

VCE Chemistry Units 3&4

Suggested Solutions

Test 8: How is scientific inquiry used to investigate the sustainable production of energy and/or materials?

- Investigation design
- Scientific evidence
- Science communication

SECTION A – MULTIPLE-CHOICE QUESTIONS

Question 1 C

C is correct. Judging the exact point of colour change is somewhat subjective and so has an uncertainty in the measurement of the required volume.

A and **B** are incorrect. The uncertainty in the measurement will be in the last figure of the measurement, not before or after the last figure.

D is incorrect. This is a mistake – a poor procedure rather than an uncertainty.

Question 2 A

A is correct. The label shown is for a flammable substance. Ethanol, used as a fuel, is a flammable liquid.

B is incorrect. Nitrogen would be labelled as a non-hazardous gas.

C is incorrect. This strong acid would be labelled as corrosive.

D is incorrect. Sodium would be labelled as ‘dangerous when wet’.

Question 3 C

C is correct. The results are close to each other, with all values within 2 mA of each other. This shows precision. However, the accurate value is 542 mA, and so the results are not accurate.

A, **B** and **D** are incorrect. They do not correctly specify the precision and accuracy of the results.

Question 4 D

D is correct and **C** is incorrect. The precise but inaccurate results show evidence of a systematic error such as an incorrectly calibrated device. This type of error is not remedied by repeated measurement and averaging. The device must be replaced or calibrated correctly.

A and **B** are incorrect. While there may be some random error present to explain the small variations in the readings, this type of error can be reduced by repeated measurement and averaging of values, but cannot be completely removed.

Question 5 D

$(5.326 \times 10^{-30}) \times (7.43 \times 10^{11}) = 39.57218 \times 10^{-19} = 3.957218 \times 10^{-18} = 3.96 \times 10^{-18}$, correct to three significant figures. The least accurate figure in the data supplied has three significant figures (7.43). This determines the number of figures to be included in the answer when multiplication is involved.

Question 6 C

C is an incorrect statement and so is the required response. Systematic error would make all values different from the accurate value, but similar to each other.

A and **B** are correct statements and so are not the required response. The value in trial 2 is an outlier and could have resulted from incorrect rinsing of the pipette, leading to dilution of the vinegar sample for that trial.

D is a correct statement and so is not the required response. The average of 4.3, 4.4 and 4.5 is 4.3% m/v. The average should not include the outlier value of 3.6.

Question 7 B

B is correct. The burette is read from the top down, as shown by the increasing numbers from 0 to 50. This reading should be recorded as 6.45 mL.

A is incorrect. This reading is taken at the top of the meniscus, not the bottom.

C is incorrect. This reading does not record the value to the appropriate precision.

D is incorrect. This would be recorded if the burette was read from the bottom to the top.

Question 8 B

B is correct. This graph shows results with random errors such as minor fluctuations in temperature, which may affect readings, giving a spread of measured values slightly either side of the expected values.

A is incorrect. This graph shows the 'perfect' result with one outlier, possibly caused by a mistake in measurement.

C is incorrect. This graph shows the 'perfect' result with no indication of any errors in any measurements.

D is incorrect. This graph shows results in which one value is consistently higher than expected. This would be the case if there was a systematic error, such as the use of a poorly calibrated instrument.

Question 9 A

A is correct. An experiment is valid if it tests the hypothesis. This requires that all variables except the one being tested remain constant throughout the experiment.

B is incorrect. This statement describes the precision of measurements.

C is incorrect. This statement relates to the accuracy of measurements.

D is incorrect. This statement describes the hypothesis.

Question 10 B

B is correct. As the independent variable (x -axis) increases, the dependent variable (y -axis) increases, but in a non-linear proportion.

A is incorrect. This graph shows a non-linear inverse relationship between the variables.

C is incorrect. This graph shows a positive, linear relationship.

D is incorrect. This graph shows that as one variable changes, the other is unaffected.

