AQA
Realising potential

Challenging AOs
GCSE Maths spring hub network meeting

This meeting will be recorded

Exam boards have an Ofqual requirement to record event audio.

Recordings are kept for one year and not shared as an accompaniment to session resources.

The recording will begin now.

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Challenging AOs

Aspects of the GCSE assessment objectives addressing inference, interpretation and evaluation.

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Objectives

- To consider GCSE questions addressing aspects of AO2 and AO3 (inference, interpretation and evaluation) which students find/found challenging.

- To consider how we might support students in preparing for and overcoming these challenges.

Starter – using information to conjecture

The table below gives information about the amount of money, £A, some customers spent on an internet site in one day.

a. What questions could be asked?

b. With modifications, what questions could be asked?

Amount spent (£A)	Frequency
0< A≤ 20	11
20< A≤ 40	13
40< A≤ 60	25
60< A≤ 80	23
80< A≤ 100	24

Realising potential

Poster reminders

- Where's the algebra?
- Consider the converse
- Assumptions?
- What if?
- What do I see? What do I know? What do they want?

Difficult questions: introduction

The following are all questions from Practice Paper Set 3, summer '17 and November '17 that were not well answered and which test aspects of the assessment objectives around inference, interpretation and evaluation.

This area stood out more than any other aspect of the new GCSE as an area that appears to be particularly challenging for students.

Assessment Objective 1

Use and apply standard techniques

Students should be able to:
- accurately recall facts, terminology and definitions
- use and interpret notation correctly
- accurately carry out routine procedures or set tasks requiring multi-step solutions

Weighting: F 50% H 40%

Assessment Objective 2

Reason, interpret and communicate mathematically

Students should be able to:
- make deductions and inferences and draw conclusions from mathematical information
- construct chains of reasoning to achieve a given result
- interpret and communicate information accurately
- present arguments and proofs
- assess the validity of an argument and critically evaluate a given way of processing information

Weighting: F 25% H 30%

Assessment Objective 3

Solve problems within mathematics in other contexts

Students should be able to:
- translate problems in mathematical or non-mathematical contexts into a process or a series of mathematical processes
- make and use connections between different parts of mathematics
- interpret results in the context of the given problem
- evaluate methods used and results obtained
- evaluate solutions to identify how they may have been affected by assumptions made
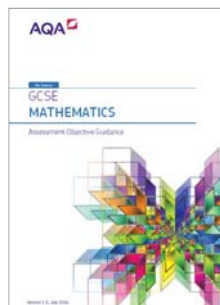
Weighting: F 25% H 30%

Assessment Objective guidance

allaboutmaths.aqa.org.uk/1355

Assessment Objective 2

Reason, interpret and communicate mathematically

Students should be able to:
- AO2.1 make deductions and **inferences** and draw **conclusions** from mathematical information
- AO2.2 construct chains of reasoning to achieve a given result
- AO2.3 **interpret** and **communicate** information accurately
- AO2.4 present **arguments** and **proofs**
- AO2.5 **assess the validity of an argument** and **critically evaluate a given way of processing information**

Weighting: F 25% H 30%

AO2: Reason, interpret and communicate mathematically

- **2.1 – Make deductions, inferences and draw conclusions from mathematical information**
- 2.1a – make deductions to draw conclusions from mathematical information
- 2.1b – make inferences to draw conclusions from mathematical information
- **2.2 – Construct chains of reasoning to achieve a given result**
- **2.3 – Interpret and communicate information accurately**

AO2: Reason, interpret and communicate mathematically

- 2.3a – interpret information accurately
- 2.3b – communicate information accurately
- **2.4 – Present arguments and proofs**
- 2.4a – present arguments
- 2.4b – present proofs
- **2.5 – Assess the validity of an argument and critically evaluate a given way of presenting information**
- 2.5a – assess the validity of an argument
- 2.5b – critically evaluate a given way of presenting information

AO2 by strand: AO2.1b

Using reasoning to make inferences. For it to be an inference, the solution must be likely but not definitive. This is often used in statistical questions, for example looking at a chart of monthly sales for the past year and drawing conclusions for future years, working out an estimate of the mean of grouped data, using relative frequencies to estimate probabilities.

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November 2H Q8-AO2.1b

The table shows information about the distances walked by 120 students on their way to school one week.

Distance, x (miles)	Frequency		
$0 < x \leqslant 5$	20		
$5 < x \leqslant 10$	48		
$10 < x \leqslant 15$	30		
$15 < x \leqslant 20$	22		
	Total = 120		

Work out an estimate for the mean distance.

