AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.4.1

Sizes of particles and their properties

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**16**
Available paper years	**2008–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.2.4.1 Sizes of particles and their properties

Answer 01 · Mark scheme January 2008 | CHY2F | Original Q7 | Legacy

(c)	7		1
(d)(i)	steeper line from around the same starting point and left of the points levelling off at 99	allow crosses if they are fully correct for **1** mark accept short level line at 99 ± ½ square	1 1
(d)(ii)	any **three** from: • particles / molecules / atoms/ ions have more energy • move faster • collide <u>more</u> often **or** <u>more</u> chance of collisions **or** bump into each other <u>more</u> • collide with <u>more</u> force / energy **or** <u>more</u> particles have the activation energy **or** <u>more</u> collisions result in reaction **or** <u>more</u> collisions are successful	allow given / gain / get energy ignore move about more ignore vibrate more / faster ignore collide quicker / faster	3
total			8

4.2.4.1 Sizes of particles and their properties

CHY2F

Question 7

question	answers	extra information	mark
(a)	any **one** from: • they are made of layers • atoms / ions / particles / layers (of atoms) can slide over each other	do **not** accept line / rows / lattice	1
(b)	any **one** from: • smaller / tiny **or** very small • correct size range 1 to 100 nanometres • a few hundred atoms in size	do **not** allow small alone if they state smaller and give a size outside range ignore size if it is less than 20,000	1
(c)	harder plus **one** from: • so does not wear as quickly / erode as quickly • less vulnerable to damage owtte • because they have a high surface area to volume ratio **or** stronger (1) plus **one** from: (1) • less likely to break / do not break • not as vulnerable to damage owtte • do not bend out of shape • because they have a high surface area to volume ratio	 ignore corrode harder to wear down = **1** mark accept withstand pressure harder and stronger alone gains **1** mark	1 1
total			4

4.2.4.1 Sizes of particles and their properties

Answer 01 · Mark scheme January 2008 | CHY2F | Original Q7 | Legacy

CHY2F

Answer 02 · Mark scheme June 2008 | CHY2F | Original Q6 | Legacy

question	answers	extra information	mark
6(a)(i)	small **or** few atoms thick **or** size in the range 1–100 nanometres	owtte	1
6(a)(ii)	sensible idea of passing through smaller gaps owtte	eg can pass through skin / pores / cells **or** more easily absorbed	1
6(b)	any **two** from: • good at absorbing UV light / radiation • spread more easily • cover better • save money / use less • transparent • less chance of getting skin cancer **or** stops skin cancer	ignore more effective alone	2
6(c)	toxic to (cells / specific cells)	allow harm / damage / kill **or** cause cancer	1
Total			**5**

4.2.4.1 Sizes of particles and their properties

Answer 02 · Mark scheme

June 2008 | CHY2F | Original Q6 | Legacy

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

4.2.4.1 Sizes of particles and their properties

Answer 03 · Mark scheme

Question 6

question	answers	extra information	mark
6(a)(i)	gives out a large amount of energy only water produced / product is non polluting (owtte)	 allow it does not harm the environment	1 1
6(a)(ii)	does not explode / burst into flames owtte	ignore will not react	1
6(a)(iii)	hydrogen absorbed and released much faster	allow more efficient allow can store a larger amount	1
6(b)(i)	B		1
6(b)(ii)	a lithium atom loses an electron		1
6(b)(iii)	C		1
6(c)	reversible		1
6(d)(i)	much smaller		1
6(d)(ii)	surface area		1
Total			**10**

4.2.4.1 Sizes of particles and their properties

Answer 03 · Mark scheme

June 2009 | CHY2F | Original Q6 | Legacy

CHY2F

4.2.4.1 Sizes of particles and their properties

Answer 04 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)	the diameter of the tube is very small		1
4(b)(i)	three		1
4(b)(ii)	covalent		1
4(b)(iii)	bonds		1
Total			**4**

4.2.4.1 Sizes of particles and their properties

Answer 04 · Mark scheme

January 2010 | CHY2F | Original Q4 | Legacy

CHY2F

4.2.4.1 Sizes of particles and their properties

Answer 05 · Mark scheme

June 2011 | CHY2F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	kills bacteria **or** stops growth of bacteria	allow destroys bacteria ignore attacks / reacts with bacteria ignore 'traps the smell' ignore microbes	1
6(b)	smaller / very small / tiny	assume they are referring to nanoparticles unless they state otherwise accept 1 – 100nm in size accept a few hundred atoms in size accept normal size particles are (much) larger	1
6(c)	any **one** from: • big(ger) surface area • react fast(er)	 accept more reactive ignore kill faster	1
6(d)	so they do not get released during washing **or** so they do not get into rivers / ecosystem / environment because this could harm fish / aquatic life **or** so the socks keep their odour – preventing properties (owtte)		1 1
Total			**5**

