

Name:

Index Number:

Class:

**YIO CHU KANG SECONDARY SCHOOL
O-LEVEL PRELIMINARY EXAMINATION 2024
SECONDARY FOUR EXPRESS**



SCIENCE (PHYSICS / CHEMISTRY)

5086/01

Paper 1

1 hour

Additional Material:

Optical Answer Sheet (OAS)

23 August 2024 (Friday)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil on the OAS.

Do not use staples, paper clips, glue or correction fluid.

Write your name, index number and class on the OAS in the spaces provided.

There are **forty** questions on this paper. Answer all questions.

For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OAS.

Read the instructions on the OAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this question paper.

The use of an approved scientific calculator is expected, where appropriate.

The colours of some common metal hydroxides are given on page 8.

A copy of the Periodic Table is printed on page 9.

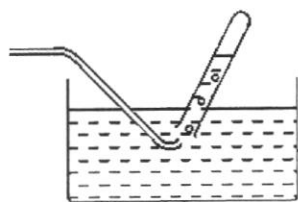
For Examiner's Use

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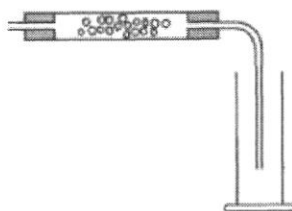
Setters: Mdm Toh Lee Wah

- 1 An acidic gas T is denser than air and insoluble in water.

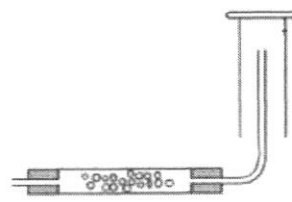
Which method(s) can be used to collect the gas?



1



2



3

- A 2 only
 B 3 only
 C 1 and 2
 D 2 and 3
- 2 Bromine is a liquid at 20 °C.

What is the melting point and boiling point for bromine?

	melting point/ °C	boiling point/ °C
A	-22	-3
B	-8	-33
C	-7	59
D	25	103

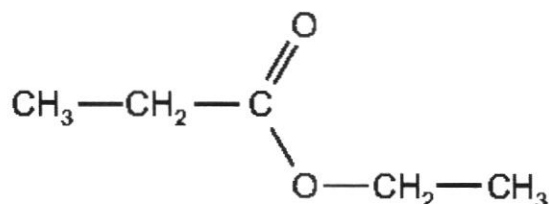
- 3 What changes occur when a gas at 200 °C becomes a solid at -5 °C?

	separation of particles	energy of particles	attractive forces between particles
A	decreases	decreases	increases
B	decreases	increases	decreases
C	increases	decreases	increases
D	increases	increases	decreases

- 4 What ions are present in iron(III) sulfate, $\text{Fe}_2(\text{SO}_4)_3$?

- A Fe^{2+} and SO_4^{2-}
 B Fe^{2+} and SO_4^{3-}
 C Fe^{3+} and SO_4^{2-}
 D Fe^{3+} and SO_4^{3-}

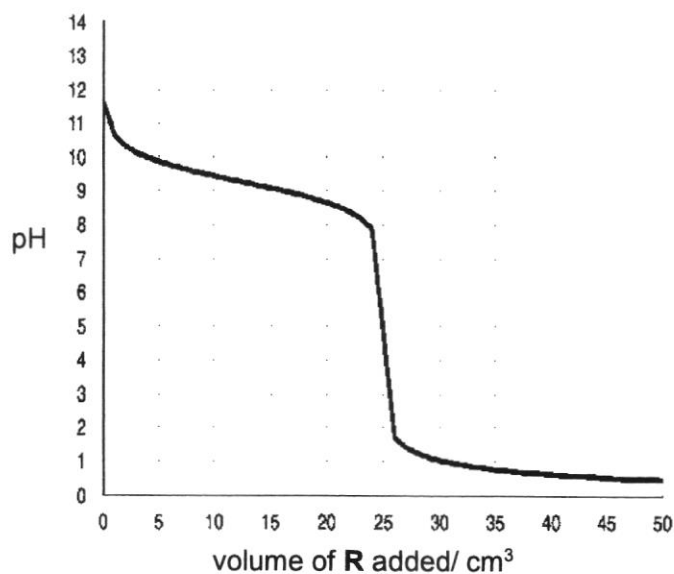
- 5 The diagram shows the molecule ethyl propanoate.



How many bonding pairs of electrons are there in the molecule?

- A 7
 B 16
 C 17
 D 20
- 6 Aqueous solution **R** is gradually added to aqueous solution **S**.

The changes in pH are shown on the graph.



What are **R** and **S**?

	R	S
A	aqueous ammonia	ethanoic acid
B	ethanoic acid	sodium hydroxide
C	hydrochloric acid	aqueous ammonia
D	sodium hydroxide	hydrochloric acid

- 7 Which substance does **not** produce copper(II) sulfate when added to dilute sulfuric acid?

- A copper
 B copper(II) carbonate
 C copper(II) hydroxide
 D copper(II) oxide

12 What are the oxidation states of chlorine in Cl_2O and ClO_4^- ?

- A -2 and -1
- B +1 and +3
- C +1 and +7
- D +2 and +8

13 Experiments were carried out to determine the positions of metals X, Y and Z in the reactivity series. The table shows the results.

test	metal X	metal Y	metal Z
reaction between metal and hydrochloric acid	effervescence	no visible observation	effervescence
heating the metal oxide with carbon	metal oxide reduced	metal oxide reduced	metal oxide not reduced

What is the order of reactivity of these metals?

	most reactive	→	least reactive
A	Z	X	Y
B	Y	Z	X
C	X	Z	Y
D	X	Y	Z

14 Chromium is placed between zinc and iron in the reactivity series.

Which metal reduces the oxide of chromium?