[3 marks]

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PP3 2F Q27, 2H Q10-AO2.1b

A charity collection was made.
Information about the amounts given by men is shown in the table.

Amount, x (£)	Midpoint	Number of men	
$0 \leqslant x < 5$		11	
$5 \leqslant x < 10$		7	
$10 \leqslant x < 15$		2	
		Total = 20	

The mean amount given by **women** was £6.30 per person.

Compare the mean amounts given by men and women.

[4 marks]

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June 2F Q8d-AO2.1b

Here is a map of a town.

Scale: 1 cm represents 200 m

North

Park

Cinema   Library   Town Hall

Monument
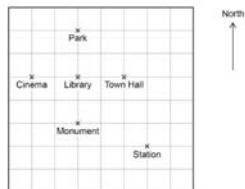
Station

8 (c)   What is the distance, in metres, from the Cinema to the Station?
[3 marks]

8 (d)   Why might the shortest **walking** distance from the Cinema to the Station be greater than your answer to part (c)?
[1 mark]

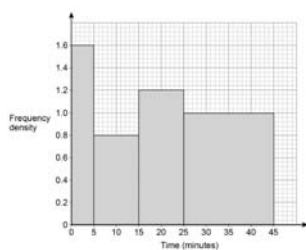19   Copyright © AQA and its licensors. All rights reserved.   AQA

June 2H Q24-AO2.1b

This histogram shows information about the times taken.

What do I see?
What do I know?
What do they want?

Frequency density (y-axis: 0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6)
Time (minutes) (x-axis: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45)

Work out an estimate of the interquartile range.
You **must** show your working.
[4 marks]

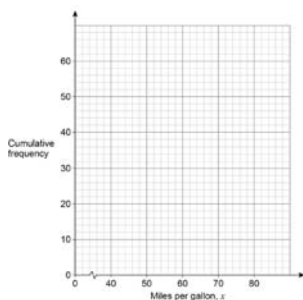20   Copyright © AQA and its licensors. All rights reserved.   AQA

November 1H Q22b-AO2.1b

Draw a cumulative frequency graph.
[3 marks]

Cumulative frequency (y-axis: 0, 10, 20, 30, 40, 50, 60)
Miles per gallon, x (x-axis: 40, 50, 60, 70, 80)

(b)   Use the graph to work out the interquartile range.
[2 marks]

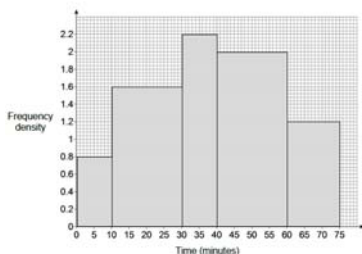21   Copyright © AQA and its licensors. All rights reserved.   AQA

PP3 1H Q22-AO2.1b

The histogram shows information about the times some students revised for a test.
The first bar represents students who revised for less than 10 minutes.

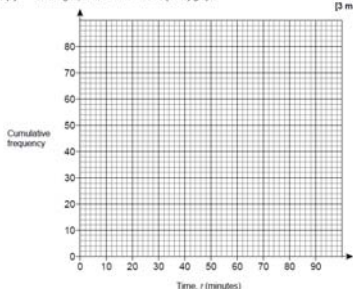Estimate the number of students who revised for less than 45 minutes.

[3 marks]

PP3 2H Q18b-AO2.1b

18 (a)   On the grid, draw a cumulative frequency graph.

[3 marks]

18 (b)   Estimate the number of teachers who took between 50 minutes and 70 minutes to travel to work.

[2 marks]

Specimen Papers 1H Q5

5   The scatter graph shows the age and the price of 18 cars.
The cars are all the same make and model.
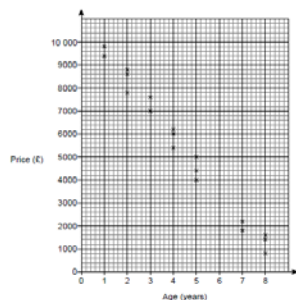
Use a line of best fit to estimate the price of a 6-year old car.

Answer £ _____

[2 marks]

AO2 by strand: AO2.5a

Assessing the validity of a given argument. Often the student will be given a statement with a (usually but not always) flawed reason:

- John thinks... because...
- Is he correct?
- Give a reason for your answer.

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AO2 by strand: AO2.5a

So if John's argument was flawed, it would be a common misconception that can easily be explained with a counter example or other simple reasoning.