4.2.4.1 Sizes of particles and their properties

Answer 05 · Mark scheme

June 2011 | CHY2F | Original Q6 | Legacy

CHY2F

4.2.4.1 Sizes of particles and their properties

Answer 06 · Mark scheme

June 2012 | CH2FP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	79 79		1 1
2(b)	hundred		1
2(c)(i)	electron(s)		1
2(c)(ii)	three		1
2(d)	changes rate of reaction **or** speeds up / slows down reaction	accept lowers activation energy accept reduces costs	1
2(e)(i)	melt		1
2(e)(ii)	crosslinking **or** (covalent) bonds between polymers / chains	allow answers on diagram allow bonds between layers do **not** allow intermolecular	1
Total			**8**

4.2.4.1 Sizes of particles and their properties

Answer 06 · Mark scheme

June 2012 | CH2FP | Original Q2 | Legacy

CH2FP

4.2.4.1 Sizes of particles and their properties

Answer 07 · Mark scheme June 2013 | CH2FP | Original Q1 | Legacy

Question 1

question	answers	extra information	Mark
1(a)	1 / one		1
1(b)(i)	protons		1
1(b)(ii)	neutrons		1
1(b)(iii)	7		1
1(c)(i)	losing		1
1(c)(ii)	a positive		1
1(c)(iii)	electrostatic		1
1(d)	high melting points strong bonds		1 1
1(e)(i)	58.5		1
1(e)(ii)	mole		1
1(f)	very small (particles) **or** 1-100nm in size **or** (particle with a) few hundred atoms	ignore tiny / small / smaller / microscopic etc.	1
Total			**12**

4.2.4.1 Sizes of particles and their properties

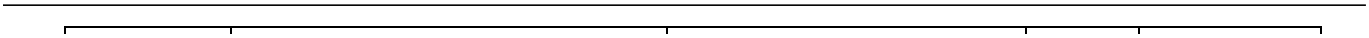
Answer 08 · Mark scheme June 2016 | CH2FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
2(a)(i)	hard	ignore strong	1	AO2 2.2.3b
2(a)(ii)	hundred		1	AO1 2.2.6a
2(b)(i)	Covalent		1	AO1 2.2.3a
2(b)(ii)	3		1	AO1 2.2.3.c
2(b)(iii)	Soft and slippery		1	AO1 2.2.3a,c
2(c)(i)	cross-links	allow bonds ignore links do **not** accept intermolecular	1	AO1 2.2.5b
2(c)(ii)	melt		1	AO1 2.2.5b
2(c)(iii)	any **two** from: • temperature • pressure • catalyst	allow heat(ing)	2	AO1 / AO3 2.2.5a
2(d)(i)	CH_4		1	AO1 2.1.1g
2(d)(ii)	Small molecules		1	AO1 2.2.1a
Total			**11**	

4.2.4.1 Sizes of particles and their properties

Answer 08 · Mark scheme

June 2016 | CH2FP | Original Q2 | Legacy



4.2.4.1 Sizes of particles and their properties

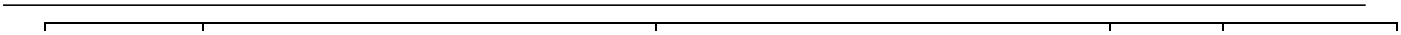
Answer 09 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	tick (✓) by: covalent		1	AO1 2.1.1g
3(a)(ii)	ticks (✓) by: oxygen consists of small molecules oxygen has a low boiling point		1 1	AO1 2.1.1g
3(b)(i)	magnesium (atom) loses (electrons) oxygen (atom) gains (electrons) two (electrons) ions formed	max 3 if reference to incorrect particle or incorrect bonding accept ionic bonding or full outer shells/noble gas structure is formed allow magnesium forms positive (ion) **or** oxygen forms negative (ion)	1 1 1 1	AO1 AO2 2.1.1a,b,c, d,e,f
3(b)(ii)	ticks (✓) by: nanoparticles contain a few hundred atoms nanoparticles have a high surface area to volume ratio		1 1	AO1 2.2.6a
3(c)	giant covalent		1	AO1 2.2.3a
Total			**10**	

4.2.4.1 Sizes of particles and their properties

Answer 09 · Mark scheme

June 2017 | CH2FP | Original Q3 | Legacy



Answer 10 · Mark scheme

June 2018 | 8462/1F | Original Q1

The full source mark scheme begins on page 30. Follow original question 1 in that document.

