

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3445U10-1



MONDAY, 20 JUNE 2022 – MORNING

APPLIED SCIENCE (Double Award)
UNIT 1: Energy, Resources and the Environment

FOUNDATION TIER

1 hour 30 minutes

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

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. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

Question **3** is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

A Periodic Table is printed on page 20.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	8	
2.	10	
3.	6	
4.	12	
5.	8	
6.	12	
7.	19	
Total	75	

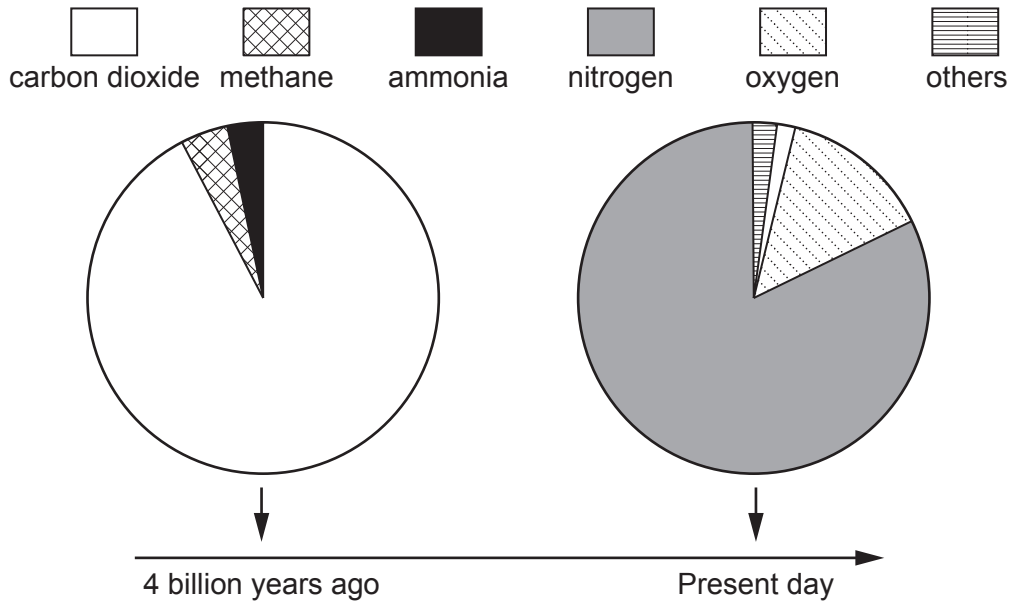
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Answer **all** questions.

1. The pie charts show the composition of the air on the Earth 4 billion years ago and the present day.



- (a) (i) Give **two** reasons why the amount of carbon dioxide has changed so much over this time period. [2]
1.
2.
- (ii) State **three** other changes shown by the pie charts. [3]
1.
2.
3.



(b) The table below shows some of the other gases in the air during the present day.

Gas	Chemical formula	Approximate percentage composition (%)
argon	Ar	1.0
hydrogen	H ₂	0.00005
methane	CH ₄	0.0002
neon	Ne	0.002
nitrous oxide	N ₂ O	0.00003
ozone	O ₃	0.000004

Tick (✓) **three** correct statements about the gases in the air.

[3]

Nitrous oxide contains carbon atoms

☐

Ozone only contains oxygen atoms

☐

Hydrogen is an element that occurs as a molecule

☐

There is a higher percentage of nitrous oxide than methane

☐

The nitrous oxide molecule contains two oxygen atoms

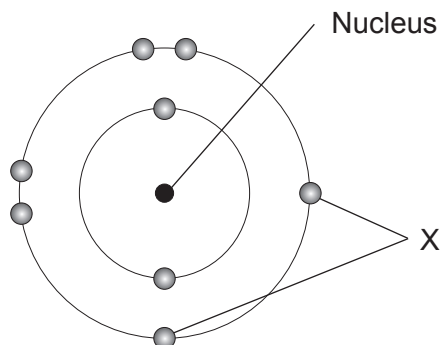
☐

Methane is a hydrocarbon

☐


2. The Periodic Table is an arrangement of the chemical elements according to their atomic number, electron configuration and chemical properties.

An oxygen atom is shown below.



- (a) Complete the following sentences using **only** the words in the box. The words may be used once, more than once, or not at all.

protons	ions	electrons	neutrons
---------	------	-----------	----------

- (i) The nucleus of the oxygen atom contains and

.....

