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 plus your additional time allowance

Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 0 _____

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**	

ADDITIONAL MATERIALS

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

ITEMS INCLUDED WITH QUESTION PAPER

Periodic Table (provided separately).
A separate Diagram Booklet.

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball – point pen, black felt tip or your usual method.

Write your name, centre number and candidate number in the spaces on the front cover.

Answer ALL questions.

Write your answers in the spaces provided on your paper.

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.

The Periodic Table is provided separately.

ANSWER ALL QUESTIONS.

1. Look at the diagram for Question 1 (a) in the separate Diagram Booklet.

The diagram shows two pie charts.

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.

1. _____

_____

2. _____

_____

[2 marks]

continued on the next page . . .

Question 1 (a) continued

1. (a) (ii) State THREE other changes shown by the pie charts.

1. _____

_____

2. _____

_____

3. _____

_____

[3 marks]

(b) Look at the table for Question 1 (b) in the separate diagram booklet.
The table shows some of the other gases in the air during the present day.

continued on the next page . . .

Question 1 (b) continued

TICK (✓) THREE correct statements about the gases in the air from the following list.

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	☐

[3 marks]

(Total for Question 1 = 8 marks)

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

Look at the diagram for Question 2 in the separate Diagram Booklet.
The diagram shows an oxygen atom.

(a) Complete the following sentences using ONLY words from the following list. 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 marks]

(ii) The particles labelled X are called _____ .

[1 mark]

continued on the next page . . .

Question 2 (a) continued

2. (a) (iii) In a neutral atom the number of protons is equal to the number of _____ .

[1 mark]

continued on the next page . . .

Question 2 continued

2. (b) Oxygen is found in Group 6 of the Periodic Table. Use the Periodic Table provided separately to answer the following questions.

(i) Give the electron configuration of oxygen.

_____ .

[1 mark]

(ii) State the name of ONE element in the same GROUP as oxygen.

_____ .

[1 mark]

(iii) State the name of ONE element in the same PERIOD as oxygen.

_____ .

[1 mark]

continued on the next page . . .

Question 2 continued

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

(i) Use the Periodic Table provided separately to complete the table below.

Element	Relative atomic mass
hydrogen	
oxygen	

[2 marks]

continued on the next page . . .

Question 2 (c) continued

2. (c) (ii) Use the information on the previous page to calculate the relative formula mass of H_2O.

SPACE FOR WORKING:

relative formula mass = _____

[1 mark]

(Total for Question 2 = 10 marks)

3. Look at the diagram for Question 3 in the separate Diagram Booklet.

The diagram shows two electrical circuits.

The two circuits are often used in a school laboratory. The lamps are identical.

For each circuit compare:

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

[6 marks QER]

(Total for Question 3 = 6 marks)

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) Look at TABLE 1 for Question 4 (a) in the separate diagram booklet.
The data in TABLE 1 shows the efficiency of a petrol driven car.

(i) Use the information in TABLE 1 to calculate the % power to the wheels.

SPACE FOR WORKING:

% power to the wheels = _____

[1 mark]

Question 4 (a) continued

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

Use your answer to part (a) (i) to calculate the actual power delivered to the wheels.

SPACE FOR WORKING:

actual power to the wheels = _____ kW

[2 marks]

continued on the next page . . .

Question 4 (a) continued

4. (a) (iii) State TWO ways in which engineers have improved the design of cars to improve their efficiency.

1. _____

_____

_____

2. _____

_____

_____

[2 marks]

continued on the next page . . .

Question 4 continued

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

Look at TABLE 2 for Question 4 (b) in the separate diagram booklet.

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

continued on the next page . . .

Question 4 (b) continued

4. (b) (i) Use the equation:

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

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

SPACE FOR WORKING:

V_1 = _____ V

[2 marks]

continued on the next page . . .

Question 4 (b) continued

4. (b) (ii) Use the equation:

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

to calculate the current, I_3,

of charger 3.

SPACE FOR WORKING:

I_3 = _____ **A**

[2 marks]

continued on the next page . . .

Question 4 (b) continued

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

Use the information provided for Question 4 (b) (iii) in the separate Diagram Booklet to explain if this claim is correct.

