

Name: _____ Student ID _____

**Prince of Songkla University
Faculty of Engineering**

Final Exam, Semester II

Date: February 19, 2009

Subject: 230-334 – Safety

(Safety in Chemical Engineering Operations)

Academic Year: 2008 – 2009

Time: 9:00 – 12:00 PM

Room: A201, A203

ทฤษฎีในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียน 1 ภาคการศึกษา

Instructions: There are a total of 5 parts 13 pages not including the cover sheet. Place your name and the student ID number on every page. This is a CLOSED BOOK exam. Students are allowed to use only a pen or pencil. No exams are allowed to leave the room.

Points Distribution (For Grader Only)		
Part	Points Value	Score
I	35	
II	45	
III	50	
IV	35	
V	30	
Total	195	

**Exam prepared by
Ram Yamsaengsung
February 16, 2009**

**PLEASE CHECK TO MAKE SURE THAT
YOU HAVE ALL 13 PAGES OF THE EXAM BEFORE BEGINNING
(not including the cover sheet).
GOOD LUCK!**

Prince of Songkla University
Faculty of Engineering

Final Exam, Semester II
Date: February 19, 2009
Subject: 230-334 – Safety
(Safety in Chemical Engineering Operations)

Academic Year: 2008 – 2009
Time: 9:00 – 12:00 PM
Room: A201, A203

CLOSED BOOK SECTION (No books or notes allowed)

I. Fill in the Blanks (35 points)

1. The _____ is the person responsible for mechanical maintenance and knows many of the faults that occur.
2. The _____ is usually a chemical engineering who draws up the flow sheet of a new plant.
3. The _____ is responsible for investigating technical problems and for transferring laboratory results to plant scale operations.
4. The _____ is responsible for plant operation as is known as a supervisor or superintendent in most US companies.
5. The _____ is usually a chemical engineer who will have to start up and operate the plant (with a new design).
6. The five components needed for a dust explosion to are _____, _____, _____, _____, and _____.
7. Experiments can be classified as _____ and _____.
8. An _____ is used to prepare workers for emergencies such as the release of toxic gas.
9. If there are some workers trapped inside the building, the 3 main tasks of emergency services team are _____, _____, and _____.
10. The _____ should be designated in a safe place in the open air where workers evacuating can meet.
11. 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.
12. Tanks containing _____ have a red band and tanks that contain _____ have yellow band.
13. To produce a fire, it is necessary to have _____, _____, and _____.
14. The amount of water pressure needed to put out a 240V electricity fire is _____ lb_f or only 70 lb_f using clean water.
15. After spillages, areas should be cleaned and _____ for at least _____ minutes.

16. The _____ will relieve the lab superintendent of the responsibility of main control and direct the shutting down and evacuation of the laboratory.
17. _____ should leave the building immediately upon hearing the fire alarm.
18. Fire fighters, rescuers, first-aid providers are all _____ and will work under the direction of the _____ and later the _____.
19. The first-aid box should be provided in laboratories and should be located near the _____ with a list of trained personnel alongside.
20. The _____ have the responsibility of assisting the orderly evacuation of the building.
21. Upon discovering a major vapor or liquid escape of a hazardous material, persons should _____ and leave immediately.
22. A communicating door must be able to provide fire resistance for at least _____.

II. Fire Prevention and Fire Fighting Procedures (45 points)

1. Name 5 things one must consider in preparing his/her organization for a fire. **(5 points)**

2. Name 4 basic ways to prevent a fire in home and office. **(4 points)**

3. Name 4 ways of extinguishing a fire. **(4 points)**

4. Which type of fire is the following: (Type A, B, C, or D) **(4 points)**

- Metallic fire such as magnesium
- Fire involving paper, wood, cloths
- Electrical Fire
- Gas or oil fire

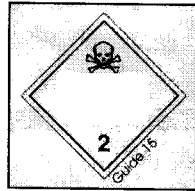
5. Name 4 outside resources are generally contacted in cases of laboratory emergencies. **(4 points)**