- A copper
- B iron
- C lead
- D magnesium

15 During a chemical reaction, the temperature of the reaction mixture increased.

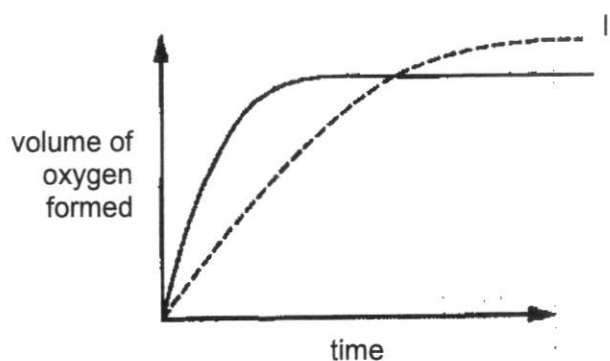
Which row correctly describes the type of energy change and the transfer of heat during this reaction?

	type of energy change	transfer of heat
A	endothermic	absorbed from surroundings
B	endothermic	lost to surroundings
C	exothermic	absorbed from surroundings
D	exothermic	lost to surroundings

- 16 Which of the following changes will increase the speed of reaction between one mole of gas T and two moles of gas U?

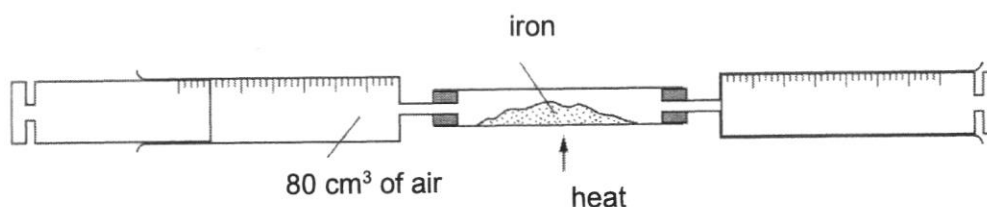
A a decrease in temperature
 B a decrease in the mass of catalyst
 C an increase in the particle size of catalyst
 D a decrease in the volume of the reaction flask

- 17 Curve I is obtained by observing the decomposition of 100 cm³ of 1 mol/dm³ aqueous hydrogen peroxide, catalysed by manganese(IV) oxide.



Which alteration to the conditions will produce curve II?

- A adding some 0.1 mol/dm³ aqueous hydrogen peroxide
 B lowering the temperature
 C using a better catalyst
 D using less manganese(IV) oxide
- 18 80.0 cm³ of a sample of air is trapped in a syringe. The air is slowly passed over heated iron in a tube until there is no further decrease in volume.



When cooled to the original temperature, what volume of gas remains?

- A 16.8 cm³
 B 40.0 cm³
 C 60.0 cm³
 D 63.2 cm³

- 19 Which substance has a main constituent that contains only one carbon atom per molecule?
- A bitumen
 - B kerosene
 - C naphtha
 - D natural gas
- 20 Which statement about vegetable oil and margarine is correct?
- A Both vegetable oil and margarine are liquids at room temperature.
 - B Margarine has a higher melting point than vegetable oil.
 - C Vegetable oil has fewer carbon-carbon double bonds than margarine.
 - D Vegetable oil is made from margarine by hydrogenation.

Name:	Index Number:	Class:
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**YIO CHU KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
SECONDARY FOUR EXPRESS**



SCIENCE (CHEMISTRY)

Paper 3

5086 &
5088/03

1 hour 15 minutes

28 August 2024 (Wednesday)

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the cover page.

Write in dark blue or black ink.

You may use a soft pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Section A

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

Section B

Answer any **one** question in the spaces provided.

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

At the end of the examination, fasten all your work securely together.

A copy of the Periodic Table is on page **16**.

For Examiner's Use

Section A	/ 55
Section B	/ 10
Total	/ 65

Setter: Mdm Toh Lee Wah

SECTION AAnswer **all** questions in the spaces provided.**1** Name the apparatus best used to carry out the following procedures.**(a)** Mix 250 cm³ each of two solutions.

.....[1]

(b) Measure the freezing point of a liquid.

.....[1]

(c) Measure the time taken to melt 10.5 g of a solid.

.....[1]

(d) Collect and measure 20 cm³ of ammonia gas.

.....[1]

[Total: 4]

2 Table 2.1 shows some information about four different substances, **A**, **B**, **C** and **D** when heated.Complete Table 2.1 by identifying whether substances, **A**, **B**, **C** and **D** is an element, compound or mixture.**Table 2.1**

substance	melting point/ °C	colour	other information	element, compound or mixture
A	-10 to -6	green	A colourless gas is given off. A greenish-white solid is left behind. Another gas condenses into water droplets on the sides of the test tube.	
B	105	white	It melts into a colourless liquid and turns brown on further heating. Finally, a black residue is left behind.	
C	115	yellow	It melts into a dark orange liquid. Upon cooling, the liquid turns back into a yellow solid.	
D	242	blue	A black solid is formed and a gas is given off.	

[4]

[Total: 4]

- 3 Lemongrass contains a variety of different pigments. These pigments can be separated using paper chromatography using ethanol as the solvent.

(a) Fig. 3.1 shows the chromatograms of lemongrass and citronellol.

