

GCSE 2004

June Series



Mark Scheme

Science: Double Award

Specification B (Co-ordinated)

3462/2H

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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.

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SCIENCE: DOUBLE AWARD CO-ORDINATED

INFORMATION FOR 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 and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

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

- 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 lines 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 / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.

On the script, the QoWC tick should be identified by a ‘q’ written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates 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)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate 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.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 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.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

- (a) A candidate who calculates average speed using $\text{speed} = \text{time}/\text{distance}$ **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.
- (b) A candidate who incorrectly calculates average speed using $\text{speed} = \text{distance}/\text{time}$ and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are 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 e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(.....) is 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.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.



**Double Award
Higher Tier 3462/2H**

3462/2H Q1

question	answers	extra information	mark
(a)(i)	coke	allow coal ignore carbon	1
(ii)	any plausible description of a difference based on diagram or their knowledge e.g. use of water power or smaller scale or use of bellows or use of cold air or slower speed / less efficient	accept converse argument but must be clear	1
(b)(i)	to remove / lose oxygen (owtte)	accept answer in terms of electrons (gain electrons) but not hydrogen	1
(ii)	iron and carbon dioxide	both for 1 mark accept Fe and CO ₂ do not accept Fe and CO ₂	1
(c)	to remove impurities / acidic compounds	accept to form slag (owtte) accept correct chemical description suggesting impurities allow to stop furnace getting blocked	1
(d)	sodium is <u>higher</u> in the reactivity series than carbon	it = sodium accept sodium is (very) high in the reactivity series accept sodium is <u>too</u> reactive accept sodium is more reactive than iron / calcium sodium is reactive = 0 marks must be a comparison with carbon for both marks	1 1
(e)(i)	chromium or nickel	accept Cr or Ni	1
(ii)	does not rust / corrode or does not react with water or does not oxidise	ignore references to heat conductivity / conduction or appearance (e.g. tarnish) ignore melting point any reference to electrical conductivity = 0 marks	1
total			9

3462/2H Q2

question	answers	extra information	mark
(a)	catalyst or speeds up the reaction (owtte)	accept lowers activation energy not just helps reaction to take place ignore increased surface area	1
(b)	C ₈ H ₁₈	allow H ₁₈ C ₈ must be upper case do not accept powers	1
(c)	B because it is a gas or because it has small molecules or because <u>they</u> are small	position and reason for mark allow it has a lower / <u>very</u> low boiling point than A ignore references to solubility accept does not condense do not accept light molecules or bubbles into B do not accept <u>it</u> is small	1
(d)	breakdown of a substance (owtte) by the action of heat (owtte)	do not accept decompose unqualified	1 1
(e)	Quality of written communication large to small molecules or scientific word that implies smaller, e.g. alkene / ethane / petrol either advantages of smaller molecules or disadvantages of larger molecules e.g. hydrocarbons with large molecules are limited in their usefulness large hydrocarbon molecules do not ignite easily / do not flow easily / are not very volatile more large hydrocarbon molecules are produced than are needed smaller molecules are useful as fuels alkenes / products can be used to make polymers	if the written communication makes sense and it is in context then award Q mark Q ✓ Q X any name or formula of alkane / alkene smaller than decane or converse for smaller molecules or converse for smaller molecules or converse for smaller molecules	1 1 1
(f)	(fractional) distillation	accept fractionation accept good description do not accept just diagram	1
total			9

3462/2H Q3

question	answers	extra information	mark
(a)(i)	argon and potassium or tellurium and iodine or cobalt and nickel	accept correct symbols allow argon and calcium	1
(ii)	it would place them in incorrect <u>groups</u> (owtte)	idea of <u>not</u> being placed with elements which have similar properties or converse argument accept would not have same number of electrons in outer shell allow it would put them in wrong period if linked to argon and potassium / calcium do not accept reasons based just on protons do not accept metals and non-metals mixed up	1
(b)	any two from: • each successive atom has one more electron • atoms in the same group have the same number of electrons in their <u>outer shells</u> / energy levels • across a period an energy level / shell is being filled • in the next period the next energy level / shell is being filled	number of electrons in outer shell = group number accept period number = shell number	2
total			4

