A

Surname ______________________

Other Names ______________________

Centre Number ______________________

Candidate Number ______________________

Candidate Signature ______________________

# GCSE

# CHEMISTRY

F

**Foundation Tier Paper 2**

## 8462/2F

**Wednesday 12 June 2019 Morning**

**Time allowed: 1 hour 45 minutes**

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

**At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.**

**[Turn over]**

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## INSTRUCTIONS

- **Use black ink or black ball-point pen.**
- **Answer ALL questions in the spaces provided. Do not write on blank pages.**
- **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 100.**
- **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.**

**DO NOT TURN OVER UNTIL TOLD TO DO SO**

**Answer ALL questions in the spaces provided.**

**0 1** This question is about drinking water.

There are two main steps in producing drinking water from fresh water.

**0 1 . 1** Draw ONE line from each step to the reason for the step. [2 marks]

| STEP | REASON FOR STEP |
| --- | --- |
| | Desalination |
| Filtration | Improve taste |
| | Increase pH |
| Sterilisation | Kill bacteria |
| | Remove solids |

**0 1 . 2** Which TWO substances are used to sterilise fresh water? [2 marks]

Tick (✓) TWO boxes.

☐ Ammonia

☐ Chlorine

☐ Hydrogen

☐ Nitrogen

☐ Ozone

[Turn over]

**A large amount of aluminium sulfate was accidentally added to the drinking water supply at a water treatment works.**

**0 1 . 3** **Scientists tested a sample of the drinking water to show that it contained dissolved solids.**

**Which TWO methods show the presence of dissolved solids in the sample of drinking water? [2 marks]**

**Tick (✓) TWO boxes.**

- [ ] **Add damp litmus paper to the sample.**
- [ ] **Evaporate all water from the sample.**
- [ ] **Measure the sample's boiling point.**
- [ ] **Test the sample with a glowing splint.**

**01.4** Scientists tested two water samples from the drinking water supply.

The scientists tested one sample for aluminium ions and the other sample for sulfate ions.

Draw ONE line from each ion to the compound needed to identify the ion. [2 marks]

| ION | COMPOUND NEEDED TO IDENTIFY ION |
| --- | --- |
| | Barium chloride |
| Aluminium ion | Copper sulfate |
| | Silver nitrate |
| Sulfate ion | Sodium hydroxide |
| | Sulfuric acid |

[Turn over]

**0 1 . 5 How could pure water be produced from drinking water that contained dissolved solids?**
**[1 mark]**

**Tick (✓) ONE box.**

- [ ] **Chromatography**
- [ ] **Cracking**
- [ ] **Distillation**
- [ ] **Sedimentation**

**9**

**0 2** Some central heating boilers use methane as a fuel.

Carbon monoxide detectors are placed near central heating boilers.

**0 2 . 1** Which THREE properties of carbon monoxide make it necessary to use carbon monoxide detectors?

Choose answers from the list below. [3 marks]

- acidic
- alkaline
- colourless
- corrosive
- insoluble
- odourless
- toxic

1 ____________________________________________

2 ____________________________________________

3 ____________________________________________

**0 2 . 2** **Complete the sentence. [1 mark]**

**Methane produces carbon monoxide when burning in a limited supply of**

**______________________________ .**

**0 2 . 3** **8 g of methane has a volume of 12 $dm^3$ at room temperature and pressure.**

**Calculate the mass of 36 $dm^3$ of methane. [2 marks]**

________________________________________

________________________________________

________________________________________

________________________________________

**Mass = ______________________________ g**

**0 2 . 4** **Most methane is obtained from natural gas, which is a fossil fuel.**

**Methane can also be produced renewably.**

**Which TWO are renewable sources of methane? [2 marks]**

**Tick (✓) TWO boxes.**

- [ ] **Animal waste**
- [ ] **Food in landfill**
- [ ] **Nitrogen in the air**
- [ ] **Non-biodegradable plastics**
- [ ] **Scrap iron**

