SURNAME ..... FIRST NAME .....

JUNIOR SCHOOL ..... SENIOR SCHOOL .....

Independent Schools Examinations Board

COMMON ENTRANCE EXAMINATION AT 13+

SCIENCE

CHEMISTRY

Tuesday 3 June 2008

Please read this information before the examination starts.

- This examination is 40 minutes long.
- The answers should be written on the question paper.
- Answer **all** the questions.
- Calculators may be required.

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1. Underline the word, number or phrase which best completes each of the following sentences.

(a) The percentage of oxygen in the air is about

20% **40%** **60%** **80%**

(b) A substance which is not a mixture is

air **brass** **copper oxide** **sea water**

(c) When water is added to anhydrous copper sulphate, the colour changes from

blue to pink **blue to white** **pink to blue** **white to blue**

(d) When calcium carbonate is heated, the following reaction occurs:
calcium carbonate $\longrightarrow$ calcium oxide + carbon dioxide

This reaction is an example of

combustion **decomposition** **oxidation** **reduction**

(e) A substance which will form an alkaline solution when added to water is

calcium oxide **carbon dioxide** **sand** **sodium chloride**

(5)

2. The following are different ways of separating mixtures:

A using a magnet
B simple distillation
C filtration
D fractional distillation
E evaporation

(a) Choose one of the letters, **A**, **B**, **C**, **D** or **E**, to state which is the best method to obtain

(i) salt from a solution of salt in water ☐

(ii) water from a solution of salt in water ☐

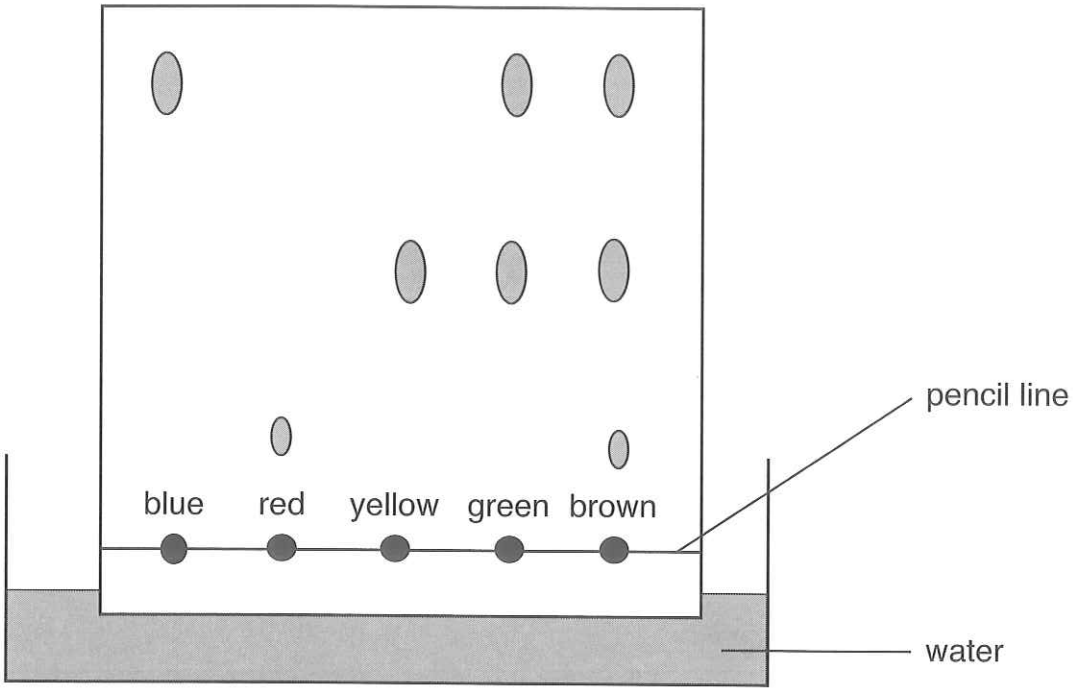
(iii) iron from a mixture of powdered iron and sulphur ☐

(iv) alcohol from beer ☐

(4)

(b) Chromatography can be used to discover which dyes are used to colour sweets.

