



UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION
OCTOBER 2025 SEMESTER

COURSE CODE : HDB31402
COURSE TITLE : TOXICOLOGY
PROGRAMME NAME : BACHELOR OF BIOMEDICAL SCIENCE (HONOURS)
DATE : 30 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*

THERE ARE 15 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. Which of the following statements best describes systemic toxicity?
 - A. The toxic effects are confined to a single target organ.
 - B. The toxic effects occur only at the site of exposure.
 - C. The toxic agent affects multiple organs throughout the body.
 - D. The toxic effects are usually reversible.

2. The organs least involved in systemic toxicity are _____.
 - A. muscle and bone
 - B. hematopoietic system and lungs
 - C. liver and kidney
 - D. brain and peripheral nerves

3. Which of the following **BEST** describes the primary toxic effect of hydrogen cyanide exposure?
 - A. Generation of excessive free radicals.
 - B. Chemical alteration of hemoglobin structure.
 - C. Direct structural damage to lung tissue.
 - D. Inhibition of cellular oxygen utilization.

4. Electrophilic toxic agents can form covalent bonds with nucleophilic molecules in biological systems. Which of the following is a non-target nucleophile primarily involved in detoxification?
- A. DNA bases
 - B. Glutathione (GSH)
 - C. Sulfhydryl (-SH) groups on cellular proteins
 - D. Lysine-rich proteins containing -NH₂ groups
5. Which of the following statements **BEST** describes an electrophilic compound in toxicology?
- A. It is always positively charged.
 - B. It contains electron-rich functional groups.
 - C. It accepts or shares electrons with nucleophilic molecules.
 - D. It preferentially attacks positively charged molecules.
6. Species differences in the toxic response to chemicals are primarily due to differences in _____.
- A. identical metabolic enzyme profiles across species
 - B. completely shared metabolic pathways
 - C. uniform rates of chemical absorption
 - D. the activity and expression of biotransformation enzymes
7. Depletion of intracellular glutathione (GSH) increases chemical toxicity primarily because it _____.
- A. inhibits Phase II metabolic reactions
 - B. serves as a major detoxifying agent for electrophiles
 - C. enhances the reactivity of electrophilic compounds
 - D. promotes DNA adduct formation

8. How is mutagenesis **BEST** defined?
- A. The process by which normal cells become immortal.
 - B. The induction of malformations during fetal development.
 - C. The transformation of a benign tumour into a malignant one.
 - D. Permanent alteration in the genetic information of a cell.
9. Base substitution leading to a premature stop codon is known as _____ mutation.
- A. nonsense
 - B. silent
 - C. frameshift
 - D. missense
10. The Ames test uses *Salmonella typhimurium* strains that are defective in _____ synthesis.
- A. tryptophan
 - B. glutathione
 - C. lysine
 - D. histidine
11. Which of the following statements describing the relationship between mutagenesis, carcinogenesis, and teratogenesis is **FALSE**?
- A. Some carcinogens exert their effects without directly causing DNA mutations.
 - B. Teratogenesis may arise as a result of mutagenic effects during development.
 - C. Carcinogenesis often involves the accumulation of genetic mutations.
 - D. Mutagenesis always results in carcinogenesis.

12. Choose the **CORRECT** statement regarding genotoxic carcinogens.
- A. They do not require metabolic activation if they are indirect carcinogens.
 - B. They act as tumour promoters.
 - C. They interact directly with DNA and may cause mutations.
 - D. They modify gene expression without altering DNA structure.
13. Epigenetic carcinogens typically act by _____.
- A. inducing chromosomal breaks
 - B. binding directly to nucleotides
 - C. causing point mutations
 - D. altering cell proliferation without DNA damage
14. The critical period for major structural birth defects in humans is during the _____ weeks of pregnancy.
- A. first 2
 - B. first 4
 - C. first 8
 - D. last 4
15. Which of the following teratogens is associated with microcephaly, growth retardation, and facial deformities?
- A. Alcohol
 - B. Thalidomide
 - C. Lead
 - D. Methylmercury