4.2.4.1 Sizes of particles and their properties

Answer 11 · Mark scheme

June 2019 | 8462/1F | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	contain delocalised electrons (so) electrons can move through the structure / nanotube	allow contain free electrons allow (so) electrons can carry charge through the structure / nanotube ignore throughout for through ignore current / electricity for charge	1 1	AO1 4.2.3.3

Question	Answers	Mark	AO / Spec. Ref.
10.2	**Level 2:** Some logically linked reasons are given. There may also be a simple judgement.	3–4	AO3 4.2.3.3 4.2.2.7
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content • wood is the least dense so lightest to use • aluminium is the most dense so will make the racket too heavy • carbon nanotube is the strongest so least likely to break • wood / aluminium are too weak so the racket will break more easily • carbon nanotube is the stiffest so least likely to bend out of shape • wood / aluminium are not very stiff so could bend out of shape • justified conclusion		

Question 10 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3		an answer of 4.0 x 10^4 (nm^2) scores **3** marks an answer of 40344 (nm^2) scores **2** marks		AO2 4.2.4.1
	(82^2 =) 6724 (nm^2)		1	
	(6 x 6724 =) 40344 (nm^2)	allow 40344 (nm^2) correctly rounded to any number of significant figures allow correct calculation using incorrectly calculated value of area of one face from step 1	1	
	= 4.0 x 10^4 (nm^2)	allow 4.0344 x 10^4 (nm^2) correctly rounded to 1 or more significant figures allow a correctly calculated and rounded conversion to standard form of an incorrect calculation of surface area	1	
10.4	any **one** from: • less can be used (for the same effect) • greater surface area (to volume ratio)	allow converse statements about fine particles ignore nanoparticles are smaller	1	AO3 4.2.4.2
Total			**10**	

4.2.4.1 Sizes of particles and their properties

Answer 12 · Mark scheme

November 2021 | 8462/1F | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	non-metallic element		1	AO3 4.1.1.1 4.1.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	compound		1	AO1 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	noble gases		1	AO1 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	the boiling points increase down the group		1	AO1 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	atoms		1	AO1 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	XO_2		1	AO2 4.2.1.3

4.2.4.1 Sizes of particles and their properties

Question 1 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	$(2.8)^2 \times 6$ $= 47.04$ $= 47$ (nm^2)	 allow an answer correct to 2 significant figures resulting from an incorrect attempt at the calculation	1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	the surface area to volume ratio of the fine particle is 10 times greater		1	AO1 4.2.4.1

Total			10

4.2.4.1 Sizes of particles and their properties

Answer 13 · Mark scheme

June 2022 | 8462/1F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	coarse particle		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(volume =) 2^3	allow (volume =) 2×2×2	1	AO2 4.2.4.1
	= 8 (nm^3)		1	
	(surface area : volume) = 24 : 8	allow correct use of an incorrectly calculated volume	1	
	(simplest ratio) = 3 : 1		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	high(er) / large(r)		1	AO1 4.2.4.1
	lower / less / smaller		1	

4.2.4.1 Sizes of particles and their properties

Answer 13 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(advantage) any **one** from: • stops (unpleasant) smells • can stop (foot) infections (disadvantage) any **one** from: • high cost (of socks) • could be harmful if breathed in	 allow specific (foot) infections allow silver can kill bacteria allow silver is (very) expensive	 1 1	AO3 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	100 times		1	AO2 4.1.1.5 4.2.4.1

Total Question 7		**10**

4.2.4.1 Sizes of particles and their properties

Answer 14 · Mark scheme

June 2023 | 8462/1F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	coarse particle		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	20 times		1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(surface area) = 6×3^2 = 54 (nm^2) (surface area : volume) = 54 : 27 (simplest ratio) = 2 : 1	 allow correct ratio from an incorrectly determined surface area 	1 1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	a smaller mass of nanoparticles is needed to be effective		1	AO3 4.2.4.1 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	TiO_2		1	AO2 4.1.1.1

Total Question 5	8

4.2.4.1 Sizes of particles and their properties

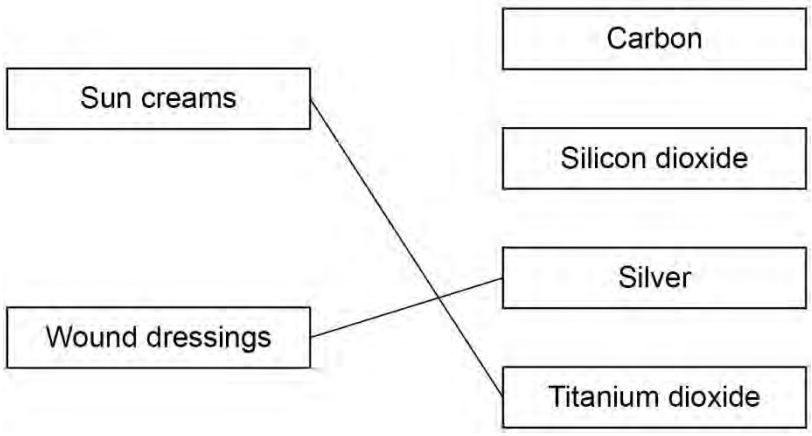
Answer 15 · Mark scheme

June 2024 | 8462/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	a few hundred atoms		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	iron		1	AO3 4.1.3.2

