



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

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COMBINED SCIENCE

0653/33

Paper 3 (Extended)

October/November 2015

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

A copy of the Periodic Table is printed on page 28.

At the end of the examination, fasten all your work securely together.

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

This document consists of **28** printed pages.

- 1 (a) Use words from the list to complete the sentences about the human gas exchange system.

Each word can be used once, more than once, or not at all.

arteries capillaries into large long
out of small veins

The alveoli have a surface area for the diffusion of oxygen the blood. There is a good supply of blood flowing in close to the alveoli which provides a short diffusion pathway for gases. [3]

- (b) Some people suffer from asthma which affects the bronchioles of the gas exchange system.

Fig. 1.1 shows a cross section of a healthy bronchiole, and a bronchiole of a person with asthma.

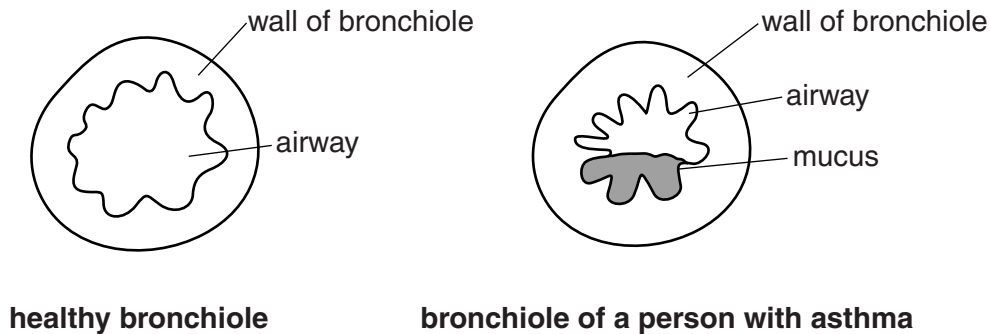


Fig. 1.1

The airflow towards the alveoli is reduced if a person has asthma.

Describe **two** features visible in Fig. 1.1 which could reduce the airflow to the alveoli.

- 1
 2 [2]

- (c) A study is carried out to compare the breathing of people with asthma with the breathing of healthy people.

The volumes of air inhaled in one minute are measured and an average is calculated.

Both groups of people are tested while resting.

Results

average volume inhaled by a healthy person = 5.8 dm³/minute

average volume inhaled by a person with asthma = 12.5 dm³/minute

- (i) Calculate the average percentage of **extra** air the person with asthma inhales per minute compared with a healthy person.

Show your working.

answer =% [2]

- (ii) The person with asthma needs to breathe a greater volume of air per minute by breathing more quickly and more deeply. The same changes occur to the breathing of all people when they exercise.

Explain why these breathing changes are needed during exercise.

.....
.....
.....
.....[2]

- (d) The tar in tobacco smoke affects the gas exchange system. Two of these effects are listed below.

- cilia become paralysed
- more mucus is produced

Choose **one** of the effects above and explain why it is **especially** harmful for a person with asthma to smoke. State which change you are choosing.

change

explanation

.....
.....
.....[2]

- 2 Fig. 2.1 shows the apparatus used to investigate the temperature changes which occur during some chemical processes.

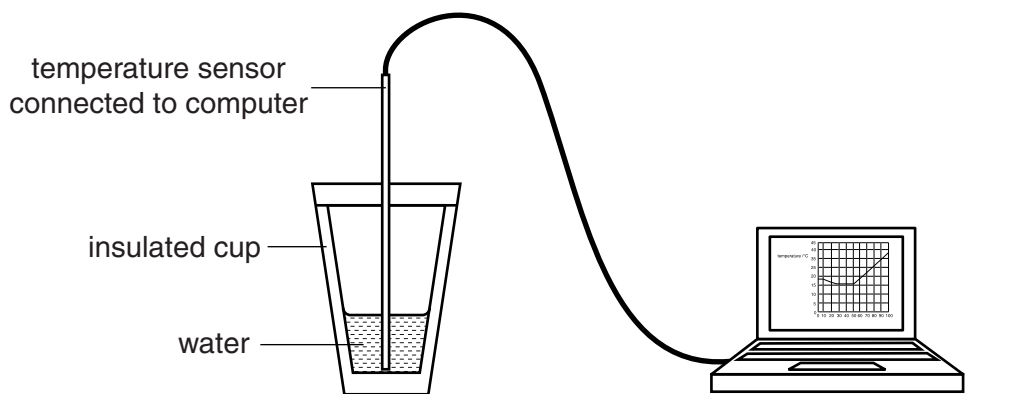


Fig. 2.1

The temperature sensor is placed in the water and the computer starts to log data. After 10 seconds some solid silver nitrate is added to the water in the cup. The mixture is stirred until the solid dissolves.

After another 40 seconds a length of copper wire is placed in the solution.

Fig. 2.2 shows the computer display of temperature change for the first 100 seconds.

