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GCSE
COMBINED SCIENCE: TRILOGY
8464/B/1F

Biology Paper 1F

Mark scheme

June 2019

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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.

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1. General

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- the marks available for each part of the question
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- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
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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.

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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.

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

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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	oxygen	name takes precedence allow O_2 ignore O^2 / O / O2	1	AO1 4.4.1.1 4.4.1.2
01.2	(use) a lamp / light (source) (and) move away and / or towards pondweed	 allow use different power ratings **or** use a dimmer switch allow change the opacity of the beaker for **2** marks	1 1	AO1 4.4.1.2
01.3	count the number of bubbles in a given time	allow measure the volume of gas collected allow for **2** marks measure time taken to collect a specific number of bubbles	1 1	AO1 4.4.1.2 AO2/2 4-5 RPA5 WS2.3
01.4	34 (arbitrary units)	allow a value in the range 33.5 – 34.5 (arbitrary units)	1	AO2 4.4.1.2
01.5	200 lumens		1	AO3 4.4.1.2
01.6	any **one** from: • temperature • carbon dioxide (concentration) • amount of chlorophyll	ignore light (intensity) ignore heat ignore oxygen allow light colour / wavelength allow water ignore pH	1	AO1 4.4.1.2
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	diffusion		1	AO1/1 4.1.3.1
02.2	(SA of one face = 2 × 2) =4 (Total SA = 4 × 6) = 24 (Volume = 2 × 2 × 2) =8 (SA:volume ratio =) 24:8 **or** 3:1	ignore units allow correct calculation using their calculated SA of 1 face x 6 ratio must be consistent with their figures	1 1 1 1	AO2 4.1.3.1
02.3	red (blood) cell(s)	allow erythrocyte(s)	1	AO1 4.2.2.3
02.4	carbon dioxide	name takes precedence allow CO_2 ignore CO^2 / CO2 ignore water (vapour)	1	AO2 4.2.2.2 4.2.2.3 4.4.2.1
02.5	any **two** from: • wall of alveolus (only) one cell thick • wall of capillary (only) one cell thick • cells of alveolus / capillary wall are flattened / thin • good blood supply • (well) ventilated	ignore large surface area ignore many alveoli ignore moist lining if none of these mentioned allow **1** mark for idea of short distance between (air in) alveolus and blood	2	AO1 4.1.3.1 4.2.2.2
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	nucleus cell tissue organ	all in correct order allow **1** mark for each consecutive pair of structures	3	AO2 4.1.1.1 4.1.1.2 4.2.1
03.2	any **one** from: • bladder • brain • heart • (small **or** large) intestine • kidney • liver • lung • pancreas • skin • stomach	allow any organ found in an animal ignore blood	1	AO1 4.2.1
03.3	phloem		1	AO1 4.2.3.1
03.4	large surface area (so) it can absorb (a lot of) water / minerals / (mineral) ions	allow long allow **1** mark for (many) mitochondria allow for **2** marks (many) mitochondria for active transport	1 1	AO1 4.1.1.3 4.2.3.2
03.5	any **one** from: • biggest / widest field of view • easier to focus		1	AO3 4.1.1.2
03.6	to avoid damage to lens / slide	ignore references to focussing	1	AO3 4.1.1.2

03.7	(×)5		1	AO2 4.1.1.2
03.8	any **one** from: (root hair cells) • are not exposed to light • do not photosynthesise	allow are underground	1	AO2 4.1.1.2 4.1.1.3 4.2.3.2 4.4.1.1
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	transpiration		1	AO1 4.2.3.2
04.2	guard cell		1	AO1 4.2.3.1 4.2.3.2
04.3	(real length of cell =) $\frac{25}{800}$ 0.03125 31.25 (µm)	an answer of 31.25 (µm) scores 3 marks allow 2 marks for $\frac{25\ 000}{800}$ allow 31 or 31.3 allow correct unit conversion of incorrect answer	1 1 1	AO2 4.1.1.5
04.4	temperature of the room		1	AO2 4.2.3.2
04.5	any water / mass lost was from the leaves / plant	allow so no water was lost (directly) from the soil	1	AO3 4.2.3.2
04.6	0.1 g		1	AO2 4.2.3.2
04.7 View with Table 1	511.2 (g)	answer line takes precedence	1	AO2 4.2.3.2
04.8	the higher the temperature the more water lost	cause and effect must be the correct way round	1	AO3 4.2.3.2

