Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Chemistry Paper 2F

Wednesday 12 June 2019 Morning Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

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0 1 . 1 This question is about gases.

Draw **one** line from each substance to the description of the substance.

[3 marks]

Substance	Description of substance
Air	Element
Carbon dioxide	Compound
Oxygen	Metal
	Hydrocarbon
	Mixture

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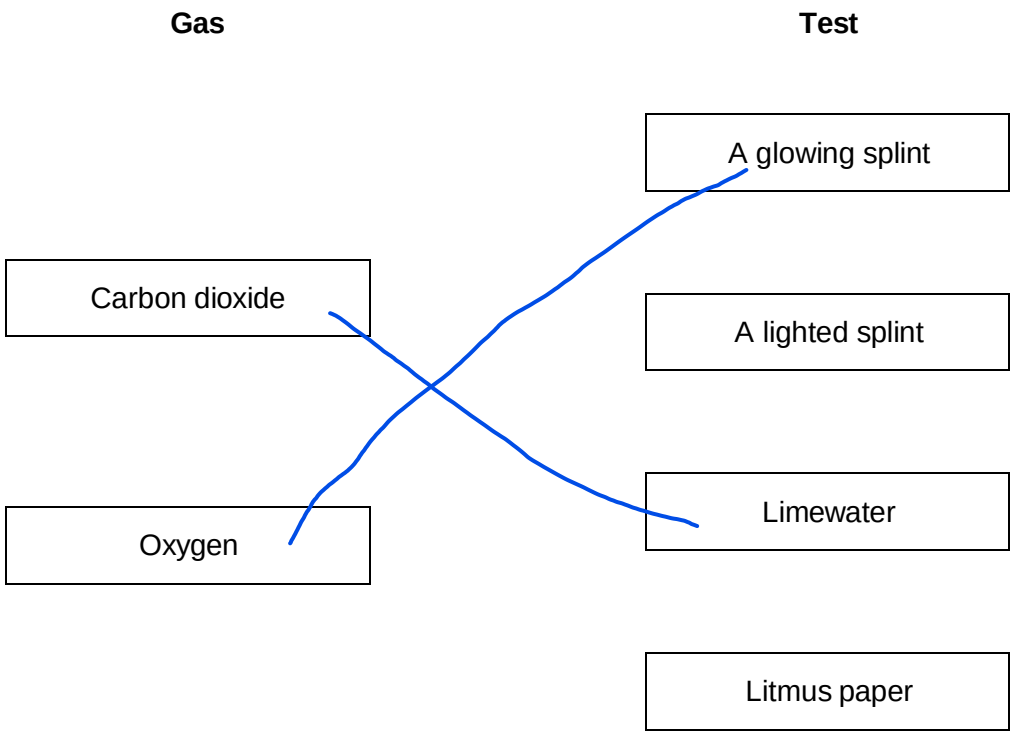
0 1 . 2 What is used to test for each of the gases?

Draw **one** line from each gas to the test for the gas.

[2 marks]



0 1 . 3 Give **two** reasons why the percentage of carbon dioxide in the air has decreased in the last 2.7 billion years.

[2 marks]

Tick (✓) **two** boxes.

- Combustion ☐
- Dissolved in oceans ☑
- Intense volcanic activity ☐
- Photosynthesis ☑
- Respiration ☐

Turn over ►

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Oxygen reacts with sulfur dioxide.

The reaction is reversible.

0 1 . 4 What is the symbol for a reversible reaction?

[1 mark]

0 1 . 5 Complete the sentence.

[1 mark]

In a reversible reaction the forward reaction is exothermic, so the

reverse reaction is endothermic .

0 1 . 6 A reversible reaction happens in apparatus which stops the escape of reactants and products.

Complete the sentence.

[1 mark]

Equilibrium is reached when the forward and reverse reactions happen at

exactly the same rate .

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 2 Concrete contains cement, water, sand and small stones.

0 2 . 1 Concrete is a mixture designed as a useful product.

What do we call a mixture which has been designed as a useful product?

[1 mark]

Tick (✓) **one** box.

Finite ☐

Formula ☐

Formulation ☑

Fraction ☐

0 2 . 2 Concrete contains cement.

Cement is made by heating a mixture containing silicon dioxide (SiO_2).

Why does silicon dioxide have a very high melting point?

[2 marks]

Tick (✓) **two** boxes.