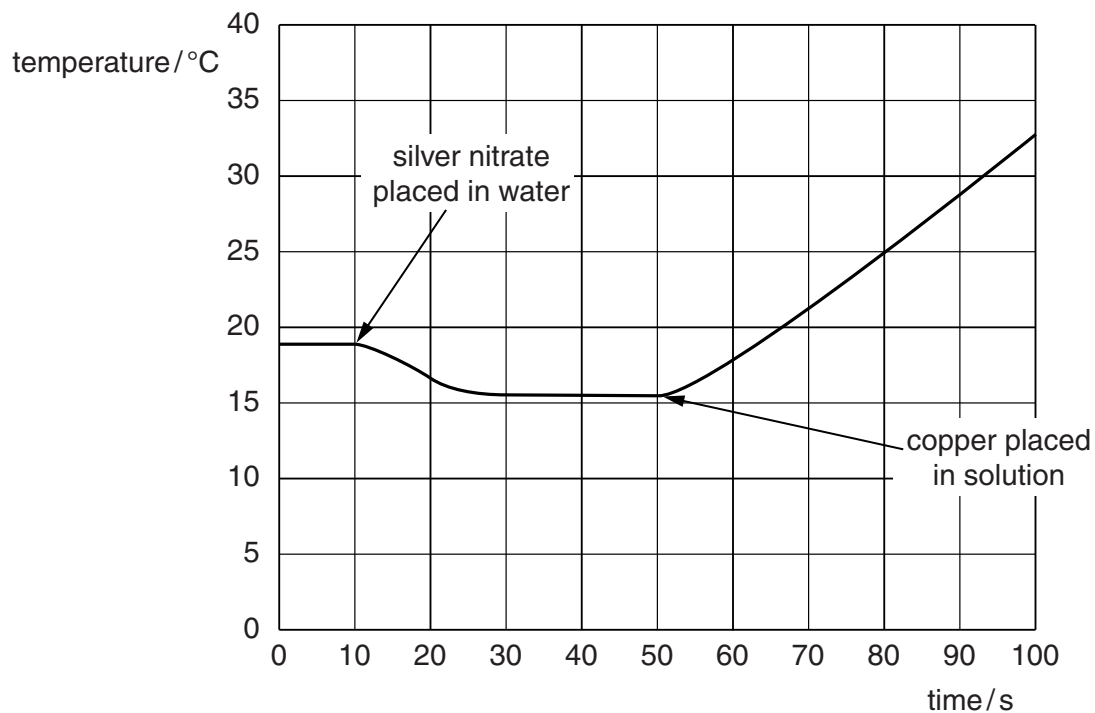


Fig. 2.2

- (a) Describe the **energy change** taking place as the silver nitrate dissolves.

.....[1]

(b) The experiment shown in Fig. 2.2 is **experiment 1**.

The procedure is repeated, using twice the mass of silver nitrate in the same volume of pure water. This is **experiment 2**.

The same length of copper wire is added at 50 seconds.

Fig. 2.3 shows part of the computer display with the results of both experiments.

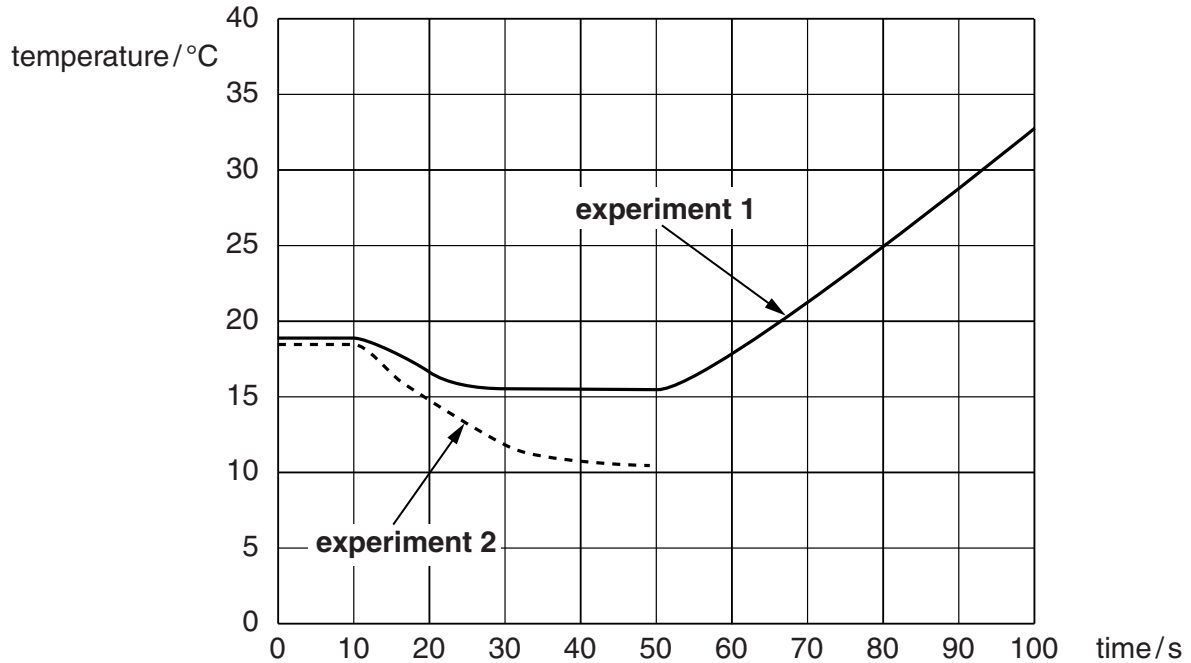


Fig. 2.3

- (i) Complete the graph for **experiment 2** on Fig. 2.3 to show the change in temperature as copper reacts. [1]
- (ii) Explain, in terms of the collision of particles, how increasing concentration affects the rate of reaction.

.....

.....

.....[2]

- (c) Fig. 2.4 shows the appearance of the contents of the cup at the end of the experiment.

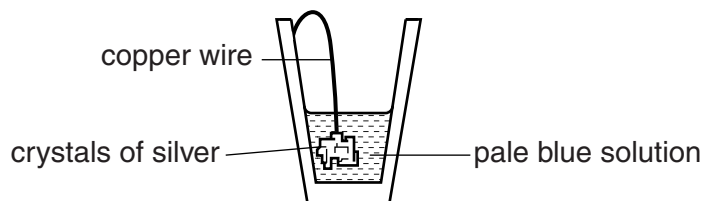


Fig. 2.4

Crystals of metallic silver coat the copper wire and the liquid is now a pale blue solution.

- (i) Use the words **atoms** and **ions** to complete the sentences which explain what happens during the reaction. Each word may be used once or more than once.

Copper in the wire become copper in the solution.

Silver in the solution become silver in the crystals. [1]

- (ii) Table 2.1 shows a list of metals in order of reactivity.

Table 2.1

potassium
sodium
calcium
magnesium
zinc
iron
copper

Write silver in its correct position in the list in Table 2.1. [1]

- (iii) Suggest how the reactivity of a metal depends on how easily its atoms change into ions in a chemical reaction.

.....

 [1]

Please turn over for Question 3.

