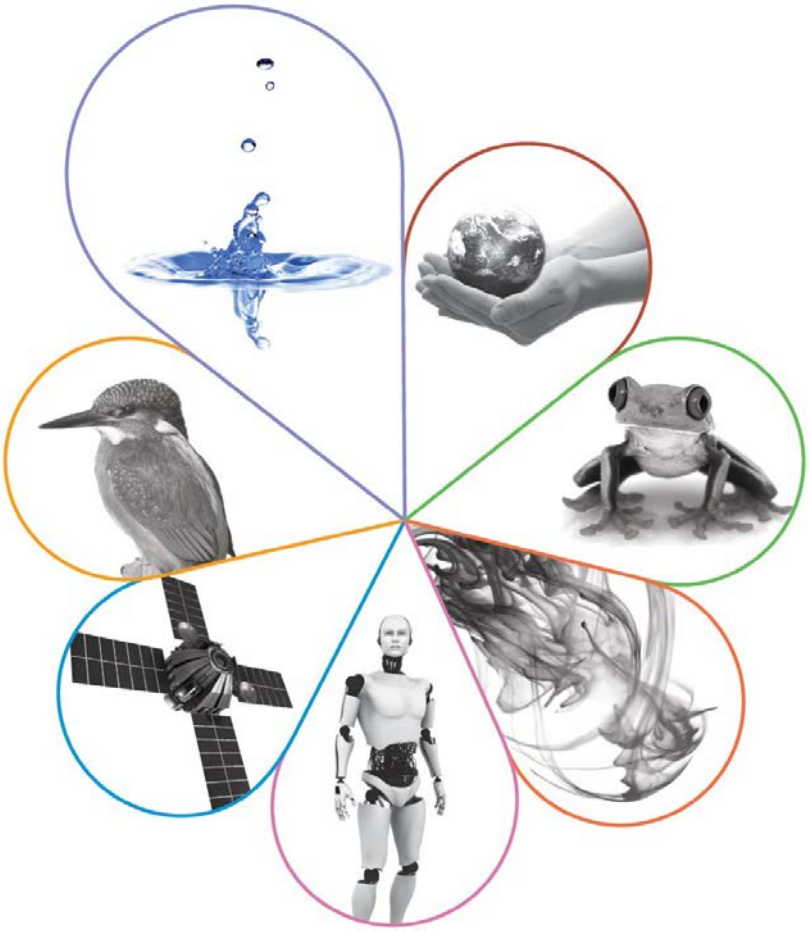
AQA
Realising potential

GCSE
SCIENCE

Science hub meeting

Resource booklet

Published: Autumn 2019



Contents

AQA results statistics 2019

GCE sciences: Cumulative percentage attaining each grade

Figures in brackets are for 2018.

AQA A-level entries increased for each subject, by slightly more than national percentages.

AQA A-level cumulative percentages at all grades slightly below national figures for biology and chemistry.

The decline in entries for AS continues following the decoupling from A-level.

Summer 2019 is the first examination of A-level Environmental Science.

AS and A-level Environmental Studies were final resits only.

	Total entries	Grade E	Grade C	Grade A
AS Biology	4772 (7812)	81.2 (80.7)	48.3 (44.7)	16.8 (15.2)
A-level Biology	33 381 (29 569)	95.6 (96.5)	65.7 (69.6)	23.4 (25.8)
AS Chemistry	3399 (5788)	82.1 (80.7)	52.4 (46.8)	19.7 (16.6)
A-level Chemistry	24 705 (21 941)	95.7 (96.7)	71.2 (73.1)	28.2 (30.9)
AS Physics	3239 (5061)	81.8 (81.8)	53.8 (47.2)	22.8 (20.0)
A-level Physics	20 385 (19 323)	95.5 (95.9)	70.5 (68.6)	27.9 (29.6)
AS Environmental Science	332 (471)	80.7 (76.9)	44.0 (38.0)	9.6 (7.4)
A-level Environmental Science	876 (n/a)	93.9 (n/a)	54.0 (n/a)	8.8 (n/a)
AS Environmental Studies	3 (202)	66.7 (93.1)	66.7 (70.8)	0.0 (18.3)
A-level Environmental Studies	15 (657)	86.7 (91.3)	60.0 (55.1)	6.7 (11.4)

Applied General Science: Cumulative percentages attaining each grade

Figures in brackets are for 2018.

Entries for Certificate down 10-15% for each unit this summer.

The overall pass rates for the Certificate (units 1-3) and Extended Certificate (units 1-6) are slightly higher this summer. This is likely to be due in part to continuing impact of the 'near pass' rule and relaxation of the resit rule on examined papers.

	Total entries	Pass	Merit	Distinction
Applied Science Certificate	1513 (1650)	65.9 (66.1)	15.4 (15.8)	0.3 (0.5)
Applied Science Extended Certificate	1320 (987)	81.4 (79.3)	32.3 (29.0)	1.8 (1.9)

GCSE results 2019: Cumulative percentage attaining each grade

Figures in brackets are for 2018.

Entries for all AQA GCSE sciences increased this year, by slightly more than the national percentage.

Predicted outcomes for this summer were based on the mean KS2 results and the average of all Awarding Bodies' outcomes in June 2018 for the linear GCSE (16 year olds). The predictions showed that the ability of this year's cohort didn't differ significantly than that of last year.

GCSE	Total entries	Grade 1	Grade 4	Grade 7	Grade 9
Combined Science: Trilogy	303 207 (284 212)	98.1 (98.4)	56.0 (55.2)	7.6 (7.6)	0.9 (0.9)
Combined Science: Synergy	6138 (5814)	96.6 (96.6)	41.4 (42.0)	3.7 (3.7)	0.3 (0.4)
Biology	130 938 (129 521)	99.4 (99.2)	90.1 (89.3)	42.8 (41.7)	12.5 (12.1)
Chemistry	126 276 (124 584)	99.5 (99.4)	90.3 (90.0)	44.5 (43.6)	13.2 (12.8)
Physics	125 656 (123 628)	99.5 (99.3)	91.1 (90.6)	44.2 (42.9)	12.6 (12.4)

Example student responses

Extended response questions

Example 1: Trilogy Biology 1F Q6.5/1H Q1.5 (Standard demand)

Command word is **Explain** – students needed to use the information given to explain why beta blockers can cause breathlessness when exercising.

Beta blockers are another type of drug that slows the heart rate.

Table 2 shows information for people who do not take beta blockers and for people who do take beta blockers.

- Stroke volume is the volume of blood pumped out of the heart each time it beats.
- Cardiac output is the total volume of blood pumped out of the heart each minute.

Table 2

	No beta blockers taken		Taking beta blockers	
	At rest	During exercise	At rest	During exercise
Heart rate in beats per minute	68	150	52	88
Stroke volume in cm^3	80	120	X	98
Cardiac output in cm^3 per minute	5440	18 000	2800	8624

Only 3% of students on Foundation Tier and only 13% of students on Higher Tier achieved 5 or 6 marks. 22% of Foundation Tier students scored no marks.

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. .		

Student A

0 6 . 5 Some people who take beta blockers get out of breath when they exercise.

Explain why beta blockers can have this effect during exercise.

You should refer to information given in **Table 2**.

[6 marks]

Because taking beta blockers decreases the amount of blood being pumped out of the heart each time it beats. Also it's very clear that the number of cardiac outputs is lower when taking beta blockers.

Commentary for Student A

This student has made some simple statements using information given in the table. However, there is no attempt at linking these statements and the relevance is not clear. This is a Level 1 response and was awarded 2 marks.

Student B

0 1 . 5 Some people who take beta blockers get out of breath when they exercise.

Explain why beta blockers can have this effect during exercise.

You should refer to information given in **Table 1**.

[6 marks]

As Beta blockers slow down the heart rate so exercise may be made more difficult. This is because when you ~~if~~ exercise the heart ~~blood~~ needs to pump the blood round the body much faster. It needs to do this because more oxygenated blood has to get to the muscle cells to enable the mitrocondria in the cells to respire. If the person is on Beta blockers their heart rate will be even lower than normal so the heart has to work even harder. This could cause loss of breath.

Commentary for Student B

This student has listed a number of relevant points, with links to reasons, about the effect of beta blockers and the effect of exercise. However, to access Level 3 there needed to be reference to all three areas and there is nothing here about the effect on breathing rate. This is a top Level 2 answer and gained 4 marks.

Further examples in Trilogy papers

Other questions that teachers might want to look at back at school are listed below.

