AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Chemistry Paper 2H

Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

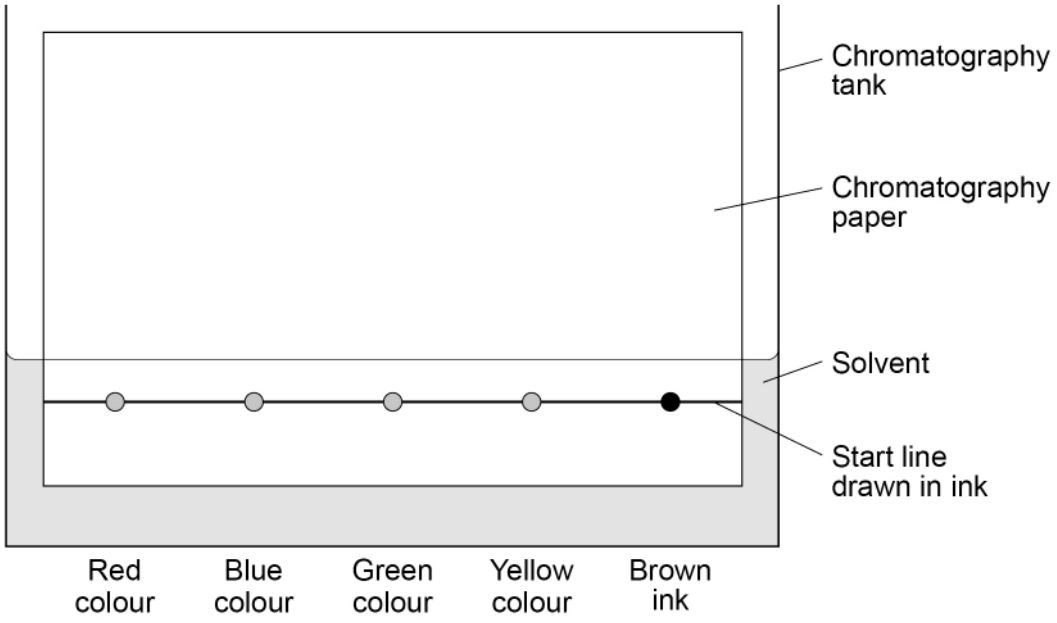
Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 A student investigated the colours in a brown ink using chromatography.

0 1 . 1 **Figure 1** shows the apparatus used.

Figure 1



Give **two** errors made by the student.

Describe the problem each error would cause.

[4 marks]

Error 1 _____

_____

Problem 1 _____

_____

Error 2 _____

_____

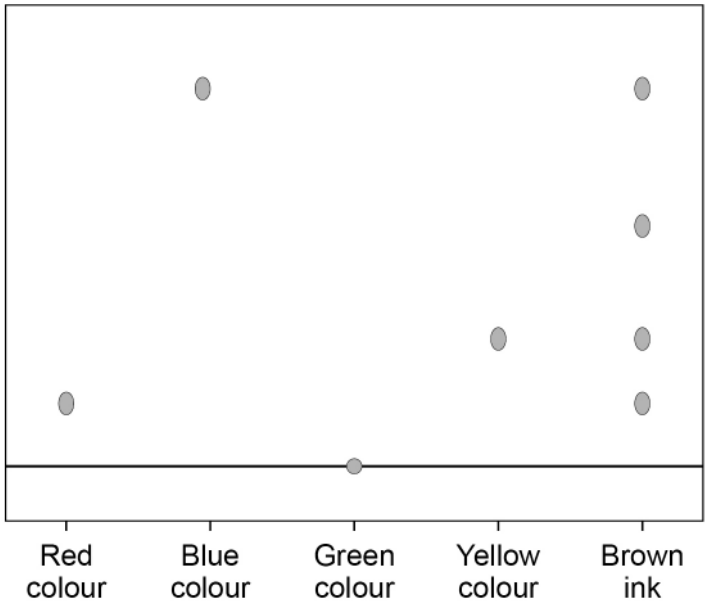
Problem 2 _____

_____

A different student set up the apparatus correctly.

Figure 2 shows the results.

Figure 2



0 1 . 2 Give **two** conclusions the student can make from **Figure 2** about the four colours in the brown ink.

[2 marks]

1 _____

_____

2 _____

_____

Question 1 continues on the next page

Do not write outside the box

0 1 . 3 Why was the green colour still on the start line at the end of the experiment?

[1 mark]

Tick (✓) **one** box.

