UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

9351351753

CO-ORDINATED SCIENCES **0654/02**

Paper 2 (Core) **October/November 2009**

2 hours

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 soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
A copy of the Periodic Table is printed on page 24.

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.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total	

This document consists of **24** printed pages.

For Examiner's Use

1 **(a)** In an electrical appliance, electricity is transformed into a different form of energy.

State the **useful** energy transformation in

(i) an electric oven, ... [1]

(ii) an electric drill. ..... [1]

(b) Fig. 1.1 shows the parts of an electric iron.

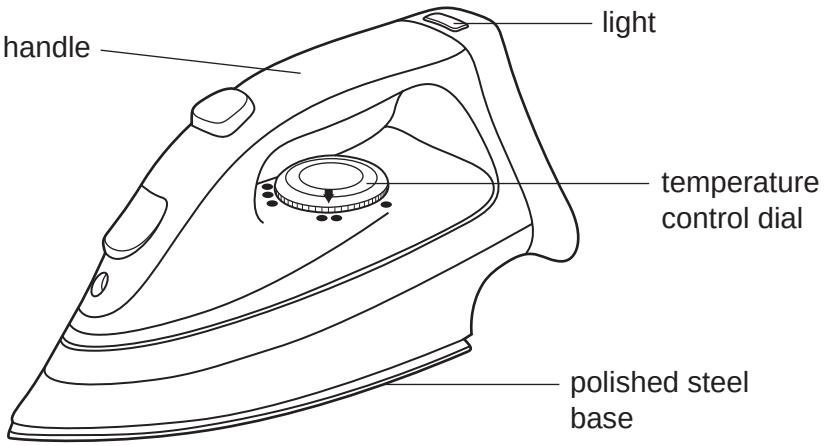


Fig. 1.1

Choose words from the list below to fill in the gaps in the sentences.

electricity	**friction**	**gravity**	**heat**
high	**low**	**poor**	**sound**

The base of the iron is made from steel because steel is a good conductor of ..... and because steel has a ..... melting point. The steel is polished until it is very smooth to reduce the force of ..... between the iron and the clothes. [3]

For Examiner's Use

2 Fig. 2.1 shows the approximate percentage by mass of elements combined in the Earth's crust.

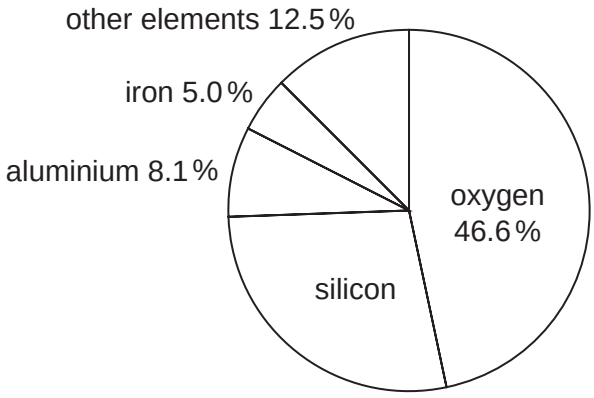


Fig. 2.1

(a) Calculate the percentage by mass of silicon in the Earth's crust.

..... % [1]

(b) Pure silicon is used in the manufacture of many types of electronic devices.

All of the silicon in the Earth's crust is found combined in compounds such as silicon dioxide, SiO_2. Silicon can be obtained by heating a mixture of silicon dioxide and carbon.

A symbolic equation for this reaction is shown below.

$$SiO_2 + C \rightarrow Si + CO_2$$

Explain why this is an example of a reduction / oxidation (redox) reaction.

.....

.....

..... [2]

(c) Aluminium is found in the Earth's crust combined in compounds such as aluminium oxide.

Fig. 2.2 shows a diagram of the process used to extract aluminium from aluminium oxide.