Question	Answers	Mark	AO / Spec. Ref.
04.3	**Use** **Substance**  do **not** accept more than one line from a box on the left	1 1	AO3 4.2.4.2

4.2.4.1 Sizes of particles and their properties

Answer 15 · Mark scheme

June 2024 | 8462/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(surface area =) 6×4^2		1	AO2 4.2.4.1
	= 96 (nm^2)		1	
	(volume =) 4^3		1	
	= 64 (nm^3)		1	
	(ratio =) 96 : 64	allow correct use of incorrectly determined area and/or volume	1	
	= 3 : 2	allow correct use of an incorrectly determined ratio	1	

Total Question 4	10

4.2.4.1 Sizes of particles and their properties

Answer 16 · Mark scheme

June 2025 | 8462/1F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	Buckminsterfullerene		1	AO1 4.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	the nanoparticles are spherical		1	AO3 4.2.3.3 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	10^2		1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(volume =) 4^3		1	AO2 4.2.4.1
	= 64 (nm^3)		1	
	(surface area : volume ratio =) 96 : 64	allow correct use of an incorrectly determined volume	1	
	= 3 : 2	allow correct use of an incorrectly determined surface area : volume ratio	1	

4.2.4.1 Sizes of particles and their properties

Answer 16 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	thinner / smaller / less greater / more		1 1	AO3 4.2.4.1 4.2.4.2

Total Question 6	**9**

4.2.4.1 Sizes of particles and their properties

AQA

GCSE
CHEMISTRY

8462/1F - PAPER 1 FOUNDATION TIER

Mark scheme

8462

June 2018

Version/Stage: 1.0 Final

4.2.4.1 Sizes of particles and their properties

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 Assessment Writer.

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

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MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

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 his or her 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.

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**. Different terms in the mark scheme are shown by a / ; 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 error / 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 planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, 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. Full marks can, however, be given for a correct numerical answer, without any working shown.

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

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **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 not 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.

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 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.

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.

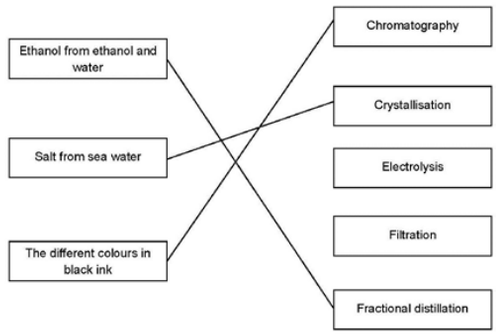
Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

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.

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1			1 1 1	AO1 4.1.1.2
01.2	include a (filter) funnel	allow funnel drawn on the diagram ignore clamp stand	1	AO3 4.1.1.2
01.3	evaporate condense	must be this order	1 1	AO1 4.1.1.2
01.4	$\frac{2}{20} \times 100$ = 10 (%)	an answer of 10 (%) scores **2** marks an answer of 11.1(%) **or** 90 (%) scores **1** mark	1 1	AO2 4.2.2.7
01.5	an alloy		1	AO1 4.2.2.7
01.6	the layers in the mixture are distorted		1	AO1 4.2.2.7

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	8000 nm^3		1	AO2 4.2.4.1
Total			**11**	

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	7		1	AO1 4.1.2.6
02.2	small molecule		1	AO2 4.1.2.6 4.2.2.4
02.3	F_2		1	AO1 4.1.1.1 4.1.2.6
02.4	the reactivity decreases (going down Group 7) (because) chlorine displaces bromine and iodine (and) bromine displaces iodine **or** iodine does not react	allow the reactivity decreases from chlorine to iodine allow (because) chlorine has two reactions allow (because) neither bromine nor iodine can displace chlorine allow (and) bromine has one reaction **or** iodine has no reactions allow (and) iodine cannot displace bromine	1 1 1	AO1 4.1.2.6 AO3 4.1.2.6 AO3 4.1.2.6
02.5	80		1	AO2 4.3.1.2

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(1.2 kg =) 1200 (g) **or** (900 g =) 0.9 (kg)	an answer of 75 (%) scores **2** marks	1	AO2 4.3.3.1
	$(\frac{900}{1200} \times 100) = 75(\%)$ **or** $(\frac{0.9}{1.2} \times 100) = 75(\%)$	allow an answer correctly calculated from: $(\frac{900}{\text{incorrect attempt at conversion of 1.2}} \times 100)$ **or** $(\frac{\text{incorrect attempt at conversion of 900}}{1.2} \times 100)$	1	
Total			**9**	

