

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3445U30-1



Z22-3445U30-1-R1

TUESDAY, 17 MAY 2022 – 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.	9	
2.	10	
3.	8	
4.	6	
5.	9	
6.	14	
7.	19	
Total	75	

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01

ADDITIONAL MATERIALS

A calculator.

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 **4** 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. The production and processing of dairy products requires a number of processes.

- (a) Statements **A-E** below show the main stages of making yoghurt. However the stages are **not** in the correct order.

A

The equipment is sterilised

B

Samples are taken to see if the yoghurt is ready

C

The milk is pasteurised by heating

D

The bacterial culture is added to the pasteurised milk and left at 46 °C for about four hours

E

Flavours and colours are added, then the yoghurt is packaged

- (i) Use the letters **B, C, D**, to arrange the stages in the correct order in the boxes below. [2]

A				E
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- (ii) Underline the type of microorganism used in this process. [1]

fungus bacterium virus

- (iii) State **one** reason why the equipment should be sterilised before use. [1]

.....

- (iv) State why the milk is pasteurised during the process. [1]

.....



- (b) (i) Whole milk, semi-skimmed milk and skimmed milk are available in supermarkets. Complete the following sentence. [2]

Semi-skimmed milk is made by skimming from
..... milk.

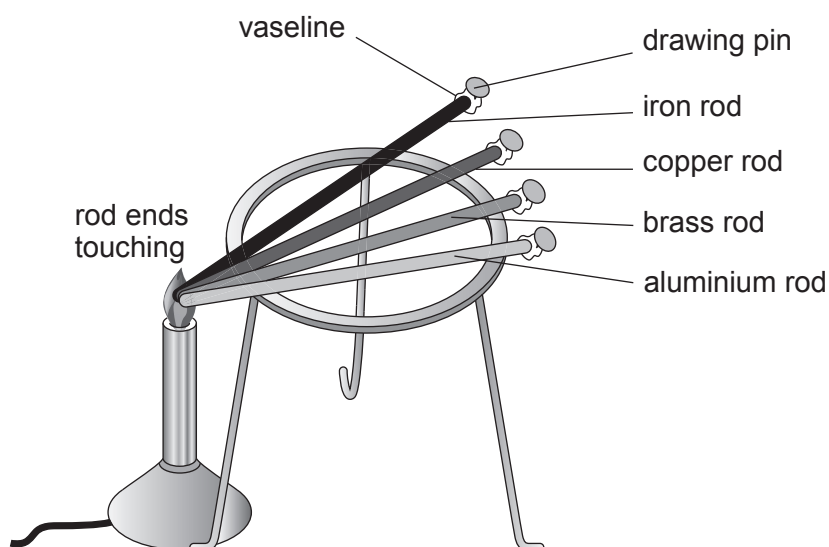
- (ii) Complete the following sentences about homogenisation of milk by underlining the correct word in the brackets.

The milk is pumped at high (**pressure** / **temperature** / **volume**) through very narrow tubes breaking up the fat globules. This prevents a layer of (**butter** / **cheese** / **cream**) forming on the milk. [2]



2. Aluminium, copper and iron are metals. Brass is a metal alloy. These materials have many uses.

The thermal conductivity of metals can be investigated using the apparatus below. The time taken for a drawing pin to fall from each metal rod is measured.



- (a) (i) State the independent variable in this experiment. [1]

.....

- (ii) State **two** variables that are controlled in this experiment. [2]

.....

.....

- (iii) Describe how the thermal conductivity is related to the dependent variable. [2]

.....

.....



- (b) Two students obtained the results shown in the table below.

Metal	Time taken for pin to drop (s)
iron	17
copper	7
brass	12
aluminium	5

- (i) Use the results shown in the table above to place iron, copper, brass and aluminium in order of conductivity. [1]

Best conductor



Poorest conductor

- (ii) The following table shows the theoretical values of the thermal conductivity of the metals.

Metal	Thermal conductivity (units)
iron	80.4
copper	401
brass	109
aluminium	210

Use the information above to explain whether the theoretical data agrees with experimental data. [3]

Best conductor



Poorest conductor

.....

.....

.....

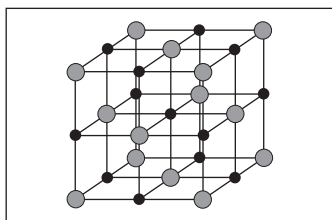
- (c) Mercury is a metal which has a melting point of -39°C . Suggest why the students could not use mercury in this investigation. [1]

.....

