Surname	Centre Number	Candidate Number
Other Names		0

GCSE

3445U30-1

S19-3445U30-1

TUESDAY, 14 MAY 2019 – AFTERNOON

APPLIED SCIENCE (Double Award)

UNIT 3: Food, Materials and Processes

FOUNDATION TIER

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**11**	
3.	**7**	
4.	**6**	
5.	**6**	
6.	**10**	
7.	**7**	
8.	**7**	
9.	**12**	
Total	**75**	

3445U301
01

ADDITIONAL MATERIALS

A calculator.

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.

INFORMATION FOR CANDIDATES

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

Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.

The Periodic Table is printed on the back cover of the examination paper.

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Answer **all** *questions in the spaces provided.*

1. Drinks manufacturers use standard food colourings which are identified by E-numbers. A student was asked to investigate which E-numbers were present in different brands of orange drinks.

The student suggested the following method:

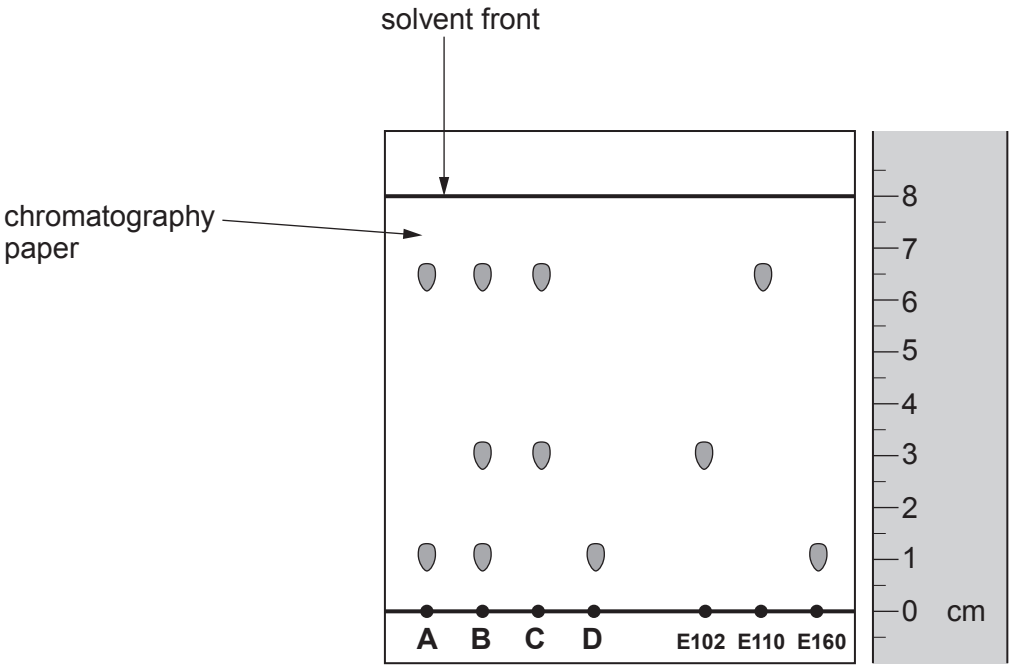
1. Place spots of each drink **A**, **B**, **C** and **D** on a pen line on chromatography paper.
2. Place spots of three common food colourings, **E102**, **E110**, **E160** on the pen line.
3. Hang the chromatography paper in a beaker and add water until it is above the pen line.
4. Leave the paper to stand in water in a beaker until the water rises to near the top of the chromatography paper.

(a) The student failed to produce a chromatogram using this method. State **two** errors in this method. [2]

1. .....

2. .....

(b) Another student, using a valid method, obtained the chromatogram below *(not drawn to scale)*.



Answer the following questions using the information in the chromatogram.

(i) State which food colouring (**E102**, **E110**, **E160**) is the most soluble. [1]

.....

(ii) State which drinks (**A**, **B**, **C** or **D**) contained **E110**. [1]

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(iii) The student predicted that all orange drinks contain the same E-numbers. Explain whether this prediction was correct by comparing the food colourings found in drinks **B** and **D**. [2]

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(iv) The retention factor (R_f) value of a substance can be used to identify that substance from a chromatogram.

I. State the distance travelled by the solvent front. [1]

Distance = ... cm

II. Use the equation:

$$R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by the solvent front}}$$

to calculate the R_f value for **E102**. [2]

R_f = ...

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2. Hydrogen peroxide, H_2O_2, has anti-fungal properties and can be used to preserve milk. Before the milk is used to make cheese the H_2O_2 needs to be removed.