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	nucleus neutron neutron electron proton	must be in this order	1 1 1 1 1	AO1 4.1.1.3 4.1.1.4 4.1.1.5
03.2	$(A_r)\ \frac{(63 \times 70) + (65 \times 30)}{100}$ = 63.6	an answer of 63.6 scores **2** marks	1 1	AO2 4.1.1.6
03.3	copper / Cu	allow ecf from answer to question **03.2**	1	AO2 4.1.1.1
03.4	$\frac{1.2 \times 10^{-10}}{10\,000}$ **or** $1.2 \times 10^{-10} \times 1 \times 10^{-4}$ $= 1.2 \times 10^{-14}$ (m)	an answer of 1.2×10^{-14} (m) scores **2** marks a correct answer not in standard form scores **1** mark	1 1	AO2 4.1.1.5
Total			**10**	

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	3.6 (cm^3)		1	AO2 4.4.3.4
04.2	hydrogen line only		1	AO3 4.4.3.4
04.3	both lines		1	AO3 4.4.3.4
04.4	graphite has delocalised electrons		1	AO1 4.2.3.2
04.5	**cathode** zinc (1) **anode** chlorine (1) hydrogen (1) bromine (1)	do **not** accept chloride allow **1** mark if chlorine and zinc the wrong way around do **not** accept bromide allow **1** mark if bromine and hydrogen the wrong way around	1+1 1+1	AO2 4.4.3.2 4.4.3.4
Total			**8**	

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	gas		1	AO1 4.2.2.2
05.2	the gas escapes	allow carbon dioxide escapes do **not** accept references to evaporation	1	AO1 4.3.1.3
05.3	5.12 (g)		1	AO2 4.3.1.3
05.4	4.00 (g) trial 1	allow 2.89 written in either space, or ringed in the table, unless contradicted by mass of copper carbonate or trial number	1	AO3 4.3.1.3
05.5	reheat (and reweigh) until constant mass	 an answer of heat to constant mass scores **2** marks if no other mark scored allow for **1** mark heat for longer **or** (heat at a) higher temperature **alternative approach**: (1) continue heating and pass gas through limewater (1) until the (lime)water stops bubbling **or** until the limewater no longer turns cloudy	1 1	AO3 4.3.1.3

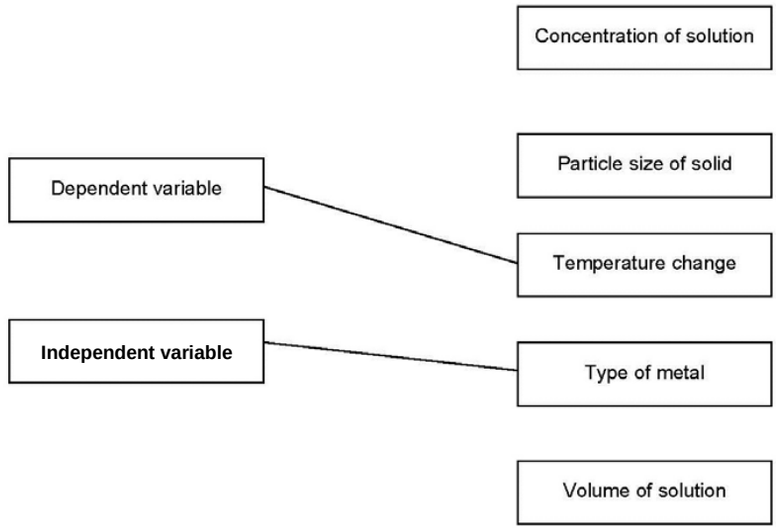
4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	straight line of best fit	must touch at least 5 of the 6 plots	1	AO2 4.3.1.3
05.7	correct value read from line of best fit in Figure 8	allow tolerance of ± ½ small square	1	AO2 4.3.1.3
05.8	(mass =) $168 \times \frac{\text{answer from question } \mathbf{05.7}}{8.4}$	a correctly calculated value from their answer to question **05.7** scores **2** marks allow (mass =) answer from question **05.7** × 20	1	AO2 4.3.1.3
	correctly calculated value (g)		1	
Total			**10**	

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	 allow **one** mark if answers are reversed		1 1	AO1 4.5.1.1
06.2	polystyrene is a better insulator		1	AO3 4.5.1.1
06.3	both bars labelled both bars correctly plotted	 allow tolerance of ± ½ small square ignore width and spacing of bars if no other mark scored, allow **1** mark for any one bar correctly plotted and labelled	1 1	AO2 4.5.1.1