These are all Standard demand questions, so the better students on the Foundation Tier paper should be able to get full marks and we would expect to see reasonable percentages of Higher Tier students reaching the top levels. But if we look at the data:

- B2F 7.3 /B2H 2.3 **Describe** the carbon cycle (AO1). Only 3% getting 5 or 6 marks on Foundation Tier and 20% on Higher Tier (43% of Foundation Tier students got no marks at all)

- C1F 7.6 /C1F 2.6 **Describe** a method – (AO2/AO3 based on RPA 10). Only 6% got 5 or 6 on Foundation Tier and 19% on the Higher Tier (45% of Foundation Tier students got nothing)

- C2F 7.2 C2H 2.2 **Evaluate** carbon footprint from data (AO3). Only 4% getting 5 or 6 marks on Foundation Tier and only 13% getting 5 or 6 marks on the Higher tier (46% of Foundation Tier students got nothing)

- P1F 7.4/ P1H 2.4 **Explain** particle arrangement and movement (simple ideas: AO1). Only 3% of Foundation Tier students got 5 or 6 marks and 22% of those on the Higher Tier (38% of Foundation Tier got nothing)

- P2F 7.1/ P2H 2.1 **Describe** how equipment is used to measure waves (AO1). Only 1% of Foundation Tier students and 10% of Higher Tier students got 5 or 6 marks (62% of Foundation Tier students got nothing).

Gaps in knowledge

There were many instances of responses where students had surprising gaps in knowledge. Listed here are a few examples from the Combined Science: Trilogy papers.

Biology Foundation Tier

- Name of the enzyme that digests starch (75% = 0)
- Reagents for starch, sugar (63% = 0)
- Name of the chemical genetic material is made from (86% = 0)
- Name of the entire genetic material of an organism (93% = 0)

Biology Higher Tier

- Differences between bacterial and eukaryotic cells (64% got 1 or less)

Chemistry Foundation Tier

- State symbol of oxygen at room temperature (87% = 0)
- Simple definition of equilibrium in a reaction (82% = 0)
- What 'formulation' means (70% = 0)

Chemistry Higher Tier

- How the early periodic table was structured by atomic weight (93% = 0)
- Why elements have low boiling points (80% = 0)
- Test for oxygen (42% = 0)

Physics Foundation Tier

- Recall of formulas generally poor
- Mass and atomic number in a symbol for isotope (62% = 0)
- Idea of peer review in scientific journals (69% = 0)
- Transverse waves (F 95% = 0; H 76% = 0)

Physics Higher Tier

- Difference between AD and DC (54% = 0)
- Circuit symbol for a thermistor (62% = 0)
- How light refracts from air–glass (73% = 0)

Practical based questions: Variables

Example 2: Trilogy Chemistry 2F Q3.5 (Low demand)

Question	Percentage scoring no marks*
3.5	82

* includes those who didn't attempt the question

Mark scheme

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

The following all demonstrate common responses that didn't gain any marks.

- vague terminology: 'amount' instead of length, mass or volume (Student C)
- referring to concentration of hydrochloric acid, which students were told was being varied (Student D)
- referring to time or time intervals (Student E).

Student C

0 3 . 5 The student repeated the experiment using different concentrations of hydrochloric acid.

Give **two** variables the student should keep the same.

[2 marks]

1 Same amount of hydrochloric acid.

2 Same amount of magnisium chips.

Student D

0 3 . 5 The student repeated the experiment using different concentrations of hydrochloric acid.

Give **two** variables the student should keep the same.

[2 marks]

1 Keep the concentration the same.

2 Keep the same measurement scheme.

Student E

0 3 . 5 The student repeated the experiment using different concentrations of hydrochloric acid.

Give **two** variables the student should keep the same.

[2 marks]

1 How long the intervals are timed for

2 The student measuring the acid.

Example 3: Trilogy Chemistry 1F Q6 / 1H Q1 (Standard demand)

Question	Percentage scoring no marks*	
	Foundation	Higher
6.3 / 1.3	61	38

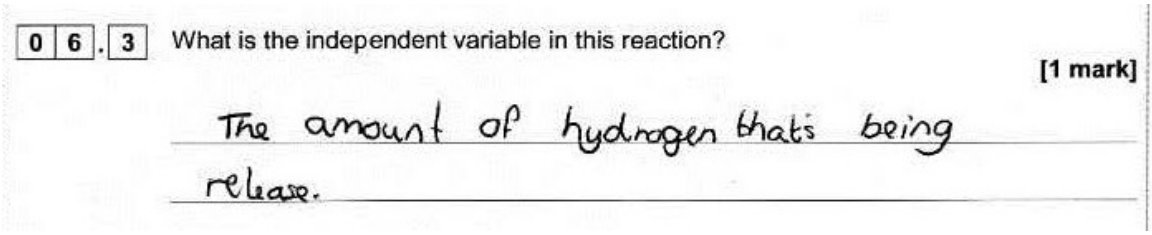
* includes those who didn't attempt the question

Mark scheme

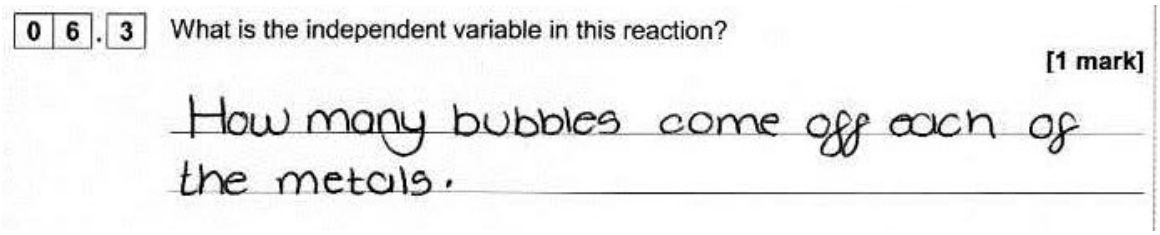
06.3	(type of) metal / element		1	AO2 5.4.1.2

A common misconception seen was that the independent variable is the amount of gas, or the number of bubbles produced. The following are examples of responses that didn't gain marks.

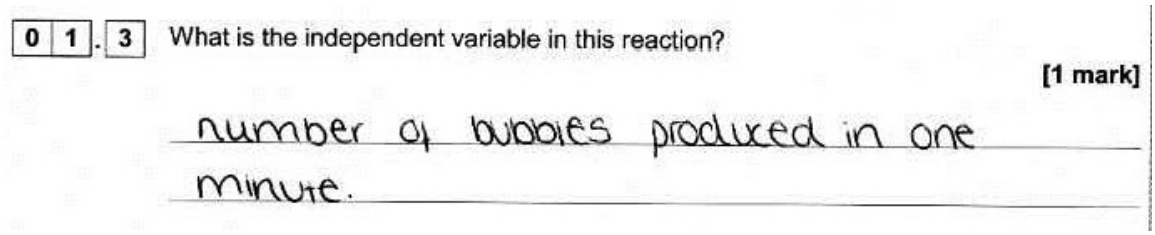
Student F



Student G



Student H



Points for discussion

- Do you use the term 'control variable' in lessons?
- Do your students understand the term?
- Do teachers ask what it means?

- When students do any practical is this difference between dependent and independent variables reinforced?
- If doing revision and using a video is it part of the questions set to accompany the video

Practical based questions: Types of error

Example 4: Trilogy Physics 1F Q2.2 (Low demand)

Question	Percentage scoring no marks*
2.2	70

* includes those who didn't attempt the question

Mark scheme

02.2	zero error		1	AO3/3b 6.1.3c WS 3.7

Student I

0 2 . 2 The student measured the output potential difference using a voltmeter.

When the voltmeter was **not** connected, the reading on the voltmeter was 0.7 V

What name is given to this type of error?

[1 mark]

Tick (✓) **one** box.

Zero error ☐

Random error ☐

Measurement error ☐

Further examples in GCSE Science 2019 papers

- Separate Physics 1H Question 8.3: 55% got no marks
- Separate Chemistry 1F Question 7.3: 30% got no marks
- Combined Science Synergy 2F Question 2.7: 63% got no marks

Practical based questions: Setting up equipment

Example 5: Trilogy Physics 1F Q6 /1H Q1 (Standard demand)

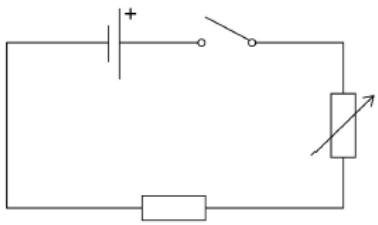
Question	Percentage scoring no marks*	
	Foundation	Higher
6.1 / 1.1	64	39
6.3 / 1.3	97	79

* includes those who didn't attempt the question

0 1 A student investigated how the current in a resistor varies with the potential difference across the resistor.

Figure 1 shows part of the circuit used.

Figure 1



0 1 . 1 The student connected an ammeter and a voltmeter into the circuit.

What is the correct way to connect the ammeter and the voltmeter into the circuit?

[1 mark]

Tick (✓) **one** box.

Ammeter	Voltmeter	
In parallel with the resistor	In series with the resistor	☐
In parallel with the cell	In series with the resistor	☐
In series with the resistor	In parallel with the resistor	☐
In series with the resistor	In parallel with the cell	☐

Common responses to **6.3/1.3** referred to changing the resistance of the circuit or changing the properties of the battery. Many responses were too vague to allow the mark, for example 'turn the battery round'.

