Section I

4 marks

Attempt Questions 1–4
Allow about 7 minutes for this section.

Select the alternative A, B, C or D that best answers the question.
Indicate your answers by filling in the response circles shown below.

					Outcomes
Question 1	Ⓐ	Ⓑ	●	Ⓓ	**H8, H9**
Question 2	●	Ⓑ	Ⓒ	Ⓓ	**H6, H10**
Question 3	Ⓐ	●	Ⓒ	Ⓓ	**H8, H9**
Question 4	Ⓐ	Ⓑ	●	Ⓓ	**H6, H10**

1 Which of the following is a catalyst necessary for the production of ethanol from ethene?

(A) Water

(B) Ultraviolet light

(C) Dilute sulfuric acid

(D) Yeast

2 The equation below shows tritium emitting a β–particle.

$$^{3}_{1}\mathrm{H} \rightarrow {}^{3}_{x}\mathrm{E} + \beta$$

Which of the correctly following identify E and x?

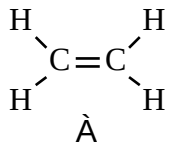
(A) He and 2

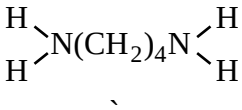
(B) H and 2

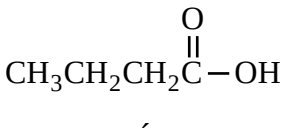
(C) He and 1

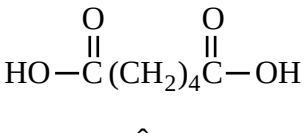
(D) H and 1

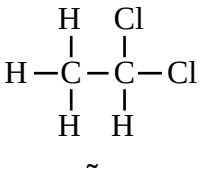
3 Which pair of compounds can be reacted together to produce a condensation polymer?











(A) 1 and 5

(B) 2 and 4

(C) 3 and 4

(D) 2 and 3

4 What is the change in the oxidation state of vanadium in this half equation?

$$VO_2^{+} + 2H^{+} + e^{-} \rightarrow VO^{2+} + H_2O$$

(A) +1 to +2

(B) +2 to +1

(C) +5 to +4

(D) +4 to +3

Section II

20 marks

Attempt Questions 5–8
Allow about 33 minutes for this section.

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 5 (3 marks)

Ethanol has the potential to be used as an alternative to fossil fuels.

(a) Ethanol can be produced from glucose by fermentation.
Write a balanced equation for this reaction. **(1 mark)**

Outcomes – H10

$$C_6H_{12}O_6 \xrightarrow{\text{yeast/ enzymes}} 2CO_{2\,(g)} + 2C_2H_5OH_{\,(l)}$$

(b) Discuss **one** advantage and **one** disadvantage of ethanol as an alternative to fossil fuels.
(2 marks)

Outcomes – H4

Advantage

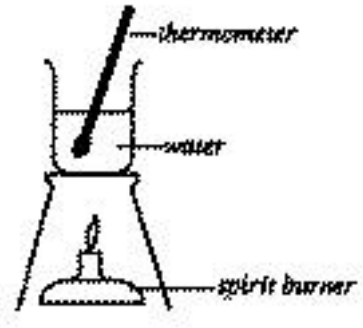
Ethanol is a renewable resource and hence would reduce the use of non-renewable oil.

Disadvantage

Large areas of agricultural land would need to be devoted to growing suitable crops with consequent problems of soil erosion, deforestation, fertiliser run-off and salinity.

Question 6 (4 marks)

A chemistry student set up the following equipment to measure the heat of combustion of ethanol. Pure ethanol was used as the fuel in the spirit burner.



(a) In order to calculate the heat of combustion of ethanol, what measurements must the student make? **(1 mark)**

Outcomes – H11

Volume of water, mass of spirit burner, temperature change.

(b) In the experiment the student found that the combustion of 0.30 g of ethanol produced an energy change of 5.2 kJ. Calculate the experimental molar heat of combustion for ethanol. **(2 marks)**

Outcomes – H10

0.30 g → 5.2 kJ
Thus, 46 g → *x* kJ
***x* = 5.2 x 46 ÷ 0.30 = 797 kJ (1 mark)**

fw C_2H_5OH = 24 + 6 + 16 = 46 (1 mark)

$\Delta_c H°$ C_2H_5OH = – 797 kJ (2 marks)

(c) The accepted value for the heat of combustion of ethanol (1364 kJ mol^{-1}) is higher than the value obtained experimentally. Account for the difference between the two values. **(1 mark)**

Outcomes – H14

Heat lost to the air or equipment is not used to heat the water, thus the measured ΔT is less than expected.

