Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3445U10-1

S19-3445U10-1

APPLIED SCIENCE (Double Award)

UNIT 1: Energy, Resources and the Environment

FOUNDATION TIER

WEDNESDAY, 12 JUNE 2019 – MORNING

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**13**	
2.	**8**	
3.	**16**	
4.	**7**	
5.	**12**	
6.	**11**	
7.	**8**	
Total	**75**	

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01

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the continuation pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

Question **3***(b)* is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

A periodic table is printed on page 24.

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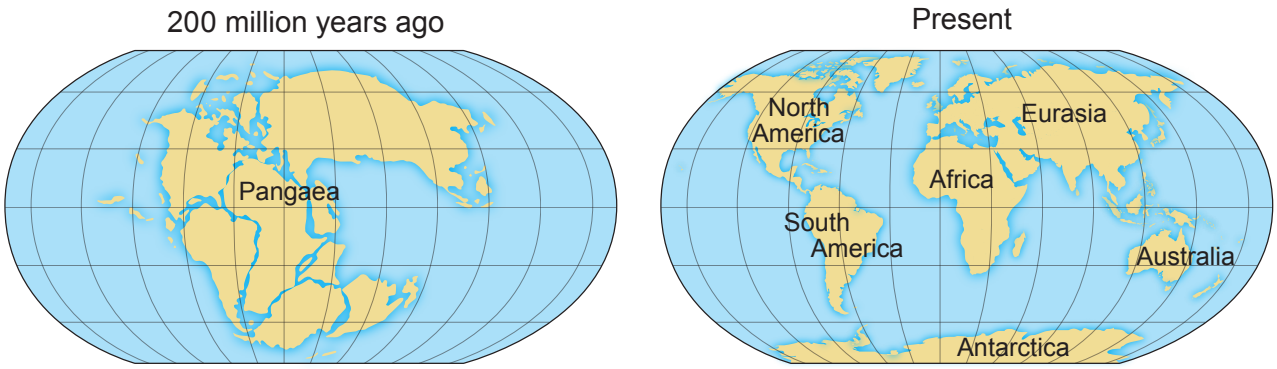
Answer **all** *questions.*

1. In 1912 Alfred Wegener suggested that all of the continents on Earth were once joined together in one supercontinent called Pangaea. These continents have since drifted apart. Wegener suggested a hypothesis called 'Continental Drift'.



(a) **Tick (✓) three** pieces of evidence that support Wegener's theory. [3]

Mountain ranges always form at the edge of each continent. ☐

The edges of continents fit like jigsaw pieces. ☐

The oceans get deeper at the continental edges. ☐

Similar rocks of the same age are found on facing sides of different continents. ☐