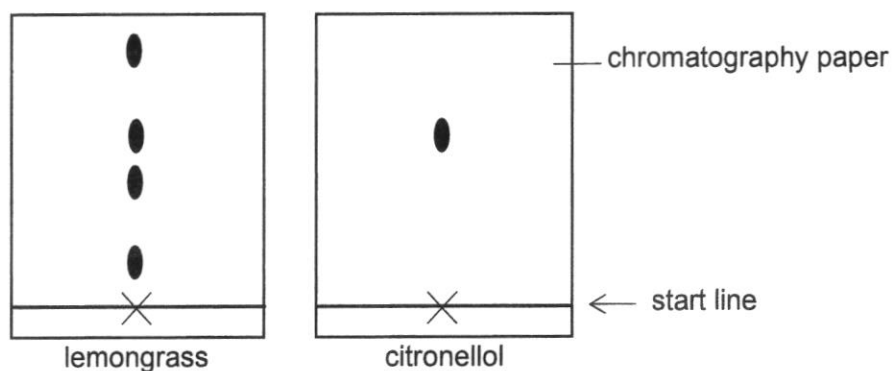


Fig. 3.1

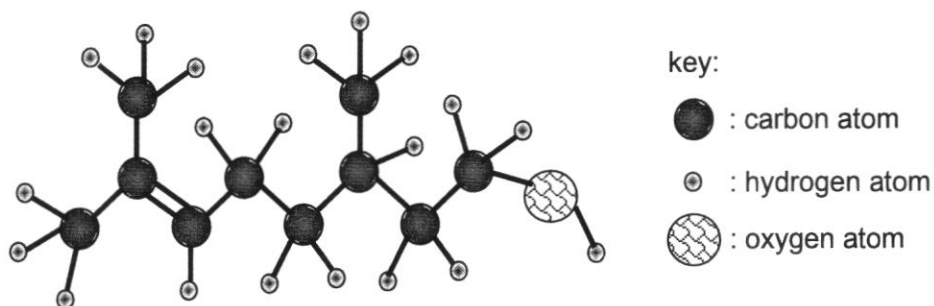
- (i) How many pigments does lemongrass contain?

.....[1]

- (ii) State **one** deduction about the purity of lemongrass and citronellol that can be made from these two chromatograms.

.....
[1]

(b) A molecule of citronellol is as shown below.



- (i) Write the chemical formula of a molecule of citronellol.

.....[1]

- (ii) Calculate the molar mass of citronellol.

molar mass = g/mol [1]

[Total: 4]

- 4 A sample of sulfur taken from the volcanic regions is found to contain two natural occurring isotopes: sulfur-32 and sulfur-34.

(a) Define *isotopes*.

.....
[2]

- (b) Using the Periodic Table provided on page 16, complete Table 4.1 to show the number of subatomic particles for each isotope of sulfur.

Table 4.1

isotopes	number of		
	protons	neutrons	electrons
sulfur-32			
sulfur-34			

[3]

- (c) Do both isotopes of sulfur have the same chemical reactivity? Explain your answer.

.....[1]

- (d) Sulfur, an impurity in fossil fuels, burns to produce sulfur dioxide. Hence the air near the industrial areas became polluted due to sulfur dioxide gas given off by the factories.

Sulfur dioxide gas reacts with oxygen and water in the air to form acid rain.

State **two** harmful effects of acid rain.

harmful effect 1

.....

harmful effect 2

.....
[2]

[Total: 8]

- 5 Table 5.1 below describes three elements, their oxides and reactions involving the oxides.

Table 5.1

element	formula of oxide	reaction of oxide with nitric acid (yes / no)	reaction of oxide with potassium hydroxide (yes / no)
	CO ₂		yes
lead	PbO		
potassium		yes	

- (a) Complete Table 5.1. [4]

- (b) (i) Using the information provided in Table 5.1, draw the 'dot and cross' diagrams to show the arrangement of electrons in the oxide formed by carbon and potassium. Show **only** the outermost electrons.

oxide of carbon

[2]

oxide of potassium

[2]

- (ii) Suggest if the oxides of carbon and potassium are able to conduct electricity at room temperature and pressure. Explain your answer.

.....

[3]

[Total: 11]

- 6 Fig. 6.1 shows the blast furnace used for the extraction of iron.

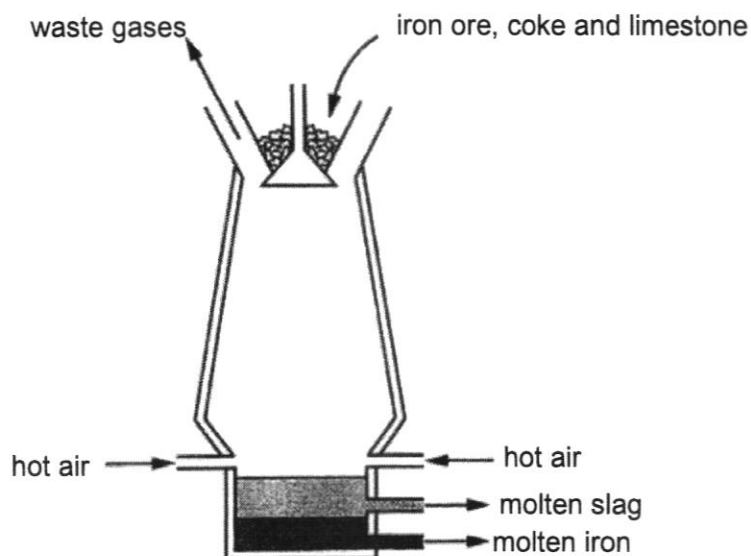


Fig. 6.1

- (a) During the extraction, hot air reacts with coke to form carbon monoxide. Carbon monoxide reacts with iron ore to form molten iron as shown by the chemical equation below.



State which element has been reduced and explain your answer.

.....

[2]

- (b) (i) Calculate the maximum mass of iron that can be formed from 5 600 g of iron(III) oxide.