The experiment was left for too long. ☐

The green colour was insoluble in the solvent. ☐

The green spot contained too many colours. ☐

The green spot was too small. ☐

0 1 . 4 A student calculated the R_f value of a colour to be 0.24

The colour moved 1.8 cm from the start line.

Calculate the distance the solvent moved.

Use the equation:

$$R_f = \frac{\text{distance moved by colour}}{\text{distance moved by solvent}}$$

[3 marks]

Distance moved by solvent = _____ cm

10

Do not write outside the box

0 2 . 1 Water that is safe to drink is called potable water.

Compare how easily potable water can be obtained from:

- waste water (sewage)
- ground water (fresh water).

[6 marks]

Question 2 continues on the next page

Do not write outside the box

A scientist produced potable water from 150 cm^3 of salty water.

0 2 . 2 Which process can be used to produce potable water from salty water?

[1 mark]

Tick (✓) **one** box.

Distillation ☐

Electrolysis ☐

Filtration ☐

Sterilisation ☐

0 2 . 3 The salty water contains sodium chloride.

The scientist collected 2.40 g of sodium chloride from 150 cm^3 of salty water.

Calculate the concentration of sodium chloride in grams per dm^3

[3 marks]

Concentration of sodium chloride = _____ g/dm^3

10

Do not write outside the box

0 3 This question is about the reaction between sodium thiosulfate solution and hydrochloric acid.

The equation for the reaction is:

$$Na_2S_2O_3(aq) + 2\,HCl(aq) \rightarrow 2\,NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

0 3 . 1 The mass of the conical flask and contents was greater at the start of the reaction than at the end.

Explain why.

[2 marks]

Question 3 continues on the next page

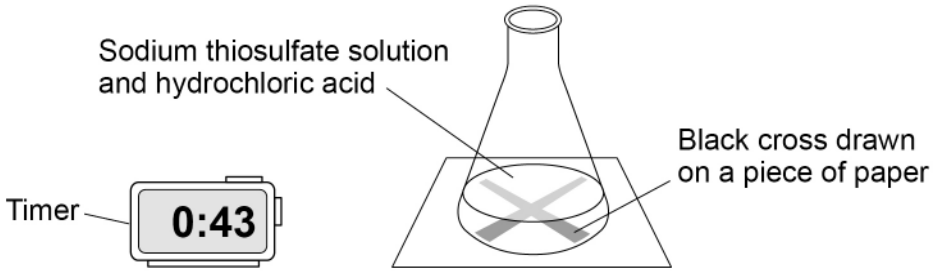
Do not write outside the box

A teacher demonstrated the reaction between sodium thiosulfate solution and hydrochloric acid.

Figure 3 shows the experiment.

The experiment was done in a fume cupboard.

Figure 3



This is the method the teacher used.

1. Pour 50 cm^3 of sodium thiosulfate solution into a conical flask.

2. Put the conical flask on a black cross drawn on a piece of paper.

3. Pour 10 cm^3 of hydrochloric acid into the conical flask and start a timer.

4. Stop the timer when the cross can no longer be seen.

5. Repeat the experiment at different temperatures.

0 3 . 2 What type of variable is time in this reaction?

[1 mark]

Tick (✓) **one** box.

Control ☐

Dependent ☐

Independent ☐

0 3 . 3 **Table 1** shows the results.

