OCR
RECOGNISING ACHIEVEMENT

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A321/02

GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A
Unit 1 Modules C1 C2 C3 (Higher Tier)

FRIDAY 18 JANUARY 2008

Afternoon
Time: 40 minutes

Candidates answer on the question paper.
Additional materials (enclosed):
None

Calculators may be used.
Additional materials: Pencil
Ruler (cm/mm)

CUP/T46540

Candidate Forename		Candidate Surname	
Centre Number		Candidate Number	

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- The Periodic Table is printed on the back page.

FOR EXAMINER'S USE		
Qu.	**Max**	**Mark**
1	6	
2	4	
3	4	
4	6	
5	8	
6	4	
7	7	
8	3	
TOTAL	42	

This document consists of **18** printed pages and **2** blank pages.

[Turn over

Answer **all** the questions.

1 Cars on motorways use the right hand lane for overtaking. The left hand lanes are used for slower vehicles.

From 2007, car pool lanes will be introduced on some motorways.
Only cars with two or more people in them will be allowed to drive in the right hand lane.

(a) The effect of car pool lanes is beneficial to those who use them and to the environment.

Here are **six** statements about the effects of car pool lanes.

A	Less fossil fuel will be extracted.
B	There will be traffic jams in the left hand lanes.
C	Journeys to work will be cheaper.
D	It will be dangerous to drive in the right hand lane.
E	There will be less air pollution.
F	Journeys to work will be faster.

(i) Which **two** statements from **A**, **B**, **C**, **D**, **E** or **F** benefit **only** those who use car pool lanes?

answer ..... and ..... [1]

(ii) Which **two** statements from **A**, **B**, **C**, **D**, **E** or **F** benefit the environment?

answer ..... and ..... [1]

(b) Pollution from car engines includes nitrogen oxides.

(i) How are nitrogen oxides produced in a car engine?

Put a tick (✓) in the box next to the **best** answer.

By the reaction of petrol with oxygen in the air. ☐

By reactions in catalytic converters. ☐

By the reaction of petrol with nitrogen in the air. ☐

By the reaction of nitrogen and oxygen from the air. ☐ [1]

(ii) Why are nitrogen oxides harmful?

Put ticks (✓) in the boxes next to the correct answers.

They react with carbon monoxide to make nitrogen. ☐

They cause breathing difficulties. ☐

They react with water and oxygen to make acid rain. ☐

They stop photosynthesis in plants. ☐ [1]

(c) Which of the following will reduce nitrogen oxide pollution from cars?

Put ticks (✓) in the boxes next to the correct answers.

Using low sulfur fuel. ☐

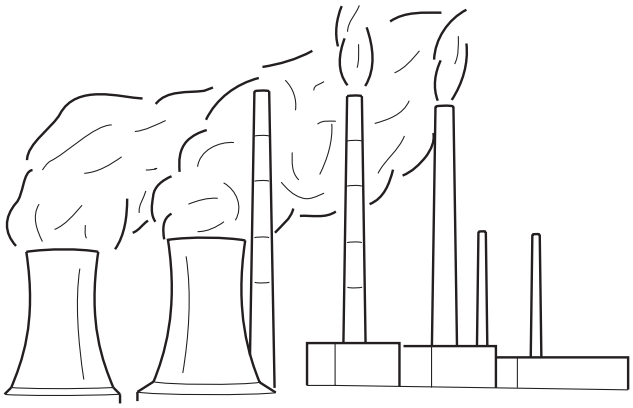
Building cars that last longer. ☐

Adding catalytic converters to car exhaust systems. ☐

Making car engines that work at lower temperatures. ☐ [2]

[Total: 6]