3462/2H Q4

question	answers	extra information	mark
(a)	hydrogen	accept H ₂ do not accept H	1
(b)	litmus paper / Universal Indicator paper / pH paper bleached / turns white or loses its colour	allow any suitable <u>named</u> indicator do not accept bleached cloth / leaves etc. allow second mark unless <u>incorrect</u> indicator given allow starch iodide paper (1) goes black / blue black (1) allow potassium iodide solution (1) goes brown / orange / black precipitate (1)	1 1
(c)	because they have a negative charge or opposite charges attract	accept (because) it is Cl ⁻ accept chlorine, Cl or chlorine ions has a negative charge do not accept Cl ⁻ on its own do not accept Cl ₂ o.e. has negative charge	1
(d)	kill bacteria / germs, etc. or sterilise / disinfect	accept destroys bacteria etc. ignore clean / purify water (owtte) do not accept just gets rid of bacteria	1
(e)	hydroxide (ion)	accept OH ⁻	1
total			6

3462/2H Q5

question	answers	extra information	mark
(a)	100	ignore units $40 + 12 + (3 \times 16)$ for 1 mark	2
(b)	40	(ecf from part (a) can get 2 marks) $\frac{40}{\text{their (a)}} \times 100$ for 1 mark	2
(c)	0.5	(ecf from part (b) can get 2 marks) $1.25 \times \left(\frac{\text{their (b)}}{100} \right)$ or other correct working for 1 mark	2
(d)	gas produced or carbon dioxide / CO ₂ produced		1
total			7

3462/2H Q6

question	answers	extra information	mark
(a)	Na_2CO_3	accept $(\text{Na}^+)_2\text{CO}_3^{2-}$ 2 and 3 below halfway do not accept $\text{Na}_2 + \text{CO}_3$	1
(b)(i)	correct number of electrons (18)	accept any combination of dots and crosses	1
	2, 8, 8	2, 8, 8 written on rings = 1 mark	1
(ii)	loses 2 electrons or loses <u>both</u> electrons	loses electrons = 1 mark any answers about gaining electrons = 0 marks	2
(c)(i)	5	accept multiples if all correct	1
(ii)	6	accept multiples if all correct	1
total			7

3462/2H Q7

question	answers	extra information	mark
	<p>Quality of written communication</p>	<p>if the written communication makes sense and it is in context then award Q mark</p> <p>Q ✓ QX</p>	1
	<p>any one from:</p> <ul style="list-style-type: none"> • earth movements • movement of tectonic plates • tectonic activity / collision of plates • mountain creation • deep burial / pushed downwards • contact with magma 	<p>any stated activity within the crust accept earthquakes / volcanoes / forces in the crust accept <u>folding</u></p> <p>do not accept simply describing sedimentation</p>	1
	<p>any one from:</p> <ul style="list-style-type: none"> • (created) high temperatures / heat / very hot • (created) <u>high</u> pressures • (caused) recrystallisation / crystalline rearrangement 	<p>any reference to melting loses this mark</p> <p>do not accept hot unqualified</p> <p>accept idea of more pressure e.g. earthquake creates pressure</p> <p>accept formation of new minerals</p>	1
total			3

3462/2H Q8

question	answers	extra information	mark
(a)	A	accept a or 2, 8, 18, 18, 8, 1	1
(b)	outer shell further from nucleus or outer shell electron less strongly attracted to nucleus or outer shell more shielded	do not accept more shells or larger / bigger atoms alone	1
	so outer shell electron lost <u>more</u> easily (owtte)	accept correct converse linked to lithium 'it' must be linked to caesium outer must be used once at least for both marks	1
total			3