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	temperature increases **or** temperature does not decrease	ignore because it is exothermic allow (because) energy / 'heat' is transferred to the surroundings energy / 'heat' is not taken in from the surroundings allow the energy of the products is less than the energy of the reactants	1	AO3 4.5.1.1
06.5	(most reactive) magnesium (zinc) nickel	this order only	1	AO3 4.5.1.1 4.4.1.2
06.6	suitable method described the observations / measurements required to place in order an indication of how results would be used to place the unknown metal in the reactivity series **approaches that could be used:** **approach 1:** add the unknown metal to copper sulfate solution (1) measure temperature change (1) place the metals in order of temperature change (1)		1 1 1	AO3 4.4.1.2 4.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6 cont.	**approach 2:** add the metal to salt solutions of the other metals **or** heat the metal with oxides of the other metals (1) measure temperature change (only if salt solutions used) **or** observe whether a chemical change occurs (1) compare temperature change or whether there is a reaction to place in correct order (1) **approach 3:** add all of the metals to an acid (1) measure temperature change or means of comparing rate of reaction (1) place the metals in order of temperature change or rate of reaction (1) **approach 4:** set up electrochemical cells with the unknown metal as one electrode and each of the other metals as the other electrode (1) measure the voltage of the cell (1) place the metals in order of voltage (1)			
06.7	D		1	AO1 4.5.1.2
06.8	C		1	AO1 4.5.1.2
Total			**12**	

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	sodium oxide	allow Na_2O	1	AO2 4.1.1.1 4.1.2.5 4.4.1.1
07.2	oxidation		1	AO1 4.4.1.1
07.3	13		1	AO1 4.4.2.4
07.4	sodium hydroxide		1	AO2 4.1.1.1
07.5	OH^-		1	AO1 4.4.2.4
07.6	(volume =) $\frac{250}{1000}$ or ¼ or 0.25 (dm^3) **or** (mass per cm^3 =) $\frac{40}{1000}$ (g) or 0.04 (g) ($\frac{250}{1000}$ × 40 =) 10 (g)	an answer of 10 (g) scores **2** marks	1 1	AO2 4.3.2.5

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	all points correct	allow a tolerance of ± ½ a small square allow **1** mark for 3 points correct ignore any attempt at a line of best fit	2	AO2 4.1.2.5
07.8	39 (°C)	allow any value from 34 to 46 (°C)	1	AO2 4.1.2.5
Total			**10**	

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	any **one** from: • metal • (metal) hydroxide • (metal) carbonate • alkali	allow named example allow correct formula ignore base allow ammonium hydroxide allow ammonium carbonate allow soluble base allow ammonia	1	AO1 4.4.2.1 4.4.2.2 4.4.2.3
08.2	$Ca(NO_3)_2$	allow $Ca^{2+}(NO_3^-)_2$	1	AO2 4.4.2.2

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Mark	AO / Spec. Ref.
01.3	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.4.2.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • use magnesium oxide and sulfuric acid • add sulfuric acid to a beaker • warm sulfuric acid • add magnesium oxide • stir • continue adding until magnesium oxide is in excess • filter • using a filter paper and funnel • to remove excess magnesium oxide • heat solution in an evaporating basin • to crystallisation point • leave to crystallise • pat dry with filter paper credit may be given for diagrams		
Total		**8**	

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	FeS_2	do **not** accept equations	1	AO2 4.2.1.3
09.2	26 30 26	must be this order	1 1 1	AO2 4.1.1.4 4.1.1.5
09.3	any **two** from: • iron has a high(er) melting / boiling point • iron is dense(r) • iron is hard(er) • iron is strong(er) • iron is less reactive • iron has ions with different charges • iron forms coloured compounds • iron can be a catalyst	allow the converse statements for sodium allow transition metal for iron allow Group 1 metal for sodium ignore references to atomic structure ignore iron rusts allow iron is less malleable / ductile allow specific reactions showing difference in reactivity allow iron is magnetic	2	AO1 4.1.2.5 4.1.3.1 4.1.3.2

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	carbon is more reactive (than nickel)	allow converse	1	AO1 4.4.1.2 4.4.1.3
	(so) carbon will displace / replace nickel (from nickel oxide) **or** (so) carbon will remove oxygen (from nickel oxide)	allow (so) nickel ions gain electrons allow (so) carbon transfers electrons to nickel (ions)	1	
09.5		an answer of 67.8 (%) scores **3** marks an answer of 67.8160919 (%) or correctly rounded answer to 2, 4 or more sig figs scores **2** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.3.2
	(total M_r of reactants =) 87		1	
	(percentage atom economy) $= \frac{59}{87} \times 100$	allow (percentage atom economy) $= \frac{59}{\text{incorrectly calculated } M_r} \times 100$	1	
	= 67.8 (%)	allow an answer from an incorrect calculation to 3 sig figs	1	
Total			**11**	