**[Turn over]**

8

**0 3** **Hydrogen is a raw material in the Haber process.**

**Hydrogen is produced from methane.**

**The word equation for the reaction is:**

**methane + steam $\rightleftharpoons$ carbon monoxide + hydrogen**

**0 3 . 1** **How can you tell that the reaction is reversible? [1 mark]**

______________________________________________

______________________________________________

______________________________________________

**0 3 . 2** **The forward reaction is endothermic.**

**Name the type of energy change in the reverse reaction. [1 mark]**

______________________________________________

______________________________________________

______________________________________________

**0 3 . 3** **A nickel catalyst is used in this reaction.**

**Why is a catalyst used in this reaction?**
**[2 marks]**

**Tick (✓) TWO boxes.**

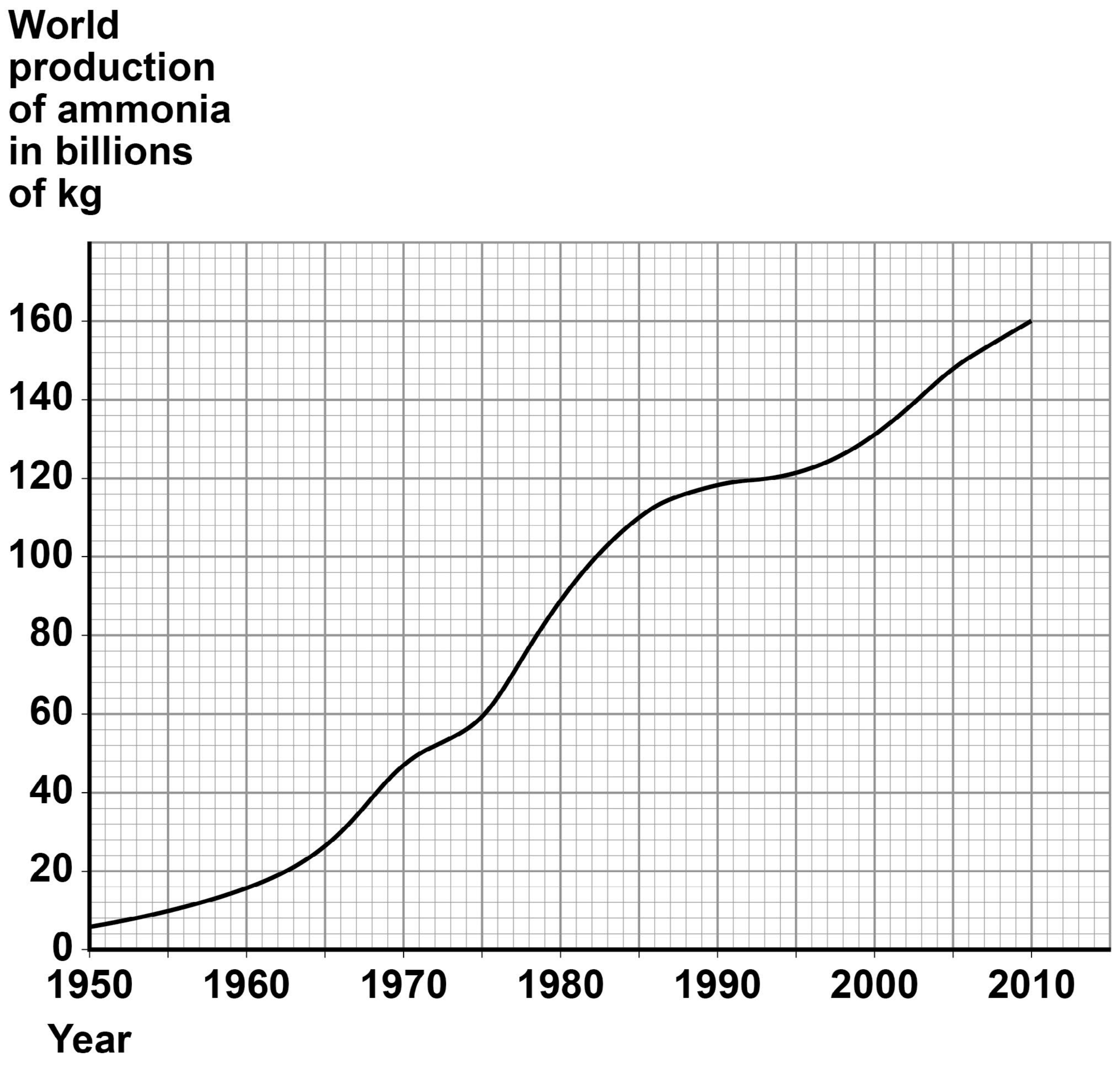
- [ ] **To increase the temperature**
- [ ] **To produce less carbon monoxide**
- [ ] **To reduce costs**
- [ ] **To use less energy**
- [ ] **To use less methane**

**[Turn over]**

**03.4** The Haber process also uses nitrogen to produce ammonia.

FIGURE 1 shows how the world production of ammonia changed between 1950 and 2010.

FIGURE 1



**Describe how the world production of ammonia changed between 1950 and 2010. [2 marks]**

**[Turn over]**

**Most of the ammonia produced is used to make fertilisers.**

**0 3 . 5 Why did the world production of ammonia change between 1950 and 2010? [2 marks]**

**Tick (✓) TWO boxes.**

☐ **The demand for food changed.**

☐ **The demand for fuels changed.**

☐ **The nitrogen percentage in air changed.**

☐ **The number of cars changed.**

☐ **The world population changed.**

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**[Turn over]**

**TABLE 1 shows data about four fertilisers, A, B, C and D.**

**TABLE 1**

| Fertiliser | Percentage by mass of nitrogen (%) | Percentage by mass of phosphorus (%) | Percentage by mass of potassium (%) |
| --- | --- | --- | --- |
| A | 35.0 | 0.0 | 0.0 |
| B | 21.2 | 0.0 | 0.0 |
| C | 21.2 | 23.5 | 0.0 |
| D | 0.0 | 0.0 | 52.3 |

**0 3 . 6** **Which combination of fertilisers A, B, C and D provides ALL of the elements needed for an NPK fertiliser?**

**Use TABLE 1. [1 mark]**

**Tick (✓) ONE box.**

☐ **A and C**

☐ **A and D**

☐ **B and C**

☐ **C and D**

**[Turn over]**

**Repeat of TABLE 1**

| Fertiliser | Percentage by mass of nitrogen (%) | Percentage by mass of phosphorus (%) | Percentage by mass of potassium (%) |
|---|---|---|---|
| A | 35.0 | 0.0 | 0.0 |
| B | 21.2 | 0.0 | 0.0 |
| C | 21.2 | 23.5 | 0.0 |
| D | 0.0 | 0.0 | 52.3 |

**0 3 . 7** **Which fertiliser is NOT made using ammonia?**

**Use TABLE 1. [1 mark]**

**Tick (✓) ONE box.**

☐ **A**

☐ **B**

☐ **C**

☐ **D**

**10**

**[Turn over]**

**04** Titan is a moon of the planet Saturn.

TABLE 2 shows the percentages of some gases in the atmosphere of Titan and in the atmosphere of the Earth.