Hydrogen peroxide decomposes to form water and oxygen gas as shown below.

hydrogen peroxide ⟶ water + oxygen

(a) Complete the balanced **symbol** equation for the reaction. [2]

$2\ H_2O_2 \longrightarrow$ ☐ ..... + O_2

(b) This reaction is very slow at room temperature.

A student suggests that the rate of reaction can be increased by adding a catalyst. State **one other** way that the rate of reaction could be increased. [1]

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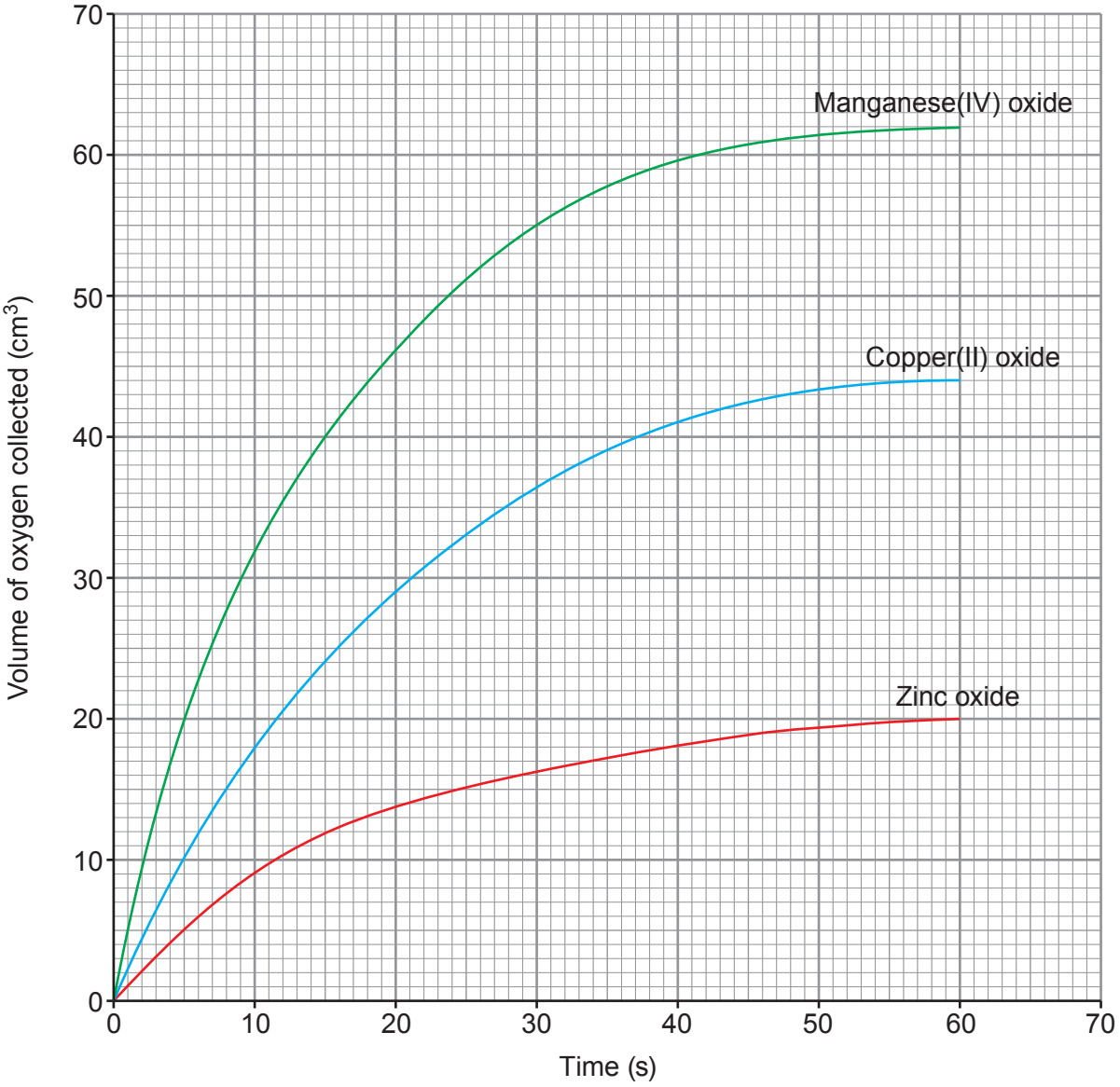
(c) Students investigated the decomposition of hydrogen peroxide using three different catalysts. The catalysts used were manganese(IV) oxide, copper(II) oxide and zinc oxide. Their results are shown on the graph below.



Use the graph to answer the following questions.