[Relative atomic masses: A_r : Fe, 56; O, 16]

mass of iron formed = kg [2]

- 6 (b) (ii) Calculate the volume of carbon dioxide produced in this reaction, measured at room temperature and pressure.

volume of carbon dioxide produced = dm³ [2]

- (c) The molten iron collected from the blast furnace is then further processed. Varying quantities of carbon and other elements are added to iron to make different types of steel which can be used to make useful objects.

Explain, with the aid of diagram, how the addition of carbon makes steel harder and stronger compared to pure iron.

.....

[2]

- (d) The iron metal formed can react with an aqueous solution of copper(II) nitrate.

Name the type of reaction that has taken place and state **one** observation during this reaction.

type of reaction [1]

observation
[1]

- (e) Iron metal can also react with dilute hydrochloric acid to form aqueous iron(II) chloride and gas Y.

- (i) Name gas Y and state a test to confirm its identity.

.....
[2]

- (ii) Write a balanced chemical equation of the reaction between iron and dilute hydrochloric acid.

.....[2]

[Total: 14]

- 7 (a) Saturated hydrocarbons are classified as alkanes homologous series which have the general formula C_nH_{2n+2} .

Besides having the same general formula, give **one** other characteristic property of a homologous series.

.....
.....[1]

- (b) Propane is a saturated organic compound and propene is an unsaturated organic compound.

- (i) How would you distinguish in the laboratory between a saturated and an unsaturated organic compound?

chemical test
.....[1]

result with the saturated compound[1]

result with the unsaturated compound[1]

- (ii) Draw the structural formula of a molecule of propene.

[1]

- (iii) Propene undergoes addition polymerisation. Draw the structural formula of the polymer showing **two** repeat units.

[1]

- 7 (c) (i) C_2H_6O is a member of the alcohol homologous series.

Draw the structural formula of this alcohol.

[1]

- (ii) The alcohol C_2H_6O can be made in the laboratory from glucose.
Name the process and list the substances and conditions required.

name of process:

[1]

substance(s):

.....

condition(s):

.....[2]

[Total: 10]

SECTION B

Answer any **one** question in the spaces provided.

- 8 A student investigated the reaction between copper(II) carbonate and dilute hydrochloric acid.



The figure shows the apparatus used by the student.

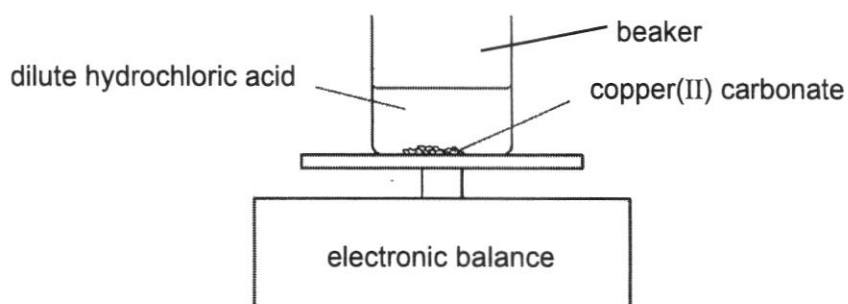


Table 8.1 shows the balance reading recorded by the student in every minute.

Table 8.1

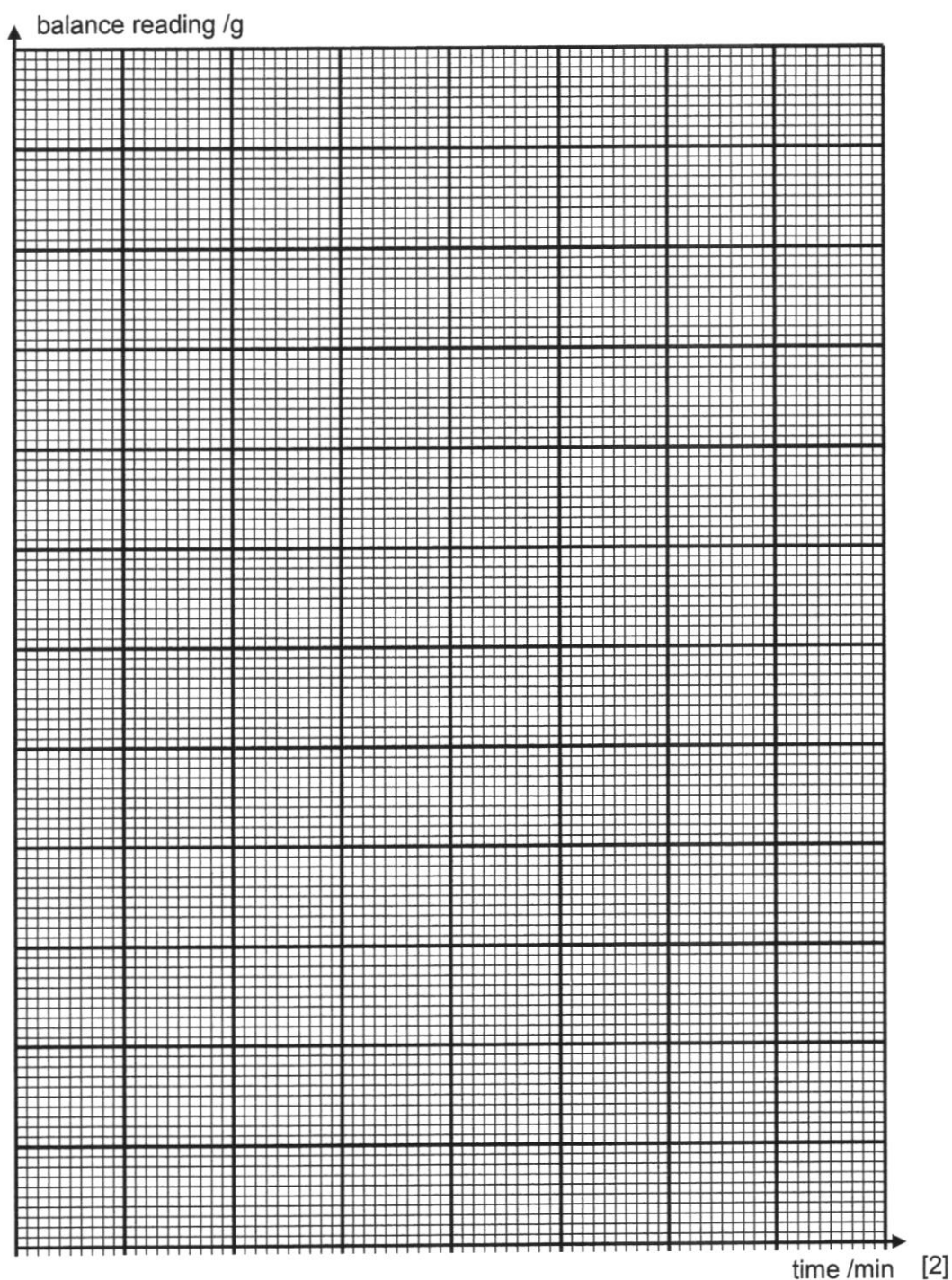
time /min	balance reading /g
0	4.00
1	2.90
2	2.40
3	2.00
4	1.70
5	1.50
6	1.30
7	1.15
8	1.00
9	0.90
10	0.85
11	0.80
12	0.75
13	0.75
14	0.75