04.9	any **two** from: • humidity • air movement • light (intensity) • water availability • rate of photosynthesis	 allow wind allow time of day allow number / size of leaves / allow number of stomata on plant ignore type of plant ignore time plant left for	2	AO1 4.2.3.2
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	840 000 – 440 000 400 000	an answer of 400 000 scores 2 marks allow tolerance of +/- half a small square allow 840 – 440 = 400	1 1	AO2 4.3.1.5
05.2	2005 to 2010		1	AO3 4.3.1.5
05.3	any **one** from: • data not collected (for 2002) • only shows a trend line • not all deaths reported / recorded	allow no data plotted for 2002	1	AO3 4.3.1.5
05.4	protist		1	AO1 4.3.1.5
05.5	makes people immune **or** they do not develop the disease (so) fewer (infected) people to pass pathogen on (to mosquitos)	allow ecf from 05.4 allow correct description of immunity allow idea of disrupting life cycle of parasite	1 1	AO1 AO2 4.3.1.5
05.6	any **one** from: • (mosquito) nets / long clothing • prevent mosquitos breeding • insecticides • insect repellents • anti-malarial tablets • kill mosquitos	allow specific method e.g. drain swamps, release GM mosquitos allow DEET / mosquito band allow names e.g. Larium / Malarone allow antibiotics	1	AO1 4.3.1.5 4.3.1.7
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	**B**		1	AO2 4.2.2.2
06.2	right atrium		1	AO1 4.2.2.2
06.3	foxgloves		1	AO1 4.3.1.9
06.4		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.
06.5	**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.
07.1	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
07.2	(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	
07.3	(Starch): Iodine (solution)	all allow phonetic spelling ignore iodide unqualified	1	AO1 4.2.2.1
	(Sugar): Benedict's (solution)		1	
07.4	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
07.5	(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
07.6	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
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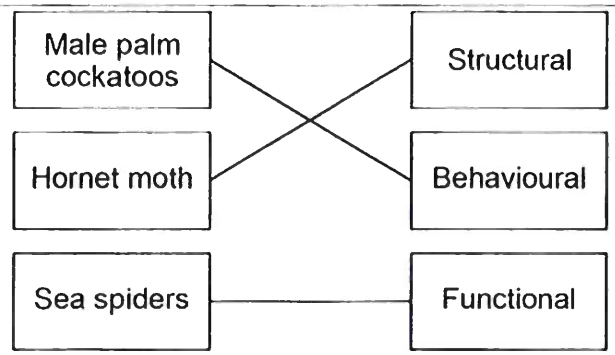
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	homeostasis		1	AO1 4.5.1
01.2	by hormones by nerve impulses		1 1	AO1 4.5.1 4.5.3.1
01.3	any **one** from: • temperature • (blood) glucose / sugar (concentration)	ignore water allow pH / ions / salts allow oxygen **or** carbon dioxide	1	AO1 4.5.1
01.4	 2000 – 1400 600 (cm^3)	an answer of 600 (cm^3) scores **2** marks allow 800 – 200 if no mark awarded allow (600 + 1000 + 400 =) 2000 for **1** mark	 1 1	AO2 4.5.1
01.5	more sweat (on hot day) cools the body		1 1	AO3 AO2 4.5.1
01.6	 $\frac{750}{3000} \times 100$ 25 (%)	an answer of 25 (%) scores **2** marks	 1 1	AO2 4.5.1
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	description of any correct method to achieve randomness e.g. random number generator	ignore throwing quadrat / frame	1	AO3 4.7.2.1 10.2.7
02.2	frame / square	allow rectangle ignore internal squares / grid	1	AO1 4.7.2.1 10.2.7
02.3 mark with **2.4** and **2.5**	9(.0)		1	AO2 4.7.2.1 10.2.7
02.4 mark with **2.3** and **2.5**	15 000 (m^2)		1	AO2 4.7.2.1 10.2.7
02.5 mark with **2.3** and **2.4**	9.0 × 15 000 135 000	answer must be consistent with answers in questions **02.3** and **02.4**	1 1	AO2 4.7.2.1 10.2.7
02.6	any **two** from: • herbivores / animals • competing (with other plants) • (human) trampling / playing • (plant) disease / pathogen • mowing	allow being eaten	2	AO1 4.7.1.2 4.7.1.3
02.7	less light / water for photosynthesis **or** fewer ions / nitrates / minerals (1) so fewer proteins (1)	ignore Sun allow fewer magnesium (ions) allow less nutrients idea of fewer only needed once to gain both marks allow fewer ions / nitrates / minerals / nutrients so less growth for **2** marks	1 1	AO3 AO2 4.7.1.3 4.7.1.2
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	 additional lines from a box on the left negates the mark for that box 3 lines correct for **2** marks 1 **or** 2 lines correct for **1** mark		2	AO2 4.7.1.4
03.2	brightly coloured flowers large quantities of pollen		1 1	AO2 4.6.2.2 4.7.1.1 4.7.1.4
03.3	biodiversity		1	AO1 4.7.3.1
03.4	any **one** from: • to grow crops • to raise cows • to build	allow farming / biofuels or named crop allow houses **or** building materials allow mining allow paper / fuel	1	AO1 4.7.3.4
03.5	any **one** from: • (new) disease • (new) herbivore • climate change **or** global warming **or** ice age • volcano / earthquake / tsunami / meteor • lack of pollinators • (new) competitor	ignore (new) predator allow drought / flooding allow plant collectors	1	AO1 4.6.3.3
03.6	DNA	allow deoxyribonucleic acid	1	AO1 4.6.1.3
03.7	genome		1	AO1 4.6.1.3
Total			9	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	mutation		1	AO1 4.6.2.1
04.2	any **three** from: • choose the cats with the blue tail • breed these cats together • choose offspring with blue tails and breed these together • repeat until all cats have blue tails	allow choose the cats with the desired characteristic allow breed for several generations	3	AO1 AO2 4.6.2.3
04.3	they are rare / beautiful / expensive	allow description e.g. the breeder will make (more) profit	1	AO3 4.6.2.3
04.4	they are produced by inbreeding		1	AO2 4.6.2.3
04.5	(male cat) XY **or** YX (female cat) XX	both required for the mark allow lower case letters	1	AO1 4.6.1.6
04.6	<table><tr><td></td><td>(X)</td><td>(X)</td></tr><tr><td>(X)</td><td>XX</td><td>XX</td></tr><tr><td>(Y)</td><td>XY</td><td>XY</td></tr></table>	allow 2 **or** 3 derivation squares correct for **1** mark	2	AO2 4.6.1.6
04.7	random (if X or Y goes into each sperm)	allow it is a chance event allow it is only a probability	1	AO3 4.6.1.6
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	secondary consumer		1	AO2 4.7.2.1
05.2	increase		1	AO3 4.7.1.1
05.3 view with **05.2**	(because) the blackflies are not being eaten	allow idea of other predators (of blackflies) if 'stay the same' selected in question **5.2**	1	AO3 4.7.1.1
05.4	biomass decreases as you go up / along the food chain	allow converse	1	AO3 4.7.2.1
05.5	label biomass in g(rams) three bars plotted correctly	 allow ± half small square allow **1** mark for 2 bars correct ignore width and spacing of bars	1 2	AO2 4.7.2.1
05.6	organisms / species are always being added / removed so population sizes not (fairly) constant	allow example of an environmental change e.g. gardener did not water for a month	1 1	AO2 4.7.1.1
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	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
06.2	193.5		1	AO2 4.5.2
06.3	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
06.4	0.217 (s)	allow any value in the range 0.2150 to 0.2180	1	AO2 4.5.2
06.5	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
06.6	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.
06.7	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 ≤ C ≤ 0.18 ignore units	1	AO2 4.5.2
06.8	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
06.9	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.
07.1	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
07.2	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
07.3	**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**	