A chromatogram obtained using the dyes from five different coloured sweets is shown below.



(i) What is the purpose of the water?

..... (1)

(ii) Why is the line on the chromatography paper drawn in pencil rather than in ink?

..... (1)

(iii) Suggest a reason why the blue sweet dye travels further up the chromatography paper than the red dye.

..... (1)

(iv) Explain what the chromatogram tells you about the brown dye.

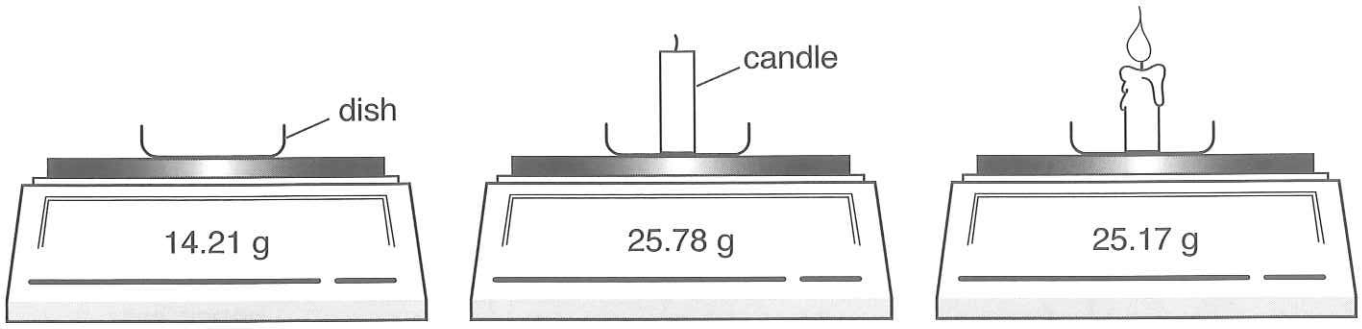
.....

..... (2)

3. In an investigation into the burning of a candle, Robbie decided to see how the mass of the candle changed when it burnt.

He weighed a glass dish on a balance and then put the candle on the glass dish. He then lit the candle and allowed it to burn for five minutes.

The diagrams below show the readings he took on the balance.



after burning for 5 minutes

(a) (i) Using the diagrams, write out a suitable results table for this experiment.

(3)

(ii) Work out the mass of the candle before burning.

..... (1)

(iii) Work out the loss in mass of the candle after burning for five minutes.

..... (1)

(iv) Why did the candle lose mass?

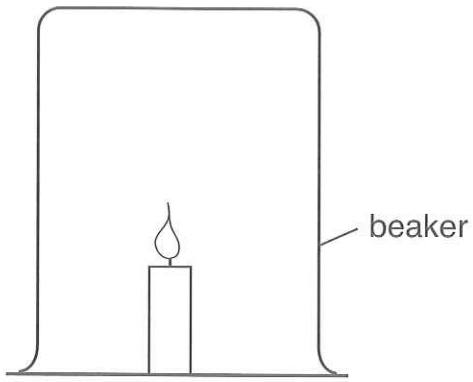
..... (1)

(b) In another experiment, Robbie lit the candle and placed a large glass beaker over the candle. His observations are recorded below:

The candle burnt with a yellow flame.

The glass sides of the beaker became misty.

After 2 minutes, the candle went out.



(i) Which gas in the air must be present for anything to burn?

..... (1)

(ii) Why did the candle flame eventually go out?

..... (1)

Robbie knew that the candle wax is a hydrocarbon – a compound of carbon and hydrogen.

(iii) Robbie predicted that the gas carbon dioxide forms when the candle burns. Which test could he do on the gas in the beaker to prove that it contained carbon dioxide?

test: .....