Similar shaped rivers are seen at each continental shoreline. ☐

Similar fossils are found on opposite sides of oceans. ☐

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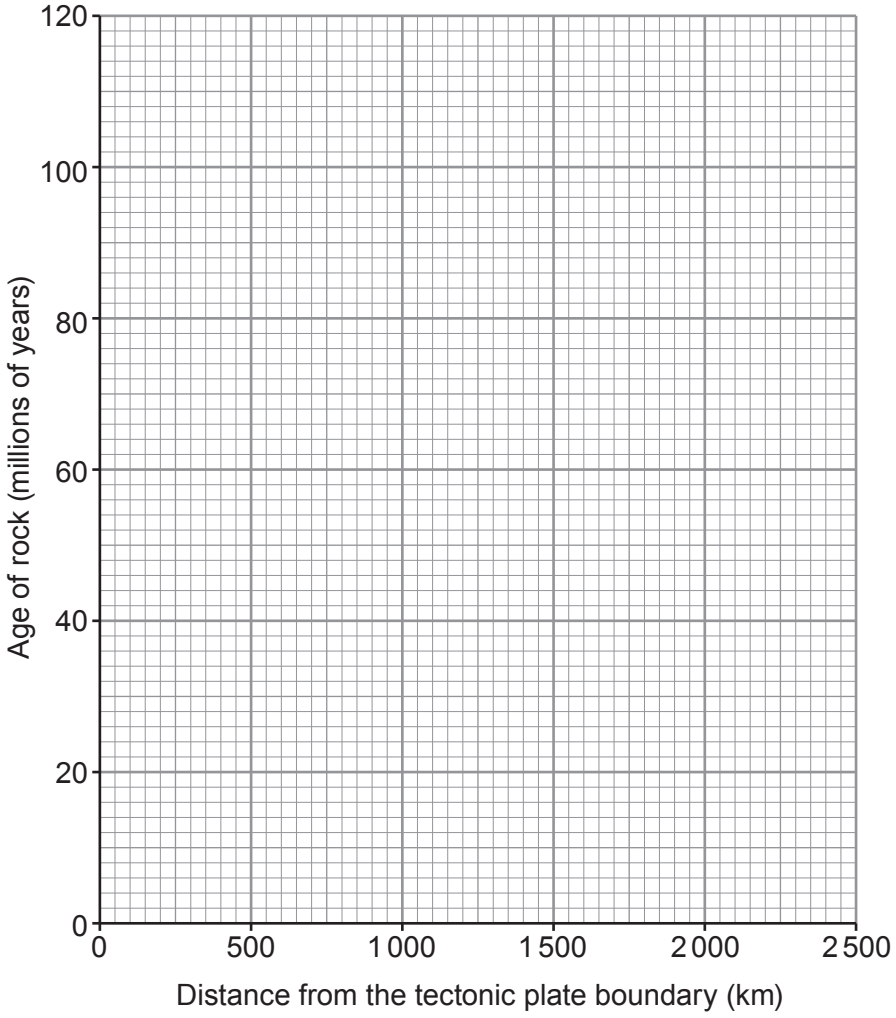
(b) The information in the table below shows the results from a geological survey around tectonic plate boundaries.

Distance from the tectonic plate boundary (km)	Age of rock (millions of years)
0	0
500	24
1000	45
1500	70
2000	90
2500	115

(i) Use the data in the table above to plot a graph on the grid below and draw a suitable line. [3]



Examiner only

(ii) Use your graph to estimate the age of rocks that are 750 km from the tectonic plate boundary. [1]

Age = ... millions of years.

(iii) Describe the trend shown by the graph. [1]

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(c) Use **only** the words in the box to complete the paragraph below. [3]

mantle	crust	core	convection	conduction	molten

The Earth's ..... is broken into large pieces called tectonic plates. These are constantly moving at a distance of a few centimetres each year. Over millions of years the movement has allowed whole continents to shift. This process is called continental drift. The plates move because of ..... currents in the Earth's ..... .

(d) State **two** natural disasters that can take place at a plate boundary. [2]

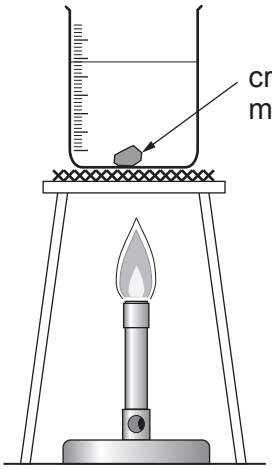
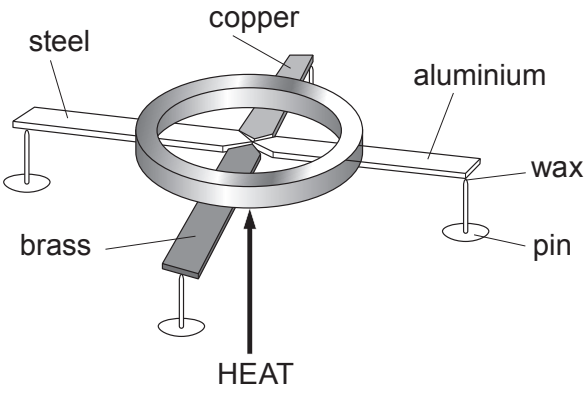
1. .....

2. .....

