



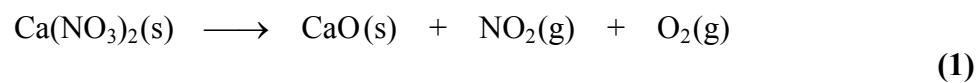
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**Answer ALL the questions. Write your answers in the spaces provided.**

**SECTION A**

1. Calcium nitrate decomposes on strong heating.

(a) Balance the equation for the reaction which takes place.



(b) A little water is added to the solid product of this reaction and the mixture is tested with full-range pH indicator paper.

(i) What colour will the indicator paper turn?

..... (1)

(ii) Write the formula of the ion responsible for turning the indicator paper this colour.

..... (1)

**(Total 3 marks)**

Q1

2. Draw a 'dot and cross' diagram to show the ions in calcium oxide. Include ALL the electrons and charges.

Q2

**(Total 2 marks)**



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3. (a) Fill in the table below to show the number of protons and electrons present in a hydride ion,  $\text{H}^-$ , and a lithium ion,  $\text{Li}^+$ .

Use the Periodic Table as a source of data.

	Protons	Electrons
$\text{H}^-$		
$\text{Li}^+$		

(2)

- (b) Which of these ions is larger,  $\text{H}^-$  or  $\text{Li}^+$ ?

Use the numbers you have entered in the table above to explain your answer.

.....

.....

.....

.....

.....

(2)

Q3

(Total 4 marks)

4. (a) What colour do lithium compounds produce during a flame test?

.....

(1)

- (b) In what way do the electronic transfers taking place in the production of a flame colour differ from those occurring when lithium atoms ionise?

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(1)

Q4

(Total 2 marks)



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5. (a) 25.0 cm<sup>3</sup> of a solution contains 0.020 mol of ethanoic acid.

Calculate its concentration in mol dm<sup>-3</sup>.

(1)

(b) Which ONE of the following types of reaction will take place when a solution of ammonia is added to this solution of ethanoic acid?

Put a cross in the box (☒) of the correct answer.

Dehydration	<input type="checkbox"/>
Ionic precipitation	<input type="checkbox"/>
Neutralisation	<input type="checkbox"/>
Redox	<input type="checkbox"/>
Thermal decomposition	<input type="checkbox"/>

(1)

Q5

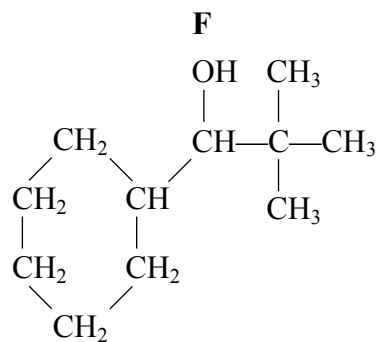
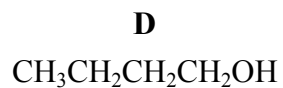
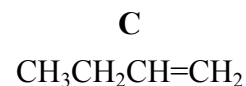
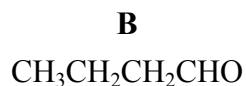
(Total 2 marks)

**TOTAL FOR SECTION A: 13 MARKS**



**SECTION B**

6. This question concerns the following compounds, A–F, which have the formulae shown below.



(a) (i) What is meant by the term **isomers**?

.....  
.....

**(1)**

(ii) Select a pair of isomers from the list above.

.....

**(1)**

(b) (i) Name compound **B**.

.....

**(1)**

(ii) Which compound above can be oxidised to **B**?

.....

**(1)**

(iii) Give the names of the TWO chemicals which can be used together to carry out this oxidation.

.....  
.....

**(2)**



(iv) Describe a test to distinguish between **B** and **E**. What would you expect to see in each case?

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.....  
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(2)

(c) The alcohol **D** can be converted to the compound **C**.

(i) Name compound **C**.

.....

(1)

(ii) What type of reaction is taking place?

.....

(1)

(iii) Name a solid reagent which could be used to carry out this conversion.

.....

(1)

(iv) Explain why the alcohol **A** cannot undergo the same type of reaction as **D**.

.....

(1)



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(d) (i) Write the **molecular** formula of the alcohol **F**.

.....  
(1)

(ii) Classify the alcohol **F** as primary, secondary or tertiary.

Explain how you arrived at your answer.

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.....  
(2)

(iii) Predict whether **F** is likely to be soluble in water.

Give a reason for your answer.

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(1)

(Total 16 marks)

Q6

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7. Some of the ionisation energies of four elements, **Q**, **R**, **S** and **T**, with consecutive atomic numbers, are shown in the table below.

	Ionisation Energies / kJ mol <sup>-1</sup>				
	1st	2nd	3rd	4th	5th
<b>Q</b>	2081	3952	6122	9370	12177
<b>R</b>	496	4563	6913	9544	13352
<b>S</b>	738	1451		10541	13629
<b>T</b>					

(a) To which group of the Periodic Table does **R** belong? Give a reason for your answer.

.....  
 .....  
 .....  
 (2)

(b) Estimate values, in kJ mol<sup>-1</sup>, for the third ionisation energy of **S**, and the first ionisation energy of **T**, represented by the shaded gaps shown in the table above.

**S** .....

**T** .....

(2)

(c) Which element is least likely to form compounds? Give a reason for your answer.

.....  
 .....  
 (1)

(d) Write a balanced equation which represents the change that corresponds to the **third** ionisation energy of **R**.

Use **R** as the symbol for the element and include state symbols in your answer.