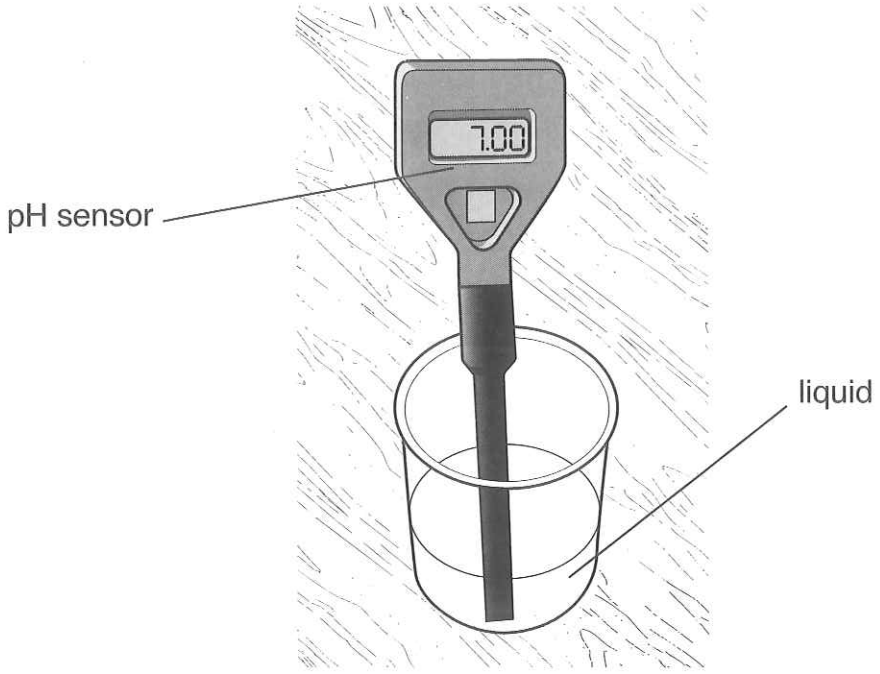
expected result: ..... (2)

(iv) Explain carefully why the inside of the beaker became misty.

.....

..... (2)

4. James used an electrical pH sensor to test different liquids. He dipped the sensor into each liquid and recorded the pH value in a table.



(a) In the table below, tick one box for each liquid to show whether it is a strong acid, a weak acid, neutral, a weak alkali or a strong alkali. *(One has already been done for you.)*

	pH value	strong acid	weak acid	neutral	weak alkali	strong alkali
tap water	8					
distilled water	7			✓		
red wine	5					
hydrochloric acid	1					
sodium hydroxide	13					

(2)

(b) Between each test, James dipped the sensor in distilled water. Why did he do this?

.....

(1)

(c) Explain why it is better to use a pH sensor to measure the pH of red wine than it is to use Universal Indicator solution.

.....

(1)

(d) James put some dilute hydrochloric acid in a beaker with the sensor and then slowly added dilute sodium hydroxide, whilst stirring.

The pH rose and when it had reached a value of 7, James stopped adding the sodium hydroxide.

(i) Suggest a safety precaution which James should have taken in doing this experiment.

..... (1)

(ii) What type of reaction occurs between the hydrochloric acid and sodium hydroxide?

..... (1)

(iii) Complete the word equation for the reaction:

hydrochloric acid + sodium hydroxide ⟶ ..... + ... (2)

(iv) James then boiled the solution he had made in an evaporating basin. Describe what he would see happening.

.....

..... (2)

(e) Rain water is naturally acidic, but water companies always adjust tap water to a pH of 8. Bearing in mind that tap water often runs through iron pipes, can you suggest why water companies make this adjustment?

