AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/B/1H

Biology Paper 1H

Mark scheme

June 2019

Version: 1.0 Final

196G8464B1H/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 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

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, level of demand 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 / ; e.g. 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.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	**B**		1	AO2 4.2.2.2
01.2	right atrium		1	AO1 4.2.2.2
01.3	foxgloves		1	AO1 4.3.1.9
01.4		an answer of 54 (cm^3) scores 3 marks		AO2 4.2.2.2
	X = 2800 / 52		1	
	53.846153		1	
	54 (cm^3)	allow correct rounding of an incorrectly calculated value of stroke volume	1	

Question	Answers	Mark	AO / Spec. Ref.
01.5	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3 4.2.2.2 4.2.2.4 4.4.2.1 4.4.2.2
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2 AO1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content effect of exercise • during exercise body needs to transfer (more) energy • energy transferred during respiration • rate of respiration increases during exercise • (so) more oxygen is needed effect of beta blockers • beta blockers reduce (the increase in) heart rate (during exercise) • beta blockers reduce stroke volume (or described) • beta blockers reduce cardiac output • (so) heart cannot supply oxygen fast enough / in sufficient quantity to muscle cells effect on breathing rate • breathing rate increases to increase rate / amount of oxygen absorbed • breathing rate increases to increase rate / amount of carbon dioxide removed from body • (but) increased breathing rate cannot fully compensate for changes in heart function A level 3 response should make links between all three sections of indicative content A level 2 response should attempt to link effect of exercise with oxygen / energy requirement **and** beta blockers to effect on heart function. .		
Total		**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	amylase	allow phonetic spelling allow carbohydrase ignore references to source of enzyme e.g. salivary / pancreatic do **not** accept amylose	1	AO1 4.2.2.1
02.2	(partially permeable tubing) small intestine	allow stomach ignore intestine unqualified do **not** accept large intestine	1	AO3 4.2.2.1
	(water in test tube) blood	allow plasma	1	
02.3	(Starch): Iodine (solution)	allow phonetic spelling ignore iodide unqualified	1	AO1 4.2.2.1
	(Sugar): Benedict's (solution)		1	
02.4	enzyme had not started to work **or** none of the starch had been digested / broken down	allow idea of not enough time (for digestion)	1	AO2 4.2.2.1
02.5	(enzyme) digested / broke down starch to form sugar		1	AO2
	(however) not all the starch was digested / broken down		1	AO3 4.2.2.1
02.6	sugar molecules formed are small enough to pass through tubing		1	AO3 4.2.2.1
	(but) starch molecules too large (to pass through tubing)		1	AO2 4.2.2.1
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	opened and closed the tap (so water enters from reservoir)	allow opened the tap (carefully / gently)	1	AO3 4.2.3.2
03.2	air bubble moves further (in a given time)	allow air bubble moves faster	1	AO3 4.2.3.2
	(so) resolution is improved	allow it is easier to see a small change (in volume) ignore is easier to measure unqualified allow measurements are more accurate ignore to make test more accurate ignore references to precision or validity	1	
03.3		an answer of 10.56 (mm^3/min) scores 3 marks		AO2 4.2.3.2
	$\frac{66}{5}$ **or** 13.2 (mm/min)	allow tolerance of ± ½ square allow full marks from calculation from other **correct** pairs of readings allow value in range 13 to 13.4 for $\frac{66}{5}$ only ignore $\frac{63}{5}$ or 12.6	1	
	13.2 × 0.8	allow their calculated value in the range from 12 to 14 x 0.8	1	
	10.56 (mm^3/min)	allow 10.6 or 11	1	

03.4	points plotted correctly suitable line of best fit	allow +/- ½ a square allow 1 mark for 4/5 correct plots	2 1	AO2 4.2.3.2
03.5	straight line starting at 0,0 with a steeper gradient than A		1	AO3 4.2.3.2
03.6	no photosynthesis (so) stomata closed (as no carbon dioxide needed) (so) no transpiration	allow plants need light for photosynthesis allow very little transpiration **or** little water lost	1 1 1	AO1 AO2 AO2 4.2.3.2 4.4.1.2
Total			**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	protist		1	AO1 4.3.1.5
04.2	any **two** methods with reason from: • Method: insecticides Reason: to kill mosquitos / vector • Method: (mosquito) nets Reason: to avoid being bitten • Method: insect repellents Reason: less likely to be bitten • Method: vaccination Reason: so people are immune (to malaria) • Method: anti-malaria tablets Reason: kills the pathogen / protist	1 mark for method and 1 mark for a correctly linked reason ignore kill insects unqualified allow long clothing ignore acts as a physical barrier allow DEET or named insect repellent allow named anti-malarial e.g. Larium / Malarone allow antibiotics allow ecf from 04.1 ignore kills malaria allow Method: drain swampy ground **or** remove pots of water **or** put oil on water / pond Reason: fewer breeding grounds for mosquitos allow Method: release GM / sterile mosquitos Reason: prevent / reduce reproduction if no other marks awarded allow **1** mark for kill mosquitos	4	AO1 4.3.1.1 4.3.1.5 4.3.1.7

04.3	any **two** from: (bacterial cell): does not have a nucleus has plasmids is smaller	 allow DNA is free in cytoplasm allow has a single loop of DNA allow has a single strand of DNA allow description, e.g. (small) ring(s) of DNA allow bacterial cells do not have mitochondria **or** do not have membrane bound organelles allow bacteria have smaller ribosomes ignore bacterial cells do not have chloroplasts	2	AO1 4.1.1.1
04.4	to allow air / oxygen in for bacteria to respire **or** so bacteria can respire aerobically	allow to allow carbon dioxide produced in respiration to escape	1	AO3 4.4.2.1

04.5	(A) (no change in population size) because no / limited cell division / reproduction	allow (no change in population size) because bacteria / cells adjusting to environment / culture conditions ignore reference to growth unqualified	1	AO2 4.1.2.2 4.3.1.1 4.4.2.1 4.4.2.3
	(B) (rapid increase in population size) as cells dividing rapidly as (plentiful) supply of nutrients / food	allow rapid binary fission as (plentiful) supply of nutrients / food	1	
	(C) (population size stays the same) as rate of cell death equals rate of cell division		1	
	(D) (population size decreasing) as cells dying due to nutrients running out **or** (population size decreasing) as cells dying due to toxins / carbon dioxide / cell wastes building up (in solution)		1	

04.6		a ratio of 30 000:1 for **X and** 0.55:1 for **Y** scores 3 marks		4.1.3.1
	(SA: vol ratio of **X** =) $2.4 \times 10^{-7} : 8 \times 10^{-12}$ **or** 0.000 000 24 : 0.000 000 000 008	if no other calculation marks awarded allow 1 mark for calculation of SA for **X and Y** **or** calculation of volume for **X and Y** **or** calculation of SA **and** volume for one **or** both cubes if not given as a ratio	1	AO2
	(SA: vol ratio of **Y** =) 726:1331		1	AO2
	conversion to same scale: 30 000:1 **and** 0.55:1		1	AO2
	(so) diffusion distance is longer in multicellular organism **or** (so) volume supplied by each unit of surface area is greater in multicellular organism	allow converse allow converse allow idea that some cells will have no surfaces exposed to outside in multicellular organism	1	AO1
	(so) diffusion rate per unit volume is slower in a multicellular organism	allow converse	1	AO2
Total			**17**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$50=\frac{43}{\text{size of real object}}$	an answer of 860 (µm) scores 4 marks	1	AO1 3×AO2 4.1.1.5
	(size of real object =) $\frac{43}{50}$		1	
	(size of real object =) 0.86 (mm)		1	
	(size of real object =) 860 (µm)	allow correct conversion of their calculated value	1	
		if no other marks awarded allow 1 mark for $\text{magnification}=\frac{\text{size of image}}{\text{size of real object}}$		