SPACE FOR WORKING:

[3 marks]

(Total for Question 4 = 12 marks)

5. Look at the diagram for Question 5 in the separate Diagram Booklet.

The diagram is a graph.

The graph 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 marks]

continued on the next page . . .

Question 5 (a) continued

5. (a) (ii) Calculate how much extra electrical energy will need to be supplied to the UK in 2030 compared to 2020.

SPACE FOR WORKING:

extra electrical energy = _____ TWh

[1 mark]

continued on the next page . . .

Question 5 (a) continued

5. (a) (iii) Calculate how much electrical energy is expected to be generated from renewable sources in 2030.

SPACE FOR WORKING:

renewable electrical energy generated

= _____ TWh

[2 marks]

continued on the next page . . .

Question 5 continued

5. (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. (1 MW = 1 000 000 W)

SPACE FOR WORKING:

[3 marks]

(Total for Question 5 = 8 marks)

6. (a) Look at the diagram for Question 6 (a) in the separate Diagram Booklet.

The diagram shows an alveolus.

The human body needs a respiratory system for gas exchange.

(i) Gases X and Y diffuse into and out of the alveolus.

Name the gases X and Y in the diagram.

X _____

Y _____

[1 mark]

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

_____

[1 mark]

continued on the next page . . .

Question 6 continued

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

Look at the table for Question 6 (b) in the separate Diagram Booklet.
The table shows information about Jade's breathing at rest and at exercise during her latest test.

(i) Complete the table.

[2 marks]

continued on the next page . . .

Question 6 (b) continued

6. (b) (ii) Describe the changes that exercise has on Jade's breathing.

_____

_____

_____

_____

_____

[2 marks]

continued on the next page . . .

Question 6 (b) continued

6. (b) (iii) Jade's coach wants her lungs to be able to absorb at least 2000 cm^3 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 marks]

6. (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 mark]

continued on the next page . . .

Question 6 (c) continued

6. (c) (ii) Give ONE ADVANTAGE and ONE DISADVANTAGE of anaerobic respiration occurring in Jade's muscle cells.

Advantage

_____

_____

_____

Disadvantage

_____

_____

_____

[2 marks]

(Total for Question 6 = 12 marks)

7. Look at the diagram for Question 7 in the separate Diagram Booklet.

The diagram shows the apparatus set up by a student for an 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 $20^{\circ}C$ 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 marks]

7. (a) (ii) Describe TWO chemical tests the student should carry out on the contents of the beaker to confirm your answer to part (a) (i) and state the expected results.

1. _____

_____

_____

_____

_____

2. _____

_____

_____

_____

_____

[4 marks]

Question 7 continued

7. (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 marks]

continued on the next page . . .

Question 7 (b) continued

7. (b) (ii) The investigation is carried out at 35°C.

_____

_____

_____

_____

_____

[2 marks]

continued on the next page . . .

Question 7 (b) continued

7. (b) (iii) The experiment is carried out with a solution of glucose of $100\,g/dm^3$ concentration replacing the distilled water in the beaker.

_____

_____

_____

_____

_____

[2 marks]

(c) State ONE of the limitations of using Visking tubing as a model intestine.

_____

_____

_____

[1 mark]

continued on the next page . . .

Question 7 continued

7. (d) Explain TWO adaptations of the small intestine for the absorption of digested food.

1. _____

_____

_____

_____

_____

2. _____

_____

_____

_____

_____

_____

[4 marks]

(Total for Question 7 = 19 marks)

END OF PAPER

TOTAL 75 MARKS

Question number	Additional pages, if required. Write the question number(s) in the left - hand margin.

Question number	Additional pages, if required. Write the question number(s) in the left - hand margin.

GCSE

3445U10-1

MONDAY, 20 JUNE 2022 – MORNING

APPLIED SCIENCE (DOUBLE AWARD)

UNIT 1: ENERGY, RESOURCES AND THE ENVIRONMENT

FOUNDATION TIER

The Diagram Booklet MUST be handed in to the invigilators and sent for marking.

