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GCSE (9–1) Combined Science (Chemistry) A (Gateway Science)

J250/03 Paper 3, C1–C3 and CS7 (PAGs C1–C5)
(Foundation Tier)

Thursday 17 May 2018 – Morning

Time allowed: 1 hour 10 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet (for GCSE Combined Science A (Chemistry) inserted)

You may use:
- a scientific or graphical calculator
- an HB pencil

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **24** pages.

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SECTION A

Answer **all** the questions.

You should spend a maximum of 20 minutes on this section.

1 A student wants to make solid ammonium sulfate from the solution of ammonium sulfate.

What should the student do first?

A Distil the solution.

B Evaporate the solution.

C Filter the solution.

D Use chromatography.

Your answer ☐ **[1]**

2 A metal carbonate reacts with an acid.

What products are made?

A Salt and carbon dioxide

B Salt and water

C Salt, carbon dioxide and water

D Salt, hydrogen and carbon dioxide

Your answer ☐ **[1]**

3 Ethanoic acid is a **weak** acid.

What is the pH of ethanoic acid?

A 1

B 5

C 7

D 12

Your answer ☐ **[1]**

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4 A student wants to re-crystallise a solute from a solution.

What type of apparatus should she use?

A An evaporating dish, wire gauze, tripod and Bunsen burner

B A filter funnel, filter paper and conical flask

C A round-bottomed flask connected to a condenser

D A separating funnel

Your answer ☐ **[1]**

5 What is the chemical formula for sodium chloride?

A Na_2Cl

B $NaCl$

C $NaCl_2$

D Na_2Cl_3

Your answer ☐ **[1]**

6 In 1808 John Dalton published his theory about matter.

Which of Dalton's ideas is now known to be **incorrect**?

A A chemical reaction is a rearrangement of atoms.

B All matter consists of atoms.

C Atoms cannot be subdivided.

D When elements react, their atoms combine in simple, whole-number ratios.

Your answer ☐ **[1]**

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7 An element has a **relative atomic mass** of 19.0.

Find this element on the Periodic Table.

How many protons does this element contain?

A 9

B 10

C 19

D 28

Your answer ☐ **[1]**

8 An atom is the smallest particle of an element.

What is the approximate size of a single atom?

A 0.0001×10^{-6} m

B 0.0001×10^{-10} m

C 0.01×10^{-10} m

D 0.1×10^{-12} m

Your answer ☐ **[1]**

9 Graphite is used in pencils.

Why can graphite make marks on paper?

A All the bonds in graphite are weak.

B Atoms in graphite are in layers.

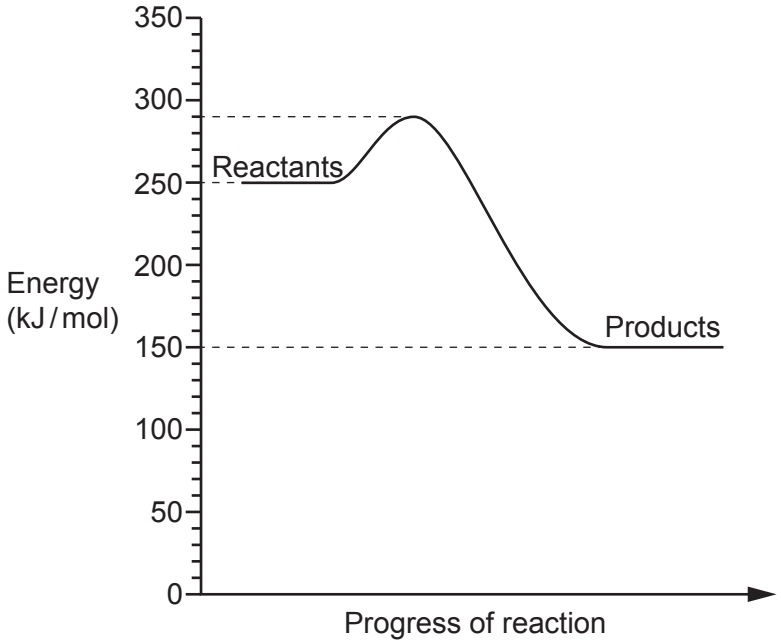
C Forces between layers in graphite are strong.

D Every atom in graphite is strongly bonded to four others.

Your answer ☐ **[1]**

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10 The diagram shows a reaction profile.