Table 1

Temperature in °C	Time in seconds
19	82
32	48
45	43
52	15
63	7
73	3

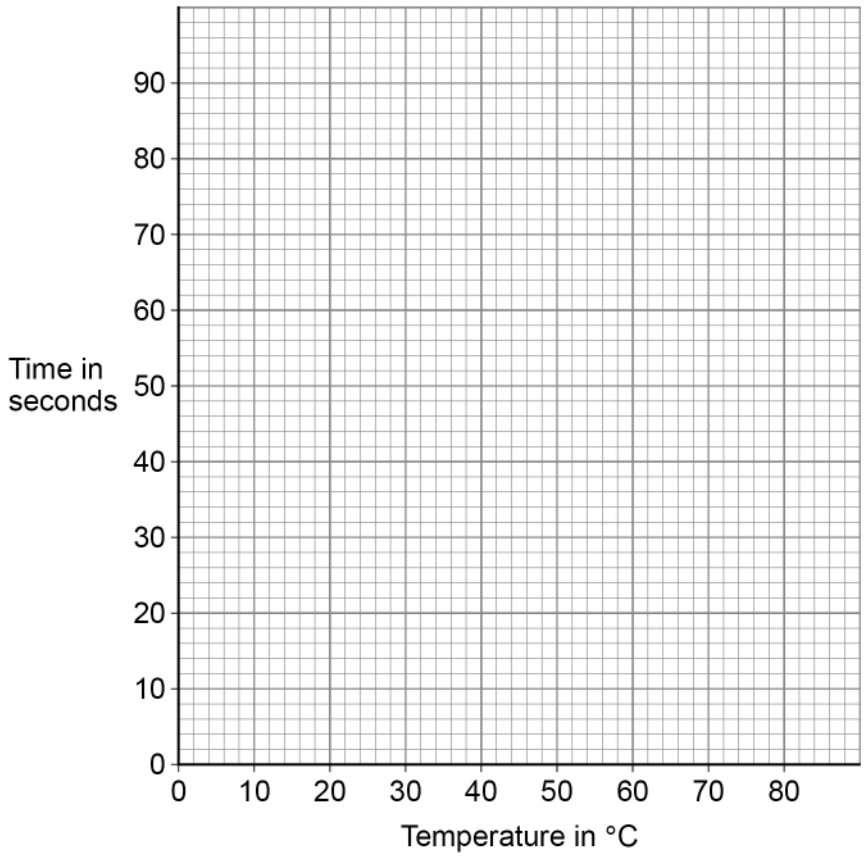
Complete **Figure 4**.

You should:

- plot the data from **Table 1** on **Figure 4**
- draw a line of best fit.

[3 marks]

Figure 4

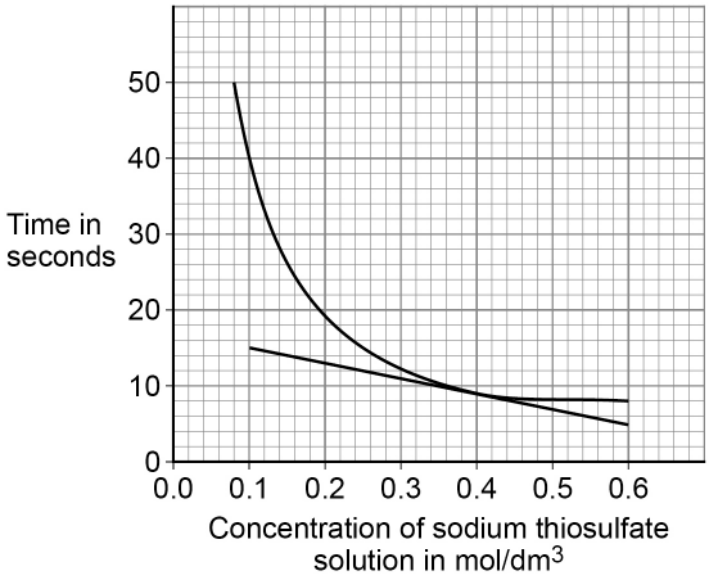


Do not write outside the box

0 3 . 4 A student investigated the effect of concentration of sodium thiosulfate on the time taken for the reaction at room temperature.

Figure 5 shows the results with a tangent drawn at 0.4 mol/dm^3

Figure 5



Calculate the gradient (slope) of the tangent at 0.4 mol/dm^3

Give the unit.

[4 marks]

Gradient = _____

Unit = _____

Do not write outside the box

0 3 . 5 The student determined the **rate** of the reaction at regular time intervals during an experiment.

Explain why the **rate** decreased during the reaction.

You should give your answer in terms of particles.

[2 marks]