2 This question is about pollution from power stations.



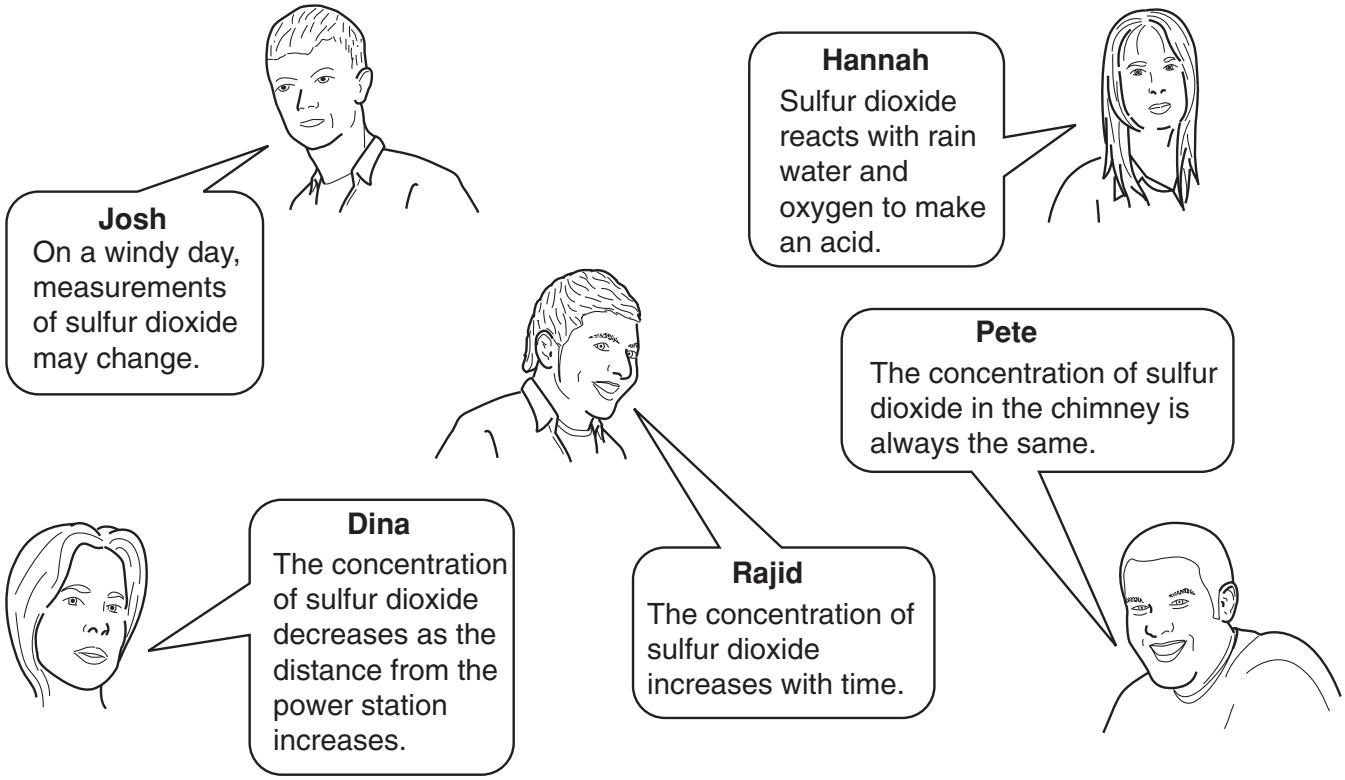
One of the pollutants from power stations is sulfur dioxide.

Sulfur dioxide levels are measured at different distances from a power station. The table shows the results on one day.

distance from power station m	**concentration of sulfur dioxide µg / m^3**
0	64
500	50
1000	14
1500	8
2000	3

Levels of sulfur dioxide higher than 50 µg/m^3 are considered harmful to humans.

Here is what five students said about the data in the table.



(a) Which **one** person has described the correlation in the table?

..... [1]

(b) On another day, the concentrations of sulfur dioxide are lower.

Which **two** people have suggested explanations for this change?