Question	Answers	Mark	AO / Spec. Ref.
05.2	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 4.1.1.2
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	AO1
	No relevant content	0	
	Indicative content • place slide on stage • use lowest power / ×4 objective lens (initially) • adjust mirror **or** switch light on so light passes through slide • move stage as close to lens as possible • slide must not touch lens • turn focussing knob so slide moves away from lens • turn focussing knob until image comes into focus • use fine focus to get clear image • change objective lens to ×10 • ×5 eyepiece and ×10 objective lenses (gives total magnification of ×50) • refocus slide using focussing knob For Level 2 reference to how to focus the slide / cells **and** achieve magnification of ×50 is required		

05.3	any **three** from: • (rate) fastest in the first 0.5 hours • (rate gradually) decreases after first 0.5 hours **or** (rate gradually) decreases throughout the investigation • rate is constant between 1.0 and 2.0 hours **or** rate is constant between 2.0 and 3.5 hours • (rate) becomes zero between 3.0 and 3.5 hours	allow 'it' for rate allow fastest rate is 120 units per hour (at start) allow mean rate over 3.5 hours is 37.14 units per hour allow (rate) is zero after 3.5 hours	3	AO3 4.1.3.3 4.2.3.2
05.4	more nitrate ions are absorbed in the presence of oxygen (which suggests) they are absorbed by active transport / uptake which requires energy from respiration some nitrate ions absorbed by diffusion **or** some nitrate ions absorbed (by active transport / uptake) requiring energy from anaerobic respiration **or** some nitrate ions absorbed by active transport / uptake using oxygen already dissolved in the solution	allow nitrate ions absorbed faster in the presence of oxygen do **not** accept energy produced / created / made	1 1 1 1	AO3 AO2 AO1 AO2 4.1.3.3 4.2.3.2

05.5	nitrate ions are used with glucose to form amino acids (which are) used to synthesise proteins (needed for growth)		1 1 1	AO1 4.4.1.3 4.4.2.3
Total			**18**	

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/B/2H

Biology Paper 2H

Mark scheme

June 2019

Version: 1.0 Final

196G8464B2H/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 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

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, level of demand 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 or three 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.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	hold a ruler (just) above the (open) hand of the other student drop the ruler and other student catches it record where the ruler is caught	ignore near the hand do **not** accept give verbal signal ignore timing	1 1 1	AO1 4.5.2
01.2	193.5		1	AO2 4.5.2
01.3	to compare the effect of no caffeine	allow as a control (group) allow to show the effect of caffeine do **not** accept control variable	1	AO3 4.5.2
01.4	0.217 (s)	allow any value in the range 0.2150 to 0.2180	1	AO2 4.5.2
01.5	as mass of caffeine increases the decrease / change in reaction time increases	allow converse ignore caffeine decreases reaction time do **not** accept the greater the increase in reaction time the greater the mass of caffeine	1	AO3 4.5.2
01.6	their reaction time was greater (after the drink)	allow converse allow slower / longer for greater do **not** accept anomalous result	1	AO3 4.5.2

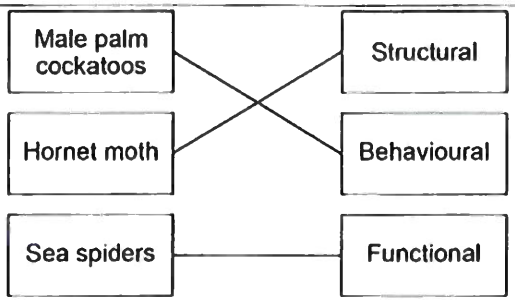
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	0.01(0) to 0.18(0) **or** 0.18(0) to 0.01(0) **or** 0.17(0)	allow values in range 0.008 to 0.012 **and** 0.178 to 0.182 allow correct calculation from values in range if no values are given, allow answers in the range 0.166 to 0.174 allow $0.01 \leq C \leq 0.18$ ignore units	1	AO2 4.5.2
01.8	any **two** from: • (same range of) age • (same) sex / gender • (same) height / weight / BMI • all had no caffeine / medication / drugs earlier that day • equally tired or (same) amount of sleep • practice of the ruler drop test • starting point of ruler / hand • same point to take measurement above / below the thumb / finger • using the same hand • (same) number of students in each group	allow height ruler dropped from do **not** accept volume / concentration of caffeine	2	AO3 4.5.2
01.9	not automatic (because) it involves the (conscious part of the) brain	allow it is a voluntary action allow because it involves thinking / decision **or** conscious action	1 1	AO2 4.5.2
Total			**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	methane	allow CH_4 **or** water (vapour) **or** H_2O allow correct example such as CFCs, nitrous oxide, ozone	1	AO1 4.7.3.5
02.2	any **two** from: • ice caps melting • rise in sea levels • desertification • extreme weather • change in species distribution • change in migration patterns • loss of biodiversity • coral bleaching • crop failure **or** food insecurity • loss of habitat qualified	ignore references to increased temperature and greenhouse gas / effect allow storms **or** droughts **or** flooding allow some species become extinct / endangered allow correct examples such as polar bears losing ice ignore forest fires	2	AO1 4.7.3.5