(i) State the volume of oxygen collected in 10 seconds when manganese(IV) oxide is used. [1]

Volume = ... cm^3

(ii) State the time taken to collect 20 cm^3 of oxygen when copper(II) oxide is used. [1]

Time = ... s

Examiner only

(iii) One student says that zinc oxide is the best catalyst to use.
Explain whether the student is correct. [2]

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(d) The mass of catalyst used at the start of each experiment was 1.2 g.
State the mass of catalyst at the end of each experiment. [1]

Mass = ... g

(e) Milk used in cheese making is stored in the refrigerator at 4°C. Room temperature in the kitchen is 24°C.

(i) Calculate the difference in temperature between the refrigerator and the kitchen. [1]

Temperature difference = ... °C

(ii) It is claimed that for every temperature decrease of 10°C, the milk will take twice as long to go sour. The milk sours in 10 hours when left out of the refrigerator in the kitchen. Calculate the time it takes the milk to sour in the refrigerator. [2]

Time = ... hours

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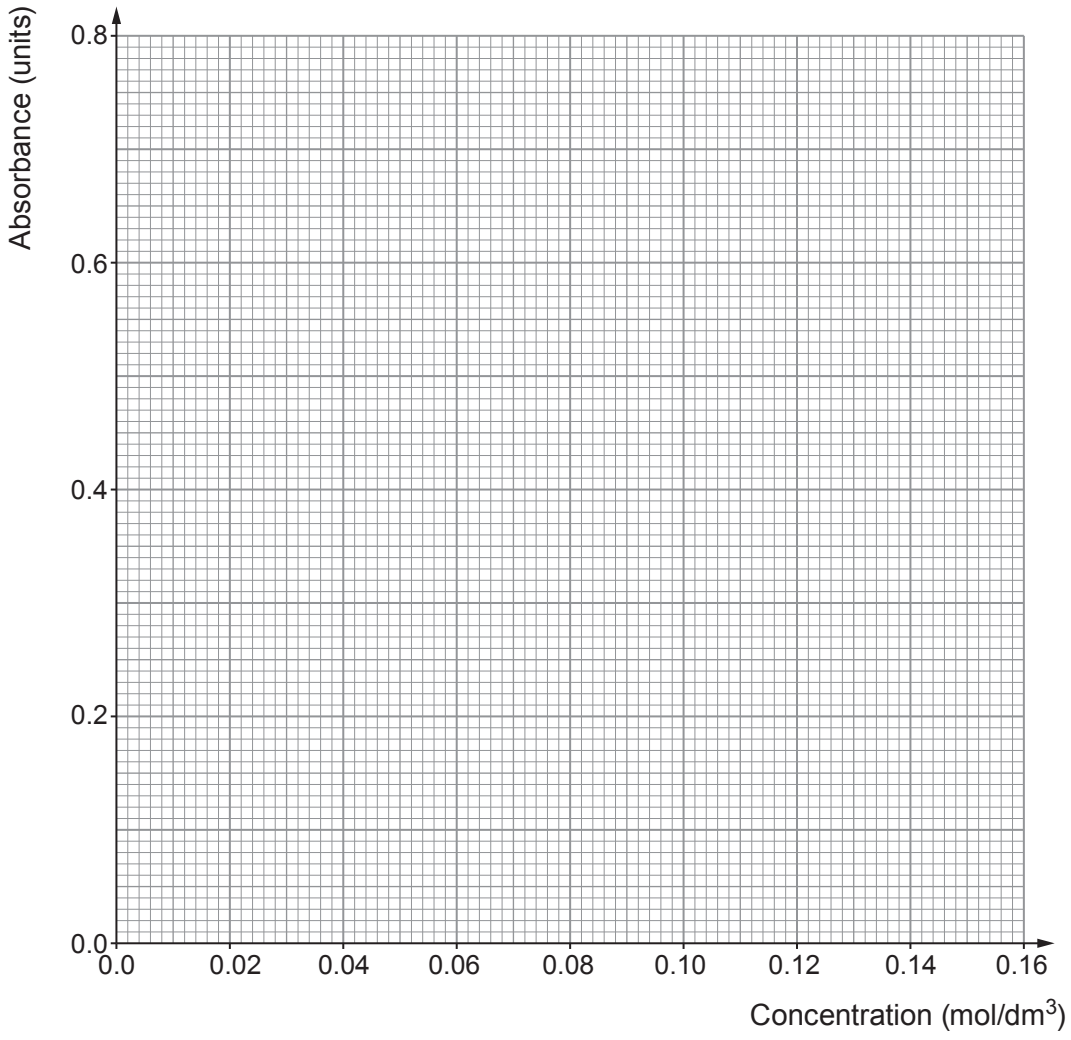
3. An experiment was carried out to find the concentration of beta-carotene in a solution using colorimetry. The results are shown in the table below.

