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

**SECTION A**

1. (a) What is the formula of the ion found in all acidic solutions?

.....  
(1)

- (b) Which of the following substances would form an acidic solution in water?

A CH<sub>4</sub>

B NaOH

C HCO<sub>2</sub>H

D NH<sub>3</sub>

E HNO<sub>3</sub>

.....  
(2)

**(Total 3 marks)**

**Q1**

2. (a) What is the formula for strontium fluoride?  
Use the Periodic Table as a source of information.

.....  
(1)

- (b) Draw a 'dot and cross' diagram for the fluoride ion.  
Include all electrons and the charge on the ion.

(1)

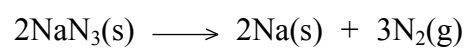
**(Total 2 marks)**

**Q2**



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3. Sodium azide,  $\text{NaN}_3$ , is used to inflate air bags in cars because, in a collision, the sodium azide decomposes rapidly to produce nitrogen gas.



- (a) (i) Calculate the mass of one mole of sodium azide,  $\text{NaN}_3$ .  
Use the Periodic Table as a source of data.

(1)

- (ii) What mass of sodium azide would be needed to liberate  $48 \text{ dm}^3$  of nitrogen?  
[Molar volume of a gas is  $24 \text{ dm}^3 \text{ mol}^{-1}$  at room temperature and pressure]

(2)

- (b) What safety problem would arise when disposing of the air bag after a collision?  
Justify your answer.

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

(2)

Q3

(Total 5 marks)

**TOTAL FOR SECTION A: 10 MARKS**



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**SECTION B**

4. The mineral carnallite is an ore which can be used to produce potassium. Its formula is  $\text{KCl.MgCl}_2.x\text{H}_2\text{O}$  where  $x$  is the number of moles of water of crystallisation in one mole of carnallite.

(a) The mass of one mole of carnallite is 277.5 g. Calculate the value of  $x$ . Show your working.  
Use the Periodic Table as a source of data.

(2)

(b) Carnallite is soluble in water. Give the formulae of all the **ions** present in the solution formed.

.....  
(2)

(c) A flame test was carried out on a solid sample of carnallite, using nichrome wire as a support.

(i) What substance would you use to clean the wire?

.....  
(1)

(ii) What colour would you expect to see in the flame test? Justify your answer by considering the metal ions present in carnallite.

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

Q4

(Total 7 marks)



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N 2 2 4 3 6 A 0 5 1 6

5. A sample of gallium, Ga, (atomic number 31) was found to consist of two different types of atoms with mass numbers 69 and 71. 60.2% of the sample had the lower mass number.

(a) What is the name given to atoms of the same element with different mass numbers?

.....  
(1)

(b) How many neutrons are there in an atom of gallium with mass number 71?

.....  
(1)

(c) (i) What instrument would be used to obtain the percentage composition of the gallium sample?

.....  
(1)

(ii) Calculate the average atomic mass of gallium in this sample. Show your working and give your answer to **3 significant figures**.

(2)



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

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

(ii) Write a balanced equation which represents the change that corresponds to the **first** ionisation energy of gallium. Include state symbols in your answer.

(2)

(iii) The first four ionisation energies, in kJ mol<sup>-1</sup>, of the Group 3 elements gallium and indium and the Group 4 elements germanium and tin are shown below.

A 558 1821 2705 5200  
B 579 1979 2963 6200  
C 709 1412 2943 3930  
D 762 1537 3302 4411

Which set of figures, A, B, C or D, represents **gallium**?..... (1)