Mark scheme

01.3	reverse the connections to the cell	allow battery for cell allow reverse the cell	1	AO1/2 6.2.1.3 RP 16 WS 2.2	E

Student J

0 6 . 3 How should the student change the circuit to give negative values for current and potential difference?

[1 mark]

decrease the resistance of the variable resistor.

Student K

0 1 . 3 How should the student change the circuit to give negative values for current and potential difference?

[1 mark]

add another resistor.

Student L

0 1 . 3 How should the student change the circuit to give negative values for current and potential difference?

[1 mark]

Use a negatively charged battery instead

Practical based questions: The purpose of method steps

Example 6: Trilogy Biology 1F question 3 (Low demand)

Question	Percentage scoring no marks*
3.5	89
3.6	86

* includes those who didn't attempt the question

Many students were able to list the steps in a method, but responses to these questions showed that understanding of the reasons behind the steps was often lacking. The following examples didn't gain any marks.

Mark scheme

03.5	any **one** from: • biggest / widest field of view • easier to focus		1	AO3 4.1.1.2

Student M

0 3 . 5 It is easier to view the cells using the low power objective lens first.

Give **one** reason why.

[1 mark]

AS it is not zoomed in making it blurred.

Student N

0 3 . 5 It is easier to view the cells using the low power objective lens first.

Give **one** reason why.

[1 mark]

As you can tell what it looks like as it is a smaller magnification.

Mark scheme

03.6	to avoid damage to lens / slide	ignore references to focussing	1	AO3 4.1.1.2

Student O

0 3 . 6 To focus the image the objective lens should be moved away from the stage.

Give **one** reason why the objective lens should **not** be moved towards the stage.

[1 mark]

The image would then be blury.

Student P

0 3 . 6 To focus the image the objective lens should be moved away from the stage.

Give **one** reason why the objective lens should **not** be moved towards the stage.

[1 mark]

It'll be to close to focus

Student Q

0 3 . 6 To focus the image the objective lens should be moved away from the stage.

Give **one** reason why the objective lens should **not** be moved towards the stage.

[1 mark]

it would be too close

Practical based questions: The science behind the practical

Example 7: Trilogy Biology 2H question 5.3

Question	Percentage scoring						
	0 marks*	1 mark	2 marks	3 marks	4 marks	5 marks	6 marks
Higher 5.3	5	7	20	30	27	9	3

*includes those who didn't attempt the question

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

Student R

0 5 . 3 The students noticed a very uneven distribution of daisy plants in the field.

Explain how different biotic factors **and** abiotic factors could have caused an uneven distribution of daisy plants.

Use **Figure 3** on page 20.

[6 marks]

Biotic and Abiotic factors may have effected this by there being living organisms in the soil and there being non-living organisms. This could have caused an uneven distribution by the biotic factors taking up all the nutrients that the daisy plants need for growth.

Commentary for Student R

There is no content in this response that is relevant to the question and no marks can be awarded.

Student S

0 5 . 3 The students noticed a very uneven distribution of daisy plants in the field.

Explain how different biotic factors **and** abiotic factors could have caused an uneven distribution of daisy plants.

Use **Figure 3** on page 20.

[6 marks]

Uneven distribution of daisy plats can occur because students are stepping on daisy's in certain spots. One side of te feild could hae very little activity ther which meas that aea will be more popriated. Sport pitched aea ~~probably~~ has less daisy's as there are more studants runing aroun a that area. Temperatre & throughout te reasons could vary their growth.

Commentary for Student S

This second response has given a description of the effect of one factor on the distribution of the daisies and is sufficient for 2 marks.

Student T

0 5 . 3 The students noticed a very uneven distribution of daisy plants in the field.

Explain how different biotic factors **and** abiotic factors could have caused an uneven distribution of daisy plants.

Use **Figure 3** on page 20.

[6 marks]

In the area on the sports pitches the would be a biotic factor of people running over the grass on the sports pitches or around the edges. This means daisies would struggle to grow there as they would die. Abiotic factor is the trees there wouldn't be as many under the trees as there wouldn't be enough light for photosynthesis meaning the daisies wont grow in vast numbers under the tree or around it.

Commentary for Student T

This third response gives a description of two factors, with relevant links made, but the detail isn't sufficient to access Level 3: 4 marks.

Example 8: Trilogy Chemistry 2H question 3.2 (High demand)

Question	Percentage scoring			
	0 marks*	1 mark	2 marks	3 marks
3.2	67	21	11	

* includes those who didn't attempt the question

In this question students weren't asked about the method, or to analyse a chromatogram, but to explain how mixtures are separated in chromatography.

A common misconception, shown by both responses here, was that the dyes react with the stationary phase in some way.

Mark scheme

03.2	dyes distributed differently between the stationary and mobile phase	allow dyes have different solubilities allow dyes have different forces of attraction for stationary phase allow dyes have different forces of attraction for mobile phase allow dyes have different forces of attraction to the paper allow dyes have different forces of attraction to the solvent ignore density	1	AO1 5.8.1.3
	(so dyes) move up the paper at different speeds / rates	allow (so dyes) move different distances up the paper ignore references to time	1	

Student U

0 3 . 2 Explain how paper chromatography separates the dyes in a food colouring.

Do **not** give details of how to do the experiment.

[2 marks]

~~Pigments~~ Different pigments seperate due to having different reactions with the water ~~as~~ as each pigment/dye is made up of different individual chemicals than the others.

Student V

0 3 . 2 Explain how paper chromatography separates the dyes in a food colouring.

Do **not** give details of how to do the experiment.

[2 marks]

The solvent at the baseline of the filter paper reacts with the solutes (the food colouring) and causes the solute to smudge and rise. Therefore, separating the dyes.

Example 9: Trilogy Physics 1H question 4

Question	Percentage scoring			
	0 marks*	1 mark	2 marks	3 marks
4.4	41	44	15	

*includes those who didn't attempt the question

Many students scored only 1 mark for this question because, although they could state that the current increased, they couldn't give a correct reason. The following are all examples of students who gained the first mark, but could not gain the second.

Mark scheme

04.4	the current increased (because) the resistance (of the thermistor) decreased	 allow because the resistance of the circuit decreased	1 1	AO1.1 AO1 in isolation 6.2.1.4 6.2.1.3

Student W

0 4 . 4 The student increased the temperature of the thermistor.

Explain how the current in the thermistor changed.

[2 marks]

As the temperature increased the current in the thermistor would increase because the ~~temperature~~ is increasing the resistance in the thermistor.

Student X

0 4 . 4 The student increased the temperature of the thermistor.

Explain how the current in the thermistor changed.

[2 marks]

the current will also increase as it's directly proportional and it'll increase the flow of electrons

Student Y

0 4 . 4 The student increased the temperature of the thermistor.

Explain how the current in the thermistor changed.

[2 marks]

The current increased as more energy is produced from the heat to speed up the circuit.

Assessing equations at different levels of demand

Example 10: Trilogy Physics 1F Q1.8 (Low demand AO2)

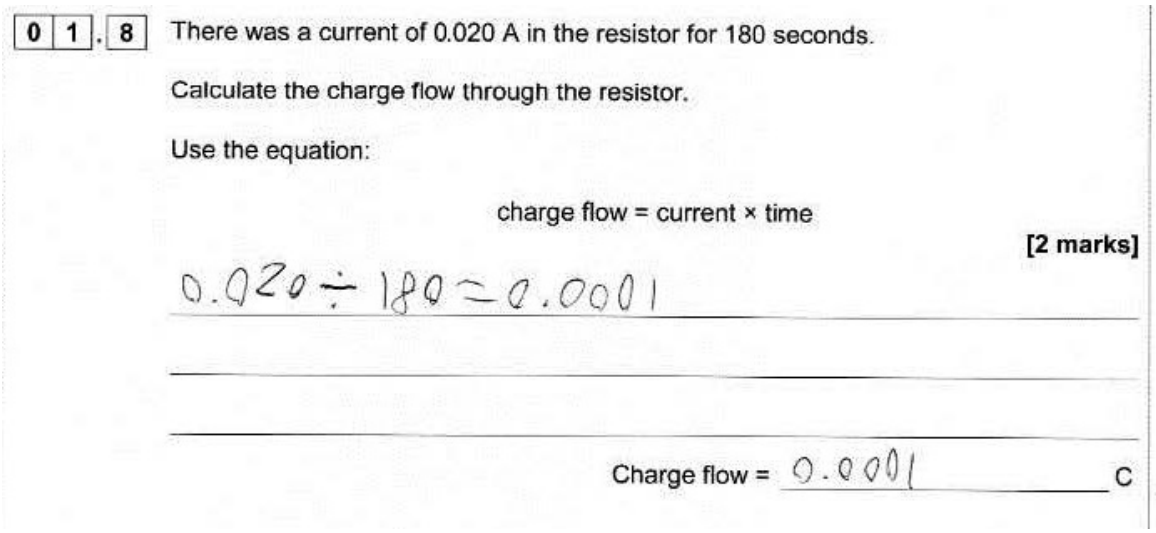
Mark scheme

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

Common responses that didn't gain marks included:

- not using the equation as given, often rearranging or using different mathematical functions (Student Z)
- not using the numbers given (Student AA)
- not showing working (Student BB).

