

UNIVERSITY OF BOLTON**SCHOOL OF CLINICAL AND BIOMEDICAL
SCIENCES****BSC (HONS) MEDICAL BIOLOGY****SEMESTER TWO EXAMINATIONS 2021/22****INTRODUCTION TO BIOCHEMISTRY****MODULE NO: BIO4007**

Date: Tuesday 17th May

Time: 10.00am – 12.00pm

INSTRUCTIONS TO CANDIDATES:

Candidates are advised that the examiners attach importance to legibility of writing and clarity of expression. **YOU ARE STRONGLY ADVISED TO PLAN YOUR ANSWERS**

There are **THREE** sections.

Answer **ALL** questions from Section A and Section B.

Answer **ONE** question from Section C.

Write all answers in answer booklet. Marks for parts of questions are shown in brackets.

This examination paper carries a total of 100 marks.

A scientific calculator is required.

There is a formulae sheet at the end of this paper.

All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.

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SECTION A: Answer ALL questions in this section; 1 mark per question, 30 marks in total. Please answer the questions in your answer booklet, not on the question paper. It is recommended that you spend approximately 35 minutes on this section.

- Which of the following statements about water molecules is true?
 - The molecule is completely uncharged.
 - The molecule is partially charged.
 - The molecule is ionic.
 - The molecule has delocalised electrons
- Organic compounds which do not contain a delocalised ring of electrons are known as what?
 - Aliphatic compounds.
 - Aromatic compounds.
 - Algebraic compounds.
 - Alithartic compounds.
- If 0.5 moles of NaHCO_3 is dissolved in water to a final volume of 2 L, what is the concentration of the resulting solution?
 - 0.25 moles.
 - 0.25 M.
 - 1 mol.
 - 0.25 mol/mL.
- Which of the following is the correct electronic configuration for Iron (atomic number = 23)?
 - $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$.
 - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^5$.
 - $1s^2 2s^2 2p^6 3s^2 3p^8 4s^2 3d^1$.
 - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$.
- How many carbon atoms does one molecule of methylpropane contain?
 - 1.
 - 2.
 - 3.
 - 4.

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6. Which of the following are **not** important when considering how electrons are configured in an atom?
- Aufbau principle.
 - Hund's rule.
 - Pauli exclusion principle.
 - Bronsted-Lowry rule.
7. The carbonyl bond (C=O) is **not** found in which functional group?
- Aldehyde.
 - Ketone.
 - Carboxylic acid.
 - Alcohol.
8. If a solution of hydrochloric acid has a pH of 2, what would the concentration of H⁺ in the solution be?
- 2×10^{-1} M.
 - 1×10^{-3} M.
 - 1×10^{-2} M.
 - -1×10^{-2} M.
9. Which of the following statements about redox is **not** correct?
- Reduction is gain of electrons.
 - Oxidation is loss of electrons.
 - A reducing agent gets reduced during a redox reaction.
 - A displacement reaction is a redox reaction.
10. When NaCl is dissolved in water, the NaCl is the _____ and the resulting liquid is the _____.
- Solvent; solution.
 - Solute; solvent.
 - Solute; solution.
 - Solvent; solute.
11. What is the oxidation number of sulphur in SO₂ ?
- 4.
 - +4.
 - 2.
 - +2.

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12. Which of these is **not** a functional group?

- a. Ester.
- b. Carbohydrate.
- c. Amine.
- d. Aldehyde.

13. Which of the following statements are false for this reaction:



- a. H_2CO_3 acts as a base.
- b. The equilibrium shifts to the left in response to a drop in pH.
- c. The equilibrium shifts to the right in response to an increase in pH.
- d. The equation is correctly balanced.

14. The secondary structure of a protein is held together by:

- a. Hydrogen bonds.
- b. Covalent bonds.
- c. Glycosidic bonds.
- d. Peptide bonds.

15. Which of the following metals is **not** thought to be essential for human life?

- a. Aluminium.
- b. Sodium.
- c. Calcium.
- d. Iron.

16. Energy is released when:

- a. ATP is added to a molecule of ATP.
- b. A phosphate group is released from a molecule of ATP.
- c. A phosphate group is either added or released from a molecule of ATP.
- d. A potassium atom is released from a molecule of ATP.

17. What type of bond is found between iron and nitrogen in a molecule of haem?

- a. Double covalent.
- b. Hydrophobic.
- c. Ionic.
- d. Coordinate.

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18. Amino acids always contain carbon, hydrogen, oxygen, and what other main element?

- a. Sulphur.
- b. Phosphorous.
- c. Nitrogen.
- d. Magnesium.

19. Chirality refers to objects that:

- a. Can be superimposed on their mirror image.
- b. Cannot be superimposed on their mirror image.
- c. Differ only by the configuration around one carbon atom.
- d. Differ by configuration around more than one carbon atom in a chain.