Choose labels from the list below and write them into the correct places in Fig. 2.2.

aluminium **anode** **cathode** **electrolyte**

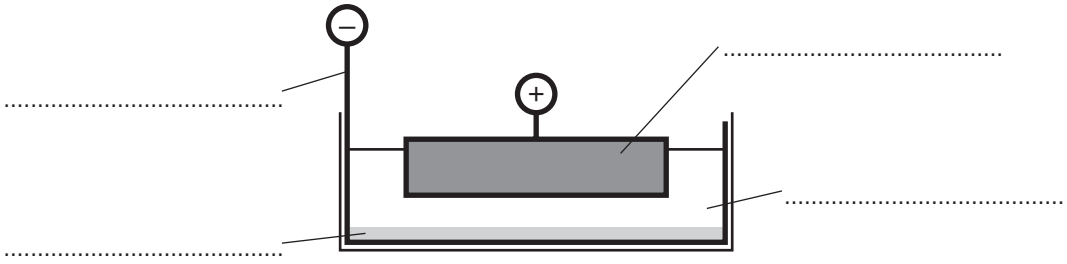


Fig. 2.2

[2]

(d) Clay consists of very small, insoluble solid particles. These particles come from rocks and are found in some types of soil.

(i) Name **one** process by which a rock can be turned into a soil containing clay.

..... [1]

(ii) When some types of clay are shaken with water, a cloudy, non-transparent mixture is produced. Fig. 2.3 shows a diagram of how such a mixture appears when magnified.

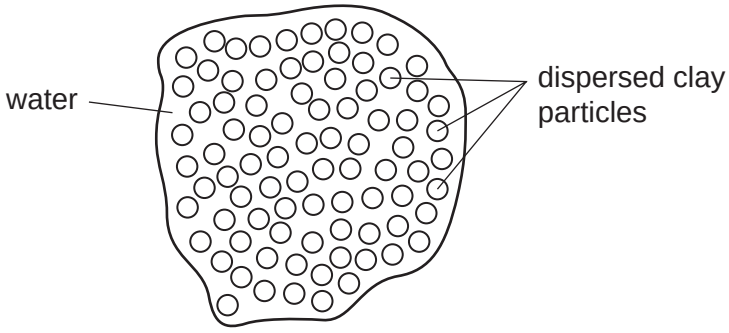


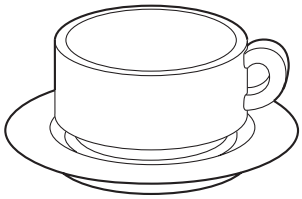
Fig. 2.3

Name the type of mixture shown in Fig. 2.3.

..... [1]

For Examiner's Use

(iii) Clay is the raw material for ceramic objects such as cups and saucers.



Describe briefly how a cup made of clay is treated to convert it into a ceramic cup.

.....

[1]

For Examiner's Use

3 Soy beans (soyabeans) are grown for their seeds. The seeds are an excellent source of protein and starch, and are used in the production of a wide variety of foods.

(a) (i) Suggest the advantage to soy bean plants of having seeds that contain protein and starch.

.....

..... [2]

(ii) Explain why we need protein and starch in our diet.

protein .....

starch ..... [2]

(iii) Describe how you could test a sample of soy bean seeds for protein.

.....

.....

..... [2]

(b) Soy beans have been cultivated for hundreds of years, and many different varieties are grown.

The more soy bean plants grow, the more seeds they produce.

An investigation was carried out to find out how four different varieties of soy beans would be affected if the concentration of carbon dioxide in the atmosphere increased.

Four varieties were used, called Arksoy, Dunfield, Mukden and Mandarin.

Several plants of each variety were grown in normal concentrations of carbon dioxide. Another set of plants of each variety was grown in a high concentration of carbon dioxide.

The mean mass of seeds produced per plant was measured at each carbon dioxide concentration. The results are shown in Table 3.1.