3462/2H Q9

question	answers	extra information	mark
(a)(i)	any three from: <ul style="list-style-type: none"> • particles / they gain energy • particles / they move faster • collide more often or more collisions or more chance of collision • have more energy when they collide or more energetic collisions or more collisions with activation energy 	accept move more violently ignore vibrate faster or start to move only or more active do not accept move more accept more successful / fruitful / violent / forceful collisions accept more likely to react	3
(ii)	does not work above 45° C or denatured / damaged / destroyed or only works best at an optimum temperature	some indication of optimum temperature do not accept killed / do not work accept only work over a narrow pH range ignore deactivated or decreases activity or explanations about cost or not removed with product	1
(b)(i)	lower temperature needed (owtte) high yield of product (owtte) only one product or (virtually) no other products (owtte)	read the whole explanation first, may be more than one mark on one statement accept 10° C alone accept no waste products / by products ignore explanations involving cost or specificity of enzymes	1 1 1
(ii)	so it functions for a long time or lasts longer or more effective over a longer period	answer must be time related	1
(iii)	enzyme is trapped in / fixed to / bonded to (owtte) / trapped / held to (inert) solid / resin / (alginate) beads, network / surface / matrix etc.	do not accept deposited or absorbed	1 1
total			10

3462/2H Q10

question	answers	extra information	mark
(a)	react with oxygen / oxidise / burn in oxygen / burning / combustion or tungsten to tungsten oxide or makes an oxide	key idea is oxidation ignore breaking ignore fire / flames / exothermic ignore react with air	1
(b)	it is (very) unreactive / not reactive / inert / does not react with tungsten or it is a noble gas or it is in group 0 or 8 or 18	do not accept unreactive / inert metal or argon is not <u>very</u> reactive	1
	full outer shell (of electrons) / 8 electrons in outer shell		1
	does not need to gain / lose / swap / transfer / share electrons or does not need to form bonds	does not bond ionically / covalently	1
total			4

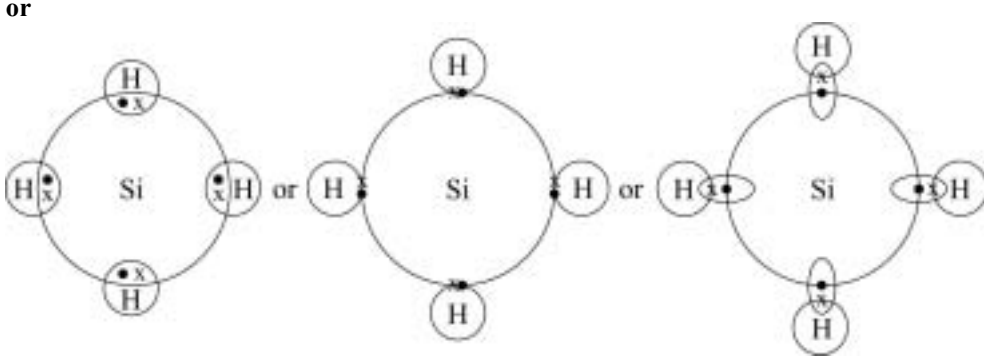
3462/2H Q11

question	answers	extra information	mark
(a)	poly(tetrafluoroethene) or polytetrafluoroethene	accept PTFE or Teflon	1
(b)	double bond all other atoms and bonds correct including F for fluorine $\begin{array}{c} \text{F} \quad \text{F} \\ \quad \\ -\text{C}=\text{C}- \\ \quad \\ \text{F} \quad \text{F} \end{array}$	$\begin{array}{c} \text{F} \quad \quad \text{F} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{F} \quad \quad \text{F} \end{array}$ <p>ignore n in front</p> <p>or</p> $\begin{array}{c} \text{F} \quad \text{F} \\ \quad \\ \text{C} - \text{C} \\ \quad \\ \text{F} \quad \text{F} \end{array} = 1 \text{ mark}$ $\left(\begin{array}{c} \text{F} \quad \text{F} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{F} \quad \text{F} \end{array} \right)_n = 1 \text{ mark}$ <p>$\text{CF}_2 = \text{CF}_2$ = 1 mark</p> <p>do not accept structures with more than 2 C atoms</p>	1 1
(c)	any three from: <ul style="list-style-type: none"> • <u>many</u> monomers / (small) molecules / tetrafluoroethene molecules • (monomers, molecules etc.) join / bond / link / combine / attach • to form one molecule or to form a long-chain or to form a large molecule • no other substances are produced / one substance formed (definition of addition) • idea of <u>double bond</u> breaking / opening / opens / bond being used to join to another molecule or the double bond becomes a single bond 	<p>allow <u>many</u> tetrafluoroethenes many particles alone is insufficient do not accept many polymers</p> <p>allow many particles <u>join</u> allow many atoms <u>join</u> do not accept collide / add ignore polymerise do not accept many polymers join</p>	3
total			6