Diagram Booklet

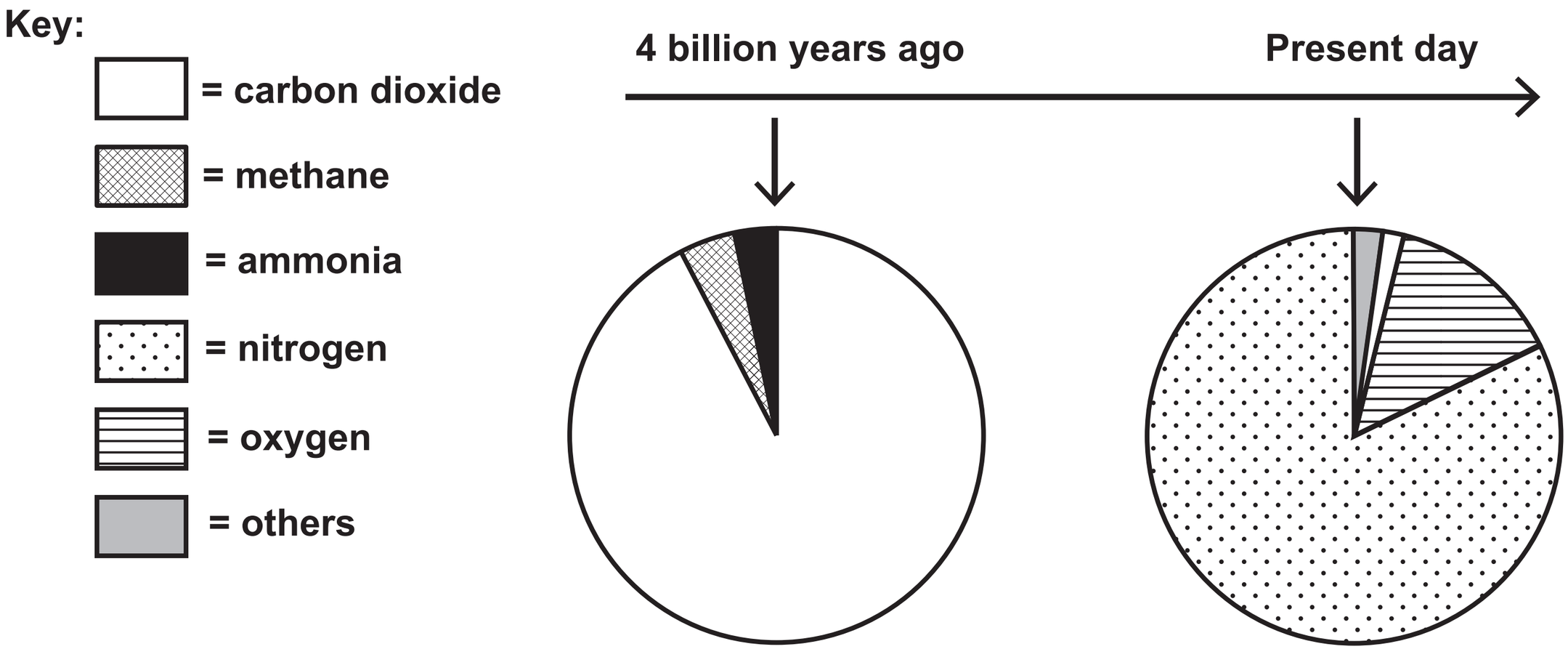
Surname: _____

First name(s): _____

Centre Number: _____

Candidate Number: 0 _____

Question 1

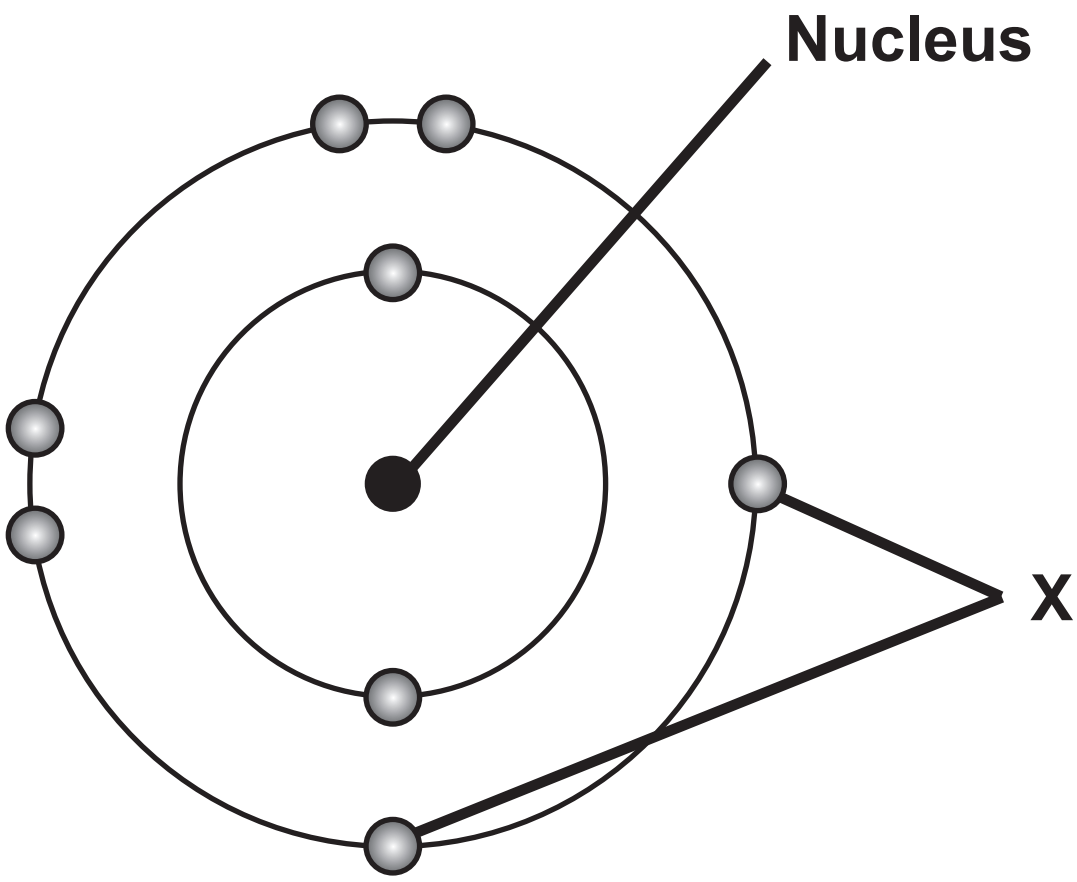

Key:
= carbon dioxide
= methane
= ammonia
= nitrogen
= oxygen
= others