It has a giant structure ☑

It has a simple molecular structure ☐

It has strong covalent bonds ☑

It has strong ionic bonds ☐

It has weak intermolecular forces ☐

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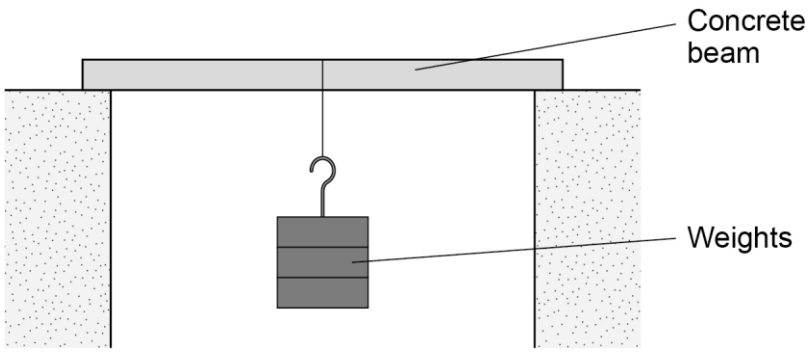
Student **A** investigated how the mass of the small stones in concrete affects the strength of a concrete beam. All other variables were kept the same.

The student added weights until the concrete beam broke.

Figure 1 shows the apparatus Student **A** used.

Figure 1



0 2 . 3 Draw **one** line from each type of variable to the correct example of the variable.

[2 marks]

Type of variable	**Example of variable**
Control	Length of concrete beam
Independent	Mass of small stones in concrete
	Time taken to add weights
	Weight needed to break concrete beam

Turn over ►

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Table 1 shows Student **A**'s results.

Table 1

Mass of small stones in grams (g)	Weight needed to break concrete beam in newtons (N)
500	70
1000	100
1500	110
2000	100
2250	85
2500	65
2750	35

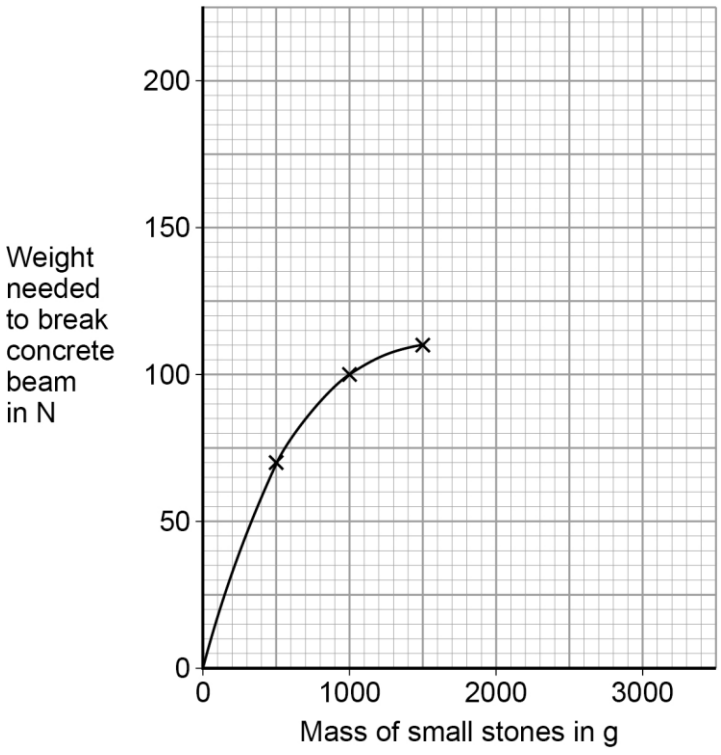
0 2 . 4 Plot the data from **Table 1** on **Figure 2**.

The first three points are plotted for you.

Draw the line of best fit.

[3 marks]

Figure 2



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0 2 . 5 What mass of small stones would be needed to make the strongest concrete?

Give a reason for your answer.

Use **Figure 2**.

[2 marks]

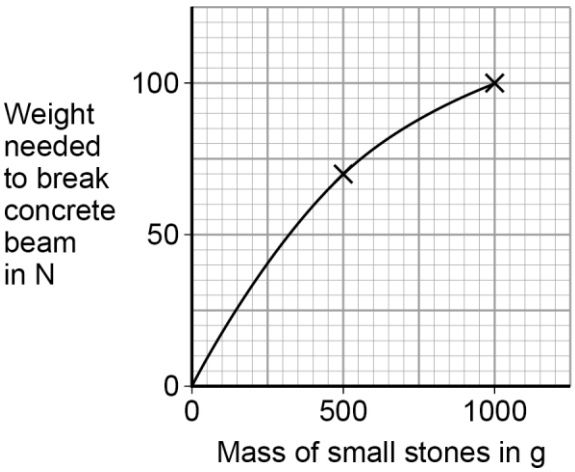
Mass = 1500 (g) g

Reason highest point on graph

0 2 . 6 Student **B** did a similar investigation.