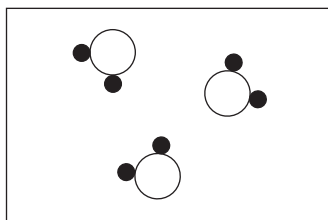
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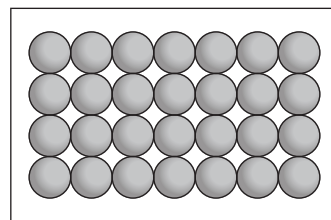
3. The following diagrams show the structure of substances.



A (solid)



B (gas)



C (solid)

- (a) State which of the structures (**A**, **B** or **C**) is an ionic compound. Give **one** reason for your answer. [2]

Letter:

Reason:

.....

.....

- (b) Sodium chloride is an ionic compound which consists of sodium and chloride ions.

Explain why sodium chloride will not conduct electricity when it is a solid but will conduct electricity when it is dissolved in water. [2]

.....

.....



- (c) Some of the materials used in sporting equipment are shown in the table below.

Material	Thermal conductivity (units)	Melting point (°C)	Density (g/cm ³)	Tensile strength (MPa)
carbon fibre	21	3650	1.78	4137
aluminium	210	660	2.71	276
lead	35	327	11.3	12

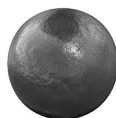
Use the data in the table to answer the following questions.

- (i) Carbon fibre is an example of a composite material used to make bicycle frames for use in cycle races.

State **two** reasons why modern bicycle frames are made of carbon fibre rather than aluminium. [2]

1.
2.

- (ii) A shot put contains lead.



Use the equation

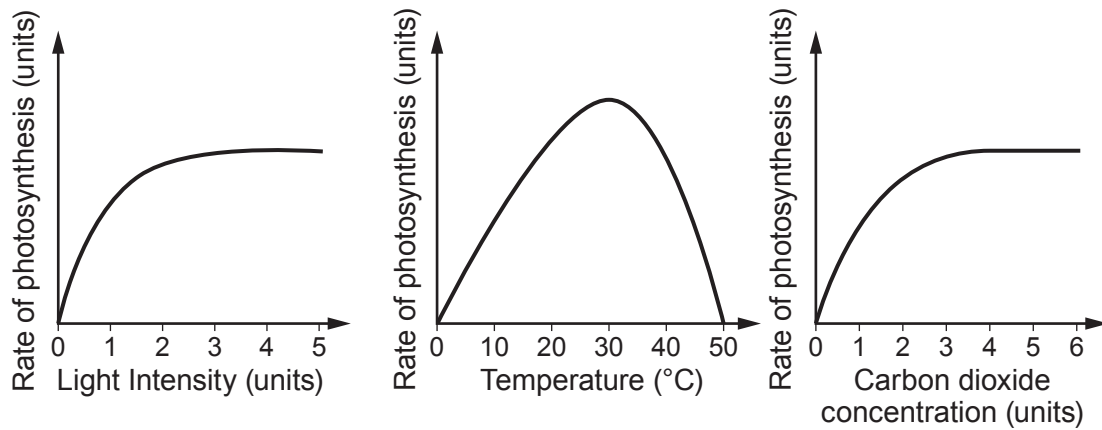
$$\text{mass} = \text{density} \times \text{volume}$$

to find the mass of lead in a shot put that has a volume of 700 cm³. [2]

mass = g



- Their results are shown in the graphs below.