Note that there has to be a statement with a reason given in the argument for the student to assess, not just a statement. If it were just a statement to verify then it is likely that AO2.1, AO2.2 or AO2.4a would be assigned depending on the complexity of the argument required.

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AO2: Reason, interpret and communicate mathematically

- **2.1 – Make deductions, inferences and draw conclusions from mathematical information**
- 2.1a – make deductions to draw conclusions from mathematical information
- 2.1b – make inferences to draw conclusions from mathematical information
- **2.2 – Construct chains of reasoning to achieve a given result**
- **2.3 – Interpret and communicate information accurately**

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AO2: Reason, interpret and communicate mathematically

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- **2.4 – Present arguments and proofs**
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- 2.4b – present proofs
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- **2.5a – assess the validity of an argument**
- 2.5b – critically evaluate a given way of presenting information

June 3F Q8d–AO2.5a

Here is information about the goals scored in some hockey games.
Each game has four quarters.

Goals in hockey games
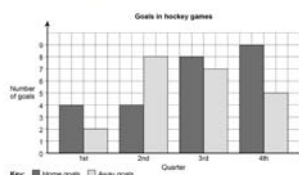
Key: ■ Home goals □ Away goals

8 (b)   There were 10 games.
Work out the mean number of goals per game.
[2 marks]

8 (d)   Rob says,
"More home teams **must** have won because there were more home goals."
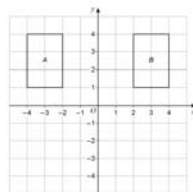Is he correct?
Give a reason for your answer.
[1 mark]

June 1H Q21a–AO2.5a

(a)   The diagram shows rectangles A and B.

Rectangle A can be mapped to rectangle B by a **single** transformation.
Javed says,
"The **only** single transformation is a reflection in the y-axis because the rectangles are on opposite sides of the y-axis."
Is he correct?
Tick a box.

Yes ☐   No ☐

Give a reason for your answer.
[1 mark]

November 2F Q17b–AO2.5a

Here is a formula to convert degrees Celsius (°C) to degrees Fahrenheit (°F).

$$F = 1.8C + 32$$

F is the number of degrees Fahrenheit
C is the number of degrees Celsius

The temperature is −15°C
Nick says,
  "Because the temperature is negative in Celsius, it **must** be negative in Fahrenheit."

Is he correct?
You **must** show your working.

[1 mark]

November 1H Q17–AO2.5a

A and B are **similar** solids.

Solid	length (cm)
A	l
B	$2l$

Alex says,
    "The volume of B is double the volume of A
     because the length of B is double the length of A."

Is he correct?
Tick a box.

Yes ☐   No ☐

Give a reason for your answer.

[1 mark]

PP3 2F Q25, 2H Q11–AO2.5a

The angles in triangle A are in the ratio 1 : 2 : 3
The angles in triangle B are in the ratio 4 : 5 : 6

Not drawn
accurately

Jack says,
    "The middle number in each ratio is one third of the total,
     so one of the angles in each triangle is 60 degrees"

Is he correct?
Show working to support your answer.

[2 marks]

Misconceptions and 'diagnostic' questions.

4    $a : b = 4 : 3$
Circle the correct statement.

[1 mark]

b is $\frac{4}{7}$ of a b is $\frac{3}{7}$ of a b is $\frac{4}{3}$ of a b is $\frac{3}{4}$ of a

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Any questions or suggestions?

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AO2 by strand

AO2.5b
Critically evaluating a given way of presenting information. This is likely to be an incorrectly drawn graph or chart or statistical diagram which the student has to evaluate and list errors. However, it could be used, for instance, to analyse a marketing claim on a new size of cereal box or a newspaper article presenting percentage changes based on some given data. It is possible that the information may be presented appropriately and that the student will need to say that the claim or article is fair.

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June 2F Q12a-AO2.5b

	Day 1	Day 2	Day 3	Day 4	Day 5
Temperature (°C)	30	26	17	22	20
Sales (£)	180	150	80	130	120

12 (a)   He drawn this scatter graph and line of best fit.

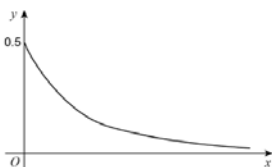**Ice cream sales and temperature**

Write down two mistakes he has made.

[2 marks]

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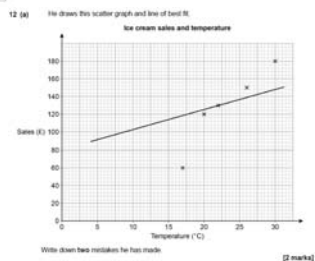
June 3H Q18-AO2.5b

18   Nick sketches the graph of $y = 0.5^x$ for $x > 0$

Make **one** criticism of his sketch.

