

MMP-B4
Occupational Health, Safety and Loss Management

Open Book Exam and Calculator Permitted

3 Hours Duration

Notes:

1. An attempt is made to provide all relevant data, but in case of doubt the student is allowed to make assumption, however he/she is urged to submit with the answer paper a clear statement of any assumptions made while solving a problem.
2. Answer any five of the six questions.
3. Only the first five questions as they appear in your answer book will be marked.
4. Weight and expected time to complete of each question is mentioned just below the question.

Question # 1

- a) What is an accident process? Explain the three main steps involve in an accident process with example.

(5%, 10 minutes)

- b) The TLV-TWA (time weighted threshold limiting value) for a substance is 100 ppm and the short term exposure limit (STEL) is 200 ppm. The data were taken in the work area at the times indicted. Has the worker exceeded the exposure limits?

(15%, 25 minutes)

Time	Concentration (ppm)
8:10 AM	120
9:05 AM	150
10:07 AM	160
11:20 AM	175
12:12 PM	150
1:20 PM	165
2:03 PM	250
3:13 PM	220
4:01 PM	165
5 PM	150

Question # 2

- a) A mineral process facility has 1200 full time employees. In a particular year facility reported 38 lost-time injuries with a resulting 274 lost work days. Compute the OSHA incidence rate based on injuries and lost workdays.

(10%, 15 minutes)

- b) Explain the inherent safety concept and provide at least one practical application.

(5%, 10 minutes)

- c) Explain the term Risk with example: how is it different than Hazard?

(5%, 10 minutes)

Question # 3

- a) Normal air contains about 21% oxygen by volume. The human body is sensitive to reductions in oxygen concentration; concentrations below 19.5% are dangerous, and concentrations below 16% can cause distress. Respiratory equipment without self-contained air supplies must never be used in atmospheres below 19.5% oxygen. A storage tank of 1000 ft³ capacity must be cleaned before reuse. Proper procedures must be used to ensure that the oxygen concentration of the air within the tank is adequate. Compute the cubic feet of additional nitrogen at 77°F and 1 atm that will reduce the oxygen concentration within the tank to (i) 19.5% and (ii) 16%. Oxygen concentrations within tanks and enclosures can be reduced significantly by small amounts of inert elements!

(10%, 20 minutes)

- b) In a processing facility Ammonia, is stored under pressure (pressure 2000 psig and temperature 80 °F). A consequence analysis has determined that crack of 0.1 inch diameter is likely to form in the tank as a result of poor maintenance. Estimate the mass flow rate through this crack.

(10%, 20 minutes)

Question # 4

An autoclave in a processing facility contains 1000 lb of a liquid mixture of 50% by weight liquid solvent. The liquid solvent is near its boiling point. A study of various release scenarios indicates formation of boiling liquid pool on the ground. The boiling rate of solvent has been estimated to be 20 lb/min. Evacuation of the population must occur in areas where the vapor concentration exceeds ERPG-1 (5 ppm or 12.5 mg/m³). If the wind speed is 3.4 mph on a clear night, estimate the area downwind that must be evacuated.

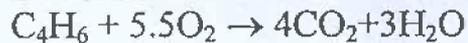
(20%, 35 minutes)

You may consider the following

- Solvent is released at ground level
- You may ignore the dense gas effect and consider this release and dispersion to be lighter than air.
- Consider the release area to be rural
- The atmospheric stability condition as Stable (Pasquill Gifford stability Class F)

Question # 5

- a) Develop flammability diagram for Butane.



(15%, 20 minutes)

- b) Explain type of explosion: deflagration and detonation?

(3%, 10 minutes)

- c) Explain basic condition/parameters required to cause a dust explosion?

(2%, 5 minutes)

Question # 6

- c) In a Ni ore refining facility solvent *RXP* is used to extract Ni. The solvent *RXP* is a volatile chemical. Through fugitive emission about 3.0 gal of solvent evaporates in an 8 hour shift. The ventilation condition in the processing facility is average ($k=1/5$). Determine the rate of dilution air required to maintain the process area safe for workers (time weighted threshold limit value of Solvent A is 50 ppm).

Temperature = 77 °F

Pressure = 1 atm

Specific gravity of solvent *RXP* = 0.85

Molecular weight of solvent A = 145

(10%, 20 minutes)

- b) Explain the main steps involved in Risk Management (you may use a flowchart). Explain with example how Risk Management is used in hazardous operation.

(10%, 15 minutes)

Marking Scheme

1. (a) 5 marks 2 marks for definition and 3 for each step of accident process
(b) 15 marks: 5 marks for each step
2. (a) 10 marks 5 marks for each steps
(b) 5 marks 3 marks for *inherent safety* definition and 2 marks for example
(c) 5 marks 3 marks for each term definition and 2 marks to identify difference
3. (a) 10 marks 5 marks for each steps
(b) 10 marks 5 marks for each step
4. 20 marks total 5 marks per sub question
5. (a) 15 5 marks each for LFL, UFL, and LOC calculation, and 5 mark for the Figure and 5 marks for identification of different region in the diagram
(b) 3 marks 1 mark for each explosion type explanation
(c) 2 marks 0.5 mark for each parameter/cause
6. (a) 10 marks 5 marks for each step of the numerical problem
(b) 10 marks 5 marks risk management explanation and its steps; 5 marks for risk management application