



UNIVERSITI KUALA LUMPUR
ROYAL COLLEGE OF MEDICINE PERAK

FINAL EXAMINATION
MARCH 2026 SEMESTER

COURSE CODE : RCB10603
COURSE NAME : PHARMACEUTICAL ANALYSIS I
PROGRAMME NAME : BACHELOR IN PHARMACEUTICAL TECHNOLOGY
(HONOURS)
DATE : 2 JULY 2026
TIME : 9.00 AM – 11.00 AM
DURATION : 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **TWO (2)** sections; Section A and Section B.
4. Answer **ALL** questions in Section A. For Section B, answer **THREE (3)** questions **WITH AT LEAST ONE (1)** question from question 3 or question 4.
5. Please write your answers on the OMR answer script and answer booklet provided.
6. Answer all questions in English language **ONLY**.

THERE ARE 10 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 40 marks)**I) MULTIPLE CHOICE QUESTIONS (20 marks)****INSTRUCTION: Answer ALL questions.****Use the OMR sheet provided.**

1. Identify the substance analysed in a titration.
 - A. Titrant
 - B. Indicator
 - C. Solvent
 - D. Analyte
 - E. Standard solution
2. Qualitative analysis in pharmaceutical testing involves _____.
 - A. determining the exact concentration of a drug
 - B. measuring volume of solution
 - C. identifying the presence or absence of a substance
 - D. calculating percentage purity
 - E. determining molar mass
3. Select the statement that best describes % (w/v) in pharmaceutical solutions.
 - A. It measures volume of solute only.
 - B. It expresses grams of solute per 100 mL of solution.
 - C. It measures density of solution.
 - D. It is only used for gases.
 - E. It measures temperature change.
4. Calculate the % (w/v) of a solution containing 10 g of sodium chloride in 200 mL of solution.
 - A. 2%
 - B. 5%
 - C. 10%
 - D. 20%
 - E. 50%

5. Which of the following is an example of inorganic impurities?
- A. Residual solvents
 - B. Heavy metals
 - C. By-products from synthesis
 - D. Organic ligands
 - E. Degradation products
6. Select the principle behind the limit test for lead.
- A. Reaction of lead with dithizone to form a violet complex.
 - B. Formation of a white precipitate with silver nitrate.
 - C. Reaction of lead with thioglycolic acid to form a pink complex.
 - D. Oxidation of lead to a higher oxidation state.
 - E. Precipitation of lead as a chloride salt.
7. Identify the example of polyprotic acid.
- A. Hydrochloric acid (HCl)
 - B. Nitric Acid (HNO₃)
 - C. Hydrobromic acid (HBr)
 - D. Acetic acid (CH₃COOH)
 - E. Phosphoric acid (H₃PO₄)
8. According to Arrhenius's theory, an acid is defined as a substance that _____.
- A. accepts a proton
 - B. donates an electron pair
 - C. donates hydrogen ions in aqueous solution
 - D. produces hydroxide ions in aqueous solution
 - E. accepts an electron pair
9. What is the pH of 0.01 M HCl?
- A. 1.15
 - B. 2.00
 - C. 2.15
 - D. 3.15
 - E. 3.33

10. According to the Quinonoid theory, indicators change color due to ____.
- A. loss of hydroxide ions
 - B. oxidation of phenol groups
 - C. structural change between benzenoid and quinonoid forms
 - D. complete dissociation of weak acid
 - E. reduction of conjugate base
11. Choose the **CORRECT** purpose of non-aqueous titration.
- A. To titrate strong acids and bases in water.
 - B. To avoid oxidation-reduction reactions.
 - C. To titrate weak acids and bases with sharper endpoints.
 - D. To test temperature-dependent solubility.
 - E. To analyse salts using aqueous solvents.
12. Identify the type of ions commonly analysed using precipitation titration.
- A. Alkali metal ions
 - B. Halide ions
 - C. Amino acids
 - D. Proteins
 - E. Alcohols
13. Which reagent is commonly used in argentometric titration?
- A. Hydrochloric acid
 - B. Sodium Hydroxide
 - C. Silver Nitrate
 - D. Potassium Permanganate
 - E. Ethylene diamine tetraacetic acid (EDTA)
14. Choose the method that uses an adsorption indicator.
- A. Mohr method
 - B. Volhard method
 - C. Fajans method
 - D. Acid-base method
 - E. Redox method

15. Identify the bidentate ligand.
- A. Ammonia
 - B. Water
 - C. EDTA
 - D. Ethylenediamine
 - E. Chloride ion
16. Select the **CORRECT** statements regarding EDTA.
- I. It is only soluble in organic solvents.
 - II. It is a multidentate ligand.
 - III. It is used in direct titration methods.
 - IV. It has six donor sites.
- A. I and II
 - B. I and III
 - C. I, II, and IV
 - D. II, III, and IV
 - E. I, II, III, and IV
17. Choose the common indicator in EDTA titration.
- A. Phenolphthalein
 - B. Methyl orange
 - C. Eriochrome Black T
 - D. Thymol blue
 - E. Calconcarboxylic acid
18. In redox reaction, the loss of electron refers to _____.
- A. oxidation
 - B. reduction
 - C. combustion
 - D. complexometric
 - E. neutralization