Student Z



0 1 . 8 There was a current of 0.020 A in the resistor for 180 seconds.

Calculate the charge flow through the resistor.

Use the equation:

charge flow = current × time

[2 marks]

0.020 ÷ 180 = 0.0001

Charge flow = 0.0001 C

Student AA

0 1 . 8 There was a current of 0.020 A in the resistor for 180 seconds.

Calculate the charge flow through the resistor.

Use the equation:

charge flow = current × time

[2 marks]

0.020 × 3

Charge flow = 0.06 C

Student BB

0 1 . 8 There was a current of 0.020 A in the resistor for 180 seconds.

Calculate the charge flow through the resistor.

Use the equation:

charge flow = current × time

[2 marks]

Charge flow = 3600 C

Example 11: Trilogy Physics 1F Q2.5 (Low demand AO2)

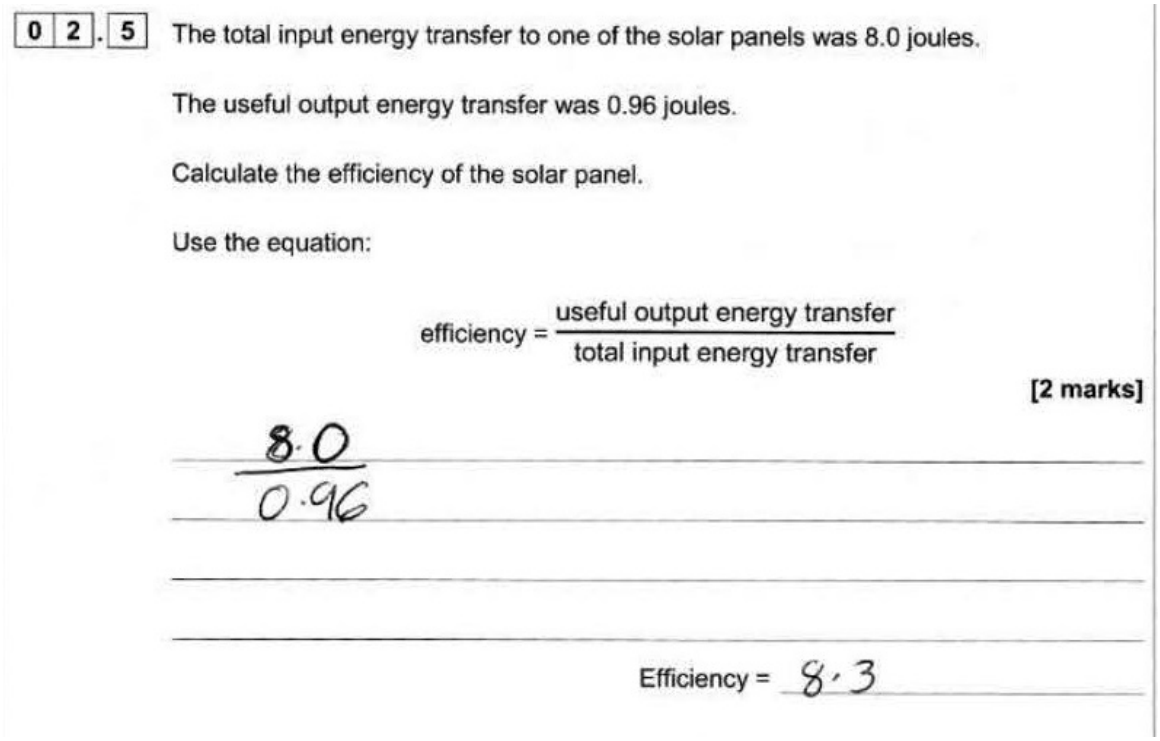
Mark scheme

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

Again, for this question, many students didn't use the equation as given, choosing to multiply the numbers rather than divide them.

Student CC shows a response that was seen often: incorrect substitution, putting the larger number at the top of the division sum.

Student CC



0 2 . 5 The total input energy transfer to one of the solar panels was 8.0 joules.

The useful output energy transfer was 0.96 joules.

Calculate the efficiency of the solar panel.

Use the equation:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

[2 marks]

$\frac{8.0}{0.96}$

Efficiency = 8.3

Example 12: Synergy 3F Q8.5 (Standard demand AO1)

Common question Foundation and Higher Tier: about a third of Foundation Tier students were able to do this correctly. On the Higher Tier about two-thirds were able to do this correctly.

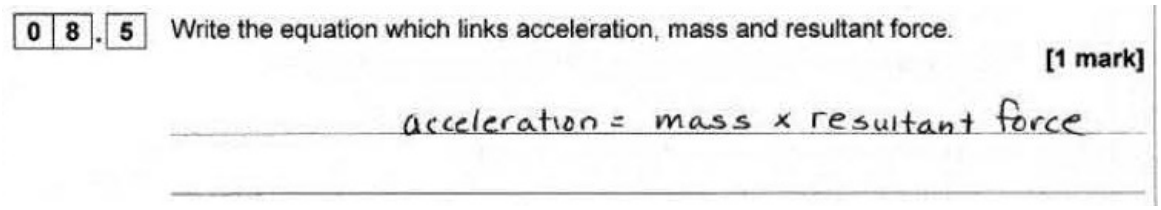
Mark scheme

08.5	(resultant) force = mass × acceleration	allow F = ma	1	AO1 4.7.1.6

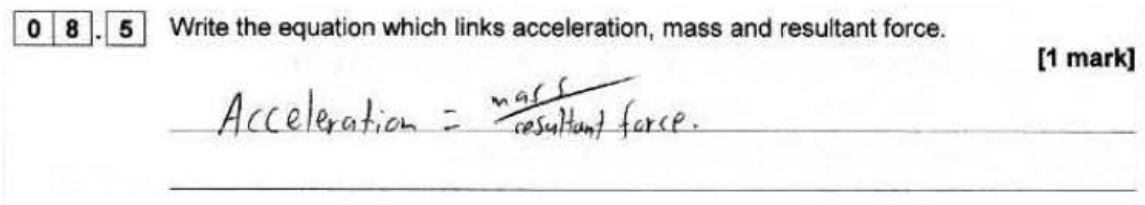
Most common errors seen:

- listing the elements as given in the question and inserting mathematical operators, usually multiplication (Student DD)
- giving in an incorrectly rearranged form (Student EE)
- not giving as an equation (Student FF).

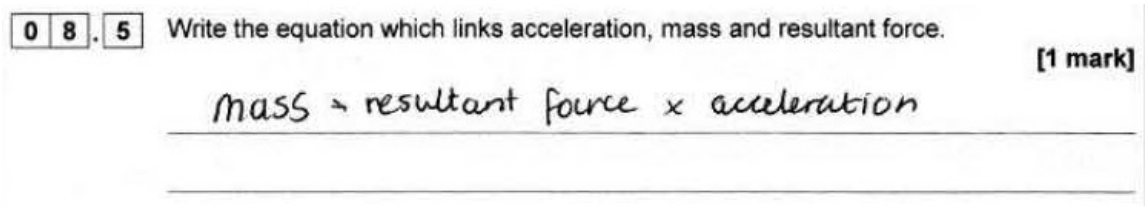
Student DD



Student EE



Student FF



Example 13: Synergy 3F Q8.6 (Standard demand AO2)

Mark scheme

08.6		an answer of 0.14 m/s^2 scores **4** marks an answer of 0.14 scores **3** marks		AO1 AO2 4.7.1.6
	0.000168 = 0.0012 × a		1	
	a = 0.000168 ÷ 0.0012		1	
	a = 0.14		1	
	m/s^2		1	

Student GG

0 8 . 6 The mass of the paper clip is 0.0012 kg

Calculate the acceleration of the paper clip when the resultant force on it is 0.000168 N

Give the unit.