12

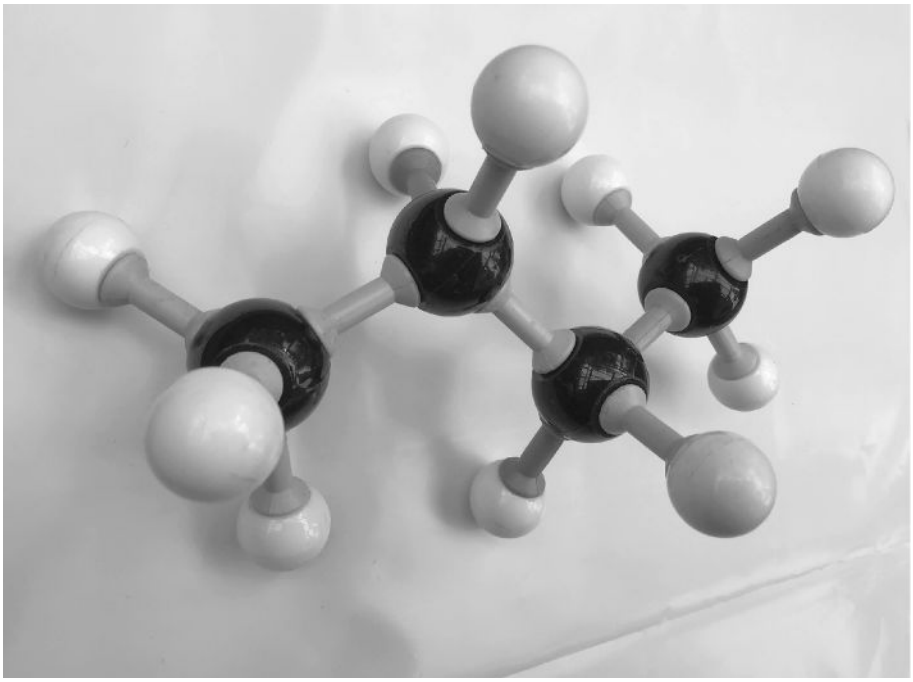
Turn over for the next question

Do not write outside the box

0 4 This question is about hydrocarbons and the uses of hydrocarbons.

0 4 . 1 **Figure 6** shows a model of an alkane.

Figure 6



What is the name of the alkane in **Figure 6**?

[1 mark]

0 4 . 2 What is a hydrocarbon?

[1 mark]

Do not write outside the box

Large hydrocarbon molecules are cracked.

0 4 . 3 When $C_{11}H_{24}$ is cracked, three products are formed.

Complete the equation for the reaction.

[2 marks]

$$C_{11}H_{24} \rightarrow C_5H_{10} + 2 \text{ \_\_\_\_\_} + \text{ \_\_\_\_\_}$$

0 4 . 4 Explain why **one** of the products of cracking is in high demand.

[2 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 Window frames can be manufactured from wood or from plastic.

Table 2 shows data from a life cycle assessment (LCA) for a wooden window frame and a plastic window frame.

Both window frames are the same size.

Table 2

	Wood	**Plastic**
Sources of hydrocarbons used for production in kg	5.37	18.23
Greenhouse gases released during production, use and disposal in kg equivalent of CO_2	457	487
Oxides of nitrogen and sulfur dioxide produced in arbitrary units	29.6	37.7
Waste materials in kg	16.5	28.8
Total energy consumption in production, use and disposal in MJ	9150	9713
Lifetime cost to customer to buy and maintain in £	147	102

Do not write outside the box

Evaluate the sustainability of wooden and plastic window frames.

You should include environmental and economic factors.

[6 marks]

12

Turn over for the next question

Do not write outside the box

0 5 This question is about the Earth's atmosphere and the Earth's resources.

0 5 . 1 After the formation of the Earth's early atmosphere, the amounts of nitrogen and oxygen in the atmosphere changed.

Explain the main changes in the amounts of nitrogen and oxygen in the Earth's atmosphere.

[4 marks]

Nitrogen _____

_____

_____

Oxygen _____

_____

_____

0 5 . 2 Describe how coal was formed from the carbon dioxide present in the Earth's early atmosphere.

[4 marks]

_____

_____

_____

_____

_____

_____

0 5 . 3 The combustion of 1.0 kg of coal produces more carbon dioxide than the combustion of 1.0 kg of natural gas.

Suggest why.

[1 mark]

_____

_____

Do not write outside the box

Metals are extracted from metal ores found in the Earth.

0 5 . 4 Describe how bioleaching is used to extract copper from low grade ores.

[3 marks]

0 5 . 5 Phytomining uses plants to extract nickel from low grade ores.

The plants contain 0.792% nickel by mass.

The plants are burned to produce ash.

The ash from these plants contains 4.80% nickel by mass.

Calculate the mass of ash produced from burning 1000 kg of plants.

Give your answer in grams in standard form.

[4 marks]

Mass of ash (in standard form) = _____ g

16

Do not write outside the box

0 6 This question is about catalysts and equilibrium.

0 6 . 1 What type of substance is a catalyst in biological systems?

[1 mark]

Tick (✓) **one** box.

Algae ☐

Alkene ☐

Enzyme ☐

Formulation ☐

0 6 . 2 Explain how a catalyst increases the rate of a reaction.

[2 marks]

Do not write outside the box

The reversible reaction for the production of ammonia is:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

0 6 . 3 What can scientists predict using Le Chatelier's Principle?

[1 mark]

0 6 . 4 Describe how a reversible chemical reaction is able to reach equilibrium.

