

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3445U30-1



FRIDAY, 10 MAY 2024 – MORNING

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.	5	
2.	10	
3.	11	
4.	12	
5.	12	
6.	6	
7.	9	
8.	10	
Total	75	

ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

- Use black ink or black ball-point pen. Do not use gel pen or correction fluid.
- You may use a pencil for graphs and diagrams only.
- 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 **6** 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.
 The Periodic Table is printed on the back cover of the examination paper.



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Answer **all** questions.

1. Supermarkets need to ensure that food products are safe to eat after purchase. They use different treatments for different foods.

- (a) (i) Join each treatment below to the way it works with a straight line. [2]

Treatment	How it works
pickling	lowers the temperature to stop bacteria multiplying
freezing	lowers the pH to stop bacteria multiplying
drying	removes water so bacteria cannot digest and absorb the food source

- (ii) **Circle** **one** other treatment method used to preserve food. [1]

adding oxygen

adding salt

adding water

- (b) Tick (✓) the boxes next to the **two** correct statements about precautions supermarkets take when dealing with raw and cooked meat. [2]

Keep raw and cooked meat apart.

Use the same weighing scales for raw and cooked meat.

Wash hands after handling raw meat.

Keep raw and cooked meat at room temperature.



2. Brewing is an important industry in the UK.

- (a) Complete the word equation for the fermentation of beer by underlining the correct word(s) in the brackets. [1]



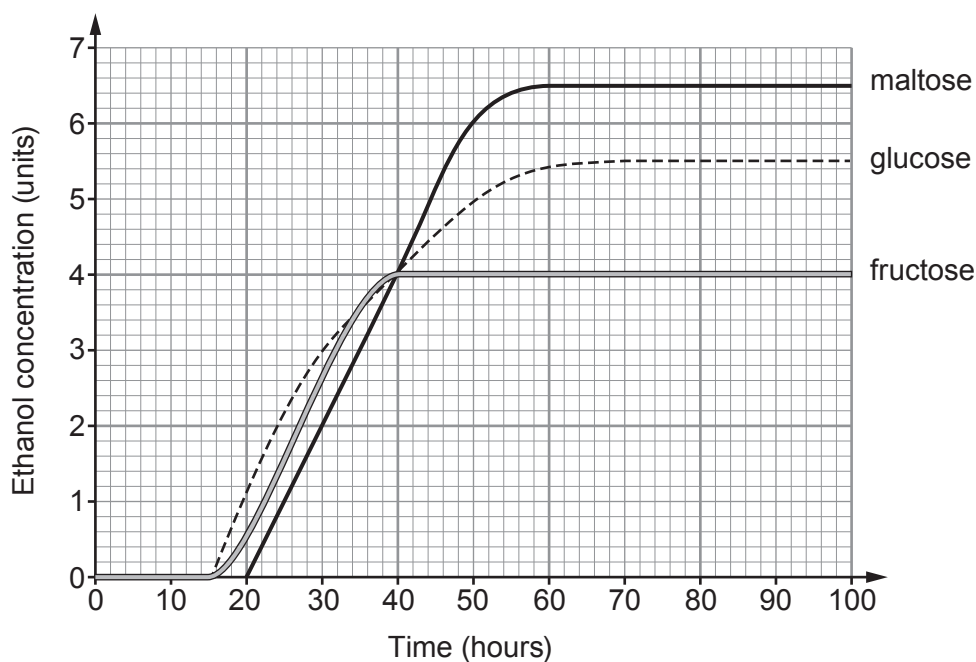
- (b) The main stages of the beer making process are shown below. However, the stages are not in the correct order. [2]

A	starch in the barley is converted to sugar, and water is added to make a brewing mixture
B	fermentation stops when all the sugar runs out
C	mixture is cooled and yeast is added
D	mixture is boiled
E	the beer is pasteurised, then stored in bottles or cans
F	hops are added for flavour

Put the statements in the correct order.

A	F				E
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- (c) A brewery tested different types of sugar in the fermentation process. These were glucose, maltose and fructose. The results are shown in the graph below.