[4 marks]

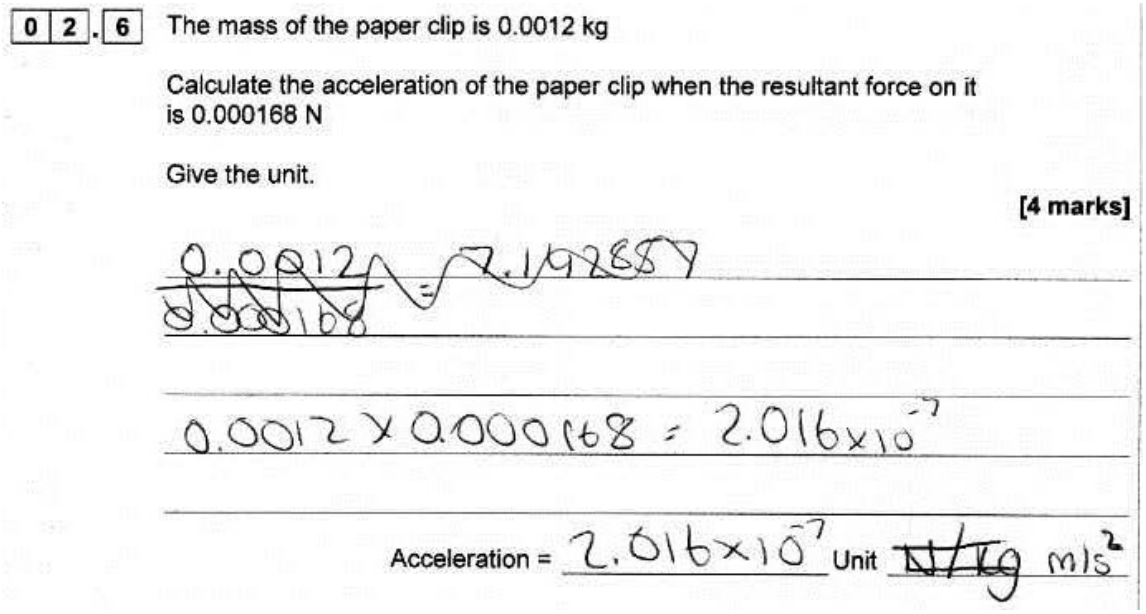
0.0012 ÷ 0.000168 = ~~7.14m/s~~ 7.14m/s

Acceleration = 7.14 Unit m/s

Commentary for Student GG

The student correctly recalled the equation in 08.5, but has incorrectly rearranged it and so substituted numbers into an equation that does not exist, demonstrating no understanding of the underlying physics. The unit given is incorrect.

Student HH



0 2 . 6 The mass of the paper clip is 0.0012 kg

Calculate the acceleration of the paper clip when the resultant force on it is 0.000168 N

Give the unit.

[4 marks]

0.0012 / 0.000168 = 7.142857

0.0012 × 0.000168 = 2.016×10^{-7}

Acceleration = 2.016×10^{-7} Unit ~~N/kg~~ m/s^2

Commentary for Student HH

The student has attempted some rearrangement of an equation (although there is no indication of what equation they are using), but has decided to multiply the two values together, which is incorrect and so gains no marks. There are no marks for giving their answer in standard form. However, the student has given the correct unit and so gains 1 mark.

Example 14: Trilogy Physics 1F Q7.2 / 1H Q2.2 (Standard demand AO2)

This question requires application of an equation from the equations sheet.

At this level of demand (and lower) we give a prompt ('Use the Physics Equations Sheet'). Students need to choose E = mL. The 'something extra' is a rearrangement – although there is also a unit conversion there.

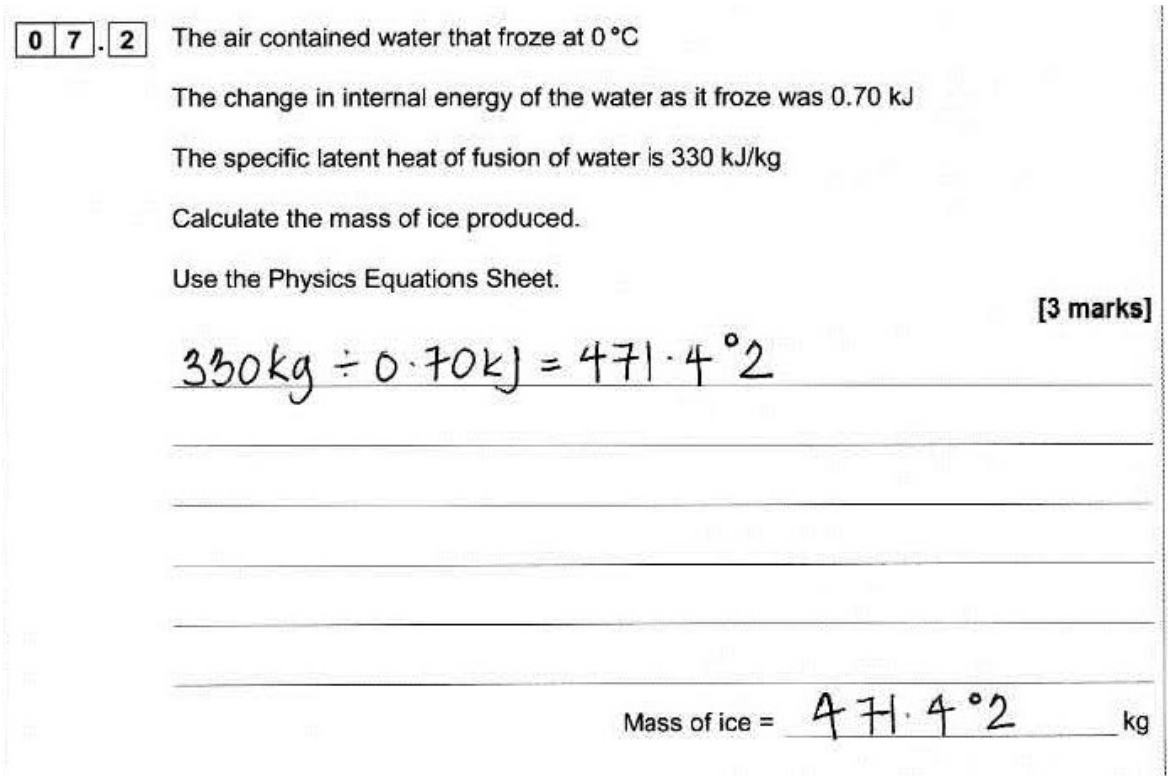
On the Foundation tier, only about 20% of students scored all 3 marks, with most not achieving anything. Some students didn't show an equation and just divided one number by the other – sometimes achieving the correct result. Others multiplied the two numbers and therefore didn't score. Some chose the wrong equation, while others multiplied or divided by zero, because it was in the question. Students who scored 2 marks had usually made an erroneous conversion of either kJ to J or kg to g. Many students tried to answer the question using the equation $E = m\ c\ \Delta\theta$, with 20 °C as their change in temperature, gaining 0 marks.

On the Higher tier about half were able to score all three marks – again the common reason for not getting all three was failure to correctly convert units.

Mark scheme

07.2		an answer of 0.0021(212121…) scores **3** marks		AO2.1 6.3.2.2 6.1.1.3
	0.70 = m × 330 **or** 700 = m × 330 000		1	
	$m = \frac{0.70}{330}$ **or** $m = \frac{700}{330\ 000}$	allow correct rearrangement using converted value(s) of E to J and/or L to J/kg	1	
	m = 0.0021 (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)	1	

Student II



0 7 . 2 The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

[3 marks]

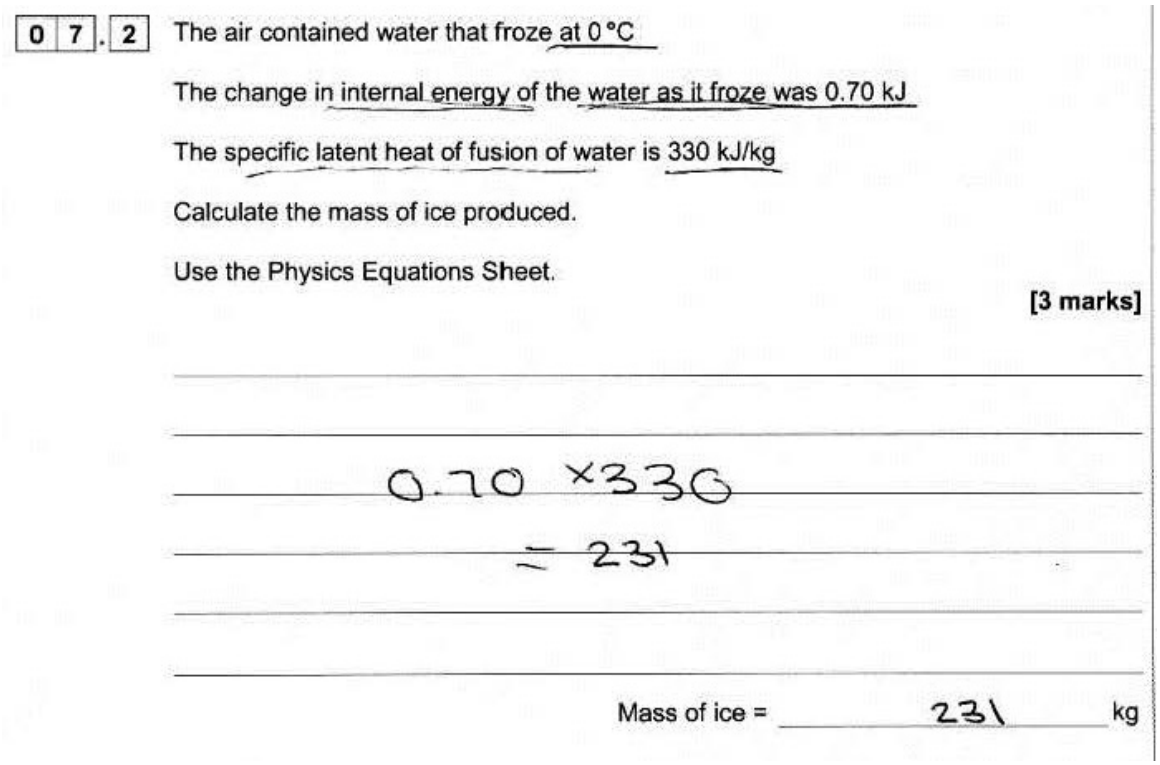
330kg ÷ 0·70kJ = 471·4°2

Mass of ice = 471·4°2 kg

Commentary for Student II

There is nothing worthy of credit in this response. There is no indication of what equation the student is using to calculate their answer: they have just divided one number by another. Although we do not ask students to write down the equation they have used, it is good practice to do so as it helps the examiner to see how they are working out their answer. There is no unit conversion.