[2 marks]

0 6 . 5 Explain the effect of increasing the pressure on the yield of ammonia.

[2 marks]

0 6 . 6 The forward reaction to produce ammonia is exothermic.

Explain the effect of increasing the temperature on the yield of ammonia.

[2 marks]

10

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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Question number	**Additional page, if required.** **Write the question numbers in the left-hand margin.**

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There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

GCSE
COMBINED SCIENCE: TRILOGY
8464/C/2H

Chemistry Paper 2H

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

226G8464C2H/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the examiner make their judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Alternative words in the mark scheme are shown by a solidus eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name **two** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and, if necessary, annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level.

The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **two** pairs from: (start) line drawn in ink (1) (so ink) will mix with solvent (1) the solvent is above the (start) line (1) (so) colours / ink will dissolve (1) no lid on tank (1) (so) solvent will evaporate (1)	 allow (start) line should be drawn in pencil allow the ink will move up the paper allow the solvent should be below the (start) line	4	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **two** from: • (the brown ink) contains the blue, yellow and red (colours) • (the brown ink) contains an unknown colour • (the brown ink) does not contain green ink • blue (colour) is the most soluble **or** red (colour) is the least soluble	 allow blue (colour) has the highest R_f value allow red (colour) has the lowest R_f value ignore green colour is insoluble	2	AO3 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	the green colour was insoluble in the solvent		1	AO2 5.8.1.3 RPA12

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$0.24 = \frac{1.8}{\text{distance moved by solvent}}$		1	AO2 5.8.1.3 RPA12
	(distance moved by solvent =) $\frac{1.8}{0.24}$		1	
	= 7.5 (cm)		1	

Total Question 1		**10**

Question 2

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td rowspan="3">02.1</td><td>Level 2: Scientifically relevant features are identified, the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.</td><td>4–6</td><td rowspan="3">AO1
5.10.1.3</td></tr>
<tr><td>Level 1: Relevant features are identified and differences noted.</td><td>1–3</td></tr>
<tr><td>No relevant content</td><td>0</td></tr>
<tr><td></td><td>Indicative content
<table>
<tr><th>ground water</th><th>waste water</th></tr>
<tr><td>easier to obtain</td><td>more difficult to obtain</td></tr>
<tr><td>fewer processes</td><td>more processes</td></tr>
<tr><td>takes less time</td><td>takes more time</td></tr>
<tr><td>filtered through filter beds

to remove insoluble particles</td><td>screening and grit removal

to remove large particles</td></tr>
<tr><td></td><td>sedimentation

to produce sewage sludge and effluent</td></tr>
<tr><td></td><td>aerobic biological treatment of effluent

to reduce solid waste</td></tr>
<tr><td>sterilised

using chlorine, ozone or uv light

to kill bacteria</td><td>and then sterilised

using chlorine, ozone or uv light

to kill bacteria</td></tr>
<tr><td></td><td>sludge is anaerobically digested

by specific bacteria

to remove organic matter</td></tr>
</table></td><td></td><td></td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	distillation		1	AO1 5.10.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	(conversion) ($\frac{150}{1000}$ =) 0.15 (dm^3) (concentration =) $\frac{2.40}{0.15}$ = 16 (g/dm^3) **OR** (conversion) $\frac{1000}{150}$ (1) = 6.67 (1) (6.67 × 2.4) = 16 (g/dm^3) (1) **OR** (concentration =) $\frac{2.4}{150}$ (1) = 0.016 (1) (conversion) (0.016 × 1000) = 16 (g/dm^3) (1)	allow correct use of incorrect / no conversion	1 1 1	AO2 5.3.2.5

Total Question 2		**10**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	sulfur dioxide produced (which) escapes from the (conical) flask	allow a gas is produced	1 1	AO3 AO2 5.2.2.2 RPA11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	dependent		1	AO2 5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	all points correctly plotted	allow **1** mark for 3, 4 or 5 points correctly plotted allow a tolerance of ± ½ a small square	2	AO2
	line of best fit		1	AO3 5.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	correct values for *x* step **and** *y* step from tangent		1	AO2 5.6.1.1 RPA11
	(rate =) $\frac{\text{value for } y \text{ step}}{\text{value for } x \text{ step}}$	allow correct use of an incorrectly determined value from tangent for *x* step and/or *y* step	1	
	correct calculation of rate		1	
	s dm^3/mol		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(as reaction proceeds) fewer (sodium thiosulfate) particles per unit volume	allow (as reaction proceeds) concentration (of sodium thiosulfate) decreases	1	AO2 5.6.1.2 5.6.1.3 RPA11
	(so) frequency of (particle) collisions decreases	allow (so) probability of collision decreases	1	