**TABLE 2**

| Gas | Percentage of gas in atmosphere (%) | |
|---|---|---|
| | Titan | Earth |
| Nitrogen | 98 | 78 |
| Oxygen | Zero | 21 |
| Methane | 1.4 | 0.0002 |
| Argon | 0.14 | 0.9 |
| Carbon dioxide | 0.0001 | 0.04 |

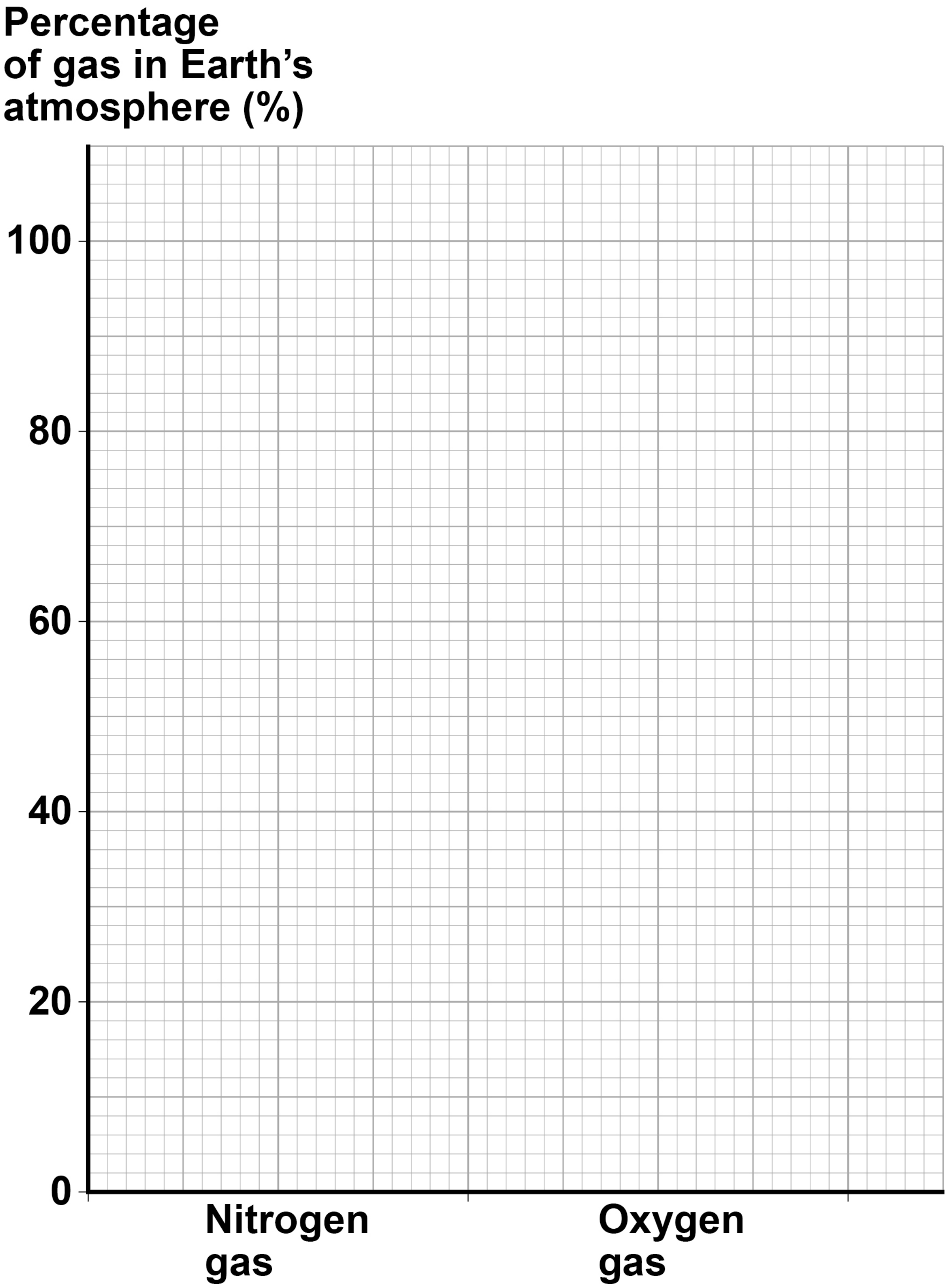
**04.1** Which TWO gases are present in smaller percentages on the Earth than on Titan?
[1 mark]

______________________________

and ______________________________

**0 4 . 2** Complete the bar chart in FIGURE 2 to show the percentages of nitrogen gas and oxygen gas in the Earth's atmosphere. [2 marks]

**FIGURE 2**



Repeat of TABLE 2

| Gas | Percentage of gas in atmosphere (%) | |
|---|---|---|
| | Titan | Earth |
| Nitrogen | 98 | 78 |
| Oxygen | Zero | 21 |
| Methane | 1.4 | 0.0002 |
| Argon | 0.14 | 0.9 |
| Carbon dioxide | 0.0001 | 0.04 |

**0 4 . 3** **Why are algae less likely to photosynthesise on Titan than Earth?**

**Use TABLE 2. [1 mark]**

**Tick (✓) ONE box.**

- [ ] **Titan's atmosphere contains too little argon.**
- [ ] **Titan's atmosphere contains too little carbon dioxide.**
- [ ] **Titan's atmosphere contains too little methane.**
- [ ] **Titan's atmosphere contains too little nitrogen.**

**[Turn over]**

**0 4 . 4** **Titan is warmer than the other moons of Saturn because of the greenhouse effect.**

**How do greenhouse gases trap energy from the sun? [1 mark]**

**Tick (✓) ONE box.**

- [ ] **All wavelengths of radiation are reflected back to the surface of Titan.**
- [ ] **Long wavelength radiation is reflected back to the surface of Titan.**
- [ ] **Short wavelength radiation is reflected back to the surface of Titan.**

As well as methane, the atmosphere of Titan contains small amounts of propene gas. Methane is an alkane and propene is an alkene.

