Analysis of Practical Activities

Reading time: 5 minutes

Writing time: 55 minutes

Student's Name: _____

Teacher: _____

Structure of booklet

Section	Number of Questions	Number of questions to be answered	Marks
Short Answer	24	24	47
		Total:	**47**

Directions to students

Materials

- Students **are permitted** to bring into the examination room: pens/pencils, highlighters, erasers, sharpeners, rulers, and an approved scientific calculator.

- Students are **NOT permitted** to bring into the examination room: white out liquid/tape, phones or electronic devices, including smart watches.
- Students are provided with the following: Question and answer book of **10** pages and VCAA Data booklet.

The task

- Please ensure that you write your name and teacher's name on this booklet. This paper consists of short answer questions.

- There are a total of **47** marks available.

- Be sure to include states with all chemical equations.

- All numerical answers need to be quoted to the correct number of significant figures.

- All working out must be shown in the space provided.

Practical Experiments referred to in this assessment

Prac 1: Formation and combustion of biodiesel

Prac 2: Combustion of ethanol

Prac 3: Electrical calibration and use of a solution calorimeter

Prac 4: Formation of an electrochemical series

Prac 5: Demonstration of a hydrogen fuel cell

Consider Prac 1 when answering these questions: (2 marks)

1. Identify the **dependent** variable in the combustion part of the investigation only. (1 mark)

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2. Other than wearing a lab coat and safety glasses, what other safety measure was taken during this experiment. (1 mark)

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   _____

3. What is a disadvantage of this fuel? (1 mark)

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Consider Prac 2 when answering these questions: (8 marks)

A student conducted experiment 2 and obtained the following results:

Measurement	**Result**
Volume of water	150.0mL
Initial temperature of water	23.5°C
Initial mass of beaker and ethanol	148.23g
Final temperature of water	38.2°C
Final mass of beaker and ethanol	146.17g

4. Using the above results, calculate the heat of combustion of ethanol to the correct number of significant figures. *Assume the density of water is 1.0g/ml.* (3 marks)

5. Using your answer to Question 4, write a balanced thermochemical equation for the combustion of ethanol. (2 marks)

6. Using your answer to question 4 and the knowledge that the heat of combustion of ethanol is 1360 kJ/mol, calculate the efficiency of this process. (1 mark)

7. One student conducted the experiment and obtained a result of 1555 kJ/mol. State what **mistake** the student may have made for this to occur? Explain how this has resulted in a higher result. (2 marks)

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Consider Prac 1 and 2 when answering these questions: (5 marks)

8. Given that the ethanol supplied was a pure substance, which experiment, given that they followed the same method for combustion, would have produced a more accurate result for the heat of combustion of each fuel? Explain your answer. (2 marks)

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9. Comment on the validity of these experiments. (2 marks)

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10. State an improvement that could be done to increase the accuracy of the experiments. (1 mark)

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Consider Prac 3 when answering these questions: (12 marks)

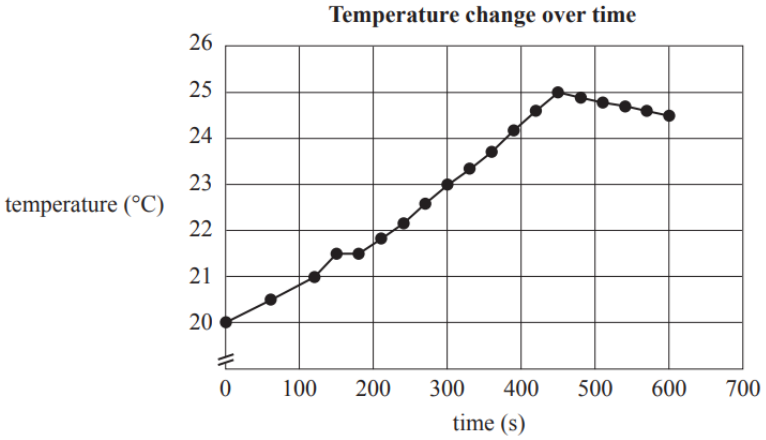
Student A conducted electrical calibration of a calorimeter and produced the graph below from their results. They turned the heater on at 0 seconds and left on for 7 minutes.

