UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	SAFETY & MAINTENANCE ENGINEERING
COURSE CODE	:	DAM 20702
PROGRAMME	:	3 DAM
EXAMINATION DATE	:	MARCH 2012
DURATION	:	2 ½ HOURS
INSTRUCTIONS	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF FOURTEEN (14) PAGES

PART A.

1. The relative exposure to hazard is known as …

   A. Risk
   B. Danger
   C. hazard
   D. accident

2. Source or a situation with a potential for harm is known as …

   A. Risk
   B. Danger
   C. hazard
   D. Accident

3. Why need to carry out risk assessment?

   A. Organization requirement
   B. Employer requirement
   C. Legal requirement
   D. Employees requirement

4. The analysis of how and why the workers fall from defective ladder is known as …

   A. failure mode and effect analysis
   B. fault tree analysis
   C. risk analysis
   D. hazard analysis

5. The analysis of how and why the disaster could occur is known as …

   A. failure mode and effect analysis
   B. fault tree analysis
   C. risk analysis
   D. hazard analysis

6. The classification of consequences of a hazardous event could be …

   A. major injuries
   B. very likely
   C. unlikely
   D. likely

7. Which is NOT related to HIRARC?

   A. Risk assessment
   B. Hazard identification
   C. Risk control
   D. Risk centre

8. Below are the purpose of HIRARC EXCEPT …

   A. to investigate how and why the accident could happened.
   B. to identify all the factors that may cause harm to employees and others.
   C. to consider what are the probability of harm could occur and the possible severity that could come from it.
   D. to enable employers to plan, introduce and monitor preventive measures.

9. Determine the likelihood categories.

A. Highly unlikely
B. Fatalities
C. Major injuries
D. First aid injuries

10. The conclusion of hazard identification should contain ...

A. accident probabilities
B. summary of control measures
C. summary of possible severity
D. list of hazard sources

11. The most effective control measure in hazard control is ...

A. substitution
B. elimination
C. isolation
D. engineering control

12. Control by engineering design would NOT include ...

A. interlocking
B. installing safety device
C. supervision
D. limitation

13. Which of the following cannot be used in Hazard Identifications?

A. Job Safety Analysis
B. Consultation
C. Fault Tree Analysis
D. Performance measuring

14. Controlling the risk would probably involve ...

A. looking at the possibility of injury
B. recognizing things that may cause injury or harm
C. reviewing steps and changing standard
D. introducing new technology

15. Poorly maintained scaffold can cause ..... hazard.

A. falling from height
B. falling from same level
C. electrocution
D. suffocation

16. Which of the following is NOT a mechanical hazard?

A. Entanglement
B. Shearing
C. Cutting
D. Explosion

17. A hazard where objects act against the inertia of the body but do not penetrate it is known as ..... hazard.

A. drawing-in
B. contact
C. impact
D. trapping

18. ..... is a hazard where body being pulled and trapped by rotating and tangentially moving parts.

A. Drawing-in
B. Contact
C. Impact
D. Trapping

19. Type of safety guarding which allow flexibility in accommodating various size stock is .....

A. fixed
B. interlock
C. adjustable
D. self-adjusting

20. The greatest danger to humans suffering from electrical shock results from .....

A. current flow
B. voltage flow
C. electrical equipment
D. multimeter

21. The primary routes of entry of harmful substances into the body are:

A. eyes, skin, ingestion and inhalation
B. inhalation, absorption through the liver and kidneys, ingestion
C. skin absorption, ingestion, inhalation, injection
D. none of the above

22. Personal hearing protection should be used ...

A. as the first measure adopted to control a noise hazard or to increase protection
B. as a temporary measure or as a last resort
C. only when you hear ringing in the ears after a noisy activity
D. to allow you to concentrate on a work task without interruption

23. Noise levels are measured in ...

A. decimals or dB
B. decibel or dB
C. millimeters per second
D. dBs per second

24. Which of the following have to be considered as potential work hazards?

A. Harmful substances
B. Noise
C. Radiation
D. All of the answer stated

25. To help manage risks of heat stress and sunburn in hot and sunny conditions, you should:

A. wear protective clothing and some form of head covering
B. use a sunscreen
C. drink plenty of water
D. all of the above