**0 4 . 5** Bromine water is an orange solution used to identify alkenes.

Draw ONE line from each gas to its effect on bromine water. [2 marks]

| GAS | EFFECT ON BROMINE WATER |
|---|---|
| | Forms a blue solution |
| Methane | Forms a colourless solution |
| | Forms a green solution |
| Propene | Forms a white precipitate |
| | No effect |

**0 4 . 6** **Propene reacts with water (steam) to make propanol.**

**The ratio of the masses of propene and water that react is:**

**propene : water**

**7 : 3**

**Calculate the mass of propene that reacts with 21 g water. [2 marks]**

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

**Mass = ____________________________ g**

**9**

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[Turn over]

**0 5** FIGURE 3 shows a surfer on a surfboard.

**FIGURE 3**

Some surfboards are made from addition polymers.

Addition polymers are made from small alkene molecules.

**0 5 . 1** **Which type of bonding is present in small alkene molecules? [1 mark]**

**Tick (✓) ONE box.**

- [ ] **Covalent**
- [ ] **Ionic**
- [ ] **Metallic**

**0 5 . 2** **What is the functional group in these small alkene molecules? [1 mark]**

**Tick (✓) ONE box.**

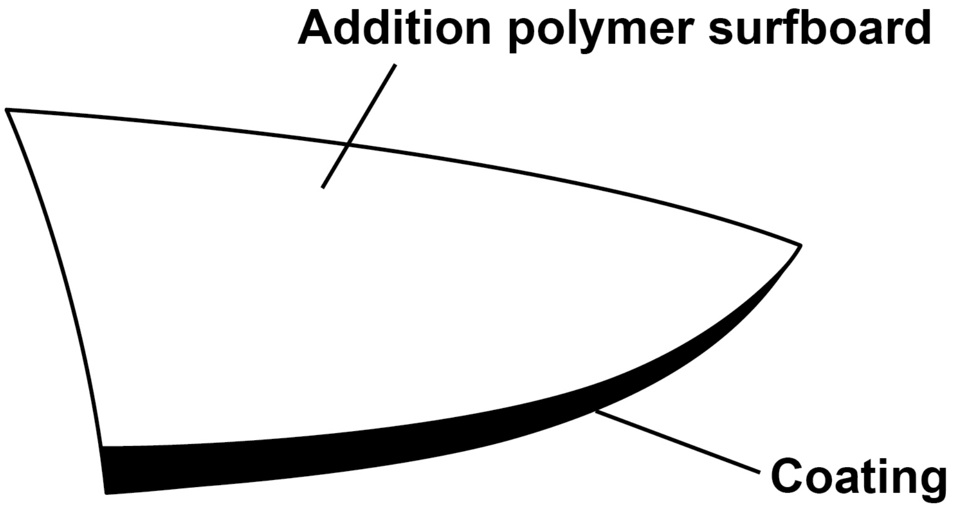
- [ ] $-\overset{|}{C}=\overset{|}{C}-$
- [ ] **— COOH**
- [ ] **— OH**

**[Turn over]**

**FIGURE 4 shows the structure of part of an addition polymer surfboard.**

**The outer surface of the surfboard is coated.**

**FIGURE 4**




**The coating is made from soda-lime glass fibres surrounded by a plastic.**

**05.3** **What type of material is the coating of the surfboard? [1 mark]**

**Tick (✓) ONE box.**

- [ ] **Alloy**
- [ ] **Ceramic**
- [ ] **Composite**
- [ ] **Nanotube**

**[Turn over]**

**0 5 . 4** **Complete the sentence.**

**Choose answers from the list below. [2 marks]**

- **air**
- **ammonia**
- **copper**
- **limestone**
- **sand**

**The materials used to make the soda-lime glass fibres are sodium carbonate,**

____________________________________________

**and** ________________________________________

0 5 . 5 Suggest TWO reasons why surfboards are coated. [2 marks]

1 ______________________________

______________________________

______________________________

2 ______________________________

______________________________

______________________________

[Turn over]

Some surfboards are made from wood.

TABLE 3 contains information about the materials in an addition polymer surfboard and a wooden surfboard.

TABLE 3

| | Addition polymer surfboard | Wooden surfboard |
|---|---|---|
| Relative strength | 14 | 38 |
| Cost (£ per $m^3$) | 140 | 390 |
| Density ($kg/m^3$) | 50 | 150 |
| Disposal at end of life | Difficult to recycle | Can be used as fuel |

0 5 . 6 Suggest TWO advantages and TWO disadvantages of using addition polymers rather than wood to make surfboards.