Student JJ



0 7 . 2 The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

[3 marks]

0.70 ×330

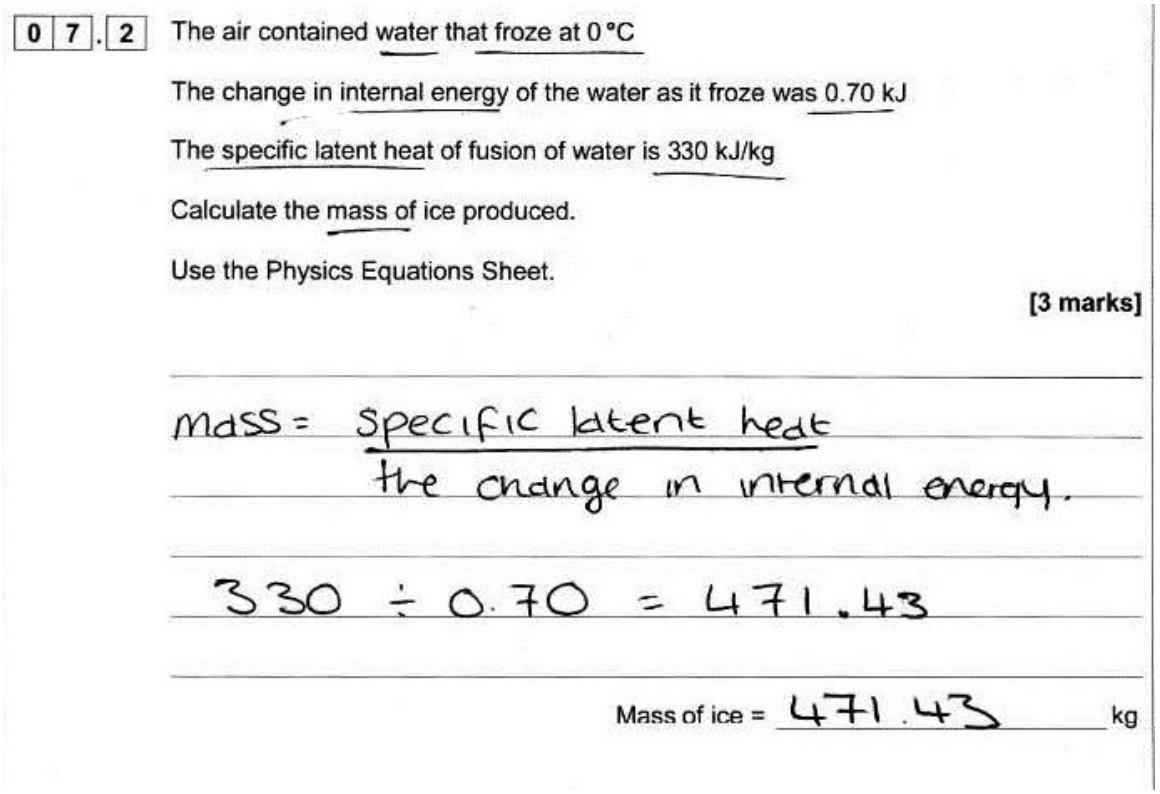
= 231

Mass of ice = 231 kg

Commentary for Student JJ

Again, there is indication of what equation the student is using to calculate their answer, and the student has simply multiplied two numbers together to get their answer. There is no unit conversion. This response gains no marks.

Student KK



0 7 . 2 The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

[3 marks]

mass = specific latent heat
the change in internal energy.

330 ÷ 0.70 = 471.43

Mass of ice = 471.43 kg

Commentary for Student KK

This student has clearly chosen the correct equation from the equations sheet, but there is no mark just for doing that: the marks are for using it correctly. The student has incorrectly rearranged the equation, and therefore cannot gain marks for substitution because the physics is incorrect. There is no attempt at unit conversion.

Example 15: Trilogy Physics 2H Q4.3 (Standard/High demand multi-step)

Mark scheme

04.3		an answer of 4.0 (A) scores **4** marks		AO2 6.7.2.2
	B = 0.360 (T)		1	
	0.072 = 0.360 × I × 0.050	allow a correct substitution using an incorrectly / not converted value of B	1	
	$I = \frac{0.072}{(0.360 \times 0.050)}$	allow a correct rearrangement using an incorrectly / not converted value of B	1	
	I = 4.0 (A)	allow a correct calculation using an incorrectly / not converted value of B	1	

Student LL

0 4 . 3 The length of the wire in the magnetic field is 0.050 m

The force on the wire is 0.072 N

magnetic flux density = 360 mT

Calculate the current in the wire.

Use the Physics Equations Sheet.

[4 marks]

0.050 ÷ 25.92 =

0.072 × 360 = 25.92

25.92 ÷ 0.050 = 518.4

Current = 518.4 A

Commentary for Student LL

There is nothing worthy of any marks in this response. There is no indication that this student has chosen the correct equation: they have simply multiplied magnetic flux density by the force and divided the answer by the length. There is no attempt at a unit conversion.

Student MM

0 4 . 3 The length of the wire in the magnetic field is 0.050 m

The force on the wire is 0.072 N

magnetic flux density = 360 mT

Calculate the current in the wire.

Use the Physics Equations Sheet.

[4 marks]

$F = B \times I \times L$

$L = \frac{F}{B \times I}$

$= \frac{0.072}{(0.050 \times 360)}$

$= 4 \times 10^{-3}$

Current = 4×10^{-3} A

Commentary for Student MM

This student has selected the correct equation (no marks for this, however). Although the rearrangement appears to have been done for L, they have substituted correctly and calculated correctly so have been given benefit of the doubt for their handwriting. There is no unit conversion, however, so this response gains 3 marks.

Example 16: Trilogy Physics 1H Q5.5 (High demand multi-step)

Mark scheme

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

Student NN

0 5 . 5 The power of the kettle was 2.6 kW

The kettle took 120 seconds to heat 0.80 kg of water from 18 °C to 100 °C

Calculate the specific heat capacity of water using this information.

Give your answer to 2 significant figures.

[6 marks]

$\Delta E = m c \Delta\theta$

$c = \frac{\Delta E}{m\Delta\theta}$

$= \frac{2.6 \times 120}{0.8 \times 82}$

$= \frac{312}{65.6}$

$= 4.756097561$

$= 4.7$

Specific heat capacity = 4.7 J/kg °C

Commentary for Student NN

This student has identified and correctly rearranged the equation from the Equations sheet. They have used the correct equation to calculate E (although haven't carried out a unit conversion, so only get MP1 here). They have substituted correctly into their rearranged equation, including the temperature change (MP3 and MP4) and calculated the answer (MP5). However, they haven't quoted their answer to the correct number of significant figures, so do not gain MP6, achieving a total of 4 marks.