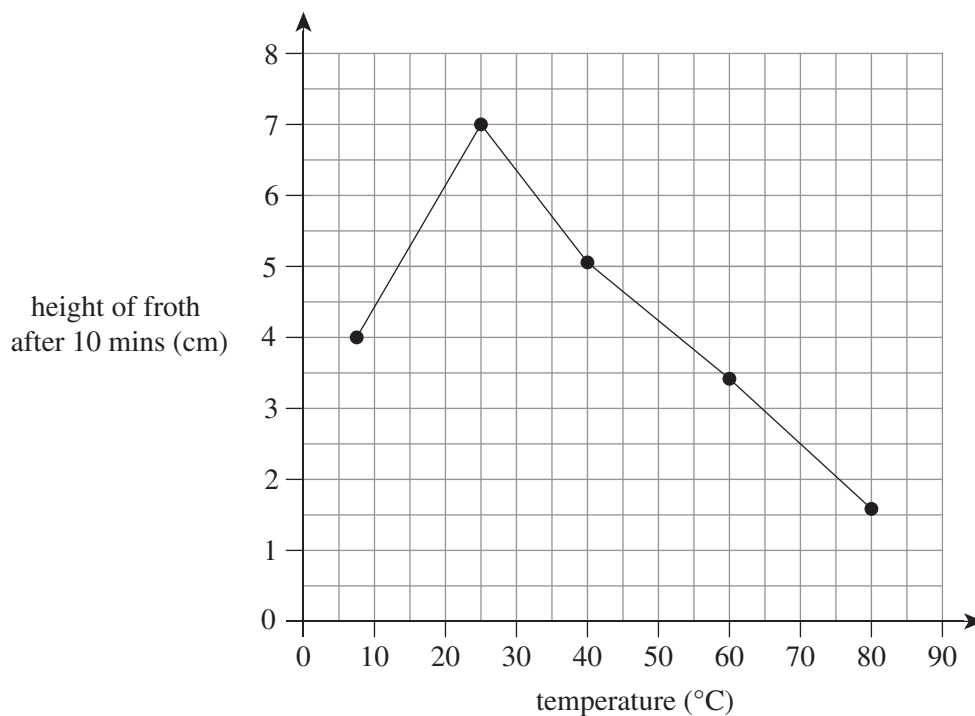
SECTION B**Question 1** (13 marks)

- a. i. enzyme activity (as measured by the froth height) 1 mark
- ii. temperature 1 mark
- iii. Any two of:
- volume of H_2O_2 solution
 - concentration of H_2O_2 solution
 - volume of enzyme solution
 - concentration of enzyme solution
 - time for froth development
 - diameter of test tube

2 marks

1 mark for each controlled variable identified.

b.



3 marks

*1 mark for correctly labelled and scaled axes.**1 mark for correctly plotted points.**1 mark for a line of best fit.*

- c. i. 25°C 1 mark
- ii. For example:
- Conduct trials at temperatures close to either side of the suggested optimum temperature to obtain a more definitive peak on the graph. 1 mark

d. Any two of:

- uncertainty in measurement of the froth height
- minor fluctuations in temperature during the 10-minute reaction time
- uncertainty in measurement of solution volumes
- minor variations in the stop/start of the timer

2 marks

1 mark for each source of random error stated.

e. All variables apart from the temperature appear to have been kept constant.

1 mark

The change in froth height/enzyme activity can therefore be attributed to the change in temperature. The experiment is valid.

1 mark

Question 2 (6 marks)

a. For example:

If the charge passed through the cell increases, then more reaction will occur and so a larger mass of copper will be deposited at the cathode.

1 mark

b.

Statement from 'Discussion' section of the report	The statement most closely relates to _____ (<i>validity, reliability, precision or accuracy</i>)
The ammeter was calibrated immediately prior to the experiment.	accuracy
For each amount of charge, three separate trials were conducted and the mass of copper deposited in each case was recorded.	reliability
All variables, such as temperature, concentration of copper(II) sulfate solution, volume of solution used, distance between the electrodes and size of electrodes, remained constant throughout the experiment.	validity

3 marks

1 mark for each correct cell.

c. i. The measured mass deposited was consistently higher than the theoretical mass for all charge values.

1 mark

ii. For example:

The electrode may not have been completely dry, giving a higher recorded mass for the deposit on the electrode.

1 mark

Question 3 (6 marks)

- a. i.** $n(\text{HCl}) = c \times V = 1.0 \times 20.0 \times 10^{-3} \text{ mol}$ 1 mark
- $n(\text{CO}_2) = \frac{1}{2} \times n(\text{HCl}) \text{ mol}$ 1 mark
- $m(\text{CO}_2) = n \times M = \frac{1}{2} \times 1.0 \times 20.0 \times 10^{-3} \times 44.0 = 0.44 \text{ g}$ 1 mark
- ii.** *For example:*
- Some carbon dioxide remains dissolved in the solution. 1 mark
- The mass recorded as lost does not include all of the carbon dioxide and so the measured value is less than the expected value. 1 mark
- OR**
- No mixing of the reactants occurred so it is possible that not all of the acid has reacted. 1 mark
- This means that less carbon dioxide is produced than expected because the reaction is not complete. 1 mark
- b.** $\frac{\text{mass of CO}_2(\text{g})}{\text{time (mins)}} = \frac{0.37}{3.0} = 0.12 \text{ g min}^{-1}$ 1 mark
- (At 3.0 mins – that is, 180 s – the mass of CO_2 is 0.37 g.)