OCR
RECOGNISING ACHIEVEMENT

GCSE

ADDITIONAL SCIENCE A

H

A218/02

Additional Science A Unit 4 Ideas in Context

Specimen Paper

45 mins

Candidates answer on the question paper:

Additional materials: ruler (cm/mm), calculator

Candidate Name	

Centre Number						Candidate Number				

TIME 45 mins

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers on the dotted lines unless the question says otherwise.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- There is a space after most questions. Use it to do your working. In many questions marks will be given for a correct method even if the answer is incorrect.
- Do not write in the bar code. Do not write in the grey area between the pages.
- DO NOT WRITE IN THE AREA OUTSIDE THE BOX BORDERING EACH PAGE. ANY WRITING IN THIS AREA WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **40.**

This specimen paper consists of 19 printed pages.

Registered Charity Number: 1066969

Useful relationships

$$\text{speed} = \frac{\text{distance travelled}}{\text{time taken}}$$

momentum = mass × velocity

change in momentum = resultant force × time for which it acts

work done by force = force × distance moved by force

change in energy = work done

change in GPE = weight × vertical height difference

kinetic energy = ½ × mass × [velocity]2

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

$$\frac{\text{voltage in primary coil}}{\text{voltage in secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$$

power = potential difference × current

energy transferred = power × time

$$\text{efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}}$$

wave speed = frequency × wavelength

There is a periodic table on the back cover of this examination paper.

Answer all questions.

Question 1

Homeostasis is the process where the body prevents the outside environment from changing things inside the body.

It is important that the body stays at 370C and keeps the same level of water in the blood no matter what is happening outside the body.

Read the following article about what happens to the human body when mountaineers attempt to climb Mount Everest.

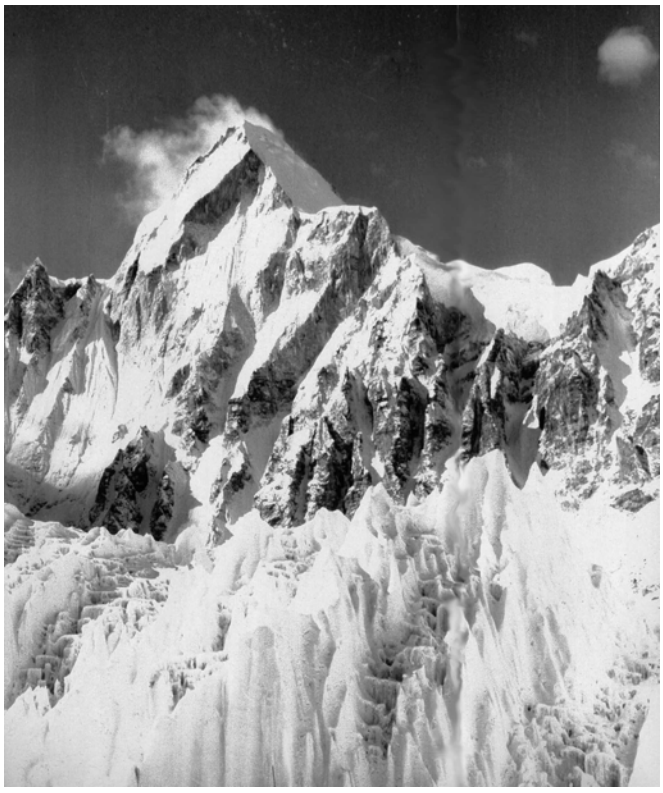
INTO THE DEATH ZONE

Climbers call mountains over 26,000 feet, the death zone. Mount Everest is 29,035 feet high. Over 90 climbers have climbed Mount Everest.

Climbers can suffer from frostbite, when fingers and toes freeze. They also have to survive winds of over 90 miles per hour. Above 25,000 feet, the air is so dry, that climbers can breathe out 5 litres of water in their breath every day.

Ultra violet radiation increases by 4% for every thousand feet and Everest is over 29,000 feet high. These high levels of ultra violet radiation can cause blindness.

The following data show what happens to the body at higher altitudes.



29,000 feet
Air pressure 30%
Climber may hallucinate.
Resting heart rate 123 per minute.

18,000 feet
Air pressure 50%
No one on Earth has a home above this height.
Lungs breathe out too much carbon dioxide turning blood alkaline.
Kidneys excrete more water.

9,000 feet
Air pressure 75%
People feel out of breath.
People get headaches as brain starts to swell.
Body starts to make more red blood cells.
Resting heart rate 85 per minute.