4 billion years ago
Present day

Question 1 (b)

Table

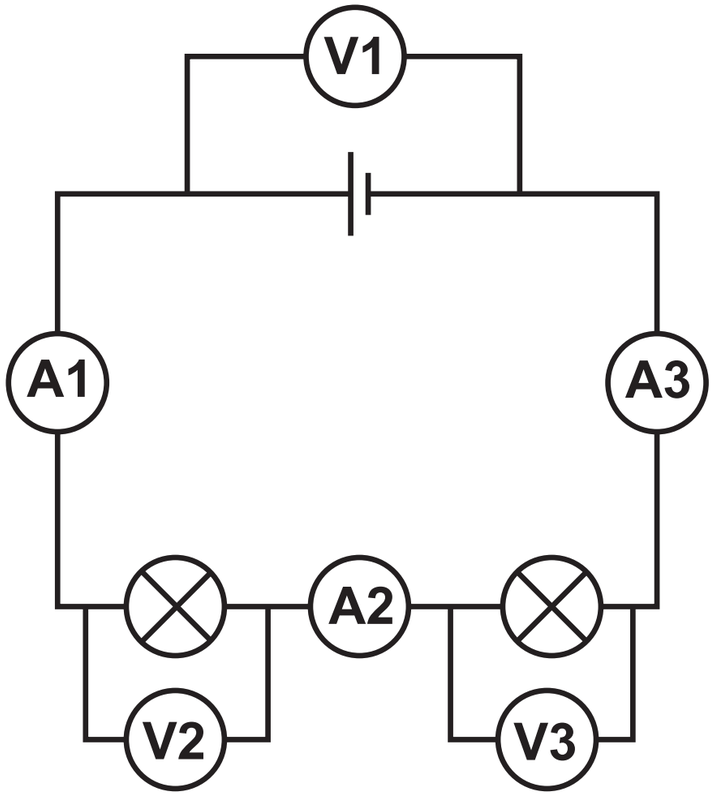
Gas	Chemical formula	Approximate percentage composition (%)
argon	Ar	1.0
hydrogen	H_2	0.00005
methane	CH_4	0.0002
neon	Ne	0.002
nitrous oxide	N_2O	0.00003
ozone	O_3	0.000004