[2]

- (ii) The particles labelled X are called

[1]

- (iii) In a neutral atom the number of protons is equal to the number of

.....

[1]

- (b) Oxygen is found in Group 6 of the Periodic Table. Use the Periodic Table on page 20 to answer the following questions.

- (i) Give the electron configuration of oxygen.

[1]

.....

- (ii) State the name of **one** element in the same **group** as oxygen.

[1]

.....

- (iii) State the name of **one** element in the same **period** as oxygen.

[1]

.....



- (c) Water is a compound that contains one oxygen atom and two hydrogen atoms joined together.

- (i) Use the Periodic Table on page 20 to complete the following table. [2]

Element	Relative atomic mass
hydrogen	
oxygen	

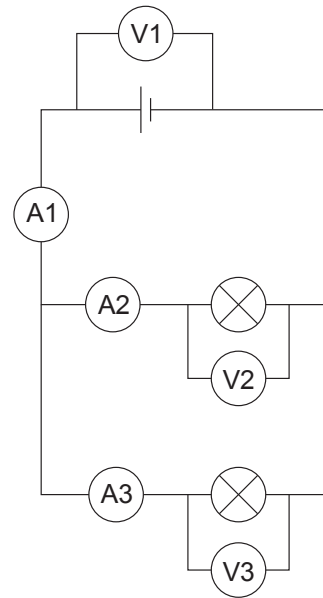
- (ii) Use the information above to calculate the relative formula mass of H_2O . [1]

relative formula mass =



Examiner
only

parallel circuit



- the readings on the ammeters
- the readings on the voltmeters.

[6 QER]

4. The UK government aims to remove the sale of petrol and diesel cars by 2030. It is expected that by 2027 more electric cars will be sold than any other type.

- (a) The data in **Table 1** shows how the power generated in a typical petrol engine is converted.

Table 1. Efficiency of a petrol driven car

	Description of energy conversion	% Power
engine	heat loss	70
movement	noise	1
	friction	6
	power to the wheels	
	total power	100

- (i) Use the information in **Table 1** to calculate the % power to the wheels. [1]

% power to the wheels =

- (ii) A petrol car generates 66 kW of power.

Use your answer to (a)(i) to calculate the actual power delivered to the wheels. [2]

actual power to the wheels = kW



- (iii) State **two** ways in which engineers have improved the design of cars to improve their efficiency. [2]

1.

.....

2.

.....

- (b) One of the biggest problems with electric vehicles is the distance travelled per charge.

Table 2 gives information about three types of battery chargers in use.

Table 2

Type of charger	Charger 1	Charger 2	Charger 3
operating voltage (V)	V_1	240	480
operating current (A)	20	80	I_3
power delivery (W)	2400	19 200	144 000
distance travelled per hour of charging (km)	3	83	545

- (i) Use the equation

$$\text{voltage} = \frac{\text{power}}{\text{current}}$$

to calculate the operating voltage, V_1 , of charger 1.

[2]

$$V_1 = \dots\dots\dots \text{ V}$$



(ii) Use the equation

$$\text{current} = \frac{\text{power}}{\text{voltage}}$$

to calculate the current, I_3 , of charger 3.

[2]

$I_3 = \dots\dots\dots$ A

(iii) Electric car companies claim that it is cheaper to run their electric cars than petrol ones.

Use the following information to explain if this claim is correct.

[3]

- A typical petrol car needs 50 litres of fuel to travel 545 km. The cost of one litre of petrol is £1.30.
- An electric car requires 144 kWh of electricity to travel 545 km. The cost of one unit of electricity is £0.30.
- cost of electricity (£) = cost per unit (£) $\times$ number of units (kWh)

