GCSE
COMBINED SCIENCE: SYNERGY
8465/3H

Higher Tier Paper 3 Physical Sciences

Mark scheme

June 2020

Version: 1.0 Final Mark Scheme

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

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

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

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make 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 errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

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

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

[1 mark]

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

Example 2: Name two 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.
01.1	correct circuit symbols ammeter in series with filament lamp voltmeter in parallel with filament lamp		1 1 1	AO1 4.7.2.4 RPA 15
01.2	chemical		1	AO1 4.7.2.8 RPA 15
01.3	energy is dissipated **or** energy is transferred to surroundings **or** it increases the temperature of the surroundings		1	AO1 4.7.2.8 RPA 15
01.4	as current increases, power (output) increases at an increasing rate	 allow not a linear relationship	1 1	AO2 4.7.2.7 RPA 15
01.5	power = current^2 × resistance **or** $P = I^2R$		1	AO1 4.7.2.7

01.6	P = 1.1 (W) $1.1 = 0.22^2 \times R$ $R = \frac{1.1}{0.22^2}$ R = 23 (Ω) **OR** 1.1 = 0.22 × V (1) V = 5.0 (V) (1) 5.0 = 0.22 × R (1) R = 23 (Ω) (1)	allow correct substitution of an incorrect value for P for MP2, MP3 and MP4	1 1 1 1	AO2 4.7.2.7 RPA 15

Total			**12**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **two** from: • volume of (copper sulfate) solution • concentration of (copper sulfate) solution • starting temperature (of copper sulfate solution)		2	AO1 4.7.3.3 4.7.5.1 RPA 18
02.2	any **one** from: • use a polystyrene cup • insulate the beaker • add a lid • use a thermometer with a higher resolution • repeat **and** calculate a mean	allow use a digital thermometer allow record temperature to more decimal places allow discard anomalies **and** calculate a mean	1	AO3 4.7.3.3 4.7.5.1 RPA 18

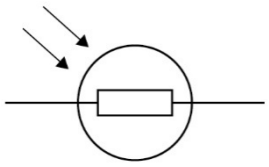
Question	Answers	Mark	AO/ Spec. Ref
02.3	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO3
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	AO2 AO3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO2
	No relevant content	0	4.7.3.3 4.7.5.1 RPA 18
	Indicative content Trends • as mass of magnesium increases, temperature (increase) increases • after 0.7 g of magnesium added, no change in temperature (increase) Conclusions and explanations • as mass of magnesium increases by 0.1 g, temperature increases by 3 °C • temperature rise is directly proportional to mass (up to 0.7 g) • (because) the reaction is exothermic (as temperature increases) • no more magnesium reacts after 0.7 g • (because) magnesium is in excess after 0.7 g added • (because) copper sulfate is the limiting reagent • anomalous result at 0.9 g • (because) 0.8 g and 1.0 g have lower values For level 3 at least one explanation is needed		

Total			**9**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	allow correct multiples allow **1** mark for correct formulae Fe + CO_2 (ignore attempts at balancing) allow **1** mark for $Fe_2 + 3CO_2$	2	AO2 4.5.2.1 4.8.2.1
03.2	loss of oxygen	allow gain of electrons allow iron oxide loses oxygen allow iron ions gain electrons do **not** accept carbon monoxide loses oxygen	1	AO1 4.8.2.1
03.3	(in pure iron) atoms are in layers (but in cast iron) carbon atoms are different sizes (to iron atoms) (so) the layers are distorted (so) the layers no longer slide over each other	 allow (so) the atoms no longer slide over each other	1 1 1 1	AO1 4.6.2.7
03.4	any **three** from: • conserves iron ore • less energy used • less waste produced • reduces carbon dioxide emissions • less mining / quarrying	ignore cost unqualified allow less use of fossil fuels allow less requirement for landfill allow reduces greenhouse gas emissions allow reduces global warming	3	AO1 4.8.2.9
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(enzyme / amylase) has an active site (with a specific / unique shape) which will only fit / bind to the starch / substrate (molecule)		1 1	AO1 4.7.4.7
04.2	time for no starch to be detected		1	AO1 4.7.4.7 RPA 20
04.3	iodine solution (iodine solution) turns blue-black	allow reagent for solution allow (iodine solution) turns black do **not** accept blue	1 1	AO1 4.7.4.7 RPA 20
04.4	to ensure the starch (suspension) and amylase (solution) both reached the same / body temperature	allow temperature of solution / suspension is a control variable ignore 37 °C is body / optimum temperature	1	AO1 4.7.4.7 RPA 20
04.5	at pH 7.5, the least time taken (for no starch to be detected)		1	AO3 4.7.4.7 RPA 20
04.6	repeat using smaller pH intervals	allow repeat at pH 7.1, 7.2 …	1	AO3 4.7.4.7 RPA 20
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(alkane) has the (general) formula C_nH_{2n+2}		1	AO2 4.5.2.1 4.8.1.2
05.2	heavy fuel oil	do **not** award any marks if incorrect fraction given	1	AO3
	contains largest molecules (which have greatest viscosity)	allow has most carbon atoms (per molecule) ignore reference to highest boiling point	1	AO2 4.8.1.3
05.3	crude oil is heated to vaporise hydrocarbons		1	AO1
	there is a temperature gradient in the column	allow the column gets cooler going up	1	AO1
	as gases rise up the column the gases condense		1	AO1
	fraction (containing octane / petrol) condenses between 40 °C and 180 °C		1	AO2 4.8.1.3
Total			**7**	