Use TABLE 3. [4 marks]

Advantages of addition polymers

______________________________________

______________________________________

Disadvantages of addition polymers

**Repeat of TABLE 3**

| | Addition polymer surfboard | Wooden surfboard |
|---|---|---|
| Relative strength | 14 | 38 |
| Cost (£ per $m^3$) | 140 | 390 |
| Density ($kg/m^3$) | 50 | 150 |
| Disposal at end of life | Difficult to recycle | Can be used as fuel |

**0 5 . 7** **Calculate the volume of wood in a wooden surfboard of mass 5.25 kg**

**Use TABLE 3 and the equation:**

$$\text{Density in kg/m}^3 = \frac{\text{Mass in kg}}{\text{Volume in m}^3}$$

**[3 marks]**

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

**Volume = ________________________________ m$^3$**

**[Turn over]**

14

**0 6** This question is about the corrosion of metals.

The corrosion of iron is called rusting.

**0 6 . 1** Plan an investigation to show that both water and air are needed for iron to rust.

You should include the results you expect to obtain.

Use apparatus and materials from the list:

- test tubes
- stoppers
- iron nails
- tap water
- boiled water
- drying agent
- oil.

**[6 marks]**

A student investigated how the mass of three iron nails, A, B and C, increased after rusting.

TABLE 4 shows the student's results.

TABLE 4

| Nail | Mass of nail before rusting in g | Mass of nail after rusting in g | Increase in mass of nail in g |
|---|---|---|---|
| A | 1.22 | 1.30 | 0.08 |
| B | 1.25 | 1.36 | X |
| C | 1.24 | 1.33 | 0.09 |

**0 6 . 2** **Calculate X in TABLE 4. [1 mark]**

______________________________________________

______________________________________________

______________________________________________

**X = ______________________________ g**

**0 6 . 3** **Calculate the mean increase in mass of the three iron nails, A, B and C.**

**Use TABLE 4 and your answer to Question 06.2 [1 mark]**

______________________________________________

______________________________________________

______________________________________________

**Mean increase in mass = ______________ g**

**8**

**[Turn over]**

**0 7** Some students investigated the rate of decomposition of hydrogen peroxide.

The equation for the reaction is:

hydrogen peroxide $\longrightarrow$ water + oxygen

**0 7 . 1** Complete the sentence.

Choose an answer from the list below. [1 mark]

- a burning splint
- a glowing splint
- damp litmus paper
- limewater

The students tested the gas produced to show that it was oxygen.

The students used

________________________________________ .

Student A investigated the effect of the particle size of a manganese dioxide catalyst on the rate of the reaction.

This is the method used.

1. Measure 25 $cm^3$ hydrogen peroxide solution into a conical flask.

2. Add some fine manganese dioxide powder to the conical flask.

3. Measure the volume of oxygen produced every 30 seconds for 10 minutes.

4. Repeat steps 1 to 3 two more times.

5. Repeat steps 1 to 4 with coarse manganese dioxide lumps.

**0 7 . 2** The method student A used did NOT give repeatable results.

How could student A make the results repeatable? [1 mark]

Tick (✓) ONE box.

☐ Student A should make measurements every 2 minutes.

☐ Student A should measure the mass of manganese dioxide.

☐ Student A should use 50 $cm^3$ hydrogen peroxide.

☐ Student A should use a beaker instead of a conical flask.

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**Student B used a method which gave repeatable results.**