6. When we see a fire, what 4 things must we do? **(4 points)**

7. 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? **(4 points)**

8. Match the following symbol with the description below. (6 points)

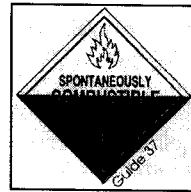
- ___ Oxidizing agents
- ___ Harmful, keep away from food stuffs
- ___ Flammable
- ___ Can easily combust without external influences
- ___ Poisonous gas
- ___ Radioactive material



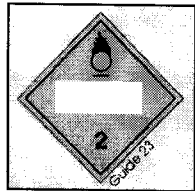
(a)



(b)



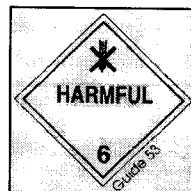
(c)



(d)



(e)



(f)

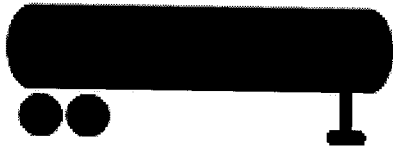
9. From the Fire Training hosted by the Hat Yai Fire Department, discuss ALL the different scenarios presented and ways of handling them (for example: gas tank leak with and without regulator). Make sure you mention all the training techniques that you were taught. (10 points)

III. Short Answers (50 points)

1. What is this a symbol of? What type of liquid does it generally store? Give 2 examples of chemicals that are stored in this container? (3 points)



2. What does this symbol represent? What does it generally transport? How is this liquid stored at customers location? (3 points)



3. What does this symbol represent? What does it generally transport? How is this liquid stored at customers location? (3 points)



4. What is the most common color for a storage cylinder and how often must the tanks be tested? (2 points)

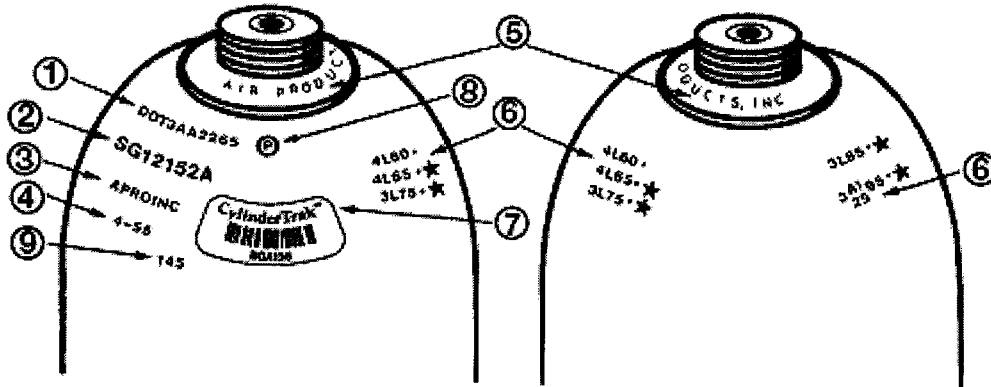
5. List 4 Guide Words and 4 Parameters that are used in HAZOP. (8 points)

6. If an existing plant must undergo HAZOP, name 4 persons that must be included in the HAZOP team? (4 points)

7. Conduct a HAZOP analysis of a boiler at an industry (or our ChE dept.). Use the **TWO GUIDE WORDS** and fill out the table. Identify the **Possible Causes**, the **Consequences**, and the **Action Required**. (10 points)

Guide Word	Deviation	Possible Causes	Consequences	Action Required
MORE OF	More Temperature	(1) _____ _____	_____ _____	(a) _____ _____
				(b) _____ _____
				(c) _____ _____
LESS OF	Low Water Level	(1) _____ _____	_____ _____	(d) _____ _____
		(2) Line Leakage	_____ _____	(e) Regular inspection
			_____ _____	

8. Cylinder Identification (8 points)



Use the following information to answer the following questions.