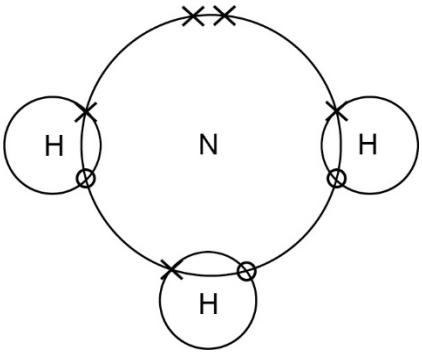
Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1			1	AO1 4.7.2.4
06.2	p.d. across 200 (Ω) resistor = 3.0 – 2.0 = 1.0 V so resistance of LDR is 400 (Ω)	 allow a justified calculation of current and resistance $I = \frac{1}{200} = 5 \times 10^{-3}$ (A) (1) $2 = 5 \times 10^{-3} \times R$ R = 400 (Ω) (1)	1 1	AO2 4.7.2.2 4.7.2.3
06.3	t = 2400 (s) 3.24 = I × 2400 $I = \frac{3.24}{2400}$ I = 0.00135 (A) **or** $I = 1.35 \times 10^{-3}$ (A)	 this mark may be awarded if t is incorrectly or not converted this mark may be awarded if t is incorrectly or not converted allow an answer consistent with their value of t incorrectly or not converted	1 1 1 1	AO2 4.7.2.1
06.4	the security light would always be on		1	AO2 4.7.2.2
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	the size of the arrow(s) represents the size of the force(s)		1	AO1 4.6.1.2
	(so) normal contact force is equal size and opposite direction to weight		1	
	(and) air resistance is equal size and opposite direction to forward force		1	
		allow forces are equal in size but opposite in direction for **1** mark only		
07.2	210 000 = F × 48		1	AO2 4.6.1.3
	$F = \frac{210\ 000}{48}$	this mark can be scored if an incorrect value is taken from the table	1	
	F = 4375 (N)		1	
	F = 4400 (N)		1	
07.3	braking distance depends on the square of the speed	allow kinetic energy depends on the square of the speed	1	AO1
	(so) $v^2 = k \times d$	allow $d = k \times v^2$	1	AO2
	(as shown by) $\frac{6^2}{3} = 12$ **and** $\frac{12^2}{12} = 12$ **or** $\frac{18^2}{27} = 12$ **or** $\frac{24^2}{48} = 12$	allow justification using two sets of values from **Table 4** allow justification using two sets of values from **Table 4** to show that doubling the speed increases the braking distance by a factor of 4	1	AO1 4.7.1.9 4.7.1.10
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	giant structure of ions		1	AO1 4.5.1.4
	with strong electrostatic forces of attraction		1	4.5.1.5 4.6.2.2 4.6.2.3
		if no other mark awarded allow **1** mark for ionic bonding		
08.2	$\left(\text{moles bromine} = \frac{1}{160}\right)$ = 0.00625		1	AO2 4.5.2.4
	(molecules of bromine =) $0.00625 \times 6.02 \times 10^{23}$	allow correct use of an incorrectly calculated value for moles of bromine	1	
	(molecules of bromine =) 3.76×10^{21} (molecules)	allow 3.7625×10^{21} (molecules)	1	