..... [2]

(c) Who has explained how sulfur dioxide is removed from the air?

..... [1]

[Total: 4]

3 This question is about chemical reactions.

Petrol is a liquid fuel. In a car engine, it burns in oxygen from the air to transfer energy.

The products of this reaction are carbon dioxide and water vapour.

Carbon dioxide and water vapour are gases.

(a) Which of the following statements show that the properties of **reactants** are different from properties of **products** of this reaction?

Put ticks (✓) in the boxes next to the correct answers.

Petrol is a liquid and oxygen is a gas. ☐

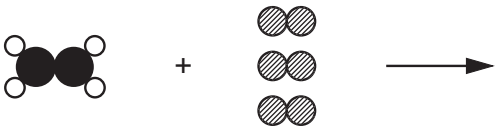
Petrol is a liquid and carbon dioxide and water vapour are gases. ☐

Water vapour condenses in the air. ☐

Petrol burns while carbon dioxide and water vapour do not. ☐

[1]

(b) Complete the diagram below to show the products made when the hydrocarbon ethene is burned in oxygen.



ethene + oxygen ⟶ carbon dioxide + water

key	
●	carbon atom
○	hydrogen atom
◍	oxygen atom

[3]

[Total: 4]

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Question 4 starts on page 8.

PLEASE DO NOT WRITE ON THIS PAGE

4 A supermarket is encouraging customers to re-use plastic carrier bags.

These carrier bags are made of polythene.

(a) Finish each sentence about polythene.

(i) The raw material used to make polythene is …… . [1]

(ii) The process of forming long chains by joining small molecules is called

…… . [1]

(b) The supermarket plans to make their bags **thicker**.

They say this will improve the Life Cycle Assessment (LCA) of the bags.

Which of the following statements when **put together** explain this?

Put ticks (✓) in the correct boxes.

Plastic bags are disposed of in landfill.	☐
Thicker bags are heavier.	☐
Thicker bags last longer.	☐
Transporting thicker bags is more expensive.	☐
The total amount of plastic used is less.	☐
Making thicker bags uses more energy.	☐

[1]

(c) Plastic bags can be disposed of by **landfill** or **incineration**.

Write down the name of another method of disposal.

answer …… [1]

(d) Some scientists believe that incineration is a better way of disposing of plastic bags than landfill.

Which **two** of the following statements when **put together** explain why **incineration** has less environmental impact than **landfill**?

Put ticks (✓) in the boxes next to the **two** correct answers.

They are burned at high temperatures.	☐
The energy made when they burn is wasted.	☐
The need for burning fuel from crude oil is reduced.	☐
Incinerators need energy to be built.	☐
The waste has to be collected.	☐
The energy made when they burn is used.	☐

[1]

(e) It is possible to make **biodegradable** plastic bags.

What is the advantage of biodegradable plastic bags?

Put a tick (✓) in the box next to the **best** answer.

There is no need to take them to landfill.	☐
Carbon dioxide is released as the bags biodegrade.	☐
They take up space in landfill but then rot away.	☐
They don't take up space in landfill.	☐

[1]

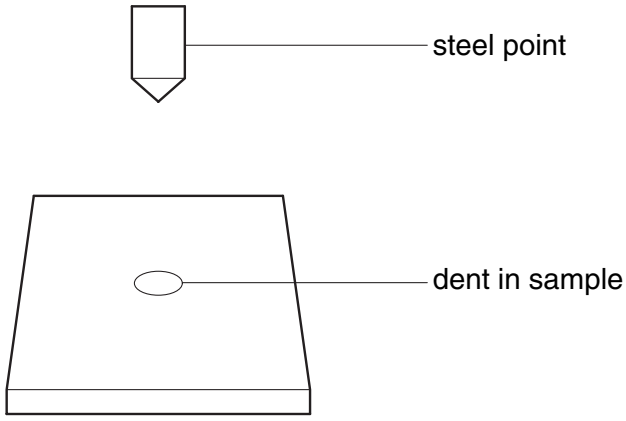
[Total: 6]

5 A scientist measures the hardness of two different materials, **X** and **Y**.

A machine presses a steel point into samples of each material.

