Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3440UB0-1

S19-3440UB0-1

APPLIED SCIENCE (Single Award)
UNIT 2: Science to Support our Lifestyles

HIGHER TIER

TUESDAY, 14 MAY 2019 – AFTERNOON

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**19**	
2.	**6**	
3.	**8**	
4.	**6**	
5.	**10**	
6.	**8**	
7.	**9**	
8.	**9**	
Total	**75**	

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ADDITIONAL MATERIALS

A calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **4** is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on page 20 of this examination paper.

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Answer **all** *questions.*

1. Food manufacturers are required to measure the amount of energy contained in their food products.

(a) A cereal bar has the following information on its label.

	Per 100 g	Per cereal bar	RDA
Energy (kJ)	1 966	787	8 400

(i) Calculate the percentage of the recommended daily allowance (RDA) provided by **one** cereal bar. Give your answer to 2 significant figures. [2]

Percentage = ... %

(ii) Calculate the mass in grams of **one** cereal bar. [2]

Mass = ... g

(iii) Give a reason for not using the value for energy **per cereal bar** when comparing different brands. [1]

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(iv) Explain why the Government is concerned about constantly exceeding the RDA for energy. [3]

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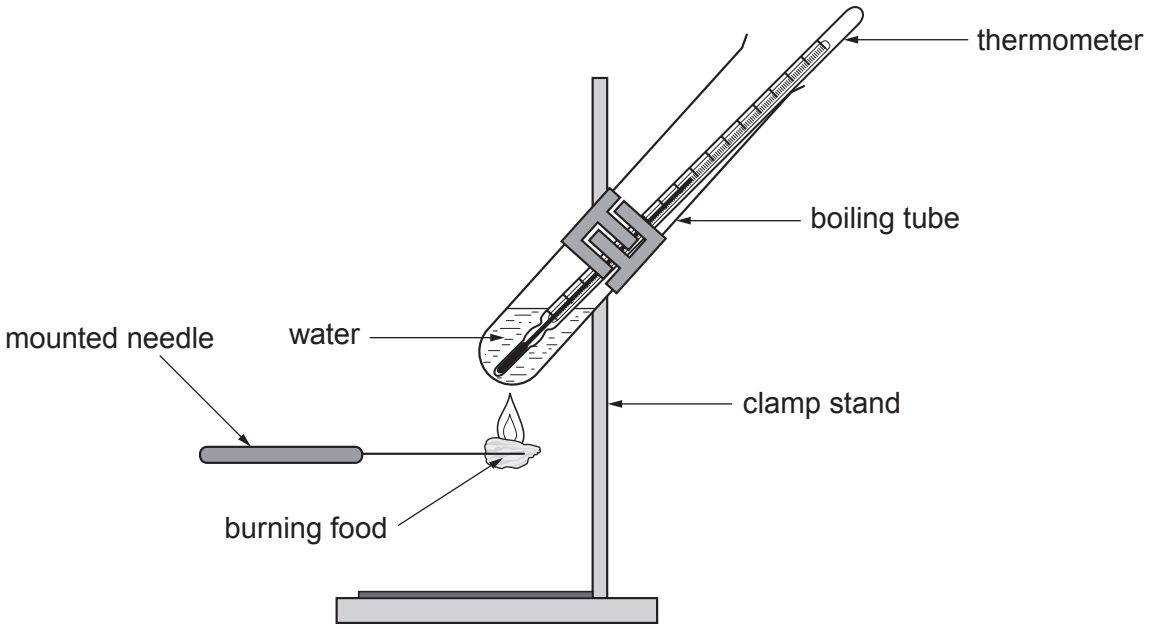
(b) A student used the following equipment to find the energy content of some foods.



(i) State the independent variable in this experiment. [1]

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(ii) State the dependent variable in this experiment. [1]

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(iii) State **one** variable that should be controlled in this experiment. [1]

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(c) The student obtained the following results.