Question 2

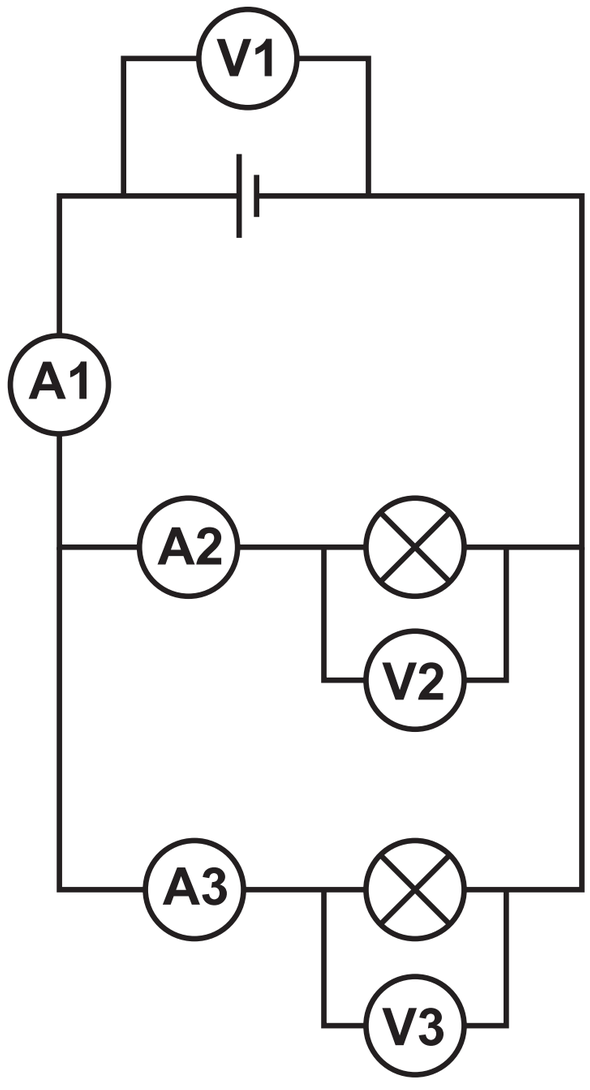


Question 3

series circuit



parallel circuit



Question 4 (a)

TABLE 1

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

Question 4 (b)

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

Question 4 (b) (iii)

