Student Name: _____

CHEMISTRY 2021
Unit 4
Key Topic Test 6 – Energy Content of Food

Recommended writing time*: 50 minutes
Total number of marks available: 50 marks

QUESTION BOOK

*The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions
- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.
- VCAA Chemistry data booklet will be provided
- A scientific calculator is permitted in this test.

Materials supplied
- Question and answer book of 9 pages.

Instructions
- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A
Answer **all** questions.
Choose the response that is **correct** for the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks are **not** deducted for incorrect answers.
If more than one answer is completed for any question, no mark will be given.

Question 1

When hiking, it is important to carry food with as much energy as possible while minimising the weight carried. Therefore, it is a good idea to carry food that is high in;

A. carbohydrate

B. protein

C. fat

D. water

Question 2

In terms of protein, the energy available for the body is less than the heat of combustion. This is due to;

A. not all of the protein being able to be metabolised by the body

B. some of the energy being converted to waste heat

C. energy being required to break down the secondary and tertiary structure of the protein

D. protein being used to build muscle as well as provide energy

Question 3

A bomb calorimeter involves;

A. the reaction of solutions

B. the presence of oxygen under high pressure

C. the burning of foods but not fuels to determine their change in heat content

D. the dissolving of ionic or covalent substances

Question 4

The calibration of a calorimeter;

A. determines the heat absorbed by water for a certain temperature rise

B. determines the heat absorbed by the water and the container and its components for a certain temperature rise

C. determines the heat absorbed by the container and its components for a certain temperature rise

D. determines the temperature rise for a certain amount of chemical

2021 CHEMISTRY KEY TOPIC TEST

Question 5

Fats and oils have a higher energy density than carbohydrates as,

A. fats and oils are larger molecules than carbohydrates
B. carbohydrates contain a lot of water
C. carbohydrates are polar while fats and oils are non-polar
D. fats and oils contain a higher proportion of carbon than carbohydrates

Question 6

Respiration involves;

A. oxidation of oxygen and reduction of carbon and is exothermic
B. oxidation of carbon and reduction of oxygen and is endothermic
C. oxidation of oxygen and reduction of hydrogen and is exothermic
D. oxidation of carbon and the products have less chemical energy than the reactants

Question 7

The calibration factor of a bomb calorimeter that has been calibrated using an electrical method compared to just calculating the energy absorbed by the water would be;

A. lower
B. higher
C. exactly identical
D. almost identical

Question 8

Apples have a very low energy content per gram compared to grains. This is mostly due to;

A. apples having very little fat in them
B. apples having a very high-water content
C. apples have a low GI value
D. apples contain a high level of vitamins and antioxidants

Question 9

A snack food has 15g of carbohydrate, 15g of protein and 10g of fat. The approximate percentage of energy from the fat is;

A. 10%
B. 25%
C. 30%
D. 40%

Question 10

One of the functions of the thermometer in a calorimeter is;
A.   to record the temperature decrease during the calibration process
B.   to record the temperature increase or decrease during the reaction of the chemical
C.   to record the energy change during the calibration and the reaction of the chemical
D.   to relate the temperature change during calibration to the energy change during the reaction of the chemical

SECTION B- Short-answer questions

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| **Instructions for Section B** |
| Questions must be answered in the spaces provided in this book. |
| To obtain full marks for your responses you should: |
| • Give simplified answers with an appropriate number of significant figures to all |
| numerical questions; unsimplified answers will not be given full marks. |
| • Show all workings in your answers to numerical questions. No credit will be given for |
| an incorrect answer unless it is accompanied by details of the working. |
| Make sure chemical equations are balanced and that the formulas for individual substances |
| include an indication of state; for example, $H_2(g)$; $NaCl(s)$. |
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Question 1
   a.   Write a thermochemical equation for cellular respiration assuming that 1 mol of glucose releases 2560 kJ of energy.

