OCR
RECOGNISING ACHIEVEMENT

GCSE

ADDITIONAL SCIENCE A

F

A218/01

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.

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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 × $[\text{velocity}]^2$

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

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

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 whereby the body prevents the outside environment from changing things inside the body.

It is important that the body stays at 370 ^{o}C 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.

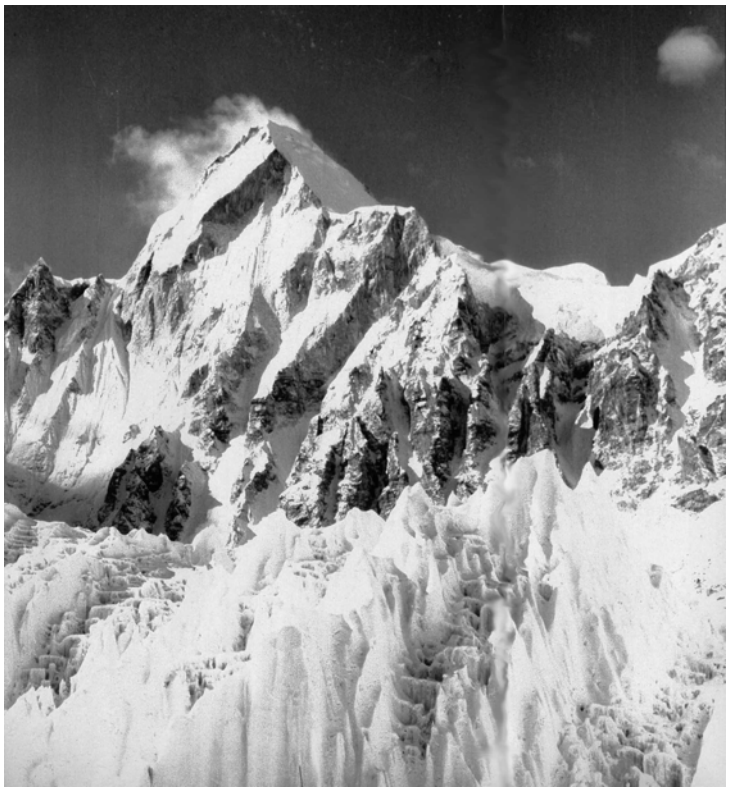
INTO THE DEATH ZONE

Climbers call mountains over 26000 feet, the death zone. Mount Everest is 29035 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 25000 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 29000 feet high. These high levels of ultraviolet radiation can cause blindness.

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



29000 feet
Air pressure 30%.
Climber may hallucinate.
Resting heart rate 123 beats per minute.

18000 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.

9000 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 beats per minute.

1. (a) Name the process by which the body keeps a constant internal environment.

Choose from the following words.

Put a (ring) around the correct answer.

homeopathy **homeostasis** **homogeneous** **homology**

[1]

(b) What happens to the air pressure as climbers go up Mount Everest?

.....[1]

(c) **(i)** Describe what happens to a climber's resting heart rate as they go higher.

Use data from the article to help your answer.

.....

.....

.....[2]

(ii) Describe **two** other effects that climbing at high altitude can have on the body.

One mark is for writing in sentences with correct spelling, punctuation and grammar.

.....

.....

..... [2+1]

(d) **(i)** A climber spends 3 days above 25000 feet on Mount Everest.

Calculate how much water the climber would lose in his breath during this time.

Show your working.

.....litres [2]

(ii) Give two **other** ways climbers can lose water from their bodies.

1. .....

2. .....[2]

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

(i) What **causes** blindness at high altitudes?

.....[1]

(ii) Suggest **why** going blind on Everest is so dangerous.

.....[1]

.....[Total:13]

Question 2

Bromine

Bromine could save your life if you had a house fire and it was used for decades to keep petrol burning smoothly.

F
Cl
Br
I
At

What is bromine?

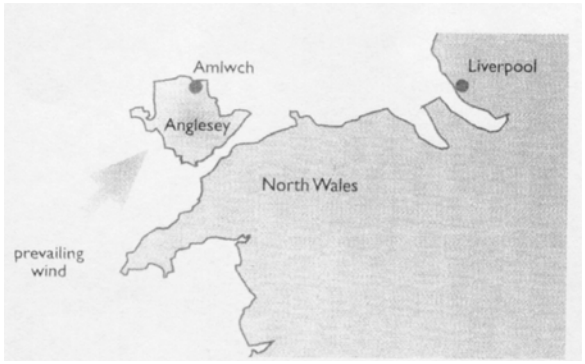
Bromine is an element in Group 7 of the Periodic Table Elements from this group are also known as halogens. The halogens that have similar properties.

Bromine has the chemical symbol Br. This reminds you of two things - it is made from brine (salty sea water) and it is a red/brown liquid.

Where does bromine come from?

In Britain, bromine is extracted from sea water off the coast of Anglesey in Wales. The siting of a chemical plant is very important.

Anglesey is a good site because there are plenty of people to use for a labour force, 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 from normal sea water, because the water evaporates 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 in 1 litre of sea water / g	mass in 1 litre of Dead Sea water / g
sodium	11	39
potassium	0.4	6.9
magnesium	1.3	39
calcium	0.4	17
chloride	19	208
bromide	0.07	5.2
sulfate	2.5	0.6

If the sea water evaporates completely, seasalt crystals which contain solid salts are left behind. These are sold for use in food and also in bath salts.

How is bromine made from sea water?

The most important stage in the extraction of bromine 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 makes bromine. Chlorine displaces bromine from sodium bromide, because it is a more reactive halogen.

chlorine + sodium bromide → bromine + sodium chloride

How is bromine used?