1. **(a)** Give a reason why climbers can become dehydrated when they climb Everest.

.....

.....[1]

(b) Some climbers in 'the death zone' go blind.

Explain why this happens and why it is dangerous.

.....

.....

.....[3]

(c) At high altitude blood becomes more alkaline.

Explain why.

.....

.....

.....

.....[3]

(d) The amount of oxygen in dry air at sea level **and** at the top of Mount Everest is 20%.

Explain why climbers on the top of the mountain suffer from a lack of oxygen.

.....

.....

.....[2]

(e) Suggest how the body acclimatises to living at high altitude.

In your answer you should;

- suggest **two** examples.
- explain how **one** of these examples enables people to survive at high altitude.


One mark will be for writing in sentences with correct spelling punctuation and grammar.

.....

.....

.....

..... [3+1]

[Total: 13]

Question 2

Bromine

Bromine is red-brown corrosive liquid that has a range of uses –including the manufacture of fire resistant foam rubber and an additive for leaded petrol.

What is bromine?

F
Cl
Br
I
At

Bromine has the chemical symbol Br.

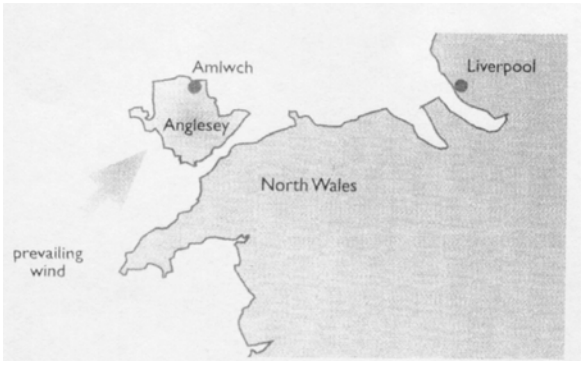
It is an element in Group 7 of the Periodic Table – one of the Halogens.

Sodium bromide is a constituent of sea water.

Where does bromine come from?

In Britain, bromine is extracted from sea water at a plant at Amlwch on the island of Anglesey in Wales.

Anglesey is a long way from large populations and the prevailing wind carries any hazardous gases out to sea.



One of the biggest bromine plants in the world is in Israel beside the Dead Sea. The water in the Dead Sea is very different to normal sea water. Water containing dissolved salts flows into the Dead Sea, but no water flows out. For millions of years water has evaporated, leaving behind a much more concentrated solution of useful ions (see Table 1).

Table 1: Ions in typical sea water and in Dead Sea Water

ion	mass of ions of sea water in mg/l	mass of ions in Dead Sea water in mg/l
sodium	11.0	39.0
potassium	0.4	6.9
magnesium	1.3	39.0
calcium	0.4	17.0

chloride	19.0	208.0
bromide	0.07	5.2
sulphate	2.5	0.6

When the water in sea water evaporates completely, sea-salt crystals form. These contain solid salts, and are sold for use in food and in bath salts.

How is bromine made from sea water?

Extracting bromine from sea water involves many stages, but the most important stage is the displacement of bromine using chlorine.

Sea water contains sodium bromide in solution. Chlorine is bubbled through sea water to cause a reaction that releases bromine. Chlorine displaces bromine from sodium bromide solution, because it is a more reactive halogen.

chlorine + sodium bromide → bromine + sodium chloride

Bromine is a very important chemical all over the world. It has many different uses. Its main use today is for making flame retardants. These are added to fabrics and foam furnishings so that they are less likely to catch fire. Since a law was passed in the UK requiring all foam-filled furnishings to contain fire retardant, this use of bromine has increased.

In the past over half the bromine made in the UK was used to make an additive for leaded petrol. Leaded petrol is no longer used, and so much less bromine is needed for the manufacture of fuel additives.

Table 2 shows how the production and use of bromine has changed over the past 30 years.

Table 2: UK bromine production and use in fuel additives

Year	UK bromine production in tonnes	% of bromine produced used in fuel	fuel additive produced in tonnes
1975	28 000	55	15 400
1980	28 000	54	15 100
1987	31 000	24	7500
1997	31 000	10	3500

2. Look at table 1.

(a) One of the salts that form crystals when sea water evaporates is magnesium sulphate.

Give the formula of magnesium sulphate.

.....[1]

(b) Give the name and formula of one **other** magnesium salt that will form in sea salt crystals.

.....

.....[2]

(c) The article mentions the advantages of siting bromine plants near labour forces and where the wind carries gases away.