What is the energy change of the reaction?

A +40 kJ / mol

B –100 kJ / mol

C +140 kJ / mol

D –140 kJ / mol

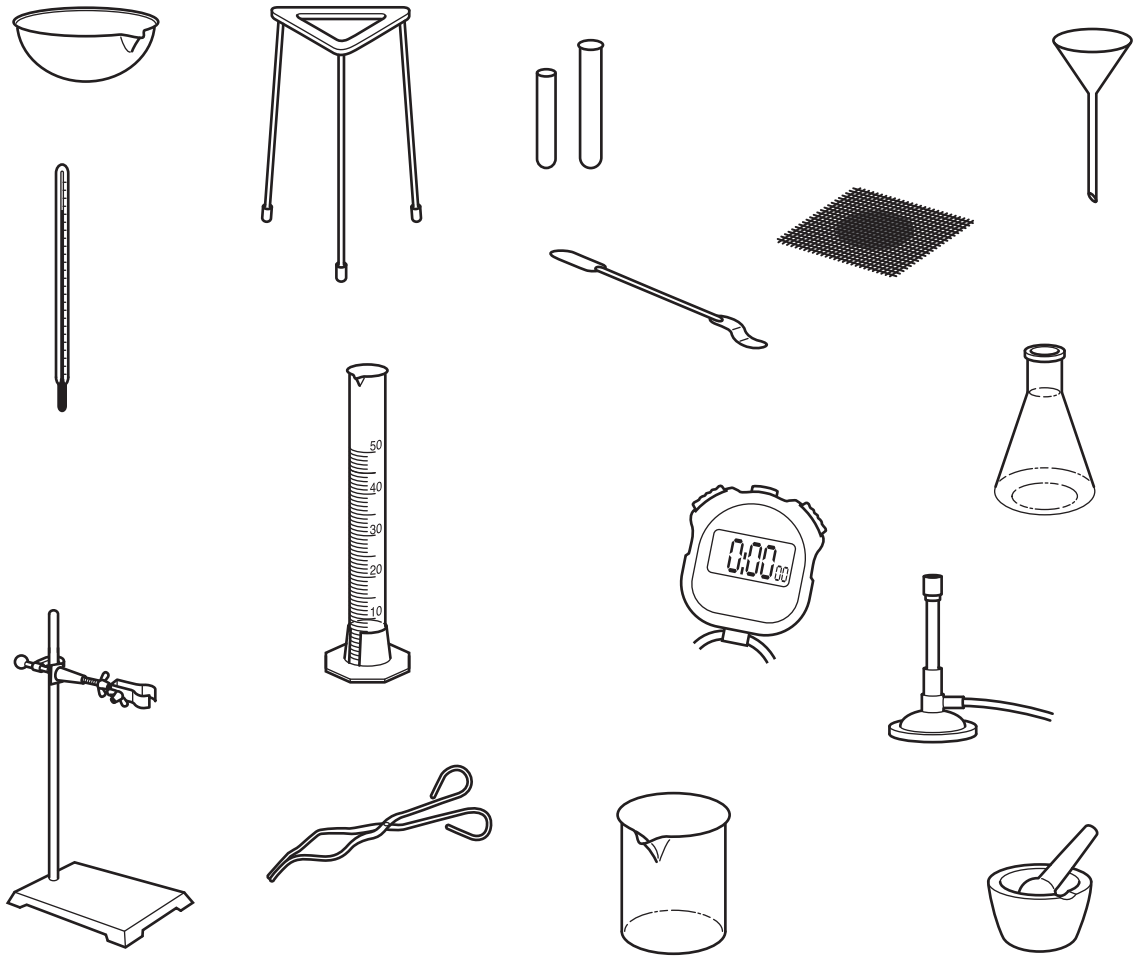
Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.

11 Look at the pictures of some common laboratory equipment.



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(a) A student wants to **accurately** measure the melting point of ice.

Describe an experiment that she could do.

You may draw a **labelled** diagram to help your answer.

Use some of the equipment from the pictures on page **6**.

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..... **[2]**

(b) Suggest **one** thing the student could do to improve the experiment.

.....

..... **[1]**

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12 **(a)** This question is about atomic structure.

(i) What is meant by **relative atomic mass**?

.....

..... **[1]**

(ii) What **two** things can you work out from the **atomic number** of an element?

1 .....

2 .....

[2]

(b) Look at the table about the particles in an atom.