Use information from the graph and the numbers in the box to answer the following questions.

2	3	6	40	50	70
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(i) State the concentration of ethanol formed from **glucose** at **30 hours**. [1]
 units

(ii) State the time at which the concentration of the **ethanol** was the same for all the sugars. [1]
 time = hours

(iii) State the time at which fermentation stops for **glucose**. [1]
 time = hours

(iv) Calculate the difference in ethanol concentration between 20 and 50 hours for maltose. [1]
 concentration difference = units

(d) (i) Use your answer in (c)(iv) above and the equation:

$$\text{mean rate} = \frac{\text{concentration difference}}{\text{time difference}}$$

to calculate the mean rate of ethanol formation for **maltose** between 20 and 50 hours. [2]

mean rate = units/hour

(ii) Charlie says that all sugars produce beer with the same ethanol concentration. State whether you agree **and** give **one** reason for your answer. [1]

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3. Magnesium alloys are used in the casings of tablet computers and mobile phones.

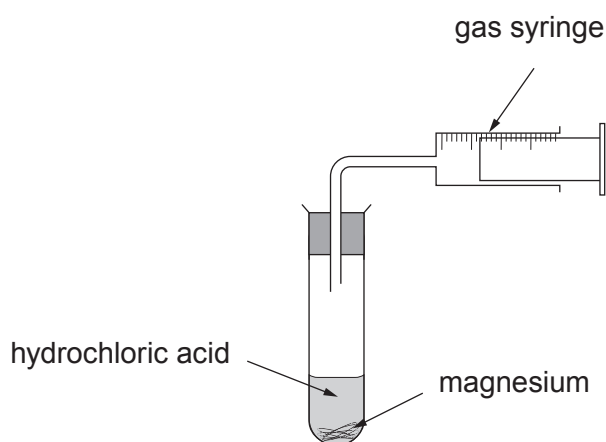
(a) Complete the sentence below by underlining the correct word in the brackets. [2]

An alloy is a (**mixture / compound / solution**) of two or more elements. One of these must be a (**gas / metal / liquid**).

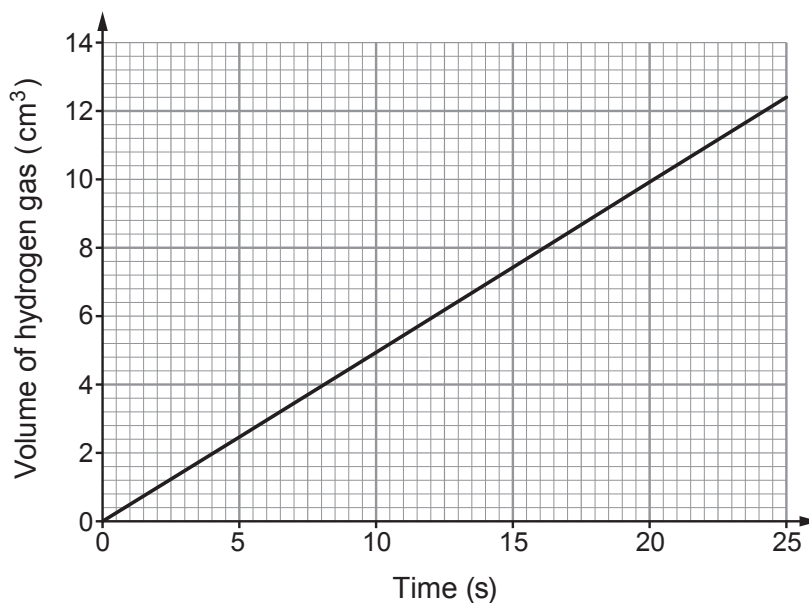
(b) Magnesium reacts with hydrochloric acid producing hydrogen gas.



A student investigated this reaction using the apparatus below.



A graph of the student's results is shown below.



Draw a line on the graph above to show the results that you would expect if the experiment was repeated with a lower concentration of hydrochloric acid. [1]



- (c) The student also investigated the reaction of hydrochloric acid and magnesium at different initial temperatures.