(2)





(e) Element **X** is in the same group of the Periodic Table as **R**, but is immediately below it. The first ionisation energy of **X** is  $419 \text{ kJ mol}^{-1}$ . Explain why this value is lower for **X** than for **R**.

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(1)

(Total 8 marks)

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Q7



N 2 6 0 4 1 A 0 9 1 6

8. Nickel is one of the elements in the d-block of the Periodic Table.

(a) Complete the electron configuration of a nickel atom using the s, p, d notation.

Use the Periodic Table as a source of data.

1s<sup>2</sup> .....

(2)

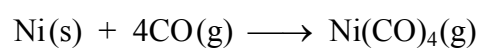
(b) A sample of nickel consists of three isotopes. Their percentage abundances are shown in the table below.

Isotope	Percentage Abundance
<sup>58</sup> Ni	69.02
<sup>60</sup> Ni	27.32
<sup>62</sup> Ni	3.66

Calculate the average relative atomic mass of nickel.

(2)

(c) Nickel reacts with carbon monoxide to give the compound nickel carbonyl, Ni(CO)<sub>4</sub>.



Calculate the volume of carbon monoxide required to react completely with 5.9 g of nickel.

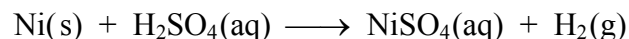
Use the Periodic Table as a source of data.

[The molar volume of a gas is 24 dm<sup>3</sup> mol<sup>-1</sup> at room temperature and pressure.]

(2)



- (d) Finely powdered nickel reacts slowly with dilute sulphuric acid to form a solution of nickel(II) sulphate.



- (i) Re-write this equation in an ionic form, omitting the spectator ion. State symbols are not required.

(1)

- (ii) Apart from the need to take care with the dilute sulphuric acid, which is corrosive, give ONE other hazard associated with this reaction. Explain what precaution you would take as a consequence.

.....  
.....  
.....

(2)

- (iii) A sample of finely powdered nickel is added to a slight excess of dilute sulphuric acid.

Describe the practical steps you would take to obtain dry crystals of hydrated nickel(II) sulphate from the mixture, after the reaction is complete.

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(3)



(iv) Calculate the maximum mass of hydrated nickel(II) sulphate,  $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$ , which could be formed from 2.95 g of nickel.

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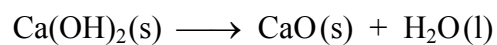
(2)

Q8

(Total 14 marks)



9. Calcium hydroxide decomposes on strong heating to form calcium oxide and water.



Two samples of **calcium hydroxide** were taken, each weighing exactly 1.00 g.

The first sample was cautiously added to 25.0 cm<sup>3</sup> of dilute hydrochloric acid contained in a glass beaker. The temperature rise was measured and found to be 16.5 °C.

The other sample was heated for some time. It was then allowed to cool and then added to another 25.0 cm<sup>3</sup> portion of hydrochloric acid as before. In this case the temperature rose by 25.5 °C.

In both cases, the acid used was an excess.

- (a) (i) Calculate the energy produced by the reaction of each solid with the acid.

Use the relationship

$$\begin{array}{ccccccc} \text{Energy produced} & = & \text{mass of solution} & \times & 4.2 & \times & \text{temperature rise} \\ / \text{J} & & / \text{g} & & / \text{J}^\circ\text{C}^{-1} \text{g}^{-1} & & / ^\circ\text{C} \end{array}$$

You may assume that 1.0 cm<sup>3</sup> of solution has a mass of 1.0 g. Ignore the mass of the solid.

For the solid calcium hydroxide

For the solid calcium oxide

(1)



- (ii) How many moles of calcium hydroxide were used in each experiment?  
[Molar mass of  $\text{Ca}(\text{OH})_2 = 74.0 \text{ g mol}^{-1}$ ]

(1)

- (iii) Using your answers to (a)(i) and (ii), calculate the enthalpy changes for each reaction.

Give your answers to **two significant figures**. Include the sign and units for each answer.

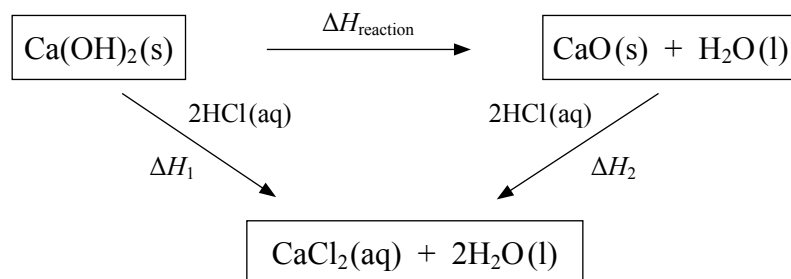
For the solid calcium hydroxide,  $\Delta H_1$

For the solid calcium oxide,  $\Delta H_2$

(2)



(b) A Hess cycle for all these reactions is shown below.



(i) Use this Hess cycle and your answers in (a)(iii) to calculate  $\Delta H_{\text{reaction}}$ . Include a sign and units.

(2)

(ii) Apart from the approximations involved in using the equation given in (a)(i), give TWO other potential sources of error which are likely to affect the accuracy of the results.

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(2)

(iii) Suggest why  $\Delta H_{\text{reaction}}$  is difficult to determine directly by experiment.

.....

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(1)

Q9

(Total 9 marks)

TOTAL FOR SECTION B: 47 MARKS  
TOTAL FOR PAPER: 60 MARKS

END



