

Reactivity of Metals

Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.4 Chemical Changes
Sub-Topic	Reactivity of Metals
Difficulty Level	Gold Level
Booklet	Question Paper 1

Time Allowed: 60 minutes

Score: /57

Percentage: /100

Grade Boundaries:

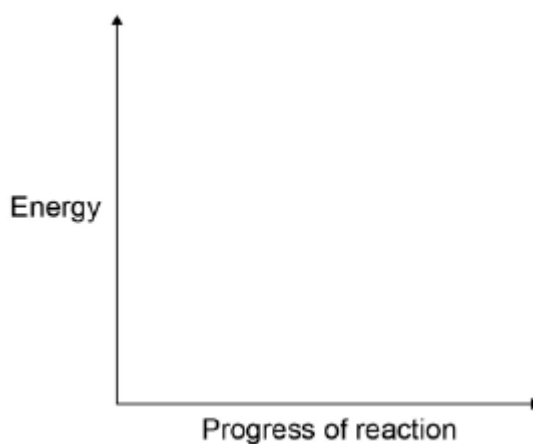
Q1. Exothermic reactions transfer energy to the surroundings.

(a) Draw a reaction profile for an exothermic reaction using the axes in **Figure 1**.

Show the:

- relative energies of the reactants and products
- activation energy and overall energy change.

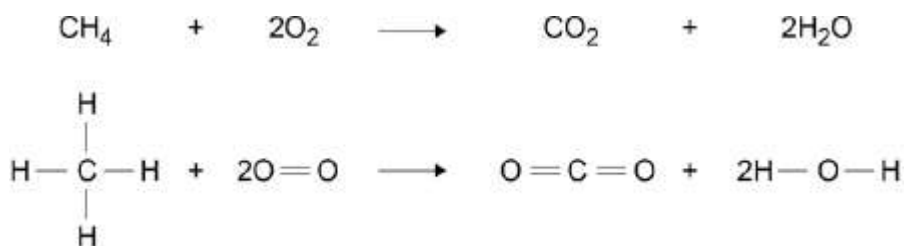
Figure 1



(2)

(b) Combustion is an exothermic reaction.

Calculate the overall energy change for the complete combustion of one mole of methane in oxygen.



Bond	Bond energy in kJ / mol
C — H	413
O = O	498
C = O	805
O — H	464

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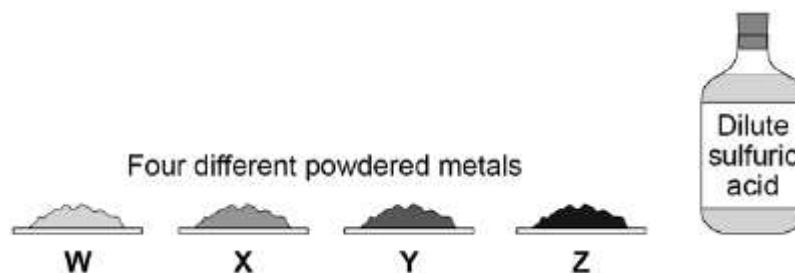
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Overall energy change = kJ / mol

(3)

- (c) **Figure 2** shows the chemicals given to a student.

Figure 2



The student wants to investigate the reactivity of the four metals.

Outline a plan the student could use to investigate the relative reactivity of the four metals, **W**, **X**, **Y** and **Z**.

The plan should use the fact that all four metals react exothermically with dilute sulfuric acid.

You should name the apparatus used and comment on the safe use of the chemicals.

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(6)

- (d) Another student used displacement reactions to investigate the relative reactivity of the four metals, **W**, **X**, **Y** and **Z**.

The table below shows the student's results.

Solution	Observations			
	Metal W	Metal X	Metal Y	Metal Z
Copper nitrate	Brown layer formed on metal	Brown layer formed on metal	Brown layer formed on metal	No change
Magnesium sulfate	No change	No change	No change	No change
Sulfuric acid	Gas bubbles produced	Few gas bubbles produced	Gas bubbles produced	No change
Zinc chloride	Grey layer formed on metal	No change	No change	No change

Give the order of reactivity of metals, **W**, **X**, **Y** and **Z**.

Use the results in the table above to justify your answer.