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/C/1F

Chemistry Paper 1F

Mark scheme

June 2019

Version: 1.0 Final

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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.

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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

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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.

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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.

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

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

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(.....) 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.

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

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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.

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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.

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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.

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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.

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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	sports injury pack		1	AO1 5.5.1.1
01.2	B		1	AO1 5.5.1.2
01.3	C		1	AO1 5.5.1.2
01.4	lower than		1	AO1 5.5.1.2
01.5	thermometer		1	AO1 5.5.1.2
01.6	27.4 (°C) (27.4–14.3 =) 13.1 (°C)	allow values in the range 27.2–27.5 (°C) allow correct subtraction of incorrect temperature reading	1 1	AO2 5.5.1.1
Total			7	

Question	Answers	Extra information	Mark	AO / Spec.
02.1	hydrochloric acid		1	AO1 5.4.2.3
02.2	(black) solid remains (after stirring)	allow copper oxide remains allow no more copper oxide reacts	1	AO1 5.4.2.3
02.3	first stage **B** second stage **A** third stage **C** fourth stage **D**	all 4 correct for **2** marks allow **1** mark if either first stage or fourth stage is correct	2	AO1 5.4.2.3
02.4	(negative electrode) copper (positive electrode) chlorine	allow Cu allow Cl_2 / Cl do **not** accept chloride or Cl^- if no other mark awarded allow **1** mark if elements are reversed	1 1	AO2 5.4.3.2

02.5	a reading of an increase in mass correct linked reading of the increase in time correct evaluation of gradient	e.g. 4 (mg) in 10 (mins) scores 2 marks e.g. ($\frac{4}{10}$ =) 0.4 (mg per min) allow correct calculation of gradient from incorrectly determined values for mass and/or time	1 1 1	AO2 5.4.3.4

02.6	cryolite oxide	this order only	1 1	AO1 5.4.3.3

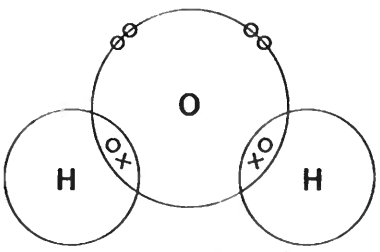
Total			**11**

Question	Answers	Extra information	Mark	AO / Spec.
03.1	atomic weight of element		1	AO1 5.1.2.2
03.2	gaps	allow spaces / blanks do **not** accept undiscovered elements	1	AO1 5.1.2.2
03.3	noble gases		1	AO1 5.1.2.4
03.4	18 22	this order only	1 1	AO2 5.1.1.5
03.5	isotopes		1	AO1 5.1.1.5
03.6	2,8,8		1	AO2 5.1.1.5
03.7	stable arrangement (of electrons)	allow full outer shell allow eight electrons in the outer shell allow does not need to gain or lose electrons	1	AO1 5.1.2.4
Total			8	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	2 Na + Cl_2 → 2 NaCl	allow multiples	1	AO1 5.1.2.2
04.2	7.1 (g)		1	AO2 5.3.1.1
04.3	silver green yellow white	this order only allow yellow allow white	1 1 1 1	AO1 5.1.2.5
04.4	Na^+ Cl^-	if no other mark awarded allow 1 mark for +(1) charge for sodium ion and –(1) charge for chloride ion	1 1	AO1 5.2.1.2
04.5	an electron		1	AO2 5.1.2.5