The machine uses the same force each time.

A hardness number is calculated from the size of the dent in the sample: the higher the number the harder the material.



(a) Each type of material is tested several times. The results are shown in the table.

	hardness number						
material	**sample 1**	**sample 2**	**sample 3**	**sample 4**	**sample 5**	**sample 6**	**mean**
X	8	10	9	8	7	12	9
Y	18	20	16	7	21	20	19

The mean hardness has been calculated for each material.

One result has not been used to calculate the mean for **material Y** because it is an outlier.

(i) Which result is the outlier?

Put a (ring) around the correct sample number.

1 **2** **3** **4** **5** **6** [1]

(ii) Here are four suggestions why this test gave the wrong result.

A	Samples of X and Y had been mixed up.
B	The steel point had been pressed with a larger force.
C	The steel point had been pressed with a smaller force.
D	The steel point had not been pressed into the sample.

Write down the letters of the **two** best suggestions.

answer ..... and ..... [2]

(b) All the test results for material X are reliable, but there are small differences between their values.

Why are these values different?

Put a tick (✓) in the box next to the correct answer.

Samples of X and Y had been mixed up. ☐

Samples of X may vary. ☐

It is not a fair test. ☐

The steel point had not been pressed into the samples. ☐ [1]

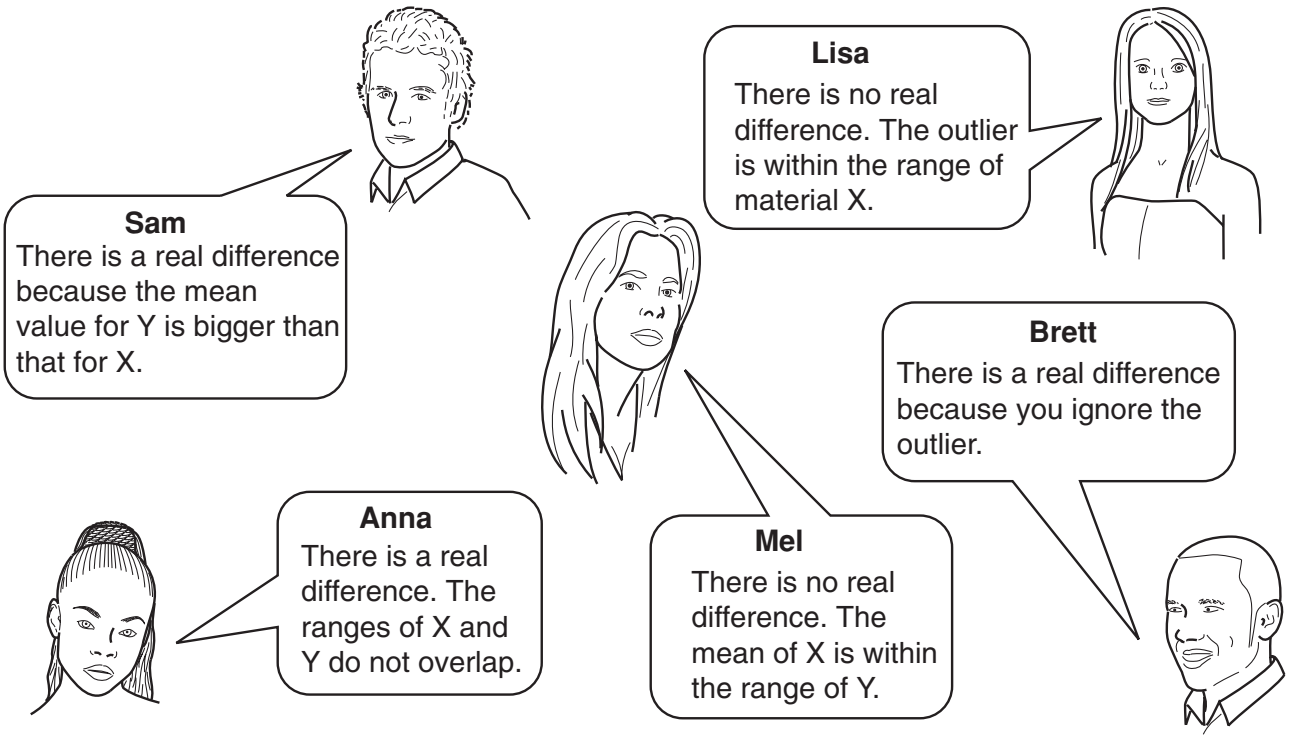
(c) Complete the table below to show the range of hardness number for material X.