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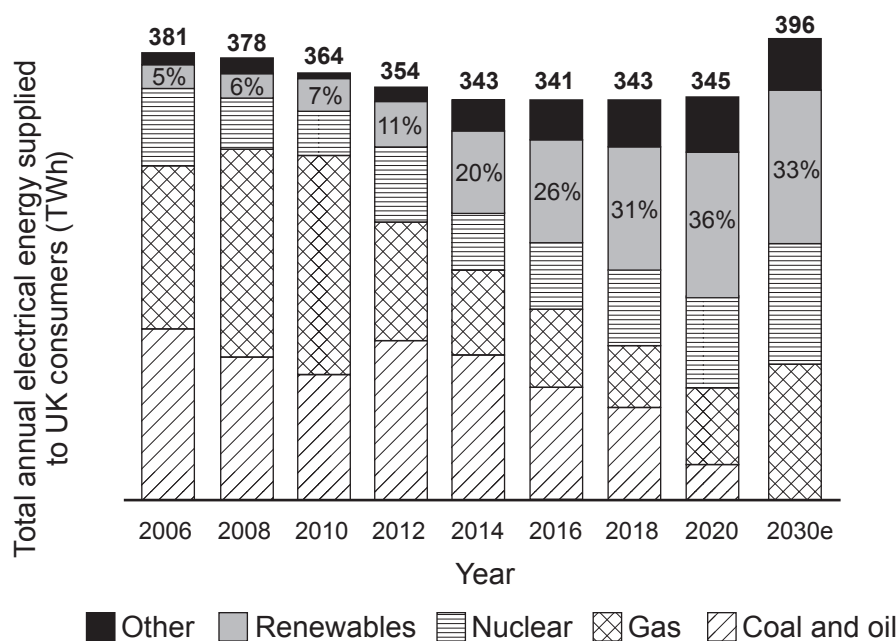
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5. The graph below shows the total annual electrical energy supplied to UK consumers and the source of generation.

The total energy is given in terawatt hours (TWh).

The figures for 2030 are estimates.



- (a) Use the graph to answer the following questions.

- (i) Describe how the use of gas has changed between 2006 and 2018. [2]

.....

.....

.....

- (ii) Calculate how much extra electrical energy will need to be supplied to the UK in 2030 compared to 2020. [1]

extra electrical energy = TWh



- (iii) Calculate how much electrical energy is expected to be generated from renewable sources in 2030. [2]

renewable electrical energy generated = TWh

- (b) One of the largest coal-fired power stations in the UK can generate 950 MW. When it was built the engineers thought it could supply at least 400 000 homes.

The mean power delivered to a house is 1840 W.

Explain whether you agree with the engineers. [3]

(1 MW = 1 000 000 W)

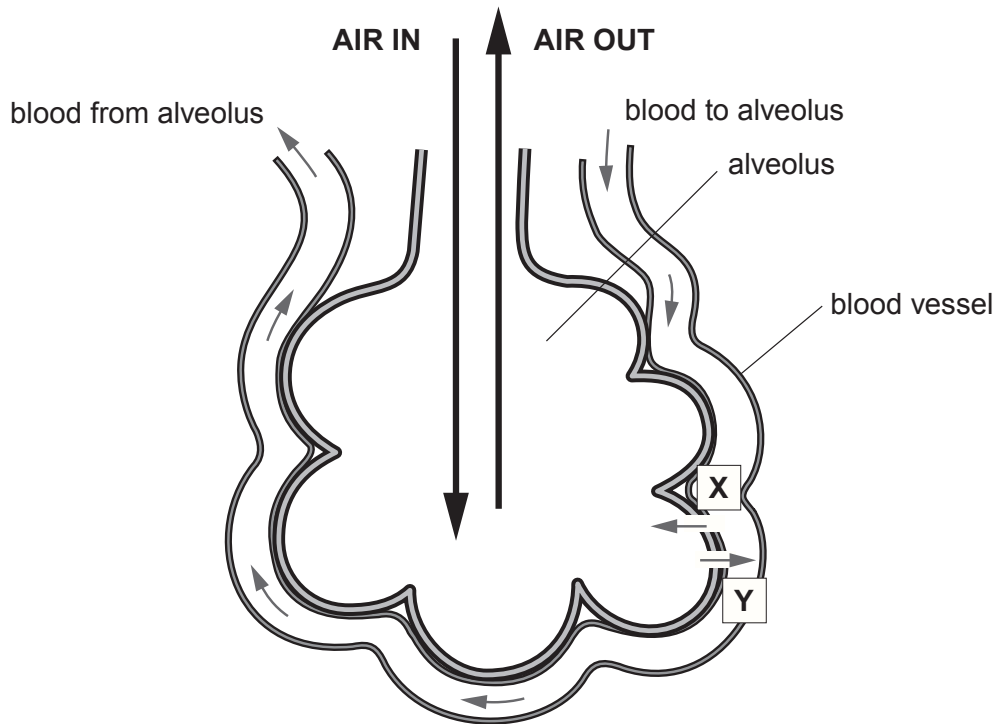
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6. The human body needs a respiratory system for gas exchange.

(a) The diagram below shows an alveolus.