Initial temperature (°C)	Time taken for magnesium to disappear (s)
10	80
20	40
30	20
40	10
50	5

- (i) State **three** variables that need to be controlled in this experiment. [3]

1.
2.
3.

- (ii) I. The student thinks that every time the temperature doubles, the time taken halves. Explain whether you agree. [2]

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- II. Predict the time it would take for the magnesium to disappear at 60 °C. [1]

time = s

- (iii) Complete the following sentences by underlining the correct words in the brackets. [2]

As the temperature increases, particles move
(**faster** / **slower** / **at the same speed**).

The particles collide (**more often** / **as often** / **less often**) in a given time.

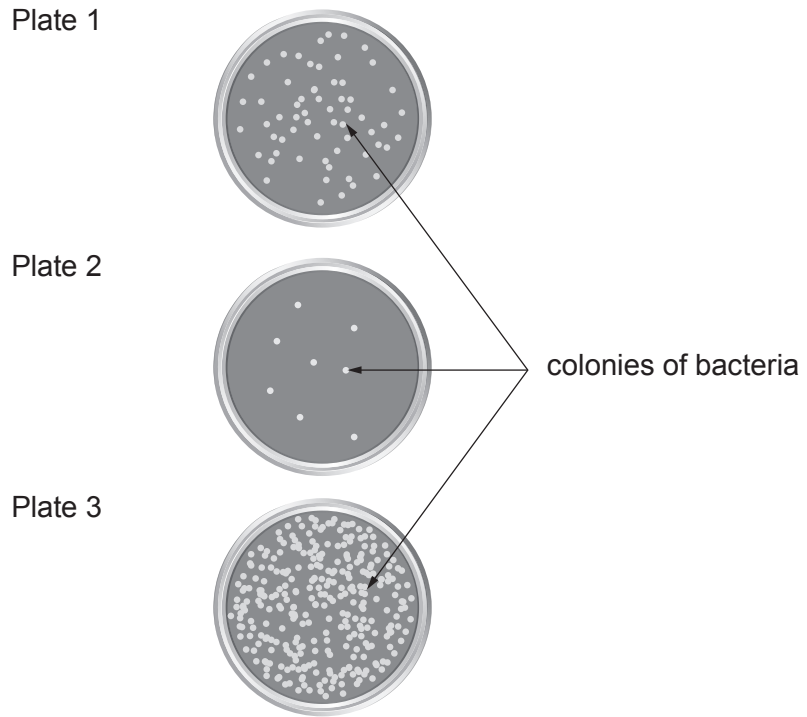


4. A laboratory technician tests **three** different food samples taken from a local restaurant by an Environmental Health Officer.

The samples were spread onto sterile agar plates which were then incubated at 37 °C.

After 3 days the agar plates were examined. The results are shown below.

It is assumed that each colony was formed from one bacterium.



(a) (i) The technician concludes that the food that produced Plate 1 was stored in the restaurant at 15 °C, the food that produced Plate 2 was stored at 25 °C, and the food that produced Plate 3 was stored at 5 °C. Explain whether you agree. [3]

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(ii) State why it is not possible to make a conclusion on the reproducibility of this analysis. [1]

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(b) Agar plates can also be used in a school laboratory to investigate bacterial growth.

(i) State why the agar plate needs to be sterile. [1]

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(ii) State what should be done to the inoculating loop before it is used to transfer the food sample to the agar plate. [1]

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(iii) Give a reason why the students are only allowed to incubate their plates at 25 °C. [1]

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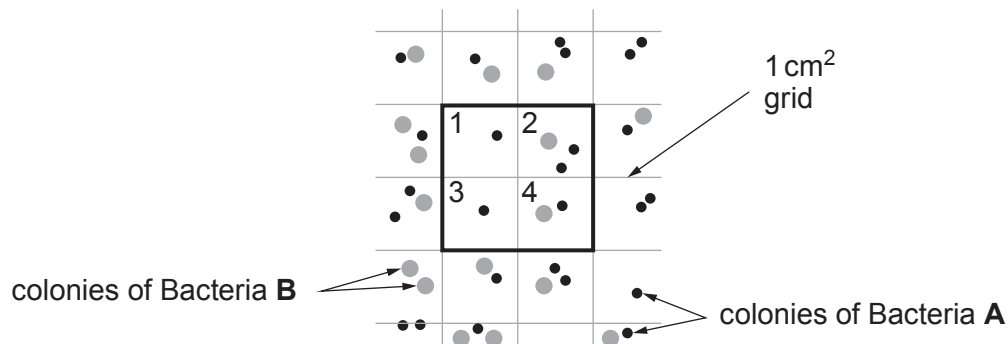
(iv) State why it is important the lid remains on the agar plate during incubation. [1]