	range
Range for X	

[1]

(d) Five students are discussing whether there is a **real difference** in the hardness of the two materials.

Here is what they say.



Who is giving the right answer **and** the right explanation for this answer?

..... [1]

(e) Material Y is a polymer with cross-links in it.

These cross-links make the polymer stronger.

(i) Which of the following statements explains this?

Put a tick (✓) in the box next to the correct answer.

Larger atoms are used to make the cross-links.	☐
The polymer molecules slide over each other more easily.	☐
Cross-links make the polymer molecules longer.	☐
The polymer molecules cannot slide past each other.	☐

[1]

(ii) Cross-linking also gives the polymer a higher melting point.

Which **two** of the following statements can be **put together** to explain this?

Put ticks (✓) in the boxes next to the **two** correct answers.

Cross-links make strong forces inside molecules.	☐
Cross-links make strong forces between molecules.	☐
More energy is needed to break up each polymer molecule.	☐
Cross-links put different atoms into polymer molecules.	☐
More energy is needed to break the polymer molecules apart from each other.	☐

[1]

[Total: 8]

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Question 6 starts on page 14.

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6 Read this article from a national newspaper.

There will be no more blue Smarties

The manufacturer is removing all artificial colours from Smarties. There is no natural alternative to the blue chemical used now.

The blue will be replaced by a white Smartie.

A recent study showed a possible harmful effect on the nervous system due to artificial colours and chemicals.

The blue colouring may cause hyperactivity and skin rashes. It is also listed as a cancer risk by the US Environmental Protection Agency.

A scientist said 'It is great news for children's health. We would now like to see the Government announce a total ban on the blue colouring.'

(a) Why are blue Smarties no longer being made?

Put a tick (✓) in the box next to the **best** answer.

Eating a blue Smartie will give all children a rash. ☐

All children who eat blue Smarties will develop health problems. ☐

The blue colouring may make some children hyperactive. ☐

All artificial additives will harm children. ☐ [1]

(b) Why would the scientist like to see the Government ban the blue colour?

Put a tick (✓) in the box next to the **best** answer.

To stop blue Smarties from being made. ☐

The blue colour is used in other foods. ☐

So the risk can be measured. ☐

To make Smarties cheaper. ☐

To reduce the risk to children's health. ☐ [1]

(c) Here are three statements about food additives.

Put ticks (✓) in the correct boxes to show whether each statement is **true** or **false**.

	true	**false**
Additives with an E number have passed a safety test.		
Preservatives slow down the growth of microbes.		
All natural additives are harmless.		

[2]

[Total: 4]

7 The Government is worried about the increase in childhood obesity.
The number of 2 to 11 year olds who are obese has risen steadily over the past 10 years, and there is a known link between obesity and type 2 diabetes.

(a) Politicians want to pass laws to help reduce childhood obesity.
The lists show some possible **actions** by the Government and the **results** they hope to achieve.
Draw a straight line from each **action** to the matching **result.**

action	result
	children won't know it is available.
banning chocolate machines from schools	
	children will get better food at home.
banning junk food advertising	
	no-one will be able to buy unhealthy food from shops.
educating new parents on nutrition	
	at least one meal a day will be of good standard.
setting nutritional standards for school dinners	
	these foods will be less easily available.

