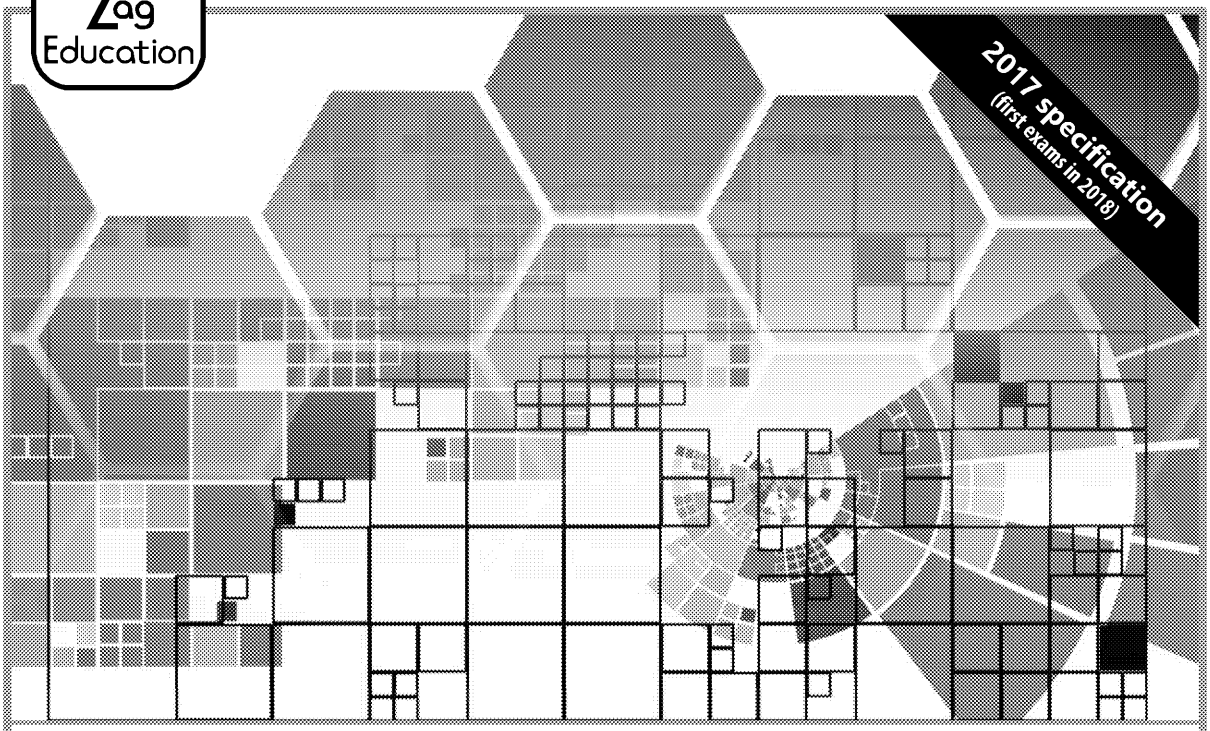
Zig Zag Education

Maths **AS / A Level | OCR A | H230/H240**



Topic Tests:
Expert Tests – Set B

For AS / A Level Year 1 OCR A Statistics and Mechanics

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Contents

Teacher's Introduction

Content

This pack contains 9 expert level topic tests and solutions for the OCR A Applied Mathematics AS / Year 1 A Level content.

Each test comes with fully worked solutions, containing helpful tips, hints, and technique boxes for students who are struggling on a particular question.

These topic tests have been **fully cross-referenced** to the Pearson, Hodder and Collins textbooks for your convenience (see reference sheet on page 2). Each test has been designed to reflect the specification fully.

About the expert tests

These **expert** tests have been designed to **prepare your students** for success in their exam. 25% of the marks come from questions similar in style to our fundamentals and challenge tests, giving all of your students a chance to show what they can do. The other 75% of the marks come from examination-style material, including compound and multistep questions that bring all parts of the topic together.

Suggested use of the A and B tests

Each test in Set A has a corresponding test in Set B that features the same styles of questions but with different numbers. This allows for a variety of **flexible** uses including:

- **Test → Homework**: Students use test B as a homework to consolidate on areas of weakness identified from completing test A under test conditions in class.
- **Homework → Test**: Students revise as homework using test A before doing test B in class under test conditions.
- **Test → Classwork**: Students work through test B with teacher input to consolidate on areas of weakness identified from completing test A under test conditions in class.
- **Classwork → Test**: Students work through test A with teacher input, before checking their learning by completing test B under test conditions.

Timings

The recommended times for students to complete each test are given at the top of individual tests. Suggested times for our entire range of topic tests are also compiled in a table on the timings sheet for convenience (see page 3). For these fundamentals tests, the relevant times are the first two listed under each topic.