Examiner only

2. Heat can be transferred through materials by conduction, convection and radiation. Three groups of students carried out two experiments to show different methods of heat transfer.

They used the following equipment to perform the two experiments.

Experiment 1	Experiment 2
Experiment to show heat transfer through the liquid by ..... 	Experiment to show heat transfer through metals by ..... 

(a) **Complete the diagrams** above by identifying the type of heat transfer shown by each experiment. [2]

(b) The results of **Experiment 2** are shown in the table below.

Metal	Time taken for the pin to drop off (s)			
	Group 1	Group 2	Group 3	Mean
Steel	73	78	74	.....
Copper	14	15	13	14
Aluminium	20	19	18	19
Brass	35	37	46	36

(i) **Complete** the table. [1]

(ii) **Circle** the anomalous result. [1]

Examiner only

(iii) Use the results to arrange the metals in order starting with the one that transfers heat the best. [1]

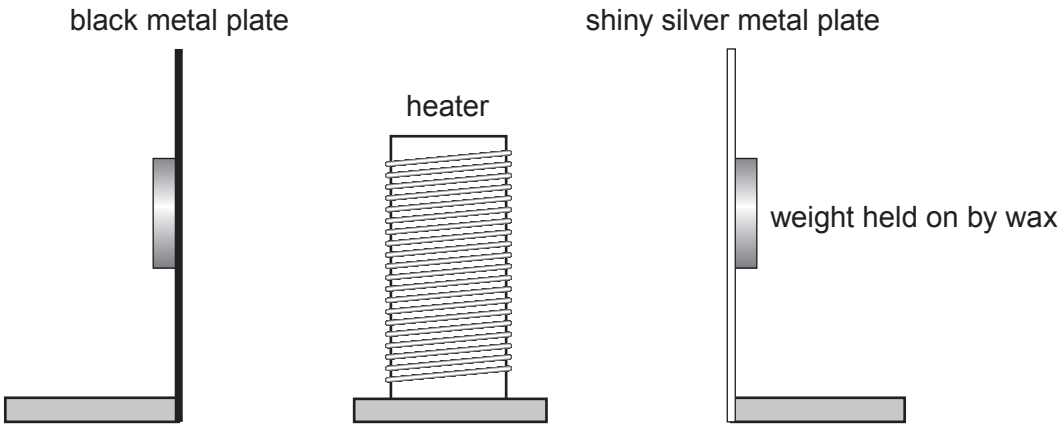
Best metal for transferring heat .....

.....

brass

Worst metal for transferring heat .....

(c) The students carried out another experiment as shown in the diagram below.



Explain why this experiment shows that the plates are heated by radiation and not by convection or conduction. [3]

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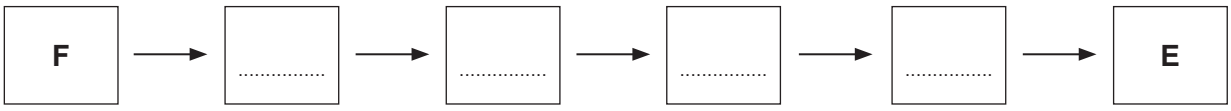
3. The water that is used in the home goes through a number of treatment steps.

(a) The steps that water undergoes before it passes into the home are given below. They are **not** in the correct order.

Step	Process	Description
A	Distribution	Water is transported through pipes underground
B	Filtration	Water is filtered through layers of sand and gravel removing small insoluble particles
C	Sedimentation	Large insoluble particles settle out by gravity
D	Chlorination	Water is disinfected to kill any remaining bacteria to make it safe to drink
E	Use	Water is used in the home
F	Collection	Water is collected and stored in reservoirs.

Arrange the steps in the **correct** order by completing the boxes below.
The first and last boxes have been completed for you. [3]



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(b) Pollutants can be found in drinking water making it unsafe to drink. Three students, Andrew, Robert and Malcolm investigated the solubility of a number of different salts at different temperatures.