- (a) Explain why the balance reading decreases during the experiment.

.....

.....[1]

- 8 (b) (i) Plot a graph of balance reading /g against time /min.



- (ii) How can the student tell when the reaction has finished?

.....[1]

- (iii) Determine the mass of carbon dioxide gas produced during the reaction.

.....[1]

- 8 (b) (iv) Find the speed of the reaction, in grams per minute.

speed of the reaction = g/min [1]

- (c) During the reaction, the beaker feels warm to touch.

Explain why.

.....[1]

- (d) 5 cm³ of the content in the beaker was transferred to a clean and dry test-tube. A few drops of aqueous ammonia were then added to the test-tube. A light-blue precipitate was formed.

- (i) Write the ionic equation for the formation of light-blue precipitate.

.....[2]

- (ii) Predict what will happen when aqueous ammonia is added in excess.

.....[1]

[Total: 10]

- 9 (a) One substance which is responsible for the fragrance of roses is 2-phenylethanol. The structure of this molecule is shown in Fig. 9.1.

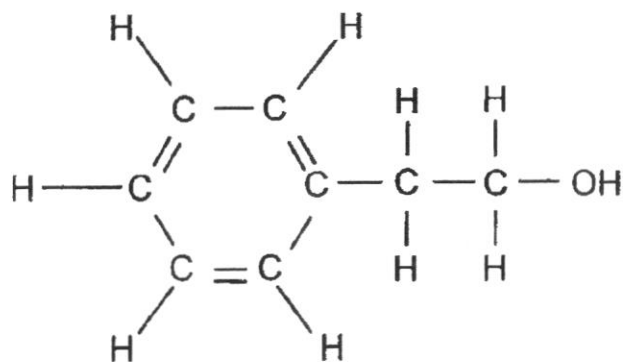


Fig. 9.1

- (i) **Circle** the functional group(s) found in 2-phenylethanol. [1]

- (ii) A student commented that the molecule is a '*hydrocarbon*'.

Do you agree with the statement? Explain your answer.

.....
[1]

- (iii) Suggest a suitable chemical reagent with relevant observation(s) to convert the 2-phenylethanol molecule to a compound with a **pH of 6.0**.

chemical reagent: [1]

observation(s):

.....
[1]

- (iv) Hence, draw the structural formula of the compound with a **pH of 6.0**.

- 9 (b) A sample of the compound with a **pH of 6.0** formed, is added to equal volume of sodium hydroxide.

(i) State the type of reaction that has taken place.

.....[1]

(ii) From the list given, **circle** the bond that is broken when the compound with a **pH of 6.0** reacts with sodium hydroxide.



[1]

(iii) Hence, write the ionic equation for the reaction.

.....[2]

[Total: 10]

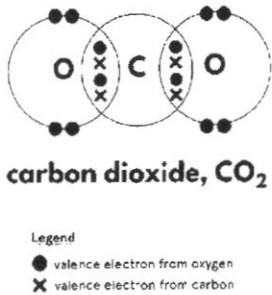
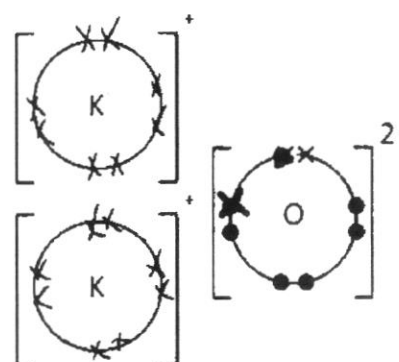
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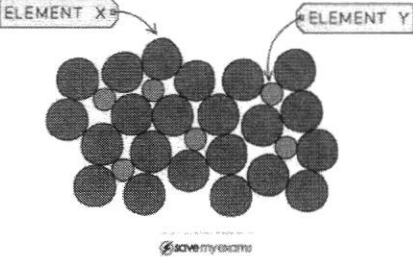
Suggested answers