26. Lead is a hazardous substance because it is ....

A. toxic
B. flammable
C. corrosive
D. heavy

27. Which statement is NOT correct?

A. heat stress causes increased sweating
B. heat stress results in reduced capacity for work, inefficiency and increased risk of hazardous incidents
C. heat stroke is a rare condition and not life threatening
D. high temperatures can result in heat stress

28. Following are the basic type of accidents EXCEPT ...

A. Near miss
B. Long term
C. Minor accident
D. First aid injury

29. Following are the basic accident causes EXCEPT ...

A. Basic causes
B. Intermediate causes
C. Immediate causes
D. Direct causes

30. During the accident investigation, the following should be done EXCEPT ...

A. Gathering information
B. Formulating theories on why and how the accident might have occurred
C. Witness should be interviewed in a relaxed atmosphere
D. Carry out investigation immediately

31. Which of the following must be reported to your employer or supervisor without delay

A. a change in the weather forecast
B. any safety concern, incident or 'near miss' while you are at work
C. any idea you have for completing the job more quickly
D. the discovery that you have forgotten to bring your lunch with you

32. Which of the following is TRUE for unsafe act?

A. Brittle roof
B. Defect ladder
C. Horseplay
D. Poor physical condition

33. Near miss can be defined as

A. Events that have potential to cause injury or ill health or may cause damage to property, personal effects or work in progress
B. Events that cause injury or ill health or may cause damage to property, personal effects or work in progress
C. Any unplanned event that causes injury or illness, property damage or harmful disruption of work process
D. All above are correct

34. Which of the following is TRUE for unsafe condition?

A. Created by the person injured in the accident
B. Created by the fellow employee or a third party
C. Created by the elements such as rain, sun, snow
D. All above

35. Accidents should be investigated

A. To find who should be blamed in that accident
B. To find the witness
C. To find the root cause of the accident
D. To help the police officer

36. Which of the following can be classified under physical hazard?

I.	Electrical	III.	Mechanical
II.	Ergonomic	IV.	Psychosocial

A.	I only	C.	I and III only
B.	I and II only	D.	All of the above

37. The following are mandatory in occupational safety and health legislation EXCEPT ...

I.	Acts	III.	Code of practice
II.	Regulations	IV.	Guidelines

A.	I and II only	C.	I, II and III only
B.	III and IV only	D.	II, III and IV only

38. When to review risk assessment?

I.	Development of new knowledge	III.	Modification of plants
II.	Amendments of national law	IV.	Changes in organization

A.	I and II only	C.	II, III and IV only
B.	I and II only	D.	All of the above

39. Which of the following control measures could be considered to be the LEAST EFFECTIVE and used as a back up control measure?

I.	Administrative control	III.	Engineering control
II.	Isolation	IV.	Personal protective equipment

A.	I and IV only	C.	I and II only
B.	I, III and IV only	D.	II, III and IV only

40. The hazards that related to poor housekeeping are ...

I.	Falling from height	III.	Fire hazard
II.	Falling from same level	IV.	Hit/crushed by falling object

A.	I, II and III only	C.	II, III and IV only
B.	I, II and IV only	D.	All of the above

41. Crushing occurs when the body is caught ...

I. Between a fixed and moving part of machine
II. Between two moving part of machine
III. Between a moving part of machine and fixed structure
IV. Between a rotating part of machine and human body

A.	I and II	C.	II and III
B.	I, II and III	D.	All of the above

42. Routes of exposure for chemical entry the body are

I.	Ingestion	III.	Absorption
II.	Inhalation	IV.	Injection

A.	I and II	C.	II and III
B.	I, II and III	D.	All of the above

43. The types of vibration that needs to be looked at in context of worker health are:

I.	Workplace vibration	III.	Whole body vibration
II.	Machining vibration	IV.	Hand-arm vibration

A.	I and II	C.	III and IV
B.	II and III	D.	I, III and IV

44. An accident investigation would .....

I. Determined causes of accident
II. Provide means to uncover new hazards
III. Identify weakness in operating procedures
IV. Record fact for future reference