Figure 3 shows Student **B**'s results.

Figure 3



How could Student **B** improve their investigation?

Use **Figure 2** and **Figure 3**.

[1 mark]

take more measurements

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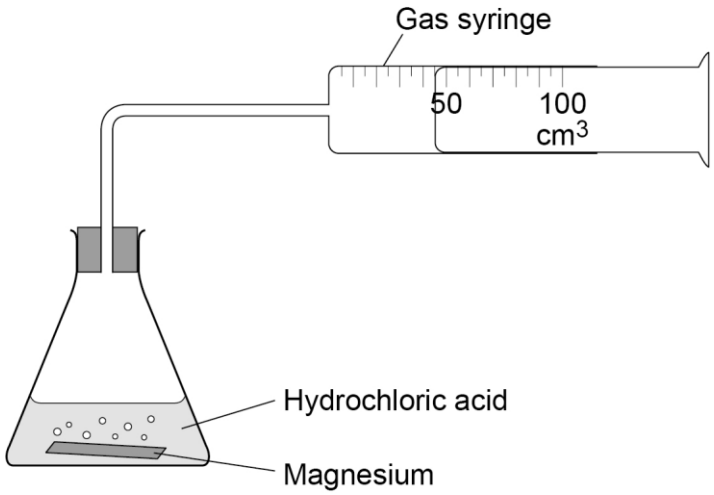
0 3 A student investigated the rate of the reaction between magnesium and hydrochloric acid.

Figure 4 shows the apparatus the student used.

Figure 4



0 3 . 1 Balance the equation for the reaction.

[1 mark]

$$Mg + \underline{2} HCl \rightarrow MgCl_2 + H_2$$

0 3 . 2 The student used 50 cm^3 of hydrochloric acid.

Which apparatus would measure 50 cm^3 of hydrochloric acid with the greatest accuracy?

[1 mark]

Tick (✓) **one** box.

50 cm^3 beaker ☐

50 cm^3 conical flask ☐

50 cm^3 measuring cylinder ☑

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0 3 . 3 The student measured the volume of gas produced every 20 seconds for 2 minutes.

The volume of gas was zero at the start of the experiment.

The measured volumes of gas were:

26 cm^3 38 cm^3 47 cm^3 55 cm^3 59 cm^3 60 cm^3

Complete **Table 2** to show these results.

[4 marks]

Table 2

Time (s)	Volume (cm3)
0	0
20	26
40	38
60	47
80	55
100	59
120	60

0 3 . 4 The volumes of gas were lower than expected.

Suggest **one** reason.

[1 mark]

some (gas) escaped

0 3 . 5 The student repeated the experiment using different concentrations of hydrochloric acid.

Give **two** variables the student should keep the same.

[2 marks]

1 surface area of magnesium

2 volume of acid

Turn over ►

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0 3 . 6 Complete the sentences.

[3 marks]

As the concentration of the hydrochloric acid increased, the rate of the reaction increased .

This is because there were more acid particles in each cubic centimetre (cm^3).

So the collisions happened more frequently .

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0 4 Large hydrocarbon molecules can be cracked to produce smaller, more useful molecules.

Alkanes and alkenes are produced when hydrocarbons are cracked.

0 4 . 1 Give **two** conditions used for cracking.

[2 marks]

1 high temperature

2 catalyst OR steam

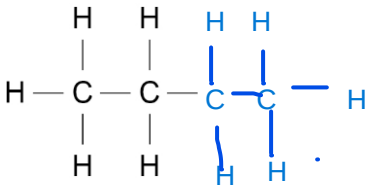
0 4 . 2 Butane (C_4H_{10}) is an alkane.

Figure 5 shows part of the displayed structural formula of butane.

Complete the displayed structural formula of butane in **Figure 5**.

[1 mark]

Figure 5



0 4 . 3 Butane burns in oxygen.

Complete the word equation for the complete combustion of butane.

[2 marks]

butane + oxygen → Carbon dioxide + water

Question 4 continues on the next page

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0 4 . 4 Ethene is an alkene.

Give a test for alkenes.

Give the result of the test if an alkene is present.