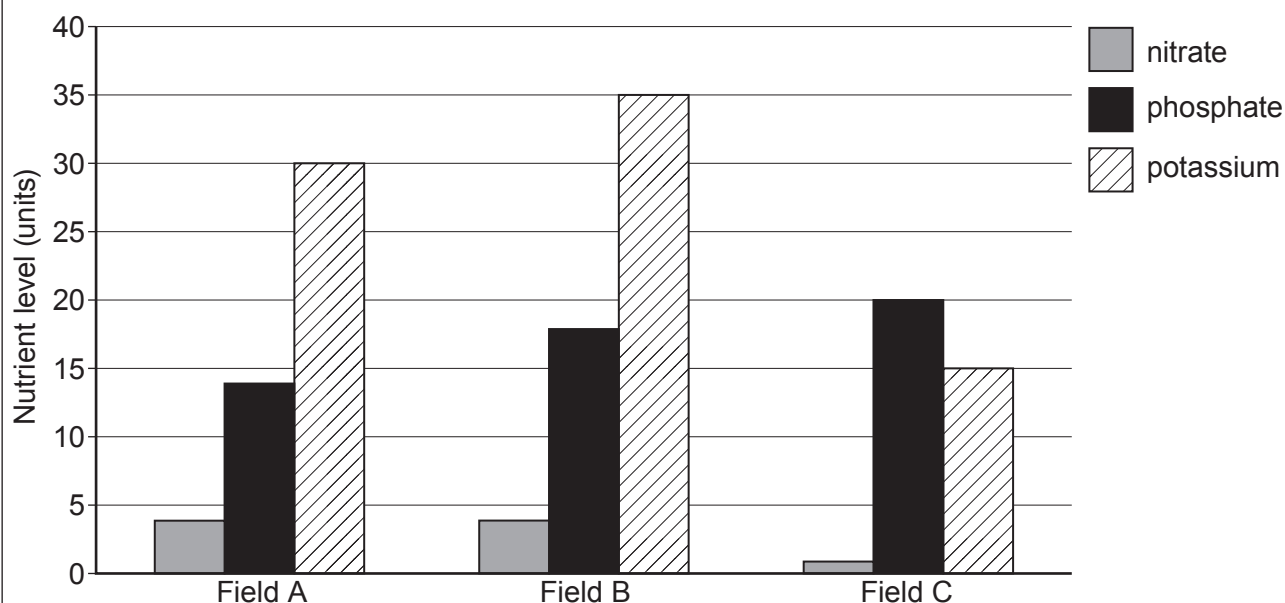
Use the graphs to describe how the rate of photosynthesis is affected by each of these factors. [6 QER]

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5. A farmer wanted to grow soybean crops on three fields. She analysed soil samples for nitrate, phosphate and potassium. The results are shown below.



Soybeans will show healthy growth if the nutrient levels in the soil are above a threshold value. The plants will show signs of mineral deficiency if the nutrient levels in the soil are below these values.

The nitrate, phosphate and potassium threshold values for soybeans are shown in the table below.

Nutrient	Threshold value (units)
nitrate	2
phosphate	16
potassium	28

- (a) Use the information above to answer the following questions.

- (i) State which field would be the most suitable to grow soybean crops. Give a reason for your answer. [2]

Field:

Reason:

.....



- (ii) State which field would result in soybeans with yellow leaves and stunted growth. Give a reason for your answer. [2]

Field:

Reason:

- (iii) State how the farmer ensures that her soybean plants do not suffer from mineral deficiencies in any field used to grow them. [1]

- (b) Some countries have banned the growing of genetically modified (GM) crops. The table below gives some arguments for and against the use of GM crops. Place a tick (✓) next to **two** arguments **against** growing GM crops. [2]

Argument	Against (✓)
cheaper food	
increased crop yield	
could cross-pollinate with weeds	
long-term effects unknown	

- (c) Selective breeding is used by large companies to increase the yield of soybeans. State **two** disadvantages of using crops developed by a selective breeding process. [2]

1.

2.



6. Despite safety precautions, industrial accidents occur.

- (a) Methyl isocyanate (MIC) was involved in the Bhopal disaster that led to the deaths of thousands of people. A highly toxic cloud of MIC was released from chimneys at the chemical plant. On the night of the disaster it reacted with water that leaked into a storage tank, causing a valve to blow.

The structural formula of MIC is $\text{H}_3\text{C}-\text{N}=\text{C}=\text{O}$.

- (i) Complete the table below to calculate the total energy required to break all the bonds in 1 mole of the reactants, MIC and water. [5]

$\text{H}_3\text{C}-\text{N}=\text{C}=\text{O}$			
Bond type	Number of bonds	Energy to break one bond (kJ/mol)	Energy to break all of each bond type (kJ/mol)
H—C	3	413	
C—N	1	305	305
N=C	1	615	
C=O	1		745

H_2O			
Bond type	Number of bonds	Energy to break one bond (kJ/mol)	Energy to break all of each bond type (kJ/mol)
H—O	2	467	

total energy to break **all** bonds = kJ/mol

- (ii) A similar calculation shows the energy released when bonds are formed in the products is greater than your answer above.

Complete the paragraph below by underlining the correct word(s) in the brackets. [3]

When a chemical reaction happens, energy is transferred to or from the surroundings. Energy is transferred to the surroundings if the energy released is **(less than / equal to / greater than)** the energy absorbed. This is called **(an endothermic / a combustion / an exothermic)** reaction. The temperature of the surroundings **(decreases / stays the same / increases)**.



- (iii) The Bhopal disaster was caused because of thermal runaway.

Explain what is meant by the term 'thermal runaway'.

[2]

.....

.....

.....

- (b) Spinach grown in north-eastern Japan was contaminated by radioactivity from the Fukushima nuclear power station accident in March 2011. Radioactive dust deposited iodine-131 atoms on spinach leaves. Its activity was 8200 units.

