

Name: _____ Student ID _____

**Prince of Songkla University
Faculty of Engineering**

Final Exam, Semester I

Date: October 4, 2011

Subject: 230-334 – Safety

(Safety in Chemical Engineering Operations)

Academic Year: 2011 – 2012

Time: 1:30 – 4:30 PM

Room: Robot

ทฤษฎีในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียน 1 ภาคการศึกษา

Instructions: There are a total of 4 parts 13 pages not including the cover sheet. Place your name and the student ID number on every page. This is a CLOSE 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	60	
IV	45	
Total	185	

Exam prepared by
Ram Yamsaengsung
September 26, 2011

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

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CLOSED BOOK SECTION (No books or notes allowed)

I. Fill in the Blanks (35 points)

1. 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.
2. The five components needed for a dust explosion to are _____, _____, _____, _____, and _____.
3. Experiments can be classified as _____ and _____.
4. The _____ is responsible for investigating technical problems and for transferring laboratory results to plant scale operations.
5. The _____ is the person responsible for mechanical maintenance and knows many of the faults that occur.
6. _____ should leave the building immediately upon hearing the fire alarm.
7. Fire fighters, rescuers, first-aid providers are all _____ and will work under the direction of the _____ and later the _____.
8. The _____ is responsible for plant operation as is known as a supervisor or superintendent in most US companies.
9. The _____ is usually a chemical engineer who will have to start up and operate the plant (with a new design).
10. The _____ is usually a chemical engineering who draws up the flow sheet of a new plant.
11. Tanks containing _____ have a red band and tanks that contain _____ have yellow band.
12. The _____ will relieve the lab superintendent of the responsibility of main control and direct the shutting down and evacuation of the laboratory.
13. Steel support should be able to withstand fire (provide resistant for at least _____).
14. An _____ is used to prepare workers for emergencies such as the release of toxic gas.
15. After spillages, areas should be cleaned and _____ for at least _____ minutes.

16. The _____ have the responsibility of assisting the orderly evacuation of the building.
17. Upon discovering a major vapor or liquid escape of a hazardous material, persons should _____ and leave immediately.
18. A communicating door must be able to provide fire resistance for at least _____.
19. If there are some workers trapped inside the building, the 3 main tasks of emergency services team are _____, _____, and _____.
20. The _____ should be designated in a safe place in the open air where workers evacuating can meet.
21. The storage of bulk amount of toxic and chemical liquids is preferably stored in _____.
22. The preferred method of stacking drums in the open air is to stack them _____.
23. LPG is an abbreviation for _____ and must be stored in properly designed vessels, in which at least _____ unfilled space must be allowed to prevent the development of dangerous pressure.

II. Short Answers (45 points)

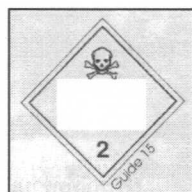
1. Which type of fire is the following: (Type A, B, C, or D) (4 points)
 Metallic fire such as magnesium
 Fire involving paper, wood, cloths
 Electrical Fire
 Gas or oil fire

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

3. 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)

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

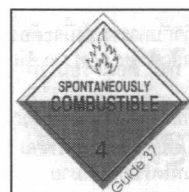
- ___ Oxidizing agents
- ___ Harmful, keep away from food stuffs
- ___ Flammable
- ___ Can easily combust without external influences
- ___ Poisonous gas
- ___ Radioactive material



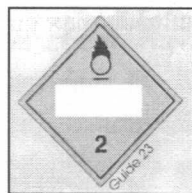
(a)



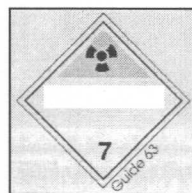
(b)



(c)



(d)



(e)



(f)

5. What is a Flame Arresters? (2 points)

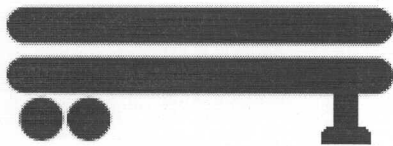
6. What is this a symbol of? What type of liquid does it generally store? Give 2 examples of chemicals that are stored in this container? (3 points)



