BITS, PILANI – DUBAI

FIRST SEMESTER 2009 – 2010

FINAL YEAR

COMPREHENSIVE EXAMINATION

Course Code: CHE C413 Date: 27.12.09
Course Title: Process Plant Safety Max Marks: 80
Duration : 3 hr (Closed Book) Weightage: 40%

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1. (a) What are the various parameters influence the toxicity of hazardous chemicals in the workplace? (4 m)

   (b) Discuss in detail about various types, characteristics and uses of the air purifying respirator. (6 m)

2. (a) Recommend the environmental guidelines for siting of industries to ensure optimum use of natural and man-made resources in a sustainable manner. (6 m)

   (b) What are the criteria needed for selecting sampling equipments and basic requirements for any sampling equipments? (2 + 3 m)

3. (a) Drive to determine the average concentration (in ppm) with assumptions, for any volatile species in an enclosure given a source and a ventilation rate Q_v. (6 m)

   (b) Recommend the precautions during storage of explosives. (4 m)

4. (a) Write in detail about the monitoring systems for safe pipeline. (3 m)

   (b) What all factors should be considered while choosing materials for process equipments and discuss in detail? (8 m)

5. (a) Discuss in detail about the HAZOP study procedure. (10 m)

   (b) Mention the basic steps involved in risk assessment process and discuss briefly. (3 m)

6. (a) Sketch the emergency information panel which is used for transporting hazardous chemicals. (6 m)

   (b) Discuss reaction hazards involved in oxidation process with an example. (4 m)

7. (a) What should be described in the operating manual for any operational practices in process industry? (4 m)

(b) Discuss reaction hazards involved in xanthation process (where CS_2 involved). (4 m)

8. (a) Discuss what went wrong in the Piper Alpha disaster which should include
   (i) the materials involved (1 m)
   (ii) root causes (2 m)
   (iii) what precautions should be considered in future to avoid such incidents (2 m)

(b) What may the significant industrial safety problem in sugar industries? (2 m)

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FIRST SEMESTER 2009 – 2010

FINAL YEAR

Course Code: CHE C413 — Test 2 — Date: 10.12.09

Course Title: Process Plant Safety — Max Marks: 20

Duration : 50 minutes — (Open Book) — Weightage: 20%

Note : Permitted to use "only prescribed Text book and original hand written notes" for the open book evaluation component. No photocopies of any sought shall be permitted.

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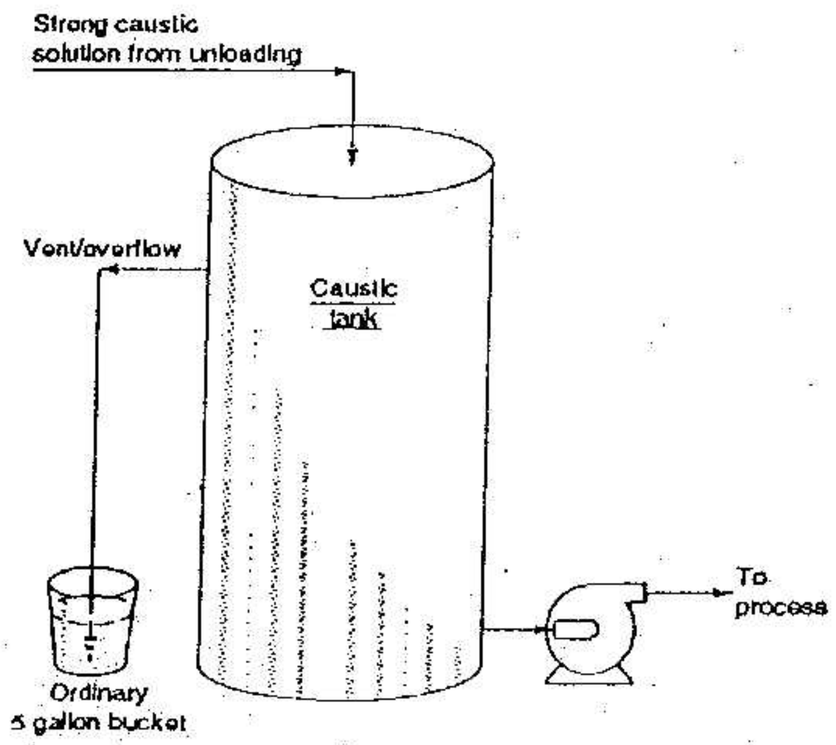
1. What all the sources are required for the dust explosion? (2.5 m)

2. Estimate the LFL and the UFL for heptane, derive the required equation. (2 + 2 m)

3. One thousand kilograms of methane (energy of explosion is 818.7 KJ/mol) escapes from a storage vessel, mixes with air, and explodes. Determine the equivalent amount of TNT and estimate the damage. Assume an explosion efficiency of 2%. (6 m)