**0 7 . 3 How could student B improve the accuracy of these results? [1 mark]**

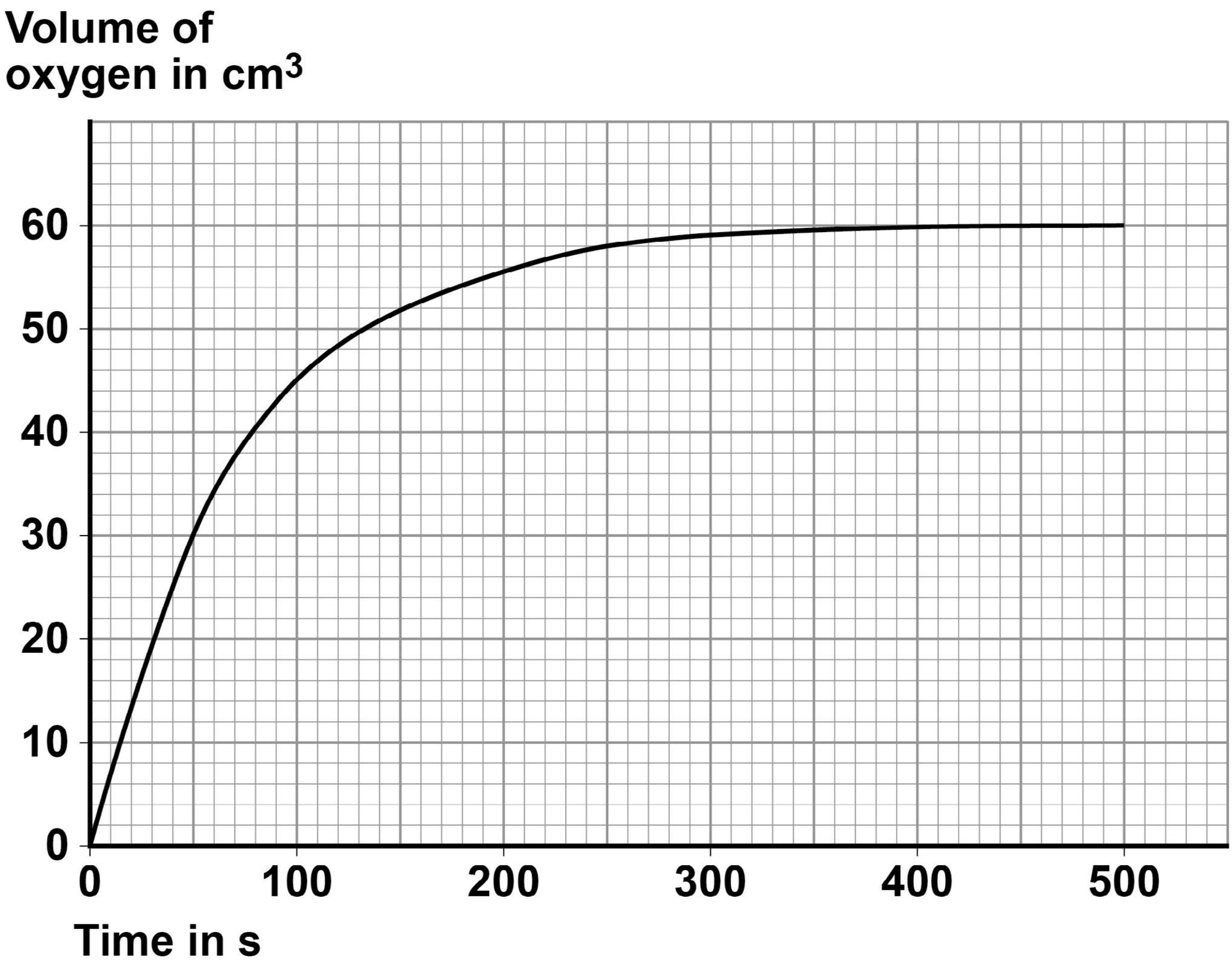
**Tick (✓) ONE box.**

- [ ] **Calculate a mean but do not include any anomalous results.**
- [ ] **Calculate a mean but do not include the first set of results.**
- [ ] **Record the results in a table and plot the results on a bar chart.**
- [ ] **Record the results in a table and plot the results on a line graph.**

**[Turn over]**

FIGURE 5 shows student B's results for coarse manganese dioxide lumps.

FIGURE 5




0 7 . 4 Calculate the mean rate of reaction between 30 and 250 seconds for coarse manganese dioxide lumps.

Use FIGURE 5 and the equation:

$$\text{Mean rate of reaction} = \frac{\text{Volume of oxygen formed}}{\text{Time taken}}$$

Give your answer to 3 significant figures.
[4 marks]

Volume of oxygen formed

______________________________________________

Time taken ________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

Mean rate of reaction =

______________________________________ $cm^3/s$

[Turn over]

**0 7 . 5** Fine manganese dioxide powder produces a higher rate of reaction than coarse manganese dioxide lumps.

Sketch on FIGURE 5, on page 48, the results you would expect for student B's experiment with fine manganese dioxide powder.
[2 marks]

**0 7 . 6** Hydrogen peroxide molecules collide with manganese dioxide particles during the reaction.

Why does fine manganese dioxide powder produce a higher rate of reaction than coarse manganese dioxide lumps? [1 mark]

Tick (✓) ONE box.

☐ Fine manganese dioxide powder has a larger surface area.

☐ Fine manganese dioxide powder has larger particles.

☐ Fine manganese dioxide powder produces less frequent collisions.

10

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[Turn over]