- (i) Gases **X** and **Y** diffuse into and out of the alveolus. Name the gases **X** and **Y** in the diagram.

[1]

X

Y

- (ii) Name the type of blood vessel that surrounds the alveolus.

[1]

.....



- (b) Jade is an Olympic athlete. She trains on a regular basis. Training improves her respiratory system.

The table shows information about Jade's breathing at rest and at exercise during her latest test.

	Breathing rate (breaths per minute)	Depth of breathing (cm ³ per breath)	Total volume of air breathed in (cm ³ per minute)
at rest	12	500	
during exercise	40		40 000

- (i) Complete the table. [2]

- (ii) Describe the changes that exercise has on Jade's breathing. [2]

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- (iii) Jade's coach wants her lungs to be able to absorb at least 2000 cm³ of oxygen per minute as this will help with aerobic respiration in her muscles.

Inhaled air contains 21% oxygen and exhaled air contains 16% oxygen.

Jade thinks she has achieved this in her latest test.

- Use the information given to determine whether you agree with Jade. [3]

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(c) The oxygen absorbed is used in the cells to release energy by aerobic respiration.

- (i) During intense exercise some of Jade's muscles use the process of **anaerobic** respiration. State what is meant by the term 'anaerobic respiration'. [1]

.....

.....

- (ii) Give **one advantage** and **one disadvantage** of anaerobic respiration occurring in Jade's muscle cells. [2]

Advantage:

.....

Disadvantage:

.....

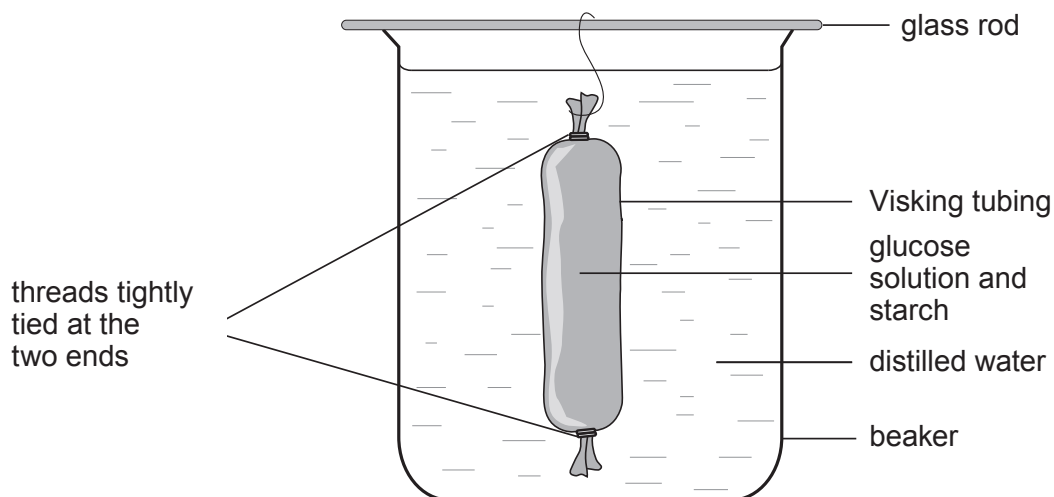


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7. A student set up the following experiment to show how diffusion of digested foods occurs in the small intestine. The Visking tubing contained starch and a solution of glucose with a concentration of 100 g/dm^3 . This was placed in a beaker containing distilled water at 20°C and left for 2 hours.



- (a) (i) Explain what is expected to happen to the starch and the glucose in the Visking tubing during the experiment. [4]

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- (ii) Describe **two** chemical tests the student should carry out on the contents of the beaker to confirm your answer to (a)(i) and state the expected results. [4]

1.

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.....

2.

.....

.....



(b) Explain how each of the following changes would affect the diffusion process in this experiment.

(i) Carbohydrase is added to the contents of the Visking tubing. [2]

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(ii) The investigation is carried out at 35°C. [2]

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(iii) The experiment is carried out with a solution of glucose of 100 g/dm³ concentration replacing the distilled water in the beaker. [2]

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(c) State **one** of the limitations of using Visking tubing as a model intestine. [1]

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(d) Explain **two** adaptations of the small intestine for the absorption of digested food. [4]

1.

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2.

.....

.....

END OF PAPER

19



[illegible]

[illegible]



Group

0

Key

A_r	Symbol	Name	Z
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atomic number