3 Fig. 3.1 shows a girl on a skateboard track which ends in a shallow pool of water.

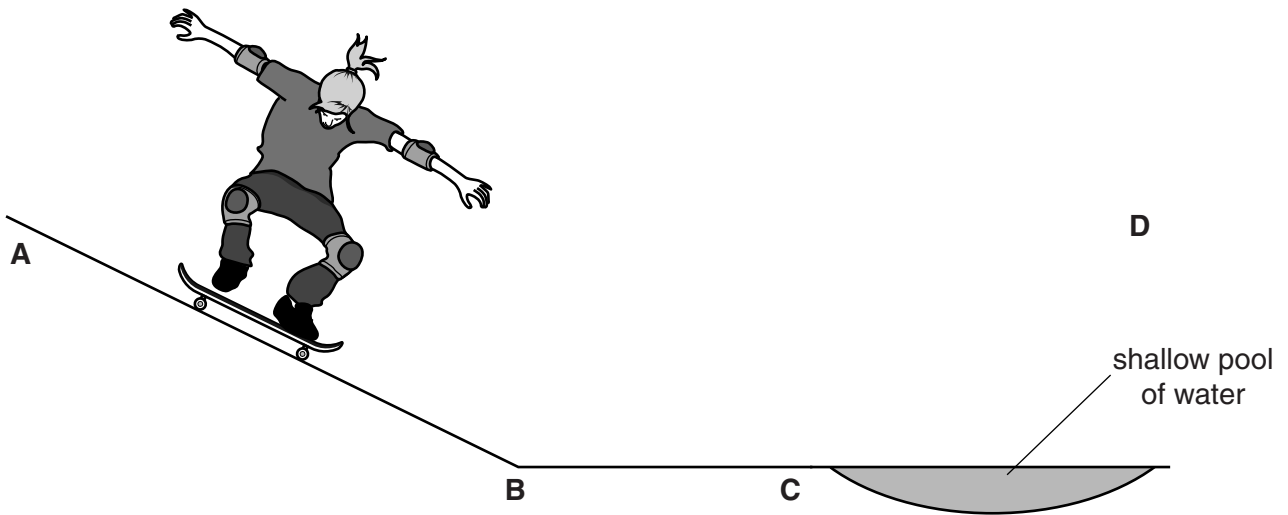


Fig. 3.1

(a) Name the force that causes the girl to move down the skateboard track from **A** to **B**.

.....[1]

(b) State the main energy transfer as the girl travels from **A** to **B**.

from energy

to energy

[1]

(c) Fig. 3.2 shows a speed/time graph of the girl as she travels.

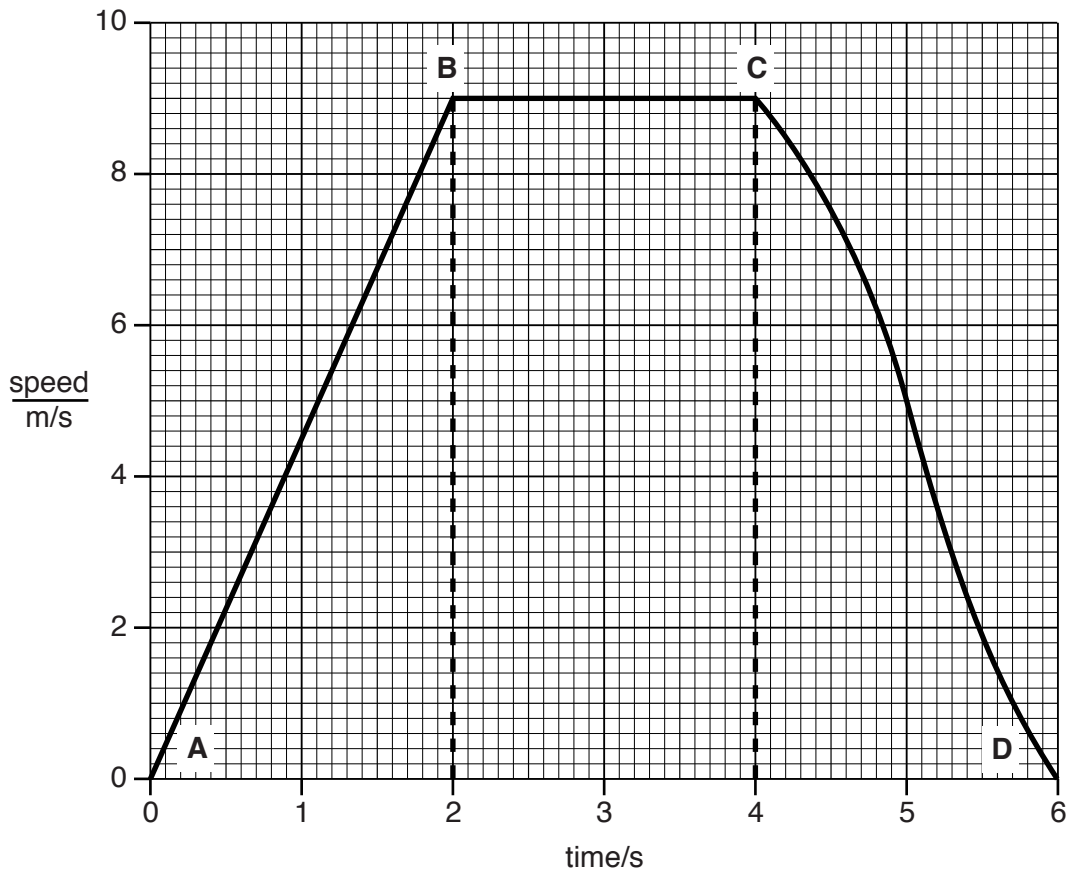


Fig. 3.2

(i) Describe the motion of the girl between points

A and **B**,

B and **C**.[2]

(ii) Use Fig. 3.2 to calculate the distance travelled by the girl between points **A** and **C**.

Show your working.

distance = m [2]

Please turn over for Question 4.

4 (a) Vitamins are needed in small quantities as part of a balanced diet. One vitamin is vitamin C.

(i) State what is meant by the term *balanced diet*.

.....

[1]

(ii) State why we need vitamin C in our diet.

.....
[1]

(b) A student does an experiment to find if temperature affects the vitamin C content of a citrus fruit juice.

The fruit juice is freshly made and then 10 cm³ samples of the juice are stored for four days at the temperatures shown in the table.

At the start, a 10 cm³ volume of fruit juice contains 5 mg of vitamin C.

Table 4.1 shows the average mass of vitamin C in each 10 cm³ sample of juice at the end of the four days.

Table 4.1

temperature / °C	mass of vitamin C / mg in 10 cm ³ of juice
4 (in refrigerator)	4.9
20	3.8
30	3.5
40	2.8
50	1.4

(i) Describe the effect of increasing temperature on the vitamin C content of the juice.