Information

- 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.**

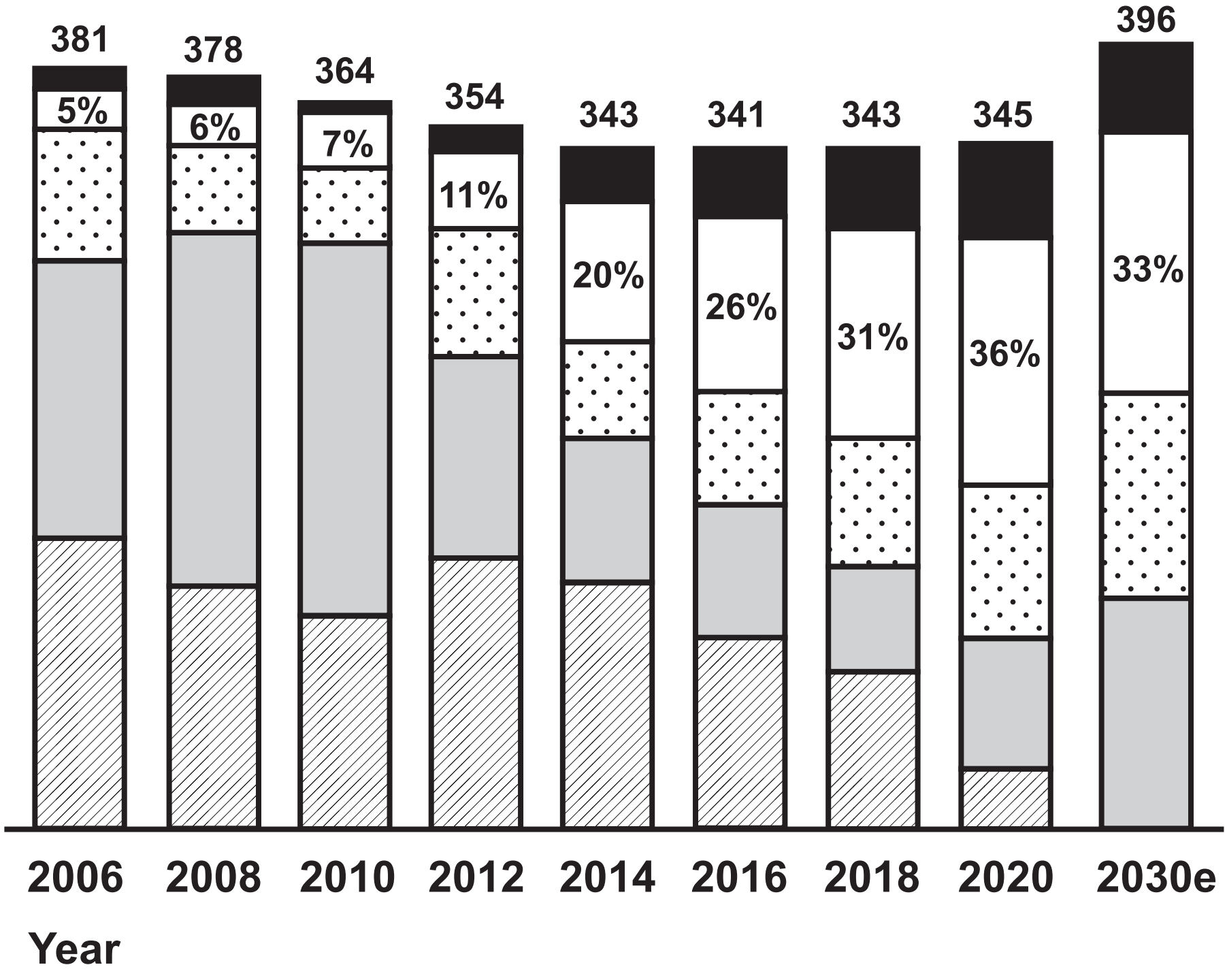
  The cost of one unit of electricity is **£0.30.**
- cost of electricity (£) = cost per unit (£) × number of units (kWh)