1		2		3		4		5		6		7		8		9		10
C		C		A		C		C		C		A		B		D		A
11		12		13		14		15		16		17		18		19		20
C		C		A		D		D		D		A		D		D		B

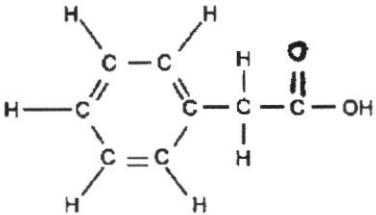
Suggested answers

1(a)	beaker	1m				
(b)	thermometer	1m				
(c)	(electronic) stopwatch	1m				
(d)	gas syringe	1m				
2	A – mixture	1m				
	B – compound	1m				
	C – element	1m				
	D - compound	1m				
3(ai)	4	1m				
(aii)	<u>Lemongrass is not pure / is a mixture and citronellol oil is pure.</u>	1m				
(bi)	C ₁₀ H ₂₀ O	1m				
(bii)	Molar mass of C ₁₀ H ₂₀ O = 10(12) + 20(1) + 16 = 156 g/mol	1m				
4(a)	Isotopes are atoms of the same element with the same number of protons but different number of neutrons .	1m 1m				
(b)	isotopes	number of	1m x 3			
		protons		neutrons	electrons	
		sulfur-32		16	16	16
		sulfur-34		16	18	16
(c)	Yes. They have the same number of valence electrons , which determines the reactivity of an element.	1m				
(d)	- acid rain corrode metal structures and limestone buildings - acid rain acidifies lakes and streams, harming aquatic life - acid rain dissolves and leaches away the nutrients from soil, destroying vegetation		Any 2 x 1m			
5(a)	element	formula of oxide	reaction of oxide with nitric acid (yes / no)	reaction of oxide with potassium hydroxide (yes / no)	Each column correct: 1m x 4	
	carbon	CO ₂	no	yes		
	lead	PbO	yes	yes		
	potassium	K ₂ O	yes	no		

(bi)	 carbon dioxide, CO₂ Legend ● valence electron from oxygen × valence electron from carbon 	For CO₂: Correct arrangement of e shared – 1m Correct no. of atoms of elements – 1m For K₂O: Correct no. of atoms of elements – 1m Correct charges on ions – 1m
(bii)	At rtp, potassium oxide exists as a solid. The ions are held in the fixed positions, hence unable to move around to carry electric charges. CO₂ is a covalent compound, it does not have any mobile ions nor electrons to act as charge carriers. Hence unable to conduct electricity.	1m x 2 1m
6(a)	Iron is reduced. Iron in Fe₂O₃ loses oxygen atoms to form Fe, hence it is reduced. Or The oxidation state of Fe decreases from +3 in Fe₂O₃ to 0 in Fe, hence Fe/iron is reduced.	1m 1m
(bi)	No of mol of Fe₂O₃ = $5600 / (56 \times 2) + (16 \times 3) = 35$ mol Fe₂O₃ : Fe 1 : 2 35 mol : 35 x 2 = 70 mol Mass of iron = 70 x 56 = 3920 g = 3.92 kg	1m 1m
(bii)	Fe₂O₃ : CO₂ 1 : 3 35 mol : 35 x 3 = 105 mol Volume of CO₂ = 105 x 24 dm³ = 2520 dm³	1m 1m

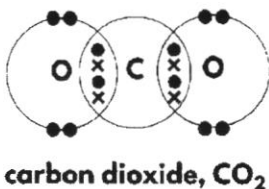
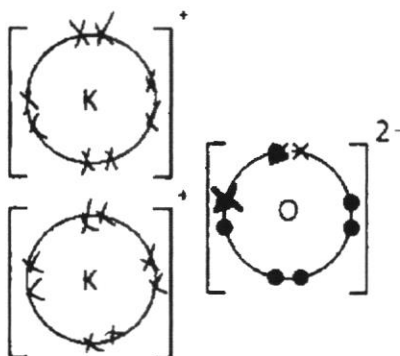
(c)	 In steel, the atoms of different sizes disrupt the orderly arrangement. The layers of atoms can no longer slide over one another easily, thus making steel harder and stronger.	1m 1m
(d)	Displacement reaction The blue solution turns green. Or A red-brown deposit is formed (on iron metal).	1m 1m
(ei)	Hydrogen gas. Gas evolved extinguishes a lighted splint with a 'pop' sound.	1m 1m
(eii)	$\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$	
7(a)	Each successive member differs by a $-\text{CH}_2$ unit. Or They have similar chemical properties. *accept all other possible answers	1m
(bi)	Bubble gaseous hydrocarbons into aqueous bromine Result with saturated: aq bromine remains unchanged Result with unsaturated: aq bromine decolorises rapidly from reddish brown to colorless.	1m 1m 1m
(bii)	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}=\text{C} \\ \quad \quad \\ \text{H} \quad \quad \text{H} \end{array} $ PROPENE	1m
(biii)	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & \\ \text{H} & \text{CH}_3 & \text{H} & \text{CH}_3 \end{array} $ poly(propene)	1m