[3]

(b) Being overweight is a leading risk factor for type 2 diabetes.

(i) What information do you need to find the real risks of children developing type 2 diabetes?

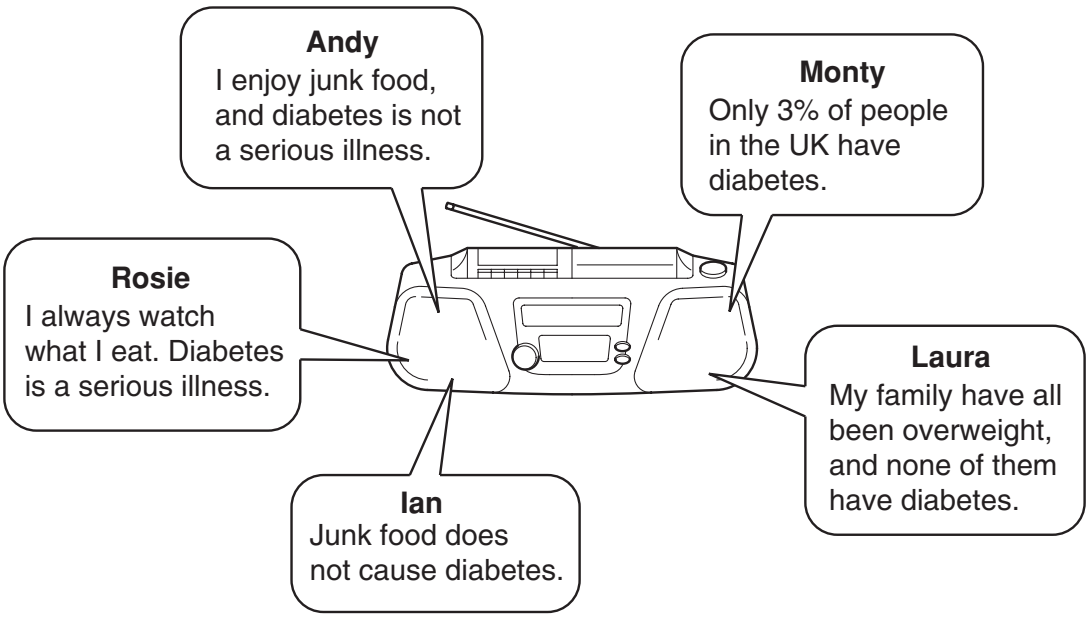
Put ticks (✓) in the boxes next to the correct answers.

The chance of overweight children becoming overweight adults.	☐
The chance of diabetes occurring in overweight children.	☐
The consequences of being diabetic.	☐
The exercise habits of children.	☐

[2]

(ii) Five people are interviewed on a radio programme about their health and diet.

Here is what they say.