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(3)

- (e) The student concluded that these results could also be used to justify the order of reactivity of copper, magnesium, hydrogen and zinc.

The student is **not completely** correct. Use the results in the table above to explain why.

Suggest one further experiment that would provide evidence for the student's conclusion.

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(4)
(Total 18 marks)

Q2.Iron is a metal that has many uses.

- (a) Iron is extracted from iron ore. Part of the process involves reduction of the ore with carbon monoxide.

Iron ore contains iron oxide (Fe_2O_3).

Write a balanced equation for the reaction of iron oxide with carbon monoxide.

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(3)

- (b) Explain why this reaction is a redox reaction.

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(2)

Steel is an alloy of iron. Steel is used to make cars.

After its useful life a car is taken to a scrapyard for recycling.

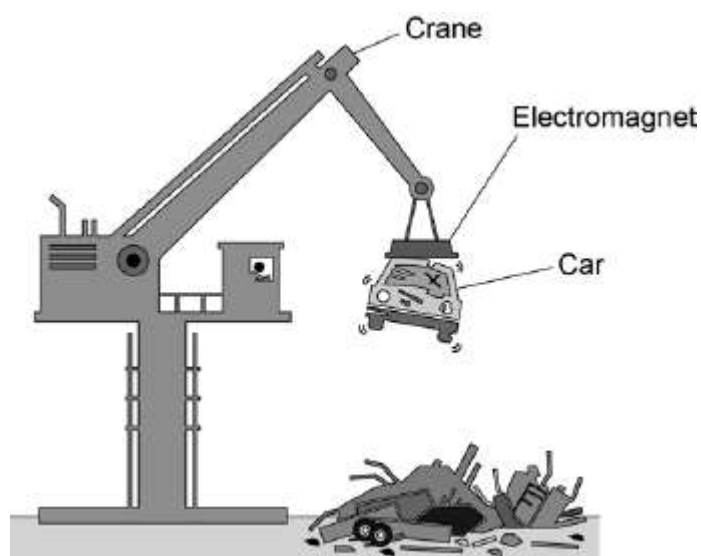
- (c) Suggest **four** benefits of recycling a car body.

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(4)

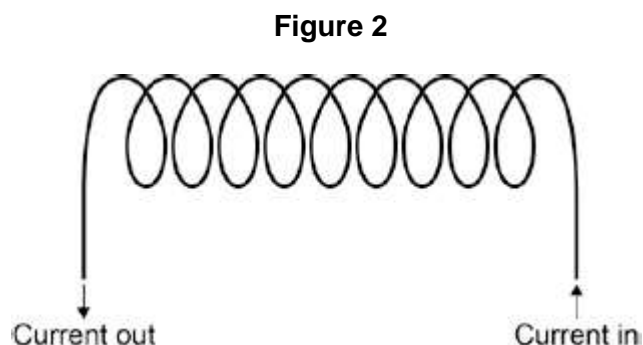
- (d) **Figure 1** shows an electromagnet being used to lift a car in a scrapyard.

Figure 1



An electromagnet is made up of a solenoid.

Figure 2 shows a solenoid.



Draw the magnetic field of the solenoid on **Figure 2**.

(2)

- (e) In a scrapyard, an electromagnet is used to lift and release cars so they can be moved around.

Suggest **two** ways a solenoid could be made to lift and release cars in a scrapyard.

Explain why each suggestion would be useful in the scrapyard.

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(Total 15 marks)

Q3.In 1869 there were 60 known elements.

Mendeleev arranged the elements in order of their atomic mass (atomic weight).

He realised that elements with similar properties occurred at regular intervals.

- (a) Suggest why one of the groups that is on today's periodic table was not in Mendeleev's periodic system.

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- (b) Explain the arrangement of the first 20 elements in today's periodic table.

You should answer in terms of atomic structure.

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- (c) A student put some potassium bromide solution in a test tube.

She added a few drops of chlorine solution and observed the result.

She repeated the process using different potassium halide salts and different halogens.

The table below shows the student's results.

Solution of halogen	Potassium chloride solution	Potassium bromide solution	Potassium iodide solution
Chlorine		Orange colour forms	Brown colour forms
Bromine	No reaction		Brown colour forms
Iodine	No reaction	No reaction	

Give the order of reactivity of the halogens from the results in the table above.