19. Which of the following is an advantage of gravimetric analysis?
- A. Requires high-end instruments
 - B. Can be automated
 - C. No calibration required
 - D. Rapid method
 - E. Requires indicator
20. Identify the element required for the combustion of substances.
- A. Hydrogen
 - B. Nitrogen
 - C. Oxygen
 - D. Helium
 - E. Chlorine

II) SHORT ANSWER QUESTIONS (20 marks)**INSTRUCTION: Answer ALL questions in the answer booklet provided.****Each question carries TWO (2) marks.**

1. Differentiate between impurities and contaminants in pharmaceutical products.
2. State **TWO (2)** physical impairments that should be avoided during limit tests.
3. Differentiate monoprotic and diprotic acid with an example each.
4. Illustrate the titration curve between weak acid and strong acid.
5. Explain the principle of precipitation titration.
6. State **TWO (2)** disadvantages of Mohr's method in precipitation titration.
7. Define complexometric titration.
8. Describe monodentate ligand.
9. List **TWO (2)** types of gravimetric analysis.
10. Define the gasometric analysis.

SECTION B: MODIFIED ESSAY QUESTIONS (Total: 60 marks)

INSTRUCTION: This section consists of **FOUR (4)** questions.

You are required to answer **THREE (3)** questions in the answer booklet provided.

Questions 1 and 2 are **COMPULSORY**.

Answer **EITHER** Question 3 **OR** 4.

Question 1

- (a) A pharmaceutical laboratory is required to determine the concentration of an unknown sulfuric acid (H_2SO_4) solution using sodium hydroxide (NaOH). A 25.0 mL sample of H_2SO_4 is titrated with 0.100 M NaOH . The average volume of NaOH required to reach the equivalence point is 30.0 mL.

i. Calculate the molarity of the H_2SO_4 solution.

(4 marks)

ii. Calculate the normality of the H_2SO_4 solution.

(3 marks)

iii. Calculate the number of equivalents of H_2SO_4 present in the sample.

(3 marks)

- (b) A pharmaceutical analyst performed calculations and titration during the assay of an active pharmaceutical ingredient (API) using two different approaches. The following calculations were obtained:

Calculation A: $6.78 \times 0.34 = 2.3052$

Calculation B: $3.14 \times 4.786 \div 1.2239 = 12.292$

However, the analyst observed that the titration results consistently showed higher concentration values than expected.

- i. Apply the rules of significant figures to determine the correct final answers for calculations A and B.

(4 marks)

- ii. Compare the results obtained in b(i) and explain the differences in terms of precision.

(3 marks)

- iii. Based on the experimental observation, identify **ONE (1)** type of error that may have occurred and analyse how it affects the reliability of the results.

(3 marks)

Question 2

- (a) i. Describe the principle of limit test for chloride.

(4 marks)

- ii. Illustrate the method to perform limit test of chloride with an appropriate explanation.

(6 marks)

- (b) Calculate the pH of a weak acid solution of 0.2 M hydrofluoric acid (HF) if the acid dissociation constant, K_a is 7.0×10^{-4} .

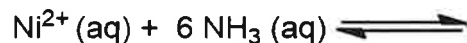
(5 marks)

- (c) Explain the acidimetry assay concepts in non-aqueous titration.

(5 marks)

Question 3

- (a) Draw the geometry of the complex formed in the reaction below:



(5 marks)

- (b) Determine the oxidation number of manganese (Mn) in KMnO_4 and antimony (Sb) in Sb_2O_5 .

(5 marks)

- (c) Calculate the mass of analyte per gram of precipitate (gravimetric factor) for the following conversion (i and ii). Given that the molar mass of Ba^{2+} is 137.3 g/mol, BaSO_4 is 233.4 g/mol, Ca^{2+} is 35.5 g/mol, and AgCl is 143.5 g/mol.

	Analyte	Precipitate
i.	Ba^{2+}	BaSO_4
ii.	Cl^-	AgCl

(6 marks)

- (d) Outline the gasometric method in determining % (v/v) of carbon dioxide.

(4 marks)

Question 4

- (a) Describe factors related to ligands that affect the stability of complex. (7 marks)

- (b) Write a balanced stoichiometry equation when KMnO_4 solution is titrated against a solution containing Fe^{2+} ions. (3 marks)

- (c) Calculate the mass of analyte per gram of precipitate (gravimetric factor) for the following conversion (i and ii). Given that the molar mass of SO_4^{2-} is 96.0 g/mol, BaSO_4 is 233.4 g/mol, Mg^{2+} is 24.3 g/mol, and $\text{Mg}_2\text{P}_2\text{O}_7$ is 222.6 g/mol.

	Analyte	Precipitate
i.	SO_4^{2-}	BaSO_4
ii.	Mg^{2+}	$\text{Mg}_2\text{P}_2\text{O}_7$

(6 marks)

- (d) Outline the assay technique in determining the percentage (%) v/v of oxygen. (4 marks)

END OF EXAMINATION PAPER