What **other** considerations need to be thought about when deciding where to site a bromine plant?

One mark will be for a clear ordered answer.

.....

.....

.....

..... [3+1]

(d) Bromine is displaced from sea water using chlorine.

(i) Name one **other** halogen that can displace bromine from sea water.

.....[1]

(ii) Write a symbol equation for this displacement reaction.

.....[2]

(e) Look at the information in the 'How is bromine used?' section and 'Table 2'.

(i) How does this information show that bromine has large scale uses other than its use in fuel additives?

.....

.....[1]

(ii) How does this information show that the amount of bromine used for uses other than fuel additives has increased since 1975?

.....

.....[2]

[Total: 13]

Question 3

NASA's Deep Space Network

NASA's Deep Space Network (DSN) is a collection of antennas at three sites around the globe used to communicate with interplanetary spacecraft missions.

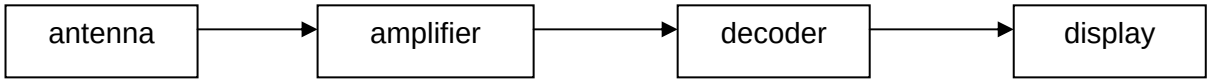
All of the DSN antennas are large "dish" antennas, used to:

- transmit commands to faraway spacecraft
- receive telemetry data from spacecraft
- track the position and speed of spacecraft
- receive science data from spacecraft

Microwaves are used for deep space communications. A microwave beam travels in a straight line through space, but is refracted by the Earth's atmosphere.

Radio signals weaken as they travel from a deep space probe across the great distance to Earth. Receiving antennas on Earth must have greater reflecting surface to pick up the weak signals. The signals are so weak it is important to use digital signals.

The digital signals received by the deep space network are processed and decoded to allow scientists to interpret the data.



The Voyager-1 spacecraft is exploring the far outer reaches of the Solar System. It is further away from Earth than any other space craft, many millions of kilometres from the Earth.

Voyager is so far away from Earth that a signal, travelling at the speed of light, takes over 12 hours to reach Voyager-1. By comparison, a signal sent to Mars, to command the Mars Global Surveyor spacecraft, takes only 15 minutes. The distance to the space craft can be calculated from the time taken for these signals to travel to the spacecraft.

Successfully sending a DSN signal into Voyager-1's receiver is like throwing a ball across thousands of miles of ocean into a porthole of a moving cruise ship.

In the future, as the Voyagers move even farther away from Earth, DSN engineers will invent new techniques to communicate with them.

3. The Deep Space Network (DSN) uses microwaves to communicate with spacecraft.

(a) Why does the DSN **not** use sound waves?

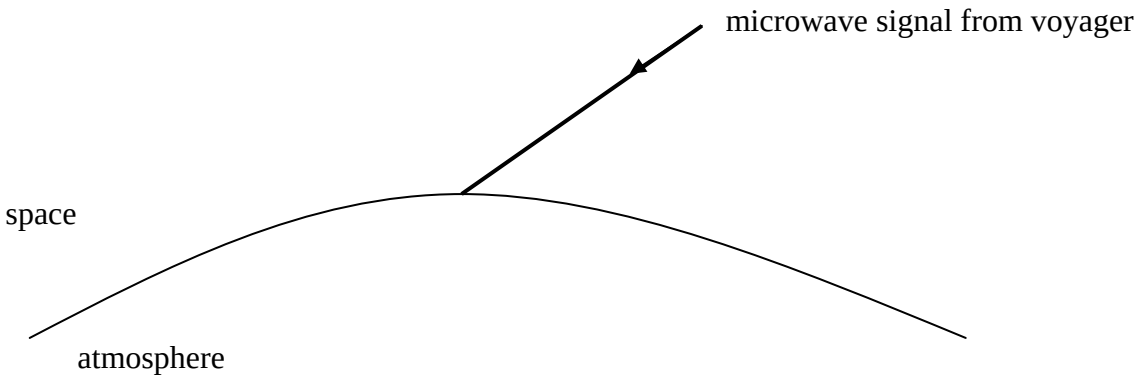
.....[1]

(b) Suggest why the radio dishes are made of metal.

.....[1]

(c) When a signal moves into the atmosphere of the Earth it slows down and is refracted.

Complete the diagram to show the path of the microwave signal.



[2]

(d) The receiving equipment has a decoder, which decodes the digital signals sent from the Voyager spacecraft.

Suggest why digital signals are used for communication with the spacecraft and why a decoder is needed.