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

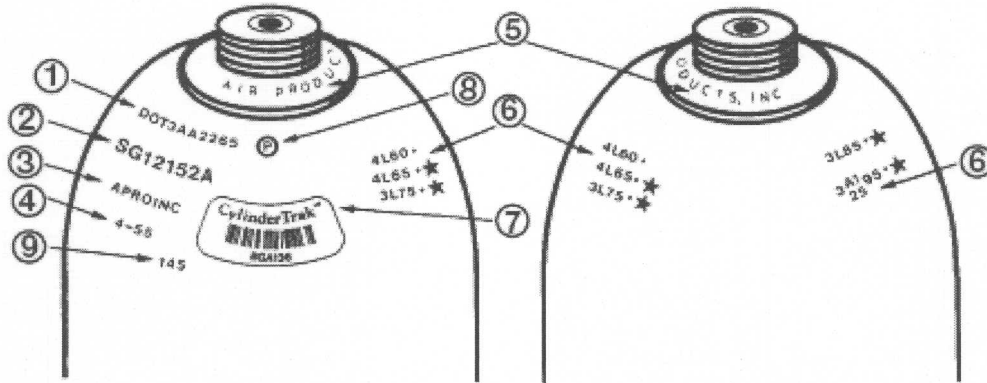


8. What does this symbol represent? What does it generally transport? How is this liquid stored at customers location? (3 points)



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

10. Cylinder Identification (8 points)



Use the following information to answer the following questions.

1. DOT3AA4500
2. SG12152A
3. GASINC (Registered Symbol of Gas Inc.)
4. 6-80
5. PTT
6. 09L00 +★
7. Cylinder Tank Bar Code Label – BGA136
8. Cylinder Manufacturer's Inspection marking
9. TW 145

10.1 When was this tank manufactured?

10.2 Who is the current owner of this tank?

10.3 What is the tare weight of this tank?

10.4 What is the working pressure of this tank?

10.5 Who is the original owner of this tank?

10.6 What do the letters SG stand for?

10.7 When was this tank retested? (month and year)

10.8 Does this cylinder meet the requirement for 10-year retest?

11. What 3 types of metals are used for gas cylinders? **(3 points)**

12. Name 3 purposes of experimentation on the pilot-plant scale? **(3 points)**

III. Risk Assessment, HAZOP and Storage Tank (60 points)

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

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

3. What are the 4 types of major damages that must be considered in assessing the overall risk of accident? **(4 points)**

4. Assess the following “Level – ระดับ” of an accident from 1 to 4. (6 points)
- 4.1 If an accident has a probability of occurring once in 5-10 years. _____
- 4.2 If an accident causes high magnitude of damage, “ความรุนแรงสูง”. _____
- 4.3 If an affected victim must be treated by a doctor, “มีการบาดเจ็บที่ต้องได้รับการรักษาจากแพทย์”. _____
- 4.4 If an accident causes the company to shut down parts of its production line, “ทรัพย์สินเสียหายมาก และต้องหยุดการผลิตเป็นบางส่วน”. _____
5. If an accident causes very high (สูง มาก) damage, but has not occurred within 10 years, what is its total hazard level (ระดับ ความเสี่ยงอันตราย)? (3 points)
6. List 4 Guide Words and 4 Parameters that are used in HAZOP. (8 points)
7. If an existing plant must undergo HAZOP, name 6 persons that must be included in the HAZOP team? (6 points)

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

9. 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)	(1)	(a) (b) (c)
LESS OF	Low Water Level	(1)	(1)	(d) (e)
		(2) Line Leakage	(2)	(f) Regular inspection

10. Draw a diagram of a typical storage tank and the safety devices that must be installed. What are LC and TC? **(12 points)**

IV. CSB Video and In-Class Accident Presentation (45 points)

1. From the Fire from Ice incident in Texas, answer the following question. **(10 points)**
 - 1.1. What is a “dead leg”? (2 points)
 - 1.2. Describe the cause of the accident. (3 points)
 - 1.3. Why did the section of the pipeline support 77 feet away fail (collapsed) from the “jet fire”? (2 points)

