UNIVERSITI KUALA LUMPUR
ROYAL COLLEGE OF MEDICINE PERAK

FINAL EXAMINATION
MARCH 2026 SEMESTER

COURSE CODE	:	RCB30603
COURSE NAME	:	CHEMISTRY OF NATURAL PRODUCTS
PROGRAMME NAME	:	BACHELOR IN PHARMACEUTICAL TECHNOLOGY (HONOURS)
DATE	:	3 JULY 2026
TIME	:	2.30 PM – 4.30 PM
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 9 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

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SECTION A (Total: 40 marks)

I) MULTIPLE CHOICE QUESTIONS (20 marks)

INSTRUCTION: Answer ALL questions.

Use the OMR sheet provided.

1. Select the **CORRECT** statement regarding linear topology of metabolic pathway.
   A. It is a simple and straightforward pathway.
   B. It is a combination of several linear pathways.
   C. It is either divergent or convergent.
   D. It maintains the equilibrium between intermediates and products.
   E. The intermediate is regenerated throughout the reaction.

2. _____ is one of the primary metabolites produced in large quantities by plant.
   A. Saponin
   B. Tannin
   C. Carbohydrate
   D. Glycoside
   E. Alkaloid

3. Identify the enzyme involved in the conversion of pyruvate to acetyl-CoA.
   A. Pyruvate oxidase
   B. Pyruvate transferase
   C. Pyruvate dehydrogenase
   D. Cytochrome P450 enzyme
   E. Chalcone synthase

4. Select the **CORRECT** intermediate produced during the conversion of fatty acid to acetyl-CoA.
   A. Enoyl-CoA
   B. Acetoacetyl-CoA
   C. Ketoacyl-CoA
   D. Fatty acyl-CoA
   E. Hydroxylacyl-CoA

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5. How many acetyl-CoA molecule(s) are produced from a single molecule of fatty acid after β-oxidation reaction?

A. 1 molecule
B. 2 molecules
C. 3 molecules
D. 4 molecules
E. 5 molecules

6. How many glucose molecule(s) are produced after completing four Calvin cycles?

A. 1 molecule
B. 2 molecules
C. 3 molecules
D. 4 molecules
E. 5 molecules

7. Select the **CORRECT** match of the major compound and its plant source.

A. Taxol - *Persea americana*
B. Aspirin - *Salix alba*
C. Quinine - *Gynura procumbens*
D. Digoxin - *Catharanthus roseus*
E. Vincristine - *Zingiber officinale*

8. Identify the **CORRECT** number of isoprene units for triterpenoids.

A. 2 units
B. 3 units
C. 4 units
D. 6 units
E. 8 units

9. Select the **CORRECT** enzyme responsible for converting 3-dehydroshikimic acid to shikimic acid.

A. Chorismate synthase
B. Dehydroquinic acid synthase
C. Dehydroquinic acid dehydratase
D. Shikimate kinase
E. Shikimate dehydrogenase

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10. Identify the important intermediate responsible for the synthesis of terpenoids in the non-mevalonate pathway.

A. Mevalonate
B. Mevalonate-5-phosphate
C. Isopentenyl pyrophosphate
D. 1-deoxy-xylulose-5-phosphate (DXP)
E. Geranyl pyrophosphate

11. Select the **CORRECT** test for lipid detection.

A. Grease spot test
B. Benedict's test
C. Ninhydrin test
D. Xanthoproteic test
E. Millon's test

12. Identify the test used to detect tyrosine in protein.

A. Emulsification test
B. Esterification test
C. Seliwanoff's test
D. Biuret test
E. Millon's test

13. Choose the best definition of alkaloids.

A. Carbohydrates containing nitrogen
B. Nitrogen-containing basic compounds
C. Neutral lipids in seeds
D. Aromatic hydrocarbons
E. Sulfur-containing organic acids

14. Which amino acid is the primary precursor for the biosynthesis of tropane alkaloids?

A. Tyrosine
B. Histidine
C. Ornithine
D. Phenylalanine
E. Tryptophan

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15. Which of the following is a pro-vitamin A carotenoid?

A. Lutein
B. Zeaxanthin
C. β-carotene
D. Lycopene
E. Astaxanthin

16. Select the **CORRECT** glycoside that is classified as a local irritant.

A. Digitoxin
B. Sinigrin
C. Sennoside
D. Salicylic acid
E. Aloin

17. Identify the technique for analyzing the skeletal structure of an isolated compound.

A. Column chromatography
B. Flow cytometry
C. High performance-liquid chromatography (HPLC)
D. Nuclear magnetic resonance
E. Transmission electron microscope

18. Choose the solvents used for alkaloid extraction.

I. Acetone
II. Chloroform
III. Ethanol
IV. Ether

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

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19. Identify the suitable mobile phase for a reverse-phase HPLC.

