Name: _____ Student ID _____

Prince of Songkla University
Faculty of Engineering

Final Exam, Semester II
Date: May 16, 2015
Subject: 231-334 – Safety
(Safety in Chemical Engineering Operations)

Academic Year: 2014 – 2015
Time: 9:00 – 12:00 PM
Room: S104

ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 2 ภาคการศึกษา

Instructions: There are a total of 5 parts 12 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	22	
III	23	
IV	60	
V	50	
Total	190	

Exam prepared by
Ram Yamsaengsung
May 7, 2015

PLEASE CHECK TO MAKE SURE THAT
YOU HAVE ALL 12 PAGES OF THE EXAM BEFORE BEGINNING
(not including the cover sheet).
GOOD LUCK!

Prince of Songkla University
Faculty of Engineering

Final Exam, Semester I **Academic Year: 2014 – 2015**
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CLOSED BOOK SECTION (No books or notes allowed)

I. Fill in the Blanks (35 points)

1. Experiments can be classified as _____ and _____.
2. Equipment oriented can be classified broadly as _____, while material oriented can be considered _____.
3. The five components needed for a dust explosion to are _____, _____, _____, _____, and _____.
4. The _____ will relieve the lab superintendent of the responsibility of main control and direct the shutting down and evacuation of the laboratory.
5. An _____ is used to prepare workers for emergencies such as the release of toxic gas.
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 _____ have the responsibility of assisting the orderly evacuation of the building.
9. Upon discovering a major vapor or liquid escape of a hazardous material, persons should _____ and leave immediately.
10. A communicating door must be able to provide fire resistance for at least _____.
11. If there are some workers trapped inside the building, the 3 main tasks of emergency services team are _____, _____, and _____.
12. The _____ should be designated in a safe place in the open air where workers evacuating can meet.
13. 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.
14. A HAZOP study should take about _____ per main plant item.
15. The _____ is responsible for investigating technical problems and for transferring laboratory results to plant scale operations.

16. The _____ is the person responsible for mechanical maintenance and knows many of the faults that occur.
17. The _____ is usually a chemical engineer who will have to start up and operate the plant (with a new design).
18. The _____ is responsible for plant operation as is known as a supervisor or superintendent in most US companies.
19. The _____ is usually a chemical engineering who draws up the flow sheet of a new plant.
20. The _____ helps setup and check control devices and control systems for a new plant.
21. Machines or moving parts must run or be operated within their safe limits of _____, _____, _____, and _____.
22. For high pressure equipment, it is essential that the design pressure of pressure vessel should not be exceeded. This is called the _____ and must be clearly marked on all vessels.

II. SHORT ANSWERS (22 points)

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

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

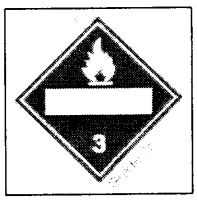
2. Name 4 outside resources are generally contacted in cases of laboratory emergencies. **(4 points)**

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)**

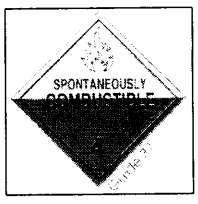
4. Match the following symbol with the description below. **(6 points)**

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

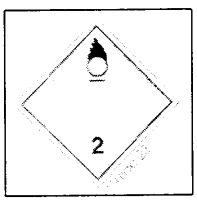
(a)



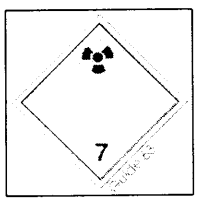
(b)



(c)



(d)



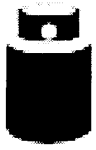
(e)

(f)

5. Name 4 purposes of experimentation on the pilot-plant scale? **(4 points)**

III. GAS CYLINDERS (23 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? **(4 points)**

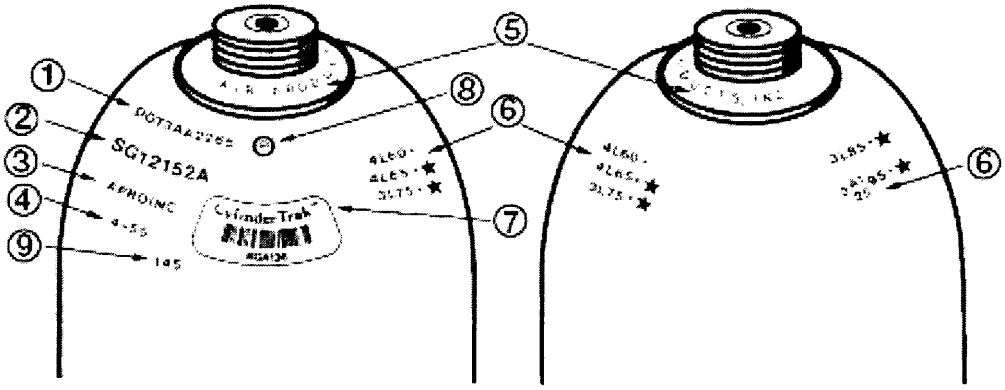


2. What does this symbol represent? What does it generally transport? How is this liquid stored at customers location? **(3 points)**

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. Cylinder Identification **(8 points)**



Use the following information to answer the following questions.