Concentration (mol/dm^3)	Absorbance (units)
0.02	0.1
0.04	0.2
0.08	0.4
0.12	0.6
0.16	0.8

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



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(b) Describe how the absorbance of beta-carotene changes with concentration. [1]

.....

(c) Use your line to predict the concentration of beta-carotene with an absorbance of 0.3 units. [1]

Concentration = ... mol/dm^3

(d) It is claimed that if the concentration is doubled then the absorbance always doubles. Explain whether you agree with this statement using data from the table. [2]

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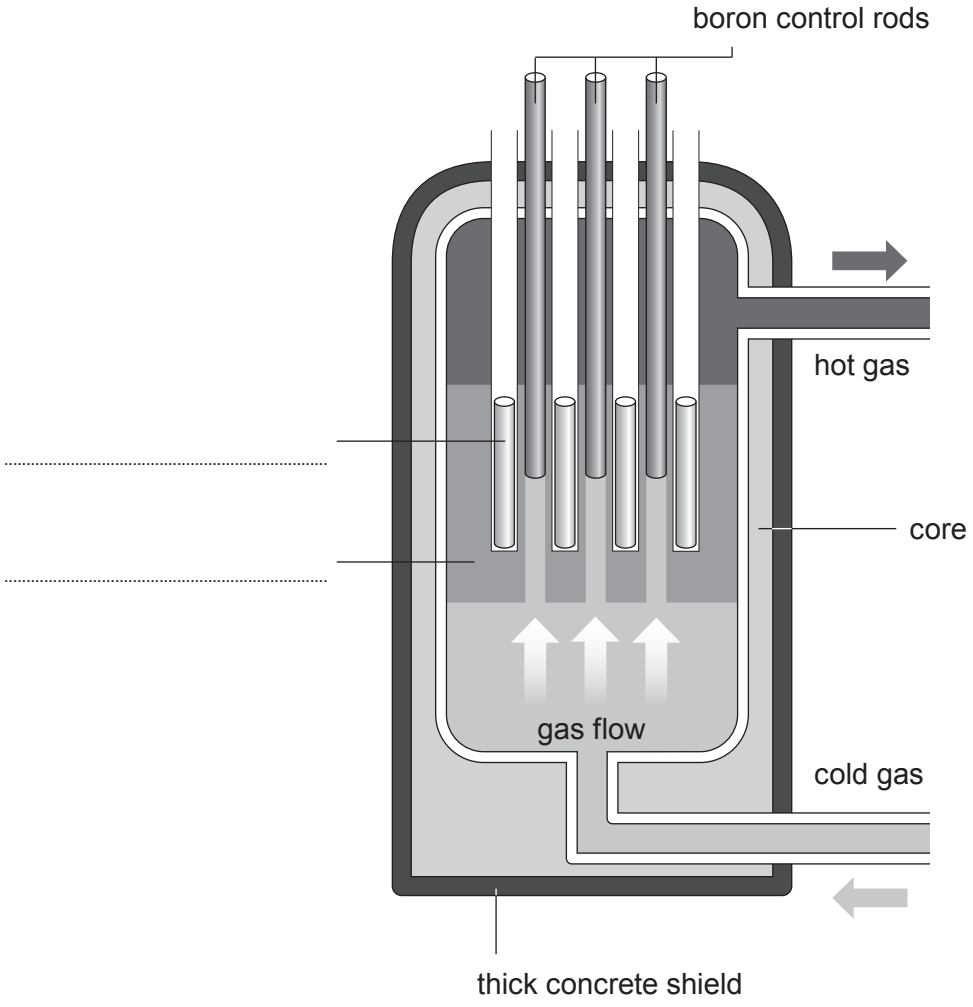
4. Nuclear fission occurs when a nucleus of uranium is split after absorbing a neutron. It is the process used in a nuclear reactor like the one shown in the diagram below.