4. The 3.5 m diameter tank was designed to periodically receive a strong caustic soda solution from a rail car. The piping inlet connection was to the top of the vessel. Once the tank car was unloaded, the fill line from the unloading station was steamed out with low-pressure steam to clear the line (shown in figure). However, during the steam-out process, some steam and air formed a mist which contained traces of caustic soda that escaped from the overflow line. If anyone were in the immediate vicinity during the steam-out, they might experience a bee sting sensation. A resourceful employee placed an ordinary 5 gallon plastic bucket on that overflow line and filled it with water. In this way, any steam and air would bubble through the water, capturing any possible caustic mist. However, the overflow line also served as a vent line. Caustic usually pumped to process only after unloading from rail car after closing the unloading ball valve. (3 m)

What will happen if above said is followed?



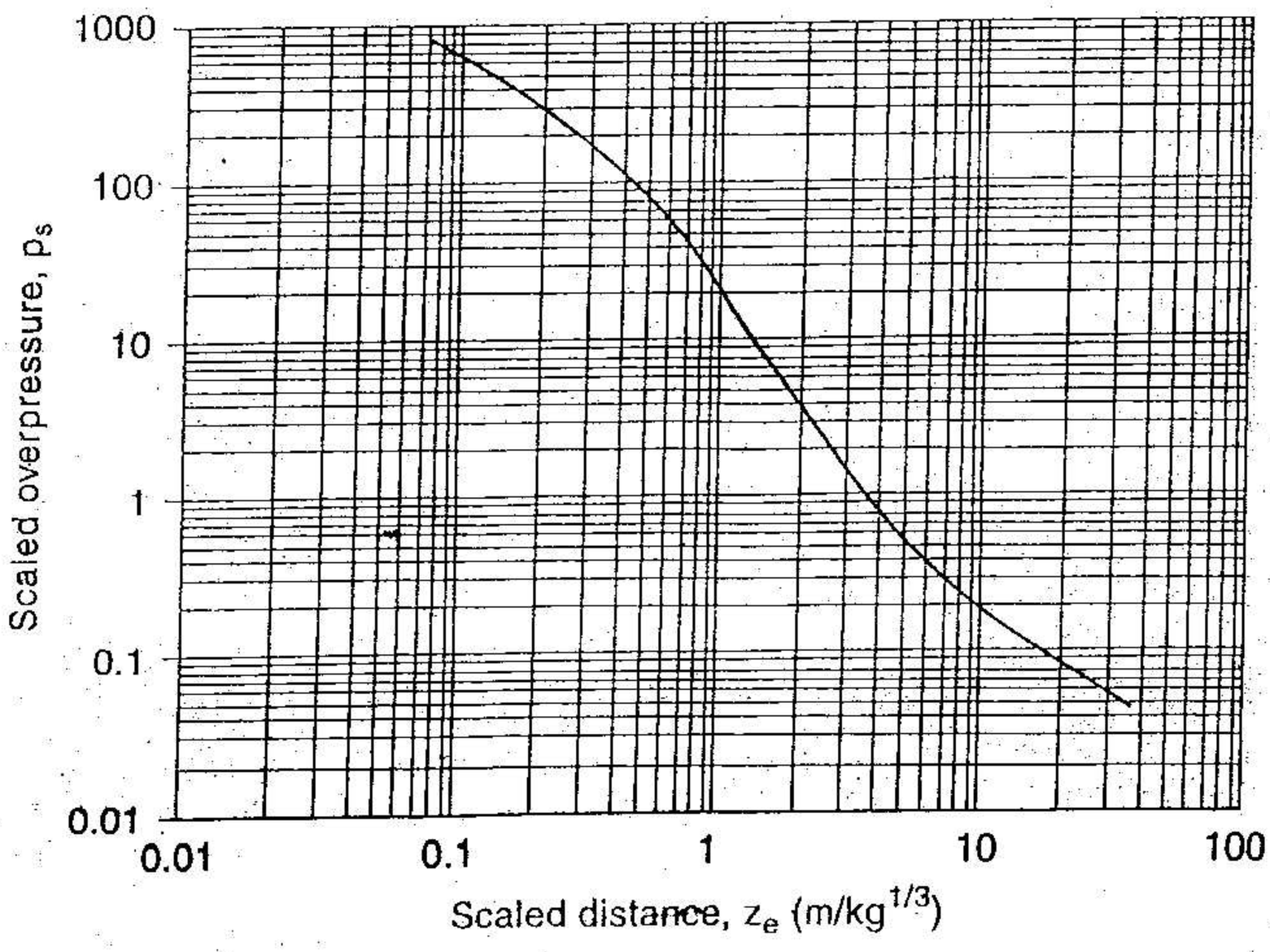
5. Mention the various techniques for evaluating hazards. (1.5 m)