Student A

Results – Electrical method of calibration

voltage = 5.8 V

current = 1.6 A



11. Determine the calibration factor (in J $^{o}C^{-1}$) of the calorimeter given 100.0mL of water was used. (3 marks)

12. How would the calibration factor calculated in question 7 be affected if the heater s turned off after:

    i. 3 minutes. (2 marks)

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_____

    ii. 30 seconds (2 marks)

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j. Name one systematic error related to the electrical calibration of the calorimeter. (1 mark)

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In the second part of this experiment, Student A wanted to determine the change in enthalpy (ΔH) of the reaction between hydrochloric acid and magnesium. They added 100mL of 1.0M HCl and 0.2515g of magnesium into the calorimeter. The temperature of the calorimeter increased by 8.6°C.

k. Give a balanced chemical equation, states included, for this reaction. (2 marks)

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l. Determine which reagent is limiting. (2 marks)

m. Calculate the volume of hydrogen gas produced at SLC. (2 marks)

n. Calculate the experimental change in enthalpy (ΔH) for the reaction. (2 marks)

Consider Prac 4 when answering these questions: (4 marks)

A sample of student results from this experiment is given below:

Cell	Negative terminal	Positive terminal	Cell Voltage
$A^{2+}/A \,||\, B^{2+}/B$	A	B	1.5V
$B^{2+}/B \,||\, C^{2+}/C$	C	B	2.0V
$D^{2+}/D \,||\, A^{2+}/A$	A	D	0.9V
$C^{2+}/C \,||\, A^{2+}/A$	C	A	0.5V
$D^{2+}/D \,||\, B^{2+}/B$	D	B	

o. Using the results above, write an electrochemical series (no voltages required). (3 marks)

p. Determine the cell voltage for the $D^{2+}/D \,||\, B^{2+}/B$ cell using the results. (1 mark)

q. Explain why you were unable to assign E.M.F (E^o) values to the electrochemical series formed and compare to the standard electrochemical series. (1 mark)

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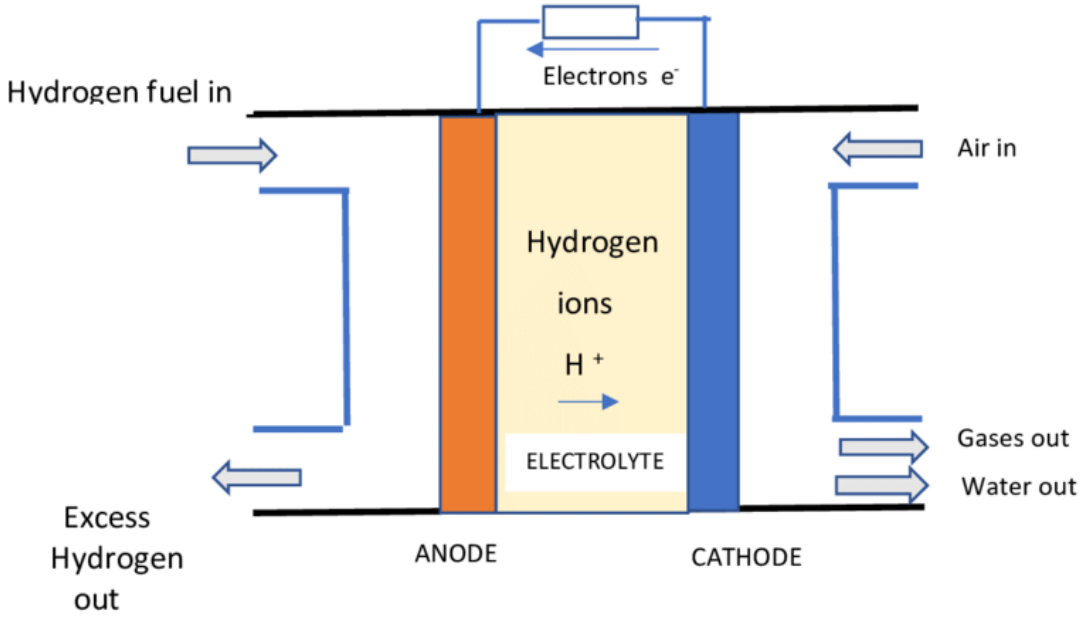
Consider Prac 5 when you answer the following questions: (7 marks)

A hydrogen fuel cell was demonstrated to you in class, the half equations for the hydrogen fuel cell and a simplified diagram are given below.

$$H_2\,(g) \rightarrow 2H^+\,(aq) + 2e^-$$

$$O_2\,(g) + 4H^+\,(aq) + 4e^- \rightarrow 2H_2O\,(l)$$



r. Given that the hydrogen oxygen fuel cell is 57% efficient. Calculate the amount (in grams) of hydrogen required to produce 150MJ of usable energy, given the heat of combustion of hydrogen is 282kJ/mol. (2 marks)

s. Another type of fuel cell can use **bioethanol** as a fuel with a **molten carbonate electrolyte.** Write the balanced half equations and overall equation for an acidic bioethanol-oxygen fuel cell. (3 marks)

   a. Anode:

   b. Cathode:

   c. Overall:

t. Would a biogas-oxygen **or** hydrogen/oxygen fuel cell be more environmentally friendly? Explain your answer. (2 marks)

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Consider Prac 1, 2, and 5 when answering these questions: (3 marks)

u. Assuming that all experiments were conducted on the same day, identify a controlled variable that was consistent across all of the investigations. (1 mark)

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v. Which of the experiments would provide the most energy efficient way to obtain energy to drive a car? Explain your reasoning. (2 marks)

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END OF SAC