(a) **Complete the labelling** of the diagram. [2]

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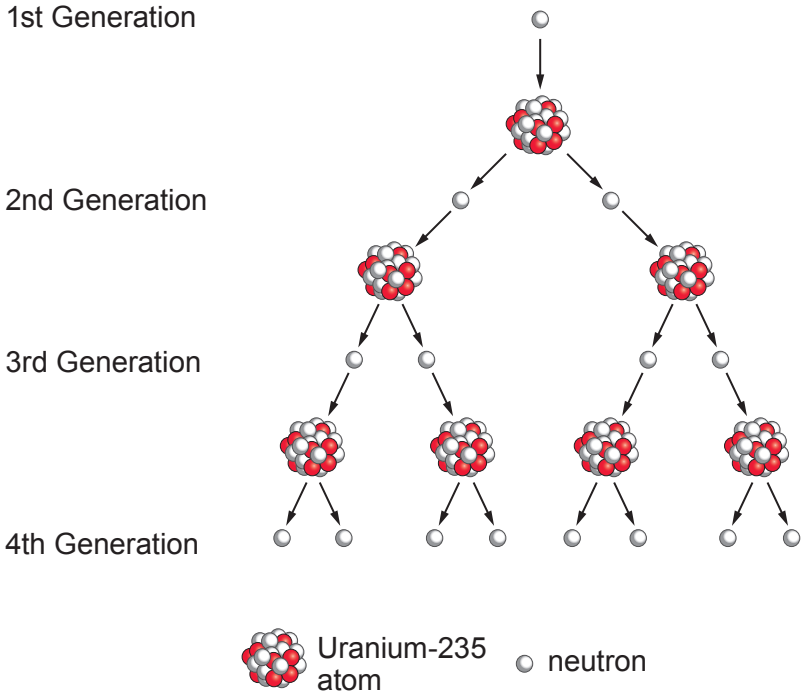
(b) The diagram below shows an uncontrolled chain reaction of the decay of uranium.



(i) Calculate the number of 5th generation neutrons. ..... [1]

(ii) Explain how the number of neutrons in your answer above would change if the control rods are lowered further into the reactor. [2]

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(iii) State the danger of an uncontrolled chain reaction in a nuclear reactor. [1]

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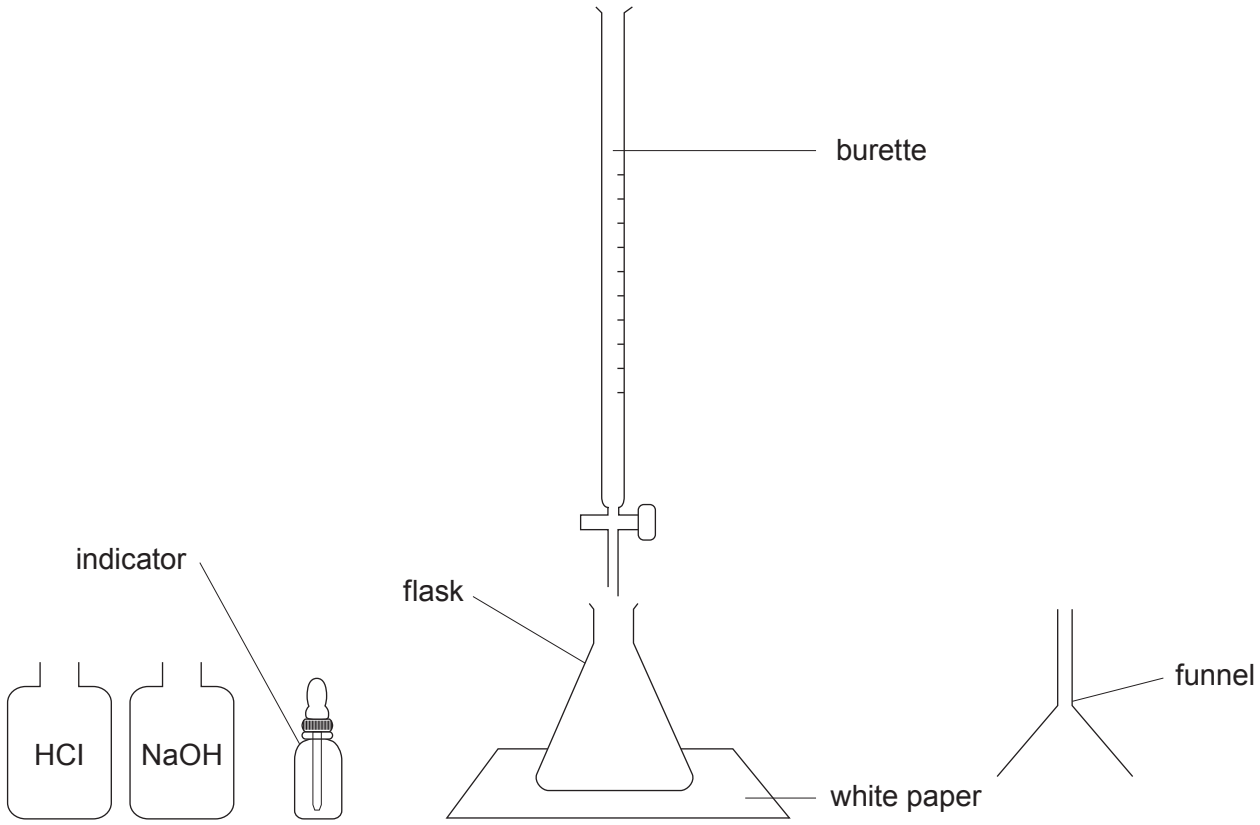
5. Describe how you would carry out a titration of hydrochloric acid against sodium hydroxide solution using an indicator and the apparatus below. Include details of the hazards and how you would control them. [6 QER]



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6. In 2016, the United Kingdom had a total area of 508 thousand hectares of land which was farmed organically.