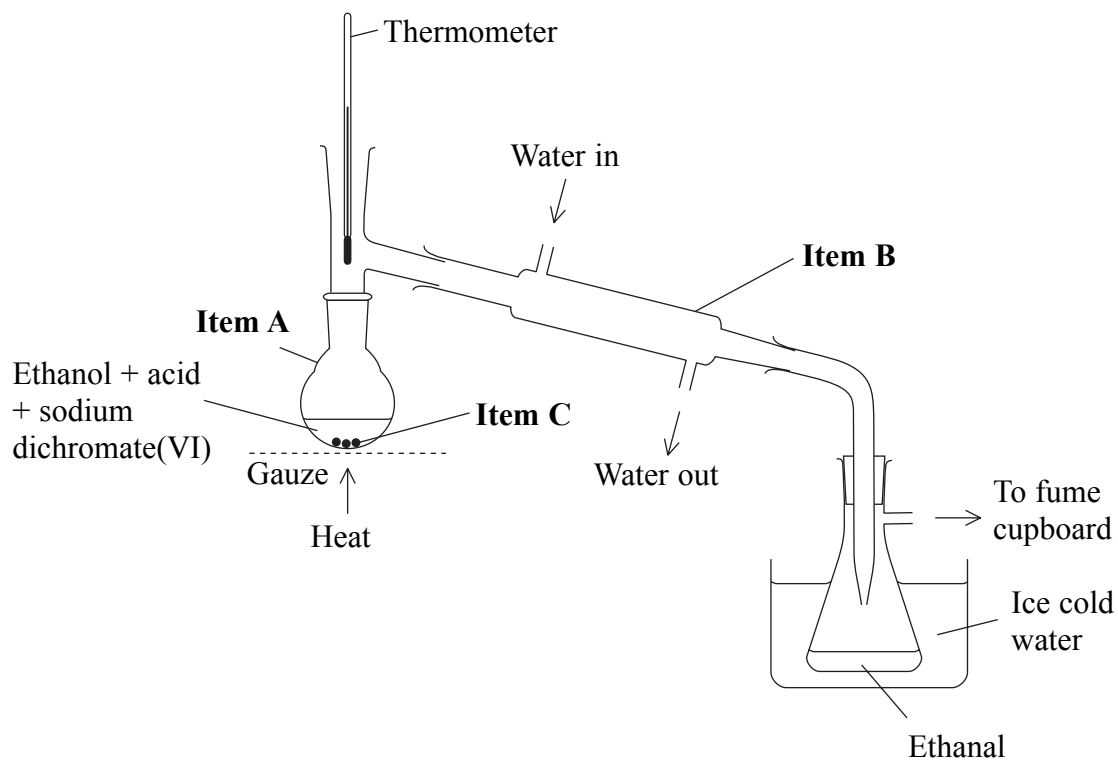
Q5

(Total 10 marks)



6. Ethanol,  $C_2H_5OH$ , can be converted into ethanal,  $CH_3CHO$ , if it is heated with an acid and sodium dichromate(VI) solution, provided that the ethanal is immediately distilled off.

A possible arrangement of apparatus for this experiment is shown below. However, it is incompletely labelled and the diagram contains some errors. You may assume that the apparatus is correctly clamped.



- (a) What are the names of the three items labelled A, B and C?

A.....  
 B.....  
 C.....

(3)





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(b) List **THREE** errors in this diagram.

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

**(3)**

(c) Which acid should be used?

.....

**(1)**

(d) What type of reaction is the conversion of ethanol to ethanal? Justify your answer by considering their formulae.

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

**(2)**

(e) (i) What is the formula of the dichromate ion in sodium dichromate(VI)  $\text{Na}_2\text{Cr}_2\text{O}_7$ ?

.....

**(1)**

(ii) What colour change would you expect to see as the reaction proceeded?

Colour at start ..... Colour at end .....

**(1)**

(f) If the mixture is refluxed first before being distilled, what is the name and formula of the organic product?

Name.....

Formula.....

**(2)**

**Q6**

**(Total 13 marks)**

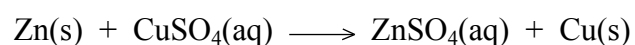
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**Turn over**



N 2 2 4 3 6 A 0 9 1 6

7. An experiment was carried out to find the enthalpy change for the reaction of zinc powder with copper(II) sulphate solution.



50 cm<sup>3</sup> of copper(II) sulphate solution, of concentration 1.0 mol dm<sup>-3</sup>, was put into a polystyrene cup and the temperature of the solution measured. After one minute, 5.0 g of zinc powder was added, the mixture stirred with a thermometer and the temperature measured every 30 s.

- (a) (i) What is meant by a spectator ion?

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

- (ii) Give the formula of the spectator ion in this reaction.

.....  
 (1)

- (iii) Write the equation for this reaction, omitting the spectator ion.

(1)

- (b) How would you measure the 50 cm<sup>3</sup> of copper(II) sulphate solution?

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

- (c) Give TWO reasons why it is better to use a polystyrene cup, rather than a metal container, to obtain more accurate results.

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



- (d) (i) Calculate the number of moles of each of the reactants and hence deduce which reactant is completely used up.  
Use the Periodic Table as a source of data.

Moles of zinc powder

Moles of copper(II) sulphate

Reactant used up ..... (3)

- (ii) Give the colour changes you would expect to see as the reaction progresses.

Solution from ..... to .....