4.2.4.1 Sizes of particles and their properties

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	copper, zinc, sodium chloride solution		1	AO2 4.5.2.1
10.2	a reactant is used up	allow the reaction stops allow electrolyte / electrode / ions / metal / metal hydroxide / alkali for reactant	1	AO1 4.5.2.1
10.3	the reaction is not reversible		1	AO1 4.5.2.1
10.4	$2H_2 + O_2 \rightarrow 2H_2O$	allow fractions / multiples allow **1** mark for O_2	2	AO1 AO2 4.1.1.1 4.5.2.2

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td rowspan="5">10.5</td><td>Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.</td><td>5–6</td><td rowspan="5">AO3

AO3

AO2

4.4.3.4
4.5.2.1
4.5.2.2</td></tr>
<tr><td>Level 2: Some logically linked reasons are given. There may also be a simple judgement.</td><td>3–4</td></tr>
<tr><td>Level 1: Relevant points are made. This is not logically linked.</td><td>1–2</td></tr>
<tr><td>No relevant content</td><td>0</td></tr>
<tr><td colspan="2">Indicative content

reasons why fuel cells could be judged as better

<table><tr><th>from the table</th><th>from other knowledge</th></tr><tr><td>• time for refuelling a fuel cell is faster than recharging
or
a fuel cell does not need to be recharged
• a fuel cell has a greater range</td><td>• hydrogen can be renewable if made by electrolysis using renewable energy
• lithium-ion batteries can catch fire
• produces only water
or
no pollutants produced
• lithium-ion batteries may release toxic chemicals on disposal
• lithium-ion batteries (eventually cannot be recharged so) have a finite life</td></tr></table>
reasons why the lithium-ion battery could be judged as better

<table><tr><th>from the table</th><th>from other knowledge</th></tr><tr><td>• lithium-ion uses energy more efficiently
• cost of lithium-ion car much less
• cost of recharging much less than refuelling with hydrogen</td><td>• hydrogen is often made from fossil fuels so is not renewable
• charging points are more widely available than hydrogen filling stations
• hydrogen takes up a lot of space
or
is difficult to store
• hydrogen can be highly flammable / explosive
• no emissions produced
• (catalyst in the hydrogen fuel-cell eventually becomes poisoned so) have a finite life</td></tr></table></td><td></td><td></td></tr>
<tr><td>Total</td><td colspan="2"></td><td>11</td></tr>
</table>

4.2.4.1 Sizes of particles and their properties

Answer 10 · Examiner comments — June 2018 | 8462/1F | Original Q1

Question 1 (low demand)

01.1 74% of students achieved two or more marks, with 34% of students achieving all three. The vast majority of students knew that black ink would be separated by chromatography, but filtration was a popular incorrect answer for obtaining salt from seawater.

01.2 This question was not well answered. Many students did not know what to call a funnel, referring to it as a plastic cone. Other errors were to use more pieces of paper, or to suggest substituting a beaker for the conical flask. Answers which gave diagrams gained credit.

01.3 69% of students gained both marks, with about one in eight scoring neither.

01.4 51% of students scored both marks on this, the first calculation on the paper. Partial credit was given to those who calculated 2 ÷ 18 as a percentage rather than 2 ÷ 20, or who correctly calculated the percentage of metal A instead of metal B.

01.5 68% of students knew that a mixture of metals is an alloy. The most popular incorrect answer was ‘a compound’.

Answer 10 · Examiner comments — June 2018 | 8462/1F | Original Q1

01.6 48% of students realised that the correct answer is that the layers in the mixture are distorted. 25% of students thought that the correct answer is that ‘the mixture has a giant structure’. Whilst true, this statement does not give the correct explanation for the extra hardness of the mixture.

01.7 74% of students could calculate the volume of the cube correctly. The most popular distractor was 400 nm^3, with 400 nm^2 being the surface area of one face.

4.2.4.1 Sizes of particles and their properties

Answer 11 · Examiner comments

June 2019 | 8462/1F | Original Q10

Question 10 (standard demand)

10.1 Approximately a third of students scored a mark for referring to the presence of delocalised electrons in carbon nanotubes.

Very few scored the mark for explaining the role of these electrons in the conduction of electricity.

10.2 Most students understood that they needed to compare the properties of the three materials. However, a few did not add value and just quoted data from the table, which is insufficient to be credited.

Approximately 45% of students achieved a Level 2 mark by giving a consequence of one of the stated differences in properties. Some gave a justified conclusion in referencing the most suitable material for a racket frame.

For some students, there was a misunderstanding that a high density was good because it made the racket strong, despite strength being one of the other properties given.

10.3 Almost a quarter of students scored full marks for this calculation. A similar proportion correctly calculated the surface area as 40344 nm^2 but did not score the mark for converting this answer to standard form.