1. DOT3AA3500
2. SG12152A
3. GASINC (Registered Symbol of Gas Inc.)
4. 8-60
5. Department of Chemical Engineering
6. 5L05 +
7. Cylinder Tank Bar Code Label – BGA136
8. Cylinder Manufacturer's Inspection marking
9. TW 150

- 8.1 When was this tank manufactured?
- 8.2 Who is the current owner of this tank?
- 8.3 What is the tare weight of this tank?
- 8.4 What is the working pressure of this tank?
- 8.5 Who is the original owner of this tank?
- 8.6 What do the letters SG stand for?
- 8.7 When was this tank retested? (month and year)
- 8.8 Does this cylinder meet the requirement for 10-year retest?

9. Discuss 5 reasons why a company does not want any accident to take place? **(5 points)**

10. From the HAZOP handout, what do PG, LIC, PIC, RF stand for? **(4 points)**

IV. Process Safety Beacon and Case Studies (35 points)

1. Write the meaning of each of these acronyms. **(8 points)**

- 1. NEMA _____
- 2. EFR _____
- 3. AIT _____
- 4. MCAS _____
- 5. BLEVE _____
- 6. MSDS _____
- 7. DOE _____
- 8. MOC _____

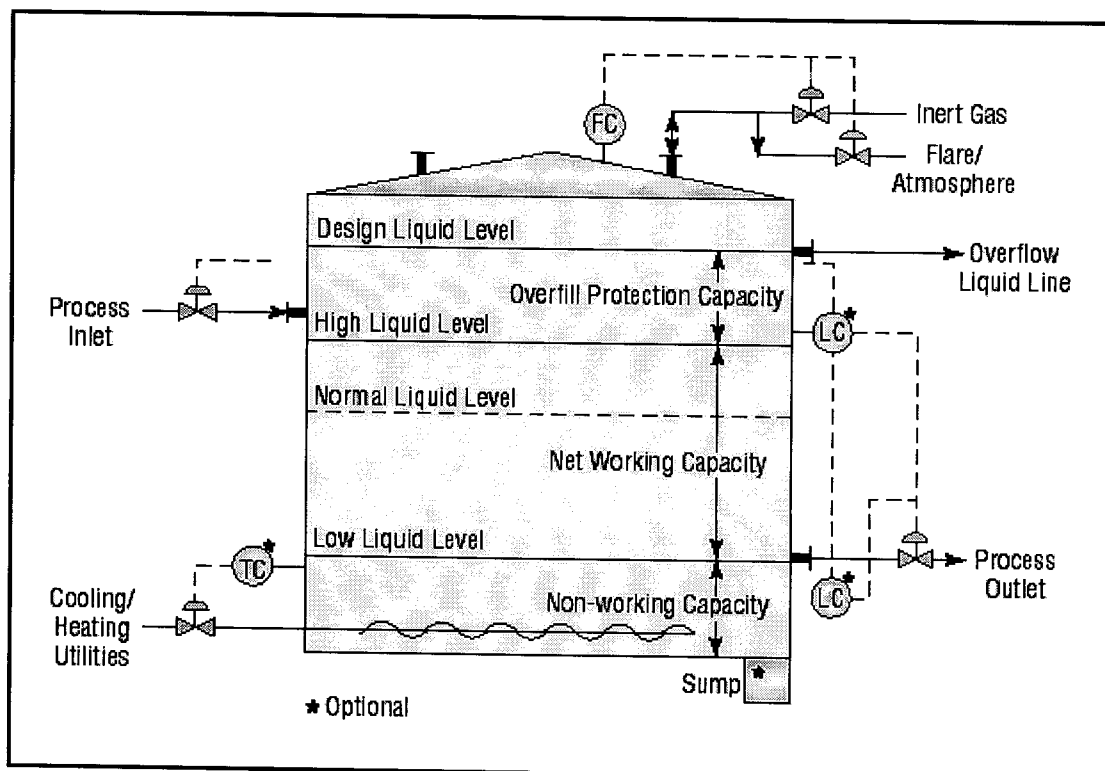
2. What are the two risk assessment criteria that are generally used? **(2 points)**

