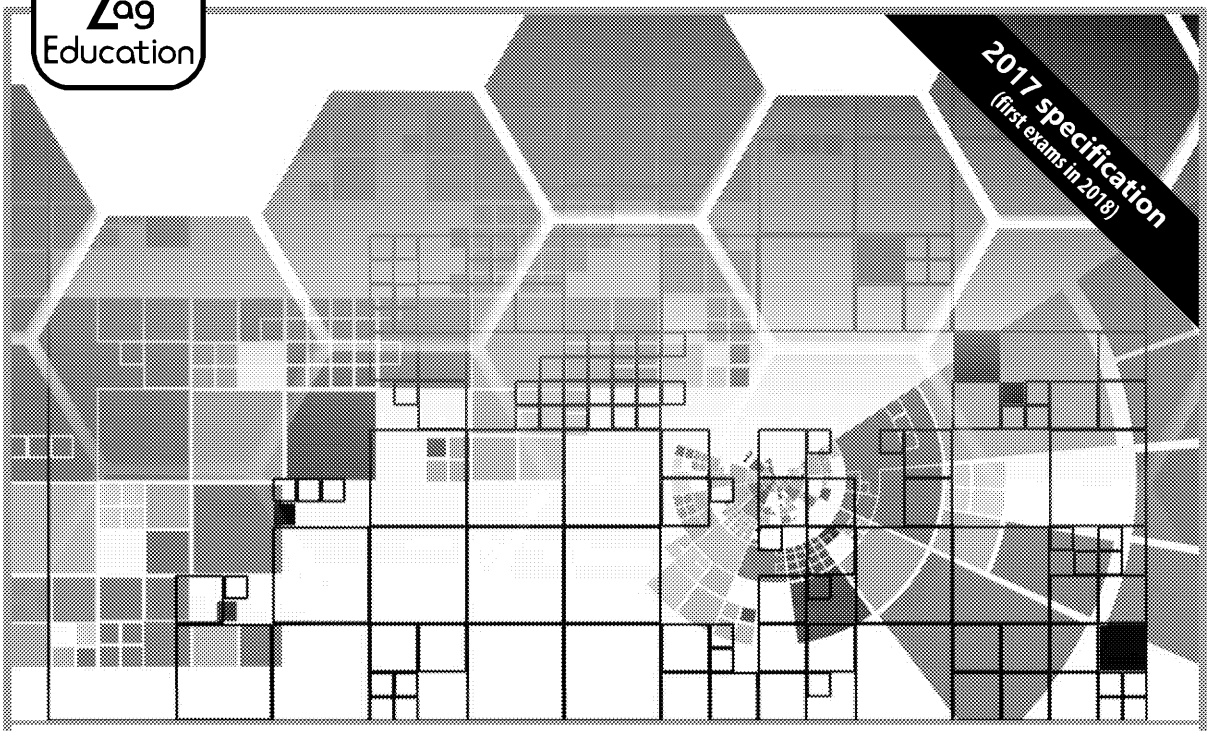
Zig Zag Education

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



Topic Tests: Fundamentals 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 fundamental level topic tests and solutions for the OCR A Applied Mathematics AS / Year 1 A Level content.

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 fundamentals tests

These **fundamentals** tests focus on isolating and testing the core skills of each topic. The questions are designed to use simple numbers and contexts **so that students can show what they can do,** and to allow them to easily identify any weaknesses.

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

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

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.

To prepare students for the exam itself, our **expert** tests contain 25% repeated marks from the fundamentals and challenge tests, and 75% exam-style material with compound/multistep questions.

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	

Constant Acceleration – Test B (22 mins)

Subtopics: Displacement–time graphs, velocity–time graphs, constant acceleration form
For this test you should take g = 9.8 m s^{-2} unless otherwise stated and give your ans

1. The diagram shows the displacement–time graph for a fox running in a straight line. Find:
   a) The **displacement** of the fox from its starting position after 6 seconds
   b) The average **velocity** of the fox in the first 4 seconds

2. The diagram shows the displacement–time graph for a van travelling a
   a) State the **displacement** of the van after 20 seconds.
   b) Find the **distance travelled** by the van in the 20 seconds.
   c) Find the average **velocity** of the van during these 20 seconds.
   d) Find the average **speed** of the van during these 20 seconds.