04.6		allow converse for sodium mark independently		AO2 5.1.2.1 & 5.1.2.5
	potassium (atom) is larger		1	
	potassium (atom) has more energy levels (of electrons) **or** potassium (atom) has more shells (of electrons)	do **not** accept more outer shells	1	

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(g)	allow g ignore formulae	1	AO1 5.2.2.2
05.2	40 (%)		1	AO2 5.1.1.1
05.3		an answer of 3.94 (g) scores **3** marks		AO2 5.3.1.3
	$\frac{3.76 + 3.98 + 4.09}{3}$ **or** $\frac{11.83}{3}$		1	
	= 3.943(333333333333333)		1	
	= 3.94 (g)	allow a correctly written answer to 3 significant figures from an incorrectly calculated mean	1	
05.4		allow combination of circles, dots, crosses or $e^{(-)}$		AO1 5.2.1.4
	one shared pair in each overlap	do **not** accept extra electron(s) on outer shell of hydrogen	1	
	4 non-bonding electrons in outer shell of oxygen	ignore any inner shell electrons	1	
		 diagram scores 2 marks		

05.5	covalent		1	AO1 5.2.2.1 5.2.2.4

05.6	higher (than) stronger (than between oxygen molecules)		1 1	AO2 5.2.2.4

Total			**10**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	Ca Mg Zn Cu		1	AO3 5.4.1.2
06.2	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
06.3	(type of) metal / element		1	AO2 5.4.1.2

06.4		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	

06.5		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.
07.1	(aq)	allow aq ignore aqueous ignore formulae	1	AO1 5.2.2.2
07.2	HNO_3		1	AO1 5.1.1.1 5.4.2.2
07.3	red purple **or** blue	allow orange or yellow do **not** accept green allow shades of purple e.g. violet	1 1	AO1 5.4.2.4
07.4	D		1	AO3 5.4.2.4
07.5	 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
07.6	**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 e.g. test tube • use insulation • add water • measure the initial water temperature (with a thermometer) • add stated mass e.g. 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**

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8464/C/2F

Chemistry Paper 2F

Mark scheme

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[1 mark]

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[2 marks]