A. Acetonitrile
B. Benzene
C. Chloroform
D. Silica
E. Hexane

20. Select the **CORRECT** statement regarding HPLC.

A. An analytical technique for separating compounds based on their volatilities.
B. It is the main choice for fingerprinting studies for the quality control of medicinal plants.
C. The compounds move through a HPLC column as gases.
D. Differential partitioning during the stationary phase allows the compounds to be separated in time and space.
E. It involves the use of ultrasound with frequencies ranging from 20 to 2000 kHz.

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II) SHORT ANSWER QUESTIONS (20 marks)

INSTRUCTION: Answer ALL questions in the answer booklet provided.

Each question carries TWO (2) marks.

1. State **ONE (1)** example of the anabolic and catabolic reactions.

2. Describe the *De novo* pathway in nucleic acid biosynthesis.

3. State **TWO (2)** reactions that occur in the β-oxidation process.

4. State **TWO (2)** drugs derived from the acetate melonate pathway.

5. State **TWO (2)** precursors required in the shikimic acid pathway.

6. Describe the positive indication in the ferric chloride test that differentiates between condensed and hydrolyzable tannins.

7. List **TWO (2)** examples of mobile phases used in thin-layer chromatography.

8. State **TWO (2)** factors that influence the degree of alkaloid basicity.

9. List **TWO (2)** examples of tyrosine-derived alkaloids.

10. Describe the pharmacological role of hyosine alkaloids. .

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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.
Question 1 and 2 are COMPULSORY.
Answer EITHER Question 3 OR 4.

Question 1

(a) The students are experimenting to detect the presence of carbohydrates in plant extract. The result of the experiment is shown in Figure 1. Name the test, explain the procedure, and the indication of the result.

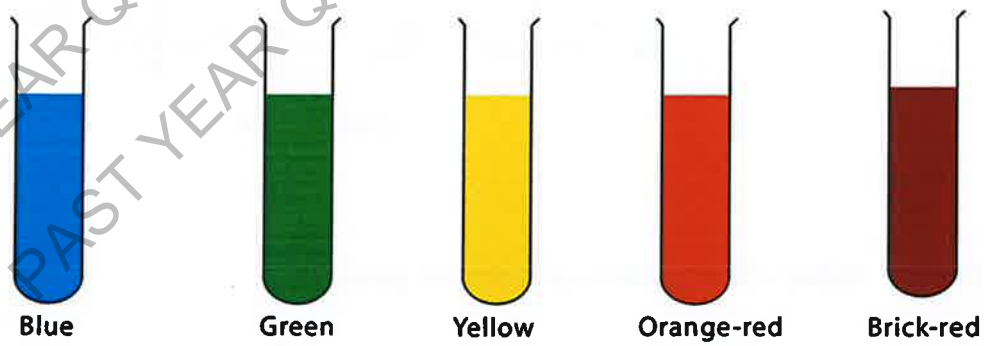


Figure 1

(5 marks)

(b) Explain the principle of nuclear magnetic resonance.

(5 marks)

(c) Describe **FOUR (4)** conditions in which atropine alkaloids are used as anticholinergic agents.

(4 marks)

(d) Ephedrine is a plant-derived alkaloid widely used in clinical settings. Explain the biosynthesis of ephedrine.

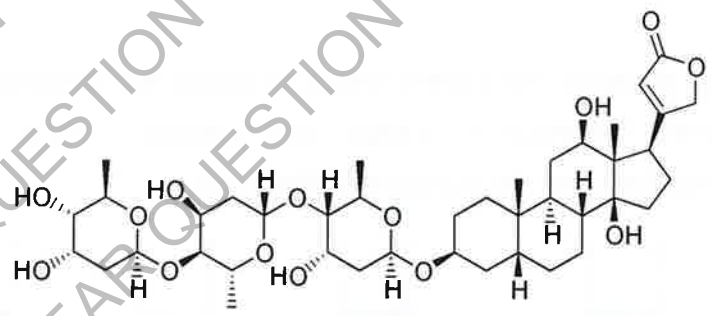
(6 marks)

Question 2

(a) Draw the general biosynthesis pathway of diterpenoid starting with **TWO (2)** isomerized compounds' structure from the acetate mevalonate pathway.

(10 marks)

(b) Draw the glycone and aglycone moieties of glycoside A shown below and suggest their functions.



Glycoside A

(6 marks)

(d) Explain the biosynthesis of cardiac glycoside.

(4 marks)

Question 3

(a) Explain percolation extraction method.

(5 marks)

(b) Explain crude drugs and the aim of their extraction.

(5 marks)

(c) Discuss the advantages and disadvantages of supercritical fluid extraction method.

(5 marks)

(d) Explain the principle of gas chromatography-mass spectrometry.

(5 marks)

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Question 4

(a) Explain **FIVE (5)** physical techniques used in the separation and purification of chemical constituents.

(5 marks)

(b) Describe the principle of conventional column chromatography.

(5 marks)

(c) Describe **FIVE (5)** advantages of microwave-assisted extraction.

(5 marks)

(d) Explain the application of high performance thin-layer chromatography.

(5 marks)

END OF EXAMINATION PAPER

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