Bromine is a very important chemical with many different uses.

Table 2 shows information about the production and use of bromine in the UK.

Over half the bromine made in the UK used to be used as an additive in leaded petrol. Leaded petrol is not used anymore, and so much less bromine is used for making fuel additives.

The main use of bromine today is for making flame retardants. These are added to fabrics and foam furnishings so that they are less likely to catch fire.

Table 2: UK bromine production and use in fuel additives

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

2. The article says that bromine is a red/brown liquid from the halogen family.

(a) Look at Table 1.

(i) Give the name of **another** halogen that can be made from ions in sea water.

.....[1]

(ii) What does this halogen you have named look like?

.....[2]

(b) One of the salts in sea salt crystals is magnesium sulfate.

Use Table 1 to help you to name one **other** magnesium salt that will form in sea salt crystals.

.....[1]

(c) The article talks about a bromine extraction plant on the coast of Anglesey.

What are the **advantages** of having a bromine plant there?

One mark is for a clear ordered answer.

.....

.....

..... [3+1]

(d) Look at the information about how bromine is made by displacement from sea water.

(i) Fluorine can be used to displace bromine from sea water.

Complete the word equation for the reaction between sodium bromide and fluorine.

Use the equation in the article to help you.

_____ + _____ → _____ + _____

[2]

(e) Look at Table 2.

Describe what has happened to UK **bromine production**.

.....[1]

(ii) Describe what has happened to the **fuel additive produced**.

.....[1]

(iii) What do your answers suggest about the uses of bromine since 1975?

.....

.....[1]

[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.

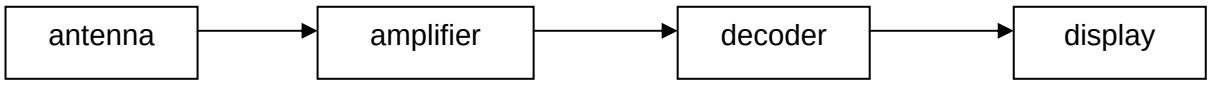
All of the DSN antennas are large "dish" antennas, used to:

- transmit commands to faraway spacecraft
- 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. 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.

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!

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

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

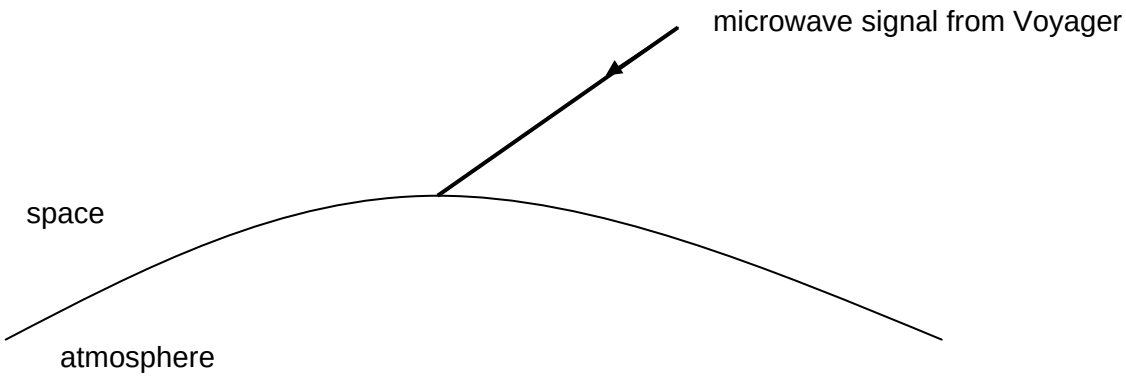
.....[1]

(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 is 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 spacecraft.

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

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

1 hour = 3600 seconds.

Calculate the distance to the Voyager spacecraft.

Show all of your working.

One mark is for a clearly presented calculation.

distance .....

units ..... [4+1]

[Total: 14]

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

F

A218/01

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.

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Question Number	Answer	Max Mark
1(a)	Homeostasis;	
1(b)	Gets less / lower / drops;	[1]
1(c)i	Gets faster / higher / quicker;	[1]
	Uses data e.g. 85 beatas per min at 9000 feet and 123 beats per min at 29,000 feet;	[1] [1]
1(c)ii	**Two from:** frostbite blindness altitude sickness Cough **accept other correct responses e.g. increased r.b.c count**	[2]
	Communication – Spelling punctuation and grammar: **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.**	[1]
1(d)i	5 x 3;	[1]
	15;	[1]
1(d)ii	Kidneys excrete more water;	[1]
	sweating;	[1]
1(e)i	Ultra violet light causes blindness/More UV at high altitude;	[1]
1(e)ii	falling into precipice/fall off mountain	[1]
	Total marks	**[13]**

2(a)i	chlorine; **do not allow 'chloride'**	**[1]**
2(a)ii	green/yellow;	
	gas	**[2]**
2(b)	magnesium bromide / magnesium chloride	**[1]**
2(c)	**Advantages: Any three**	
	prevailing wind carries gases out to sea;	
	on coast/by the sea;	
	salts/bromide ions in sea water;	
	transport idea;	
	no nearby population centres	**[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 + sodium bromide → bromine + sodium fluoride	**[2]**
	1 left hand side, 1 right hand side	
2(e)i	increased/levelled off	**[1]**
2(e)ii	decreased	**[1]**
2(e)iii	must be other uses/not all used as fuel additives	**[1]**
	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)	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]**
	1 mark each, max 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 (= 1.35×10^{10})	**[1]**
	km	**[1]**
	Communication:	**[1]**
	The candidate has laid out the calculation in a clear and logical manner	
	Total marks	**[14]**
	Overall marks	**[40]**