1. **DOT3AA5000**
2. **SG12152A**
3. **GASINC (Registered Symbol of Gas Inc.)**
4. **6-90**
5. **SCG**
6. **07L08 +★**
7. **Cylinder Tank Bar Code Label – BGA136**
8. **Cylinder Manufacturer's Inspection marking**
9. **TW 155**

11.1 When was this tank manufactured?

11.2 Who is the current owner of this tank?

11.3 What is the tare weight of this tank?

11.4 What is the working pressure of this tank?

11.5 Who is the original owner of this tank?

11.6 What do the letters SG stand for?

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

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

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

IV. RISK ASSESSNENT, 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. **(4 points)**

   4.1 If an accident has a probability of occurring once in 1-5 years. _____

   4.2 If an accident causes high magnitude of damage, "ความรุนแรงสูง". _____

   4.3 If an affected victim must be treated by a nurse, "มีการบาดเจ็บเล็กน้อยในระดับปฐมพยาบาล"". _____

   4.4 If an accident causes the company to shut down parts of its production line, "ทรัพย์สินเสียหายมาก และต้องหยุดการผลิตทั้งหมด". _____

5. If an accident causes very high (สูง มาก) damage, but has occurred once within 5 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)	-	(a) (b) (c)
LESS OF	Low Water Level	(1)	-	Cover by (a), (b), and (c) (d)
		(2) Line Leakage	-	(e)

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

V. CSB Video and In-Class Accident Presentation (50 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? **(20 points)**

(a) Fire from Ice, Valero, Texas
(b) Static sparks explosion in Kansas
(c) Propylene Fire at Plax-Air, St. Louis
(d) Explosion and Fire at Formosa, PVC, Illinois
(e) Blast Waves in Danvers, Massachusetts

___ 1. Air got inside a pipe and storage tank, causing turbulence
___ 2. Explosion occurred at a paint company.
___ 3. Shockwaves destroyed windows miles away
___ 4. Pipe made from PVC broken because of deformation of tank
___ 5. Worker turned the wrong way trying to clean out a reactor
___ 6. Explosion occurred during the transfer of non-conductive VANP Naphtha
___ 7. Worker bypassed an interlock and released dangerous toxic chemicals
___ 8. Structural support at this factory collapsed leading to broken pipelines
___ 9. Hot weather likely caused the release of gas
___ 10. Pipe broken because of cold weather

3. From the above VDO's, select one VDO can discuss how the accident could have been prevented. **(4 points)**

4. From the news report below, answer the questions below. **(8 points)**

Fire-affected production unit at IRPC plant closed for 90 days

Source: http://englishnews.thaipbs.or.th/. Posted on June 10, 2014 5:08 pm

Governor Thanee Samart said today (Tuesday) that the closure of the unit was intended to enable authorities concerned to find out the cause of the explosion which caused the VGOH unit to catch fire.

Damage to the unit and its subsequent closure will scale down the daily production of benzene by 1.3 million litres and 360 tonnes of propylene.

Pollution Control Department head Vichien Choongroongruang, meanwhile, said that initial checks of the air quality at the scene and adjacent areas showed that the amounts of toxic substances such as benzene, styrene, and sulphur dioxide are still within acceptable standards.

Mr Sukrit Surabotsophon, president of IRPC Corp, said that the company was in the process of assessing the damage caused to the production unit. He however said that other production units unaffected by the fire were operational as normal.

The entire facility was insured at US$1.2 billion, it was reported.

4.1 What is the production benzene and propylene is this plant? **(2 points)**

4.2 How long will the plant be closed down? **(2 points)**

4.3 Who is the President of IRPC at the time? **(2 points)**

4.4 Which toxic chemicals did the company checked for? **(2 points)**

5. From the **Oil Spill in the Gulf of Mexico, of the coast of Louisiana (US) on June 10, 2010,** (1) discuss the possible causes of the accident, (2) list 5 consequences from the accident, and (3) list recommendations for preventing the accident. **(8 points)**

Causes: (2 points)

5 Consequences: (3 points)

Recommendations: (3 points)

CONGRATULATIONS! END OF EXAM!

Bonus: (6 points)

1. What color jersey is Bright and Brave wearing?
2. What football team from Europe is it a jersey of?
3. Who is Bright's favorite football player?
   (a) Van Persie
   (b) Messi
   (c) Ronaldo
   (d) Nemar