3462/2H Q12

question	answers	extra information	mark
(a)	low / lower / lowest temperature (or 100 °C from graph)	2 marks for comments related to temperature ignore references to catalyst	1
	any one from: <ul style="list-style-type: none"> (forward) reaction exothermic if the temperature is increased the yield of product will decrease or reaction right to left 	or reverse reaction endothermic high temperature favours reverse reaction or reverse argument the lower the temperature the greater the yield = 2 marks	1
	high / higher / highest pressure (or greater than 200 atm. from graph)	2 marks for comments related to pressure	1
	any one from: <ul style="list-style-type: none"> four reactant molecules but only two product molecules (owtte) increase in pressure favours the reaction which produces the least number of molecules 	reverse reaction goes from 2 molecules / moles / volumes to 4 molecules / moles / volumes decrease in pressure favours the back reaction because it produces the most molecules	1
(b)	any three from: <ul style="list-style-type: none"> at low temperatures the reaction is too slow 450 °C gives a reasonable yield at a fast rate / compromise between yield and rate 200 atm. gives a reasonable yield at a reasonable cost / safely / compromise between yield and cost / safety catalyst works better at higher temperature (very) high pressures could be dangerous (owtte) (very) high pressures are expensive (owtte) (yield is not too important because) unreacted gases can be recycled 	} or 450°C and 200 atm / these are compromise conditions for 1 mark safety factor	3
total			7

3462/2H Q13

question	answers	extra information	mark
(a)	$M_r(\text{SiO}_2) = 60$ $60 \text{ g SiO}_2 \rightarrow 28 \text{ g Si}$ $2.14 \text{ g SiO}_2 \rightarrow 1 \text{ g Si}$ OR $M_r(\text{SiO}_2) = 60$ (1) $\text{moles of silicon needed} = \frac{1}{28} = 0.0357$ $\text{mass of SiO}_2 \text{ needed} = 0.0357 \times 60$ (1) $= 2.14 \text{ g}$ (1) OR $M_r(\text{SiO}_2) = 60$ (1) $\text{mass SiO}_2 = 1 \times \left(\frac{60}{28}\right)$ (1) $= 2.14 \text{ g}$ (1)	if M_r incorrect ecf for max 2 correct answer for 3 marks allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2 a unit is not required but an incorrect unit loses the third mark allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2 allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2	1 1 1
(b)(i)	$\text{MgO(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{O(l)}$	penalise incorrect symbols correctly balanced equation for 1 mark state symbols for 1 mark allow correct multiples / fractions	2
(ii)	$\begin{array}{c} \text{H} \\ \times \bullet \\ \text{H} \times \text{Si} \times \text{H} \\ \times \bullet \\ \text{H} \end{array}$ or 	ignore inner shell electrons of silicon allow correct drawings without symbols must clearly indicate four shared pairs of electrons with one electron from each atom	1

continued:

3462/2H Q13 continued

(iii)	Si	H	
	$\frac{1.4}{28}$	$\frac{0.15}{1}$	1
	= 0.05	= 0.15	1
	1	3	for whole number ratio can be implied
	Si H ₃		accept H ₃ Si or any correct formula with 1:3 ratio
		if in step 1 they get either of ratios incorrect they lose first 2 marks but can be ecf for 3 rd and 4 th mark	1
		evidence of mass / A _r	1 mark
		proportions of each	1 mark
		whole number ratio	1 mark
		correct formula	1 mark
(iv)	C		accept c
(c)	any four from: <ul style="list-style-type: none"> giant structure / macromolecule / lattice / giant molecule each silicon atom joined to four other atoms covalent bonds bonds are strong or large amount of energy needed to break bonds large number of bonds to be <u>broken</u> 	allow giant molecular / giant atomic structure (or diagram) accept hard to break bonds mention of giant ionic structure or intermolecular forces or intermolecular bonds max 1 mark diamond or carbon discussion max 3 marks unless clearly linked to silicon	4
total			15