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- (c) Two types of bacteria, **A** and **B**, were found on one of the plates. The plate has an area of 52 cm^2 . Each square in the grid is 1 cm^2 .

Section of agar plate



The results for four squares numbered 1 to 4 are shown in the table below. The students have completed the table for Bacteria **A**.

Grid number	Number of bacteria in 1 cm^2	
	Bacteria A	Bacteria B
1	1	0
2	2	1
3	1	0
4	1
Mean colonies per cm^2	1.25
Mean colonies per 52 cm^2 plate	65	26
Total number of colonies in squares 1–4	5

- (i) Complete the table for Bacteria **B**. [3]
- (ii) State how the results would be improved by counting the number of bacteria in 12 squares. [1]
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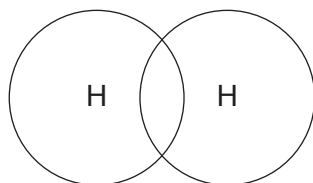
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5. Hydrogen could be used to produce hydrogen chloride gas.

- (a) The diagram represents the bonding in hydrogen. Complete the dot and cross diagram for a molecule of hydrogen. [1]



- (b) The reaction between hydrogen and chlorine can be represented by the following equation.



The bond energy values are shown in the table.

Bond	Energy needed to break or form the bond (kJ)
H-H	436
Cl-Cl	242
H-Cl	431

Use the information in the table to answer the following questions.

- (i) Calculate the energy needed to break all the bonds in the reactants. [2]

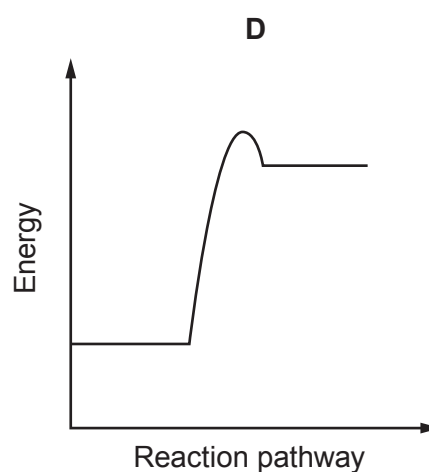
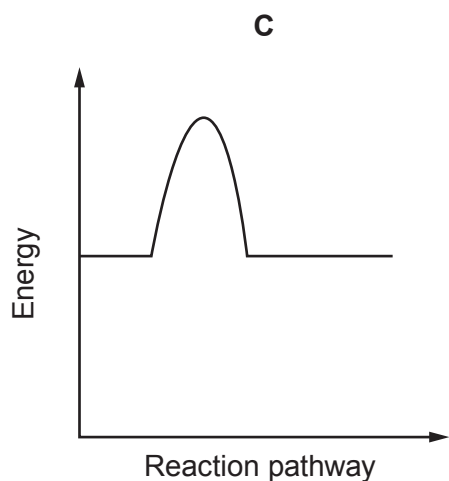
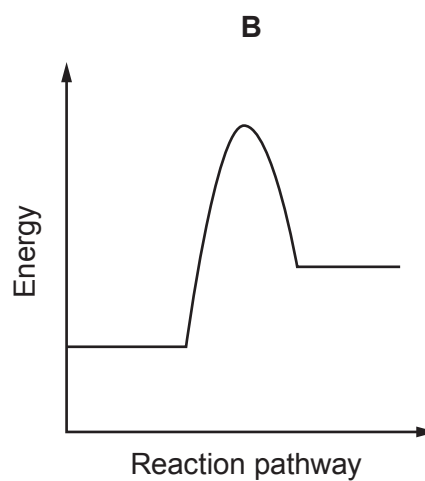
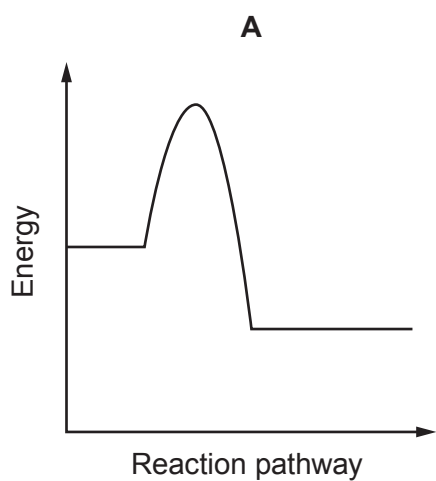
energy = kJ