3. From the MCAS study, what are the 3 types of major damages that must be considered in assessing the overall risk of accident? **(3 points)**


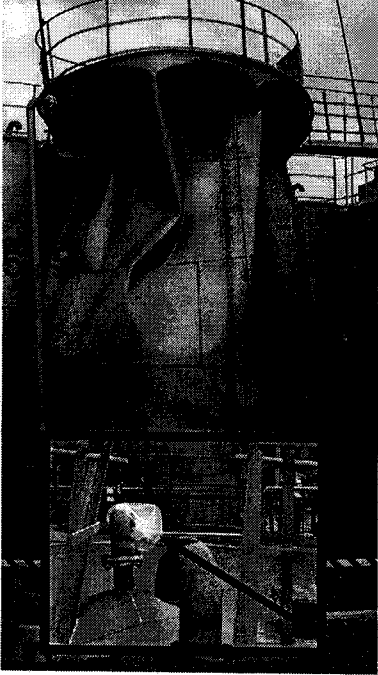
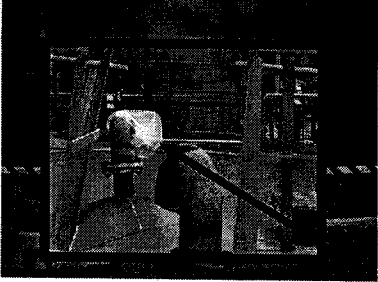

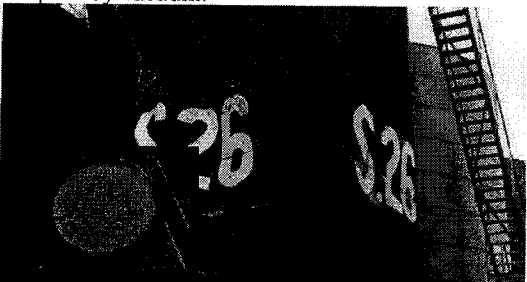
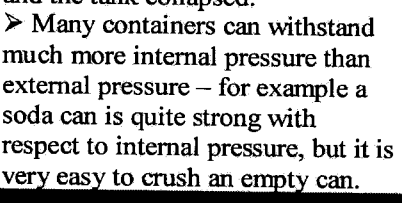
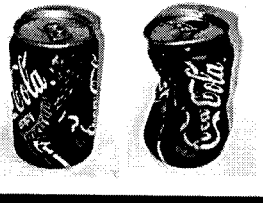
4. What are the two types of Flame Arresters and what is the difference between the two? (4 points)

5. What is the difference between an Internal Floating Roof and an External Floating Roof? Which condition is the IFR more suitable for? (2 points)

6. Draw a diagram of a typical storage tank and the safety devices that must be installed. (10 points)



7. Read the PSB article below and answer the following questions? (6 points)

	<p style="text-align: center;">Process Safety Beacon</p> <p style="text-align: center;">http://www.aiche.org/ccps/safety/beacon.htm Messages for Manufacturing Personnel</p>	<p style="text-align: center;">Sponsored by CCPS Supporters</p>
<p>February 2007</p>		
<p><u>Vacuum Hazards - Collapsed Tanks</u></p>		
	<p>The tank on the left collapsed because material was pumped out after somebody had covered the tank vent to atmosphere with a sheet of plastic. Who would ever think that a thin sheet of plastic would be stronger than a large storage tank? But, large storage tanks are designed to withstand only a small amount of <i>internal</i> pressure, not vacuum (external pressure on the tank wall). It is possible to collapse a large tank with a small amount of vacuum, and there are many reports of tanks being collapsed by something as simple as pumping material out while the tank vent is closed or rapid cooling of the tank vapor space from a thunder storm with a closed or blocked tank vent. The tank in the photograph on the right below collapsed because the tank vent was plugged with wax. The middle photograph shows a tank vent which has been blocked by a nest of bees! The February 2002 Beacon shows more examples of vessels collapsed by vacuum.</p>	
		