(a) Tick (✓) the **three** boxes next to the correct statements about the advantages of organic farming. [3]

The environment benefits because natural habitats are less threatened. ☐

Production of food is cheaper. ☐

Organic crops grow quicker. ☐

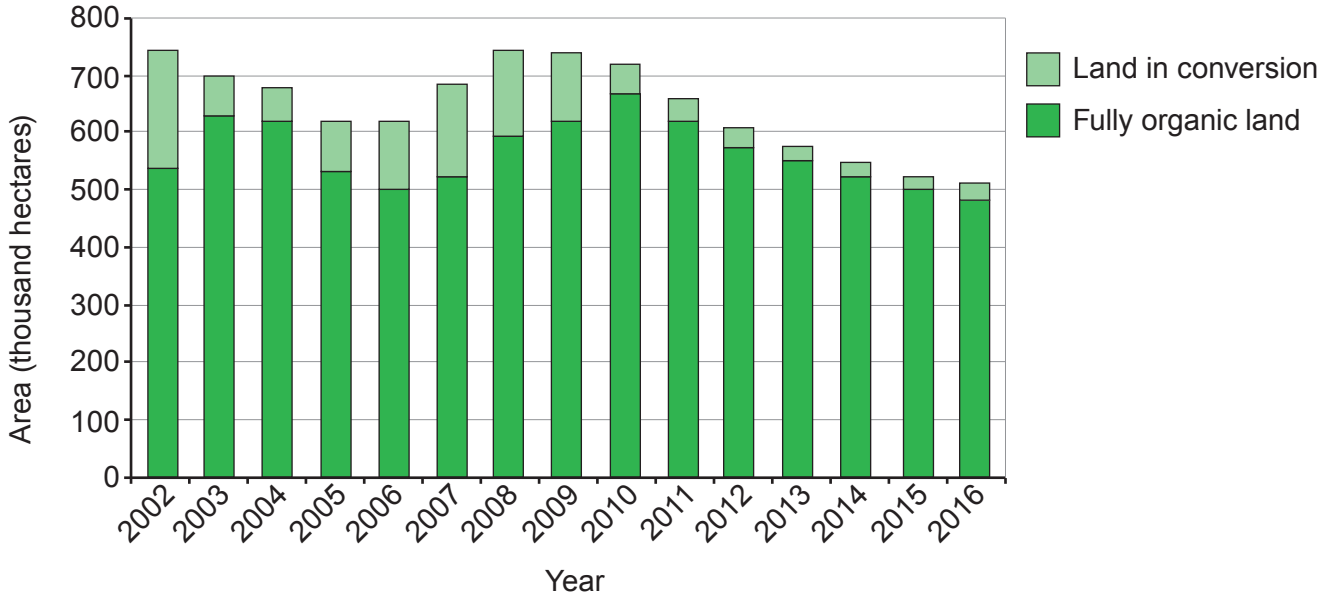
Artificial fertilisers are not used. ☐

Less labour involved in collection of organic food. ☐

Less harm to bees and other insects as less chemicals are used. ☐

(b) Since 2005, farmers who use intensive farming methods have been encouraged to change to organic farming. Before an area can be considered as fully organic, it must undergo a conversion process.

The chart below shows how the area of fully organic land and land in conversion has changed since 2002.



Use the data in the chart to state whether there has been an increase in the area of land in conversion since 2005. [2]

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Examiner only

(c) The table below shows the area of fully organic land used to produce crops from 2013 to 2016.

	Area of fully organic land use, 2013 to 2016 (thousand hectares)			
	2013	**2014**	**2015**	**2016**
Cereals	43.7	42.2	39.6	38.4
Other crops	7.6	7.3	6.9	7.3
Fruit & nuts	2.1	2.1	1.9	1.9
Vegetables	11.3	9.4	10.4	10.2
Total	**64.7**	**61.0**	**58.8**	

Calculate the change in area of fully organic land used to produce these crops from 2013 to 2016. [2]

Change in area = ... thousand hectares

(d) The table below shows how organic livestock numbers have changed from 2013 to 2016.