Particle	Relative Charge	Relative Mass
Proton	+1	.....
Neutron	.....	1
Electron	.....	Almost 0

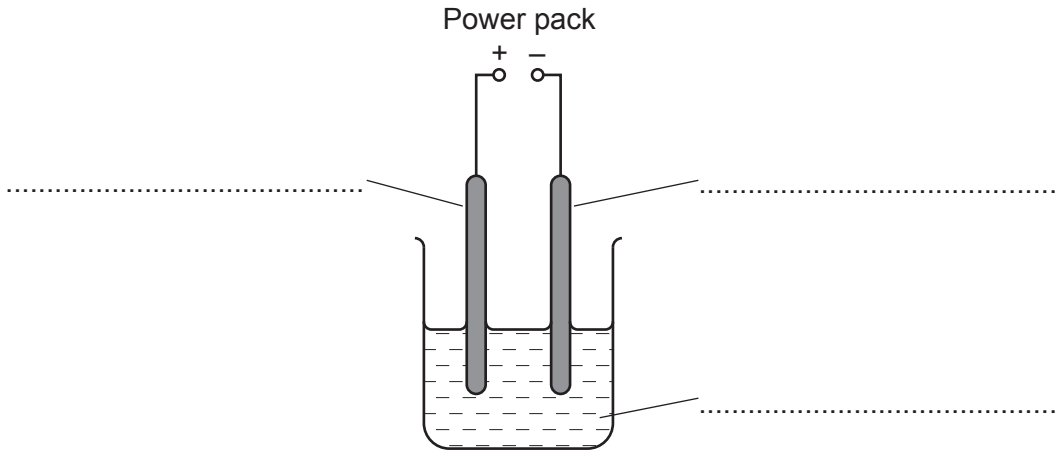
Complete the table.

[3]

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13 **(a)** Look at the diagram of an electrolysis experiment.

(i) Complete the labels on the diagram.



[2]

(ii) Sodium chloride is an **ionic** compound.

Sodium chloride

- Will **not** conduct electricity when it is solid
- Will conduct electricity when it is dissolved in water.

Explain why.

.....

.....

..... **[2]**

(b) A scientist electrolyses three different compounds.

Complete the table below to show what products will be formed.

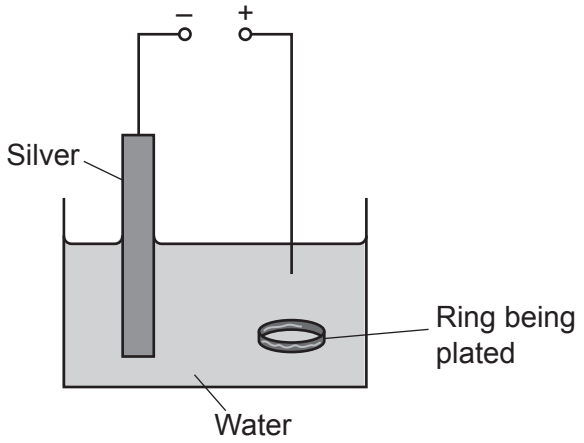
Compound	Product formed at negative electrode	Product formed at positive electrode
Molten $PbBr_2$	Lead	.....
A solution of KBr	Hydrogen	.....
A solution of $CuCl_2$	Copper	.....

[3]

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(c) Electrolysis can also be used to **electroplate** one metal onto another.

Look at the diagram of this experiment.



The experiment shown in this diagram will **not** work.

Suggest **two** things that must be changed to make the experiment work.

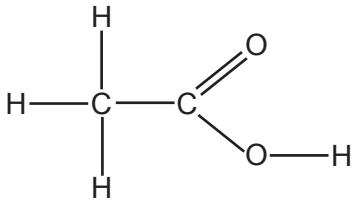
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..... **[2]**

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14 Look at the molecule below:



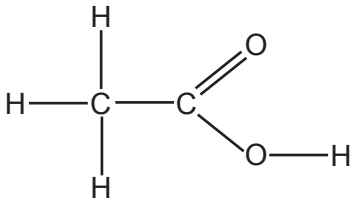
(a) Write down the **empirical formula** for this molecule.

..... **[1]**

(b) Calculate the **relative formula mass**, M_r, for this molecule.

Answer = ... **[1]**

(c) The displayed formula for the molecule does not show the exact length of the bonds.