<p><u>Did you know?</u></p>		<p><u>What can you do?</u></p>
<ul style="list-style-type: none"> ➤ Engineers calculated that the total force from atmospheric pressure on <u>each panel</u> of the storage tank in the left photograph was about 60,000 lbs. ➤ The same calculation revealed that the total force on the plastic sheet covering the small tank vent was only about 165 lbs. Obviously this force was not enough to break the plastic, and the tank collapsed. ➤ Many containers can withstand much more internal pressure than external pressure – for example a soda can is quite strong with respect to internal pressure, but it is very easy to crush an empty can. 		<ul style="list-style-type: none"> ➤ Recognize that vents can be easily blocked by well intended people. They often put plastic bags over tank vents or other openings during maintenance or shutdowns to keep rain out of the tank, or to prevent debris from entering the tank. If you do this, make sure that you keep a list of all such covers and remove them before startup. ➤ Never cover or block the atmospheric vent of an operating tank. ➤ Inspect tank vents routinely for plugging when in fouling service.
		
<p style="font-size: small;">AIChE © 2007. All rights reserved. Reproduction for non-commercial, educational purposes is encouraged. However, reproduction for the purpose of resale by anyone other than CCPS is strictly prohibited. Contact us at ccps_beacon@aiiche.org or 212-591-7319</p>		

- 7.1 What caused the tank on the left to collapse?

- 7.2 What other things have been known to cover tank vents?

- 7.3 What is recommended to prevent such an accident?

- 7.4 Why do operators usually cover tank vents with something like a piece of plastic during maintenance and shut downs? What should they do immediately before start up?

V. CSB Video (30 points)

1. Match the following information with the safety video that it was from?
(20 points)

- (a) Wastewater Plant Explosion in Florida**
- (b) Explosion and Fire at Formosa PVC in Illinois**
- (c) Propane Explosion at Ghent, West Virginia**
- (d) Propylene Fire at Praxair in St. Louis**
- (e) Blast Waves in Danvers**

- 1. Maintenance workers were killed repairing an ethanol storage tank.
- 2. Ten thousand pounds of flammable liquid were heated and mixed for more than 8 hours releasing heptane and propanol vapor.
- 3. A relieve valve set point was too low.
- 4. The accident had to do with making pizza.
- 5. Acetylene gas tanks rocketed (shot off) as far as 800 ft.
- 6. A worker did not know if the reactor was on or off and drained the wrong reactor.
- 7. An inexperience technician was transferring propane.
- 8. Blast waves woke up sleeping residents on eve of Thanksgiving.
- 9. A flame arrester was badly corroded allowing sparks to enter the tank.
- 10. Supervisor forgot to turn off steam valve.
- 11. Four workers died because they did evacuate immediately when a pool of flammable liquid was building up.
- 12. An operator turned the wrong way when he went downstairs to drain water from a reactor.
- 13. A safety plug released liquid fuel when it was opened.
- 14. An operator bypassed an interlock and released vinyl chloride for a reactor
- 15. An explosion occurred at a compressed gas facility.
- 16. A convenience store/gasoline station exploded.
- 17. "Hot Work" accident.
- 18. A hot summer day caused a relief valve to release gas.
- 19. This accident occurred at a quiet residential neighborhood near Boston.
- 20. Plastic piping cracked after the tank exploded.

2. From the CSB Video, discuss the causes of the **Blast Waves at Danvers**, how much damage resulted, and how the accident could have been prevented.
(10 points)



**Congratulations and Good Luck on your Job Search!!!
See you back for Graduation!**