.....
[1]

(ii) Suggest an explanation for the effect you described in (b)(i).

.....
[1]

(iii) When the experiment was repeated in different parts of the world, the initial masses of vitamin C in the 10 cm³ samples were found to be very different.

Suggest and explain a reason for this observation.

.....
.....
.....
.....[2]

(c) Many new mothers feed their babies on formula milk which is made up with warm water and given to the baby from a bottle.

Using the information in Table 4.1 suggest why boiling water should not be used to make up formula milk.

.....
.....
.....[1]

(d) A new mother was deciding whether to bottle-feed her baby.

Explain one advantage and one disadvantage of bottle feeding.

advantage

.....

disadvantage

.....[2]

- 5 (a) Fig. 5.1 shows Period 3 of the Periodic Table.

A								
23 Na Sodium 11	24 Mg Magnesium 12		27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
B								

Fig. 5.1

Draw an arrow in box **A** to show the direction of increasing metallic character of the elements across the period.

Draw an arrow in box **B** to show the direction of increasing number of outer shell electrons in atoms of the elements across the period. [1]

- (b) (i) Table 5.1 shows some observations made after a piece of sodium is dropped into water containing some full-range indicator (Universal Indicator).

Complete Table 5.1 to explain each observation.

Table 5.1

observation	explanation
bubbles of gas	
indicator changes from green to purple	

[2]

(ii) Fig. 5.2 shows part of Group I of the Periodic Table.

Group I	
7	Li Lithium
3	
23	Na Sodium
11	
39	K Potassium
19	
85	Rb Rubidium
37	

Fig. 5.2

Predict **one** way in which the reaction between rubidium and water differs from the reaction between sodium and water.

Explain your answer.

difference

explanation

.....

.....[2]

(iii) Fig. 5.3 shows the outer electron shell in a sodium atom.

Complete the diagram of the outer shell of a rubidium atom to suggest how many electrons there are in the outer shell of a rubidium atom.

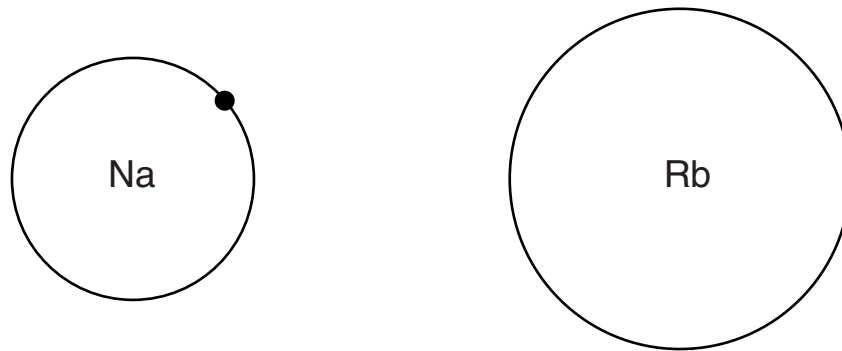


Fig. 5.3

Describe how you used the Periodic Table to make this suggestion.

.....

.....

.....[2]

Please turn over for Question 6.

- 6 Electric power can be generated using the energy of waves on the sea. Fig. 6.1 shows a group of small wave energy converters which are anchored to the sea floor below.

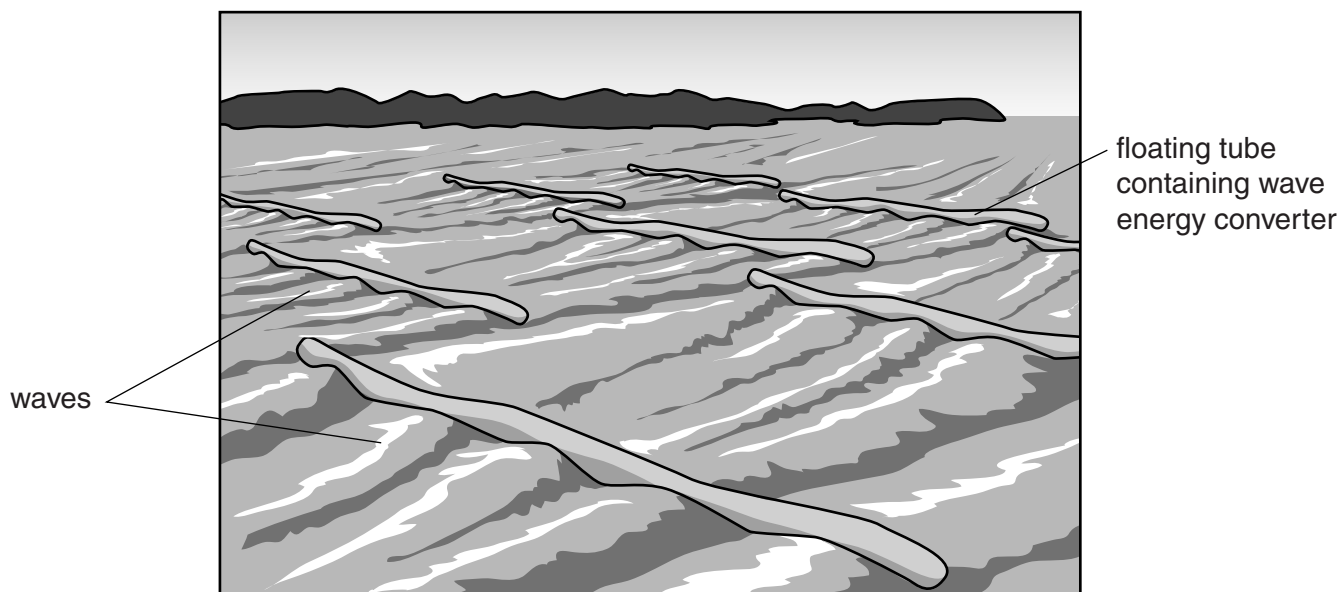


Fig. 6.1

Inside each floating tube there are several generators that convert the wave movement energy into electrical energy.

- (a) (i) A total of 10 waves passed one end of a container in 20 seconds.

Calculate the frequency of the waves. Show your working and state the unit of your answer.

frequency = unit [2]

- (ii) Each floating container is 30m long. In Fig. 6.1 each sea wave takes 10 seconds to pass along each floating container from end to end.

Calculate the speed of the waves across the sea.

speed =m/s [1]

(iii) Use your answers to (a)(i) and (ii) to calculate the wavelength of the waves.