Describe a method they could follow to find the solubility of a salt at different temperatures. [6 QER]

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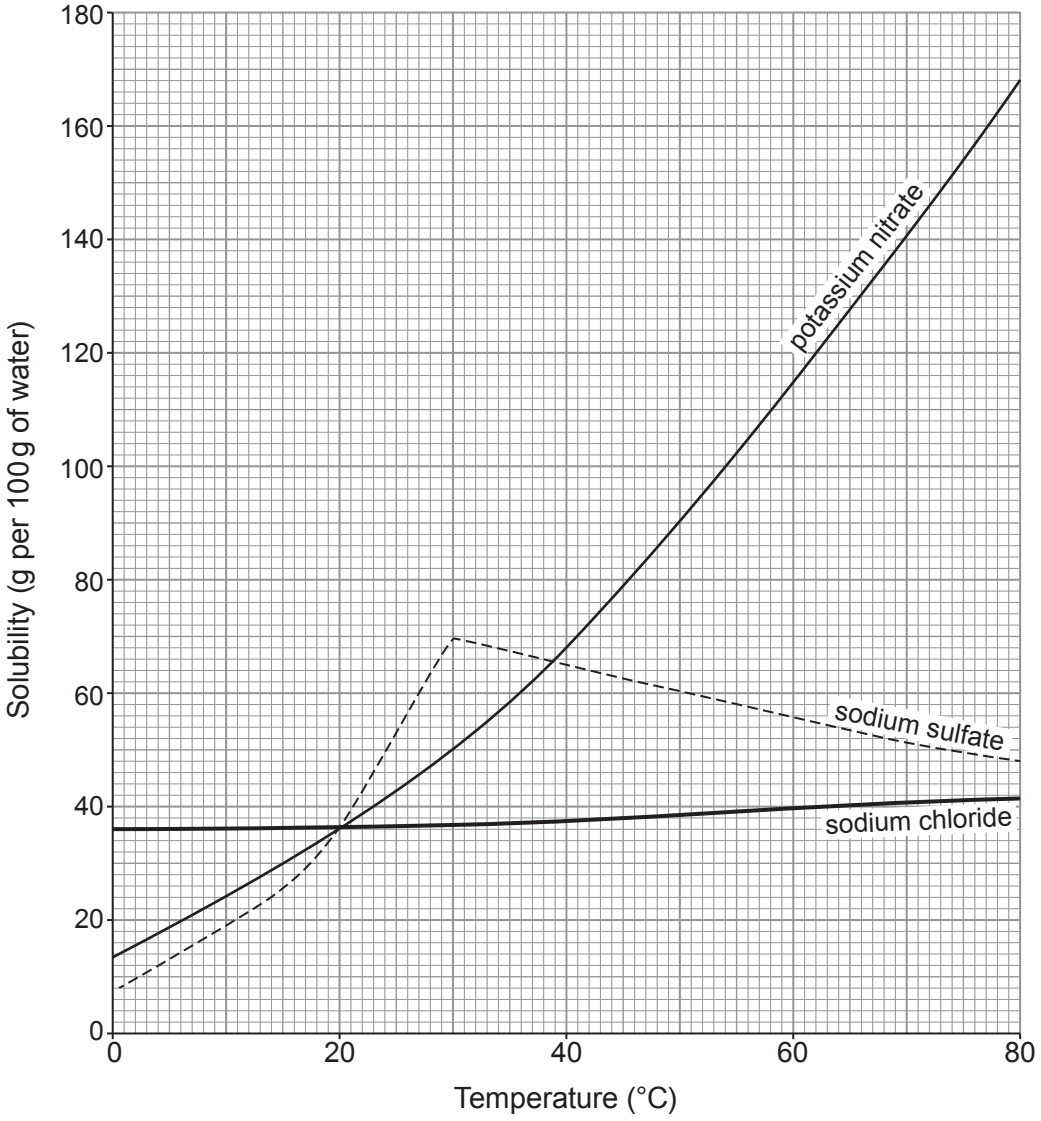
(c) The results of an investigation into the solubility of three salts are shown in the graph below.