Table 3.1

variety	mean mass of seeds per plant / g	
	in normal carbon dioxide concentration	in high carbon dioxide concentration
Arkoy	30.8	42.4
Dunfield	46.1	55.9
Mukden	41.4	56.5
Mandarin	31.3	58.4

(i) State which variety of soy bean gives the highest yield of seeds in normal carbon dioxide concentration.

..... [1]

(ii) State which variety of soy bean showed the greatest increase in seed production at high carbon dioxide concentration compared with normal carbon dioxide concentration.

..... [1]

(iii) Suggest why the plants grew more at high carbon dioxide concentration than at normal carbon dioxide concentration.

.....

..... [1]

(iv) Suggest and explain why it is important to find out how crops grow in carbon dioxide concentrations that are greater than in our present atmosphere.

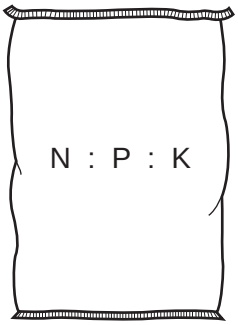
.....

.....

..... [2]

[Turn over

4 Some types of fertiliser have the letters NPK on the package label, indicating the chemical symbols of three elements contained in the fertiliser.



(a) (i) Two of the elements shown in the name NPK are in the same group of the Periodic Table.

State the group number of the Periodic Table which contains these two elements.

..... [1]

(ii) State and explain which of the elements shown in the name NPK contains atoms that have their electrons arranged as shown in Fig. 4.1.

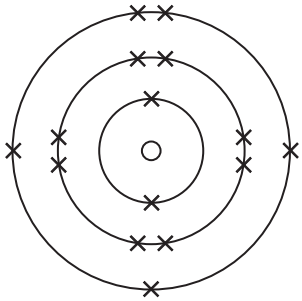


Fig. 4.1

element .....

explanation .....

.....

..... [2]

(b) (i) State which of the elements in an NPK fertiliser is found in amino acids.

..... [1]

(ii) Describe briefly how amino acids react together in plants, and name the type of compound which is formed.

.....

.....

..... [2]

(c) Ammonia is an important compound that is used in the manufacture of NPK fertilisers.

Fig. 4.2 shows a simplified diagram of the type of reaction vessel that is used in the production of ammonia.

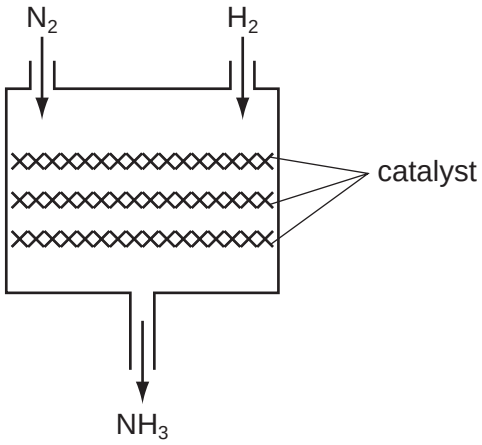


Fig. 4.2

(i) Use the chemical formulae shown in Fig. 4.2 to explain the difference between an element and a compound.

.....

.....

..... [2]

(ii) Describe a chemical test which could be used to show that the gas coming out of the reaction vessel contained some ammonia.

.....

.....

..... [2]

For Examiner's Use

5 An aluminium can containing a fizzy drink is shown in Fig. 5.1.
There is information printed on the can.

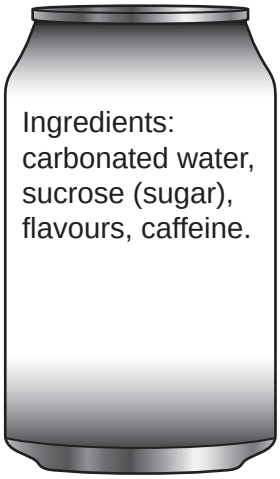


Fig. 5.1

(a) (i) Name the gas in the drink which makes it fizzy.