OR

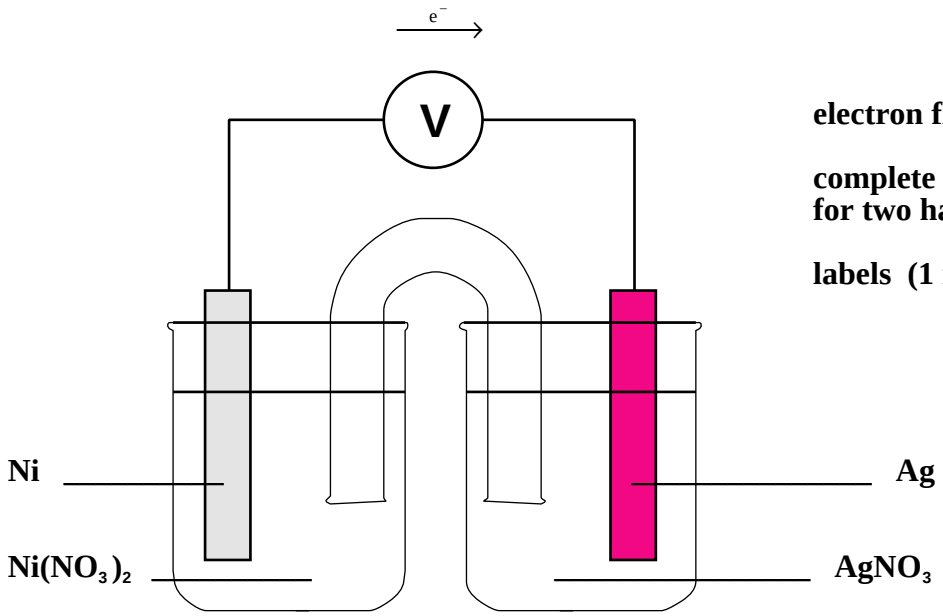
Not all heat liberated from the combustion reaction has gone into the water, thus a lower than expected ΔT is measured.

Question 7 (8 marks)

A galvanic cell was constructed using two half cells. One half cell consisted of silver metal and a silver nitrate solution and the other half cell consisted of nickel metal and a nickel nitrate solution.

(a) Draw a neat labelled diagram of the galvanic cell. **(3 marks)**
Indicate electron flow in the diagram.

Outcomes – H6, H8



electron flow (1 mark)

complete circuit (1 mark)
for two half cells

labels (1 mark)

(b) Which electrode is the anode? **(1 mark)**

Outcomes – H6, H13

Nickel

(c) Write two half equations for the reactions which occur in the cells. **(2 marks)**

Outcomes – H6

$Ni_{(s)} \rightarrow Ni^{2+} + 2e^-$

$Ag^+ + e^- \rightarrow Ag_{(s)}$

(d) Write the net ionic reaction occurring in the galvanic cell and calculate the voltage of the cell under standard conditions. **(1 mark)**

Outcomes – H6

$Ni_{(s)} + 2Ag^+ \rightarrow Ni^{2+} + 2Ag_{(s)}$ $E° = 0.23 + 0.80 = 1.03\ V$

(e) Which species is the oxidant? **(1 mark)**

Outcomes – H6, H13

Ag^+

Question 8 (5 marks)

A chemistry student observed that pieces of paper lying on soil soon developed holes that became larger with time. The student knew that paper is almost pure cellulose and she hypothesised that the holes could be due to the action of decay bacteria on cellulose. To test her hypothesis, she sets up the following experiment…

- A weighed amount of shredded paper was mixed with a weighed amount of soil (obtained from the same site where the original observation was made) in a beaker. The mixture was allowed to stand for a few days.
- A known quantity of water was added to the mixture in the beaker, stirred for a given time interval and then filtered through glass wool into a conical flask. (Glass wool is a material similar in appearance to cotton wool, but is made of glass. Like cotton wool, the fibres are fine but, unlike cotton wool, are fragile.)
- The filtrate was tested for the presence of glucose.

(a) Suggest two more tests/set-ups for this experiment to ensure that the investigation is valid. **(2 marks)**

Outcomes – H12, H14

1. **Same quantity of soil without the paper is treated similarly. The filtrate is tested for glucose.**

2. **Same quantity of mashed paper (with no soil) is treated similarly. The filtrate is tested for glucose.**

(b) What assumption did the student use as a basis for the test? **(1 mark)**

Outcomes – H11

The student assumed that bacteria breakdown cellulose to glucose.

(c) Will a negative result refute her original hypothesis? Explain your answer. **(1 mark)**

Outcomes – H14

No. This is because the bacteria in that soil sample may not necessarily breakdown cellulose to glucose. The degradation product may be CO_2 instead.

(d) Identify one safe work practice for this investigation. **(1 mark)**

Outcomes – H11

The wearing of safety glasses protects the eyes from soil or particles and glass wool bits.

The wearing of gloves prevents contamination by disease producing bacteria and injury/irritation from glass wool.