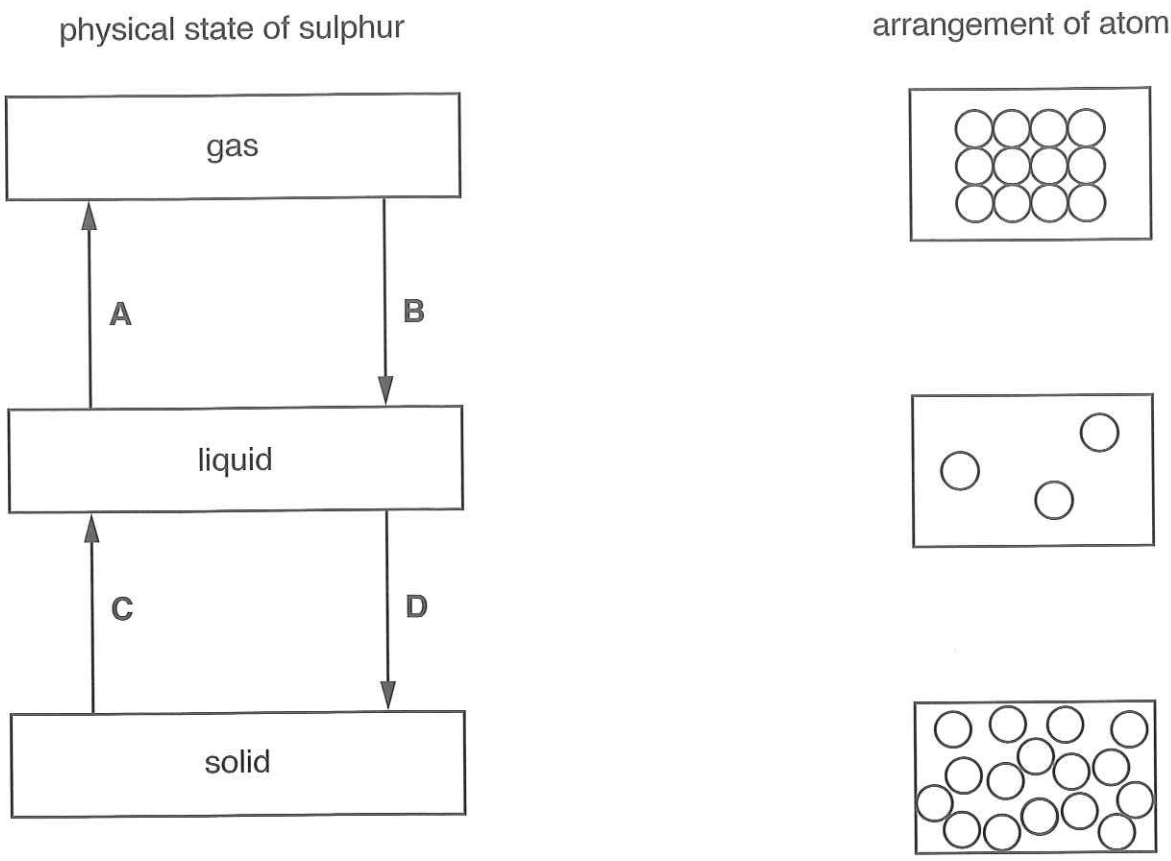
.....

..... (1)

5. The element sulphur can be a solid, a liquid or a gas. In the diagram below, the arrows marked **A**, **B**, **C** and **D** represent changes between these states.

The boxes on the right show the arrangement of atoms of sulphur in the three physical states.

Each circle represents an atom of sulphur.



(a) (i) Draw a line from each physical state of sulphur to the arrangement of atoms in that physical state. Draw only three lines. (1)

(ii) Arrows **A**, **B**, **C** and **D** represent changes of state. State which arrow represents

melting: .....

evaporation: ..... (2)

(iii) Draw another arrow, labelled **S**, which would represent sublimation of sulphur. (1)

(b) Sulphur has a melting point of 118 °C and a boiling point of 444 °C.

(i) What would be the physical state of sulphur at 300 °C?

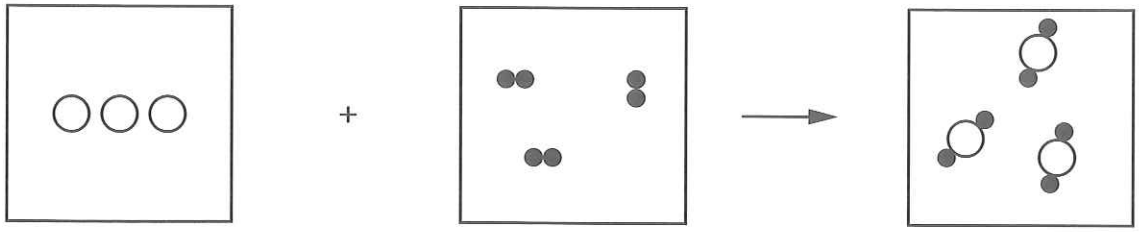
..... (1)

(ii) Explain your answer.

.....

..... (1)

(c) When sulphur burns in air, a chemical reaction occurs.



sulphur oxygen

(i) How can you tell from this diagram that sulphur is an element?