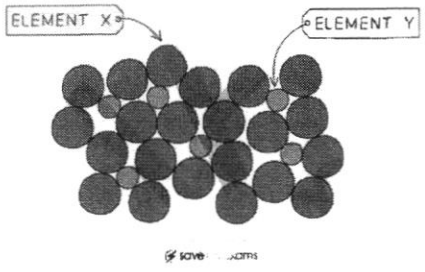
(ci)	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $	1m
(cii)	Name of process: fermentation Substances and conditions: <u>Yeast</u> in glucose solution at 37°C , absence of oxygen * substance - 1m; conditions – 1m	1m 1m x 2
8(a)	Carbon dioxide gas produced during the reaction escaped into the atmosphere	1m
(bi)	Scale + correct plotting Smooth curve	1m 1m
(bii)	When the <u>gradient becomes zero</u> / balance reading <u>remain constant</u> (0.75 g) Effervescence stops.	1m
(biii)	Mass of CO ₂ produced = 4.00 – 0.75 = <u>3.25 g</u>	1m
(biv)	Speed of reaction = 3.25 / 12 = <u>0.271 g/min</u>	1m
(c)	The reaction is <u>exothermic</u> in nature, thus liberating heat to the surroundings.	1m
(di)	$\text{Cu}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Cu}(\text{OH})_2(\text{s})$	1m, 1m
(dii)	Light-blue precipitate is <u>soluble</u> in excess aq ammonia to form a <u>dark blue solution</u> .	1m
9(ai)		Both correct - 1m
(aii)	No. It contains <u>oxygen</u> atom.	1m
(aiii)	Chemical reagent: (acidified) potassium manganate(VII)/ potassium dichromate (VI) Observation: Purple KMnO ₄ decolourises/Orange K ₂ Cr ₂ O ₇ turns green.	1m 1m

(aiv)		1m, 1m
(bi)	neutralisation	1m
(bii)	Circle O – H	1m
(biii)	$\text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l})$	1m, 1m

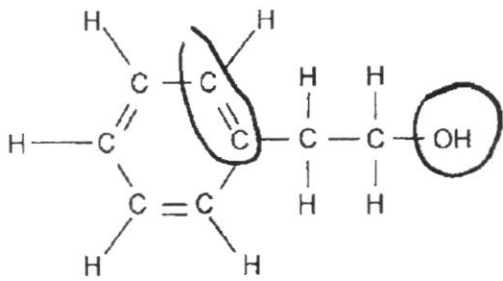
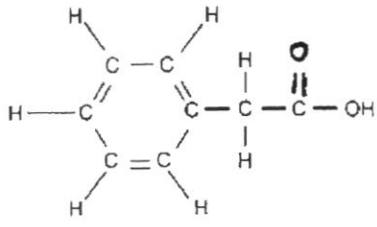
Suggested answers

1(a)	Beaker Many wrote measuring cylinder	1m															
(b)	Thermometer Generally well done	1m															
(c)	(electronic) stopwatch Generally well done	1m															
(d)	gas syringe marked wrong if the word "gas" is not included	1m															
2	A – mixture	1m															
	B – compound	1m															
	C – element	1m															
	D - compound	1m															
	Some students still struggled with the properties of ECM																
3(ai)	4 Many wrote 3	1m															
(aia)	<u>Lemongrass</u> is <u>not pure</u> / is a <u>mixture</u> and <u>citronellol</u> oil is <u>pure</u> . Many wrote citronellol is "purer" than lemongrass. This indicates that students do not know that having 1 spot on the chromatogram is pure.	1m															
(bi)	C ₁₀ H ₂₀ O Accept C ₁₀ H ₁₉ OH (or in kind)	1m															
(bii)	Molar mass of C ₁₀ H ₂₀ O = 10(12) + 20(1) + 16 = <u>156</u> g/mol Allow ECF	1m															
4(a)	Isotopes are atoms of the same element with the same number of protons but different number of neutrons . Many failed to say that isotopes are ATOMS. Many used the non-existent word "neutron number" – should be nucleon number.	1m															
		1m															
(b)	<table><tr><td rowspan="4">isotopes</td><td colspan="3">number of</td></tr><tr><td>protons</td><td>neutrons</td><td>electrons</td></tr><tr><td>sulfur-32</td><td>16</td><td>16</td><td>16</td></tr><tr><td>sulfur-34</td><td>16</td><td>18</td><td>16</td></tr></table> Quite a handful cannot calculate for the number of neutrons present.	isotopes	number of			protons	neutrons	electrons	sulfur-32	16	16	16	sulfur-34	16	18	16	1m x 3
isotopes	number of																
	protons		neutrons	electrons													
	sulfur-32		16	16	16												
	sulfur-34	16	18	16													
(c)	Yes. They have the same number of valence electrons , which determines the reactivity of an element.	1m															

	Marked wrong if students omit "valence".																		
(d)	- acid rain corrodes metal structures and limestone buildings - acid rain acidifies lakes and streams, harming aquatic life - acid rain dissolves and leaches away the nutrients from soil, destroying vegetation marked wrong if students wrote "damage buildings", they did not exemplify the harmful effects of increased acidity in water bodies. Many wrote "breathing difficulties / eye irritation" – I suppose they misunderstood the question for effects of SO₂.				Any 2 x 1m														
5(a)	<table border="1"> <thead> <tr> <th>element</th><th>formula of oxide</th><th>reaction of oxide with nitric acid (yes / no)</th><th>reaction of oxide with potassium hydroxide (yes / no)</th></tr> </thead> <tbody> <tr> <td>carbon</td><td>CO₂</td><td>no</td><td>yes</td></tr> <tr> <td>lead</td><td>PbO</td><td>yes</td><td>yes</td></tr> <tr> <td>potassium</td><td>K₂O</td><td>yes</td><td>no</td></tr> </tbody> </table> Many wrote CO₂ instead of C as they did not understand the question. Many do not know what is meant to be acidic/basic oxides – refers to the ability to react with bases/ acids respectively.	element	formula of oxide	reaction of oxide with nitric acid (yes / no)	reaction of oxide with potassium hydroxide (yes / no)	carbon	CO ₂	no	yes	lead	PbO	yes	yes	potassium	K ₂ O	yes	no	Each column correct: 1m x 4	
element	formula of oxide	reaction of oxide with nitric acid (yes / no)	reaction of oxide with potassium hydroxide (yes / no)																
carbon	CO ₂	no	yes																
lead	PbO	yes	yes																
potassium	K ₂ O	yes	no																
(bi)	 carbon dioxide, CO₂ Legend ● valence electron from oxygen x valence electron from carbon  Very badly attempted. They still do not know when ionic/covalent compounds are formed.				For CO₂: Correct arrangement of e shared – 1m Correct no. of atoms of elements – 1m For K₂O: Correct no. of atoms of elements – 1m Correct charges on ions – 1m														
(bii)	At rtp, potassium oxide exists as a solid. The ions are held in the fixed positions, hence unable to move around to carry electric charges. CO₂ is a covalent compound, it does not have any mobile ions nor electrons to act as charge carriers. Hence unable to conduct electricity. Handful did not understand the term "at rtp", they went on to explain how ionic compounds conduct electricity in molten/aqueous states.				1m x 2 1m														
6(a)	Iron is reduced.				1m														