No spinach was allowed to be used for 96 days.

Iodine-131 has a half-life of 8 days.

- (i) The initial activity of the iodine-131 was 8200 units. Calculate the activity after 8 days.

[1]

activity units

- (ii) Calculate the number of half-lives in 96 days.

[1]

number =

- (iii) Calculate the activity after 96 days.

[2]

activity units



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7. Criminals will try to hide their activities but forensic scientists, using biological and chemical testing, are able to find evidence that reveals what happened.

(a) DNA profiling is commonly used to identify criminals.

(i) State where DNA is found in the cell.

[1]

.....

(ii) There were three suspects in a crime. Suspect 1 did not have an alibi but suspects 2 and 3 did. Initially it was thought that suspect 1 was the criminal. DNA samples were collected from the crime scene.



Compare the DNA samples above to explain whether having an alibi or not is sufficient to decide on guilt.

[2]

.....

.....

.....

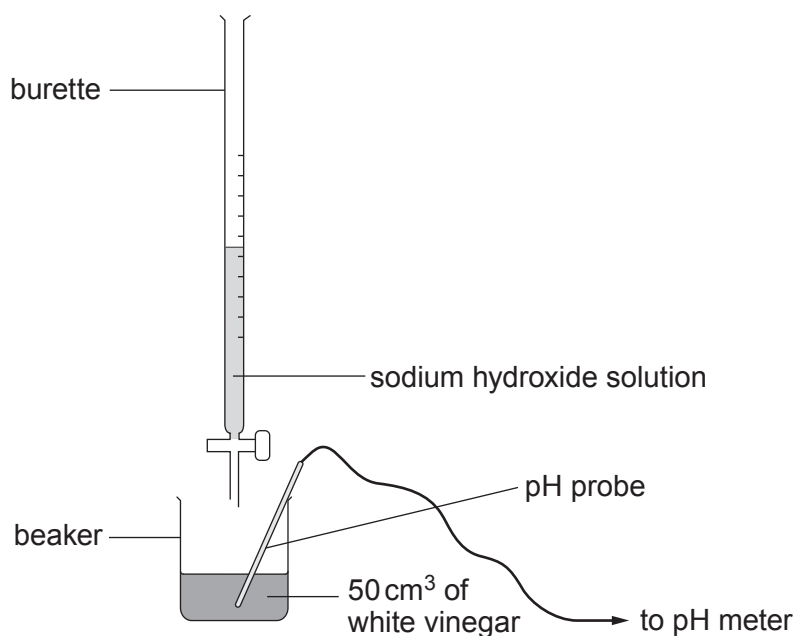
(iii) State **one other** use of DNA profiling.

[1]

.....



- (b) It is suspected that supplies of vinegar have been tampered with by adding a strong acid. White vinegar usually contains ethanoic acid at a concentration of 0.01 mol/dm^3 . Samples of the vinegar are taken and tested by titrating against 0.5 mol/dm^3 sodium hydroxide solution using the apparatus below.