(i) State which salt is the most soluble at 30 °C. [1]

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(ii) Calculate the difference in solubility between potassium nitrate and sodium chloride at 60 °C. [1]

Answer = ... g / 100 g of water

Examiner only

(iii) Compare the solubilities of potassium nitrate and sodium sulfate between 30 °C and 60 °C. [3]

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(d) Sam, a school technician, found a salt in an unlabelled container. She followed the same method as the students and her results are shown below.

Temperature (°C)	Solubility of unknown salt (g per 100 g of water)
10	24.0
30	52.0
50	120.0

Sam compared her results with the graph and identified the salt as potassium nitrate. Explain why Sam made this conclusion and whether she was correct to do so. [2]

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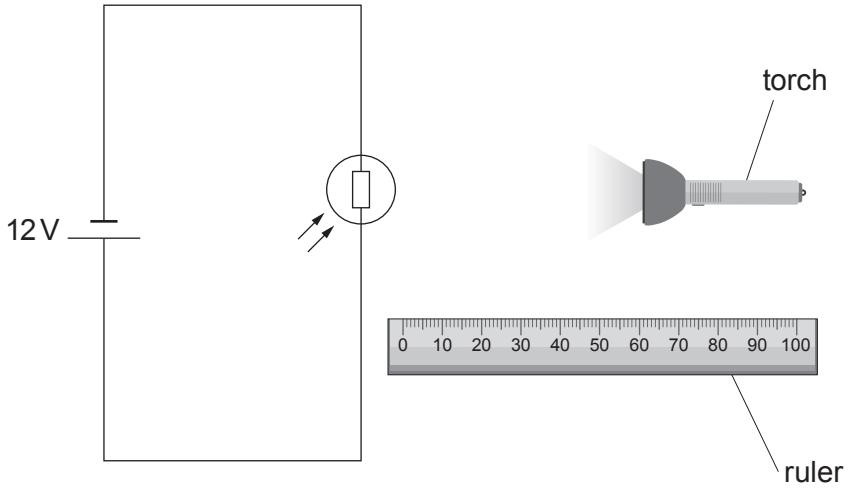
Turn over.

Examiner only

4. Dafydd, a year 10 student, set up a circuit to investigate the properties of a light dependent resistor (LDR). He changed the distance between a torch and the LDR. He then took measurements of current and voltage to calculate the resistance of the LDR.



(a) (i) **Complete** the circuit above by adding an ammeter to measure the current through the LDR and a voltmeter to measure the voltage across the LDR. [2]

(ii) The results of Dafydd's experiment are shown in the table below.

Distance of the torch from the LDR (cm)	Resistance of the LDR (Ω)
2	400
4	800
6	1000
8	1200
12	1300
16	1800
20	2000

Examiner only

Use the equation:

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

to calculate the **current** passing through the LDR when the light source is 4 cm away. [2]

Current = ... A

(iii) Dafydd claims that for every 2 cm he moves the torch away from the LDR its resistance doubles. Use Dafydd's results to explain whether his claim is correct. [2]

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(b) Emyr, another student, also carried out the experiment, but he used a 6 V battery. **Complete** the following sentence by underlining the correct phrase in the brackets. [1]

The resistances of the LDR in the table **(would be greater / stayed the same / would be less)**.