Some students calculated the volume of the nanoparticle rather than the surface area.

Even if the answer to their calculation was incorrect, a mark could still be scored for correctly converting this answer to standard form, provided that an attempt to calculate the surface area had been made.

10.4 Students found it difficult to give a reason why it costs less to use nanoparticles in sun-cream with only approximately 10% scoring the mark.

4.2.4.1 Sizes of particles and their properties

Answer 11 · Examiner comments June 2019 | 8462/1F | Original Q10

Common responses seen that were not credited included:

- nanoparticles are smaller
- nanoparticles are easier to make.

4.2.4.1 Sizes of particles and their properties

Answer 11 · Examiner comments

June 2019 | 8462/1F | Original Q10

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.2.4.1 Sizes of particles and their properties

Answer 13 · Examiner comments — June 2022 | 8462/1F | Original Q7

Question 7 (Low and standard demand)

07.1 Nearly two-thirds of students correctly identified the coarse particle as the largest, with the fine particle being the more commonly selected of the two distractors.

07.2 Most students could calculate the volume correctly. Some attempted to calculate the surface area of the cube from scratch, failing to use the value given in the question. Nearly a half of students did obtain full marks for the question, though many failed to show their working for each step and just gave the two answers.

07.3 Fewer than a quarter of the students realised that the surface area to volume ratio of nanoparticles is greater so less of the substance needs to be used. Fewer than half gained any credit at all.

07.4 This was very well answered, with nearly all students gaining at least one mark and more than two-thirds gaining both. However, some students thought that a disadvantage could be that feet would smell, not recognising that unpleasant smells would be prevented by the silver. Another misunderstanding was that the socks could cause infections, rather than prevent them.

07.5 About a half of students could work out that the radius was 100 times larger, with 2 times larger being the most commonly chosen distractor.

Answer 14 · Examiner comments — June 2023 | 8462/1F | Original Q5

Question 5 (low and standard demand)

05.1 This piece of knowledge from the specification was not at all well known. Fewer than a quarter of students gave the correct answer, with the rest being evenly split between the two distractors.

05.2 The vast majority answered this correctly.

05.3 This question discriminated very well; about two fifths of students scored all four marks and two thirds scored two or more. Many could not use the given expression to calculate the surface area of one face and then multiply it by 6. Many also recalculated the volume of the cube, despite being given that value, and often disagreeing with the provided value. Students could gain the last two marks by using their answer for the surface area, but some did not know which two values to use in their ratio or could not simplify the ratio to the simplest whole number ratio.

05.4 This question proved difficult with more students giving the third option rather than the correct answer.

4.2.4.1 Sizes of particles and their properties

Answer 14 · Examiner comments — June 2023 | 8462/1F | Original Q5

05.5 Fewer than a fifth of students gave the correct answer, with the majority opting for Ti_4O_2 rather than TiO_2.

Answer 15 · Examiner comments — June 2024 | 8462/1F | Original Q4

Question 4 (low and standard demand)

04.1 Fewer than one in eight students knew that a nanoparticle is only a few hundred atoms, despite this being clearly stated in the specification. The correct answer was a less popular option than all three distractors. The most popular answer was a few million atoms.

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Answer 15 · Examiner comments — June 2024 | 8462/1F | Original Q4

04.2 Fewer than a third of students could apply their knowledge that transition metals make good catalysts and select iron as the most likely element. By far the most popular distractor was magnesium.

04.3 More than four fifths of students scored both marks. Nearly all students identified the use of titanium dioxide for sun creams, and most also identified silver for wound dressings. There was no apparent pattern to incorrect responses.

04.4 Two fifths of students scored all six marks, with well over four fifths scoring at least 1 mark. The most common error was in the surface area, where the answer was often given as 6 times the volume, ie 384 nm^3. Most students were able to cancel down their numbers to give the simplest whole number ratio and gained credit for doing so.

4.2.4.1 Sizes of particles and their properties

Answer 16 · Examiner comments

June 2025 | 8462/1F | Original Q6

Question 6 (low and standard demand)

06.1 Nearly three fifths gave the correct answer, with the two distractors being almost equally popular despite the diagram looking nothing like a tube.

06.2 About half chose the correct reason, with the more popular distractor being that the nanoparticles are made of carbon atoms.

06.3 The vast majority could select the correct answer. 10^3 was the most popular distractor.

06.4 This was well done, with more than half of students scoring full marks. Many could calculate the volume, but some tried to calculate the surface area, ignoring the value provided. Some did not cancel their ratio down to the simplest whole number ratio, eg leaving the answer as 12:8. Partial credit was awarded for attempts to cancel down incorrect values of volume and / or surface area.

06.5 Over half of students scored both marks; most applied what they knew about nanoparticles to the context of the question.