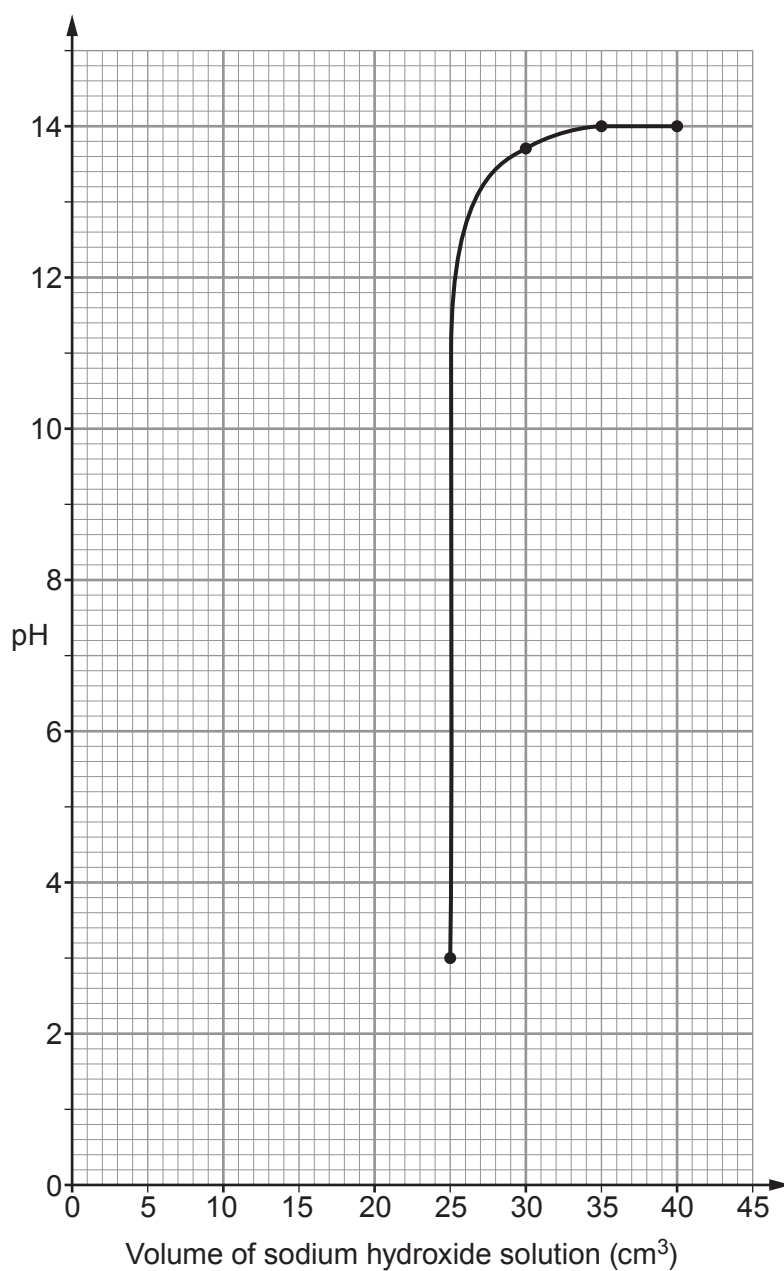
A pH meter is used to monitor the pH of the solution in the flask. The results are shown in the table below.

Volume of sodium hydroxide solution (cm^3)	pH reading
0	1.5
5	1.6
10	1.7
15	1.9
20	2.2
25	3.0
30	13.7
35	14.0
40	14.0



- (i) Use the data in the table to complete the graph on the grid below.

[3]



- (ii) Use the graph to find the volume of sodium hydroxide solution required to neutralise the white vinegar.

[1]

volume = cm³

- (iii) Use the information on pages 16 and 17 and the equation

$$\text{concentration of white vinegar} = \frac{\text{concentration of sodium hydroxide} \times \text{volume of sodium hydroxide}}{\text{volume of white vinegar}}$$

to determine whether or not the samples had been tampered with. [3]

-
.....
- (iv) Complete the word equation for the reaction between an acid and a base. [2]

acid + base →

- (v) Explain why taking multiple readings will increase the accuracy of the result. [2]

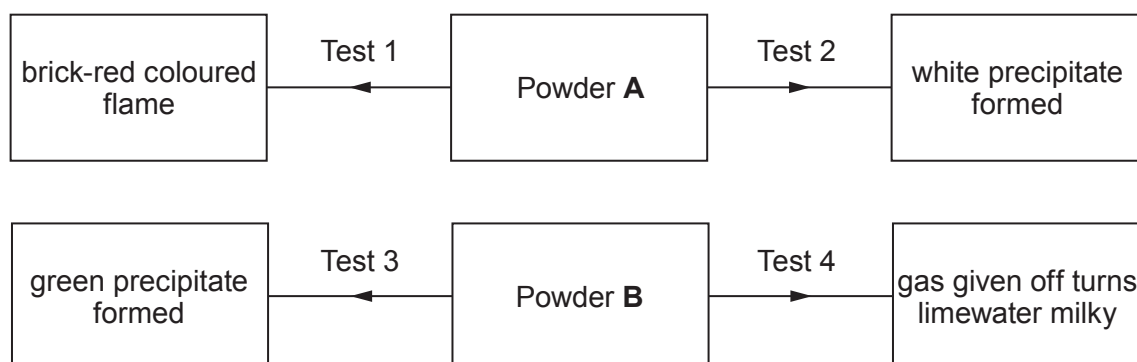
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- (c) Powders **A** and **B** are collected at a crime scene. The following tests are used to identify them.

Test	Action
1	Flame test
2	Add silver nitrate solution
3	Add sodium hydroxide solution
4	Add dilute hydrochloric acid and bubble gas through limewater

The results are given below.



Identify powders **A** and **B**.

[4]

Powder **A**:

Powder **B**:

END OF PAPER





THE PERIODIC TABLE

Group 1 2 3 4 5 6 7 0

1 H Hydrogen 1										4 He Helium 2									

Key

Ar	relative atomic mass
Symbol	
Name	
Z	atomic number