7

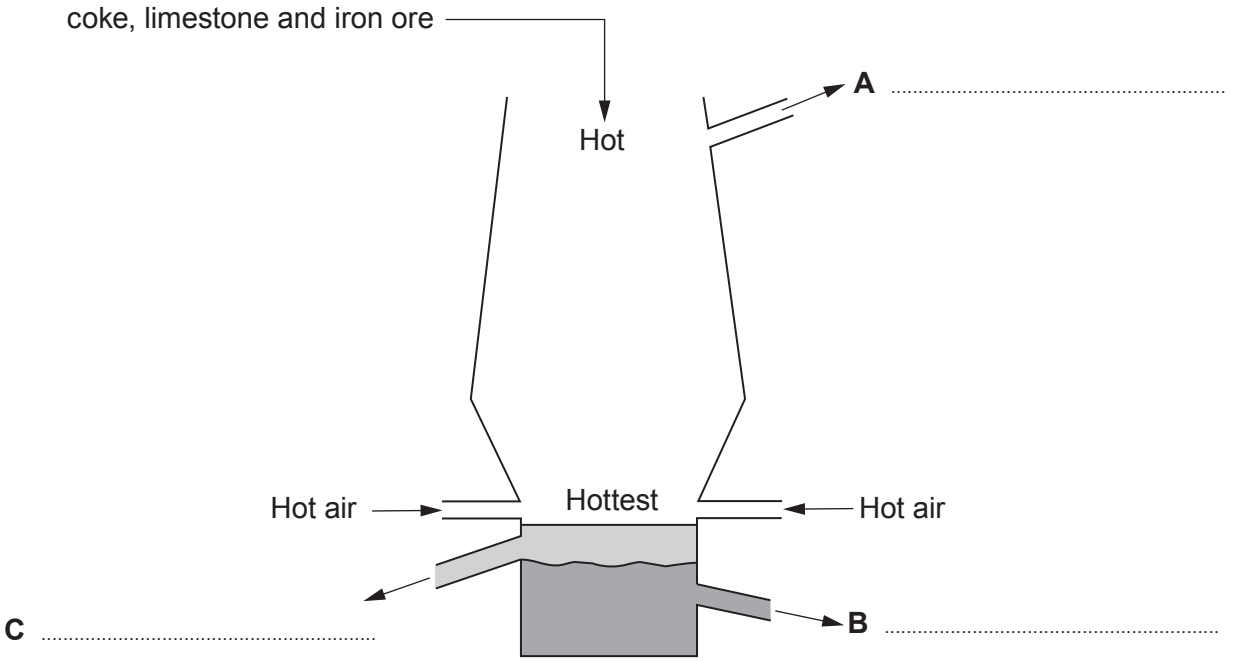
Examiner only

5. Port Talbot steel works in South Wales is one of the largest in the UK. It is capable of producing 5 million tonnes of steel every year.

A number of raw materials are used in a blast furnace to produce iron.

(a) The diagram below shows the blast furnace and the substances that are added. Hot waste gases, molten iron and slag are the products formed.

Complete the labelling of the diagram. [2]



(b) The table below shows some information about the substances used in the blast furnace.

Complete the table. [4]

Substance	Chemical name	Chemical formula	Type of material
iron ore	.....	Fe_2O_3	compound
coke	carbon	.....	.....
limestone	calcium carbonate	$CaCO_3$	.....

Examiner only

(c) The blast furnace relies on the processes of reduction and oxidation.

Complete the balanced symbol equations for two of the processes occurring in the blast furnace. [3]

$\square\ C + O_2 \longrightarrow \square\ CO$

$Fe_2O_3 + 3$ ..... $\longrightarrow 2$ ..... $+ 3CO_2$

(d) The table below shows the cost of the raw materials required to produce one tonne of iron in the blast furnace.

Raw material	Mass of raw material (tonnes)	Cost per tonne of raw material (£)	Total cost of raw material (£)
iron ore	1.75	80	.....
coke	0.25	120	30
limestone	0.25	60	15
air	4.00	3	12
		Total cost to produce one tonne of iron	£ .....

Complete the table above to calculate the total cost of materials required to produce one tonne of iron. [2]

(e) Aluminium is also extracted from its ore but by a different process. Explain why aluminium cannot be extracted in a blast furnace using coke (carbon). [1]