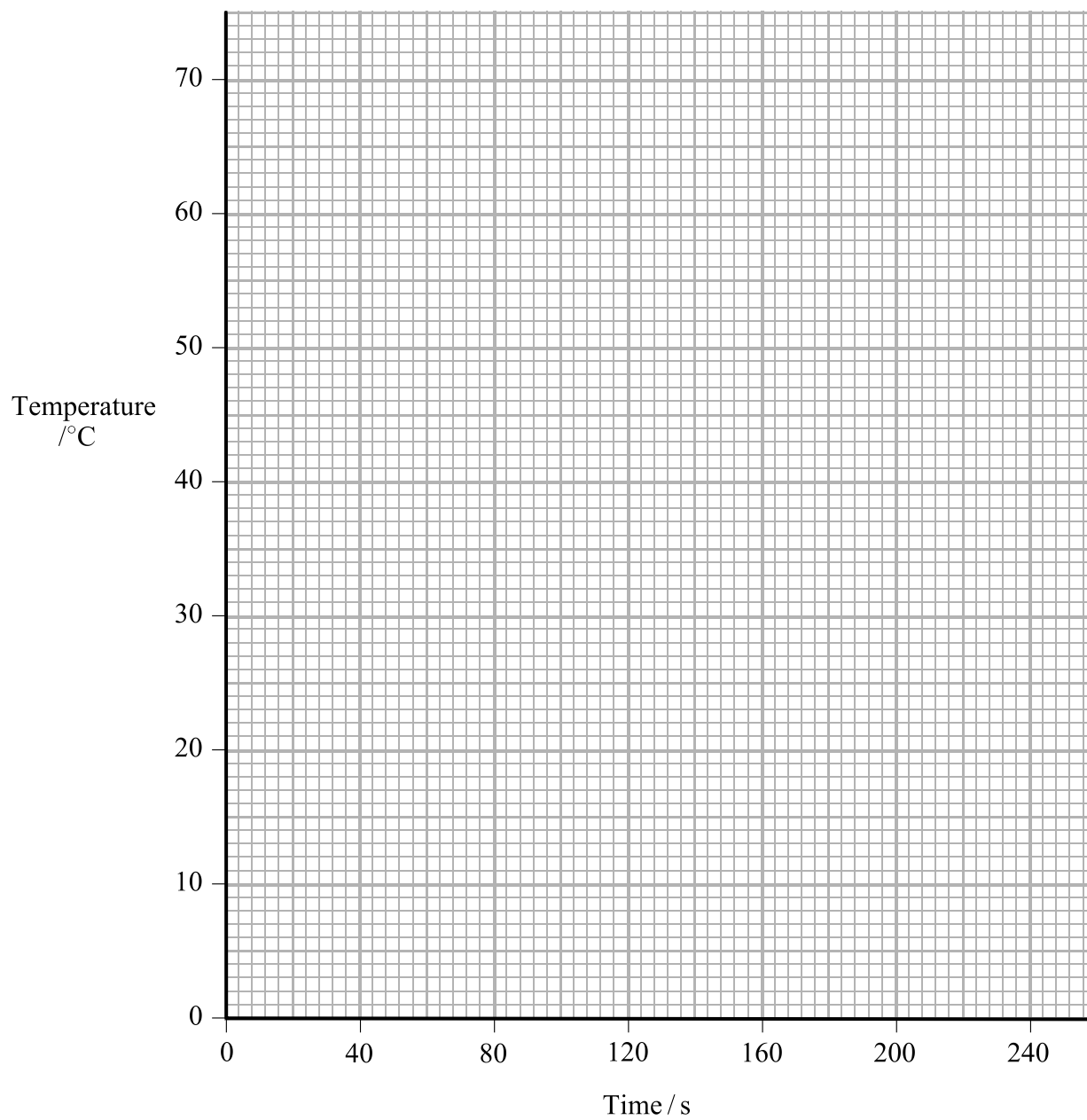
Solid from ..... to ..... (2)



(e) The following results were obtained.

Time /s	0	60	90	120	150	180	210
Temperature /°C	22	22	60	65	63	61	59

(i) On the graph paper below, plot the results of this experiment.



(2)



(ii) Explain the shape of your graph

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

(2)

(iii) The maximum recorded temperature in this experiment was 65°C. Use your graph to estimate a more accurate maximum temperature.

.....

(1)

(f) (i) Calculate the energy change in this experiment using your answer to (e)(iii) and the relationship

$$\begin{array}{ccccccc} \text{energy change} & = & \text{mass of} & \times & \text{specific heat capacity} & \times & \text{temperature rise} \\ & & \text{solution} & & \text{of solution} & & \\ & & / \text{g} & & / \text{J}^\circ\text{C}^{-1} \text{g}^{-1} & & / ^\circ\text{C} \end{array}$$

You may assume that

- 1.0 cm<sup>3</sup> of solution has a mass of 1.0 g
- The specific heat capacity of the solution is 4.2 J °C<sup>-1</sup> g<sup>-1</sup>

(1)

(ii) Use your answers to (d)(i) and (f)(i) to calculate ΔH for this reaction. Include a sign and units in your answer.

(3)

Q7

(Total 20 marks)

**TOTAL FOR SECTION B: 50 MARKS**  
**TOTAL FOR PAPER: 60 MARKS**

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