6. Mention the risk associated with industrial activity. (1.5 m)

7. Discuss reaction hazards involved in neutralization process with an example. (1.5 m)

Pressure (these values are approximations)

Pressure		
psig	kPa	Damage
0.02	0.14	Annoying noise (137 dB if of low frequency, 10–15 Hz)
0.03	0.21	Occasional breaking of large glass windows already under strain
0.04	0.28	Loud noise (143 dB), sonic boom, glass failure
0.1	0.69	Breakage of small windows under strain
0.15	1.03	Typical pressure for glass breakage
0.3	2.07	"Safe distance" (probability 0.95 of no serious damage below this value); projectile limit; some damage to house ceilings; 10% window glass broken
0.4	2.76	Limited minor structural damage
0.5–1.0	3.4–6.9	Large and small windows usually shatter; occasional damage to window frames
0.7	4.8	Minor damage to house structures
1.0	6.9	Partial demolition of houses, made uninhabitable
1–2	6.9–13.8	Corrugated asbestos shatters; corrugated steel or aluminum panels, fastenings fail, followed by buckling; wood panels (standard housing), fastenings fail, panels blow in
1.3	9.0	Steel frame of clad building slightly distorted
2	13.8	Partial collapse of walls and roofs of houses
2–3	13.8–20.7	Concrete or cinder block walls, not reinforced, shatter
2.3	15.8	Lower limit of serious structural damage
2.5	17.2	50% destruction of brickwork of houses
3	20.7	Heavy machines (3000 lb) in industrial buildings suffer little damage; steel frame buildings distort and pull away from foundations
3–4	20.7–27.6	Frameless, self-framing steel panel buildings demolished; rupture of oil storage tanks
4	27.6	Cladding of light industrial buildings ruptures
5	34.5	Wooden utility poles snap; tall hydraulic presses (40,000 lb) in buildings slightly damaged
5–7	34.5–48.2	Nearly complete destruction of houses
7	48.2	Loaded train wagons overturned
7–8	48.2–55.1	Brick panels, 8–12 in thick, not reinforced, fail by shearing or flexure
9	62.0	Loaded train boxcars completely demolished
10	68.9	Probable total destruction of buildings; heavy machine tools (7000 lb) moved and badly damaged, very heavy machine tools (12,000 lb) survive
300	2068	Limit of crater lip



BITS, PILANI – DUBAI

FIRST SEMESTER 2009 – 2010

FINAL YEAR

Course Code: CHE C413 — **Test 1** — Date: 18.10.09

Course Title: Process Plant Safety — Max Marks: 25

Duration : 50 minutes — (Closed Book) — Weightage: 25%

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1. An open benzene container is weighed as a function of time, and it is determined that the average evaporation rate is 0.1 g/min. the ventilation rate is 3 m^3/min. the temperature is 320K and the pressure is 1 atm. Estimate the concentration of toluene vapor in the enclosure, and compare your answer to the TLV for benzene of 30 ppm and nonideal mixing factor is having 0.5 (4 m)

2. Mention the significance of DTA analysis for the explosives. (2m)

3. Discuss in detail about how safety and the layout of the process areas in any process plant are linked. (3 m)

4. Mention the PPE (other than head, eye and face protections) for Chlorine, NaOH (2 + 2 m)

5. Discuss in detail about various methods for monitoring the airborne chemicals at workplace environment. (12 m)

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FIRST SEMESTER 2009 – 2010

FINAL YEAR

Course Code: CHE C413
Course Title: Process Plant Safety
Duration : 20 minutes

QUIZ 2

(Closed Book)

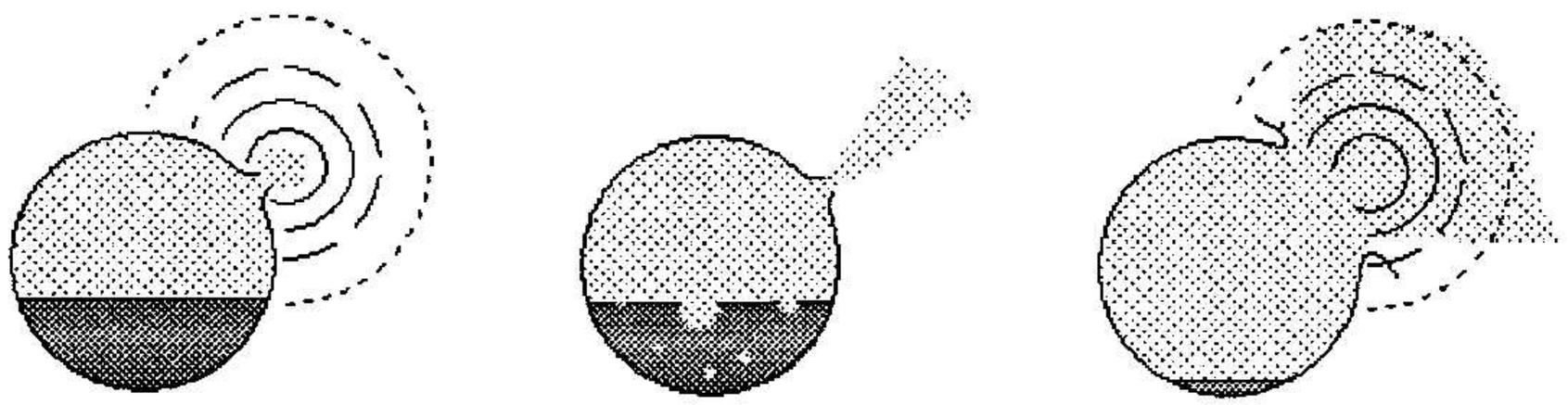
Date: 23.11.09
Max Marks: 07
Weightage: 7%