Explain how you used the results to show this order of reactivity.

Order

Explanation

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(2)

- (d) Write a balanced ionic equation for the reaction of chlorine with bromide ions in solution.

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- (e) Explain the order of reactivity of Group 7 elements.

Include information about atomic structure.

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(Total 10 marks)

- Q4.** Use the Reactivity Series of Metals on the Data Sheet to help you to answer this question.

The table gives information about the extraction of some metals.

Metal	Date of discovery	Main source	Main extraction method
Gold	Known to ancient civilisations	In the Earth as the metal itself	Physically separating it from the rocks it is mixed with

Zinc	1500	Zinc carbonate	Reduction by carbon
Sodium	1807	Sodium chloride	Electrolysis

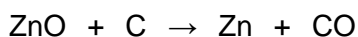
- (a) Explain why gold is found mainly as the metal itself in the Earth.

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(1)

- (b) One of the reactions involved in producing zinc is represented by this equation.



Explain why carbon can be used to extract zinc.

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(1)

- (c) Sodium is one of the most abundant metals on Earth.

Explain, as fully as you can, why sodium was not extracted until 1807.

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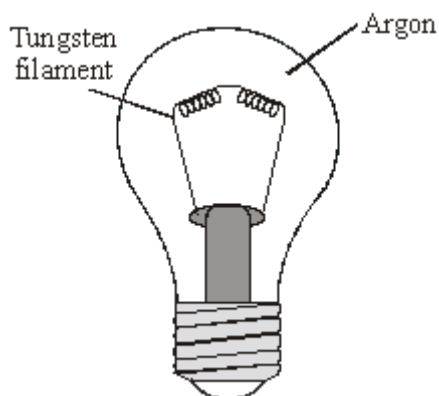
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(2)

(Total 4 marks)

Q5. The diagram shows an electric light bulb.



When electricity is passed through the tungsten filament it gets very hot and gives out light.

- (a) What reaction would take place if the hot tungsten was surrounded by air?

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- (b) State why argon is used in the light bulb. Explain your answer in terms of the electronic structure of an argon atom.

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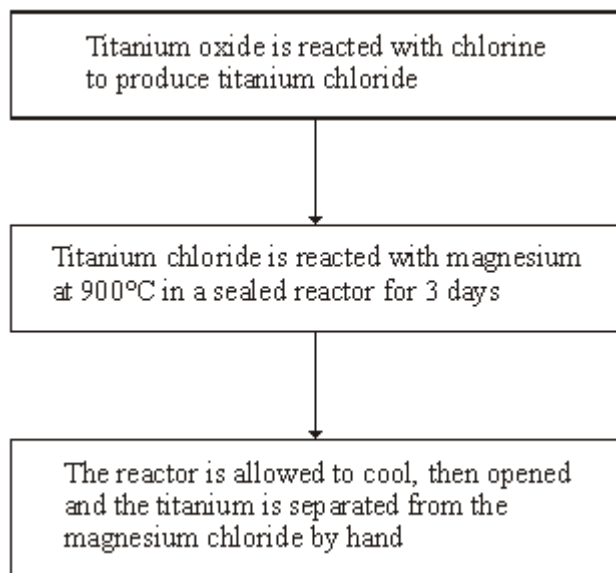
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(3)

(Total 4 marks)

- Q6.** Titanium is used in aircraft, ships and hip replacement joints. Titanium is as strong as steel but 45% lighter, and is more resistant to acids and alkalis.

Most titanium is produced from its ore, rutile (titanium oxide), by a batch process that takes up to 17 days.



Titanium reactors produce about 1 tonne of the metal per day.
Iron blast furnaces produce about 20 000 tonnes of the metal per hour.

- (a) Give **one** property of titanium that makes it more useful than steel for hip replacement joints.

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(1)

- (b) In the reactor magnesium is used to produce titanium. If carbon were used instead of magnesium, no titanium would be produced.

What does this tell you about the relative reactivities of carbon, magnesium and titanium?

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- (c) The use of titanium is limited because it is expensive.

Explain why titanium costs more than steel.

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(Total 6 marks)