..... [1]

(ii) Describe a test and the expected result for this gas.

.....

..... [2]

(b) The empty can may be recycled by melting it down.

The mass of the aluminium in the can is 15 g and its volume is 5.6 cm^3.

(i) Calculate the density of aluminium.

State the formula that you use and show your working.

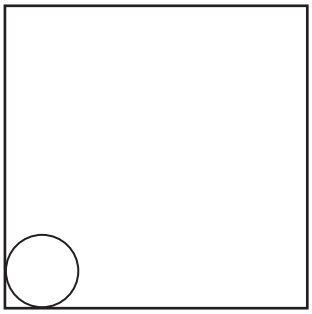
formula

working

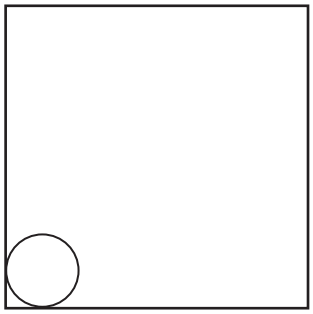
..... g/cm^3 [2]

For Examiner's Use

(ii) Draw diagrams to show the arrangement of aluminium atoms in solid aluminium and liquid aluminium. One atom has already been drawn in each diagram.



solid



liquid

[2]

(c) Some fizzy drinks contain a lot of sugar.

Explain why too much sugar in the diet is unhealthy.

.....

..... [2]

(d) Fig. 5.2 shows apparatus set up to measure the specific heat capacity of aluminium.

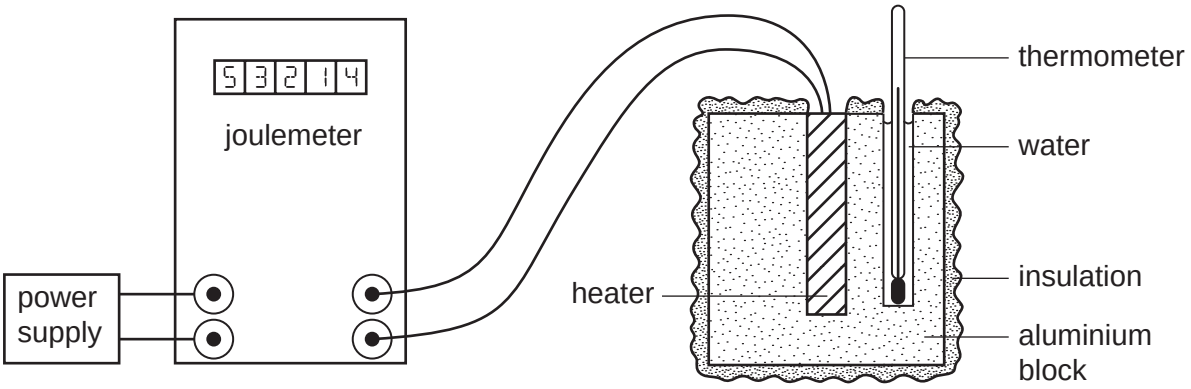


Fig. 5.2

The block is heated electrically and the electrical energy input is measured using a joulemeter.

The temperature of the block and the total electrical energy supplied are measured at intervals.

Fig. 5.3 shows the results.