Name: ..... **ID No:** ..... **Sec / Prog:** .....

1. Match the following:(1 m each)

BLEVE	-boiling liquid evaporation vapor explosion
LOC	-a type of explosion
	- none
	-maximum safe oxygen concentration

2. Mention the type of an explosion represents from the following picture? (1 m)



3. Most solid _____ materials will explode if the particles are _____ enough and dispersed in sufficient concentration (2 m)

a) small b) large c) medium d) none e) none f) inorganic g) organic

4. Sketch the process of risk assessment study in a hazardous chemical manufacturing industry. (2 m)

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FIRST SEMESTER 2009 – 2010

FINAL YEAR

Course Code: CHE C413 — **QUIZ 1** — Date: 05.10.09

Course Title: Process Plant Safety — Max Marks: 08

Duration : 20 minutes — (Closed Book) — Weightage: 8%

Name: ..... **ID No:** ..... **Sec / Prog:** .....

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1. Which type of toxicants has zero threshold limit values? (1 m)

2. What are the hazards are protected by a) paper shoes b) shoes with non ferrous metal parts? (1+ 1 m)

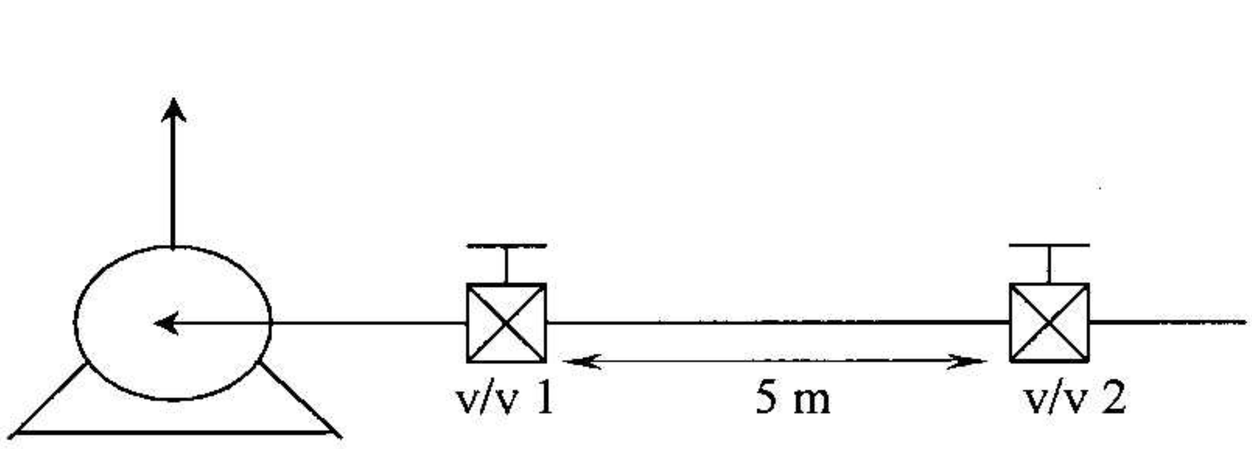
   a)

   b)

4. Disposable mask protects against _____
   (very fine dust, chemicals, none) (1m)

5. A butane pump was operated in a cold region for long time. It was isolated to remove the choke in the connected pipe line (1 feet dia). It was found with fully choked solids. A steam hose was used to clear the choke, soon after which was ignited by a furnace 40 m away and exploded.
   Discuss brief the reason behind the explosion. (2 m)

   It was confirmed that the valve 1 was closed and no liquid butane exists in the pipe lines. The valve 2 was removed to clear the choke in the pipe line.



6. Match the following:(1 m each)

Heavy chemical cartridge respirator	- High concentration
	Light concentration
	Oxygen deficient
	None

White with yellow stripes	- Ammonia
	Hydrocyanic acid vapors or hydrogen cyanide gas
	Organic vapors
	Carbon monoxide
	None