Total Question 3		**12**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	butane		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(molecule) made up of carbon and hydrogen (atoms) only		1	AO1 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_2H_4 + C_2H_6$ **OR** $C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_3H_6 + H_2$ (2) **OR** $C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_2H_6 + C_2H_2$ (2)	allow **1** mark for $2\,C_2H_4$ allow **1** mark for C_2H_6 allow **1** mark for $2\,C_3H_6$ allow **1** mark for H_2 allow **1** mark for $2\,C_2H_6$ allow **1** mark for C_2H_2	2	AO2 5.1.1.1 5.3.1.1 5.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	C_2H_6 is useful as a fuel	allow smaller molecule so useful as a fuel	1	AO1 5.7.1.3 5.7.1.4
	(because more) flammable (than larger molecules)		1	
	OR			
	C_2H_4 / C_3H_6 / C_5H_{10} is used to make polymers (1)	allow C_2H_4 / C_3H_6 / C_5H_{10} is used to make plastics allow C_2H_4 / C_3H_6 / C_5H_{10} is used to make other chemicals		
	(because more) reactive (than alkanes) (1)			
		if a named product is given, allow **1** mark for a correct use and **1** mark for a correct linked reason		

Question	Answers	Mark	AO / Spec. Ref.
04.5	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons is given.	5–6	AO3 5.9.2.2 5.10.1.1 5.10.2.1
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content • production of plastic uses more hydrocarbons which are from non-renewable crude oil • production of plastic produces more greenhouse gases in the atmosphere which contributes to global warming • production of plastic produces more sulfur dioxide which causes acid rain • production of plastic produces more oxides of nitrogen which cause acid rain and respiratory problems • disposal of plastic produces more waste which increases landfill • burning plastic produces fumes which are toxic so cause respiratory problems • lifetime cost of plastic frames is less • plastic frames have lower costs for maintaining • the total energy consumption for plastic frames is greater than for wooden frames • judgement		

Total Question 4		**12**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	nitrogen increased		1	AO1 5.9.1.2
	(because of) emission from volcanoes	allow (because of) denitrifying bacteria	1	5.9.1.3
	oxygen increased		1	
	(because of) photosynthesis		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	carbon dioxide is used during photosynthesis		1	AO1 5.9.1.4
	in trees		1	
	(which) die and are compressed		1	
	over millions of years		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	coal has a higher proportion / percentage of carbon		1	AO2 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	uses bacteria to produce solutions containing copper compounds from which copper is obtained by displacement / electrolysis	 allow to produce leachate solutions	1 1 1	AO1 5.10.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	1000 (kg of plants) gives 7.92 (kg of nickel)		1	AO2 5.10.1.4
	(mass = $\frac{7.92}{4.8}$ × 100 =) 165 (kg)		1	
	(conversion 165 kg =) 165 000 (g)	allow correct conversion of an incorrectly determined mass in kg	1	
	= 1.65 × 10^5 (g)	allow a correctly calculated and rounded conversion to standard form of an incorrect calculation of mass in grams	1	
	OR			
	(mass =) $\frac{0.792}{4.8}$ × 1000 (1)			
	= 165 (kg) (1)			
	(conversion 165 kg =) 165 000 (g) (1)	allow correct conversion of an incorrectly determined mass in kg		
	= 1.65 × 10^5 (g) (1)	allow a correctly calculated and rounded conversion to standard form of an incorrect calculation of mass in grams		

Total Question 5		**16**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	enzyme		1	AO1 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	provides a different reaction pathway (which) has a lower activation energy		1 1	AO1 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	the effects of changing conditions on the position of an equilibrium (in a closed system)	allow the effects of changing conditions on the yield of an equilibrium reaction (in a closed system)	1	AO1 5.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(when) the forward and reverse reactions have the same rate in apparatus which prevents the escape of reactants and products	 allow in a closed system	1 1	AO1 5.6.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	yield increases (because) there are more moles (of gas) on the left hand side	 allow (because) there are fewer moles (of gas) on the right hand side	1 1	AO2 5.6.2.1 5.6.2.2 5.6.2.3 5.6.2.4 5.6.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	yield decreases (because) the system shifts in the endothermic direction		1 1	AO2 5.6.2.1 5.6.2.2 5.6.2.3 5.6.2.4 5.6.2.6

Total Question 6		**10**