- (ii) Calculate the energy given out when all the bonds in the product are formed. [2]

energy = kJ



(iii) Possible energy diagrams for this reaction are shown below.



I. Select the correct energy diagram for this reaction. [1]

II. Explain your choice. [2]

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- (c) Use words from the box to complete the sentences below about an **endothermic** reaction. [4]

more less taken in given out increase decrease thermal runaway

In an endothermic reaction energy is stored in the bonds **after** the reaction than before. This means energy is from the surroundings.

This will cause the temperature to during the reaction.

This cannot lead to a reaction.

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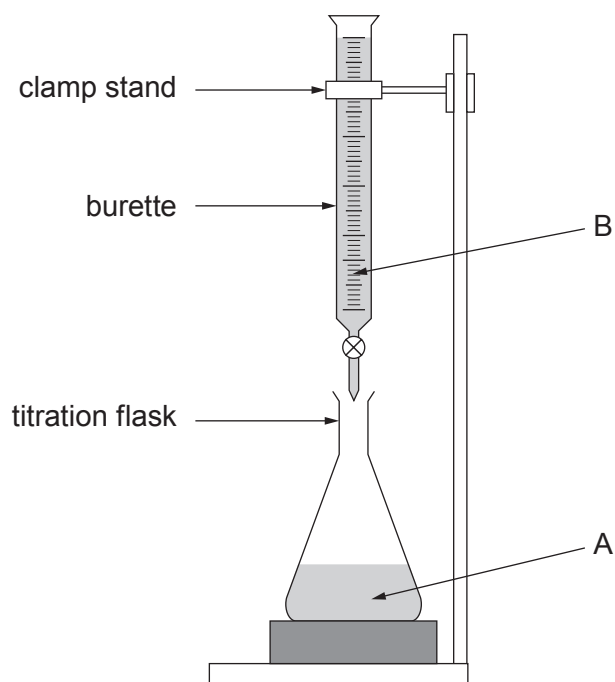
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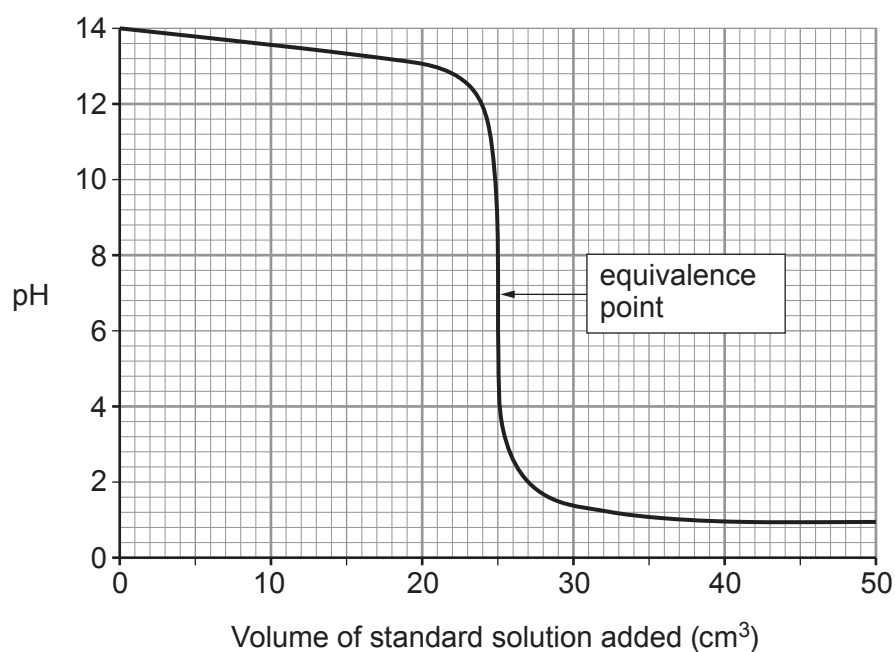