Student 00

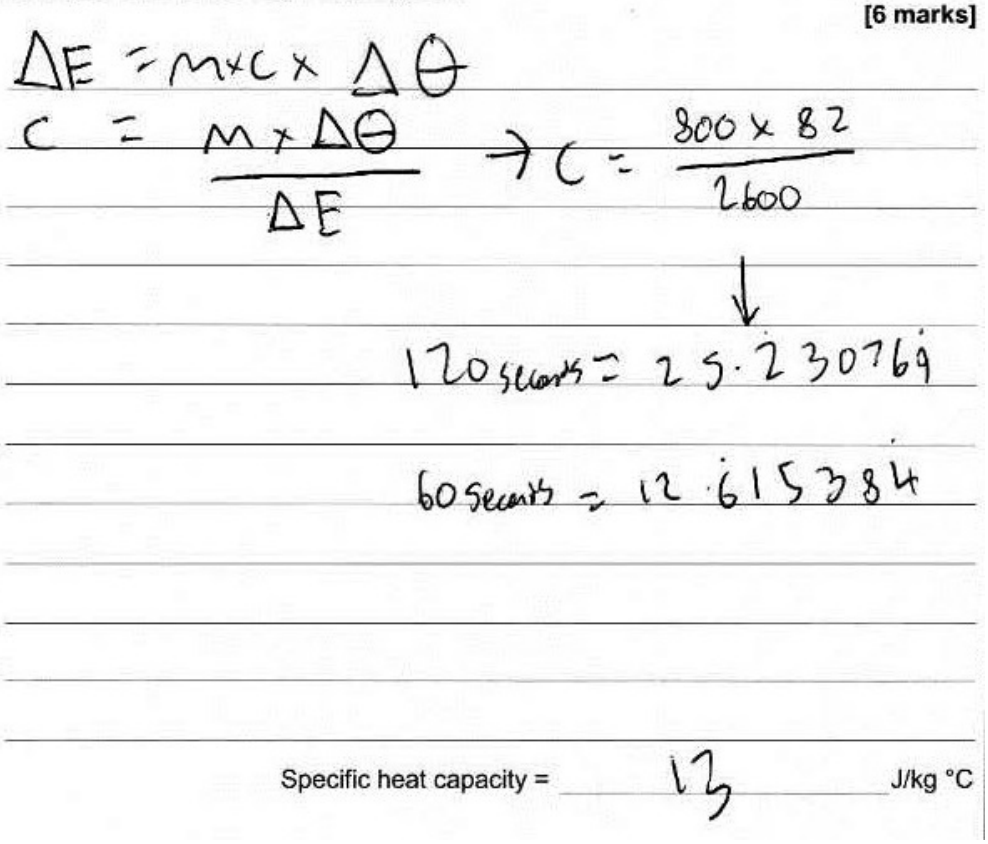
0 5 . 5 The power of the kettle was 2.6 kW

The kettle took 120 seconds to heat 0.80 kg of water from 18 °C to 100 °C

Calculate the specific heat capacity of water using this information.

Give your answer to 2 significant figures.

[6 marks]



Commentary for Student 00

This student has identified the correct equation, but has rearranged it incorrectly.

They have converted 2.6 kW correctly into 2600 W, but then have substituted that value into the equation as ΔE, which is incorrect. They have correctly calculated the temperature change (but there are no marks for that on its own) and multiplied it by the mass (which they have converted, incorrectly, from kilograms to grams). The decision to divide the answer by 2 to give a value for 60 seconds demonstrates no understanding. There is no indication here that the student knows what they need to do to find the specific heat capacity and no marks are gained.

Further examples from Combined Science

Trilogy Biology 1F Q4.3

Low demand application of the magnification equation. The equation (as given in the specification) is given in a rearranged form so what students need to do is a simple substitution (no transformation). There is also a unit conversion – the conversion factor is given for the students to use. Nearly half of Foundation Tier students managed to gain all 3 marks – the main reason for not doing so being not or incorrectly converting the units.

Trilogy Physics 1F Q2.7

Low demand application. Extra difficulty in that sig figs required: about 80% of students were able to do the substitution and calculation and get 2 marks, but the sig figs proved too much for most.

Synergy 2F Q1.8

Low demand application. Equation given and simple substitution only required. Most students able to gain the mark for this.

Synergy 3F Q1.8

Low demand application. Equation given, simple substitution required. Most students able to carry out the calculation, main reason for not getting 3 marks was incorrect choice of unit.

Synergy 1F Q5.4

Standard demand recall question 'Write down the equation that links' (density, mass, volume).

Trilogy Physics 1F Q5.6

Standard demand application of the recalled equation. The 'something extra' here involved a rearrangement of the equation to find h. Three quarters of students got nothing for this question. Even if they had been able to recall the equation correctly they seemed unable to rearrange it to find h. Some answers gave unfeasible numbers (eg 1mm or 1000m) – which should have prompted students to do a reality check on their calculation.

Trilogy Physics 1F Q6.6 / 1H Q1.6

Standard demand application question of recalled equation – again, the 'something extra' was a rearrangement to find R. On the F tier, nearly three quarters of students gained nothing for this although on the H tier most students got all three marks.

Trilogy Physics 2H Q6.2

High demand multi-step calculation. No prompts given as aimed at the most able. Students need to recall and rearrange two equations: acceleration = $\Delta v / t$, rearrange it to get acceleration. Then also recall $F = m a$, rearrange it to get m. As it is HD (targeting top students) there are no prompts. Nearly 30% got full marks.

Synergy 2H Q7.5

High demand multi step calculation to calculate wavelength from period and speed. No prompts given because aimed at the most able. Need to recall $v = f \lambda$, rearrange it to get λ. Then use equation from Equations sheet ($p = 1/f$) and rearrange to get f so can plug into rearranged recall question. Includes a unit conversion. About 14% got 4 marks – the most common reason for not getting 5 was missing the unit conversion.

Trilogy Biology 1H Q5.1

Standard/High demand application of magnification equation. At this level of demand students are not given the equation to use (they need to recall it) and they need to rearrange the equation (ie transformation) to get the answer. Nearly three quarters were able to get 3 marks – the main reason for not getting 4 was unit conversion.

GCSE Specification updates

The following is a summary of the updates to the GCSE Science specifications, which can be found on the subject pages of the AQA website.

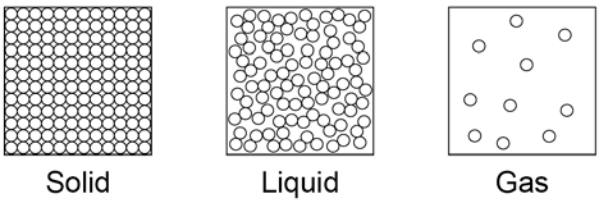
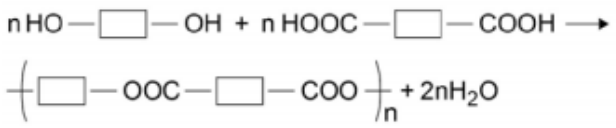
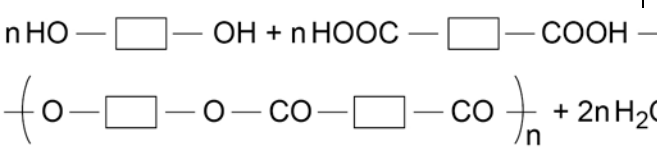
Clarification for 2020

We've clarified the expectation that knowledge and understanding of fundamental concepts and principles of chemistry may be examined in Chemistry Paper 2 of GCSE Chemistry and GCSE Combined Science: Trilogy. As this information was already outlined at the beginning of the specification subject content, this clarification will apply to exams sat in 2020 and onwards.

Specification	Section	Amendment
8462 GCSE Chemistry 8464 GCSE Combined Science: Trilogy	4 Subject content (introduction) 5 Chemistry subject content (introduction)	Amended to highlight content that may be examined in Paper 2: **Fundamental concepts and principles in chemistry** The concepts and principles in Sections 4.1, 4.2 and 4.3 are fundamental to an understanding of chemistry and underpin much of the content detailed in later sections of the specification. Students will be directly examined on these fundamental concepts in Paper 1. Students should be able to apply these concepts in their answers to some questions in Paper 2.
8462 GCSE Chemistry 8464 GCSE Combined Science: Trilogy	2.2 Assessments 2.2 Assessments	Added into box for Paper 2: Questions in Paper 2 may draw on fundamental concepts and principles from Sections 4.1-4.3.

Changes for 2021 exams and onwards

For exams due to be sat in 2021 and onwards, we've made a small number of changes to the content which are listed in the table below, by specification.