Calculator use

The effective use of a calculator is one of the objectives of the new specification and is encouraged for all the enclosed tests. In particular, students should be comfortable using the statistical functions on their calculator.

The large data set

As part of their assessment, students will be tested on data from the **large data set** provided by OCR. This data set contains data on workers' commutes and the age structure of the England & Wales population from two years in various locations. Familiarity with the large data set is assumed in these topic tests, but a copy of it is not needed to take the tests themselves.

Also available from ZigZag Education

The perfect starting point for students of all abilities are our **fundamentals** tests. These isolate and test the core skills in each topic so that your students can show what they can do. They get a confidence boost and you can see at a glance where each student's weaknesses lie.

For students who are ready to go beyond the fundamentals, a complete set of **challenge** tests are available. 50% of the marks in these tests come from concepts covered in the fundamentals tests in order to reinforce learning and boost students' confidence, while the other 50% increases in difficulty and progresses the concepts covered.

Cross-referencing Grid

Topic	OCR A spec. points	Sub-topics	Edexcel Pearson textbook [ISBN: 9781292232539]
Data Collection	2.01a – d	Populations, samples, sampling, non-random sampling, types of data, the large data set	1
Measures of Location and Spread	2.02f – g	Measures of central tendency, other measures of location, measures of spread, variance and standard deviation, *coding (Edexcel only)*	2
Representations of Data & Correlation	2.02a – e, 2.02h – j	Outliers, box plots, cumulative frequency, histograms, comparing data, correlation, linear regression	3 - 4
Probability	2.03a – b	Calculations, mutually exclusive and independent events, Venn diagrams, tree diagrams	5
Statistical distributions	2.04a – c	Probability distributions, binomial distribution, cumulative probabilities	6
Hypothesis testing	2.05a – c	Hypothesis testing, finding critical values, one-tailed tests, two-tailed tests	7
Constant Acceleration	3.02a – d, 3.03f	Displacement-time graphs, velocity-time graphs, constant acceleration formulae, vertical motion under gravity	9
Modelling in Mechanics & Forces and Motion	3.01a – b, 3.03a – d, 3.03f – k, 3.03n, 3.03r	Force diagrams, forces as vectors, forces and acceleration, motion in 2 dimensions, connected particles, pulleys	8, 10
Variable Acceleration	3.02f	Functions of time, using differentiation, maxima and minima problems, using integration, constant acceleration formulae	11

Timings Sheet

For the **fundamentals** tests, refer to the tests marked X.1a and X.1b.
For the **challenge** tests, refer to the tests marked X.2a and X.2b.
For the **expert** tests, refer to the tests marked X.3a and X.3b.

Topic test reference	Recommended time (minutes)	Topic test reference	Recommended time (minutes)	
Data Collection		**Probability**		
1.1.a	12	4.1a	30	
1.1b	12	4.1b	30	
1.2a	9	4.2a	26	
1.2b	10	4.2b	26	
1.3a	1	4.3a	32	
1.3b	12	4.3b	32	
Measures of Location and Spread		**Statistical Distributions**		**M**
2.1a	28	5.1a	24	
2.1b	28	5.1b	24	
2.2a	31	5.2a	24	
2.2b	30	5.2b	24	
2.3a	34	5.3a	31	
2.3b	32	5.3b	31	
Representations of Data & Correlation		**Hypothesis Testing**		
3.1a	16	6.1a	17	
3.1b	16	6.1b	17	
3.2a	19	6.2a	17	
3.2b	19	6.2b	17	
3.3a	22	6.3a	17	
3.3b	22	6.3b	17	

Data Collection – Test B (12 mins)

Subtopics: Populations and samples, sampling, non-random sampling, types o

1. A head teacher wants to carry out a survey in his school. There are 25
school. The head teacher wants to be able to compare the responses fr
boys. He decides to take a sample of size 60.
   a) Describe how the head teacher could take a **stratified sample**.
   b) Describe how the head teacher could take a **quota sample**.
   c) The head teacher decides to use quota sampling. Give **three reas**

2. Here is some data based on the large data set, from districts of Yorksh

Local Authority / Unitary District	Percentage of 0–17-
Barnsley	21.
Calderdale	22.
Craven	19.
East Riding of Yorkshire	19.
Hambleton	19.
Harrogate	20.
Leeds	20.
North Lincolnshire	21.
Richmondshire	20.
Ryedale	19.
Scarborough	18.
Sheffield	20.
Wakefield	21.