A. I, III and III only
B. II, III and IV only
C. I, II and IV only
D. I, II, III and IV

45. Internal investigation team include

I. Safety officer
II. External consultants
III. DOSH officer
IV. Police officer

A. I only
B. I and II only
C. III and IV only
D. II, III and IV only

Question 46 until 50 match best given answer below:

A. Hazard
B. Danger
C. Health
D. Risk
E. Safety

46. Protection of bodies and minds of people from illness resulting from materials, processes or procedures used in workplace. .....

47. Measures and practices undertaken to prevent and minimize the risk of loss of life, injury and damage to property and environment. .....

48. Source or a situation with a potential for harm in terms of human injury or ill health, damage to property, damage to the environment or a combination of these. .....

49. Combination of likelihood of an occurrence of hazardous events and the severity of injury or damage to property or environment or combination of this. .....

50. Relative exposure to hazard. .....

PART B.

Q1. (a) Explain the flammable diagram in the fire prevention system and explosion in the work place.

(5 marks)

(b) Draw the complete flammable diagram for ethylene C_2H_4 material. Show all the solution steps and necessary data such as Lower Flammable Limit on air and oxygen, Upper Flammable Limit on air and oxygen, Limiting Oxygen Concentration, Stoichiometric line and chemistry equation.

(20 marks)

Q2. Exploded gas material of 1000 litre in storage tank with the following given data:

Gas material	:	ethane C_2H_6
Density, (ρ)	:	480 kg/m^3
Temperature, (T)	:	27 ^{0}C
Atmospheric pressure, (P)	:	1.013 bar
Efficiency of explosion, (η)	:	16 %
Explosion energy, (E_{TNT})	:	4686 KJ/kg
Mass	:	C = 12 , H = 1 , N = 17 , O = 16

Find,

(i) Equivalent mass of explosion.
(ii) Scale value Z_e at distance of r = 50 m from the blast.
(iii) Estimating the structure damage from the blast at that distance.

(25 marks)