1.4. List 3 ways of preventing the accident. (3 points)

2. Match the following information with the Presentations from CLASS?
(14 points)

- (a) Fire from Ice, Valero, Texas
- (b) Static sparks explosion in Kansas
- (c) Wastewater Plant, Florida
- (d) Explosion and Fire at Formosa, PVC, Illinois
- (e) Propane Explosion at Ghent, West Virginia
- (f) Propylene Fire at Plax-Air, St. Louis
- (g) Blast Waves in Danvers, Massachusetts

- ___ 1. Explosion occurred at local convenient store.
- ___ 2. Explosion occurred at a paint company.
- ___ 3. Pipe made from PVC broken because of deformation of tank
- ___ 4. Fire and explosion caused by "hot works"
- ___ 5. Worker turned the wrong way trying to clean out a reactor
- ___ 6. Gas tanks rocketed into residential area damaging cars and buildings
- ___ 7. Explosion occurred during the transfer of non-conductive VANP Naphtha
- ___ 8. Replacement of gas tank and malfunction "cap" led to an explosion
- ___ 9. Worker bypassed an interlock and released dangerous toxic chemicals
- ___ 10. Structural support at this factory collapsed leading to broken pipelines
- ___ 11. Hot weather likely caused the release of gas
- ___ 12. Pipe broken because of cold weather
- ___ 13. Shockwaves destroyed windows miles away
- ___ 14. Air got inside a pipe and storage tank, causing turbulence

2. From the above VDO's, select one VDO and discuss how the accident could have been prevented. (5 points)

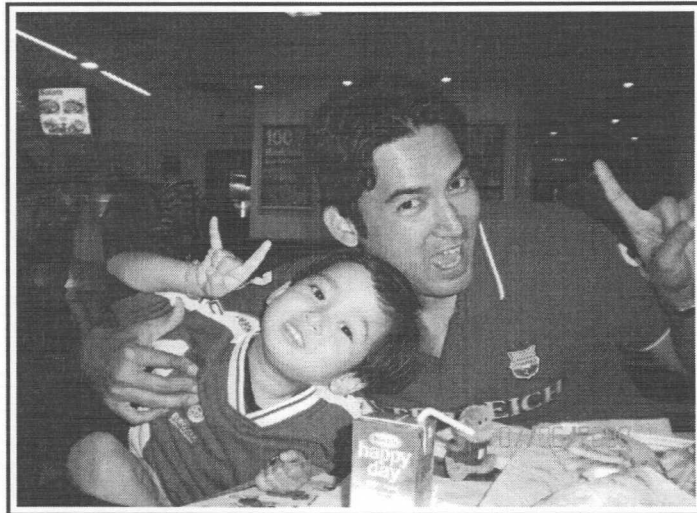
3. From the In Class Presentation above, select **TWO** of the presentations and (1) discuss the accident, (2) the possible causes of the accident, (3) consequences from the accident, and (4) recommendations about the accident or how it could have been prevented. **(16 points)**

Case 1:

Case 2:

BONUS: Match the following Ajarns with the university that they get their PhD's degree from. (5 points)

- | | |
|-------------------|--|
| 1. A.Pakamas | _____ Texas A&M University |
| 2. A. Sininart | _____ Prince of Songkla University |
| 3. A.Surasawasdee | _____ Johns Hopkins University |
| 4. A. Chayanoot | _____ Lehigh University |
| 5. A. Ram | _____ Colorado School of Mines |
| 6. A. Kulchanart | _____ University of Colorado |
| 7. A. Lupong | _____ Vanderbilt University |
| 8. A. Sukritthira | _____ Petroleum and Petrochemical College,
Chulalongkorn University |
| 9. A. Charun | _____ Chulalongkorn University |
| 10. A. Pornsiri | _____ Cranfield University (England) |



Congratulations and have a good vacation!