Calculate the **mean** and **range** of the percentage of 0–17-year-olds in the
the Humber in 2011. Show your working clearly and give your answers c

3. Freddie takes a sample of the daily mean wind speed in June and July
is shown below.

Date	Daily Mean Wind
04/06/2015	3.8
09/06/2015	6.5
14/06/2015	4.5
19/06/2015	4.3
24/06/2015	3.8
29/06/2015	4.5
04/07/2015	2.8
09/07/2015	4.8
14/07/2015	3.5
19/07/2015	3.3
24/07/2015	3.0
29/07/2015	3.8

   a) W**pe** of sample has Freddie taken? Give a reason for your a
   b) Suggest a reason why Freddie used this type of sampling instead o

4. A teacher wants to find out the heights of the students in her class. She
   a) What are the sampling units for this sample?
   b) Suggest a sampling frame that the teacher could use.
   c) Is the data which the teacher is collecting qualitative or quantitativ
   d) Is this data discrete or continuous? Justify your answer.

Preview of Questions Ends Here

Solutions to Measures of Location and Spread – Test B

1. a) $\text{Mean} = \dfrac{2\times0+6\times1+9\times2+6\times3+3\times4+3\times5+1\times6}{2+6+9+6+3+3+1}$ **M1**

$= \dfrac{75}{30} = 2.5$ **A1**

Median $\dfrac{30+1}{2} = 15.5^{\text{th}}$ value, which is 2. **A1**

Mode = 2 **A1**

Range $= 6-0 = 6$ **A1**

b) The average of 3 and 2 is 2.5 which is the same as the original mean. **M1**

Hence the mean stays the same. **A1**

Median stays the same since it is now the $\dfrac{32+1}{2}$ $^{\text{th}}$ value in the new list w

2. a) $\text{Mean} = \dfrac{\sum x}{n} = \dfrac{4974}{30}$ $= 165.8 = 166$ grams (3 s.f.) **M1A1**

Standard Deviation $= \sqrt{\dfrac{\sum x^2}{n} - \left(\dfrac{\sum x}{n}\right)^2}$

$= \sqrt{\dfrac{832422}{30} - 165.8^2} = \sqrt{257.76} = 16.0549... = 16.1$ gra

b) Now, $n = 32$, $\sum x = 4974+166+171 = 5311$ **M1**

$\sum x^2 = 832422+166^2+171^2 = 889219$ **M1**

So mean $= 5311 \div 32 = 165.968... = 166$ grams (3 s.f.) **A1**

Standard Deviation $= \sqrt{\dfrac{889219}{32} - \left(\dfrac{5311}{32}\right)^2} = 15.5713... = 15.6$ grams (3 s.f.) **M**

3. a) $15 \le t < 16$ **A1**

b) Median is $\dfrac{32}{2} = 16^{\text{th}}$ value, lower quartile is $\dfrac{32}{4} = 8$, so 8$^{\text{th}}$ value and upper qua

The 16$^{\text{th}}$ value is $16-3-9 = 4$ out of 11 of the way through $15 \le t < 16$ **M1**

Therefore, the median is $\dfrac{4}{11}\times(16-15)+15 = 15.3636... = 15.4$ seconds (3 s.f.)

The 8$^{\text{th}}$ value is $8-3 = 5$ out of 9 of the way through $14 \le t < 15$ **M1**

Therefore, the lower quartile is $\dfrac{5}{9}\times(15-14)+14 = 14.5555... = 14.6$ seconds (3

The 24$^{\text{th}}$ value is $24-3-9-11 = 1$ out of 7 of the way through $16 \le t < 18$ **M1**

Therefore, the upper quartile is $\dfrac{1}{7}\times(18-16)+16 = 16.2857... = 16.3$ seconds (3

Interquartile range = Upper quartile − Lower quartile $= 16.2857... - 14.5555...$

$= 1.73015... = 1.73$ (3 s.f.) **A1**

c) The midpoints of the intervals, y, are: 13, 14.5, 15.5, 17 and 19 **M1**

$\sum fy = 3\times13+9\times14.5+11\times15.5+7\times17+2\times19 = 497$ **M1**

So estimate of mean $= 497 \div 32 = 15.53125 = 15.5$ seconds (3 s.f.) **A1**

d) $\sum fy^2 = 3\times13^2+9\times14.5^2+11\times15.5^2+7\times17^2+2\times19^2 = 7787$ **M1**

So estimate of stand. dev. $= \sqrt{\dfrac{\sum fy^2}{n} - \left(\dfrac{\sum fy}{n}\right)^2} = \sqrt{\dfrac{7787}{32} - \left(\dfrac{497}{32}\right)^2} = 1.45740$

e) The actual times taken are not known and so cannot be used in the calculations

4. There are 30 days in June so the median is the $\frac{30}{2} = 15^{th}$ value. **M1**

This is the $15 - 7 - 6 = 2^{nd}$ value in the interval $8 - 9$. **M1**

The interval $8 - 9$ actually ranges from 7.5 hours to 9.5 hours since the sunshine is re

So estimate of the median is $7.5 + \frac{2}{8} \times 2 = 8$ hours **M1A1**

Preview of Answers Ends Here