State the formula that you use and show your working.

formula

working

wavelength = m [2]

(b) The amplitude of the waves on one day was 0.5 m.

State the vertical distance that each container will move through as a wave passes.

distance = m [1]

(c) The generators are controlled by radio signals. A radio signal is sent from a control centre 100 km away.

Fig. 6.2 shows an incomplete diagram of the electromagnetic spectrum.

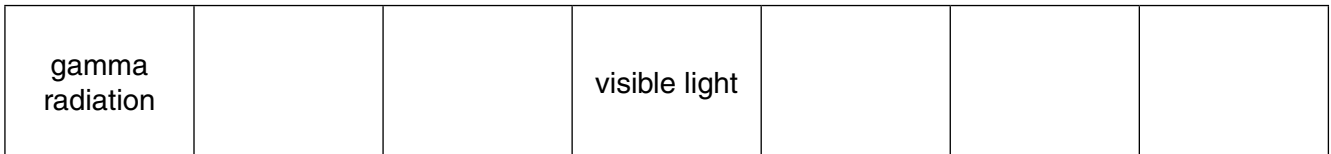


Fig. 6.2

Write an **R** in the box for the part of the spectrum where radio waves are found. [1]

- (d) Fig. 6.3 shows a tidal energy turbine, which is placed on the sea-bed. The flow of the tide turns the turbine.

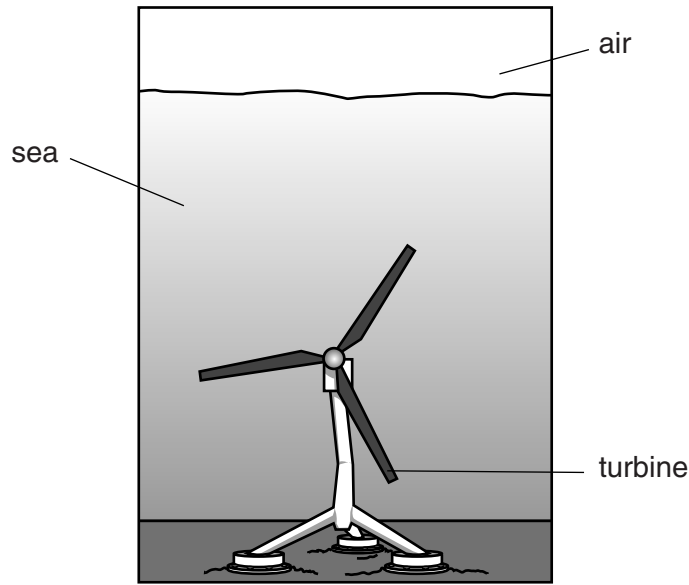


Fig. 6.3

Engineers believe wave generators and tidal generators will be important for supplying electrical energy in the future.

- (i) Give **one** advantage, other than cost, that tidal generators have over wave generators for the supply of electrical energy.

.....
[1]

- (ii) The water flow through a tidal generator delivers energy at 500kW. The electrical output from this turbine is 150kW.

Calculate the efficiency of the tidal turbine.

State the formula that you use and show your working.

formula

working

efficiency = % [1]

7 Fig. 7.1 shows what happens to most of the solar radiation reaching the Earth.

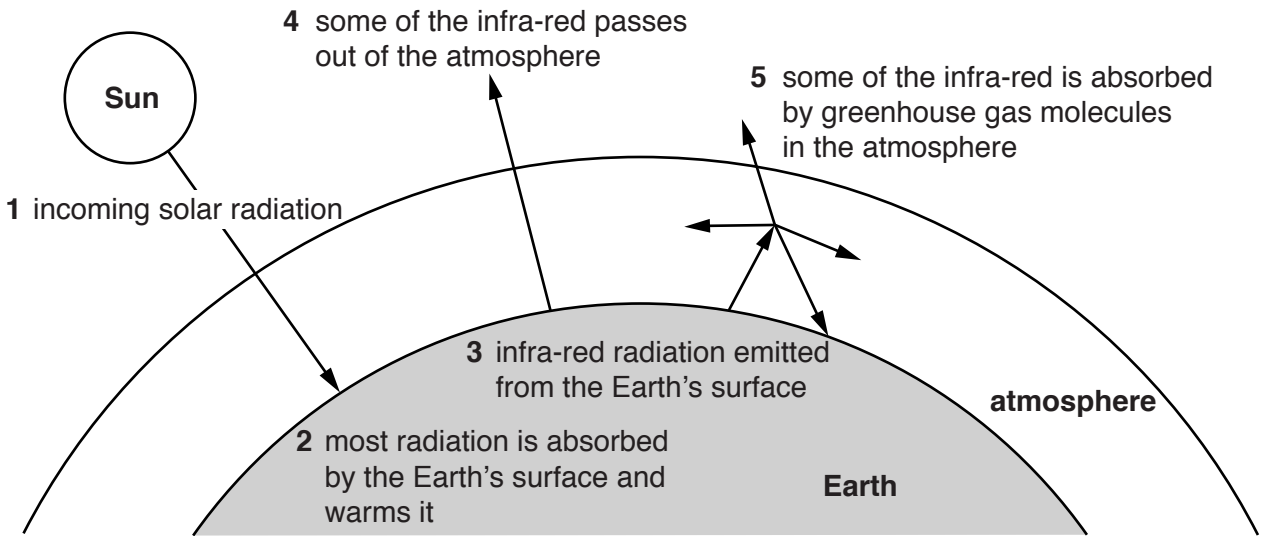


Fig. 7.1

Use Fig. 7.1 to

(a) Describe the role of the atmosphere in keeping the Earth warm.

.....

 [2]

(b) Name **two** greenhouse gases.

..... and [1]

(c) Describe **two** ways in which human activities cause the concentrations of these greenhouse gases to increase.

1

 2
 [2]

(d) State one measure that can be taken to reduce the levels of greenhouse gases in the atmosphere.

.....
 [1]

8 A student extracts some copper from a sample of green copper carbonate, CuCO_3 .

(a) He adds dilute hydrochloric acid to the copper carbonate until it is all dissolved.

A blue solution of copper chloride, CuCl_2 , is formed.

Fig. 8.1 shows that bubbles of gas appear.