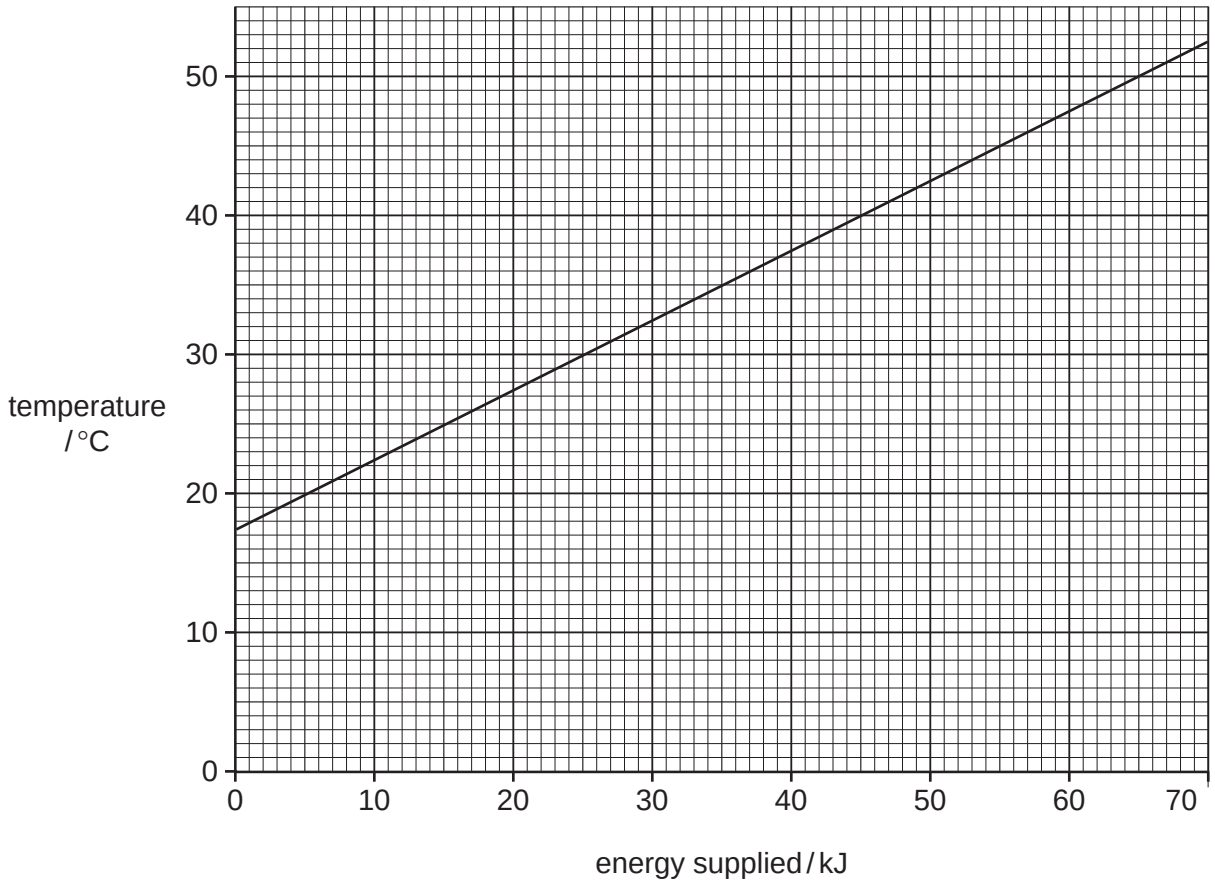


Fig. 5.3

For Examiner's Use

(i) State the relationship between the temperature and the energy supplied.

.....

..... [1]

(ii) Use the graph to calculate the energy needed to raise the temperature of the block from 25 °C to 45 °C.

Show your working on the graph.

..... J [2]

(iii) Define the term *specific heat capacity*.

.....

..... [1]

(iv) The temperature of the block rose from 25° C to 45 °C in 600 seconds.

Use your answer from **(ii)** to calculate the electrical power during this time.

State the formula that you use and show your working.

formula

working

..... W [2]

(v) The voltage of the power supply in Fig. 5.2 is 12 V. It is fitted with a 10 amp fuse.

Use the formula

power = voltage x current

to explain why this fuse is adequate for this experiment.

.....

.....

..... [2]

For Examiner's Use

(e) A thin sheet of aluminium is placed between a radioactive source and a radiation detector. The source emits one type of radiation only.