..... (1)

(ii) How can you tell from this diagram that a chemical reaction has occurred?

..... (1)

(iii) Suggest the name of the product of this reaction.

..... (1)

(iv) Explain, using the diagram above, why the total mass always remains unchanged after a chemical reaction has occurred.

.....

..... (2)

6. When Sarah added some iron powder to some copper sulphate solution, she noticed that

- a pinky-brown deposit of copper was formed
- the blue solution turned pale green
- the solution became warm

She realised that a displacement reaction had occurred.

(a) (i) Complete the word equation:

iron + copper sulphate ⟶ ..... + ... (2)

(ii) What does this reaction tell you about the positions of iron and copper in the reactivity series?

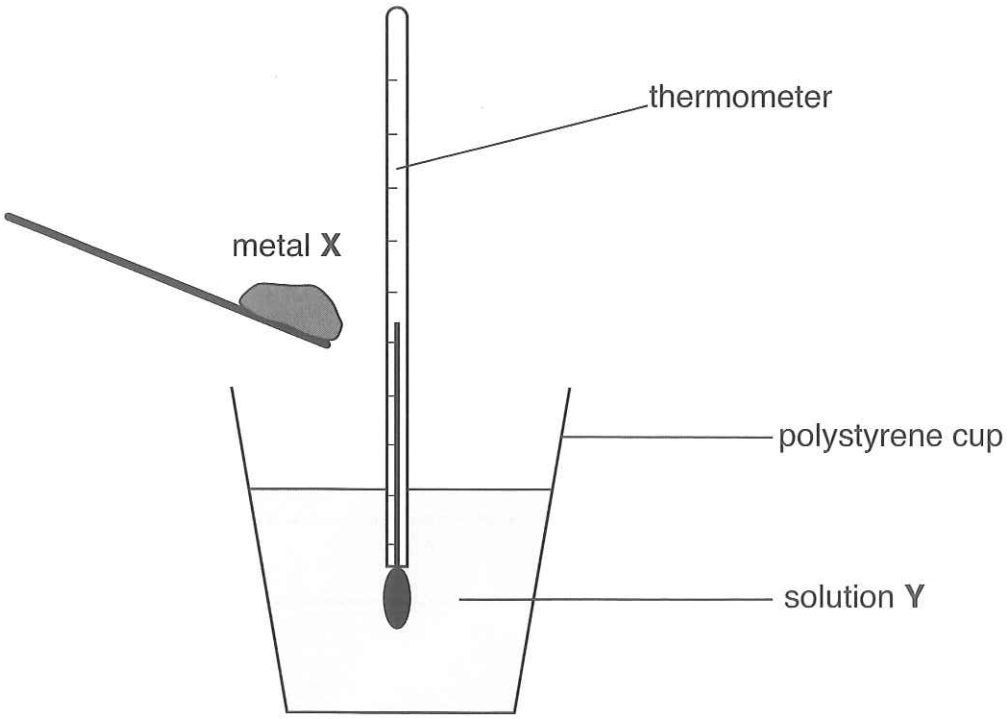
..... (1)

(iii) Why did the solution turn from blue to pale green?

.....

..... (2)

Sarah then decided to investigate the temperature changes which occur when various metals are added to solutions of compounds of other metals. She used the apparatus shown below.



She added some powdered metal, **X**, to a solution of **Y**. The solution **Y** is a compound of another metal. She stirred the mixture and then measured the temperature rise of the solution.

The experiments were all carried out as fair tests.

She put her results in a table:

metal **X**	solution **Y**	temperature rise, in °C
iron	copper sulphate	27
zinc	iron sulphate	13
copper	zinc sulphate	0
magnesium	copper sulphate	48

(b) (i) Why did she use powdered metals rather than larger pieces?

..... (1)

(ii) Why did she use a polystyrene cup rather than a glass beaker?

..... (1)

(iii) Suggest two ways in which Sarah could have made these fair tests.

1: .....

2: ..... (2)

(iv) Suggest why the largest temperature rise occurred in the reaction between magnesium and copper sulphate.

..... (1)

(v) Why was there no temperature change when copper was added to zinc sulphate?