Write down **two** other limitations of the displayed formula.

.....

.....

.....

.....

..... **[2]**

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15 This question is about electronic structure and bonding.

(a) The electronic structure of phosphorus is 2.8.5.

Use these **three numbers** to explain the **position** of phosphorus in the Periodic Table.

.....

.....

.....

..... **[2]**

(b) Phosphorus bonds with hydrogen to form the toxic gas phosphine, PH_3.

Draw a 'dot and cross' diagram to show the **covalent** bonding in PH_3.

[2]

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16 Sodium hydroxide reacts with hydrochloric acid.

Sodium chloride and water are made.

(a) Write a **word** equation for this reaction.

..... **[1]**

(b) A student adds 5 cm^3 of hydrochloric acid (HC*l*) to 55 cm^3 of sodium hydroxide (NaOH).

He measures the highest temperature reached during the reaction.

He also measures the pH at the end of the reaction.

He repeats this experiment three times and works out the mean temperature.

He then repeats the experiment with different volumes of hydrochloric acid and sodium hydroxide.

Look at his results.

Experiment	Volume of HC*l* (cm^3)	Volume of NaOH (cm^3)	Highest temperature reached during reaction (°C)				pH at the end of the reaction
			1	2	3	Mean	
A	10	50	29.3	30.6	30.7	30.2	12.0
B	20	40	34.5	35.3	35.2	35.0	7.8
C	30	30	37.3	37.6	36.7	37.2	7.0
D	40	20	34.3	35.5	34.6		6.3

(i) Calculate the mean temperature for experiment **D**.

Answer = ...°C **[1]**

(ii) Describe the pattern of the highest temperature reached for experiments **A** to **C**.

.....

..... **[1]**

(iii) Describe the pattern of pH at the end of the reaction for experiments **A** to **D**.

.....

.....

..... **[1]**

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(iv) How could the student measure the pH?

.....

..... **[1]**

(c) What conclusion can you draw from the student's experiments?

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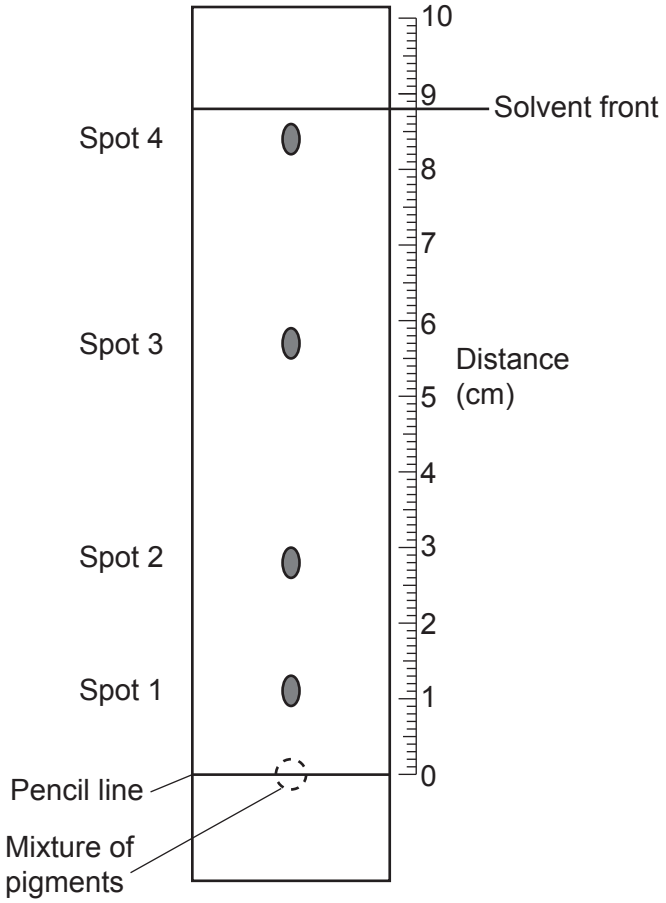
..... **[1]**

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17* A student wants to find out which pigments are in a plant.

She does a chromatography experiment on a sample from the plant.

Look at her results.



Distance to **spot 1**	= 1.1 cm
Distance to **spot 2**	= 2.8 cm
Distance to **spot 3**	= 5.7 cm
Distance to **spot 4**	= 8.4 cm

The R_f values for some pigments are shown in the table.