The radiation detected is reduced but not completely stopped.

(i) Suggest which type of radiation is being used and explain your answer.

.....

.....

..... [2]

(ii) A thin sheet of another metal will completely stop this type of radiation. Suggest what this metal could be.

..... [1]

For Examiner's Use

6 Fig. 6.1 shows the main bones, muscles and tendons in the human arm.

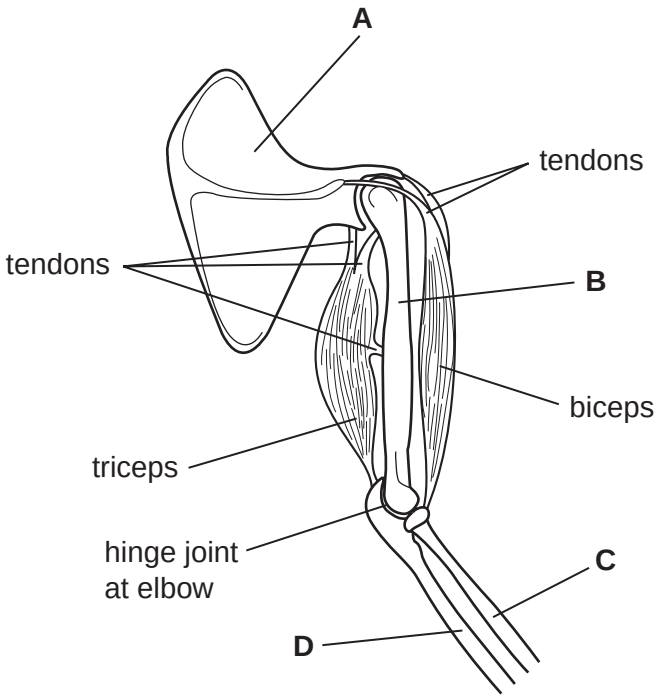


Fig. 6.1

(a) Give the letter of each of the following bones.

scapula .....

humerus .....

ulna .....

radius ..... [2]

(b) Describe the roles of each of the following structures in helping to make the arm bend at the elbow.

(i) biceps muscle

.....

.....

..... [2]

(ii) tendons

.....

..... [1]

For Examiner's Use

(c) Muscles have a good blood supply. The blood brings oxygen and nutrients to the muscle.

(i) Name the **type** of blood vessel that

carries blood from the heart towards a muscle, ...

delivers blood close to the muscle cells. ..... [2]

(ii) State two changes that take place in the body and help to supply the muscles with more oxygen more quickly during exercise.

1 .....

.....

2 .....

..... [2]

