UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	HRB30203
COURSE TITLE	:	INDUSTRIAL TOXICOLOGY
PROGRAMME NAME	:	BACHELOR OF OCCUPATIONAL SAFETY & HEALTH (HONOURS)
DATE	:	24 JANUARY 2026
TIME	:	9:00AM - 12:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. Which organ is the primary site for biotransformation?

   A. Liver.

   B. Kidneys.

   C. Lungs.

   D. Stomach.

2. Which protein is primarily involved in binding toxic substances in the blood?

   A. Keratin.

   B. Hemoglobin.

   C. Albumin.

   D. Fibrinogen.

3. How does plasma protein binding affect toxicants?

   A. Speeds up their elimination.

   B. Prolongs their effect.

   C. Increases their concentration in the bloodstream.

   D. Enhances the intensity of their toxic effects.

4. Where are astrocytes located?

   A. Near the brain's capillaries.

   B. In the liver.

   C. In the placenta.

   D. In muscle tissues.

5. Which of the following is most preferable when establishing safety standards for exposure to toxic substances?

   A. A low NOAEL and a low LOAEL

   B. A high NOAEL and a low LOAEL

   C. A low NOAEL and a high LOAEL

   D. A high NOAEL and a high LOAEL

6. What term describes the phenomenon in which a toxicant's effects become more severe at higher doses?

   A. Antagonism

   B. Potentiation

   C. Synergism

   D. Dose–response relationship

7. Which of the following statements regarding NOAEL and LOAEL is correct?

   A. The LOAEL is identified at a dose higher than the NOAEL.

   B. They are interchangeable terms describing the same toxicological endpoint.

   C. Both NOAEL and LOAEL correspond to the same dose producing adverse effects.

   D. The NOAEL represents the dose at which adverse effects first appear, while the LOAEL indicates a safe exposure level.

8. Which process describes the formation of malignant tumors due to carcinogens?

   A. Detoxification

   B. Carcinogenesis

   C. Sensitization

   D. Biotransformation

9. What is the primary excretion route for volatile organic solvents?

   A. Exhalation through the lungs

   B. Skin evaporation

   C. Bile excretion

   D. Skin evaporation

10. What type of exposure limit is designed to ensure no part of a working exposure exceeds it?

   A. Time-weighted average (TWA)

   B. Short-term exposure limit (STEL)

   C. Daily limit value (DLV)

   D. Ceiling limit

11. What is the effect of sensitizers in workers exposed to them?

   A. Allergic reactions upon repeated exposure

   B. Immediate tissue necrosis

   C. Enhanced tissue regeneration

   D. Permanent immunity to allergens

12. Occupational exposure limits are intended to _____.

   A. eliminate all risks

   B. ensure zero exposure

   C. protect most workers

   D. prevent chemical use

13. What defines a heavy metal?

    A. Metals with low atomic weight.

    B. Metals with high density and toxicity at low concentrations.

    C. Metals that degrade easily in the environment.

    D. Metals that are only biologically beneficial.

14. Which type of tissue is most affected by lipophilic solvents?

    A. Skeletal muscle

    B. Cardiac tissue

    C. Lipid-rich tissues, like the nervous system

    D. Bone tissue

15. Which agent poses the highest risk during early pregnancy?

    A. Neurotoxin

    B. Teratogen

    C. Irritant

    D. Hepatotoxin

16. Given that the LD_{50} of Chemical A is 5 mg/kg and the LD_{50} of Chemical B is 50 mg/kg, which statement correctly describes their relative toxicity?