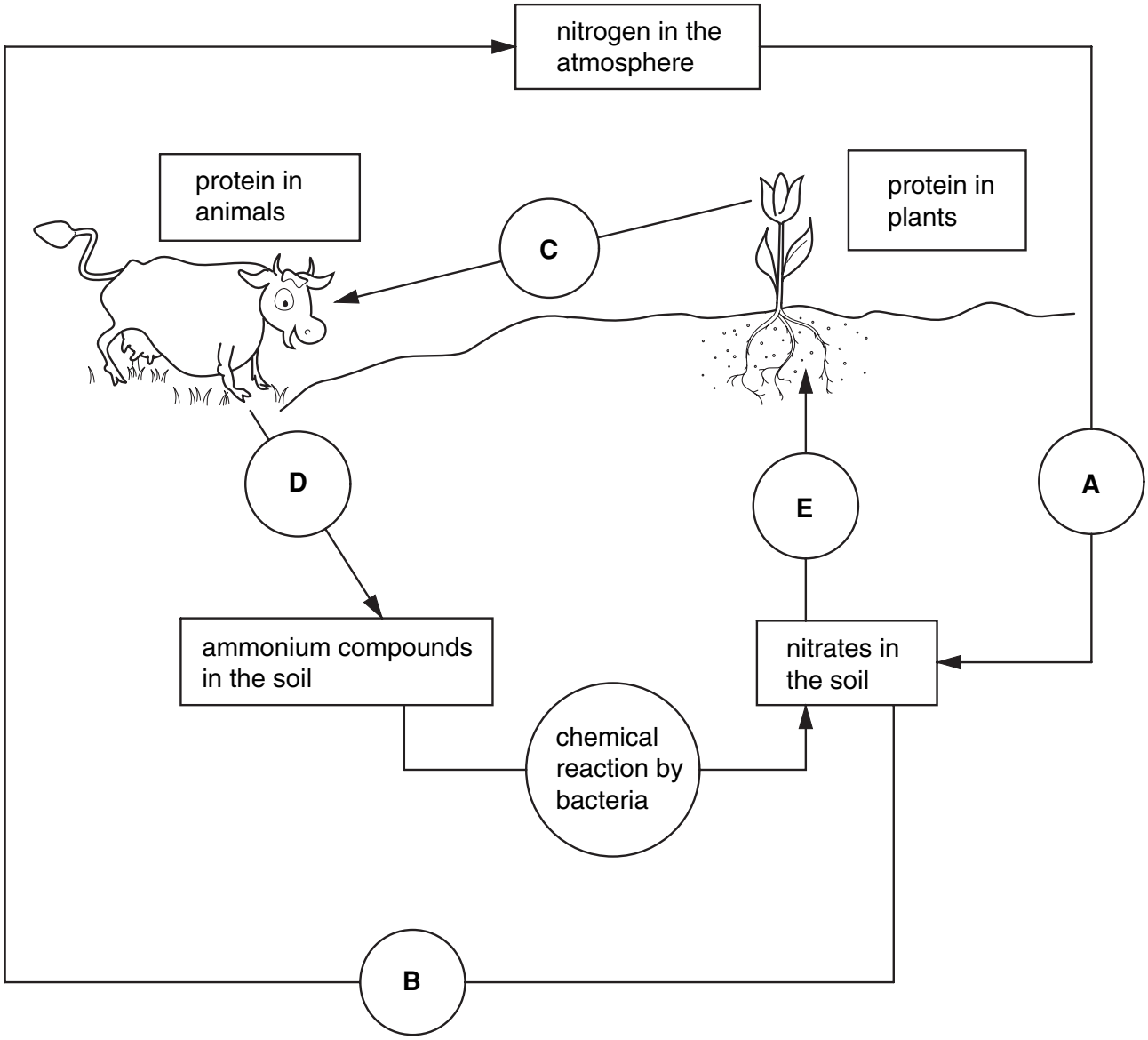
Which people are giving a reason to accept the risk of eating a poor diet?

answer ..... and ..... [2]

[Total: 7]

8 This question is about the nitrogen cycle.

A simplified diagram of the nitrogen cycle is shown below.



A, **B**, **C**, **D** and **E** are all processes in the cycle of nitrogen atoms on the earth.

(a) Write down the letters of **two** processes in the cycle which involve the formation of amino acids.

answer ..... and ..... [2]

(b) Process **A** shows nitrogen being taken from the air and put into the ground.

In which **two** ways can this happen?

Put ticks (✓) in the boxes next to the **two** correct answers.

Bacteria in the soil that turn nitrates into nitrogen.	☐
Bacteria in the roots of some plants.	☐
Lightning.	☐
Decomposition.	☐

[1]

[Total: 3]

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							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 **Sn** 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	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.