BENCHMARK

VCE Chemistry Assessments

2027 VCE Chemistry

Teacher Guide

Open SAC 4.3: Student-designed investigation

- Unit 4, Outcome 3: **40 marks**
- Class time is **at least 10 hours**

This guide contains

- Conditions, checkpoints and authentication
- Investigations that suit the laboratory stock
- The marking scheme, with what each level requires

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Running the task

This task assesses Unit 4, Outcome 3 (40 marks): the design, analysis and findings of a student-designed and student-conducted investigation, communicated through a structured scientific poster and logbook entries. It covers the key knowledge of Area of Study 3 (4.3.1.1 to 4.3.3.3).

Conditions

- At least 10 hours of class time for designing, conducting and communicating the investigation.
- Complete the work mainly in class, within the timeframe you set, including the poster draft.
- Where students choose different investigations, check that the options are of comparable scope and demand: each should generate quantitative data over at least five values of the independent variable.
- Approve every proposal and its risk assessment before any practical work begins (Checkpoint 1).

Authentication

- Sight and initial each student's logbook in every practical session, and date your initials.
- Check that every value in the poster can be found in the logbook. Where it cannot, resolve this with the student before marking.
- Where partners generate data together, check that each logbook records this and that each poster has its own analysis and wording.
- Keep the signed checkpoint tables with the marked work.

Marking

- Mark the poster and logbook together. The logbook line item is marked from the logbook; the others mainly from the poster.
- Circle the one cell in each line item that best matches the work: VH 4, H 3, M 2, L 1, NA 0. Add the ten marks for the total out of 40.
- Do not penalise a fault under one line item that is already penalised under another.
- Words beyond 600 are a fault under Science communication only; mark the rest of the poster as written.

Suitable investigations

Each investigation below generates quantitative data, relates to energy, chemical production or organic chemistry, and uses only equipment and chemicals in the laboratory stock list. None needs an open flame or sulfuric acid. Students may propose others; approve them against the same tests.

Investigation question	Independent / dependent variable	Equipment and chemicals	Main hazards
How does the current affect the mass of copper deposited in the electrolysis of copper(II) sulfate solution?	Current (set with the power supply and read on a multimeter) / mass gained by the cathode	0 to 12 V DC power supply, multimeter, leads with crocodile clips, copper electrodes, sandpaper, copper sulfate solution, beakers, electronic balance, electronic timer	Copper(II) sulfate: harmful if swallowed, eye irritant, toxic to aquatic life; collect for disposal
How does the time of electrolysis affect the mass of copper deposited, and how close is it to the mass predicted from Faraday's laws?	Time / mass gained by the cathode; percentage of the theoretical mass	As above	As above
How does the concentration of sodium chloride solution affect the current from a magnesium and copper cell through a fixed resistor?	Concentration of sodium chloride / current	Magnesium ribbon, copper electrode, sandpaper, sodium chloride, volumetric flask, beakers, resistor, multimeter, leads	Magnesium ribbon is flammable (no flames); low hazard otherwise
How does the mass of anhydrous calcium chloride dissolved in 100.0 mL of water affect the temperature rise, as in a self-heating can?	Mass of calcium chloride / maximum temperature rise	Anhydrous calcium chloride, electronic balance, 100 mL measuring cylinder, beakers insulated with paper, digital thermometer, stirrer	Calcium chloride: eye irritant; solution becomes hot
How does the concentration of hydrochloric acid affect the temperature change when a fixed length of magnesium ribbon reacts?	Concentration of hydrochloric acid (diluted from 1 mol L^{-1}) / temperature change	Magnesium ribbon, hydrochloric acid 1 mol L^{-1}, measuring cylinders, beakers, digital thermometer, electronic timer	Hydrochloric acid: corrosive, eye damage; hydrogen gas produced is flammable: no flames, good ventilation
How does temperature affect the rate of the reaction between sodium thiosulfate and hydrochloric acid?	Temperature (water bath on a hot plate) / time for a cross under the flask to disappear	Sodium thiosulfate, hydrochloric acid 1 mol L^{-1}, conical flasks, hot plate, beakers as water baths, digital thermometer, electronic timer, paper marked with a cross	Sulfur dioxide is released: small volumes, good ventilation, not for students with asthma without advice
How does temperature affect the rate at which diastase hydrolyses starch, a step in making glucose for bioethanol?	Temperature (water baths) / time until a drop of the mixture no longer turns iodine solution blue-black	Diastase, starch 1%, iodine solution, spot tiles, test tubes, hot plate, beakers as water baths, digital thermometer, 3 mL droppers, electronic timer	Enzyme powder can sensitise the airways: avoid raising dust; iodine stains skin