6. Solutions can be acidic, alkaline or neutral. Analytical chemists use titrations to find the concentrations of solutions.

The concentration of solution A can be found by titrating against a standard solution B of known concentration.



The titration curve is shown below.



Explain the **pH** changes during the titration.

Include in your answer:

- what can be deduced from the curve about solutions A and B
- the point at which the solution becomes neutral
- which solution is acid and which solution is alkaline.

[6 QER]

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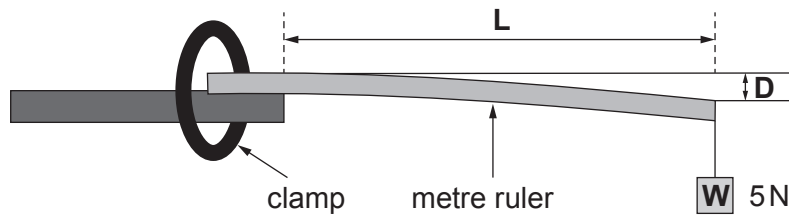
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7. Students are investigating how the stiffness of a wooden metre ruler depends on its length. They use the apparatus shown below. The weight, \mathbf{W} , on the end of the ruler remains constant at 5 N.



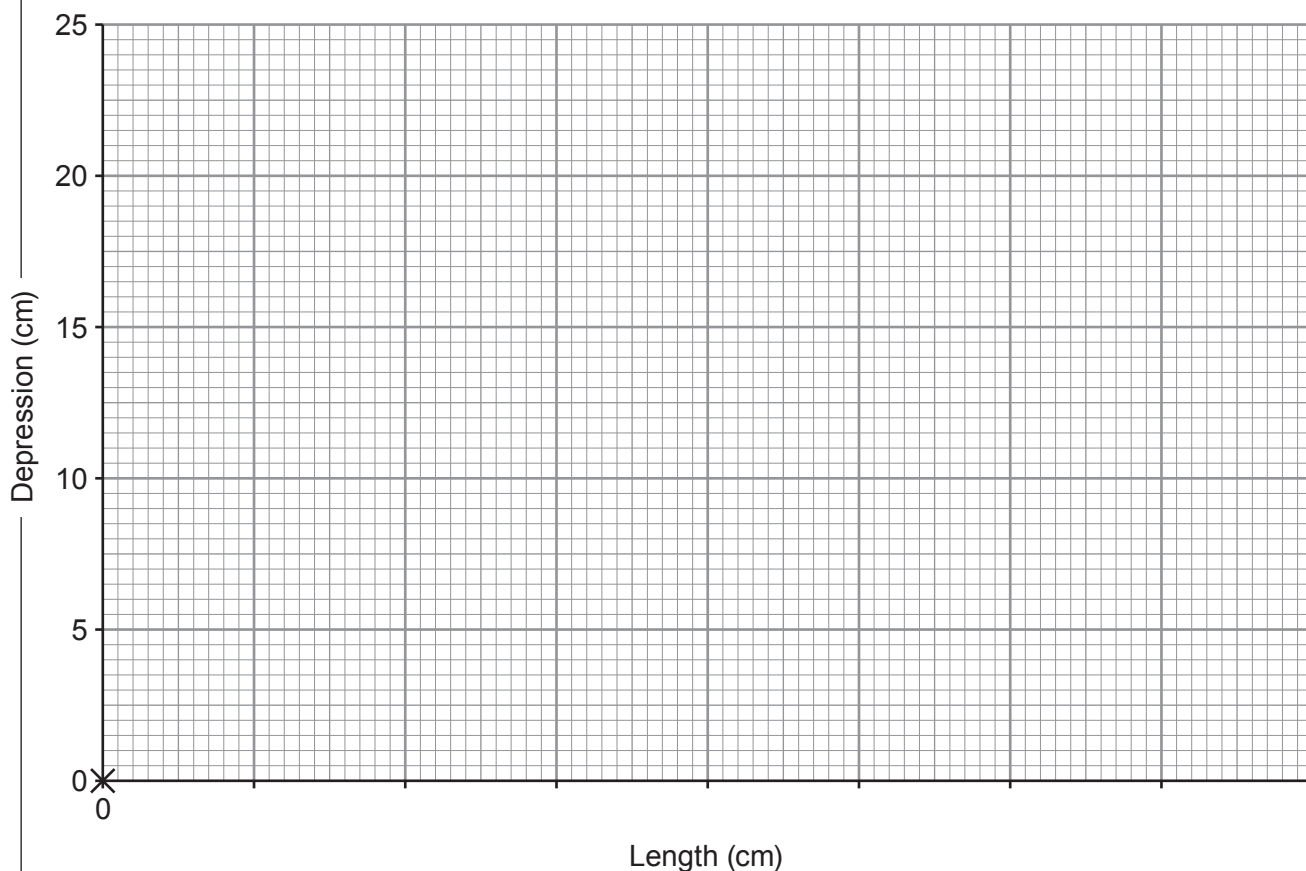
The length, \mathbf{L} , is varied. For each length, \mathbf{L} , the depression, \mathbf{D} , of the end of the ruler is measured.