7 Two processes carried out at an oil refinery are shown in Fig. 7.1 and Fig. 7.2.

For Examiner's Use

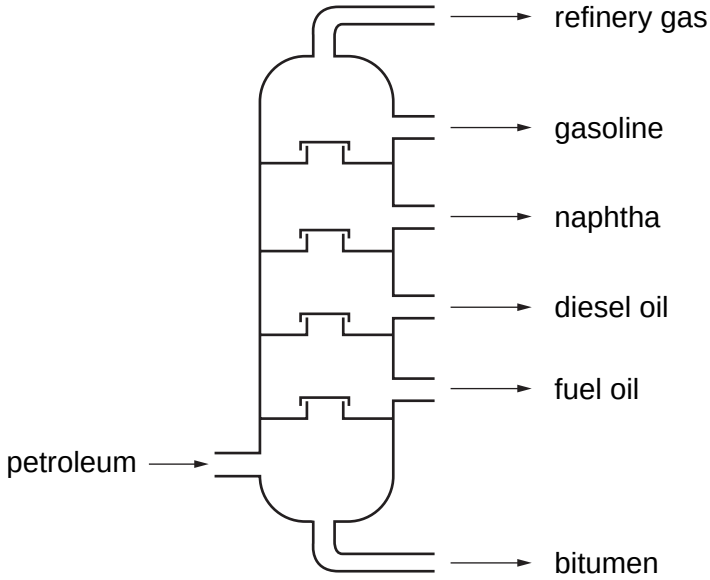


Fig. 7.1

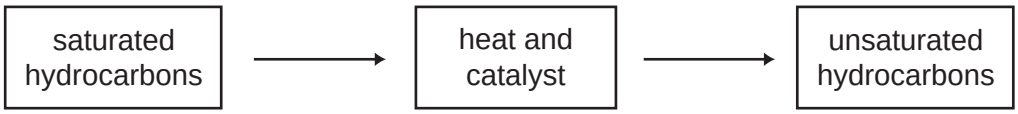


Fig. 7.2

(a) (i) Name the process in Fig. 7.1. ..... [1]

(ii) State two ways in which the properties of gasoline are different from those of fuel oil.

1 .....

.....

2 .....

..... [2]

(iii) Petroleum (crude oil) is a fossil fuel. Suggest why petroleum contains a very large amount of the element carbon.

.....

.....

..... [2]

For Examiner's Use

(b) (i) Name the process in Fig. 7.2. ..... [1]

(ii) Complete the spaces in the following passage using only words chosen from the list.

alcohols	**alkenes**	**fractions**
oils	**saturated**	**unsaturated**

Most of the compounds in petroleum are hydrocarbons. Compounds called alkanes are known as ..... hydrocarbons. Compounds called ..... are known as ..... hydrocarbons. [2]

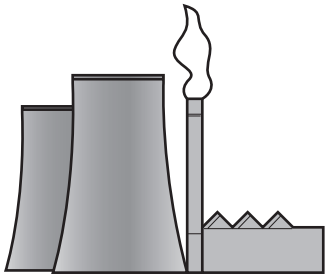
(iii) Explain why it is **not** possible for an alkene molecule to have less than two carbon atoms per molecule.

.....

.....

..... [2]

(c) Fuel oil is used as an energy source in some power stations. Fuel oil contains sulfur compounds. These increase air pollution if they burn with the fuel oil.



Describe and explain the damage that would be caused to the environment if sulfur compounds are **not** removed from fuel oil before it is burnt.

.....

.....

.....

..... [3]

For Examiner's Use

8 **(a)** Humans keep a constant concentration of glucose in the blood and a constant internal body temperature.

(i) State the term for the maintenance of a constant internal environment.

..... [1]

(ii) Name the part of the digestive system from which glucose is absorbed into the blood.

..... [1]

(iii) Describe how the pancreas helps to bring blood glucose level down to normal, if the concentration rises too high.

.....

..... [1]

(iv) Name the condition that results if the pancreas cannot regulate blood glucose.

..... [1]

(v) Describe how an embryo developing in the uterus is supplied with glucose.

.....

.....

..... [2]

For Examiner's Use

(b) One way in which body temperature is kept constant is by sweating.

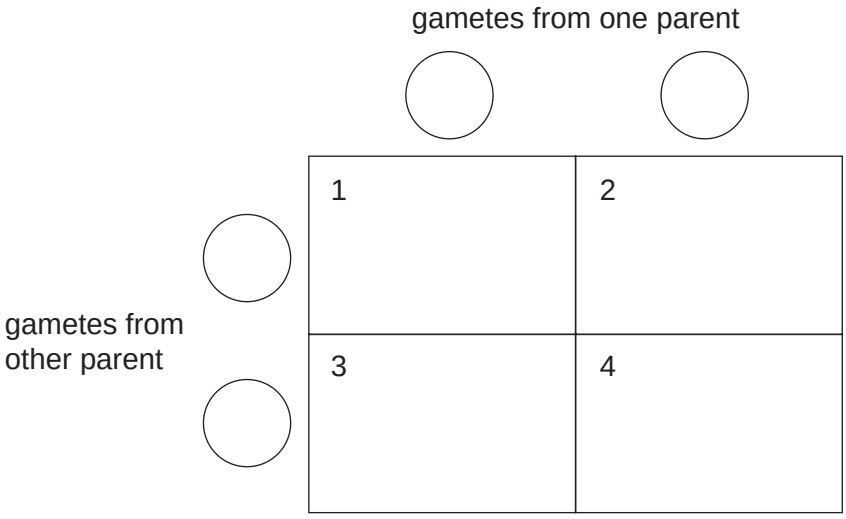
A gene has recently been discovered which affects the ability to smell a particular component of male sweat.