Investigation question	Independent / dependent variable	Equipment and chemicals	Main hazards
How does pH affect the rate at which diastase hydrolyses starch?	pH (buffer sachets at pH 4 and 6.86, with mixtures between them) / time until the iodine test is negative	As above, with pH 4 and 6.86 buffer sachets	As above

Students reach five or more values of the independent variable by dilution (concentration), by the power supply setting (current), by water-bath temperature or by mixing the two buffers. Hydrogen peroxide in stock is probably past its use-by date, so it is not suggested.

Marking scheme

Student name	
Investigation question	

Line item	VH (4)	H (3)	M (2)	L (1)	NA (0)
Title and investigation question	Names the independent and dependent variables and the values studied; the data can answer it.	Names both variables; the data can answer it.	Names one variable clearly, or is too broad for the data to answer.	A topic or an aim, not a question.	No title or question.
Introduction	Clear aim; hypothesis gives a direction and a correct chemical reason; relevant concepts explained and linked to a contemporary challenge.	Clear aim; hypothesis gives a direction and a reason; most relevant concepts explained.	Aim given; hypothesis lacks a reason or a direction; concepts listed, not explained.	Aim or hypothesis unclear or untestable; little relevant chemistry.	No introduction.
Methodology and variables	Methodology named and justified; all relevant controlled variables, with how each is kept constant; at least five values, three trials each.	Methodology suits the question; variables identified, most controls explained; at least five values with repeats.	Controls not explained, or fewer than five values, or no repeats.	Method summarised without variables, or the design cannot answer the question.	No methodology.
Logbook	Every session dated and initialled; specific approved risk assessment; raw data with units and resolution; every change and outlier explained.	Sessions dated; approved risk assessment; raw data with units; most changes and outliers explained.	Some entries undated; generic risk assessment; outliers removed without a reason.	Few entries; raw data missing or written up later.	No logbook.
Results	All processing correct, with suitable significant figures; table with headings and units; suitable graph, titled, units on axes, line of best fit within the data.	Processing correct; table and suitable graph with minor faults in titles, units or precision.	Errors in processing, an unsuitable graph type, or missing units.	Raw data only, with no processing or graph.	No results.
Discussion: analysis	Trend described with specific values and fully explained with correct chemistry, linked to the introduction.	Trend described with data and explained with mostly correct chemistry.	Trend described without data, or the explanation is incomplete.	Results restated with no explanation.	No analysis.
Discussion: evaluation	Accuracy judged against a theoretical value; precision from the repeats; main errors classed as random or systematic, with effects and specific improvements.	Accuracy and precision distinguished and judged; main errors with their effects; improvements given.	Errors named without effects; general improvements; accuracy and precision confused.	Only “human error” or “equipment error”, with no effect stated.	No evaluation.

Line item	VH (4)	H (3)	M (2)	L (1)	NA (0)
Discussion: limitations and hypothesis	Limitations of the data and method, and assumptions, with their effect on the conclusion; hypothesis judged against specific evidence.	Main limitations identified; hypothesis judged against the evidence.	Limitations listed without effects; hypothesis judged without evidence.	Hypothesis mentioned with no judgement.	Not addressed.
Communication statement and conclusion	One central sentence giving the key finding and answering the question; conclusion states how far the question is answered, with nothing new.	Statement gives the key finding; conclusion answers the question.	Statement restates the aim or is more than one sentence; conclusion partly answers the question.	Statement or conclusion unrelated to the data.	Neither present.
Science communication	All sections in order, within 600 words, count shown; correct terms, formulas, state symbols and units; sources in one style; help acknowledged.	Within 600 words; minor notation errors; sources referenced.	Over 600 words, several notation errors, or inconsistent referencing.	Sections missing; frequent errors; sources not referenced.	No poster.
Total					**/40**

Authentication	Initials	Date
Logbook sighted in every practical session		
All poster data found in the logbook		
Word count checked (no more than 600 words)		

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