16. A 26-year-old pregnant woman at 6 weeks of gestation takes an over-the-counter (OTC) herbal supplement for nausea. The supplement is later found to contain a compound structurally related to thalidomide. Which fetal outcome is MOST likely if exposure occurs at this stage?
- A. Neural tube closure defects.
 - B. Cleft palate only.
 - C. Limb reduction defects (phocomelia).
 - D. No observable defects because exposure is too early.
17. Which of the following best explains why animal teratogenicity studies may not always predict human outcomes?
- A. Human embryos are more resistant to toxins.
 - B. Species differ in sensitivity and metabolic pathways.
 - C. Animal placenta is identical to human placenta.
 - D. Humans metabolize all drugs more slowly.
18. Nitrites are used as preservatives in cured meats. Their toxicological concern primarily relates to their potential to react with amines forming _____.
- A. dioxins
 - B. N-nitrosamines
 - C. organophosphate esters
 - D. polycyclic aromatic hydrocarbons (PAHs)
19. Certain food additives may pose toxicological concerns. Which of the following pairs CORRECTLY matches the food additive with its primary function?
- A. Benzoic acid — Antioxidant
 - B. Sorbic acid — Colouring agent
 - C. Aspartame — Artificial sweetener
 - D. Tartrazine — Preservative

20. Which of the following pairs of food additives or contaminants and their associated adverse health effects is **INCORRECT**?
- A. Monosodium glutamate (MSG) – Endocrine disruption
 - B. Aflatoxins – Hepatocellular carcinoma
 - C. Tartrazine – Allergic reactions
 - D. Methylmercury – Neurotoxicity
21. Bisphenol A (BPA) found in some food packaging is considered _____.
- A. an indirect additive
 - B. a safe contaminant
 - C. a vitamin supplement
 - D. a direct food additive
22. The metabolic conversion of a synthetic food colourant in the liver into a toxic, reactive intermediate represents a process of bioactivation. This process is most critically mediated by which enzyme system?
- A. Glutathione S-transferases (GSTs)
 - B. Cytochrome P450 monooxygenases (CYPs)
 - C. UDP-glucuronosyltransferases (UGTs)
 - D. N-acetyltransferases (NATs)
23. Which artificial sweetener raised early concerns about bladder cancer in animal studies?
- A. Saccharin
 - B. Stevia
 - C. Sucralose
 - D. Aspartame

24. Which of the following is an example of a natural contaminant in food?
- A. Sodium nitrite
 - B. Monosodium glutamate (MSG)
 - C. Aflatoxin
 - D. Tartrazine
25. Exposure to nitrogen dioxide (NO₂), a common air pollutant generated primarily from motor vehicle exhaust and industrial combustion processes, may lead to which of the following pulmonary effects?
- A. Reduced free radical formation.
 - B. Decreased alveolar macrophage activity.
 - C. Increased mucociliary clearance.
 - D. Enhanced immune resistance to respiratory infections.
26. Which of the following is a major source of hydrocarbon contamination in soil?
- A. Leakage from underground petroleum storage tanks.
 - B. Excessive application of nitrogen-based fertilizers.
 - C. Domestic pesticide application.
 - D. Chemicals used in groundwater treatment.
27. A nuclear power plant worker is found to have elevated blood levels of cesium-137 (¹³⁷Cs). Its accumulation in the human body is best explained by its chemical similarity to which of the following ions?
- A. Calcium
 - B. Iodide
 - C. Sodium
 - D. Potassium

28. Chronic exposure to benzene results in leukemia because _____.
- A. it destroys hepatocytes
 - B. it forms ozone in the bloodstream
 - C. it reduces renal excretion of metabolites
 - D. its metabolites damage bone marrow DNA
29. In the early 20th century, factory workers known as "radium-dial painters" were exposed to radium while painting luminous watch dials. Which of the following conditions was MOST strongly associated with this occupational exposure?
- A. Bone cancer
 - B. Kidney failure
 - C. Lung fibrosis
 - D. Dermatitis
30. Which pollutant is **MOST** closely associated with emphysema in chronic exposure?
- A. Carbon monoxide (CO)
 - B. Sulphur dioxide (SO₂)
 - C. Ozone
 - D. Suspended particulate matter
31. Chronic exposure to ozone (O₃), a major component of photochemical smog, primarily leads to which of the following long-term health effects?
- A. Hemolytic anemia
 - B. Liver necrosis
 - C. Reduced lung elasticity
 - D. Renal tubular damage