The gene has two alleles. Allele **A** is dominant and causes the ability to smell this substance. Allele **a** is recessive and causes inability to smell it.

(i) Complete the genetic diagram to show the expected genotypes **and** phenotypes of the offspring of two parents who are both heterozygous for these alleles.

genotypes of parents **Aa** .....

gametes ○ and ○ ○ and ○



phenotypes of offspring 1 ..... 2 .....

3 ..... 4 ..... [4]

(ii) The couple have one child. Use your answer to **(i)** to state the probability that this child **can** smell the substance.

..... [1]

For Examiner's Use

9 **(a)** An elephant of mass 4000 kg is moving at 0.5 m / s.

(i) Calculate the kinetic energy of the elephant.

State the formula that you use and show your working.

formula

working

.....J [2]

(ii) Show that the elephant has a momentum of 2000 kg m / s.

State the formula that you use and show your working.

formula

working

[2]

(b) An elephant lifts a mass of 300 kg through a vertical distance of 2 m.

(i) State the weight that the elephant lifts.

.....N [1]

For Examiner's Use

(ii) Calculate the work done by the elephant.

State the formula that you use and show your working.

formula

working

.....J [2]

(c) An elephant weighing 40 000 N stands with all four feet in contact with the ground. Each foot of the elephant has an area of $0.4\,m^2$.

Use the formula

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

to calculate the pressure exerted by the elephant on the ground.

Show your working

.....N/m^2 [2]

(d) Elephants live in hot countries and need to keep cool. Elephants' ears are large and contain many blood vessels.

Suggest how this allows elephants to cool down.

.....

..... [1]

For Examiner's Use

(e) Table 9.1 shows the lowest and highest frequencies that five mammals can hear.

Table 9.1

mammal	lowest frequency / Hz	highest frequency / Hz
cat	20	65 000
dog	25	50 000
elephant	5	10 000
human	20	20 000
rabbit	300	40 000

(i) What is meant by the term *frequency*?

.....

..... [1]

(ii) Which three mammals in Table 9.1 **cannot** hear a frequency of 45 000 Hz?

.....

.....

..... [1]

(iii) Which mammal in Table 9.1 can hear the widest range of frequencies?

..... [1]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	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	64 **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	**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	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr Francium 87	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

*58-71 Lanthanoid series
†90-103 Actinoid series

140 **Ce** Cerium 58	141 **Pr** Praseodymium 59	144 **Nd** Neodymium 60	**Pm** Promethium 61	150 **Sm** Samarium 62	152 **Eu** Europium 63	157 **Gd** Gadolinium 64	159 **Tb** Terbium 65	162 **Dy** Dysprosium 66	165 **Ho** Holmium 67	167 **Er** Erbium 68	169 **Tm** Thulium 69	173 **Yb** Ytterbium 70	175 **Lu** Lutetium 71
232 **Th** Thorium 90	**Pa** Protactinium 91	238 **U** Uranium 92	**Np** Neptunium 93	**Pu** Plutonium 94	**Am** Americium 95	**Cm** Curium 96	**Bk** Berkelium 97	**Cf** Californium 98	**Es** Einsteinium 99	**Fm** Fermium 100	**Md** Mendelevium 101	**No** Nobelium 102	**Lr** Lawrencium 103

Key: a over **X** over b

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).