- END OF QUESTION -

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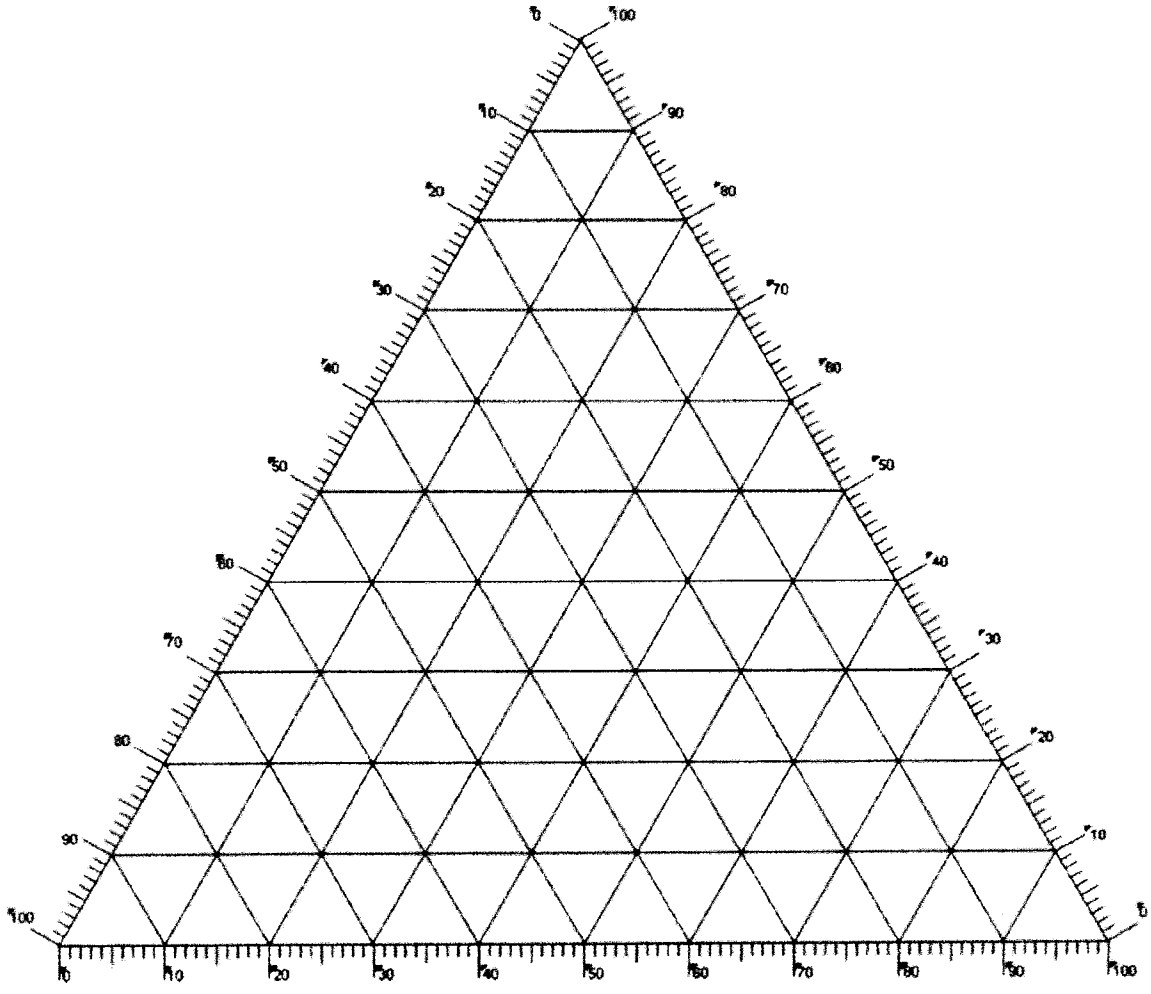
KURSUS	:	KEJURUTERAAN KESELAMATAN DAN PENYELENGGARAAN	KOD KURSUS	:	DAM 20702



FLAMMABLE DIAGRAM

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Table 1 : Unit conversion table

Volume equivalents				
in^3	ft^3	US gal	L	m^3
1	$5.787 * 10^{-4}$	$4.329 * 10^{-3}$	$1.639 * 10^{-4}$	$1.639 * 10^{-5}$
1728	1	7.481	28.32	$2.832 * 10^{-2}$
231	0.1337	1	3.785	$3.785 * 10^{-3}$
61.03	$3.531 * 10^{-2}$	0.2642	1	$1.000*^{-3}$
$6.102 * 10^4$	35.31	264.2	1000	1

Table 2 : Flammable material of selected hydrocarban

Material	Formula	Energy of explosion (kJ/mol)	Heat of combustion (kJ/mol)	Flammability limit (vol.% in air)		Flash point temperature (°C)	Autoignition temperature, AIT (°C)
				Lower	Upper		
Hexane	C_6H_{14}	-4030.3	-4194.5	1.2	7.5	-230.0	487
Methane	CH_4	-818.7	-890.3	5.3	15.0	-222.5	632
Ethane	C_2H_6	-1468.7	-1599.8	3.0	12.5	-130.0	472
Propane	C_3H_8	-2110.3	-2219.9	2.2	9.5	-104.4	493
Butane	C_4H_{10}	-2750.2	-2877.5	1.9	8.5	-60.0	408
Propylene	C_3H_6	-1959.8	-2057.3	2.4	10.3	-107.8	458
Ethylene	C_2H_4	-1322.4	-1411.2	3.1	32	-	490
Toluene	C_7H_8	-3835.1	-3947.9	1.4	6.7	4.4	810
Hydrogen	H_2	-237.4	-285.8	4.0	75.0	-	572
Ammonia	NH_3	-339.7	-382.6	15.0	28.0	-	651
Methanol	CH_4OH	-707.8	-764.0	7.3	36.0	12.2	574
Carbon monixide	CO	-	-	12.5	74	-	-