Question	Answers	Mark	AO/ Spec. Ref
02.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	4–6	AO1 4.7.2.2 4.4.1.1
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1-3	4.4.1.3 4.4.2.1
	No relevant content	0	
	Indicative content Photosynthesis • (carbon dioxide is) taken in through stomata / leaves • (carbon dioxide is) used in photosynthesis • to make glucose / carbohydrate • (glucose used) to make other carbon compounds or named example such as proteins, lipids • (glucose) stored as starch Feeding • plants are eaten / consumed by animals • which use the carbon compounds to make other carbon compounds Decay • when plants / animals die they are decomposed / decayed • by microorganisms • which use the carbon compounds to make other carbon compounds Respiration • plants / animals / microorganisms respire • (respiration) releases carbon dioxide back into the atmosphere Level 2 answers must consider photosynthesis and at least one other process in the carbon cycle. Level 2 answers must include some accurate detail.		
Total		**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	vectors are used to insert genes into cells		1	AO1 4.6.2.4
	vectors are usually plasmids or viruses		1	
03.2	wheat not affected by spraying / herbicide	allow only weeds affected / killed by spraying / herbicide	1	AO1 AO2 4.6.2.4 4.7.1.1
	(so) wheat gets more light / water / nitrates / ions / minerals	allow less competition for light / water / nitrates / ions / minerals ignore nutrients ignore carbon dioxide ignore space	1	4.4.1.1
	(so) more photosynthesis / glucose / proteins (for more yield)	idea of more needed at least once for mp 2 and 3	1	
03.3	any **two** from: • production of human insulin / medicines • crops resistant to diseases / pests • crops resistant to frost • crops resistant to drought • crops / foods with added nutrients • plants / crops with more / bigger fruits **or** higher yield • crops with improved taste • crops with improved shelf life	allow examples such as potatoes resistant to blight allow examples such as golden rice with vitamin A gene allow examples such as larger tomatoes	2	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	identify genes linked to (certain) disease so can lead to better prevention / treatment of that disease **or** identify genes causing inherited disorders (1) so may prevent children being born with the disorder by using IVF **or** gene therapy (1) **or** tracing human migration patterns from the past **or** evolution of humans (1) so to better understand the ancient history of humans (1)	allow correctly named diseases such as cancer / diabetes	1 1	AO1 AO2 4.6.1.3
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec.
04.1	 all correct for **2** marks allow **1** mark for one or two correct line(s) additional lines from a box on the left negates the mark for that box		2	AO2 4.7.1.4
04.2	any **four** from: • growing on other plants means support to absorb more light (for photosynthesis) • bright colours attract pollinators **or** bright colours attract insects to transfer pollen • large quantities of pollen (increases the likelihood of pollen transfer) and so more seeds / reproduction • tiny / light seeds will travel long distances to grow in new areas • many seeds mean many new plants so will out-compete other species	allow to obtain water / minerals / ions / glucose from the other plant ignore nutrients allow fertilisation for transfer of pollen allow tiny / light seeds will travel away from competitors allow many seeds so more (orchids) will survive	4	AO2 4.7.1.4 4.7.1.1 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	any **four** from: • mutations for purple flower (in ancestral species) • isolation **or** change in environment e.g. area had more insects • (plants with purple flowers) survive and breed • (plants with purple flowers) pass on allele / gene / DNA / mutation • until they were so different they could no longer interbreed (with the ancestral species)	 allow genetic variation gives purple flowers allow purple orchid more suited to a new environment allow genetic material for allele allow breed successfully for interbreed	4	AO2 4.7.1.4 4.7.1.1 4.4.1.1
04.4	species **D** because it has the lowest number of amino acids different (in the sequence) **or** because it has the lowest number of differences in the sequence **or** only one / sixth amino acid is different	must be an attempt at an explanation to gain this mark allow because it has the highest number of amino acids which are the same (in the sequence) allow because it has only one difference in the sequence allow only the glycine / gly has been changed to tyrosine / tyr	1 1	AO3 4.6.4 4.6.1.3 4.6.1.4
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	repeat for another ten quadrats		1	AO3 4.7.2.1
	use a random method to place the quadrats		1	
05.2		an answer of 4.8×10^5 scores **5** marks an answer of 481 766.4 **or** 481 766 **or** 480 000 scores **4** marks an answer of $15\,744 \times 4 \times 7.65$ scores **3** marks an answer of 15 744 (m^2) scores **2** marks		AO2 4.7.2.1
	(area of field =) $62 \times 164 + 164 \times 68 \div 2$ **or** equivalent		1	
	15 744 (m^2)		1	
	$15\,744 \times 4 \times 7.65$	allow use of incorrect area allow $\frac{7.65}{0.25} \times 15744$	1	
	481 766.4	allow 481 766 **or** 480 000	1	
	4.8×10^5	allow incorrect calculation expressed correctly	1	

Question	Answers	Mark	AO/ Spec. Ref
05.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3-4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content • trees over / in field • (which) reduce light for photosynthesis • (so) fewer daisies there • trees over / in field • (which) take water / nitrates / ions from the soil • (so) fewer daisies there • trampling on sports pitches • (will) kill plants • (so) fewer daisies there • competition from plants / grasses on field • (will) use up water / nitrates / ions / space • (so) fewer daisies there • gardener may water / fertilise / mow field • (which provides) more water / nitrates / ions • (so) more / fewer daises grow there • more insects / disease / animals in some areas • (may) eat / kill plants • (so) fewer daisies there • school buildings • (which) reduce light for photosynthesis • (so) fewer daisies near school • pollution / toxins from vehicles on roads • (which will) reduce growth • (so) fewer daisies near roads • wrong pH **or** lack of ions **or** poor drainage **or** poor / wet / dry soil in some areas • (which will) slow growth • (so) fewer daisies there Level 3 answers must refer to several factors in accurate detail		4.7.1.1 4.7.1.2 4.7.1.3 4.4.1.1
Total		**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	regulation / control / maintenance of internal conditions (of a cell / body) for optimum (cell / enzyme activity)	allow keeping the internal conditions (of a cell / body) the same allow description of optimum functioning (of cell / body)	1 1	AO1 4.5.1
06.2	glucagon	correct spelling only	1	AO1 4.5.3.2
06.3	any **two** from: • fasting blood glucose is higher than normal range • reached a very high concentration after glucose drink • did not return to normal after 3 hours **or** fell slowly after reaching peak. use of correct data in comparison to normal ranges given for any of the above points	 allow ± half a small square for values quoted from the graph ignore references to person A	2 1	AO3 4.5.3.2
06.4	 (person A has Type) 2 (pancreas) producing (lots of) insulin but body cells cannot respond to it. (person B has Type) I (pancreas) not producing enough insulin (to control concentration of glucose in the blood)	type of diabetes must be correct allow cells becoming resistant to insulin for respond to insulin. do **not** accept the person has become resistant to insulin	 1 1	AO3 4.5.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	starving children have used up their glycogen stores	allow starving children have no / low glycogen stores	1	AO1 AO2 4.4.2.1
	(so) would need (liver enzyme) to release glucose from fats		1	4.5.3.2
	as enzyme is stopped from working they get low / no glucose	allow no working enzyme leads to hypoglycaemia	1	
	(cell) respiration is insufficient (so they die)	allow starving children use proteins to release energy (which leads to death)	1	
	children that are not starving have glycogen stores in liver / muscle		1	
	(so) glucagon will continue to release glucose (into the blood for them)		1	
Total			**14**	

GCSE
COMBINED SCIENCE: TRILOGY
8464/C/1H

Chemistry Paper 1H

Mark scheme

June 2019

Version: 1.0 Final

I96G8464cIh/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 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

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, level of demand 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, i.e. 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	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	Ca Mg Zn Cu		1	AO3 5.4.1.2
01.2	any **two** from: • mass (of metal / element) • surface area (of metal / element) • concentration (of acid) • volume (of acid) • temperature (of acid)	 allow weight ignore size ignore length ignore pH ignore strength ignore room temperature	2	AO3 5.4.1.2
01.3	(type of) metal / element		1	AO2 5.4.1.2

01.4		allow converse answers for magnesium MP2 only if MP1 is correct		AO3 5.1.2.3 5.1.2.5 5.4.1.2
	(beryllium is) less reactive		1	
	any **one** from: • greater attraction between nucleus and outer electrons • more energy is needed to remove electrons • loss of electrons is more difficult • outer electrons closer to nucleus • less shielding	allow higher in group allow reactivity increases down the group ignore reactivity series	1	

