how must the machines be chosen? **(2 points)**

5. Name 5 outside resources are generally contacted in cases of laboratory emergencies. **(5 points)**
6. Name 4 usual causes of emergencies. **(5 points)**
7. What are the 2 main purposes of fire drills? **(2 points)**
8. When an emergency alarm goes-off (toxic gas release), what should personnel/workers do? In case of toxic releases, if the building is located upwind, what should you do? **(2 points)**
9. Name 3 specific aims of first-aid. **(3 points)**

10. Name 4 types of injuries that must reported immediately. **(4 points)**
  
11. Name 4 accidents that must be reported immediately. **(4 points)**
  
12. According to the Recent Chemical Accidents article, what are the 5 common factors of these accidents? **(5 points)**
  
13. List the Safety Precedence Sequence listed in the Recent Chemical Accidents article. **(6 points)**
  
14. List 4 Guide Words and 4 Parameters that are used in HAZOP. **(8 points)**

**III. Process Safety Beacon and Case Studies (35 points)**

1. Write the meaning of each of these acronyms. **(5 points)**

- 1. NEMA \_\_\_\_\_
- 2. EFR \_\_\_\_\_
- 3. AIT \_\_\_\_\_
- 4. MCAS \_\_\_\_\_
- 5. BLEVE \_\_\_\_\_

2. What are the two risk assessment criteria that are generally used? **(2 points)**

3. Draw a diagram of a typical storage tank and the safety devices that must be installed. **(8 points)**

4. What is the title of your semester project? Name 2 other semester projects that were presented by your classmates. **(6 points)**

5. Draw a schematic diagram of a control valve and the necessary components involved. **(5 points)**
6. Match the following information with the article that it was from? **(9 points)**
- (a) Reactive Chemistry: Not always when or where you want it!**
  - (b) What? No Spark?**
  - (c) A “Good Idea” Can Turn Bad...when you ignore Management of Change**
  - (d) Interlocked for a Reason...a Very Good Reason!**
  - (e) Static Electricity + Flammables + Air = ??**
  - (f) Simple Mixing Chemicals...can be Hazardous to your Health**
  - (g) Dust did This?**
  - (h) Don't pop your top...**
  - (i) But the pressure rating was okay...!?**
- \_\_\_ **1. Draining oil from a large gear box using an air hose**
  - \_\_\_ **2. Pipe FULL of peroxide**
  - \_\_\_ **3. The air purge system was not interlocked to the sieve operation**
  - \_\_\_ **4. A second explosion took place**
  - \_\_\_ **5. A fire water system was used in the operation**
  - \_\_\_ **6. The instrument failed because it could not withstand the steam pressure at the elevated temperature**
  - \_\_\_ **7. An exothermic reaction took place when organic materials passed through activated carbon**
  - \_\_\_ **8. A heater exploded because the operator skipped one of the operating procedure**
  - \_\_\_ **9. A worker did not study the MSDS and his hand was severely burned**

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**OPEN BOOK SECTION (You can use the Case Studies and HAZOP Handout)**

**IV. Short Answers (45 points)**

1. Discuss the various reasons why a company does not want any accident to take place? **(5 points)**
  
  
  
  
  
  
  
  
  
  
2. Name two different administrative procedures that Shotiwat enforces to minimize hazards and to prevent accidents? **(4 points)**
  
  
  
  
  
  
  
  
  
  
3. If an existing plant must undergo HAZOP, who should be included in the HAZOP team? **(6 points)**



4. From the HAZOP study of the Olefin Dimerization Unit: Line Section from Intermediate Storage to buffer/settling tank, answer the following questions. What are the possible causes of More Pressure and the consequences that followed? **(4 points)**
  
5. What is a DCS? What is CFD? What is UTS? What is TNT? **(4 points)**
  
6. Name 4 types of fires? **(2 points)**
  
7. What does a control loop consist of? What is range of valve stroke that should be used when operating a control valve? **(2 points)**
  
8. What caused the Bhopal Accident? What is MIC used in and which company owned the MIC plant? **(3 points)**
  
9. In the Case Study presented in the MCAS article, which scenario of Ammonia release is the most dangerous? Which has the highest probability of occurring? Which scenario lies in the uncertainty range? **(3 points)**

10. What was the common compound that caused the 5 major explosions in China? Which accident resulted in the most number of deaths? **(2 points)**
  
11. What accidents can lead to the Domino Effects of Chains of Accidents? What is the radius of the fire ball created by the secondary accident in the Refinery I of MRL? **(2 points)**
  
12. What are the common types of enclosure used in outdoor applications and indoor applications? What type of materials are recommended for Acids and Alkalies resistance? **(3 points)**
  
13. What are the 3 fluid properties that must be considered in thermal fluid systems? If a system circulates 800 gal of fluid with a thermal expansion of 0.08 gal/gal of fluid per 100°F temperature rise and operates at 420°F, determine the size of the expansion tank for this system. Assume that room temperature is 70°F. **(3 points)**
  
14. What are the two types of floating roof tanks and when should they be used? **(2 points)**