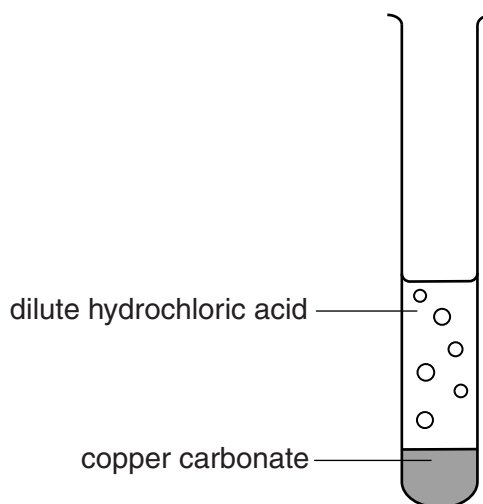


Fig. 8.1

(i) The word equation for the reaction is:

hydrochloric acid + copper carbonate \longrightarrow copper chloride + carbon dioxide + water

Write the balanced chemical equation for this reaction.

.....[2]

(ii) The student checks that the gas is carbon dioxide.

When the reaction is complete, he collects some of the gas in a pipette.

Fig. 8.2 shows how he collects the gas and then passes it through a solution **X**.

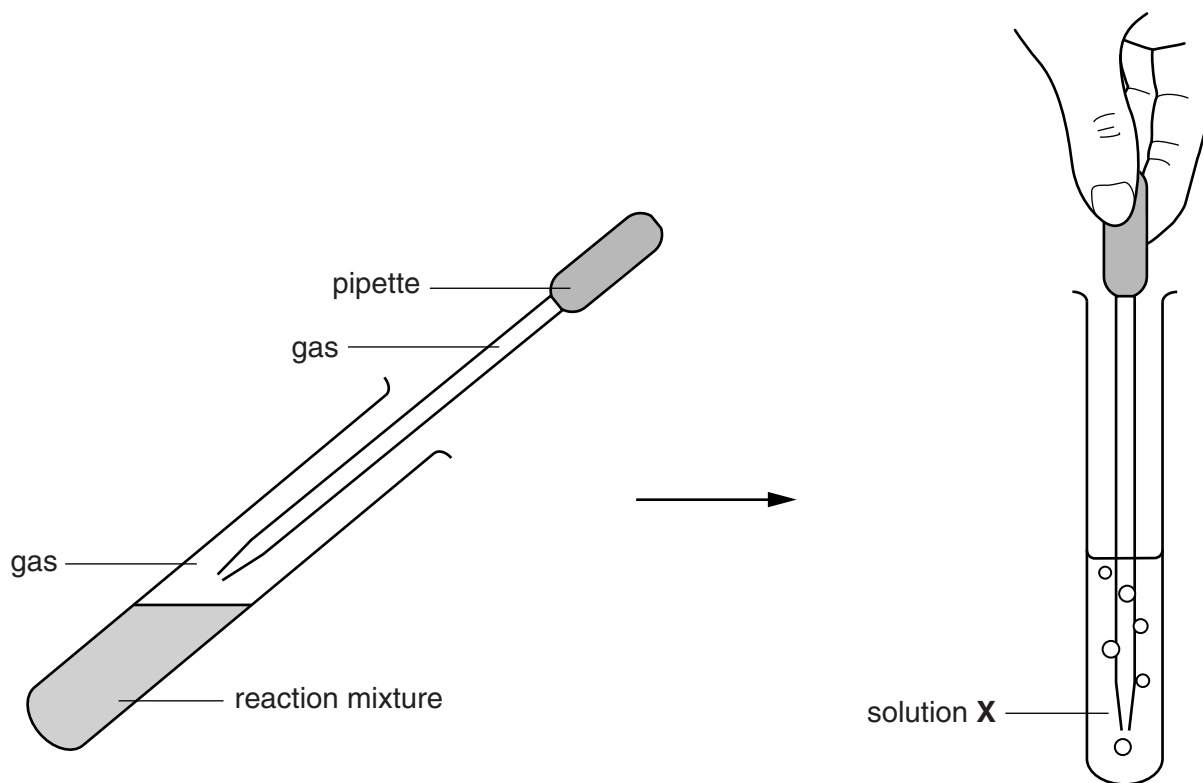


Fig. 8.2

State the name of solution **X** and describe the effect of carbon dioxide on its appearance.

name

effect

.....[2]

- (b) The student places the copper chloride solution that he has made into the electrolysis cell shown in Fig. 8.3.

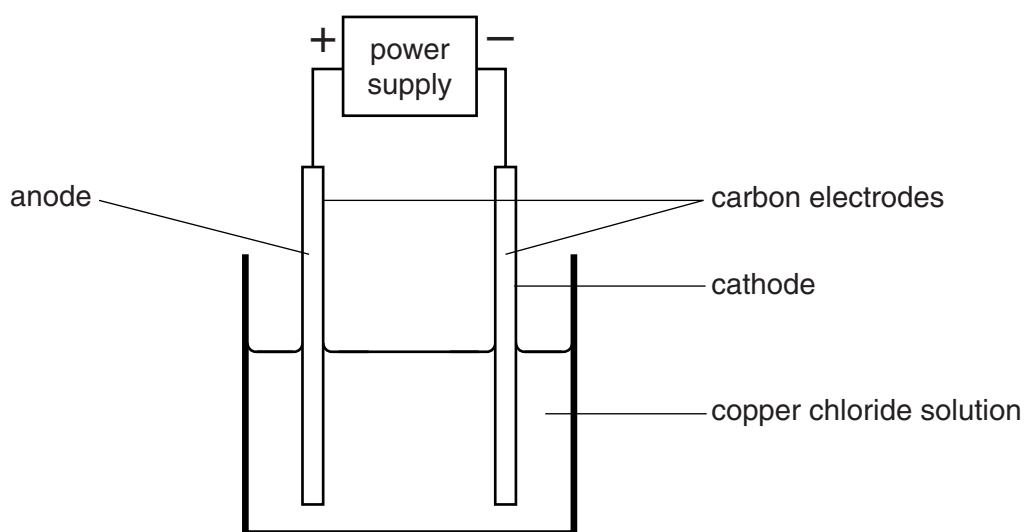


Fig. 8.3

- (i) Complete Fig. 8.3 by labelling each electrode to show the product formed. [2]
- (ii) The electrolyte contains copper ions and chloride ions. Describe the direction of movement of these particles when the switch in the circuit is closed.

copper ions (Cu^{2+})

.....

chloride ions (Cl^-)

.....[2]

(c) Another compound of copper and chlorine exists, with a different formula.