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3 marks

   b.   As well as glucose, other nutrients provide energy to humans. Place an X against the nutrients that would NOT be expected to provide significant amounts of energy,

   o   Starch
   o   Cellulose
   o   Fat
   o   Protein
   o   Vitamins
   o   Salt

3 marks

c. Labelling on a 5.0g sample of biscuits indicates that they contain 3.10 g of carbohydrates, 0.55 g of protein and 0.80g of fat. Calculate the energy value of the cereal in kJ g^{-1}.

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5 marks

Total 11 marks

Question 2

a. A sample of food was burnt to heat 100 mL of water. Calculate the heat energy in kJ that has been transferred to the water if the temperature of the water increased from 20.5°C to 28.5 °C.

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2 marks

b. A 1.030 g cashew nut was burnt under a steel can containing 100 mL of water. After the flame went out the mass of the cashew nut was 0.290 g and the temperature of the water had risen by 21.0°C. Calculate the energy content of the cashew nut in kJ g^{-1}.

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3 marks

c. Discuss how accurate the technique in part b would be. Refer to the design features of the experiment that could lead to an inaccurate result.

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4 marks

Total 9 marks

Question 3

a. A bomb calorimeter was calibrated by passing 1.50 A of current through a calorimeter for 5.0 minutes at a potential difference of 5.50 V. The temperature of the water rose by 5.7°C. Determine the calibration factor of the calorimeter.
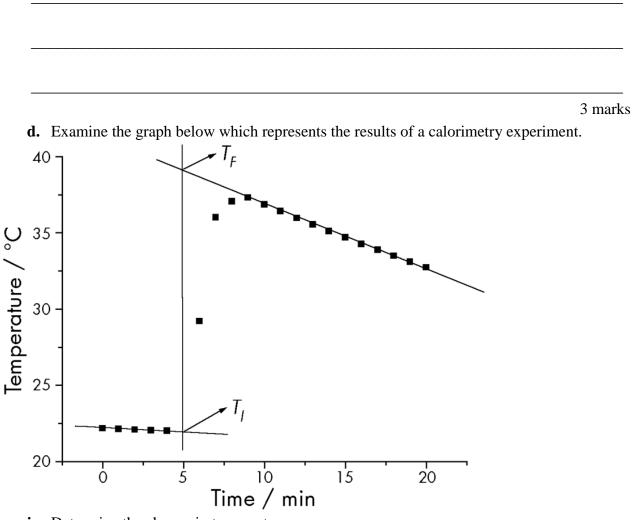
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3 marks

b. During the calibration of another calorimeter, 0.124 g of benzoic acid was burnt, resulting in an increase in temperature of 3.02 °C. The molar mass of benzoic acid is 122.0 g/mol and the Heat of combustion of benzoic acid is 3228 kJ/mol. Determine the calibration factor of the calorimeter.

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3 marks

c. Describe three differences between a bomb calorimeter and solution calorimeter.

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3 marks

d. Examine the graph below which represents the results of a calorimetry experiment.

i. Determine the change in temperature.

_____

ii. Comment on how well the calorimeter is insulated.

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$1 + 1 = 2$ marks

Total 11 marks

Question 4

   a. 1.50 g of dry biscuits were burned in a bomb calorimeter. The calibration factor of the bomb calorimeter was 6.80 kJ $°C^{-1}$. During the combustion of the biscuits, the temperature of the water rose by 10.7°C. The mass of ash left at the end of the experiment was negligible. Calculate the energy content of the biscuits in kJ g^{-1}.

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<div align="right">2 marks</div>

   b. A solution calorimeter is calibrated by passing 6.15 V at a current of 1.40 A through 250 mL of water for 9 minutes. A temperature rise of 10.14°C occurred. Then 44.60 g of sucrose is dissolved in 250 mL of water. If the temperature of the water decreases by 1.45°C, calculate the enthalpy of solution of sucrose in Jg^{-1} and $kJmol^{-1}$.

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<div align="right">7 marks
Total 9 marks</div>

<div align="center">END OF TASK BOOK</div>