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Table 3 : Flammability limits in pure oxygen

Compound	Formula	Flammability limit (vol.% in O_2)	
		LFL	UFL
Hidrogen	H_2	4.0	94
Carbon Monoxide	CO	15.5	94
Ammonia	NH_3	15.0	79
Methane	CH_4	5.1	61
Ethane	C_2H_6	3.0	66
Ethylene	C_2H_4	3.0	80

Rumus

- Time Weighted Average, TWA

$$\text{TWA} = \frac{C_1T_1 + C_2T_2 + C_3T_3 + \ldots + C_nT_n}{8 \text{ hr}} \quad (1)$$

- Scaled Distance:

$$z_e = \frac{r}{m_{TNT}^{1/3}}; \qquad r \text{ in meter}, m \text{ in kg}. \quad (2)$$

- Scaled Overpressure:

$$p_s = \frac{p_0}{p_a}; \qquad p_a = 101.3 \text{ kPa}. \quad (3)$$

- The equivalent mass of TNT:

$$m_{\text{TNT}} = \frac{\eta m \Delta H_e}{E_{\text{TNT}}}; \quad E_{\text{TNT}} = 4686 \text{ kJ/kg} \quad (4)$$

- LOC

$$\text{LOC} = z * \text{LFL} \quad (5)$$

- Mol-mass of C = 12 g, H = 1 g, N = 17, O = 16.

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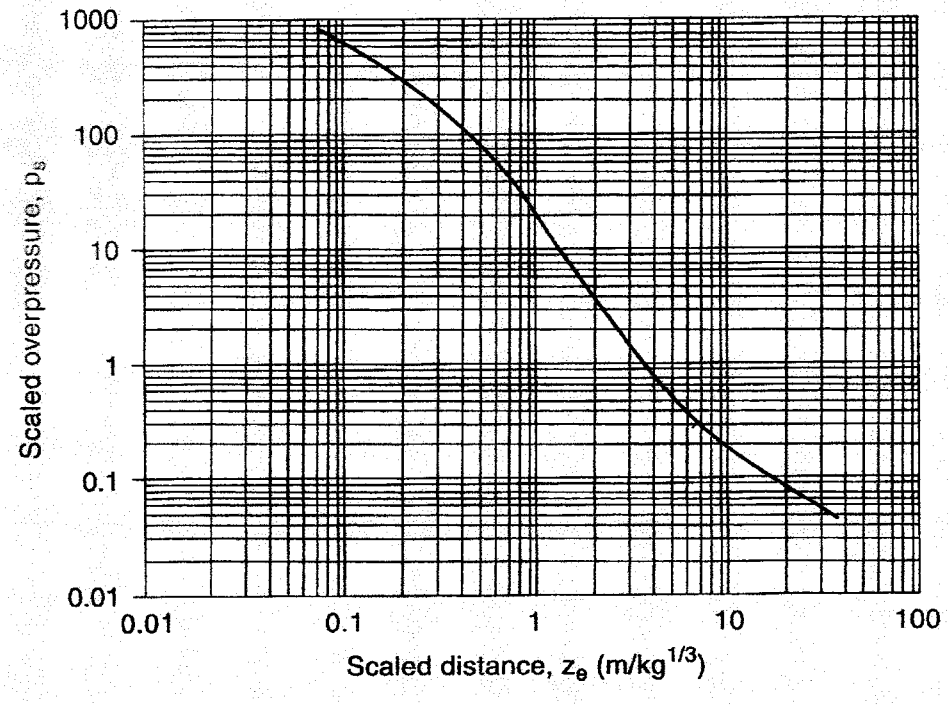

GRAPH OF SCALED DISTANCE AND EXPLOSION PEAK SIDE ON OVERPRESSURE

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Table 4 : Damage estimates for common based on overpressure

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

[1] V. J. Clancey, "Diagnostic Features of Explosion Damage," paper presented at the *Sixth International Meeting of Forensic Sciences* (Edinburgh, 1972).