Their results are shown in the table below.

Length \mathbf{L} (cm)	Depression \mathbf{D} (cm)
0	0.0
30	1.0
40	3.0
50	6.0
60	10.0
70	15.0
80	22.0



- (a) Plot the data on the grid below and draw a smooth curve. The point (0,0) has already been plotted for you. [4]



- (b) It was expected that depression, **D**, would be directly proportional to length, **L**. Explain whether the graph shows a proportional relationship. [2]

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- (c) Use information in the table and the equation:

$$\text{stiffness} = \frac{\text{weight}}{\text{depression}}$$

to calculate the stiffness of the ruler at a length of 50 cm. [3]

stiffness = N/cm

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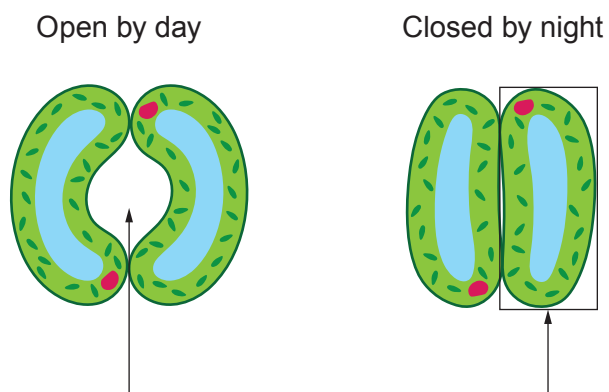


8. Photosynthesis is the process by which plants make food from water and carbon dioxide.

(a) Stomata are an important part of the leaf. In many plants, stomata remain open during the day and closed at night.

(i) Label the diagram below.

[2]



(ii) State **two** functions of stomata.