08.3		allow converse		
	boiling point decreases up the group	allow boiling point decreases down the table	1	AO2
	(because) the relative formula / molecular mass decreases **or** (because) the size of the molecule decreases		1	AO1
	(so) the intermolecular forces decrease (in strength)	allow (so) the forces between molecules decrease (in strength)	1	AO1
	(so) less energy is needed to overcome the intermolecular forces	allow (so) less energy is needed to separate the molecules do **not** accept a reference to breaking bonds unless specifically between molecules	1	AO1 4.5.1.5 4.6.2.5

Total			**9**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	3 bonding pairs of electrons 1 non-bonding pair of electrons on nitrogen outer shell	allow dot, cross, open circle, $e^{(-)}$ for electrons do **not** accept if non-bonding electrons drawn on hydrogen do **not** accept if total number of electrons on outer shell of nitrogen is not 8 an answer of  scores **2** marks	1 1	AO1 4.6.2.4
09.2	the forward reaction happens at the same rate as the reverse reaction		1	AO1 4.7.4.8 4.7.4.9
09.3	at higher temperature position of equilibrium is further to the left **or** at higher temperature position of equilibrium is further in the endothermic direction (so) yield of products decreases		1 1	AO1 4.7.4.8 4.7.4.10
09.4	(prediction) no effect (reason) same number of gas molecules on both sides of equation		1 1	AO2 4.7.4.8 4.7.4.10

09.5	speed up reaction reduce energy costs	 allow so less energy required	1 1	AO1 AO3 4.7.4.6

09.6	a weak acid only partially ionises in aqueous solution (whereas) a strong acid completely ionises in aqueous solution	allow dissociates for ionises	1 1	AO1 4.7.3.5

09.7	(mass of ammonia produced =) $\frac{1.275 \times 10^{11}}{85} \times 100$		1	AO2 4.5.2.5 4.8.2
	$= 1.5 \times 10^{11}$ (kg)		1	
	(moles ammonia =) $\frac{1.5 \times 10^{11} \times 10^{3}}{17}$ **or** 8.82×10^{12}	allow correct use of incorrectly calculated value for mass of ammonia from MP1 and/or MP2	1	
	(moles nitrogen =) $\frac{8.82 \times 10^{12}}{2}$ **or** 4.41×10^{12}	allow correct use of incorrectly calculated value for moles of ammonia	1	
	(mass of nitrogen =) $28 \times 4.41 \times 10^{12}$ (g) **or** $28 \times 4.41 \times 10^{9}$ (kg)	allow correct use of incorrectly calculated value for moles of nitrogen	1	
	$= 1.235 \times 10^{11}$ (kg)		1	
	alternative approach for MP3 to MP6 2 $M_r NH_3 = 34$ (1) **or** $M_r NH_3 = 17$ 28 (kg) nitrogen gives 34 (kg) ammonia (1) **or** 14 (kg) nitrogen gives 17 (kg) ammonia (mass of nitrogen =) $\frac{28}{34} \times 1.5 \times 10^{11}$ (kg) (1) **or** $\frac{14}{17} \times 1.5 \times 10^{11}$ (kg) $= 1.235 \times 10^{11}$ (kg) (1)	allow correct use of incorrectly calculated value for M_r of ammonia		

Total			**17**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(when the switch is closed) the wire has a current in it		1	AO1 4.6.3.5
	(which causes a) magnetic field around wire		1	
	(which) interacts with the magnetic field of the permanent magnet		1	
	causing a force on the wire		1	
10.2	$1.50 = I \times 0.600$ **or** $I = \frac{1.50}{0.60}$		1	AO2
	$I = 2.50$ (A)		1	AO2
	$3.75 \times 10^{-4} = B \times 2.50 \times 0.050$	allow $3.75 \times 10^{-4} = B \times$ their calculated value of I × 0.050	1	AO2
	$B = \frac{3.75 \times 10^{-4}}{(2.50 \times 0.050)}$	allow $B = \frac{3.75 \times 10^{-4}}{\text{(their calculated value of I} \times 0.050)}$	1	AO2
	$B = 3.0 \times 10^{-3}$	allow a correctly calculated value for B consistent with their calculated value of I	1	AO2
	Tesla/T		1	AO1 4.6.3.5 4.7.2.2
Total			**10**	