**0 8** This question is about crude oil and hydrocarbons.

**FIGURE 6 shows a fractionating column used to separate crude oil into fractions.**

**FIGURE 6**

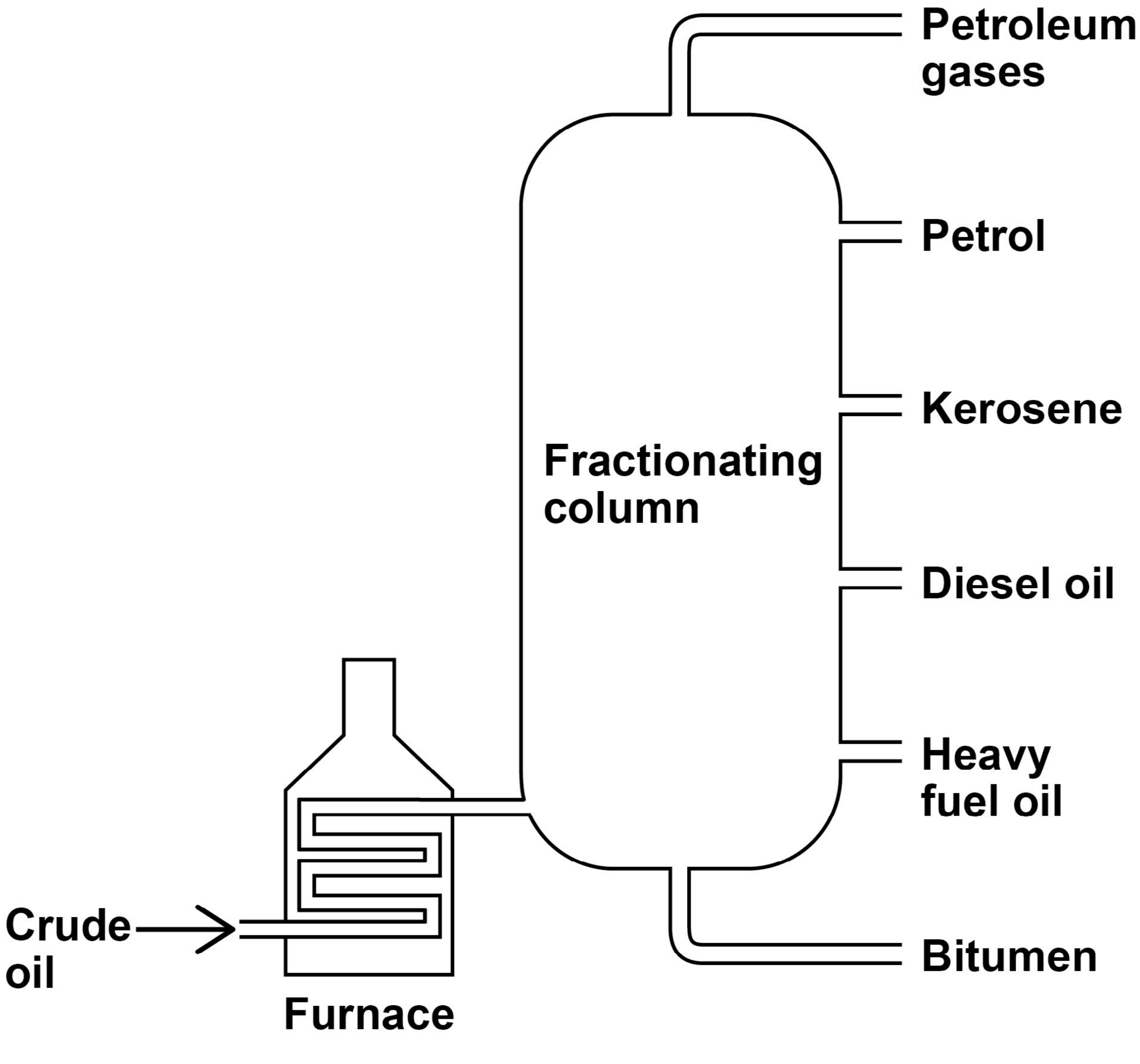

**TABLE 5 gives information about some of the fractions.**

**TABLE 5**

| FRACTION | BOILING POINT RANGE IN °C |
|---|---|
| Petroleum gases | Below 30 |
| Petrol | 40–110 |
| Kerosene | 180–260 |
| Diesel oil | 260–320 |
| Heavy fuel oil | 320–400 |
| Bitumen | 400–450 |

**0 8 . 1** **Suggest a suitable temperature for the furnace in FIGURE 6. [1 mark]**

____________________ °C

[Turn over]

Repeat of TABLE 5

| FRACTION | BOILING POINT RANGE IN °C |
|---|---|
| Petroleum gases | Below 30 |
| Petrol | 40–110 |
| Kerosene | 180–260 |
| Diesel oil | 260–320 |
| Heavy fuel oil | 320–400 |
| Bitumen | 400–450 |

**0 8 . 2** Explain why diesel oil collects above heavy fuel oil but below kerosene in the fractionating column.

Use TABLE 5. [2 marks]

**08.3** **Suggest TWO reasons why bitumen is NOT used as a fuel. [2 marks]**

**1** 

**2** 

**[Turn over]**

**0 8 . 4** **Petrol contains mainly alkanes.**

**Which of the following compounds is an alkane? [1 mark]**

**Tick (✓) ONE box.**

☐ $C_2H_4$

☐ $C_4H_8$

☐ $C_6H_{14}$

☐ $C_8H_{16}$

**Large hydrocarbon molecules in the diesel oil fraction are cracked to produce smaller hydrocarbon molecules.**

**0 8 . 5** **Describe the conditions needed to crack hydrocarbon molecules from the diesel oil fraction. [2 marks]**

______________________________________________

______________________________________________

______________________________________________

0 8 . 6 **Explain why large hydrocarbon molecules in the diesel oil fraction are cracked to produce smaller hydrocarbon molecules. [2 marks]**

0 8 . 7 **Complete the equation for the cracking of $C_{15}H_{32}$**

**[1 mark]**

$C_{15}H_{32} \rightarrow C_{12}H_{26}$ + ______

**0 9** This question is about lithium carbonate.

Lithium carbonate is used in medicines.

FIGURE 7 shows a tablet containing lithium carbonate.

FIGURE 7

**0 9 . 1** Lithium carbonate contains lithium ions and carbonate ions.

A student tested the tablet for lithium ions and for carbonate ions.

The student used:

- a metal wire
- dilute hydrochloric acid
- limewater.

**Plan an investigation to show the presence of lithium ions AND of carbonate ions in the tablet.**

**You should include the results of the tests for the ions. [6 marks]**

**[Turn over]**

**0 9 . 2** **The tablet also contains other substances.**

**The substances in tablets are present in fixed amounts.**

**What name is given to mixtures like tablets? [1 mark]**

______________________________________

**0 9 . 3** **The tablet has a mass of 1.20 g and contains 700 mg of lithium carbonate.**

**Calculate the percentage by mass of lithium carbonate in this tablet. [3 marks]**

______________________________________

______________________________________

______________________________________

______________________________________

______________________________________

______________________________________

**Percentage by mass of lithium carbonate =**

______________________________________ **%**

**10**

**1 0** This question is about rate of reaction.

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

The equation for the reaction is:

$$Mg(s) + 2\,HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

**1 0 . 1** Which state symbol in the equation for the reaction does NOT represent one of the three states of matter? [1 mark]

_______________________________________________

The student determined the rate of production of hydrogen gas.

**1 0 . 2** What TWO pieces of measuring apparatus could the student use to find the rate of production of hydrogen gas? [2 marks]

1 _____________________________________________

_______________________________________________

2 _____________________________________________

_______________________________________________

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[Turn over]

TABLE 6 shows the results of the investigation.