[2]

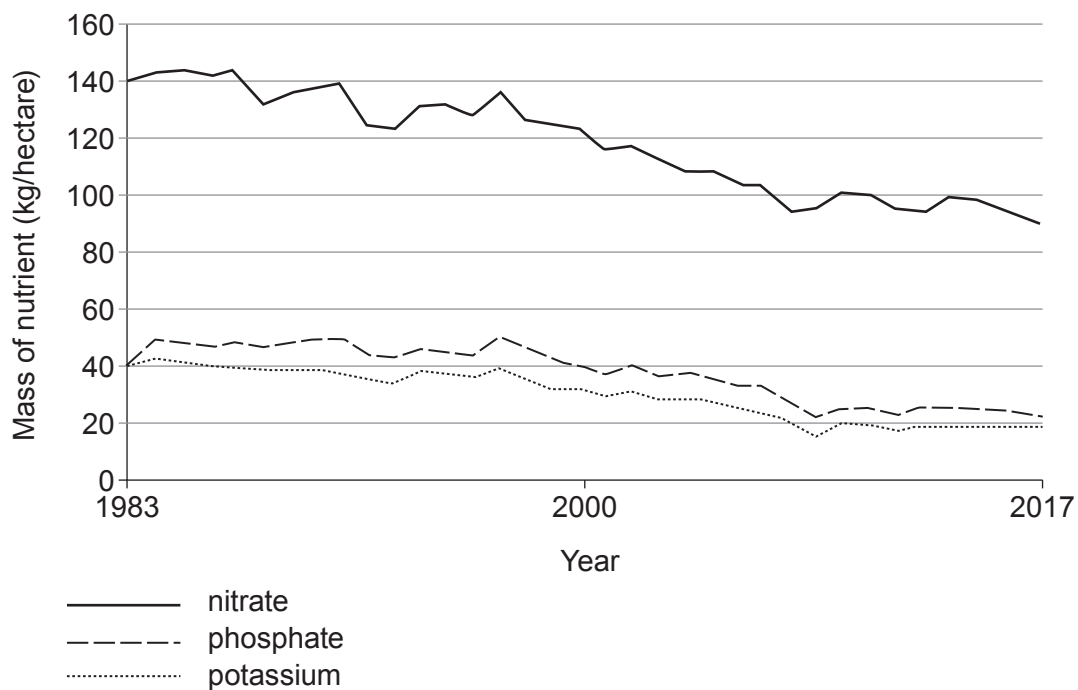
1.

2.



- (b) Healthy plants require a supply of nutrients. Many farmers use artificial fertilisers to supply these nutrients to the soil.

The graph shows the mass of different nutrients applied to agricultural land between 1983 and 2017.



Use the data from the graph to answer the following questions.

- (i) It is claimed that the use of nitrate fertilisers halved between 1983 and 2017. Use the graph to explain whether you agree. [3]

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- (ii) The total land area of Wales is approximately 2 100 000 hectares.
60% of this land is used for farming.

I. Calculate the area of land used for farming in Wales. [1]

area = hectares

II. Calculate the total mass of phosphates used in farming in Wales in 1983. [2]

mass = kg

END OF PAPER

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THE PERIODIC TABLE

Group 1 2 3 4 5 6 7 0

7 Li Lithium 3	9 Be Beryllium 4	11 Na Sodium 11	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulfur 16	17 Cl Chlorine 17	18 Ar Argon 18	20 Ne Neon 10	2 He Helium 2																																																																																									
19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Caesium 55	56 Ba Barium 56	57 La Lanthanum 57	58 Ce Cerium 58	59 Pr Praseodymium 59	60 Nd Neodymium 60	61 Pm Promethium 61	62 Sm Samarium 62	63 Eu Europium 63	64 Gd Gadolinium 64	65 Tb Terbium 65	66 Dy Dysprosium 66	67 Ho Holmium 67	68 Er Erbium 68	69 Tm Thulium 69	70 Yb Ytterbium 70	71 Lu Lutetium 71	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103	104 Rf Rutherfordium 104	105 Db Dubnium 105	106 Sg Seaborgium 106	107 Bh Bohrium 107	108 Hs Hassium 108	109 Mt Meitnerium 109	110 Ds Darmstadtium 110	111 Rg Roentgenium 111	112 Cn Copernicium 112	113 Nh Nihonium 113	114 Fl Flerovium 114	115 Mc Moscovium 115	116 Lv Livermorium 116	117 Ts Tennessine 117	118 Og Oganesson 118

Key

Ar	relative atomic mass
Symbol	
Name	
Z	atomic number