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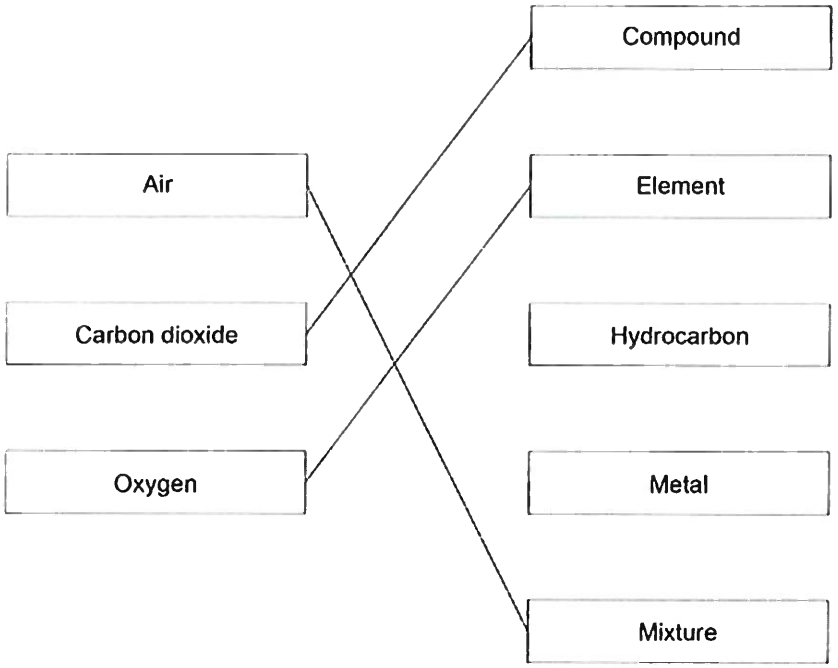
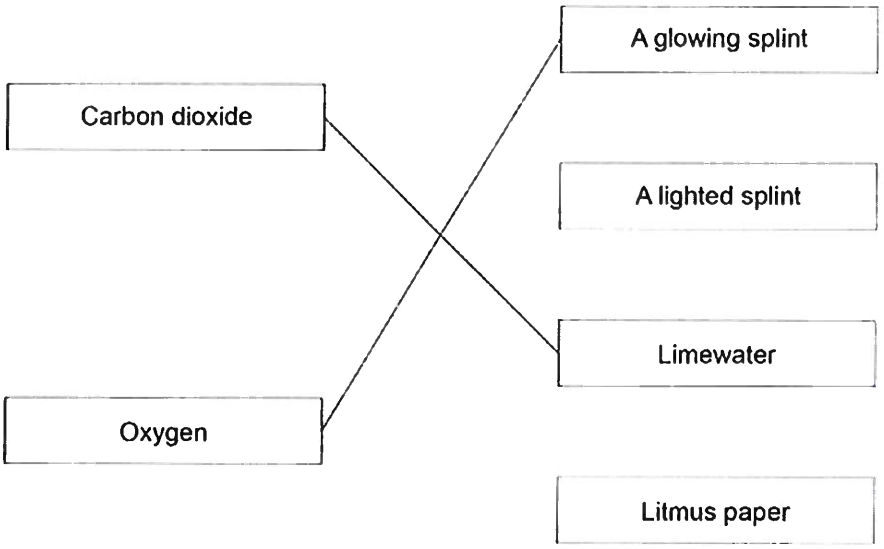
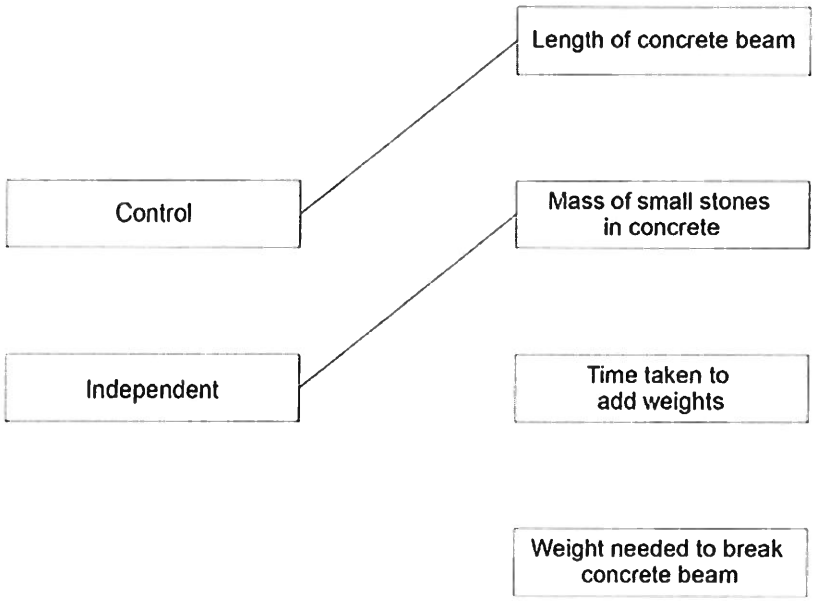
An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	 If more than one line is drawn from any one substance and not crossed out, no mark is given for that substance. The other marks can be awarded.		1 1 1	AO2.1 5.1.1.2 5.8.1.1 5.1.1.1
01.2	 If more than one line is drawn from any one gas and not crossed out, no mark is awarded for that gas. The other mark can be awarded.		1 1	AO1.1 5.8.2.2 5.8.2.3
01.3	dissolved in oceans photosynthesis		1 1	AO1 5.9.1.2 5.9.1.4

01.4	⇌	ignore any other words, formulae or symbols	1	AO1.1 5.6.2.1
01.5	endothermic (reaction)	spelling must be correct do **not** accept exothermic	1	AO1.1 5.6.2.2
01.6	rate (of reaction)	allow speed or velocity do **not** accept any other response	1	AO1 5.6.2.3
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	formulation		1	AO1 5.8.1.2
02.2	it has a giant structure it has strong covalent bonds		1 1	AO1 5.2.2.6 5.2.1.4
02.3			1 1	AO3 AO2 5.8.1.2
02.4	all points correctly plotted line of best fit	allow a tolerance of ± ½ a small square allow 1 mark for 3 points correctly plotted allow reasonable attempt at line of best fit using incorrectly plotted points	2 1	AO2.2 5.8.1.2

02.5	1500 (g) highest point on graph	allow range from 1400 (g) to 1600 (g) allow ecf from graph drawn in **Figure 2** MP2 dependent on MP1 allow highest / largest / greatest / most weight needed to break concrete. ignore numbers quoted from graph ignore strongest	1 1	AO3 5.8.1.2

02.6	take more measurements	allow indication of a greater range of values or allow indication of measurements at smaller intervals ignore repeat the investigation	1	AO3 5.8.1.2