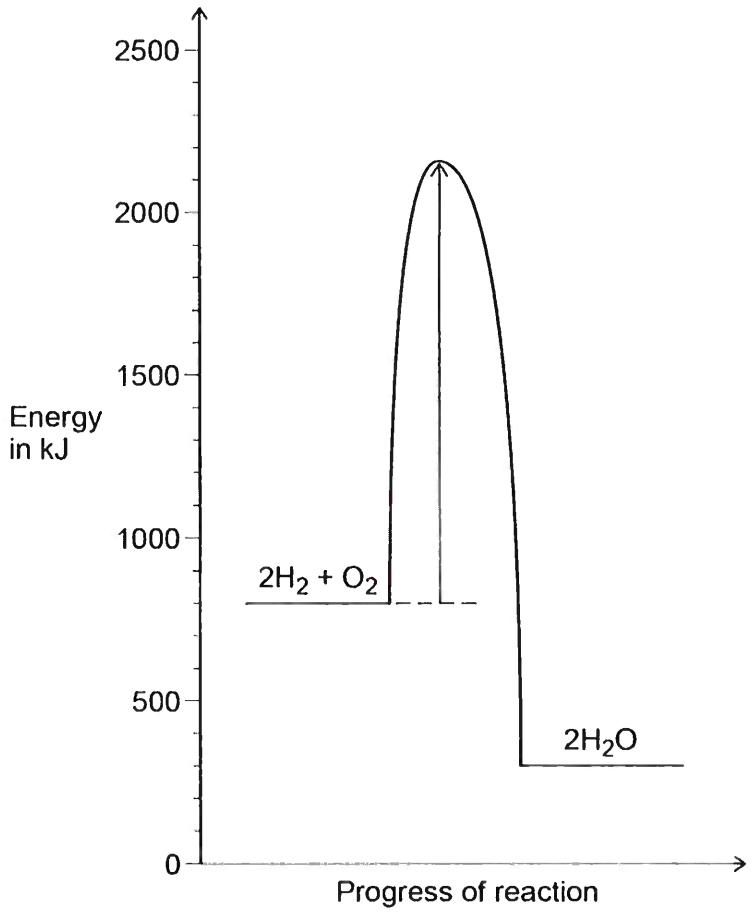
01.5		an answer of 64 (g per dm^3) scores **3** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 5.3.2.5
	$\frac{50}{1000}$ (dm^3)		1	
	= 0.05 (dm^3)		1	
	($\frac{3.2}{0.05}$) = 64 (g per dm^3)		1	
	alternative approach: $\frac{3.2}{50}$ (1) = 0.064 (1) (× 1000) = 64 (g per dm^3) (1)			
	alternative approach: $\frac{1000}{50}$ (1) = 20 (1) (× 3.2) = 64 (g per dm^3) (1)			
		an answer of 0.16 / 0.064 / 0.64 / 6.4 / 6.4 × 10^{-5} (g per dm^3) gains **2** marks		

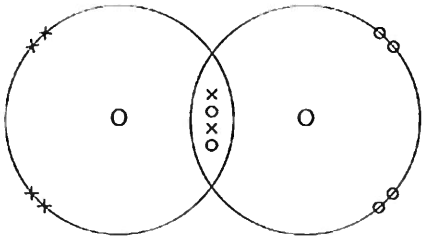
Total			**9**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(aq)	allow aq ignore aqueous ignore formulae	1	AO1 5.2.2.2
02.2	HNO_3		1	AO1 5.1.1.1 5.4.2.2
02.3	red purple **or** blue	allow orange or yellow do **not** accept green allow shades of purple eg violet	1 1	AO1 5.4.2.4
02.4	D		1	AO3 5.4.2.4
02.5	 3 × 16 **or** 48 $\frac{48}{80}$ (×100) 60 (%)	an answer of 60 (%) scores **3** marks an answer of 20 (%) scores **2** marks for: $\frac{16}{80}$ (× 100) (1) = 20 (%) (1)	 1 1 1	AO2 5.3.1.2

Question	Answers	Mark	AO/ Spec. Ref
02.6	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO3 AO2
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	5.5.1.1
	Level 1: The design/plan 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 **Steps** • use a suitable container eg test tube • use insulation • add water • measure the initial water temperature (with a thermometer) • add stated mass eg 1g **or** 1 spatula • stir (to dissolve the solid) • measure the final (allow lowest or highest) temperature of the solution • calculate the temperature difference **or** determine graphically • repeat with different masses • repeat with the same volume of water to access level 3 there must be an indication of how the temperature change is determined using different masses dissolved in the same quantity of water		

Total			14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	line from reactants to top of curve (i.e. from 800 to 2160)  ignore arrowheads		1	AO1 5.5.1.2
03.2		an answer of (–) 500 (kJ) scores **2** marks ignore sign		AO2 AO3 5.5.1.2
	reads levels of reactants (800 kJ) and products (300 kJ)		1	
	(800 – 300) = 500 (kJ)	allow correct subtraction of one incorrect value determined for the energy change	1	

03.3		allow combination of circles, dots, crosses or $e^{(-)}$		AO2 5.2.1.4
	two shared pairs in overlap		1	
	all non-bonding electrons in outer shell (4 electrons on each O atom)	ignore any inner shell electrons	1	
		 diagram scores 2 marks		

03.4	(bonds broken) ((4×463) + (2×138) =) **2128** (bonds made) ((4×463) + (496) =) **2348** (energy change = bonds broken – bonds made) (2128 – 2348 =) (–) **220** (kJ) **alternative approach:** (bonds broken) (2× (O–O) = (2×138) =) **276** (1) (bonds made) (1× (O=O) =) **496** (1) (energy change = bonds broken – bonds made) (276 – 496 =) (–) **220** (kJ) (1)	an answer of (–) 220 (kJ) scores **3** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps ignore energy change sign allow correct calculation using incorrect values from step 1 and/or step 2	1 1 1	AO2 5.1.1.1 5.5.1.1 5.5.1.3
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	atomic weight	do **not** accept atomic mass or A_r	1	AO1 5.1.2.2
04.2	left gaps / spaces **or** changed the order based on atomic weights	 allow placed them in correct groups according to properties do **not** accept reference to atomic number	1	AO1 5.1.2.2
04.3	weak forces between the molecules **or** weak intermolecular forces (so) little energy required to overcome / break the forces between molecules **or** (so) little energy required to overcome / break the intermolecular forces	allow weak intermolecular bonds do **not** accept incorrect references to covalent bonds allow (so) little energy required to separate the molecules allow (so) little energy required to overcome / break the intermolecular bonds ignore less energy	1 1	AO1 AO3 5.1.2.6 5.2.2.4

04.4	(the) molecules get larger going down the group (so the) forces between the molecules increase **or** (so the) intermolecular forces increase (so the) boiling points increase going down the group **or** (so the) boiling points increase with increasing relative atomic mass	allow converse explanation in terms of boiling point allow (so) more energy is needed to separate the molecules	1 1 1	AO1 AO3 5.1.2.6 5.2.2.4

04.5	2,8 (so) stable arrangement of electrons **or** (so) full outer shell	allow diagram or description	1 1	AO1 5.1.2.4

04.6	$\frac{1}{40} \times 6.02 \times 10^{23}$ **or** $0.025 \times 6.02 \times 10^{23}$ 1.51×10^{22}	an answer of 1.51×10^{22} scores **2** marks allow 1.505×10^{22}	 1 1	AO2 5.3.2.1

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	metal is too reactive to be extracted using carbon **or** metal reacts with carbon	allow metal is more reactive than carbon	1	AO1 5.4.3.3
05.2	aluminium oxide cryolite	either order ignore bauxite **or** aluminium ore	1 1	AO1 5.4.3.3
05.3	negative electrode: $Cu^{2+} + 2e^- \rightarrow Cu$ positive electrode: $2Cl^- \rightarrow Cl_2 + 2e^-$	allow multiples allow $2Cl^- - 2e^- \rightarrow Cl_2$	1 1	AO2 5.4.3.2 5.4.3.5
05.4	any **two** from: • concentration / volume of solution was different • impurities in solution • error in timing • copper falls off (electrode) • copper removed when drying electrode • electrode not dry (when weighed) • voltage / current was different	 allow copper at bottom of beaker ignore power supply ignore recorded mass inaccurately	2	AO3 5.4.3.4

05.5		an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 5.4.3.4
	reading of mass at stated time	allow tolerance of ± ½ small square eg at 30 minutes value is 5.4 (mg)	1	
	factor from time to 24 hours	eg 5.4×48 $\left(= \frac{24 \text{ hours}}{30 \text{ minutes}}\right)$ allow correct calculation using incorrectly read value for mass at time quoted	1	
	correct evaluation	eg = 259 (mg)	1	
	alternative approach:			
	calculates the gradient (1)	eg (1.8÷10) = 0.18		
	gradient × time in minutes in 24 hours (1)	eg 0.18 × 24 × 60 **or** eg 0.18 × 1440 allow correct use of incorrectly determined gradient		
	correct evaluation (1)	eg = 259 (mg)		