Your answer should include:

- a description of what a digital signal is.
- an explanation of the jobs of the amplifier and decoder.
- why digital signals are better than analogue signals over very long distances.

One mark will be for the use of appropriate diagrams in your answer.

.....

.....

.....

.....

..... [4+1]

(e) The Deep Space Network is used to find the distance to the Voyage space craft.

It takes 12.5 hours for a signal to reach the Voyager space craft.

The speed of light is 300,000 km/s.

1 hour = 3600 seconds.

Calculate the distance to the Voyager space craft.

Show all of your working.

One mark will be for a clearly presented calculation.

distance .....

units ..... [4+1]

[Total: 13]

1	2											3	4	5	6	7	8
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
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
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sb** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111							

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

*The Lanthanides (atomic numbers 58-71) and the Actinides (atomic numbers 90-103) have been omitted
Cu and Cl have not been rounded to the nearest whole number

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GCSE

ADDITIONAL SCIENCE A

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A218/02

Additional Science A Unit 4 Ideas in Context

Specimen Mark Scheme

45 mins

Maximum mark for this paper is [40]

This specimen mark scheme consists of 4 printed pages.

Registered Charity Number: 1066969

Question Number	Answer	Max Mark
1(a)	Breathe out more water/Kidneys excrete more water.	**[1]**
1(b)	Ultra violet light causes blindness;	**[1]**
	More UV at high altitude;	**[1]**
	Description of hazard e.g. falling into precipice;	**[1]**
1(c)	lungs breath out too much carbon dioxide;	**[1]**
	Carbon dioxide is acid	**[1]**
	less acid implies more alkaline	**[1]**
1(d)	Air pressure is less;	**[1]**
	Therefore less air and amount of oxygen is less;	**[1]**
1(e)	**2 examples named**	
	e.g. more red blood cells / bigger heart / bigger lungs; **2 marks max**	**[2]**
	relevant explanation	
	e.g. carries more oxygen / pumps more blood and oxygen /	
	breathes in more oxygen;	**[1]**
	Communication – Spelling punctuation and grammar:	**[1]**
	The candidate can make an average of one error per sentence without penalty. A very long sentence, which should be several shorter sentences, will automatically score zero.	
	Total marks	**[13]**

2(a)	$MgSO_4$	**[1]**
2(b)	magnesium chloride/magnesium bromide;	
	$MgCl_2$ / $MgBr_2$;	**[2]**
2(c)	**Any 3:**	
	concentration of salts/bromide ions in sea water;	
	transport idea;	
	qualification of transport idea e.g. rail links / road links/ ease of transport of named material;	
	availability of fuel;	
	near to chlorine plant;	
	location relative to residential housing;	
	disposal of waste;	**[3]**
	Communication:	**[1]**
	The candidate has attempted to answer the question using statements that are ordered in a logical way to answer the question.	
2(d)i	fluorine;	**[1]**
2(d)ii	$F_2 + 2NaBr \rightarrow Br_2 + 2NaF$	**[2]**
	two of four species fully correct = (1)	
2(e)i	only a %ge of bromine is used for fuel additives;	**[1]**
2(e)ii	**Any 2:**	
	fuel additives produced has fallen since 1975;	
	production of Br_2 has increased since 1975;	
	%ge used for fuel additives has fallen since 1975;	
	idea of huge tonnage of alternative use needed to alter figures.	**[2]**
	Total marks	**[13]**

3(a)	Sound waves cannot travel in space/vacuum/need a medium	**[1]**
3(b)	Reflects microwaves/radiowaves	**[1]**
3(c)	Straight line bending at edge of atmosphere	**[1]**
	Bends towards the normal	**[1]**
3(d)	**1 each, max 4** Digital signal is binary/O and 1/high-low/ etc.	
	Amplifier –increases amplitude of received signal	
	Decoder – converts digital signal to original information	
	Digital signal less effected by transmission/noise/interference	
	digital important when signal weak	
	Signal very weak after travelling long distance	**[4]**
	Communication:	**[1]**
	The candidate has produced a clear diagram, illustrating a marking point or point in answer.	
3(e)	t= 12.5 x 3600 = 45,000 (sec)	**[1]**
	d=vt (=300,000 x 45,000)	**[1]**
	13,500,000,000 (= 1.35 x 1010)	**[1]**
	km	**[1]**
	Communication:	**[1]**
	The candidate has laid out the calculation in a clear and logical manner	
	Total marks	**[14]**
	Overall marks	**[40]**