Type of food	Mass of water (g)	Mass of food burned (g)	Temperature at start (°C)	Temperature at end (°C)	Temperature increase (°C)	Energy released (J)	Energy released per gram (J/g)
cheese biscuit	20	3.0	20	56	36	2268	756
corn snack	20	0.5	21	36	15	.....	1848
digestive biscuit	20	4.0	20	93	73	1636	409
cereal bar	20	4.0	22	48			

(i) How would the student make sure the results are reproducible? [1]

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(ii) Calculate the energy released by the **corn snack**. Write this value in the table. [1]

Space for working

(iii) Use the information in the table and the equation:

$$\text{Energy released per gram (J/g)} = \frac{\text{mass of water (g)} \times \text{temperature increase (°C)} \times 4.2}{\text{mass of food sample (g)}}$$

to calculate the energy released per gram for the **cereal bar**. [3]

Energy released per gram = ... J/g

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(iv) The student suggests that a 30 g packet of corn snacks contains half the energy of four digestive biscuits of total mass 60 g.

Explain whether the student is correct. [3]

Space for working

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Turn over.

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2. Rugby players are prone to knee injuries, some of which lead to long-term pain through osteoarthritis.

(a) Describe how the synovial membrane helps to maintain a healthy knee joint. [2]

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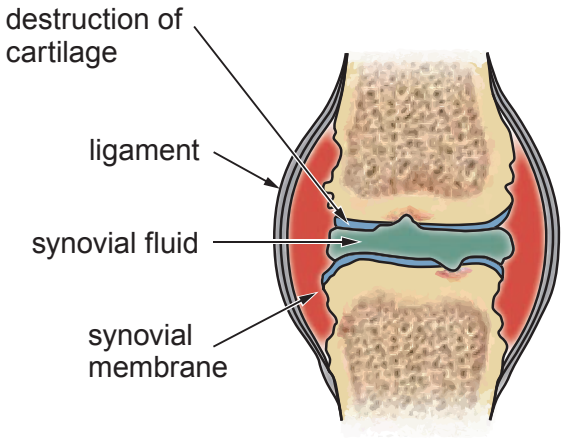
(b) The diagram below shows a knee joint damaged by osteoarthritis.



Explain what has happened to cause pain in the joint. [4]

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3. Cardiff University has developed a drug called INX-189 that treats the liver disease, hepatitis C. The World Health Organisation estimates 170 million people are carriers of the hepatitis C virus worldwide. More than 350 000 people die from hepatitis-related illnesses every year. In initial animal trials the drug is described as 'promising and needs to progress to full clinical trials'.

(a) Discuss the ethics of animal testing. [2]

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(b) In a double-blind clinical trial for INX-189, 30 000 patients in several countries were randomly divided into two groups.

(i) Describe what is meant by a *double-blind trial*. [2]

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(ii) Suggest **two** reasons for carrying out the trial with a large number of people from several countries. [2]

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(c) The World Health Organisation monitors the number of cases of different diseases per 100 000 people worldwide. The world's population is 7.5 billion (7.5×10^9). Calculate the number of hepatitis C carriers per 100 000 people. [2]

Number of hepatitis C carriers per 100 000 = ...

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07

Turn over.

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4. Hospitals started to introduce control measures against MRSA in 2005.

Measles is a disease which was common before 1965, but is now very rare.

Describe the methods used to control the spread of MRSA and measles. Account for the differences in these methods. [6 QER]