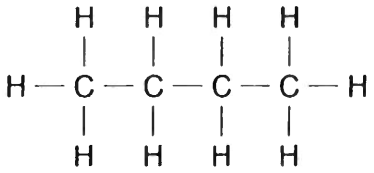
Total			**11**

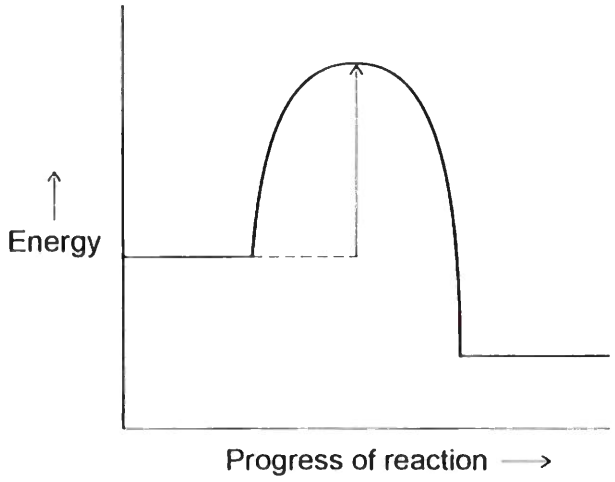
Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	2	allow multiples of whole equation	1	AO2 5.1.1.1 5.3.1.1 5.6.1.1 10.2.11
03.2	50 cm^3 measuring cylinder		1	AO3 5.6.1.1 10.2.11
03.3	headings: time **and** volume (of gas) units: s **and** cm^3 time values correct (and match units) volume values match time values	allow in either column allow any units of time and volume placed in relevant column ignore incorrect representation of time values if no other marks awarded allow **1** mark for time with correct units or volume with correct units	1 1 1 1	AO2 5.6.1.1 10.2.11
03.4	any **one** from: • concentration of the acid was lower (than expected) • some (gas) escaped • impure magnesium • temperature lower (than expected)	answers must relate to figure 4 ignore answers relating to amount or surface area or time	1	AO3 5.6.1.2 10.2.11

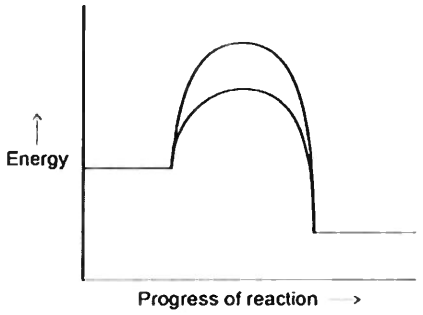
03.5	any **two** from: • length of magnesium or surface area of magnesium • volume of acid • temperature (of acid)	 allow mass of magnesium allow same form of magnesium allow same size of magnesium ignore concentration of hydrochloric acid ignore room temperature	2	AO2 5.6.1.2 10.2.11

03.6	increased particles frequently	allow went up allow got bigger allow ions or molecules ignore concentration allow often	1 1 1	AO1 5.6.1.2 5.6.1.3 10.2.11

Total			**12**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any **two** from: • high temperature • catalyst • steam • high pressure • low oxygen atmosphere	 ignore heat / hot allow a temperature between 400 °C and 900 °C allow aluminium oxide, alumina, porous pot, zeolites	2	AO1 5.7.1.4
04.2		all bonds and atoms must be present	1	AO1 5.7.1.1
04.3	 carbon dioxide water	in either order allow CO_2 allow H_2O	 1 1	AO1.1 5.7.1.3
04.4	bromine (water) turns (from orange / brown / yellow to) colourless	do **not** accept bromide MP2 is dependent on MP1 allow decolourises ignore clear	1 1	AO1 5.7.1.4
04.5	sustainable development		1	AO1 5.10.1.1
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	3.50 %		1	AO2 5.10.1.1
05.2	correct bar to 2.1 (%)	allow a tolerance of ± ½ a small square	1	AO2 5.10.1.1
05.3	(617 + 258) – 648 **or** 875 – 648 = 227 (kg)	an answer of 227 (kg) scores **2** marks	1 1	AO2 5.3.1.1
05.4	 ignore arrow heads		1	AO1 5.6.1.4

05.5	(curve) starts and ends at same energy levels as existing curve maximum of curve below maximum of existing curve	ignore references to activation energy only award if MP1 correct an answer of  scores **2** marks	1 1	AO1 5.6.1.4
05.6	enzymes		1	AO1 5.6.1.4
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	potable		1	AO1 5.10.1.2
06.2		allow boils at 100°C for **2** marks		AO2 5.8.1.1
	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		
06.3	**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 5.10.1.2 10.2.13
	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.			

06.4		an answer of 0.031 (g) scores **4** marks		AO2 5.3.2.5 10.2.13
	(conversion of cm^3 to dm^3) (250 cm^3 =) $\frac{250}{1000}$ or 0.25 (dm^3)		1	
	(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	

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

Total			**13**

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

07.2	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	
	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**

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1F

Physics Paper 1F

Mark scheme

June 2019

Version: 1.0 Final

I96G8464pIf/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

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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	LED		1	AO1.1 AO1 in isolation 6.2.1.1	A
01.2	the same as		1	AO1.1 6.2.1.2	G
01.3		an answer of 600 (thousand) or 600 000 scores **2** marks		AO2.2 6.2.1.2 WS 3.2	G
		two correct readings from the graph scores **1** mark	1		
	1500 – 900	allow a range of 1480 to 1520 and a range of 880 to 920	1		
	600 (thousand)	allow an answer in the range of 560 (thousand) to 640 (thousand) consistent with their allowed readings			
01.4	repeat the experiment using exactly the same method		1	AO3.3a 6.2.1.2	A
01.5		an answer of 0.016 (W) scores **2** marks		AO2.1	E
	power = 0.80 × 0.020		1	6.2.4.1 WS 3.3	
	power = 0.016 (W)		1		
01.6	power = (current)^2 × resistance		1	AO1.1 AO1 in isolation 6.2.4.1	A
01.7	temperature increases		1	AO1.1 6.1.1.1	E

