

BIO484 (S) 2021

UNIVERSITY OF ESWATINI
FACULTY OF SCIENCE AND ENGINEERING
DEPARTMENT OF BIOLOGICAL SCIENCES
SUPPLEMENTARY EXAMINATION PAPER 2021

COURSE CODE: BIO484

TITLE OF PAPER: DRUG METABOLISM AND TOXICOLOGY

TIME ALLOWED: **THREE (3) HOURS**

INSTRUCTIONS: NUMBERS IN BRACKETS DENOTE THE NUMBER OF MARKS

THIS PAPER COMPRISES OF **THREE SECTIONS**. SECTION A COMPRISES OF 13 QUESTIONS (15 MARKS). SECTION B COMPRISES OF 5 QUESTIONS (60 MARKS). ANSWER ALL QUESTIONS IN SECTIONS A AND B. SECTION C HAS TWO QUESTIONS. ANSWER ONLY ONE QUESTION FROM SECTION C (25 MARKS).

CLEARLY INDICATE THE SECTION AND QUESTION NUMBER ON YOUR ANSWER PAPER.

CALCULATORS MAY BE TAKEN INTO THE EXAMINATION.

DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN GRANTED BY THE CHIEF INVIGILATOR

Section A

Total marks available: 15

There are thirteen (13) questions in this section. Answer **ALL** the questions in this section

AQ1: A poison that is haemotoxic will be damaging to which organ? [1]

- a) Eyes
- b) Kidney
- c) Heart
- d) All of the above
- e) None of the above

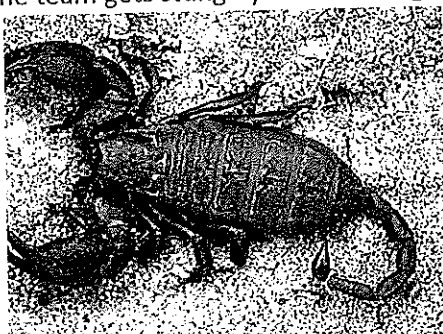
AQ2: After 45mg of a drug is administered to a patient intravenously the plasma concentration was found to be $82\mu\text{g/L}$. The volume of distribution of this drug is: [1]

- a) 549L
- b) 0.549L
- c) 1822L
- d) 1.82L
- e) 24.7g

AQ3: A child has swallowed some berries and is now feeling very sick. The pK_a of the berries is 7.9. Where is the best site of absorption for these berries? [1]

- a) Skin
- b) Rectum
- c) Stomach
- d) Small intestine
- e) Buccal cavity

AQ4: You have been asked to join a team of toxicologists researching river pollution. Whilst camping along the Usuthu river, one of the team gets stung by the following organism:



What should the team member who has been stung do next? [2]

- a) Wash the bite site with clean water, this organism is not very venomous to humans
- b) Immediately travel to the nearest hospital to get antivenom, this organism is highly venomous to humans
- c) Urinate on the wound to neutralize the venom
- d) Apply vinegar to the wound to neutralize the venom
- e) Make cuts at the sting site and suck out all the venom

- AQ5: The dose-effect relationship is [1]
- a) Relationship between dose and effect on the population level
 - b) Best described by the 'all or nothing' effect
 - c) Usually linear for toxic chemicals
 - d) All of the above
 - e) None of the above

- AQ6: Poisonous organisms are toxic because [1]
- a) Actively deploy their toxin into an organism
 - b) Actively deploy their toxicant into an organism
 - c) Passively deploy their toxicant into an organism
 - d) Passively deploy their toxin into an organism
 - e) None of the above

- AQ7: Liberation is when [1]
- a) A xenobiotic dissociates from a plasma protein
 - b) A xenobiotic enters the blood stream from the body's storage sites
 - c) When a xenobiotic in liquid form disintegrates in the digestive system
 - d) When a xenobiotic in an emulsion disintegrates in the digestive system
 - e) None of the above

- AQ8: Active transport is when [1]
- a) Molecules too large to pass through normal aqueous channels
 - b) Energy is used to facilitate the transport of molecules
 - c) Substances move against a concentration gradient
 - d) All of the above
 - e) None of the above