	Organic livestock numbers 2013 to 2016 (thousand)			
	2013	**2014**	**2015**	**2016**
Cattle	283.3	304.1	291.5	296.4
Sheep	999.2	954.9	844.6	840.8
Pigs	30.2	28.3	30.0	31.5
Poultry	2487.6	2398.7	2560.2	2821.2

(i) State **one** ethical argument against the intensive farming of livestock. [1]

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(ii) Explain whether the data in the table supports that this ethical argument has changed livestock farming practices. [2]

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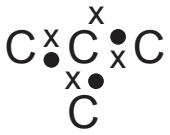
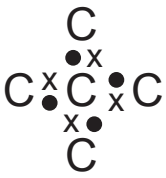
7. Carbon exists in many forms. Each carbon atom has 4 electrons available for bonding.

(a) Four different dot and cross diagrams are shown below.

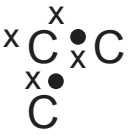
A



B



C



D

(i) State which diagram shows the bonding found in diamond. ..... [1]

(ii) Give a reason for your choice. [1]

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(iii) Name the type of bond found between carbon atoms in diamond. [1]

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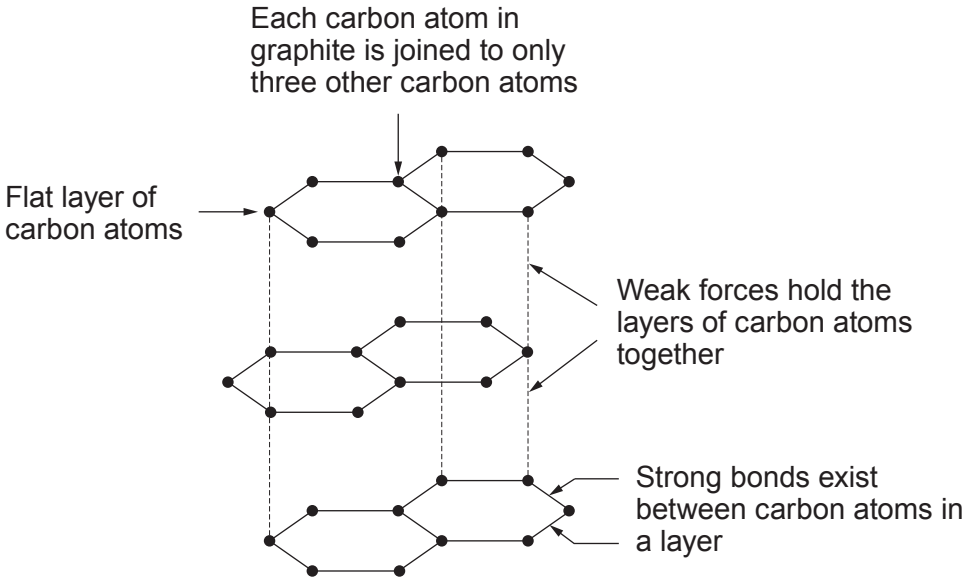
(b) Carbon also exists in the form of graphite. The diagram shows the giant molecular structure of graphite.



(i) Explain why graphite conducts electricity. [2]

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(ii) Explain why graphite is slippery. [2]

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8. Photosynthesis is the process by which green plants produce their own glucose.

(a) Complete the word equation for photosynthesis below. [1]

..... + ... → glucose + oxygen

(b) State **three** different ways green plants use the glucose they produce. [3]