01.8	Q = 0.020 × 180 Q = 3.6 (C)	an answer of 3.6 (C) scores **2** marks	1 1	AO2.1 6.2.1.2 WS 3.3	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	the brightness of the lamp		1	AO3/3a 6.1.3c WS 2.2	A
02.2	zero error		1	AO3/3b 6.1.3c WS 3.7	A
02.3	C		1	AO3/1b 6.1.3c WS 3.7	A
02.4	10.0	allow 10	1	AO3/1a 6.1.3c WS 3.5	G
02.5	$\frac{0.96}{8.0}$ = 0.12	an answer of 0.12 or 12% scores **2** marks allow 12%	 1 1	AO2.1 6.1.2.2	E
02.6	replenished		1	AO1.1 in isolation 6.1.3b	G
02.7	E = 490 × 31 E = 15 190 E = 15 000 (J)	an answer of 15 000 (J) scores **3** marks allow 15 200 if correct substitution is seen allow an answer to 2 s.f. consistent with their calculated value of E using E=QV	 1 1 1	AO2.1 6.2.4.2	E

02.8	less fossil fuel is burned		1	AO3.2a 6.1.3e	A
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	they changed direction	allow deflected/reflected/repelled	1	AO 1/1 6.4.1.3	E
03.2	diameter = $\frac{0.18}{6000}$ = 0.000 030 (nm)	an answer of 0.000 03 (nm) or 3.0×10^{-5} (nm) scores **2** marks allow 3.0×10^{-5} (nm)	1 1	AO2/2 6.4.1.1	E
03.3	A		1	AO 1/1 6.4.1.1	A
03.4	1100 (°C)		1	AO3/2b 6.3.2.3	G
03.5	8 (minutes)	allow 12 (minutes)	1	AO3/2b 6.3.2.3	G
03.6	the rate of change of temperature of the gold		1	AO3/1a 6.1.1.3, 6.3.2.2	A
Total			7		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	$^{234}_{91}Pa$		1	AO1/1 6.4.1.2	A
04.2	points correctly plotted to within 1 mm a curved line of best fit passing within 1 mm of all 5 points	 ignore any line beyond 200 seconds	1 1	AO2.2 6.4.2.3 WS 3.2	E
04.3	70 (s)	allow an answer between 65 and 75 (s) allow an answer consistent with their drawn line	1	AO2/2 6.4.2.3 WS 3.5	E
04.4	70 (s)	allow an answer between 65 and 75 (s) allow their answer to question **04.3**	1	AO3/2b 6.4.2.3	E
04.5	beta		1	AO1.1 6.4.2.1	A
04.6	articles in scientific journals are peer reviewed	allow articles in scientific journals are based on evidence/data allow newspaper articles may be oversimplified/inaccurate/biased	1	AO1.1 6.4.2.4 WS 1.6	E
Total			**7**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	to stop the metal case of the toaster becoming live if a fault occurs		1	AO1.1 6.2.3.2	A
05.2	yellow brown blue		1 1 1	AO1.1 AO1 in isolation 6.2.3.2	G
05.3	$E = 850 \times 120$ $E = 102\,000$ (J)	an answer of 102 000 (J) scores **2** marks	1 1	AO2.1 6.2.4.2 6.1.1.4 WS 3.3	E
05.4	elastic potential kinetic		1 1	AO1.1 6.1.1.1	G
05.5	gravitational potential energy = mass × gravitational field strength × height or $E_p = m\ g\ h$	allow gpe allow any correct re-arrangement	1	AO1.1 AO1 in isolation 6.1.1.2	E
05.6	$0.049 = 0.050 \times 9.8 \times h$ $h = \frac{0.049}{0.050 \times 9.8}$ $h = 0.10$ (m)	an answer of 0.10 (m) scores **3** marks	1 1 1	AO2.1 6.1.1.2 WS 3.3	E
Total			**12**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	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
06.2	current decreased	ignore slows down	1	AO1/1 6.2.1.3 RP 16 WS 3.6	E
06.3	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
06.4	(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
06.5	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
06.6	 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>07.1</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>07.2</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>07.3</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 can score a mark</td><td></td><td>2</td><td>AO3/2b