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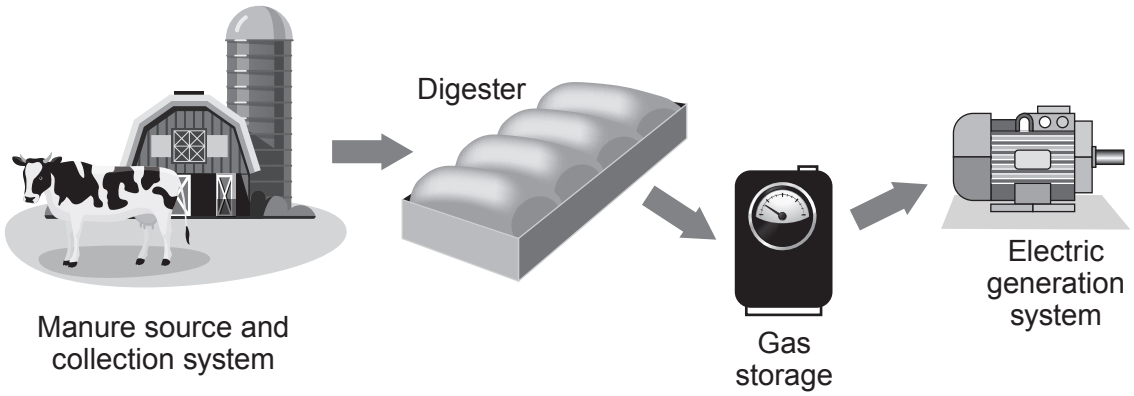
Examiner only

6. A farmer has installed a biogas generator to save money. The farmer's monthly electricity bill before installation was £3 000. The farmer spent £120 000 to buy and install the biogas generator. After installation the monthly electricity bill was expected to reduce to £600.

The biogas generator works by using the animal waste produced on the farm. This waste is digested by bacteria and the product, methane gas, is used to generate electricity. Methane is a greenhouse gas and produces carbon dioxide and water when it is burned.

The animal waste used in the digester is a renewable energy source.



(a) The biogas generator can provide some of the farm's electricity.

Use the information above to calculate the expected payback time for the biogas generator. [3]

Payback time = ... months

(b) The farmer considered installing wind turbines to generate electricity before investing in the biogas generator.

Give **two** disadvantages of using wind power rather than the biogas generator. [2]

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Examiner only

(c) The biogas generator needs to produce 160 000 kWh of electricity per year to power the farm. A typical cow produces 10 tonnes of waste per year of which the farmer is only able to collect 3 tonnes. For every tonne of waste collected 480 kWh of heat energy is produced, which generates 160 kWh of electricity.

(i) Use the equation:

$$\% \text{ Efficiency} = \frac{\text{energy usefully transferred}}{\text{total energy supplied}} \times 100$$

to calculate the efficiency of this biogas generator [2]

% Efficiency = ...

(ii) The farmer owns 120 cows. He thinks that he will be able to collect enough waste to power his farm for a year. [4]

Explain whether you agree with the farmer. Show your workings as part of your answer.

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Examiner only

7. In a diffusion experiment, gelatin was mixed with a pink pH indicator and allowed to set. The gelatin was then cut into different sized cubes. The cubes were placed in a beaker containing dilute acid. As the acid diffused through the gelatin the cubes became colourless. The time taken to change from pink to colourless was recorded.

The surface area and volume of the cubes were calculated using the following equations:

surface area of cube = length × width × number of sides

volume of cube = length × width × height

(a) The results of the experiment are shown below.

Length of side of gelatin cube (cm)	Time taken to become colourless (s)	Surface area of cube (cm^2)	Volume of cube (cm^3)	Surface area:volume ratio
1	20	6	1	6:1
5	41	150	.....	6:5
7	104	.....	343	6:7
10	610	600	1 000	.....

(i) **Complete** the table. [3]

(ii) Sarah suggested that diffusion of the acid into the gelatin is quicker in the smaller cubes because the time taken for them to become colourless is less. Explain whether you agree with Sarah. [2]

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Examiner only

(b) Red blood cells transport oxygen around the body to allow respiration to occur in the tissues. Red blood cells have a volume of 90 units and a surface area of 136 units. Explain how the surface area:volume ratio of red blood cells make them suitable for their function. [3]

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END OF PAPER

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THE PERIODIC TABLE

1	2	Group										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
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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	179 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key