AQ9: Dlaminite and Magagulite are two toxic compounds regularly used by the construction industry. Dlaminite has greater affinity to plasma proteins than Magagulite. Based on the information you have, which statement below is correct? [2]

- a) Dlaminite is lipophilic
- b) Magagulite is a base
- c) Magagulite has a lower half-life than Dlaminite
- d) Dlaminite binds irreversibly to plasma proteins
- e) Dlaminite has the greater bioavailability

AQ10: Gcebile is 55-year-old female. She is 160cm tall and weighs 87kg. She needs to go to Mbabane Government Hospital for an operation to remove her uterus under general anaesthetic. Which drug would be suitable for Gcebile? [1]

- a) Short acting anaesthetic – Thiopental
- b) Short acting anaesthetic – propofol
- c) Anticonvulant – phenytoin
- d) All of the above
- e) None of the above

AQ11: Phagocytosis is when [1]

- a) Solid particles are engulfed by a cell
- b) Dissolved particles are engulfed by a cell
- c) Solid particles are expelled by a cell
- d) Dissolved particles are expelled by a cell
- e) None of the above

AQ12: Which of the following does NOT affect the activity of a xenobiotic? [1]

- a) Marital status
- b) Nutritional status
- c) HIV status
- d) Psychological status
- e) Occupational status (including working hours)

AQ13: The blood brain barrier can allow the diffusion of [1]

- a) molecules greater than 5kDa
- b) plasma bound molecules
- c) hydrophilic molecules
- d) non-ionised molecules
- e) All of the above

Section B

Total marks available: 60

BQ1: Nomcebo was a 17-year-old female weighing 75kg. Three days ago, she was found dead in her school dormitory. A post-mortem carried out 2 days ago from peripheral blood samples found elevated levels of cyp450 and the following results:

	Plasma level	Normal plasma range	LD50	ED50	Fraction bound	t _{1/2}	pKa	Primary route of elimination
Alprazolam	13.7ng/ml	8.0 - 37ng/ml	231mg/kg	0.5mg/kg	80%	11.2 hr	2.4	Liver
Fentanyl	22.4ng/ml	0.2 – 1.3 ng/ml	0.03mg/kg	4.1µg/kg	85%	7hr	8.99	Liver
Morphine	15.1ng/ml	21 – 41ng/ml	670mg/kg	0.1mg/kg	35%	3hr	8.21	Liver
Acetylfentanyl	436pg/ml	0.13 -0.54 ng/ml	9.3mg/kg	0.3mg/kg	75%	4hr	8.4	Liver

- a) Explain the difference between EC₅₀ and LD₅₀. [5]
- b) For each drug, calculate the LD50 and ED50 dose for Nomcebo. Give your answer in grams. [8]
- c) What is the likely cause(s) of death for Nomcebo? Explain your answer. [7]
- d) Which drug do you expect to have the greater volume of distribution? Explain your answer. [3]
- e) Which drug do you expect to be best absorbed in the stomach? Explain your answer. [2]

BQ2: List the types of receptors and provide an example for each type of receptor. [10]

BQ3: Describe how xenobiotics are eliminated in the body. [10]

BQ4: Describe the effects of the venom from ONE venomous organism, and how this has been used for drug design and discovery. [10]

BQ5: Using an example, provide a brief overview of ONE toxic substance that causes cardiotoxicity. [5]

Section C

Total marks available: 25

There are two questions in this section. Answer only **ONE** question

CQ1: Explain the role of CYP450 enzymes in the metabolism of xenobiotics by humans. [25]

OR

CQ2: Explain the toxicology of ONE toxicant that affects humans. [25]

ADDITIONAL INFORMATION

Henderson-Hasselbalch Equation

$$\text{Acids: } pH - pKa = \log \frac{\text{nonionised}}{\text{ionised}}$$

$$\text{Bases: } pH - pKa = \log \frac{\text{ionised}}{\text{nonionised}}$$

END OF EXAMINATION