Question 5

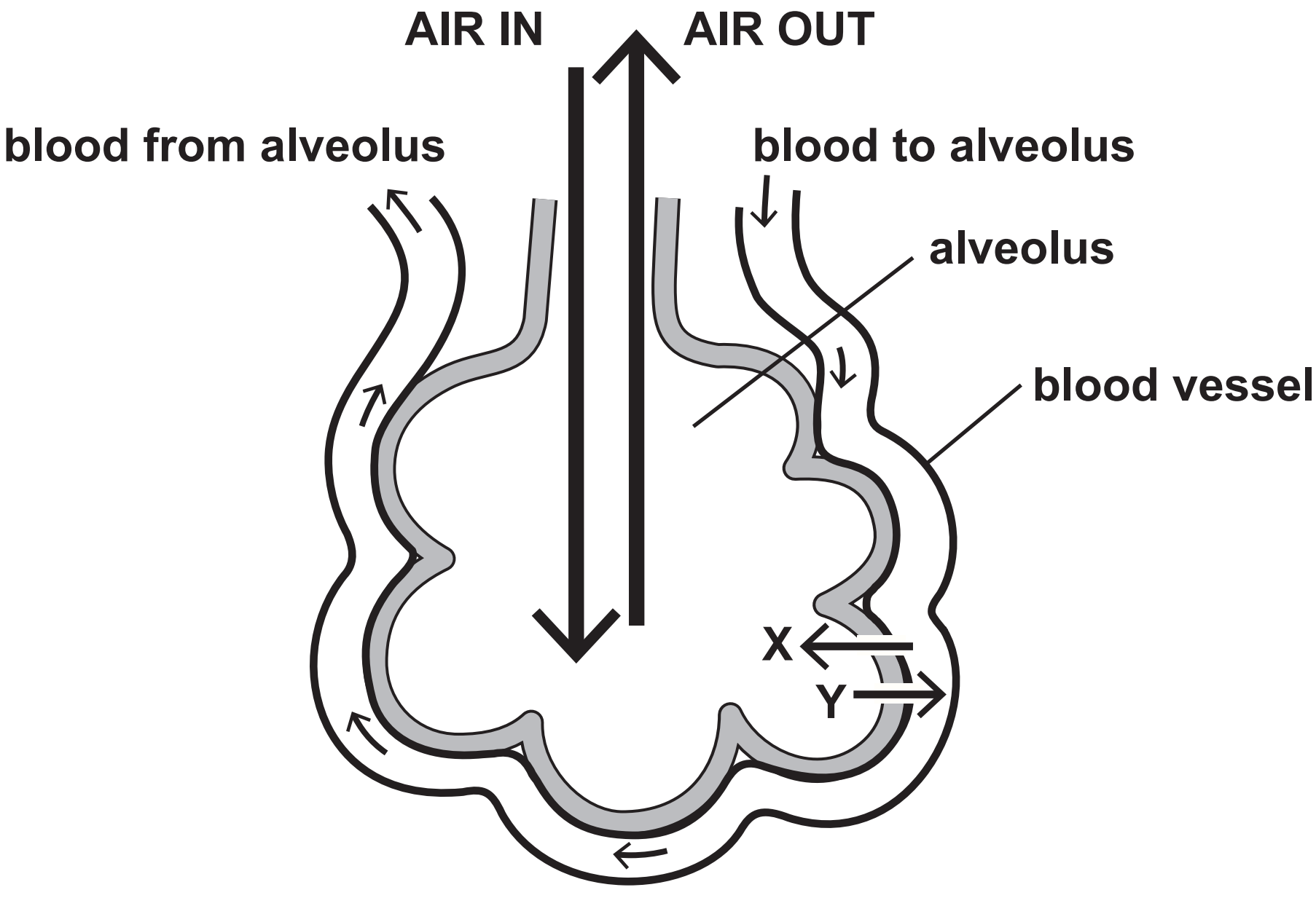
Key:

- Other
- Renewables
- Nuclear
- Gas
- Coal and oil

Total annual electrical energy supplied to UK customers (TWh)



Question 6 (a)