[2 marks]

Test bromine (water)

Result turns from orange / brown / yellow to colourless

0 4 . 5 Each year many tonnes of crude oil are extracted from the Earth.

It took millions of years for the crude oil to be formed.

What do we call development that meets the needs of current generations without compromising the resources for future generations?

[1 mark]

Tick (✓) **one** box.

Finite development ☐

Global development ☐

Natural development ☐

Sustainable development ☑

8

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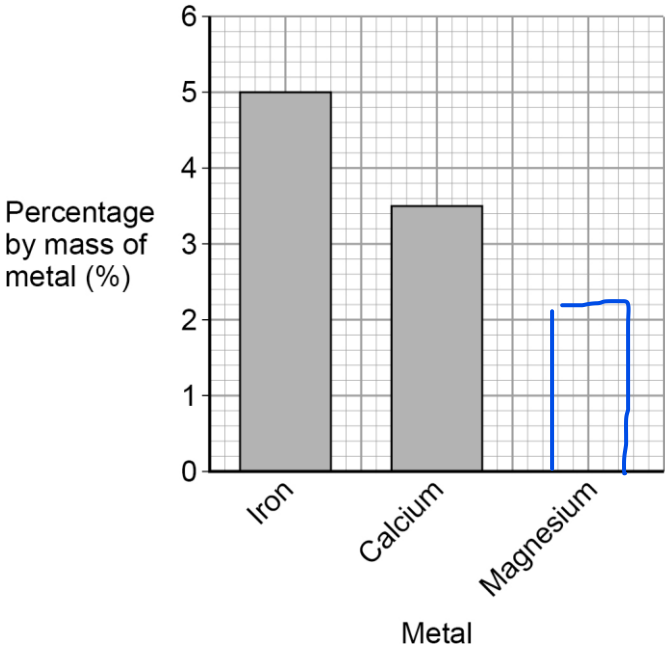
0 5 **Figure 6** shows the percentage by mass of some metals in the Earth's crust.

Figure 6



0 5 . 1 What is the percentage by mass of calcium in the Earth's crust?

[1 mark]

Tick (✓) **one** box.

3.25% ☐ 3.50% ☑ 4.50% ☐ 5.00% ☐

0 5 . 2 The percentage by mass of magnesium in the Earth's crust is 2.1%

Draw the bar for magnesium on **Figure 6**.

[1 mark]

Question 5 continues on the next page

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0 5 . 3 Copper sulfate is produced during the extraction of copper from the Earth's crust.

Copper is produced from copper sulfate solution using iron.

The word equation for the reaction is:

copper sulfate + iron → iron sulfate + copper

From the equation a company calculated that 648 kg of copper sulfate are needed to produce 617 kg of iron sulfate and 258 kg of copper.

Calculate the mass of iron needed to make 258 kg of copper.

[2 marks]

(617 + 258) – 648

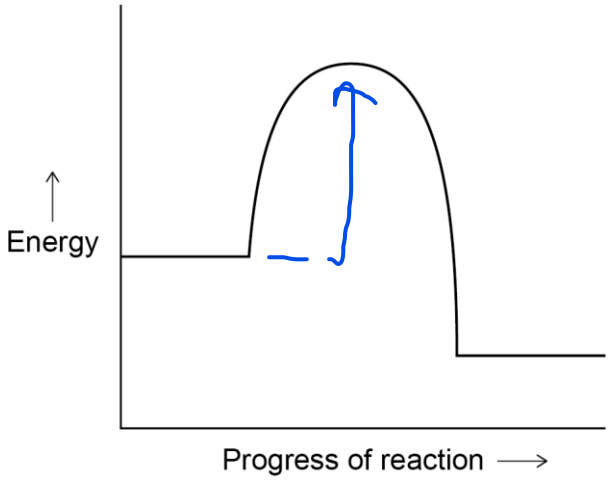
875 – 648 = 227 (kg)

Mass = _____ kg

Copper is used as a catalyst.

0 5 . 4 **Figure 7** shows the reaction profile for a reaction without a catalyst.