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

07.4	**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**	

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/2F

Physics Paper 2F

Mark scheme

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Version: 1.0 Final

1 9 6 G 8 4 6 4 P 2 F / 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

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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	electrostatic gravitational		1 1	AO1 6.5.1.2	A
01.2	D		1	AO2 6.7.1.1	A
01.3	bring two unlike poles close together bring two like poles close together	allow north and south poles allow opposite poles allow two north / south poles allow N for north and S for south	1 1	AO1 6.7.1.1	E
01.4	induced magnetism		1	AO1 6.7.1.1	A
01.5	all 4 poles correctly labelled north and south	allow N for north and S for south allow 1 mark for 2 or 3 correctly labelled poles	2	AO3 6.7.1.1	E
Total			**8**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	it is the same size as the downward force		1	AO2 6.5.4.3.2	A
02.2	weight is a vector		1	AO1 6.5.1.1	A
02.3	centre of mass		1	AO2 6.5.1.3	A
02.4	W = 45 × 9.8 W = 441 (N)	an answer of 441 (N) scores **2** marks allow 440 (N)	1 1	AO2 6.5.1.3	E
02.5	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.		3–4	AO1 6.1.1.1	E
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.		1–2		
	No relevant content.		0		
	Indicative content • as height changes gravitational potential energy changes • gravitational potential energy decreases when moving to the lower bar • as speed changes kinetic energy changes • kinetic energy increases when moving to the lower bar • transfer from gravitational potential energy to kinetic energy as height decreases • the sum of the kinetic energy and gravitational potential energy is constant				
02.6	reduces the force exerted the risk of injury to gymnast is reduced	ignore impact allow so the gymnast does not get injured	1 1	AO3 6.5.4.2.2	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	there is a resultant force on the ball		1	AO1 6.5.4.2.1	A
03.2	s = 11 × 0.25 s = 2.75 (m)	an answer of 2.75 scores **2** marks allow 2.8 (m)	1 1	AO2 6.5.4.1.2	E
03.3	$\frac{75}{100}$ × 30.0 22.5 (cm) (25.1 > 22.5) therefore the ball can be used OR $\frac{25.1}{30.0}$ ×100 (1) 84 % (1) (84% > 75%) therefore the ball can be used (1)	allow any correct method of determining 75% of 30 this mark can only be awarded if a supporting calculation has been done allow any correct supported conclusion allow a conclusion consistent with an incorrect percentage calculation this mark can only be awarded if a supporting calculation has been done allow any correct supported conclusion allow a conclusion consistent with an incorrect percentage calculation	1 1 1	AO3 6.5.4.1.2	E
03.4	the smaller ball has a smaller area (so) air resistance is less (on the smaller ball)		1 1	AO2 6.5.4.2.1	E
Total			8		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	(thinking distance) will double any correct pair of points from graph eg (200,6) and (400,12)	 allow graph shows direct proportionality (after 200 ms) allow **1** mark for thinking distance increases with supporting data.	1 1	AO3 6.5.4.3.2	E
04.2	(most) people cannot react any quicker than 200 ms		1	AO1 6.5.4.3.2	E
04.3	there is variation in the measurements	allow the data is not very precise allow lots of random error ignore references to accuracy / reliability / average	1	AO3 6.5.4.3.2	E
04.4	(258+265+302+248+327) / 5 280 (ms)	an answer of 280 gains **2** marks	1 1	AO2 6.5.4.3.2	E
04.5	8.4 (m)	allow 7.9 (m) to 8.9 (m) allow ecf from **04.4**	1	AO2 6.5.4.3.2	E
04.6	any **two** from: • (material of) road surface • condition of the tyres • speed of the car • wet / icy road surface • gradient of road • mass / weight of the car	 Ignore any reference to brakes	2	AO1 6.5.4.3.3	
04.7	work done = force × distance (along the line of action of the force)	allow W = F s allow any correct re-arrangement	1	AO1 6.5.2	

04.8	F = 6000 N	an answer of 450 000 scores 3 marks	1	AO2 6.5.2	
	W = 6000 × 75	allow a correct substitution using an incorrectly / not converted value of F	1		
	W = 450 000 (J)	allow a correct calculation using an incorrectly / not converted value of F	1		
Total			**13**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	velocity frequency wavelength		1 1 1	AO1 6.6.2.3	G
05.2	so people are not exposed to (as much) gamma radiation because gamma radiation can damage human tissue	allow less gamma radiation reaches the Earth's surface allow increases the risk of cancer or (cell) mutation allow gamma rays are ionising ignore any reference to temperature / heating of the atmosphere	1 1	AO1 6.6.2.3	E
05.3	(microwaves) are used in (satellite) communications	ignore any reference to temperature / heating of the atmosphere	1	AO2 6.6.2.4	E
05.4	can cause skin cancer / premature ageing	allow sunburn allow eye / skin damage cancer on its own is insufficient	1	AO1 6.6.2.3	E
05.5	risk from UV radiation is highest in July / summer two correct readings from the bar chart which support their comparison	allow any sensible comparison of named months / seasons if no other mark scored, two correct readings from the graph scores 1 mark	1 1	AO3 6.6.2.3	E
Total			9		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	(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
06.2	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
06.3	(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
06.4	wave speed = frequency × wavelength	allow $v = f\lambda$ allow any correct re-arrangement	1	AO1 6.6.1.2	E
06.5	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
06.6	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
07.1	**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			

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