    A. Chemical B exhibits higher toxicity.

    B. Relative toxicity cannot be assessed using LD_{50}.

    C. Both chemicals exhibit equal toxicity.

    D. Chemical A exhibits higher toxicity.

17. Passive diffusion across membranes depends primarily on _____.

A. enzyme activity

B. ATP availability

C. molecular charge

D. concentration gradient

18. What does "time-weighted average" (TWA) represent in workplace exposure limits?

A. The cumulative exposure over a worker's lifetime

B. The highest peak exposure allowed for 15 minutes

C. The average exposure over an 8-hour workday

D. The maximum exposure allowed over 24 hours

19. What is the most prevalent occupational exposure to lead?

A. Water contamination.

B. Emissions from lead-acid batteries.

C. Ingestion of lead paint chips.

D. Dust in construction and smelting industries.

20. A delayed effect with long latency is typical of _____.

A. irritants

B. corrosives

C. narcotics

D. carcinogens

21. What is the legal framework in Malaysia for controlling chemical exposure in workplaces?

A. OSHA Act 1970

B. USECHH Regulations 2000

C. Threshold Limit Value Guidelines

D. ACGIH Workplace Standards

22. Acute toxicity studies are primarily useful for _____.

A. identifying target organs

B. determining immediate hazards

C. cancer risk assessment

D. reproductive toxicity

23. A worker developing dermatitis after repeated exposure to latex demonstrates _____.

A. irritation

B. systemic toxicity

C. sensitization

D. corrosion

24. Lead toxicity commonly affects the _____.

A. lungs and heart

B. kidneys and nervous system

C. liver and skin

D. gastrointestinal tract only

25. What is the difference between acute and chronic exposure?

A. Acute exposure is systemic, while chronic exposure is localized.

B. Acute exposure lasts longer, while chronic exposure is brief.

C. Both terms mean the same thing.

D. Acute exposure involves high concentration for a short time; chronic exposure involves low concentration over time.

26. Which condition is most associated with chronic exposure?

A. Cyanide poisoning

B. Silicosis in miners

C. Skin irritation from acid splash

D. Headache after solvent inhalation

27. GHS labels are designed to inform workers about _____.

A. supplier location

B. health and physical hazards

C. waste disposal costs

D. chemical composition

28. The main purpose of industrial toxicology in Occupational Safety and Health (OSH) is to _____.

A. prevent occupational illness

B. regulate chemicals

C. diagnose diseases

D. improve production

29. What is the primary goal of establishing occupational exposure limits?

A. To comply with international trade agreements

B. To protect workers from adverse health effects

C. To improve chemical efficiency in processes

D. To optimize industrial production

30. If Chemical A has an LD_{50} of 5 mg/kg and Chemical B has an LD_{50} of 50 mg/kg, which chemical is more toxic?

A. Toxicity cannot be determined using LD_{50} values

B. Both chemicals have equal toxicity

C. Chemical B

D. Chemical A

31. What is the most common route of organic solvent exposure in the workplace?

A. Inhalation of vapors

B. Gastrointestinal ingestion

C. Injection into the bloodstream

D. Skin absorption

32. What is the purpose of a Biological Exposure Index (BEI)?

A. To measure physical exertion limits in workers

B. To determine acceptable noise levels in the workplace

C. To assess total exposure via biological monitoring

D. To monitor airborne concentrations of chemicals

33. A "local" toxic effect refers to an effect that _____.

A. resolves completely within a fixed time period

B. produces effects throughout the entire body

C. is confined to internal organs such as the liver and kidneys

D. occurs at the site of direct contact with the substance (e.g., skin or eyes)

34. A chemical with a long biological half-life is more likely to _____.

A. be rapidly detoxified

B. accumulate in the body

C. be harmless

D. cause acute toxicity

35. Which control measure reduces exposure at the source?

A. Engineering control

B. Medical surveillance

C. PPE

D. Training

36. What is the term for the highest dose that does not cause an adverse effect?

A. No observed adverse effect level (NOAEL)

B. Maximum exposure dose (MED)

C. Threshold dose (TD)

D. Lowest observed adverse effect level (LOAEL)

37. In a synergistic interaction, what is the expected outcome when two chemicals produce individual effects of 2 and 3, respectively?

A. The combined effect equals 3

B. The combined effect equals 2

C. The combined effect equals 4

D. The combined effect is greater than 5

38. The statement "all substances are poisons" emphasizes the importance of _____.

A. chemical source

B. exposure route

C. dose

D. exposure frequency

39. Toxicology integrates knowledge from chemistry, biology and medicine to _____.

A. evaluate chemical synthesis

B. control industrial processes

C. improve drug efficacy

D. understand adverse health effects

40. Which toxicological parameter reflects chemical potency?

A. Absorption rate

B. Exposure duration

C. Route of exposure

D. LD_{50} value

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Workers in industrial and occupational settings are frequently exposed to various toxic substances through multiple routes. Understanding these routes and the factors affecting absorption is critical for effective risk management Analyse the major routes of exposure to toxic substances in occupational settings. In your answer, differentiate each route by critically discussing the key factors that influence the absorption of toxic substances through these routes.

(20 marks)

Question 2

According to the National Institute for Occupational Safety and Health (NIOSH), it is estimated that 2-8% of all cancers worldwide are caused by exposure to workplace carcinogens.

(a) Outline ONE (1) proven carcinogen and the type of cancer that it can cause.

(2 marks)

(b) Analyze the mechanisms through which carcinogenic compounds contribute to cancer development.

(18 marks)

Question 3

A new cleaning process uses a mixture of three solvents to achieve optimal results. The safe exposure limit for this mixture is not yet established. Therefore, air monitoring has been conducted, and the data obtained for the three solvents are given in Table 1 below:
Refer Below - Table1 : Table 1 .

Table 1: Table 1

Time	Solvent	Data collected
7.00 am to 10.00 am (3 hours)	A	200
	B	100
	C	25
10.30 am to 12.30 pm (2 hours)	A	700
	B	400
	C	100
2.00 pm to 4.00 pm (2 hours)	A	500
	B	450
	C	400
4.00 pm to 5.00 pm (1 hour)	A	100
	B	300
	C	450
PEL	A	1000 ppm
	B	800 ppm
	C	500 ppm

(a) Calculate the 8-hour Total Weight Average (TWA) for each solvent.

(9 marks)

(b) Calculate the Permissible Exposure Limit (PEL) mixture for the new solvent formed.

(6 marks)

(c) Based on the calculated mixture PEL, is the worker's current exposure to the solvent mixture acceptable?

(5 marks)

Question 4

Occupational Exposure Limits (OELs) are established to protect workers from the adverse health effects of exposure to hazardous substances in the workplace.

(a) Analyze the role of Threshold Limit Values (TLVs) in protecting workers' health in occupational settings.

(5 marks)

(b) In the workplace, an operator is exposed to the following hazardous chemicals: 100 mg/m^3 of chemical A for 100 minutes, 160 mg/m^3 of chemical B for 150 minutes, and 200 mg/m^3 of chemical C for 200 minutes. Calculate the 8-hour total weighted average (TWA).

(15 marks)

END OF EXAMINATION PAPER