05.6	4.75 (g)	allow values in range 4.7–4.8 (g)	1	AO2 5.4.3.4

05.7		an answer in the range 0.18–0.25 scores **2** marks (**3** marks with correct unit)		AO2 5.4.3.4
	(working) Y increase **and** X increase measured from graph	allow ecf from question **05.6**		
	and substitution into $\frac{\text{Y increase}}{\text{X increase}}$	eg = $\frac{2.0}{10}$	1	
	correct evaluation	eg = 0.2	1	
	(units) g/hour	allow g/h **or** g/hr **or** g per hour	1	

Total			**14**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$2\ Na + Cl_2 \rightarrow 2\ NaCl$		1	AO2 5.1.1.1 5.1.2.5
06.2	(before) silver solid / liquid / metal **or** green (gas)	 allow grey solid / metal allow yellow (gas)	 1	AO1 5.1.2.5
	(during) yellow flame **or** white smoke **or** green colour fades / disappears	 allow orange / white flame allow vigorous reaction	 1	
	(after) white solid / powder		 1	

06.3	(sodium has) fewer energy levels / shells	allow converse for potassium allow diagrams of electron structure	1	AO1 5.1.2.5
	<u>outer</u> electron / shell is closer to nucleus **or** <u>outer</u> electron / shell is less shielded		1	
	(so) greater attraction between nucleus and outer electron / shell		1	
	(so) outer electron is less easily lost	allow (so) loses an / one electron less easily allow (so) more energy needed to remove an / one electron	1	

Question	Answers	Mark	AO/ Spec. Ref
06.4	**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.	4–6	AO1 AO2
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	

Indicative content

	sodium chloride	hydrogen chloride
differences in bonding	ionic	covalent
	metal & non-metal	two non-metals
	transferring electrons	sharing electrons
	ions (Na^+ and Cl^-)	molecules
	charged particles	neutral **or** no overall charge
differences in structure	**giant** structure or lattice	**small / simple / discrete** molecules
	electrostatic	intermolecular forces
	(electrostatic forces) are **strong**	(intermolecular forces) are **weak**
	act in all directions	random **or** between the molecules
	regular	irregular / random
similarities in bonding	full shells **or** stability	full shells **or** stability
	(transferring) electrons	(sharing) electrons
	strong bonds	**strong** (covalent) bonds
similarities in structure	(electrostatic) forces	(intermolecular) forces

ignore properties eg melting points, conduct electricity

to access level 2 there must be a comparison of the structure **and** bonding **and** magnitude of both sodium chloride **and** hydrogen chloride.

Total			**14**

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/C/2H

Chemistry Paper 2H

Mark scheme

June 2019

Version: 1.0 Final

1 9 6 G 8 4 6 4 C 2 H / M S

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

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, level of demand 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.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	potable		1	AO1.1 5.10.1.2	A
01.2		allow boils at 100°C for **2** marks		AO2 5.8.1.1	E
	boil (water)	ignore heat do **not** accept filter do **not** accept incorrect test	1		
	(boils) at 100°C		1		
		alternative approach freeze (water) (1) (freezes) at 0°C (1) if no other mark awarded, allow 1 mark for evaporate or distil water **and** no solid left			
01.3	**Level 2:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		3–4	AO1.1 5.10.1.2 10.2.13	E
	Level 1: The design/plan would not necessarily lead to a valid outcome. Some steps are identified, but the plan may not be logically sequenced.		1–2		
	No relevant content		0		
	Indicative content • weigh container. • measure volume (100 cm^3) of water into container. • evaporate / heat until dry. • weigh container and remaining solids. • determine mass of dissolved solids To access Level 2 there should be an indication of using a known volume of water, heating until dry and determining the mass of solid.				

01.4	(conversion of cm^3 to dm^3) ($250\ cm^3$ =) $\frac{250}{1000}$ or 0.25 (dm^3)	an answer of 0.031 (g) scores **4** marks	1	AO2 5.3.2.5 10.2.13	E
	(conversion of mg to g) (125 mg =) $\frac{125}{1000}$ or 0.125 (g)		1		
	(0.25 × 0.125) = 0.03125	allow correct calculation from incorrect attempt(s) at conversion	1		
	=0.031 (g)	allow an answer correctly rounded to 2 significant figures from an incorrect calculation that uses the values in the question	1		

01.5	$\frac{44}{500} \times 100$	an answer of 8.8 (%) or 9 (%) scores **2** marks	1	AO2 5.10.1.2 10.2.13	E
	= 8.8 (%)	allow 9 (%)	1		

Total			**13**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	high temperatures (in the engine)		1	AO1 5.9.3.1	E
	enable oxygen and nitrogen (from air) to react	allow combine / bond for react	1		

02.2	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6		E
	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 Examples of relevant points might include: • car **C** produces the most CO_2 during manufacture • car **A** produces the most CO_2 per km when driving • car **C** produces the most CO_2 from manufacture and 40,000km when driving • car **B** produces the most CO_2 from manufacture and 100,000km when driving Examples of linked statements might include: • car **A** produces least CO_2 during manufacture, but most CO_2 per km • car **C** produces most CO_2 during manufacture, but least CO_2 per km • car **A** produces least CO_2 during manufacture, but car **C** produces the least CO_2 per km Examples of judgements might include: • overall car **A** has the smallest carbon footprint as it has the smallest CO_2 production during manufacture, the smallest mass of CO_2 after 40,000km of driving and the smallest mass of CO_2 produced after 100,000km of driving. • car **A** eventually (after 157,895km) will have the largest carbon footprint because the mass of carbon dioxide produced per km is highest.		AO3 5.9.2.2 5.9.2.45.10.2.1	

Total			**8**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	a mixture designed as a useful product		1	AO1 5.8.1.2
03.2	dyes distributed differently between the stationary and mobile phase	allow dyes have different solubilities allow dyes have different forces of attraction for stationary phase allow dyes have different forces of attraction for mobile phase allow dyes have different forces of attraction to the paper allow dyes have different forces of attraction to the solvent ignore density	1	AO1 5.8.1.3
	(so dyes) move up the paper at different speeds / rates	allow (so dyes) move different distances up the paper ignore references to time	1	
03.3	(because chromatogram has) different dots / colours		1	AO2 5.8.1.3
	in a (vertical) column	allow above the (original) spot	1	
03.4	run known dyes and food colouring (as a chromatogram)		1	AO2
	compare distances moved **or** compare R_f values		1	AO2
	(so) can identify those that move the same distance as known dyes **or** (so) can identify those that have the same R_f values as known dyes	allow (so) can identify those that move different distances as unknown dyes **or** allow (so) can identify those that have different R_f values as unknown dyes	1	AO2 5.8.1.3
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	growing plants (on low-grade ore)	allow named plant	1	AO1 5.10.1.4
	plants are burnt (to produce ash)		1	
	(ash dissolved in acid to produce) solution of a copper compound	allow named copper compound	1	
	electrolysis (of solution of a copper compound) **or** displacement (by adding scrap iron to a solution of a copper compound)	allow addition of scrap iron (to a solution of a copper compound)	1	
04.2		an answer of 0.002 **or** 2×10^{-3} (mol) scores **3** marks		AO2 5.3.2.1 5.3.2.5
	M_r $CuSO_4$ = 159.5		1	
	$\frac{0.319}{159.5}$	allow correct use of incorrectly calculated value for M_r	1	
	= 0.002 (mol)	allow 2×10^{-3} (mol)	1	
04.3	both reaction profiles start at the same energy level and end at the same energy level.		1	AO3 5.6.1.4