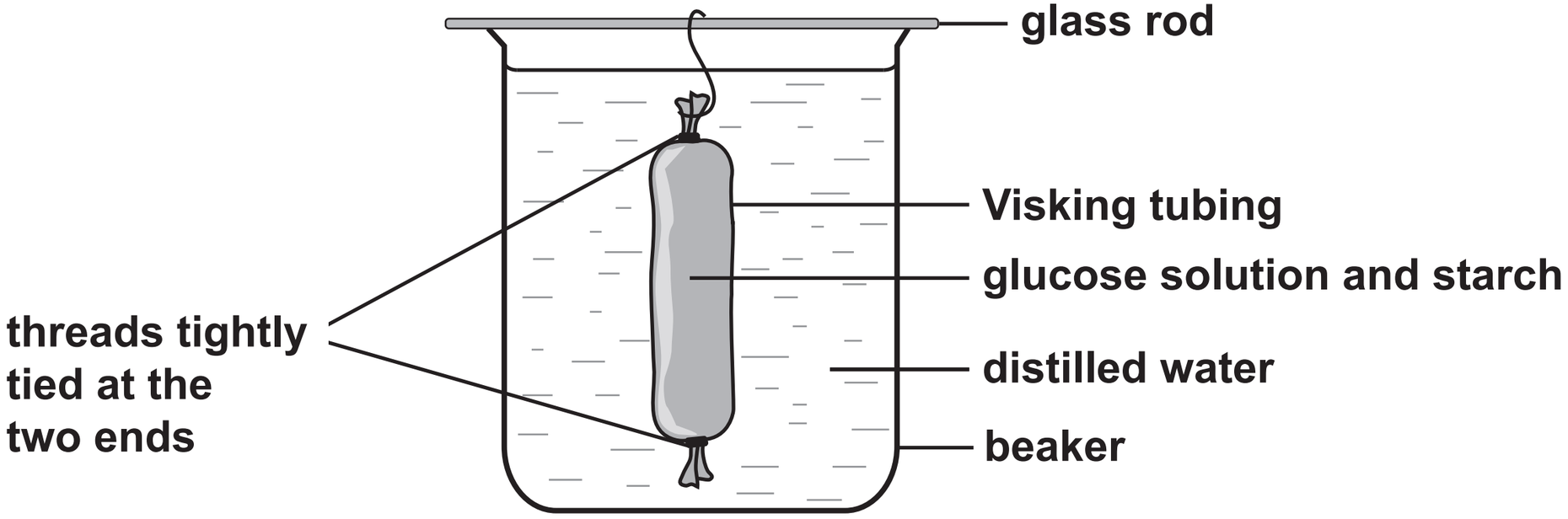

AIR IN
AIR OUT
blood from alveolus
blood to alveolus
alveolus
blood vessel
X
Y

Question 6 (b)

Table

	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

Question 7


glass rod
Visking tubing
glucose solution and starch
distilled water
beaker
threads tightly tied at the two ends

Periodic Table

1 H 1

Key:

A_r Symbol Z

A_r : Relative atomic mass
Symbol : Chemical symbol
Z : Atomic number

| | represents where elements 58-71 (lanthanides) are omitted

1	2											
7 Li 3	9 Be 4											
23 Na 11	24 Mg 12											
39 K 19	40 Ca 20	45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27	59 Ni 28	63.5 Cu 29	65 Zn 30
86 Rb 37	88 Sr 38	89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48
133 Cs 55	137 Ba 56	139 La 57	179 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80
223 Fr 87	226 Ra 88	227 Ac 89									

3	4	5	6	7	0
					4 He 2
11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10
27 Al 13	28 Si 14	31 P 15	32 S 16	35.5 Cl 17	40 Ar 18
70 Ga 31	73 Ge 32	75 As 33	79 Se 34	80 Br 35	84 Kr 36
115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86

List of elements in the Periodic table in order of atomic number

KEY: atomic number – chemical symbol – element

1 – Hydrogen – H

2 – Helium – He

3 – Lithium – Li

4 – Beryllium – Be

5 – Boron – B

6 – Carbon – C

7 – Nitrogen – N

8 – Oxygen – O

9 – Fluorine – F

10 – Neon – Ne

11 – Sodium – Na

12 – Magnesium – Mg

13 – Aluminium – Al

14 – Silicon – Si

15 – Phosphorous – P

16 – Sulphur – S

17 – Chlorine – Cl

18 – Argon – Ar

19 – Potassium – K

20 – Calcium – Ca

21 – Scandium – Sc

22 – Titanium – Ti

23 – Vanadium – V

24 – Chromium – Cr

25 – Manganese – Mn

26 – Iron – Fe

27 – Cobalt – Co

28 – Nickel – Ni

29 – Copper – Cu

30 – Zinc – Zn

31 – Gallium – Ga

32 – Germanium – Ge

33 – Arsenic – As

34 – Selenium – Se

35 – Bromine – Br

36 – Krypton – Kr

37 – Rubidium – Rb

38 – Strontium – Sr

39 – Yttrium – Y

40 – Zirconium – Zr

41 – Niobium – Nb

42 – Molybdenum – Mo

43 – Technetium – Tc

44 – Ruthenium – Ru

45 – Rhodium – Rh

46 – Palladium – Pd

47 – Silver – Ag

48 – Cadmium – Cd

49 – Indium – In

50 – Tin – Sn

51 – Antimony – Sb

52 – Tellurium – Te

53 – Iodine – I

54 – Xenon – Xe

55 – Caesium – Cs

56 – Barium – Ba

57 – Lanthanum – La

(The lanthanides, elements 58-71, are omitted)

72 – Hafnium – Hf

73 – Tantalum – Ta

74 – Tungsten – W

75 – Rhenium – Re

76 – Osmium – Os

77 – Iridium – Ir

78 – Platinum – Pt

79 – Gold – Au

80 – Mercury – Hg

81 – Thallium – Tl

82 – Lead – Pb

83 – Bismuth – Bi

84 – Polonium – Po

85 – Astatine – At

86 – Radon – Rn

87 – Francium – Fr

88 – Radium – Ra

89 – Actinium – Ac