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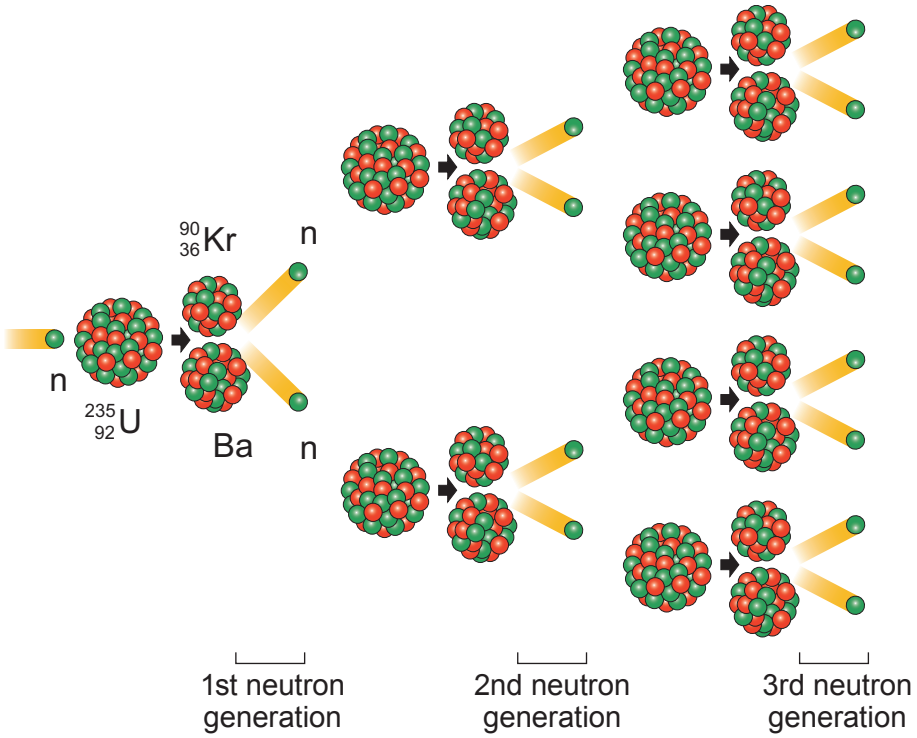
5. Nuclear fission reactors are designed with safety features to prevent nuclear accidents. However in Chernobyl in 1986, during testing, an accident caused a meltdown of the nuclear reactor.

The diagram below shows one possible chain reaction for uranium-235.



(a) Use the information in the diagram to answer the following questions.

(i) Complete the balanced nuclear equation for the fission reaction shown in the diagram. [2]

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{90}_{36}Kr + \text{.....}$$

(ii) **Complete** the table below. [1]

Neutron generation	Number of neutrons released
1st	2
2nd	4
3rd	8
4th	16
5th	32
10th	.....

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(b) Explain how an uncontrolled chain reaction could result in a reactor meltdown. [2]

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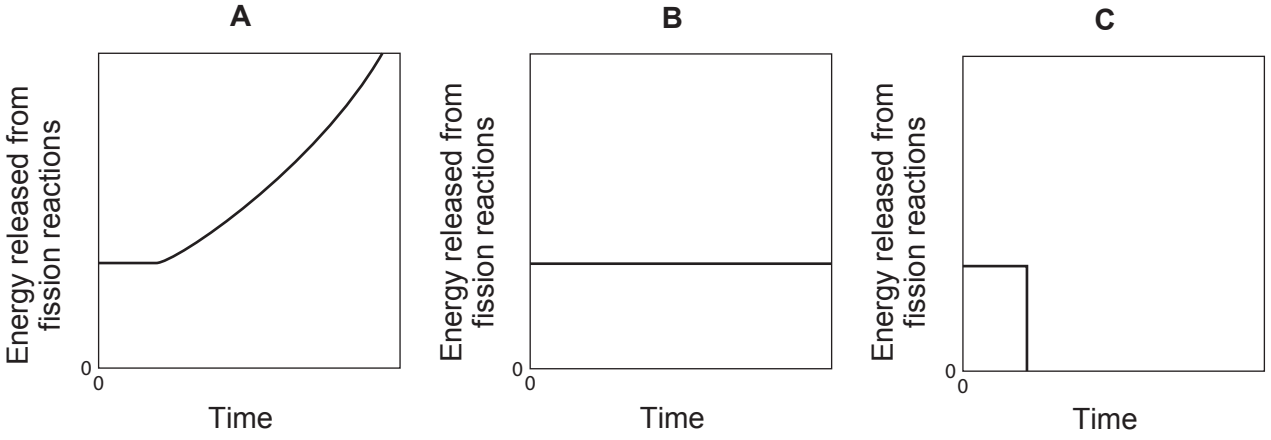
(c) The graphs below show how the energy released in a nuclear reactor changes when the control rods are in 3 different positions.



Explain the difference in energy production in graphs **A**, **B** and **C** in terms of the relative positions of the control rods. [5]

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6. Doctors can use radioisotopes to treat lung cancer by internal radiotherapy and external radiotherapy.

External radiotherapy uses a radioisotope outside the body. The radiation it emits is targeted at the tumour.

During internal radiotherapy a radioisotope is inserted into the tumour.