04.4	the amount of carbon dioxide used to produce the ethanol is the same as the amount of carbon dioxide given off when the ethanol is burned	**alternative approach** there is sufficient carbon dioxide (in the atmosphere) (1) because carbon dioxide is constantly produced from burning fossil fuels (1) if no other mark awarded allow for **1** mark burning ethanol produces carbon dioxide	1 1	AO3 5.9.2.2 5.9.3.1

04.5	meets needs of current generation		**1**	AO1 5.10.1.1
	without compromising needs of future generations	allow so there are enough resources for future generations ignore references to harming / damaging planet / environment	1	

Total			**12**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$Mg + 2H^+ \rightarrow Mg^{2+} + H_2$		1	AO2 5.6.1.2 5.1.1.1
05.2	electron transfer		1	AO2 5.11
05.3	all points correctly plotted	allow a tolerance of ± ½ a small square allow **1** mark for at least 4 points correctly plotted	2	AO2 5.6.1.1
	line of best fit		1	
05.4	(rate) decreases	allow (rate is) fastest at the beginning	1	AO3 5.6.1.1
	(rate decrease) more slowly as time increases (in rate)		1	AO3 5.6.1.1
	(rate) becomes zero at time read from graph	allow reaction stops at time read from graph	1	AO3 5.6.1.1
05.5		Incorrect reference to energy scores **max. 1**		AO2 5.6.1.3
	(rate decreases because) fewer particles (of acid / magnesium) as reaction progresses	allow (rate decreases because) concentration of acid decreases as reaction progresses	1	AO1 5.6.1.3
	(so) less frequent collisions	allow collisions less likely ignore less / fewer collisions	1	AO2 5.6.1.3
	reaction stops due to limiting factor / reagent	allow reaction stops because a reactant is used up	1	5.3.2.4
Total			11	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	glowing splint relights		1 1	AO1 5.8.2.2
06.2	equilibrium shifts to right-hand side (because) concentration of SO_3 decreases	allow towards the products allow in favour of the forward reaction this marking point is dependent on first marking point being awarded allow pressure decreases allow to increase the concentration of SO_3 allow to re-establish equilibrium	1 1	AO3 AO2 5.6.2.5 5.6.2.7
06.3	(M_r CaO =) 56 (M_r $CaSO_3$ =) 120 $\frac{7}{56} \times 120$ = 15(.0 g)	an answer of 15(.0 g) scores **4** marks in all approaches allow a correct calculation using an incorrectly calculated M_r **alternative approach A** (M_r CaO =) 56 (1) $\frac{7}{56}$ = 0.125 (moles) (1) (mass $CaSO_3$ =) 0.125 × 120 (1) = 15(.0 g) (1)	1 1 1 1	AO2 5.3.1.2 5.3.2.1 5.3.2.2

		alternative approach B (M_r CaO =) 56 (1) $\frac{56}{7}$ = 8 (factor) (1) (M_r $CaSO_3$ =) 120 (1) $\frac{120}{8}$ = 15(.0 g) (1) **alternative approach C** (M_r CaO =) 56 (1) (M_r $CaSO_3$ =) 120 (1) $\frac{120}{56}$ = 2.14235714 (factor) (1) 2.14235714 × 7 = 15(.0 g) (1)		

Total			**8**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1		maximum of **3** marks if incorrect reference made to cracking ignore fractional distillation ignore fracking		AO1 5.7.1.2
	heat or vaporise (oil)		1	
	temperature gradient in column	allow column is cooler at the top or allow column is hotter at the bottom	1	
	(vapour) condenses (into fractions)		1	
	depending on boiling point of fraction	allow at different levels	1	
07.2	different amounts of oxygen available	allow complete combustion **and** incomplete / partial combustion	1	AO2 5.9.3.1
07.3	$2\ C_4H_{10} + 9\ O_2 \rightarrow 8\ CO + 10\ H_2O$	allow correct multiples / halves	1	AO2 5.7.1.3 5.9.3.1 5.1.1.1

07.4	short wavelength radiation which enters the atmosphere	because uv / ultra violet radiation which enters the atmosphere	1	AO1.1 5.9.2.1
	is absorbed by materials **and** re-emitted		1	
	as a longer wavelength radiation	as ir / infrared radiation	1	
	(the longer wavelength radiation is trapped by) a greenhouse gas / carbon dioxide / methane which stops radiation escaping (from the atmosphere)	allow so temperature increases	1	

Total			**10**

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1H

Physics Paper 1H

Mark scheme

June 2019

Version: 1.0 Final

I96G8464pIh/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 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

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, level of demand 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 / ; e.g. 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 examples 1 and 2) 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	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, i.e. 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	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	ammeter in series with the resistor, voltmeter in parallel with the resistor		1	AO1/1 6.2.1.4 RP 16 WS 2.4	A
01.2	current decreased	ignore slows down	1	AO1/1 6.2.1.3 RP 16 WS 3.6	E
01.3	reverse the connections to the cell	allow battery for cell allow reverse the cell	1	AO1/2 6.2.1.3 RP 16 WS 2.2	E
01.4	(directly) proportional	do not allow inversely proportional do not allow indirectly proportional	1	AO1/2 6.2.1.3 RP 16 WS 3.5	G
01.5	potential difference = current × resistance **or** V=IR	allow voltage for potential difference allow any correct re-arrangement	1	AO1/1 6.2.1.3 RP 16 WS 3.3	E
01.6	 3.0 = 0.12 × R $R = \frac{3.0}{0.12}$ R = 25 (Ω)	an answer of 25 (Ω) scores **3** marks	 1 1 1	AO2/1 6.2.1.3 RP 16 WS 3.3	E
Total			8		

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td>02.1</td><td>pressure decreased

because molecules have less (kinetic) energy

so fewer collisions (with the wall/container each second)</td><td>

allow less speed/velocity

allow collide with less force

allow less force on the walls</td><td>1

1

1</td><td>AO2.1

6.3.3.1</td><td>E</td></tr>
<tr><td>02.2</td><td>

0.70 = m × 330
or
700 = m × 330 000

$m = \frac{0.70}{330}$
or
$m = \frac{700}{330\,000}$

m = 0.0021 (kg)</td><td>an answer of 0.0021(212121…) scores 3 marks

allow correct rearrangement using converted value(s) of E to J and/or L to J/kg

allow 0.0021(212121…)
allow correct calculation using converted value(s) of E and/or L

3 marks can only be awarded for m = 0.0021(212121…) (kg)</td><td>

1

1

1</td><td>AO2.1

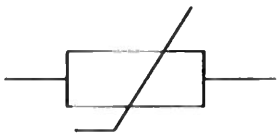
6.3.2.2
6.1.1.3</td><td>E</td></tr>
<tr><td>02.3</td><td>
<table>
<tr><th>Substance</th><th>Solid</th><th>Liquid</th><th>Gas</th></tr>
<tr><td>Oxygen</td><td></td><td>✓</td><td></td></tr>
<tr><td>Nitrogen</td><td></td><td></td><td>✓</td></tr>
<tr><td>Carbon dioxide</td><td>✓</td><td></td><td></td></tr>
</table>
2 correct answers scores 1 mark.
if more than one tick in a row, neither tick can score a mark</td><td></td><td>2</td><td>AO3/2b

