

UNIVERSITY OF BOLTON**SCHOOL OF SPORT AND BIOLOGICAL SCIENCES****BSC (HONS) MEDICAL BIOLOGY****SEMESTER TWO EXAMINATIONS 2018/19****INTRODUCTION TO BIOCHEMISTRY****MODULE NO: BIO4007**

Date: Wednesday 22 May 2019

Time: 10.00 am – 1.00 pm

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, and **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, 25 marks in total. Please answer the questions in your answer booklet, not on the question paper.

1. When NaCl is dissolved in water, the NaCl is the _____ and the water is the _____.

- a. Solvent; solution.
- b. Solute; solvent.
- c. Solute; solution.
- d. Solvent; solute.

2. Which of the following is **NOT** a common organic reaction mechanism?

- a. Condensation.
- b. Elimination.
- c. Substitution.
- d. Precipitation.

3. If 4 moles of NaCl are dissolved in 1 L of water, what is the concentration of the resulting solution?

- a. 0.25 moles.
- b. 4 M.
- c. 4 moles.
- d. 0.25 M.

4. Which of the following is the correct electronic configuration for potassium (atomic number = 19)?

- a. $1s^2 2s^2 2p^7 3s^2 3p^6$.
- b. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$.
- c. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$.
- d. $1s^2 2s^2 2p^6 3s^2 3p^7$.

5. How many carbon atoms does one molecule of propane contain?

- a. 1.
- b. 2.
- c. 3.
- d. 4.

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6. Which of the following statements are **true** 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 a drop in pH.
 - d. The equation is not correctly balanced.
7. Which of the following metals is commonly found in proteins which bind DNA?
- a. Zinc.
 - b. Calcium.
 - c. Sodium.
 - d. Potassium.
8. The overall ΔG for respiration is:
- a. Positive.
 - b. Negative.
 - c. Zero.
 - d. Incalculable.
9. Which of the following is not an example of protein tertiary structure?
- a. Disulphide bridges.
 - b. Hydrophobic interactions.
 - c. Ionic bonding.
 - d. β -pleated sheets.
10. Which of the following metals **is** thought to be essential for human life?
- a. Titanium.
 - b. Potassium.
 - c. Aluminium.
 - d. Scandium.

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11. What form of bond is found between iron and nitrogen in a molecule of haem?
- Hydrogen.
 - Ionic.
 - Co-ordinate.
 - Hydrophobic.
12. Which of the following are **not** typically found coupled to a high-performance liquid chromatography (HPLC) system?
- Mass spectrometry system.
 - Ultraviolet detector.
 - SDS-PAGE system.
 - Photodiode array detector.
13. Chirality refers to objects that:
- Cannot be superimposed on their mirror image.
 - Can be superimposed on their mirror image.
 - Differ only by the configuration around one carbon atom.
 - Differ by configuration around more than one carbon atom.
14. The generic formula "RCOH" refers to which functional group?
- Aldehyde.
 - Ketone.
 - Carboxylic acid.
 - Alcohol.
15. There are two forms of carbohydrates:
- Aldoses and Esters.
 - Esters and Alkanes.
 - Alkanes and Ketoses.
 - Aldoses and Ketoses.
16. Which of the following are **not** important when considering how electrons are configured in an atom?
- Bronsted-Lowry rule.
 - Pauli's principle.
 - Aufbau principle.
 - Hund's rule.

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17. A protein can be unfolded by a process called:

- a. Renaturation.
- b. Denaturation.
- c. Oxidation.
- d. Reduction.

18. If a solution of hydrochloric acid has a pH of 5, what would the concentration of H^+ in the solution be?

- a. 1×10^{-5} M.
- b. -1×10^5 M.
- c. 1×10^5 M.
- d. -1×10^{-5} M.

19. The proteins that control the reactions of metabolism are:

- a. Amino acids.
- b. Catalysts.
- c. Enzymes.
- d. Substrates.

20. Which parts of amino acids are involved in peptide bonds?

- a. The carboxyl group on one amino acid and the side chain on the other.
- b. The carboxyl group on both amino acids.
- c. The amino group on one amino acid and the carboxyl group on the other.
- d. The amino group on both amino acids.

21. Which chemical groups attach to glycerol in a triglyceride?

- a. Phosphates.
- b. Alcohols.
- c. Fatty acids.
- d. Amino acids.

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22. The absence of a double bond makes a fatty acid:
- Saturated.
 - Hydrogenated.
 - Oxygenated.
 - Unsaturated.
23. Which of the following is not an important factor in membrane fluidity?
- The proportion of unsaturated fats.
 - The proportion of saturated fats.
 - The presence of albumin.
 - The presence of cholesterol.
24. Monosaccharides may be synthesised from simpler substances in a process called:
- Glycolysis.
 - Gluconeogenesis.
 - Glucogenesis.
 - Glycoconjugation.
25. If the Standard Gibb's free energy, ΔG , for a reaction is negative then:
- The products will be favoured.
 - The reactants will be favoured.
 - The concentration of the reactants and products will be equal
 - Enzymes will be unable to increase the rate of the reaction.

[Total for Section A: 25 marks]

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SECTION B: Answer ALL questions in this section; 5 marks per question, 50 marks in total.

1. Explain why carbohydrate molecules are often said to be “chiral” molecules. [5 marks]
2. Name and describe the four levels of protein structure. [5 marks]
3. Explain how a phospholipid bilayer forms. [5 marks]
4. Explain how enzymes allow energetically favourable chemical reactions to occur more quickly. [5 marks]
5. You are working as a technician in a medical laboratory, and are required to make some chemical solutions.
- a. Describe how you would make 1.50 L of a 5 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 500 mL of a 625 mM solution? [2 marks]
- [Total 5 marks]
6. With reference to the Aufbau principle, explain how electrons are organised in an atom. [5 marks]

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7. Explain how a chemical such as carbonic acid can act as a buffer. [5 marks]

8. Describe two spectroscopic techniques that can be used in biochemical experiments. [5 marks]

9. a) What is the pH of a solution containing 6.2×10^{-3} M hydrochloric acid (HCl)? [2 marks]

b) What is the concentration of OH^- in a solution with a pH of 6.5? [3 marks]

[Total 5 marks]

10. Draw the chemical structure of:

a) Ethane. [1 mark]

b) 2-methylpentane. [2 marks]

c) Cis-but-2-ene. [2 marks]

[Total 5 marks]

[Total for Section B: 50 marks]

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SECTION C: Answer ONE question only; 25 marks.

1. "The human body can function perfectly well without metals". Discuss whether or not this statement is true.

[25 marks]

OR

2. With reference to both protein structure and phospholipid structure, explain how a membrane protein such as porin can be stably incorporated within the cell membrane.

[25 marks]

OR

3. Describe, with illustrations, some of the 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.

[25 marks]

[Total for Section C: 25 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

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

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

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