(a) Strontium-90 is a beta source which has a half-life of 29 years. Explain whether you would recommend this radioisotope for use in:

(i) external radiotherapy. [2]

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(ii) internal radiotherapy. [2]

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(b) The dose of radiation received for each type of radiotherapy is shown below.

Region	External dose (units)	Internal dose (units)
tissue surrounding tumour	12	4
tumour	20	20

The following results were obtained using the two methods on one type of lung cancer.

	External	Internal
% of patients who survived for at least 5 years after treatment	60	61
% of patients who developed other tumours in the lung within 5 years of treatment	52	35

A patient was diagnosed with a lung tumour. Use the data in the tables to compare the effectiveness of both types of radiotherapy to treat the tumour. [4]

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7. A technician carries out an investigation to find how the rate of decomposition of hydrogen peroxide (H_2O_2) changes with temperature.

She controlled the following variables:

- volume and concentration of hydrogen peroxide
- mass of lead(IV) oxide catalyst

The equation for this reaction is shown below.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

(a) The volume of oxygen gas produced at 40 °C is shown in the table below.

Time (s)	Volume of oxygen produced (cm^3)
0	0.0
10	4.4
20	7.2
30	7.6
40	7.6
60	7.6

(i) Plot the data on the grid opposite and draw a suitable line. [3]

(ii) Add a line to the grid to show the results you would expect if the experiment was repeated at 50 °C. [2]

(iii) Explain in terms of particles, how the rate of reaction is affected by temperature. [2]

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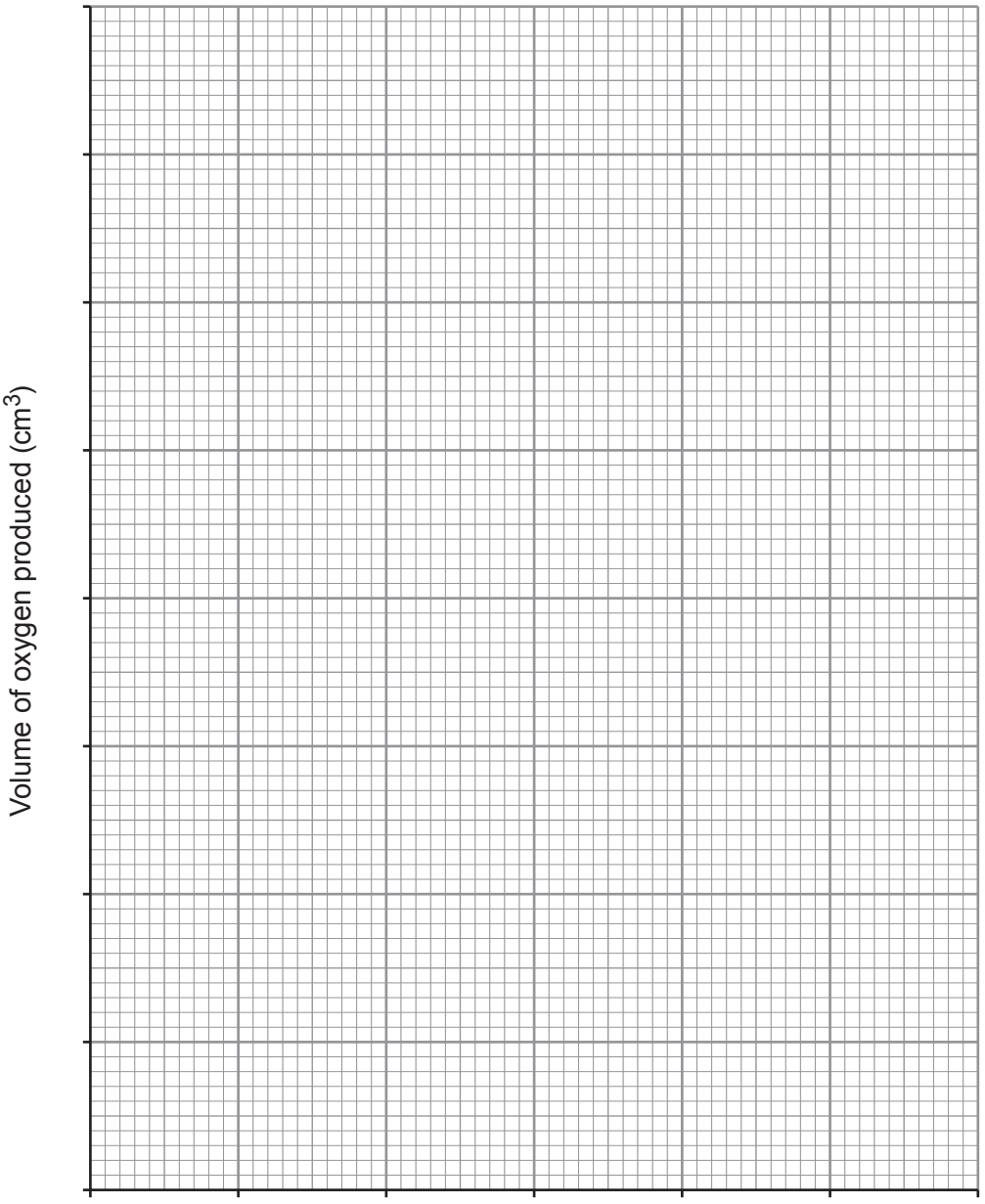
Examiner only