Figure 7

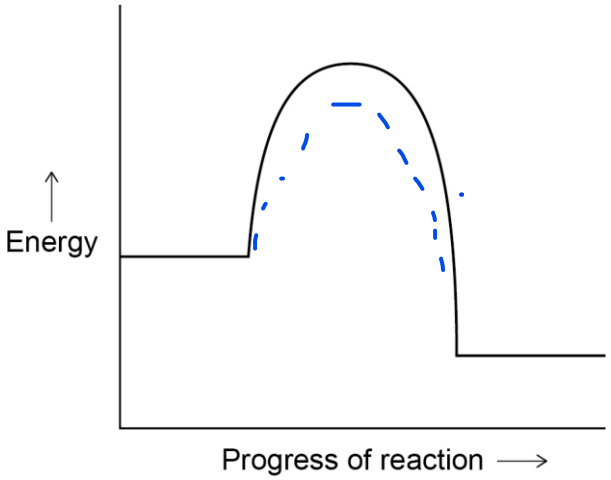


Draw an arrow on **Figure 7** to show the activation energy.

[1 mark]

0 5 . 5 The reaction profile for the reaction without a catalyst is shown again in **Figure 8.**

Figure 8



Draw a reaction profile on **Figure 8** for the same reaction with a catalyst.

[2 marks]

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0 5 . 6 What are catalysts in biological systems called?

[1 mark]

Tick (✓) **one** box.

- Detergents ☐
- Enzymes ☑
- Polymers ☐
- Solvents ☐

8

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0 6 Water that is safe to drink contains dissolved substances.

0 6 . 1 What do we call water that is safe to drink?

[1 mark]

Tick (✓) **one** box.

- Desalinated ☐
- Filtered ☐
- Fresh ☐
- Potable ☑

0 6 . 2 Describe a test for pure water.

Give the result of the test if the water is pure.

[2 marks]

Test: boil water

Result: Pure boils at 100°C

Question 6 continues on the next page

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0 6 . 3 Describe a method to determine the mass of dissolved solids in a 100 cm^3 sample of river water.

[4 marks]

weigh container.

• measure volume (100 cm3) of water into container.

• evaporate / heat until dry.

• weigh container and remaining solids.

• determine mass of dissolved solids

0 6 . 4 A sample of river water contains 125 mg per dm^3 of dissolved solids.

Calculate the mass of dissolved solids in grams in 250 cm^3 of this sample of river water.

Give your answer to 2 significant figures.

[4 marks]

~~(conversion of cm3 to dm3)~~
(250 cm3 =) 250 /1000

= 0.25 (dm3)

(conversion of mg to g)

(125 mg =) 125/ 1000
~~= 0.125 (g)~~

(0.25 × 0.125) = 0.03125

=0.031 (g)

Mass of dissolved solids = 0.031 g

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0 6 . 5 A water company allows a maximum of 500 mg per dm^3 of sulfate ions in drinking water.

A sample of drinking water contains 44 mg per dm^3 of sulfate ions.

Calculate the percentage (%) of the maximum allowed mass of sulfate ions in the sample of drinking water.

[2 marks]

44/500 ×100

= 8.8 (%)

Percentage (%) of the maximum allowed mass = 8.8 %

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Turn over for the next question

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0 7 This question is about atmospheric pollutants from fuels.

0 7 . 1 Fuel burns in a car engine.

Describe how oxides of nitrogen are produced in a car engine.

[2 marks]

High temperatures in the engine enable oxygen and nitrogen from air to react

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0 7 . 2 **Table 3** shows the carbon footprint during the manufacture and use of three cars.

Table 3

Car	Mass of CO_2 produced during manufacture in kg	Mass of CO_2 produced when driving in kg per km	Total mass of CO_2 produced from manufacture and 40 000 km driving in kg	Total mass of CO_2 produced from manufacture and 100 000 km driving in kg
Car A	14 000	0.123	18 920	26 300
Car B	20 000	0.085	23 400	28 500
Car C	23 000	0.044	24 760	27 400

Evaluate the carbon footprint of the cars.

Use information from **Table 3**.

[6 marks]

Examples of relevant points might include:

• car C produces the most CO2 during manufacture

• car A produces the most CO2 per km when driving

• car C produces the most CO2 from manufacture and 40,000km when driving

• car B produces the most CO2 from manufacture and 100,000km when driving

Examples of linked statements might include:
• car A produces least CO2 during manufacture, but most CO2 per km
• car C produces most CO2 during manufacture, but least CO2 per km
• car A produces least CO2 during manufacture, but car C produces the least CO2 per km

Examples of judgements might include:

• overall car A has the smallest carbon footprint as it has the smallest CO2 production during manufacture, the smallest mass of CO2 after 40,000km of driving and the smallest mass of CO2 produced after 100,000km of driving.
• car A eventually (after 157,895km) will have the largest carbon footprint because the mass of carbon dioxide produced per km is highest.

END OF QUESTIONS

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