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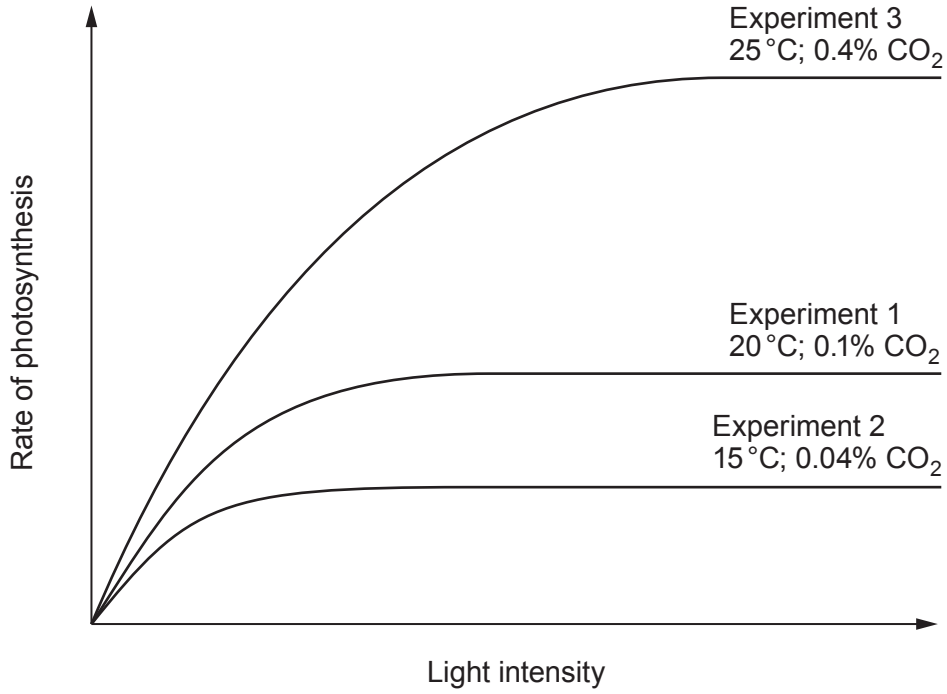
(c) The rate of photosynthesis is affected by light intensity, temperature and carbon dioxide concentration as shown in the graph below.



Use the information in the graph to describe how differences in light intensity, temperature and carbon dioxide concentration affect the rate of photosynthesis. [3]

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9. *(a)* Food poisoning is a notifiable disease in Wales. Doctors are required to report every case of food poisoning.

(i) Explain how some bacteria cause food poisoning. [2]

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(ii) State **two** symptoms of food poisoning. [1]

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(iii) State **two** different types of precaution that can be taken when **preparing** food to reduce the risk of food poisoning. [2]

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(b) **Figure 1** shows the number and rate of reported cases of food poisoning in Wales between 1992 and 2016.

Figure 1

Year	Total number of reported cases	Rate (number per 100 000 population)
1992	3 590	124.5
1998	5 946	205.0
2000	4 716	162.2
2006	4 301	145.4
2010	4 980	165.6
2014	4 516	146.1
2016	4 504	145.7

The percentage of reported cases of food poisoning during each quarter of a year is shown in **Figure 2**.

Figure 2

Quarter	% of total for year		
	2012	2014	2016
Jan-Mar	18	17	19
Apr-Jun	26	26	25
Jul-Sep	32	32	33
Oct-Dec	24	25	23

Figure 3 shows the rate of food poisoning amongst females by age group in 2016.

Figure 3

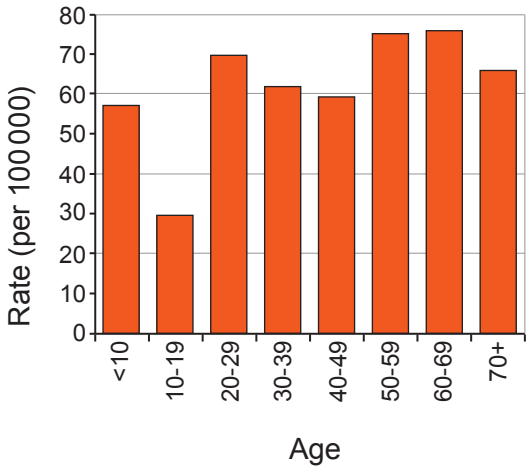

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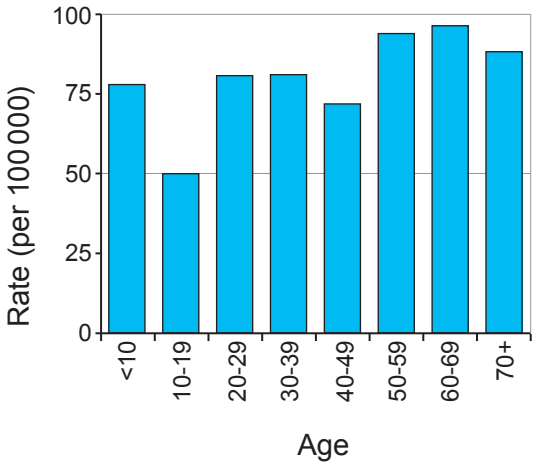
Figure 4 shows the rate of food poisoning amongst males by age group in 2016.

Figure 4



Use the data in **Figures 1 to 4** to answer the following questions.

(i) Since 1998, egg-laying hens have been vaccinated against a species of *Salmonella*. Explain how this has affected the number of reported cases of food poisoning. [2]

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(ii) Explain the variation in the percentage of reported cases of food poisoning in each of the quarters in a year. [3]

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(iii) It is suggested that the rate of food poisoning does not depend on gender or age. Explain whether this suggestion is confirmed by the data. [2]

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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