(b) Explain how a catalyst affects the rate of reaction. [2]

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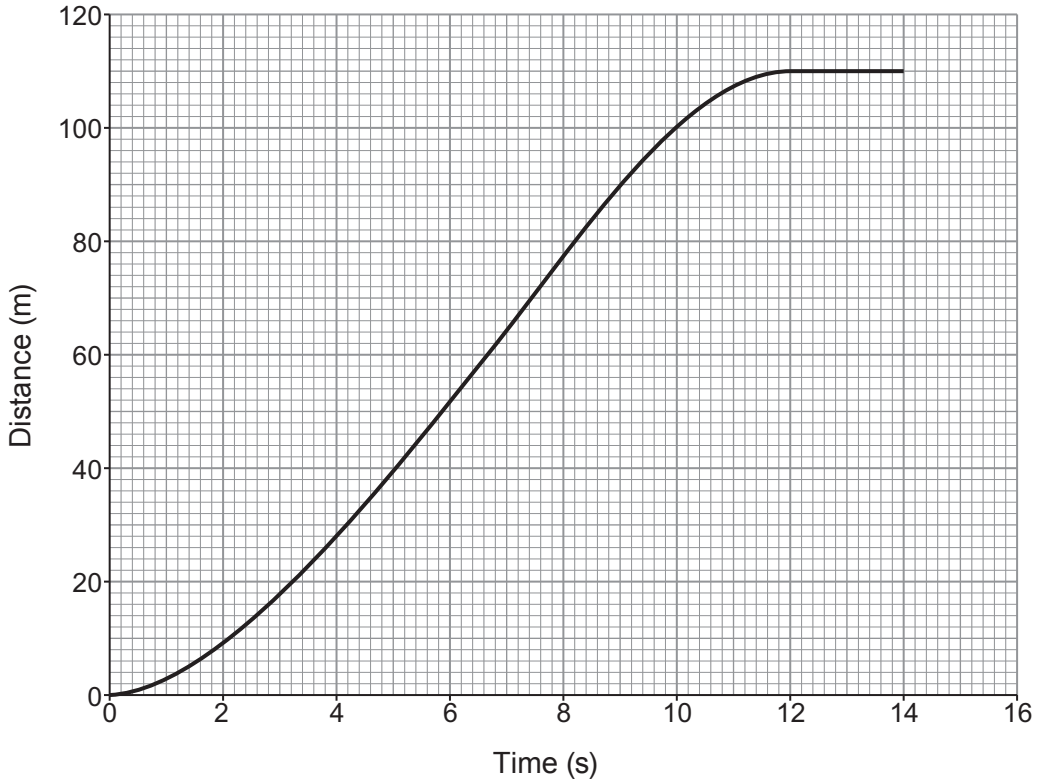
8. An athlete ran a 100 m race in a time of 10 seconds. The distance-time graph for the race is shown below.



(a) (i) A commentator suggests that the maximum speed of the athlete is 10.0 m/s. Explain whether you agree with the commentator. Add to the graph and show any calculations used in your answer. [4]

Maximum speed = ...