.....

..... (2)

(Total marks: 60)

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MARK SCHEME

This is a suggested, not a prescriptive, mark scheme.

Tuesday 3 June 2008

S.A. 28383M31

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<table>
<tr><th>Q.</th><th>Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>1. (a)
(b)
(c)
(d)
(e)</td><td>20%
copper oxide
white to blue
decomposition
calcium oxide</td><td>5</td><td></td></tr>
<tr><td>2. (a) (i)
(ii)
(iii)
(iv)</td><td>E
B
A
D</td><td>4</td><td></td></tr>
<tr><td>(b) (i)
(ii)
(iii)
(iv)</td><td>to dissolve the dye / solvent
ink would smudge / dissolve / run / pencil would not dissolve
more soluble in water / sticks less strongly to paper
it contains three dyes
– red, yellow and blue</td><td>1
1
1
2</td><td>

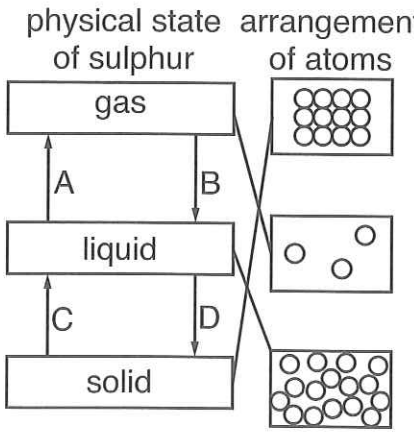
any sensible answer
</td></tr>
<tr><td>3. (a) (i)

(ii)
(iii)
(iv)</td><td><table><tr><th></th><th>mass, in g</th></tr><tr><td>dish</td><td>14.21</td></tr><tr><td>dish + candle (before)</td><td>25.78</td></tr><tr><td>dish + candle (after)</td><td>25.17</td></tr></table>
25.78 – 14.21 = 11.57 g
25.78 – 25.17 = 0.61 g
gases given off when candle burns</td><td>3

1
1
1</td><td>1 mark for correct descriptions
1 mark for correct values + units
1 mark for well laid-out table

accept smoke given off</td></tr>
<tr><td>(b) (i)
(ii)
(iii)</td><td>oxygen
all the oxygen used up
limewater
goes milky / cloudy</td><td>1
1
2</td><td>

</td></tr>
</table>

Q.	Answer	Mark	Additional Guidance
(iv)	water formed in burning condenses on beaker	2	
4. (a)	tap water weak alkali red wine weak acid hydrochloric acid strong acid sodium hydroxide strong alkali	2	1 mark for acids and alkalis correctly identified 1 mark for 'weak' or 'strong' correctly identified
(b)	to wash off previous liquid	1	accept answers which say that water is neutral and will not affect the pH of the next substance
(c)	colour of red wine would hide colour of Universal Indicator	1	
(d) (i)	safety spectacles	1	accept any other sensible precaution
(ii)	neutralisation	1	
(iii)	sodium chloride water	2	
(iv)	steam given off / spitting white solid (salt) left	2	
(e)	acids react with iron	1	
5. (a) (i)		1	all three lines correct
(ii)	*melting:* C *evaporation:* A	2	
(iii)	S should show any change from solid to gas	1	

Q.	Answer	Mark	Additional Guidance
(b) (i)	liquid	1	accept any explanation which is valid
(ii)	300 °C lies in between the melting and boiling points	1	
(c) (i)	atoms are all the same	1	
(ii)	a rearrangement of atoms has occurred	1	
(iii)	sulphur (di)oxide	1	
(iv)	same number of atoms before and afterwards	2	
6. (a) (i)	copper iron sulphate	2	
(ii)	iron is above copper / iron is more reactive than copper	1	
(iii)	blue colour is copper sulphate green colour is iron sulphate	2	
(b) (i)	reaction goes faster	1	
(ii)	polystyrene is a better insulator	1	
(iii)	same mass of metal X same volume of solution Y same apparatus	2	any two accept same concentration of Y
(iv)	magnesium and copper have the biggest difference in reactivity	1	
(v)	no reaction copper is below zinc in the reactivity series	2	
Total		**60**	