6.3.1.1</td><td>E</td></tr>
</table>

02.4	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1.1 6.3.1.2	E
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4		
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2		
	No relevant content	0		
	Indicative content cooling • as the argon cools the particles slow down • particles in a liquid move slower than particles in a gas • particles in a solid move slower than particles in a liquid • as the liquid/solid cools the particles get closer together • as the liquid/solid cools the density increases gas to liquid • particles change from being spread apart to touching each other • particles will (collide with other particles more often and) change direction more often liquid to solid • particles change from a random arrangement to a regular pattern • particles change from moving freely to fixed positions • particles change from moving freely/randomly to vibrating explanation • (internal) energy (of the argon) decreases • (kinetic) energy (of the particles) decreases with temperature • (potential) energy (of the particles) changes with change of state (of the argon) • forces between particles in a gas are negligible/zero • attractive forces act between atoms when they are close to each other • attractive forces between particles are stronger in a solid than in a liquid to access level 3 there must be an explanation of changes to arrangement and movement of particles during either cooling or a change of state			

Total			**14**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	an energy resource that cannot be replenished as it is used	allow an energy resource that will run out ignore cannot be re-used	1	AO1.1 AO1 in isolation 6.1.3	E
03.2	6.9 k(W) = 6900 (W) 6900 = 230 × I $I = \frac{6900}{230}$ I = 30 (A)	an answer of 30 (A) scores **4** marks allow correct substitution of an incorrectly/not converted value for power allow a correct transformation using an incorrectly/not converted value for power allow a correct calculation using an incorrectly/not converted value for power	1 1 1 1	AO2.1 6.2.4.1	E
03.3	direct potential difference is always in the same direction alternating potential difference changes direction	allow direct current is always in the same direction allow alternating current changes direction	1 1	AO1.1 6.2.3.1	E
03.4	lower potential difference across the cable it is more efficient **OR** (lower resistance gives) a greater current (for the same potential difference) (1) so the car battery can charge faster (1)	allow lower power/energy dissipation allow it won't get as hot	1 1	AO1.1 6.1.2.2 6.2.4.1	E
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	less than 20 Ω		1	AO2/1 6.2.2	A
04.2	the resistance of the lamp is added to the total resistance of the resistors in parallel	allow resistors in series add up	1	AO3/1a 6.2.2	E
	the resistors in parallel have a total resistance of less than 10 ohms	allow resistors in parallel have a smaller resistance than the lowest value resistor	1		E
04.3			1	AO1.1 AO1 in isolation 6.2.1.1	E
04.4	the current increased		1	AO1.1 AO1 in isolation 6.2.1.4 6.2.1.3	E
	(because) the resistance (of the thermistor) decreased	allow because the resistance of the circuit decreased	1		

04.5	**the resistor** the potential difference across the resistor becomes 0V because there is a short circuit across the resistor **the lamp** the potential difference across the lamp increases because the current increases	 allow because there is no current in the resistor allow switch has no resistance If neither of the first two marking points awarded, allow **1** mark for p.d. decreases because there is less current in the resistor **or** p.d. decreases because components in parallel have less resistance **or** p.d. decreases because there is an alternative route for the current allow the potential difference across the lamp will be the same as the battery allow because the resistance of the circuit decreases allow because there is less p.d. across the resistor	 1 1	AO2.2 6.2.2 6.2.1.1 6.2.1.3 WS 3.6	E
Total			**10**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	electrons collide with particles in the heating element which increases the (kinetic) energy of the particles (in the heating element)	allow there is a current in the heating element allow internal store of energy increases allow the particles (in the heating element) vibrate more rapidly	1 1	AO1.1 6.2.4.2 6.3.2.1 WS 1.2	E
05.2	the starting temperature of the water	allow the starting temperature of the kettle	1	AO3.3a 6.2.4.2 WS 2.2	E
05.3	(the heating element of) the kettle took time to heat up		1	AO3.1a 6.2.4.2 WS 3.7	E
05.4	the (rate of) energy transfer (per kg of water) to the surroundings decreases as the mass of water increases **or** the efficiency of the kettle increases as the mass of water increases	allow the (rate of) energy transfer (per kg of water) to the surroundings changes as the mass of water changes allow the efficiency of the kettle changes as the mass of water changes	1	AO3.1b 6.2.4.2 WS 3.7	E

05.5		an answer of 4800 (J/kg °C) scores **6** marks a correct answer given to more than 2 s.f. scores **5** marks		AO2.1 6.3.2.2 6.1.1.3 6.1.1.4	E
	E = 2600 × 120	allow a correct substitution of an incorrectly/not converted value of P and/or t.	1	WS 3.3	
	E = 312 000 (J)	this answer only the equation E=Pt must have been used to score subsequent marks.	1		
	312 000 = 0.80 × c × (100-18) **or** 312 000 = 0.80 × c × (82)	allow use of their value of E calculated using E =Pt for this and subsequent steps	1		
	$c = \frac{312\,000}{0.80 \times 82}$		1		
	c = 4 756		1		
	c = 4 800 (J/kg °C) (2 s.f.)	this mark can only be scored for a correct rounding of a value of c calculated using correct equations	1		
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	mass number stays the same, charge stays the same		1	AO1.1 6.4.2.2	A
06.2	gamma radiation is only weakly ionising **or** most gamma radiation will pass through any detector	 allow gamma radiation is very penetrating	1	AO1.1 6.4.2.1	E
06.3	any two from • the radiation spreads out in all directions • only some of the radiation goes into the G-M tube • only some of the radiation passing into the GM tube is detected	allow **2** marks for only some of the radiation passing into the GM tube is detected because gamma is weakly ionising	2	AO1.1 6.4.2.4	E
06.4	to reduce the amount of radiation received because radiation increases the risk of cancer or (genetic) mutation	allow to reduce irradiation (of the teacher) allow causes cancer or (genetic) mutation ignore references to contamination	1 1	AO1.1 6.4.2.1 WS 1.4	E

06.5	a calculation of the product of thickness and count rate a second calculation of the product of thickness and count rate a comparison of the calculated values and a recognition that they are different **OR** A calculation of half the count rate (1) A comparison with the count rate for double that thickness (1) A recognition that the values are different (1)	examples of calculations 0.5 × 110 = 55 1.0 × 60 = 60 1.5 × 33 = 50 2.0 × 18 = 36 2.5 × 10 = 25 e.g. $\frac{110}{2} = 55$ the first two marks may be scored for a count rate divided by 3, 4 or 5 compared with the corresponding count rate for 3, 4 or 5 times the thickness e.g. 55 ≠ 60	1 1 1	AO3.1b 6.4.2.1	E
06.6	$^{140}_{57}La \longrightarrow {}^{0}_{-1}e + {}^{140}_{58}Ce$	allow **1** mark for correct numbers on electron allow **1** mark for correct numbers on Ce	2	AO1.1 AO1 in isolation AO1.2 6.4.2.2	E

06.7		an answer of $\frac{1}{32}$ or equivalent scores **4** marks		AO3.1a 6.4.2.3	E
	half-life = 50 seconds	this may be indicated on Figure 7	1		
	250 seconds difference in age = 5 half lives	allow 100 seconds = 2 half lives **and** 350 seconds = 7 half lives	1		
	ratio = $\left(\frac{1}{2}\right)^5$ **or** ratio = $\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}$	allow this mark if they have halved $1.25(\times 10^{23})$ five times to get $0.0390625(\times 10^{23})$ for example $1.25(\times 10^{23})$ → $0.625(\times 10^{23})$→ $0.3125(\times 10^{23})$→ $0.15625(\times 10^{23})$ → $0.078125(\times 10^{23})$→$0.0390625(\times 10^{23})$	1		
	ratio = $\frac{1}{32}$ **or** ratio = 1:32	allow ratio = 0.031 allow 32:1 **or** 32	1		
06.8	tangent drawn on graph	do not allow a line drawn that crosses the graph line	1	AO2.2 6.4.2.1	E
	use of gradient = $\frac{(\Delta \text{ no. of atoms})}{\Delta \text{ time}}$	values must be taken from their tangent drawn at 20 seconds	1		
	gradient = 5.3 $(\times 10^{21})$ (Bq)	allow gradient = 0.053 $(\times 10^{23})$ (Bq) allow a range between 4.7 $(\times 10^{21})$ (Bq) and 5.9 $(\times 10^{21})$ (Bq)	1		
Total			**18**		

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/2H

Physics Paper 2H

Mark scheme

June 2019

Version: 1.0 Final

196G8464P2H/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 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

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, level of demand 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 <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.