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(ii) State why your calculated maximum speed and the mean speed are different. [1]

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(b) Use the information from the graph to explain how the acceleration of the athlete changes during the 14 seconds shown. [4]

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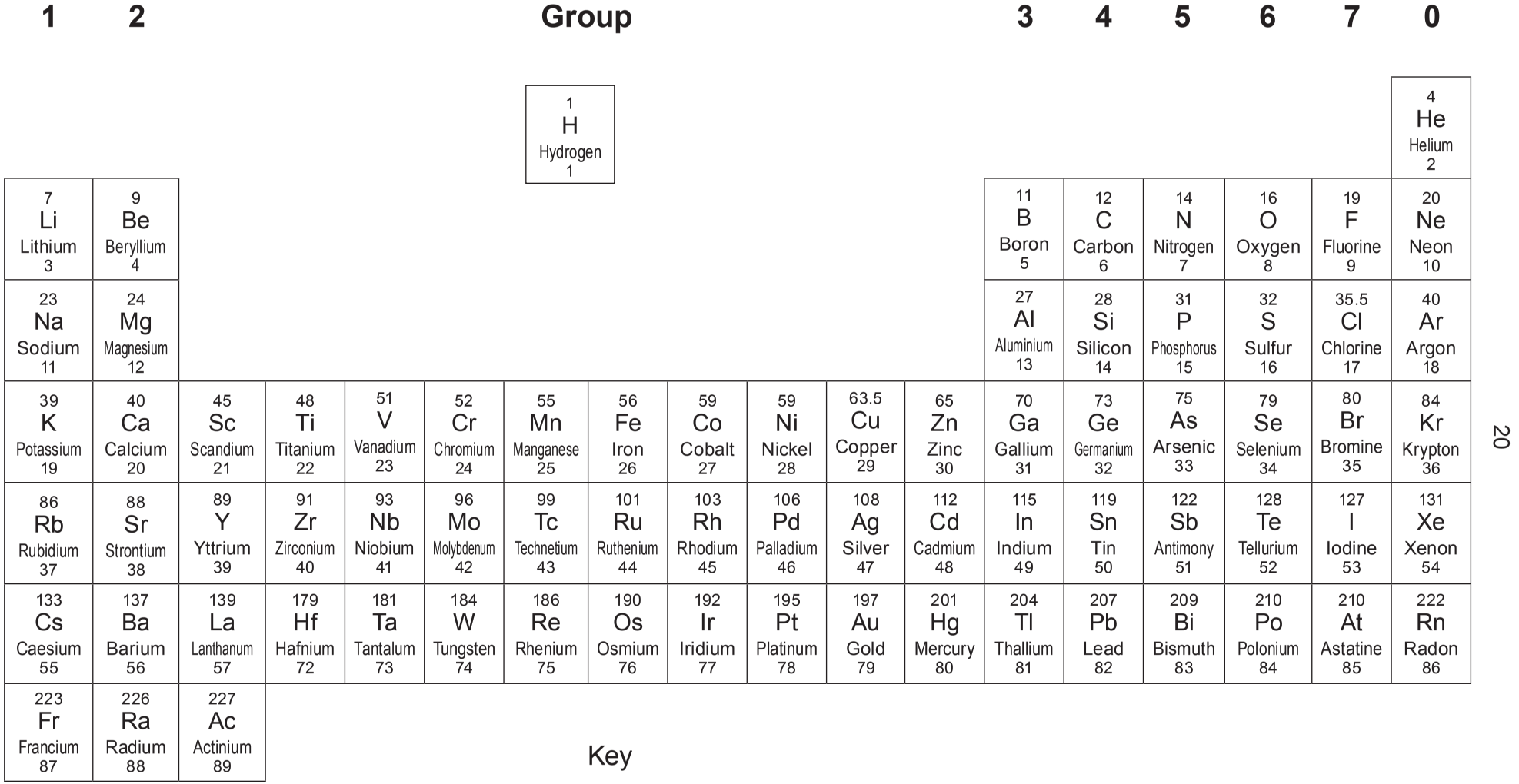
THE PERIODIC TABLE



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