Specification	Section	Amendment
GCSE Chemistry (8462) GCSE Combined Science: Trilogy (8464) GCSE Combined Science: Synergy (8465)	4.2.2.1 The three states of matter 5.2.2.1 The three states of matter 4.1.1.1 A particle model	Artwork for liquid improved from  to 
GCSE Chemistry (8462) GCSE Combined Science: Trilogy (8464) GCSE Combined Science: Synergy (8465)	4.3.1.2 Relative formula mass 5.3.1.2 Relative formula mass 4.5.2.3 Relative formula mass	Added paragraph to clarify maths requirement in context of specification content: Students should be able to calculate the percentage by mass in a compound given the relative formula mass and the relative atomic masses
GCSE Chemistry (8462)	4.7.3.2 Condensation polymerisation (HT only)	Corrected spelling from ethane diol to ethanediol.
GCSE Chemistry (8462)	4.7.3.2 Condensation polymerisation (HT only)	Corrected artwork for formulae from  to 
GCSE Chemistry (8462)	4.7.3.3 Amino acids (HT only)	Correct formulae from $(\text{-HNCH}_2\text{COO-})_n$ and $n\ H_2O$ to $(\text{HNCH}_2\text{CO})_n$ and $n\,H_2O$

Specification	Section	Amendment
GCSE Chemistry (8462)	8.2.7 Required practical 7	Corrected reference to safe use of a Bunsen burner to AT2 instead of AT1.
GCSE Physics (8463)	4.3.2.3 Changes of heat and specific latent heat	Corrected heading to: 4.3.2.3 Changes of state and specific latent heat
GCSE Physics (8463) GCSE Combined Science: Trilogy (8464) GCSE Combined Science: Synergy (8465)	Appendix A: Physics equations Appendix B: Physics equations Appendix A: Physics equations	Corrected order of terms in the following equation to match symbol equation: potential difference across primary coil x current in primary coil = potential difference across secondary coil x current in secondary coil Vp Ip = Vs Is
GCSE Combined Science: Trilogy (8464) GCSE Combined Science: Synergy (8465)	6.2.4.3 The National grid 4.7.2.9 The National grid	Clarified requirement for transformer power equation given on equations sheet (equation 7): (HT only) Students should be able to select and use the equation potential difference across primary coil x current in primary coil = potential difference across secondary coil x current in secondary coil as given on the equation sheet. Detailed knowledge of the structure of a transformer is not required.
GCSE Combined Science: Synergy (8465)	4.1.1.5 Microscopy	Amended text to: Carry out calculations involving magnification, real size and image size including numbers written in standard form.
GCSE Combined Science: Synergy (8465)	4.7.1.8 Momentum (HT only)	Corrected spelling of mass: momentum = mass x velocity

Resources

Changes from the summer update are highlighted.
Please note that the science pages on the AQA website are being updated. Information in the following tables was correct at time of going to print, but some materials may have been relocated.

Previous Hub meetings

Meeting session	Material covered	Location
Summer 2019	How we assess AO3 at different levels of demand; using Legacy ISA materials as extra resource.	Available on current Hub page aqa.org.uk/subjects/science/hub-schools-network
Spring 2019	Marking extended response questions using student examples from Summer 2018.	Available on current Hub page aqa.org.uk/subjects/science/hub-schools-network
Autumn 2018	Discussion of student work from summer 2018 exams covering marking of complex calculations.	Available on current Hub page: aqa.org.uk/subjects/science/hub-schools-network
Summer 2018	What went well with the new GCSEs; what to expect on results day; using ERA to analyse results.	Archive of Hub materials: access from link on current Hub page or directly: aqa.org.uk/subjects/science/hub-schools-network/science-meeting-materials-archive
Spring 2018	Marking extended response questions.	Archive of Hub materials: Access from link on current Hub page or directly: aqa.org.uk/subjects/science/hub-schools-network/science-meeting-materials-archive
Autumn 2017	Discussion of practical work and AO2-focused questions.	Archive of Hub materials: access fromlink on current Hub page or directly: aqa.org.uk/subjects/science/hub- schools-network/science-meeting- materials-archive
Summer 2017	Discussions on maths in science. Required practicals, stretch and challenge.	Archive of Hub materials: access fromlink on current Hub page or directly: aqa.org.uk/subjects/science/hub- schools-network/science-meeting- materials-archive

Spring 2017	Sample high-demand questions, practical work, structure of the new papers, which includes explanation of how physics equationswill be assessed.	Archive of Hub materials: access fromlink on current Hub page or directly: aqa.org.uk/subjects/science/hub- schools-network/science-meeting- materials-archive

General information and guidance

Resource	Description	Location Plan/Teach/Assess are all found on the subject page of our website
Results insights	Reflections on the 2019 GCSE results, guidance on where to find subject-specific analysis, feedback events etc	aqa.org.uk/results-insights
Guidance on tiering	Ofqual's tiering decisions for 2019. Link to specific guidance on choosing the appropriate tier for yourstudents.	aqa.org.uk/news/updated- science-tiering-guide- foundation-or -higher Tiering guide and posteralso available on Plan
How the 9 to 1grading scale isapplied to GCSECombined Science	Updated information on awarding grades for the GCSE Combined Science specifications. A similar document is available directed at the separate science GCSEs.	Assess
Co-teaching combined scienceand separate sciences	List of topics common between combined science and each separate science. Shows extra content that is separates only.	Plan
Command word document	List of command words and an explanation of what is expected in a response.	Teach
Subject-specific vocabulary	Definitions of working scientifically terms.	Teach
Our examsexplained	Booklet covering the different typesof questions used in our papers.	Assess

Making questions clear	Booklet covering how we make our assessments accessible to students and how we develop questions during the question paper process.	Assess
Teaching guide: sample AO2 questions and mark	A simple explanation of what AO2 is and the type of questions that cover AO2. There are some suggestions.	Teach

Maths in science

Resource	Description	Location
Maths PowerPoints	Slides to incorporate into lessons to support the teaching of the maths skills.	Teach/Maths skills in GCSE
Sample questions: maths in science	Selection of questions taken from the 1st set of SAM which illustrate how the range of maths skills might be assessed at different levels of demand.	Teach/Maths skills in GCSE
GCSE Science: Delivering the mathematical requirements	Powerpoint looking at basic maths skills and putting them into a science context.	Teacher support tab of anyof the GCSE sciences onSecure Key Materials (e- AQA)
The language of mathematics in Science: A guide for teachers of 11-16 science	Guidance produced by the Association for Science Education, in conjunction with the Nuffield Foundation, intended to achieve common understanding of important terms and techniques related to the use of mathematics in the science curriculum. There is an associated book on teaching approaches.	Free to download from theASE website: ase.org.uk/mathsinscience

Practical work

Resource	Description	Location
Practical support for practicals and maths	Presentation and link to a web cast	Teach/Practicals
Technician Advisors	Practical experts with classroom experience, who can answer questions on setting up practical work-based lessons.	Teach/Practicals/Technician Advisors
Practical handbooks	Teacher and technician notes and student worksheets covering suggested methods for the required practicals.	Teach/Practicals
Practical work and learning outcomes	This summary shows possible aims and learning outcomes which teachers could use for each of the RPAs.	Spring 2017 Hub meeting
Teaching guide: effective use of practicals	Series of slides summarising all our information about practical requirements and a suggested teaching approach to make the most out of practical lessons.	Teach/Practicals
How practical skills are assessed	Selection of questions taken from the 1st set of SAM which illustrate how practical skills may be assessed for each of the AOs.	Teach/Practicals
Supporting effective practical work	Presentation on practical work based on the Combined Science practicals, which could also be used for separate sciences.	Teacher support tab for Combined Science on Secure Key Materials (e-AQA)

Entry Level Certificate

Resource	Description	Location
Co-teaching ELC and Combined Science: Trilogy, Co-teaching ELC and Combined Science: Synergy	Guidance on teaching ELC science with Foundation tier Combined Science.	Plan
ELC teaching guide	Background information on the course, suggestions for practical activities, supporting information on outcomes, keywords.	Teach
ELC Schemes of work	Guidance on teaching the individual components.	Teach
Specimen Teacher Devised Assignments	Example writing frames for TDAs for each component.	Assess
Maximising outcomes for Foundation learners	Guidance on co-teaching ELC with Foundation tier Combined Science.	Teacher support tab for ELC Science on Secure Key Materials (e-AQA)

Ofqual resources

Resource	Description	Location
Guide to GCSE results for England, 2019	Information about standards, grades, entry patterns in all GCSEs. Includes information about the 4-3 boundary in HT Combined Science and an infographic summarising all results.	gov.uk/government/news/guide-to-gcse-results-for-england-2019
Ofqual blog: 11 things we know about marking and 2 we don't … yet	Ofqual blog gives some insights into marking in UK exams from the regulator's point of view.	ofqual.blog.gov.uk/2019/03/05/14572/
Ofqual blog: how do we achieve fairness in exams?	Gives some insights on how Ofqual ensures that the qualifications system is fair.	ofqual.blog.gov.uk/2019/04/26/how-do-we -achieve- fairness-in-exams/
How grade boundaries are set	Video from Ofqual outlining the awarding process.	twitter.com/ofqual/status/1122417684946268160

Update on resources from Exampro

Available now

GCSE Required Practical Resources
- only £50 per annum
- downloadable word documents and powerpoints

GCSE Maths for Science question bank
- free with Exampro Science

GCSE Extended response exemplars - 'Highlights' from June 2018
- free access within the question bank

KS2/3 Transition Test (Y7 baseline assessment)
- hard copy printed papers available to order
- includes MERiT access

MERiT online mark entry and reporting tool
- analyse Mock results and compare performance to the wider population
- now includes the option to upload marks from a spreadsheet
- free with GCSE Science or Secondary Science packages

Coming soon

GCSE Extended response exemplars - 'Highlights' from June 2019.
- free access within the question bank

KS3/4 Transition Test
- free download with Exampro Science
- includes MERiT access

For more detail

see exampro.co.uk//science
email andy@exampro.co.uk

Notes

Notes

Notes

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