It contains copper ions which have only one positive charge, Cu^+ .

(i) Deduce the formula of the copper chloride compound containing the ion Cu^+ .

Explain your answer.

formula

explanation

.....

.....[2]

(ii) Copper is a transition metal.

The ability to form more than one compound with another element is typical of transition metals.

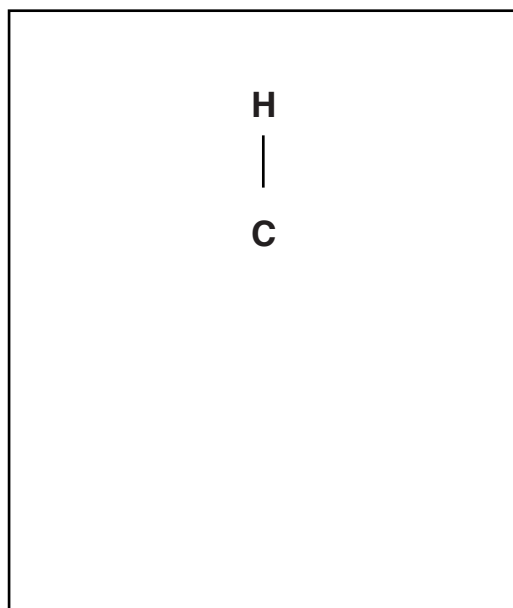
State another property which is typical of transition metals but **not** of other metals.

.....[1]

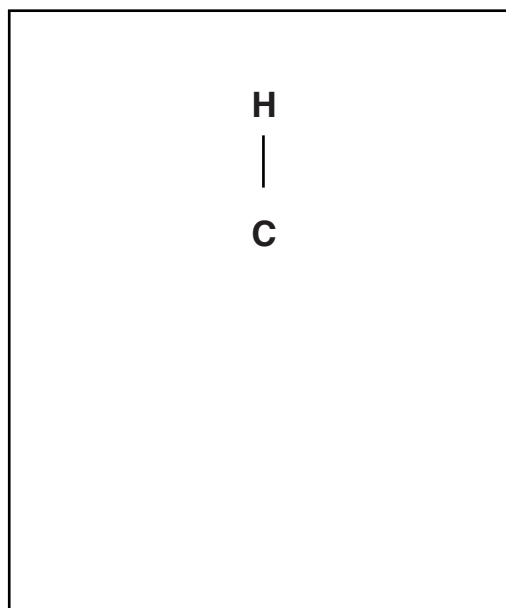
(d) Carbon is an element that forms different compounds with the element hydrogen.

Draw the structures of molecules of the carbon compounds methane and ethene in the boxes.

methane



ethene



[2]

9 (a) Fig. 9.1 shows two oppositely charged metal plates.

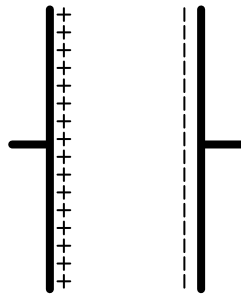


Fig. 9.1

The two oppositely charged plates are free to move.

State what will happen. Give a reason for your answer.

.....

.....

.....[2]

(b) (i) Complete the following sentence:

An electric field is a region in which an electric charge experiences a [1]

(ii) Fig. 9.2 shows an electron entering the electric field between two oppositely charged plates.

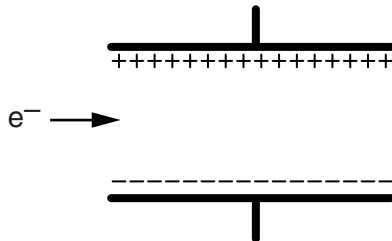


Fig. 9.2

An electron carries a negative charge.

On Fig. 9.2 draw a line to show the path the electron might take after it enters the electric field. [1]

(c) Fig. 9.3 shows a circuit diagram for an electric heater, supplied with 12V from a car battery.

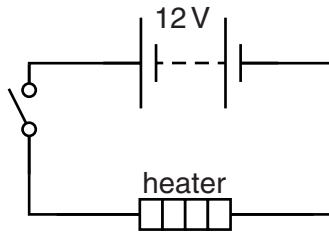
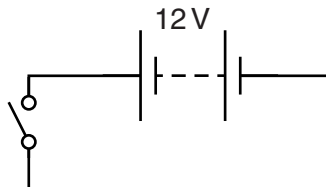


Fig. 9.3

(i) The heater circuit is changed to include a second identical heater and a lamp to show when the heaters are switched on. The heaters must be connected in parallel to work.

Complete the circuit diagram below to include both heaters and the lamp connected so that the circuit works when the switch is closed.



[3]

(ii) The heater transfers thermal energy to some water. This causes convection in the water.

Explain why the thermal energy causes convection in the water.

.....

.....

.....[2]