32. Photochemical smog is formed by atmospheric chemical reactions involving which of the following combinations of components?
- A. Sunlight, nitrogen oxides, and volatile organic compounds.
 - B. Ozone, molecular oxygen, and sunlight.
 - C. Molecular oxygen, sunlight, and nitrogen oxides.
 - D. Particulate matter, nitrogen oxides, and volatile organic compounds.
33. Good Laboratory Practice (GLP) primarily emphasizes which of the following aspects of laboratory studies?
- A. Complete elimination of human error.
 - B. Safe clinical practice.
 - C. Quality assurance and integrity of generated data.
 - D. Minimization of costs associated with animal studies.
34. Which of the following is the primary objective of risk assessment in toxicology?
- A. Determine the effectiveness of therapeutic interventions following exposure.
 - B. Describe the molecular and cellular mechanisms of toxic agents.
 - C. Identify and characterize adverse health effects associated with chemical exposure.
 - D. Predict the environmental persistence and distribution of hazardous substances.
35. Which of the following statements **BEST** describes a quantal dose–response relationship in toxicology?
- A. A continuous, individual-level response to varying doses.
 - B. A graded increase in response intensity with increasing dose.
 - C. An all-or-none response observed across a population.
 - D. Toxic effects occurring only at high exposure levels.

36. Which of the following toxicological endpoints is **LEAST** likely to be adequately evaluated using in vitro toxicity testing?
- A. Genotoxic potential.
 - B. Identification of chemically reactive groups.
 - C. Effects on fertility and embryonic development.
 - D. Skin corrosion or irritation.
37. A chemical with a very low LD₅₀ is generally considered _____.
- A. poorly absorbed
 - B. highly toxic
 - C. non-hazardous
 - D. less toxic
38. Which of the following assumptions must be considered when conducting an in vivo toxicity test?
- A. Human responses always match animal responses.
 - B. High dose effects in animals may suggest human risk.
 - C. Animal metabolism has no relevance to humans.
 - D. Low doses are never hazardous.
39. In an Ames test, a cosmetic ingredient shows mutagenic potential only after metabolic activation with S9 fraction from the rat liver. The scientist conducting the test concluded that the compound is a _____.
- A. pre-mutagen requiring metabolic activation
 - B. non-mutagenic chemical
 - C. direct-acting mutagen
 - D. carcinogen based on this result alone

40. Why are human epidemiological data particularly valuable in toxicological risk assessments?
- A. They always establish a definitive causal relationship between exposure and disease.
 - B. They eliminate the need for uncertainty factors in safety assessments.
 - C. The data directly reflect health effects under realistic exposure conditions.
 - D. The data can be easily controlled for all confounding variables.

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Mutagenesis and carcinogenesis are closely related processes in toxicology and are critical considerations in the safety evaluation of chemical substances.

- (a) Define mutagenesis and carcinogenesis, and explain how genetic mutations contribute to the development of cancer.

(6 marks)

- (b) Describe the mechanistic relationship between mutagenesis and carcinogenesis, highlighting why not all mutagens are carcinogens and why not all carcinogens are mutagenic.

(6 marks)

- (c) Discuss how toxicity testing and bioassays are used to evaluate the mutagenic and carcinogenic potential of chemicals, giving relevant examples of both in vitro and in vivo tests.

(8 marks)

Question 2

Evaluating chemical safety depends on a range of experimental methods used to identify toxic effects and potential risks to human health.

- (a) Explain the principles and applications of in vitro and in vivo toxicity studies in toxicological assessments. Your answer should include the concept of the test, advantages and limitations.

(12 marks)

- (b) Discuss the significance of an integrated testing approach that combines in vitro and in vivo data to improve the prediction of human toxicity and support risk assessment.

(8 marks)

Question 3

Occupational toxicology plays a crucial role in safeguarding workers from chemical, physical, and biological hazards encountered in the workplace.

- (a) Discuss the principal health risks linked to occupational exposure to toxicants, citing relevant examples from various industries.

(15 marks)

- (b) Suggest practical and effective measures to reduce occupational exposure to toxic substances in the workplace.

(5 marks)

Question 4

Individual responses to toxic chemicals vary due to both biological characteristics and toxicokinetic processes.

- (a) Explain how biological factors such as age, species, gender, nutritional status, health and genetics influence susceptibility to toxicants.

(12 marks)

- (b) Discuss how alterations in absorption, distribution, metabolism, and excretion modify the overall toxicity of chemicals.

(8 marks)

END OF EXAMINATION PAPER