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.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	(4 - 0) + (10 - 7) **or** 4 + 3 **or** 10 - 3 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
01.2	gradient = $\frac{0-2}{24-14}$ (-)0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
01.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
01.4	wave speed = frequency × wavelength	allow $v = f\lambda$ allow any correct re-arrangement	1	AO1 6.6.1.2	E
01.5	300 000 000 = 2 400 000 000 × λ $\lambda = \frac{300\,000\,000}{2\,400\,000\,000}$ λ = 0.125 (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow λ = 0.13 (m)	1 1 1	AO2 6.6.1.2	E
01.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E

Total			**11**		

Question	Answers	Mark	AO / Spec. Ref.	ID
02.1	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.6.1.2	E
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4		
	Level 1: The design/plan 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 • If two quantities have been determined, $v = f \lambda$ can be used to find the third. **Frequency** • use a stopclock • count the number of waves passing a point in a fixed time period • divide the time by the number of waves to determine the time for one wave, T • $f = 1/T$ • read the frequency off the oscillator **Wavelength** • use a camera to freeze the image • use a metre rule to measure the distance between two wavefronts • count the number of waves between the wavefronts • divide distance by the number of waves to determine λ **Velocity** • determine a mean value of frequency • determine a mean value of wavelength • measure the time it takes one wavefront to travel the length of the screen • measure the length of the screen • speed = distance / time to access Level 3 there must be a description of how frequency, wavelength and velocity can be determined			

02.2	(the duck) moves perpendicular to the direction of wave travel	duck moves up and down is insufficient	1	AO2 6.6.1.1	E
02.3	mean maximum height = 511 **and** mean minimum height = 500	an answer of 5.5 gains **3** (mm) marks	1	AO2 6.6.1.2	E
	511 – 500 = 11	allow a calculated difference from incorrect means	1		
	11 / 2 = 5.5 (mm)	allow their difference divided by 2 any correct method of determining the mean amplitude can score **3** marks	1		
Total			**10**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	distance speed		1 1	AO1 6.5.4.1.3	A
03.2	(both have magnitude) only a vector has direction	allow scalar does not have a direction	1	AO1 6.5.1.1	E
03.3	any **two** from: • mass • velocity • friction • power of the motor	 allow weight allow speed or direction allow air resistance or drag	2	AO1 6.5.5.2	E

03.4	total momentum is zero after the collision (because the bumper cars are stationary) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) so the total momentum of the bumper cars was zero before the collision and momentum is conserved **OR** total momentum is zero after the collision (because the bumper cars are stationary) (1) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) (1) both cars exert an equal and opposite force on each other (for equal periods of time) (1) so the cars accelerate (in opposite directions) (1)		1 1 1 1	AO3 5.5.5.2	E
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1			1	AO1 6.7.2.2	A
04.2	reverse the direction of the current reverse the direction of the magnetic field		1 1	AO1 6.7.2.2	E
04.3	 B = 0.360 (T) 0.072 = 0.360 × I × 0.050 $I = \frac{0.072}{(0.360 \times 0.050)}$ I = 4.0 (A)	an answer of 4.0 (A) scores **4** marks allow a correct substitution using an incorrectly / not converted value of B allow a correct rearrangement using an incorrectly / not converted value of B allow a correct calculation using an incorrectly / not converted value of B	 1 1 1 1	AO2 6.7.2.2	E

04.4	there is a magnetic field (due to the permanent magnet) **and** current in a wire causes a magnetic field		1	AO1 6.7.2.3	E
	current is in opposite directions in each side of the coil		1		
	so forces act in opposite directions on either side of the coil		1		
	(the split ring ensures that) the current in the left / right side of the coil is always in the same direction	allow (the split ring ensures that) the force in the left / right side of the coil is always in the same direction allow the current reverses each half rotation	1		
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	force ∝ extension		1	AO1 6.5.3	A
05.2		an answer of 60 (kg) scores **4** marks		AO2 6.5.1.3	E
	$F = 0.49 \times 1\,200$		1		
	or				
	$F = 588$ (N)				
	$588 = m \times 9.8$	allow a correct substitution using an incorrectly calculated value of F	1		
	$m = \frac{588}{9.8}$	allow a correct rearrangement using an incorrectly calculated value of F	1		
	$m = 60$ (kg)	allow a correct calculation using an incorrectly calculated value of F	1		
	OR				
	0.49 = mean mass per spring × 9.8 (1)				
	mean mass per spring $= \frac{0.49}{9.8}$ (1)				
	mean mass per spring = 0.050 (1)				
	$m = 0.050 \times 1200 = 60$ (kg) (1)				
05.3		an answer of 140 scores **3** calculation marks		3 x AO2 1 x AO1 6.5.3	E
	$0.49 = k \times 3.5 \times 10^{-3}$		1		
	$k = \frac{0.49}{3.5 \times 10^{-3}}$		1		
	140		1		
	N/m		1		

05.4	springs with a low spring constant because they can compress by a larger amount (for a given force)	 allow they can compress by the same amount for a smaller force allow low stiffness	1 1	AO3 6.5.3	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	thrust decreases	allow air resistance or drag increases ignore air resistance decreases as speed decreases	1	1xAO1 1xAO2 2xAO3 6.5.4.2.1	E
	so there is a resultant force in opposite direction	allow so air resistance or drag is greater than thrust	1		
	lift must decrease (because weight stays the same)		1		
	so there is a resultant downwards force	allow so weight is greater than lift the last two marking points cannot be awarded if there is a reference to the weight increasing	1		
06.2		an answer of 300 000 (kg) scores **5** marks		AO2 6.5.4.1.5 6.5.4.2.2	E
	$a = \frac{(10-80)}{28}$	allow $a = \frac{(80-10)}{28}$	1		
	$a = (-)2.5\ (m/s^2)$	a valid equation must have been used to calculate a to score subsequent marks	1		
	$(-)\ 750\ 000 = m \times (-)2.5$	allow a correct substitution using their calculated value of a	1		
	$m = \frac{(-)750\ 000}{(-)2.5}$	allow a correct rearrangement using their calculated value of a	1		
	$m = 300\ 000$ (kg)	allow a correct calculation using their calculated value of a	1		
Total			9		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
7.1	speed / velocity in the glass is lower	speed / velocity changes is insufficient allow the refractive index of glass is higher than that of air allow glass has a higher optical density than air	1	AO1 6.6.2.2	E
	so the edge of the wave(front) entering the glass slows down		1		
	but the part of the wave(front) in the air continues at the higher speed / velocity (causing a change in direction)		1		
7.2	correct ray in the prism bent towards the normal		1	AO1 6.2.2.2	E
	second normal at 90° at the point the ray emerges		1		
	correct emergent ray bent away from the normal	this mark can be awarded without a normal line drawn	1		
7.3	violet has the shortest wavelength (400 nm)		1	AO3 6.2.2.2	E
	violet light travels the slowest in water		1		
	violet light undergoes the greatest change in speed (and direction)		1		
Total			9		