DATA SHEET
The Periodic Table of the Elements

Group		I	II	III	IV	V	VI	VII	0	
		1 H Hydrogen 1							2 He Helium 2	
3	4	7 Li Lithium	9 Be Beryllium		11 B Boron	12 C Carbon	14 N Nitrogen	16 O Oxygen	19 F Fluorine	20 Ne Neon
11	12	23 Na Sodium	24 Mg Magnesium		27 Al Aluminium	28 Si Silicon	31 P Phosphorus	32 S Sulfur	35.5 Cl Chlorine	40 Ar Argon
19	20	39 K Potassium	40 Ca Calcium		45 Sc Scandium	48 Ti Titanium	51 V Vanadium	52 Cr Chromium	55 Mn Manganese	56 Fe Iron
37	38	85 Rb Rubidium	88 Sr Strontium		89 Y Yttrium	91 Zr Zirconium	93 Nb Niobium	96 Mo Molybdenum	101 Ru Ruthenium	106 Pd Palladium
55	56	133 Cs Caesium	137 Ba Barium		139 La Lanthanum	178 Hf Hafnium	181 Ta Tantalum	184 W Tungsten	190 Os Osmium	195 Pt Platinum
87	88	223 Fr Francium	226 Ra Radium		227 Ac Actinium					
						29 Cu Copper	30 Zn Zinc	31 Ga Gallium	33 As Arsenic	34 Se Selenium
					47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium
					77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	83 Bi Bismuth	84 Po Polonium
					94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	100 Fm Fermium	101 Md Mendelevium
					140 Ce Cerium	141 Pr Praseodymium	142 Nd Neodymium	143 Pm Promethium	144 Sm Samarium	145 Eu Europium
					146 Gd Gadolinium	147 Tb Terbium	148 Dy Dysprosium	149 Ho Holmium	150 Er Erbium	151 Tm Thulium
					152 Yb Ytterbium	153 Lu Lutetium	154 La Lanthanum	155 Ce Cerium	156 Pr Praseodymium	157 Nd Neodymium
					158 Sm Samarium	159 Eu Europium	160 Gd Gadolinium	161 Tb Terbium	162 Dy Dysprosium	163 Ho Holmium
					164 Er Erbium	165 Tm Thulium	166 Yb Ytterbium	167 Lu Lutetium	168 La Lanthanum	169 Ce Cerium
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					236 Tb Terbium	237 Dy Dysprosium	238 Ho Holmium	239 Er Erbium	240 Tm Thulium	241 Yb Ytterbium
					242 Lu Lutetium	243 La Lanthanum	244 Ce Cerium	245 Pr Praseodymium	246 Nd Neodymium	247 Pm Promethium
					248 Sm Samarium	249 Eu Europium	250 Gd Gadolinium	251 Tb Terbium	252 Dy Dysprosium	253 Ho Holmium
					254 Er Erbium	255 Tm Thulium	256 Yb Ytterbium	257 Lu Lutetium	258 La Lanthanum	259 Ce Cerium
					260 Pr Praseodymium	261 Nd Neodymium	262 Pm Promethium	263 Sm Samarium	264 Eu Europium	265 Gd Gadolinium
					266 Tb Terbium	267 Dy Dysprosium	268 Ho Holmium	269 Er Erbium	270 Tm Thulium	271 Yb Ytterbium
					272 Lu Lutetium	273 La Lanthanum	274 Ce Cerium	275 Pr Praseodymium	276 Nd Neodymium	277 Pm Promethium
					278 Sm Samarium	279 Eu Europium	280 Gd Gadolinium	281 Tb Terbium	282 Dy Dysprosium	283 Ho Holmium
					284 Er Erbium	285 Tm Thulium	286 Yb Ytterbium	287 Lu Lutetium	288 La Lanthanum	289 Ce Cerium
					290 Pr Praseodymium	291 Nd Neodymium	292 Pm Promethium	293 Sm Samarium	294 Eu Europium	295 Gd Gadolinium
					296 Tb Terbium	297 Dy Dysprosium	298 Ho Holmium	299 Er Erbium	300 Tm Thulium	301 Yb Ytterbium
					302 Lu Lutetium	303 La Lanthanum	304 Ce Cerium	305 Pr Praseodymium	306 Nd Neodymium	307 Pm Promethium
					308 Sm Samarium	309 Eu Europium	310 Gd Gadolinium	311 Tb Terbium	312 Dy Dysprosium	313 Ho Holmium
					314 Er Erbium	315 Tm Thulium	316 Yb Ytterbium	317 Lu Lutetium	318 La Lanthanum	319 Ce Cerium
					320 Pr Praseodymium	321 Nd Neodymium	322 Pm Promethium	323 Sm Samarium	324 Eu Europium	325 Gd Gadolinium
					326 Tb Terbium	327 Dy Dysprosium	328 Ho Holmium	329 Er Erbium	330 Tm Thulium	331 Yb Ytterbium
					332 Lu Lutetium	333 La Lanthanum	334 Ce Cerium	335 Pr Praseodymium	336 Nd Neodymium	337 Pm Promethium
					338 Sm Samarium	339 Eu Europium	340 Gd Gadolinium	341 Tb Terbium	342 Dy Dysprosium	343 Ho Holmium
					344 Er Erbium	345 Tm Thulium	346 Yb Ytterbium	347 Lu Lutetium	348 La Lanthanum	349 Ce Cerium
					350 Pr Praseodymium	351 Nd Neodymium	352 Pm Promethium	353 Sm Samarium	354 Eu Europium	355 Gd Gadolinium
					356 Tb Terbium	357 Dy Dysprosium	358 Ho Holmium	359 Er Erbium	360 Tm Thulium	361 Yb Ytterbium
					362 Lu Lutetium	363 La Lanthanum	364 Ce Cerium	365 Pr Praseodymium	366 Nd Neodymium	367 Pm Promethium
					368 Sm Samarium	369 Eu Europium	370 Gd Gadolinium	371 Tb Terbium	372 Dy Dysprosium	373 Ho Holmium
					374 Er Erbium	375 Tm Thulium	376 Yb Ytterbium	377 Lu Lutetium	378 La Lanthanum	379 Ce Cerium
					380 Pr Praseodymium	381 Nd Neodymium	382 Pm Promethium	383 Sm Samarium	384 Eu Europium	385 Gd Gadolinium
					386 Tb Terbium	387 Dy Dysprosium	388 Ho Holmium	389 Er Erbium	390 Tm Thulium	391 Yb Ytterbium
					392 Lu Lutetium	393 La Lanthanum	394 Ce Cerium	395 Pr Praseodymium	396 Nd Neodymium	397 Pm Promethium
					398 Sm Samarium	399 Eu Europium	400 Gd Gadolinium	401 Tb Terbium	402 Dy Dysprosium	403 Ho Holmium
					404 Er Erbium	405 Tm Thulium	406 Yb Ytterbium	407 Lu Lutetium	408 La Lanthanum	409 Ce Cerium
					410 Pr Praseodymium	411 Nd Neodymium	412 Pm Promethium	413 Sm Samarium	414 Eu Europium	415 Gd Gadolinium
					416 Tb Terbium	417 Dy Dysprosium	418 Ho Holmium	419 Er Erbium	420 Tm Thulium	421 Yb Ytterbium
					422 Lu Lutetium	423 La Lanthanum	424 Ce Cerium	425 Pr Praseodymium	426 Nd Neodymium	427 Pm Promethium
					428 Sm Samarium	429 Eu Europium	430 Gd Gadolinium	431 Tb Terbium	432 Dy Dysprosium	