Pigment	**R_f value**
A	0.95
B	0.45
C	0.32
D	0.25
E	0.15

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Calculate the R_f value for each spot.

Describe and explain which pigments are in the sample from the plant and suggest why further analysis of the plant pigments is needed.

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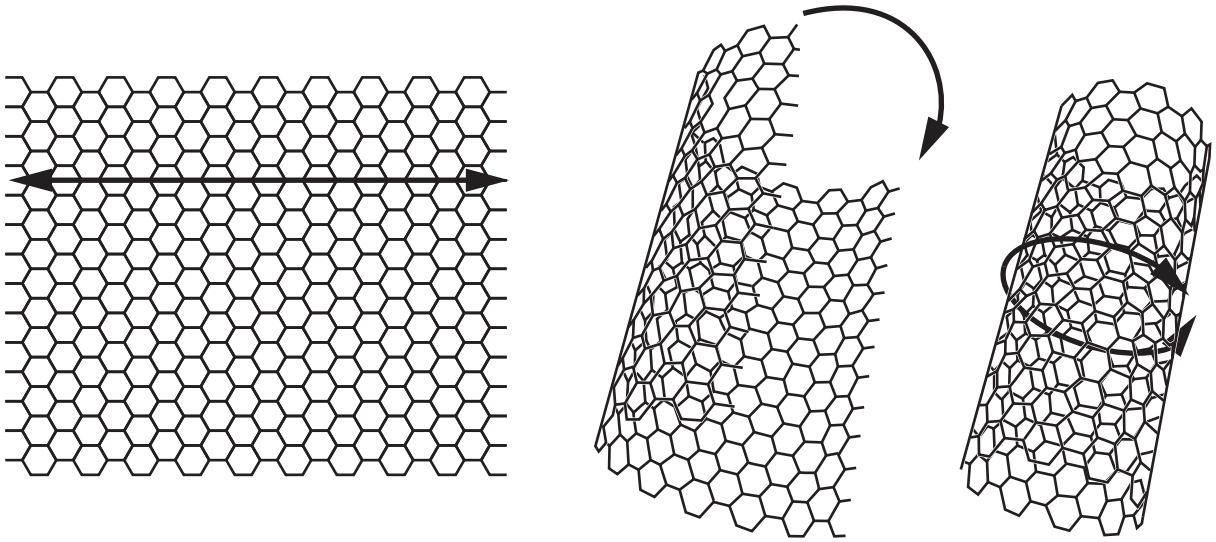
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..... **[6]**

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18 Carbon nanotubes are a new material.

The diagrams show how a graphene sheet can form a nanotube.



(a) Nanotubes are more than 100 times stronger than iron.

Explain why nanotubes are so strong. Use ideas about bonding.

.....

.....

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.....

..... **[2]**

(b) Carbon is a non-metal.

Carbon nanotubes conduct electricity.

Explain why carbon nanotubes conduct electricity.

.....

.....

..... **[2]**

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(c) Carbon nanotubes and iron have very similar electrical conductivities.

Look at some other properties of carbon nanotubes and iron.

Material	**Density (g/cm^3)**	**Melting point (°C)**
Carbon nanotubes	1.6	3500
Iron	7.9	1538

(i) Calculate how many times more dense iron is than carbon nanotubes.

Answer = ... **[2]**

(ii) Explain why iron is more dense than carbon nanotubes.

.....

.....

..... **[1]**

(iii) Suggest a reason why carbon nanotubes have a higher melting point than iron.

.....

..... **[1]**

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19 The table shows some common ions.

Negative ions		**Positive ions**	
Nitrate	NO_3^-	Aluminium	Al^{3+}
Oxide	O^{2-}	Magnesium	Mg^{2+}

(a) Write the formula for **aluminium oxide**.

..... **[1]**

(b) A teacher wrote the formula for magnesium nitrate as:

$MgNO_3$

A student says that the formula is incorrect.

Who is right? Explain your answer.

.....

..... **[1]**

(c) Aluminium sulfide reacts with dilute hydrochloric acid.

(i) Balance the equation for this reaction.

$$Al_2S_3 + \text{.....} \; HCl \rightarrow \text{.....} \; AlCl_3 + \text{.....} \; H_2S$$

[1]

(ii) The table shows the melting point and boiling point of H_2S.

Melting point	–85.5 °C
Boiling point	–60.7 °C

What state does H_2S exist in at room temperature?

..... **[1]**

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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