	Many wrote Fe_2O_3. Question did not ask for the SUBSTANCE reduced. Iron in Fe_2O_3 loses oxygen atoms to form Fe, hence it is reduced. Or The oxidation state of Fe decreases from +3 in Fe_2O_3 to 0 in Fe, hence Fe/iron is reduced.	1m
(bi)	No of mol of $\text{Fe}_2\text{O}_3 = 5600 / (56 \times 2) + (16 \times 3) = 35 \text{ mol}$ Fe_2O_3 : Fe 1 : 2 35 mol : $35 \times 2 = 70 \text{ mol}$ Mass of iron = $70 \times 56 = 3920 \text{ g} = 3.92 \text{ kg}$ Well-attempted by those who tried. Quite a handful left the Q blank.	1m 1m
(bii)	Fe_2O_3 : CO_2 1 : 3 35 mol : $35 \times 3 = 105 \text{ mol}$ Volume of $\text{CO}_2 = 105 \times 24 \text{ dm}^3 = 2520 \text{ dm}^3$ A handful divided 2520 by 1000, guess they failed to know that molar gas volume is expressed as dm^3.	1m 1m
(c)	 In steel, the atoms of different sizes disrupt the orderly arrangement. The layers of atoms can no longer slide over one another easily, thus making steel harder and stronger. Poorly attempted. Fail to provide essential key words.	1m 1m
(d)	Displacement reaction The blue solution turns green [many wrote colourless]. Or A red-brown deposit is formed (on iron metal).	1m 1m
(ei)	Hydrogen gas. Gas evolved extinguishes a lighted splint with a 'pop' sound. Well attempted	1m 1m
(eii)	$\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$ Many write FeCl	

7(a)	Each successive member differs by a $-CH_2$ unit. Or They have similar chemical properties. *accept all other possible answers Well attempted (some wrote patterns to physical properties)	1m
(bi)	Bubble gaseous hydrocarbons into aqueous bromine Result with saturated: aq bromine remains unchanged Result with unsaturated: aq bromine decolorises rapidly from reddish brown to colorless. Well attempted (some were confused for the results with aq bromine for saturated and u saturated)	1m 1m 1m
(bii)	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}=\text{C} \\ \quad \quad \\ \text{H} \quad \quad \text{H} \end{array} $ PROPENE	1m
(biii)	$ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & \\ \text{H} & \text{CH}_3 & \text{H} & \text{CH}_3 \end{array} $ poly(propene) Badly done. Many who attempted drew polyethene with 3 repeat units.	1m
(ci)	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $ Well attempted	1m
(cii)	Name of process: fermentation Substances and conditions: Yeast in glucose solution at 37°C , absence of oxygen * substance - 1m; conditions - 1m Well attempted (some unsure what's meant by substance and conditions)	1m 1m x 2
8(a)	Carbon dioxide gas produced during the reaction escaped into the atmosphere Many wrote that the solid has reacted hence loss in mass.	1m
(bi)	Scale + correct plotting [minus 1m for students whose graph is less than half of the graph paper] Smooth curve	1m 1m

(bii)	When the <u>gradient becomes zero</u> / balance reading <u>remain constant</u> (0.75 g) Effervescence stops. Marked wrong if they wrote "no more gas is produced" cos its not a physical observation Well attempted.	1m
(biii)	Mass of CO ₂ produced = 4.00 – 0.75 = <u>3.25 g</u> Well attempted	1m
(biv)	Speed of reaction = 3.25 / 12 = 0.271 g/min Many divide by 14 instead of 12.	1m
(c)	The reaction is <u>exothermic</u> in nature, thus liberating heat to the surroundings. Well attempted	1m
(di)	$\text{Cu}^{2+}(\text{aq}) + 2\text{OH}^{-}(\text{aq}) \rightarrow \text{Cu}(\text{OH})_2(\text{s})$ Many did not include s.s / not balanced	1m, 1m
(dii)	Light-blue precipitate is <u>soluble</u> in excess aq ammonia to form a <u>dark blue solution</u> . Handful wrote "dark blue PPT"!	1m
9(ai)	 Handful did not circle the C=C bond	Both correct - 1m
(aii)	No. It contains <u>oxygen</u> atom. Well attempted	1m
(aiii)	Chemical reagent: (acidified) potassium manganate(VII)/ potassium dichromate (VI) Observation: Purple KMnO ₄ decolourises/Orange K ₂ Cr ₂ O ₇ turns green. Well attempted	1m 1m
(aiv)	 Poorly attempted	1m, 1m
(bi)	Neutralisation Well attempted	1m
(bii)	Circle O – H Many chose C-H bond	1m

(biii)	$\text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l})$ Well attempted – however without s.s	1m, 1m
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