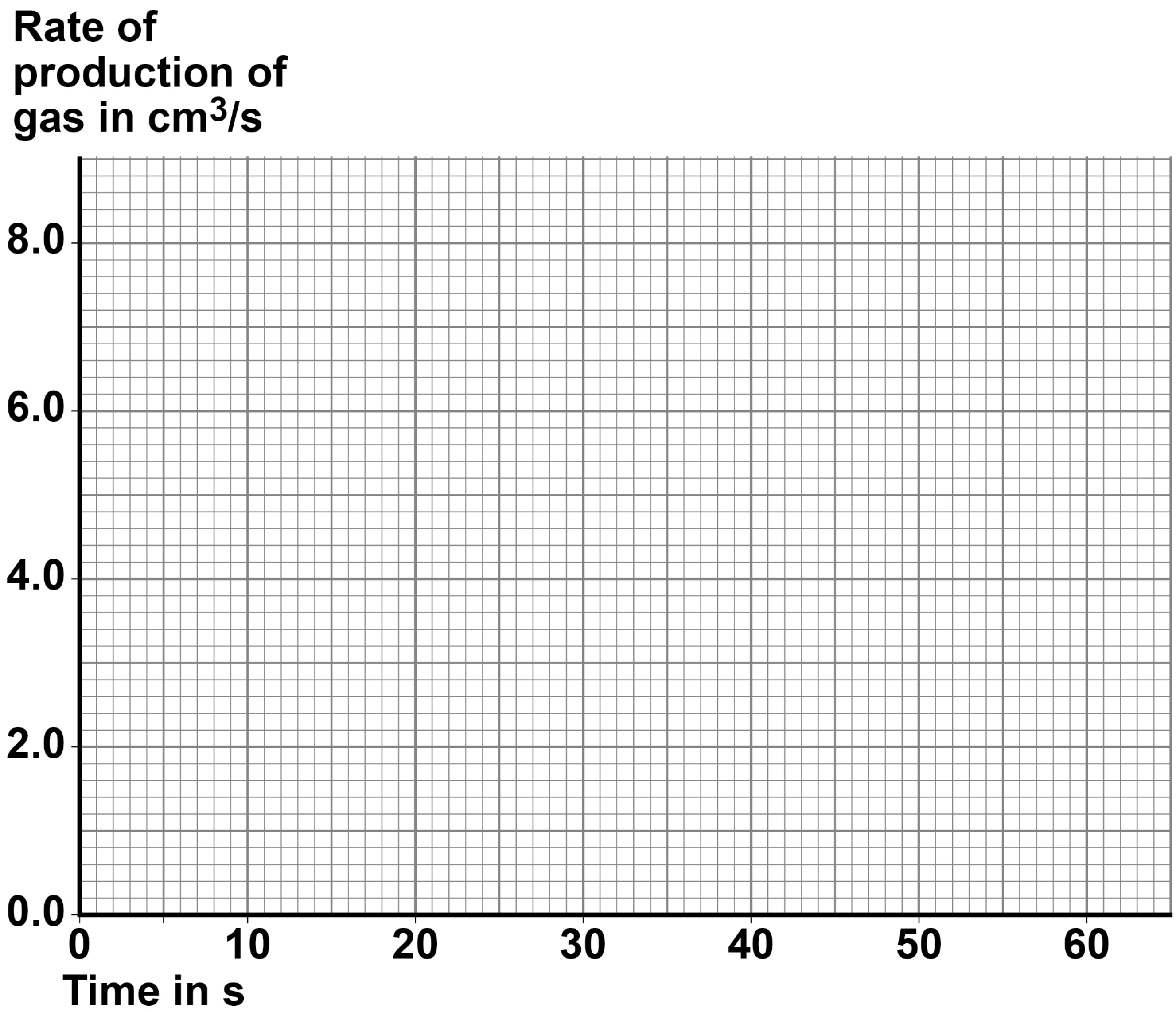
TABLE 6

| Time in s | Rate of production of gas in $cm^3/s$ |
|---|---|
| 10 | 6.9 |
| 20 | 3.9 |
| 30 | 2.0 |
| 40 | 0.9 |
| 50 | 0.3 |
| 60 | 0.0 |

**10 . 3** Plot the data from TABLE 6 on FIGURE 8 on the opposite page.

You should draw a line of best fit. [3 marks]

**FIGURE 8**


Rate of production of gas in cm³/s
8.0
6.0
4.0
2.0
0.0
0
10
20
30
40
50
60
Time in s

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**10.4** **Give THREE conclusions that can be drawn about the rate of reaction between magnesium and dilute hydrochloric acid in this investigation.**

**Use data from FIGURE 8, on page 65, and TABLE 6, on page 64. [3 marks]**

**1** ______________________________________

______________________________________

______________________________________

**2** ______________________________________

______________________________________

______________________________________

**3** ______________________________________

______________________________________

______________________________________

**10.5** The student repeated the investigation using dilute hydrochloric acid at a higher temperature.

All the other variables were kept the same.

Which TWO statements are correct?
[2 marks]

Tick (✓) TWO boxes.

- [ ] More bubbles were produced in the first 10 seconds.
- [ ] The activation energy for the reaction was higher.
- [ ] The magnesium was used up more quickly.
- [ ] The reaction finished at the same time.
- [ ] The total volume of gas collected was greater.

| |
|---|
| 11 |

**END OF QUESTIONS**

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| For Examiner's Use | |
|---|---|
| Question | Mark |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| **TOTAL** | |