[1 mark]

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November 3H Q23-AO2.5b

Joe draws this graph to identify the region R represented by

$y \leqslant x + 2$ and $y > 3 - x$ and $x < 3$
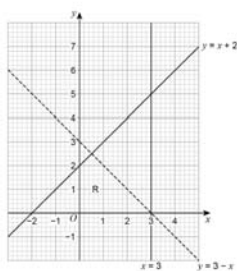
Make **two** criticisms of his graph.

[2 marks]

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PP3 3F Q15–AO2.5b

In a game, Anna has to describe a hexagonal prism.
She must **not** use the words 'hexagonal' or 'prism'.

She says,

"It has a uniform cross section.
It has 6 faces.
It has 12 vertices.
It has 12 edges."
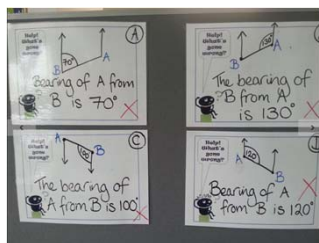
Correct any mistakes Anna has made.

[2 marks]

Ideas for the classroom: capture misconceptions

@TheMathsMagpie

"I really like to celebrate mistakes and misconceptions"

Template on TES:
tes.co.uk/teaching-resource/mistakes-are-perfect-learning-tools--poster-6344624

Discuss mistakes

Discuss mistakes

Algebraic expressions – misconceptions?

$3a + 2a$

$3a^2 \, means?$

$(3a^2)^2 \, means?$

$6 - 2(3 - x)$

$x^2 \times x^3 =$

$2x^2 \times 3x^3 =$

$x^0 = ?$

$\dfrac{9x^9}{3x^3} =$

$3a - a =$

- twice m
- 3 more than m
- 3 less than m
- m doubled
- a third of m
- the square of m

How many a's in ab?

Algebra cards

2a means	a² means	3a² means		3 x a x a	a x a	a + a or 2 x a
ab means	2ab means	a means 2		a ÷ 2	2 x a x b	a x b or a lots of b
(3a)² means	3(a + b) means	3a +2a is the same as....		5a	3 lots of a + b 3a + 3b	3a x 3a = 3 x a x 3 x a = 3 x 3 x a x a = 9a²
3a - a is not the same as 3. Why?	3a x 2b is the same as...	3a x 2a is the same as........		3a x 2a = 3 x a x 2 x a = 3 x 2 x a x a = 6a²	3a x 2b = 3 x a x 2 x b = 3 x 2 x a x b = 6ab	3a - a is 3a - 1a = 2a not 3

Algebra cards

Simplify $(3y^2)^3$	Simplify $\dfrac{6x^6}{3x^3}$	Simplify $3x + 2x^2 - x$
Factorise $3x + 6$	Expand $(x + 3)(x + 4)$	Simplify $3x^3 \times 4x^2$
Simplify $9^{\frac{1}{2}}$	Write as a fraction 2^{-2}	Solve $3x = 12$
Solve $\dfrac{x}{3} = 12$	Simplify $3x - x$	Solve $3x - 1 = 8$

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Algebra cards

What is the value of $3x^2$ When $x = -2$	$x + 2$ $\square$ What is the perimeter of this square?	Write $3^6 \div 3^3$ as a power of 3
Expand $(x + 1)(x - 1)$	Factorise $6a + 3$	Factorise completely $6x^2 + 9x$
Evaluate $3x^2 - 2x$ when $x = 3$	Evaluate $3x^2 + 2x$ when $x = -2$	Evaluate x^3 when $x = -2$
Simplify $3ab^2 \times 2a^2b^3$	Simplify $\dfrac{10b^3c^2}{5bc}$	Evaluate $9^{3/2}$

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Final question suggestions

- Where's the algebra
- Consider the converse
- Assumptions?
- What if?
- What do I see? What do I know? What do they want?
- Algebra- key facts cards
- Collect misconceptions
- Teach routine solutions – 'practice makes permanent'
- Use multi-choice diagnostics questions
- Encourage sentences – compare sentences
- Compare solutions

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How did we do?

Please take a moment to complete a brief evaluation form for today's event. Your feedback is very important to us as it helps us improve and plan future training.

You should have been emailed the evaluation form. Please check your inbox (possibly your junk mail folder). If you haven't received it please give your trainer your name, centre name/ number and email address so that we can look into it for you.

Thank you.

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Thank you