20. What is the IUPAC name for a 6-carbon chained alkane with an -OH on carbon number 3, and a CH₃ on carbon number 4?

- a. Pentane-6-hydroxide
- b. Hexane-4-methyl-3-alcohol
- c. 4-methylhexanol
- d. 3-hexanol-4-methyl

21. For a Hydrogen Bond to exist, hydrogen must be bonded to:

- a. Carbon, Chlorine, or Oxygen
- b. Fluorine, Oxygen, or Sodium
- c. Oxygen, Fluorine, or Chlorine
- d. Nitrogen, Oxygen, or Fluorine

22. The presence of a single bond makes a fatty acid:

- a. Saturated.
- b. Hydrogenated.
- c. Oxygenated.
- d. Unsaturated.

23. Which of the following are **not** typically found coupled to a high-performance liquid chromatography (HPLC) system?

- a. Mass spectrometry system.
- b. Ultraviolet detector.
- c. SDS-PAGE system.
- d. Photodiode array detector.

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24. Which of the following is true for an enzyme-catalysed reaction?
- The E_A for the reaction is changed compared to that for the same reaction without the enzyme.
 - The overall ΔG for the reaction is larger compared to that for the same reaction without the enzyme.
 - The enzyme structure is changed as a result of the reaction.
 - The enzyme can only be used once.
25. Bonds formed between carbohydrate molecules are known as:
- Glycolipid bonds.
 - Hydrogen bonds.
 - Disulphide bridges.
 - Glycosidic bonds.
26. The most common covalent cross-links in proteins are sulphur–sulphur bonds that form between two amino acids with SH (thiol) groups as side chains. Which amino acid has this side chain?
- Cysteine.
 - Methionine.
 - Phenylalanine.
 - Proline.
27. The 'Phenyl' group is:
- Sulphur
 - Hydrocarbon chain
 - Benzene (aromatic) ring
 - NH_2
28. How many L are there in 8.6mL?
- 8600
 - 0.0086
 - 8.6
 - 4.3

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29. Which of the following statements is NOT correct about the phospholipid molecules in the plasma membrane?

- a. Each phospholipid molecule has three nonpolar tails.
- b. Each phospholipid molecule has one polar head.
- c. The phospholipid tails are not attracted to water.
- d. The phospholipid heads face outward.

30. The fatty acids in a phospholipid molecule attach to:

- a. Inositol.
- b. Glycerol.
- c. Phosphate.
- d. Glucose.

[Total for Section A: 30 marks]

END OF SECTION A

SECTION B OVER THE PAGE

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SECTION B: Answer ALL questions in this section; 5 marks per question, 40 marks in total. It is recommended that you spend approximately 50 minutes on this section.

1. You are working as a technician in a medical laboratory and are required to make some chemical solutions.

a. Describe how you would make 1.5 L of a 13 M stock solution of sodium bicarbonate (NaHCO_3) (Molar Mass Na = 23; Molar Mass H = 1; Molar Mass C = 12; Molar Mass O = 16).

[3 marks]

b. How would you dilute the solution described in part (a) to make 100 mL of a 500 mM solution?

[2 marks]

[Total 5 marks]

2. With reference to a drawn example, explain why sugar molecules are often said to be "chiral" molecules. Your answer should also include the *name* and *type* of sugar you have referenced.

[5 marks]

3. Name and describe the four levels of protein structure and how they are related to each other.

[5 marks]

4. Describe two spectroscopic techniques that can be used in biochemical experiments and the reasons for carrying out these techniques.

[5 marks]

5. Enzymes allow energetically favourable chemical reactions to occur more quickly despite these reactions already being spontaneous. Discuss.

[5 marks]

6. With reference to each of the various principles covered, explain how electrons are organised in an atom.

[5 marks]

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7. a) What is the pH of a solution containing 2.5×10^{-3} M hydrochloric acid (HCl)?
[2 marks]

b) What is the concentration of OH^- in a solution with a pH of 13.6?
[3 marks]

[Total 5 marks]

8. Draw the displayed formulae for each of the following:

a) Pentane.
[1 mark]

b) 2,3-dimethylhexane.
[2 marks]

c) Trans-1-bromobut-1-ene.
[2 marks]

[Total 5 marks]

[Total for Section B: 40 marks]

END OF SECTION B

SECTION C OVER THE PAGE

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PAST EXAMINATION PAPER

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SECTION C: Answer ONE question only; 30 marks. It is recommended that you spend approximately 35 minutes on this section.

1. Describe, with illustrations, the structure and properties of at least five different functional groups that are found in organic chemistry. As part of your answer you should give examples of how these groups are relevant to human biology and/or medicine.

[30 marks]

OR

2. "All metals are important for normal human functions". Discuss.

[30 marks]

OR

3. Explain how a membrane protein such as porin can be stably incorporated within the cell membrane. In your answer, you should give an account of both protein structure and phospholipid structure.

[30 marks]

[Total for Section C: 30 marks]

END OF QUESTIONS

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FORMULAE SHEET

Molarity and dilution

$$\text{Moles} = \frac{\text{Mass}}{M_r}$$

$$\frac{\text{Moles}}{\text{Solvent volume (L)}} = \text{Molarity (M)}$$

$$M_1V_1 = M_2V_2$$

pH

$$K_w = [\text{H}^+][\text{OH}^-] = 1.0 \times 10^{-14} \text{ M}^2$$

$$\text{pH} = -\log [\text{H}^+]$$

$$[\text{H}^+] = 10^{-\text{pH}}$$

END OF PAPER