3. The diagram shows the velocity–time graph for a train as it is leaving a station. The train accelerates uniformly from rest to 30 m s^{-1} in 60 seconds. It then travels in a straight line at a constant velocity of 30 m s^{-1} for 90 seconds. Find:
   a) The **acceleration** of the train during the first 60 seconds
   b) The **distance travelled** by the train between $t = 60$ s and $t = 150$ s

4. A particle moves along a straight line. The particle accelerates uniformly from rest to a velocity of 3 m s^{-1} in 7 seconds. It then moves at a constant velocity of 3 m s^{-1} for 20 seconds. It then takes 12 seconds to decelerate uniformly to rest at point B. Sketch a velocity–time graph to illustrate the motion of the particle.

5. A runner starts the final sprint of a race along a straight track with velocity 8 m s^{-1} and accelerates at a constant rate of 0.4 m s^{-2} for 10 seconds before crossing the finish line.
   a) The runner's **velocity** when he crosses the finish line
   b) The **distance travelled** by the runner in the 10 seconds before he crosses the finish line

6. A plane travels along a straight horizontal runway. The plane accelerates from rest with constant acceleration 4.5 m s^{-2} for a distance of 900 m before it takes off. Find the time it reaches the point of take-off.

7. A skier is moving along a flat surface with constant deceleration 2.5 m s^{-2}. She crosses the point A with velocity 10 m s^{-1}. At time $t = 2$ s, the skier is at point B. Find the distance **from A to B**.

8. A stone is dropped from a cliff top 20 m above the ground. Modelling the stone as falling freely under gravity, with initial velocity 0 m s^{-1}, find the **time taken** for the stone to reach the ground.
   For this question, take g = 10 m s^{-2}.

9. Brenda projects a ball vertically upwards with velocity 4 m s^{-1}. Find the maximum height above its point of projection.

10. The diagram shows the velocity–time graph of a particle accelerating in a straight line with acceleration, a m s^{-2}. Using the diagram, derive the formula for:
    a) The final velocity of the particle, $v = u + at$ **[2]**
    b) The total distance travelled by the particle, $s = \left(\frac{u+v}{2}\right)t$ **[2]**

Preview of Questions Ends Here

Solutions to Hypothesis Testing – Test B

1. a) The null hypothesis, H_0, is the hypothesis that you assume to be correct. **A1**
   b) The alternative hypothesis, H_1, tells you about the population parameter if your assumption is shown to be wrong. **A1**

2. a) One-tailed **A1**
   b) One-tailed **A1**
   c) Two-tailed **A1**

3. a) The test statistic is the number of people who say they support the development plan. **A1**
   b) H_0: $p = 0.3$ **A1**
   H_1: $p < 0.3$ **A1**
   c) There is enough evidence to reject the null hypothesis, assuming that $p = 0.3$, if the number of people saying they support the development plan is less than 5%. **A1**

4. A critical value is: the first value of the probability distribution to fall inside the critical region **OR** the first value that the test statistic equals it, causes you to reject the null hypothesis.

5. **Method 1:**
   Assume H_0 is true, then $X \sim B(25, 0.4)$ **M1**
   $P(X \leq 6) = 0.0736$ [using tables or calculator] **A1**
   $0.0736 > 0.05$ so there is not enough evidence to reject H_0 **A1**
   Method 2:
   Let c be the critical value.
   $P(X \leq c) \leq 0.05$ **(M1)**
   $P(X \leq 5) = 0.0294 < 0.05$
   $P(X \leq 6) = 0.0736 > 0.05$
   So the critical region is $X \leq 5$ **(A1)**
   The observed value of 6 does not lie in the critical region so H_0 is not rejected. **(A1)**

6. Assume H_0 is true, then $X \sim B(30, 0.3)$ **A1**
   $P(X \geq 13) = 1 - P(X \leq 12) = 1 - 0.9155 = 0.0845$ **M1**
   $P(X \geq 14) = 1 - P(X \leq 13) = 1 - 0.9599 = 0.0401$ **M1**
   The critical region is $14 \leq X \leq 30$ **A1**

7. **Method 1:**
   Assume H_0 is true, then $X \sim B(20, 0.4)$ **M1**
   $P(X \leq 5) = 0.1256$ **A1**
   The test is two-tailed; therefore, we test at significance level 0.05
   $0.1256 > 0.05$ **M1**
   There is insufficient evidence to reject H_0 **A1**
   Method 2:
   Let c_1 and c_2 be the two critical values.
   $P(X \leq c_1) \leq 0.05$ and $P(X \geq c_2) \leq 0.05$ **(M1)**
   For the lower tail:
   $P(X \leq 3) = 0.0160 < 0.05$
   $P(X \leq 4) = 0.0$[illegible]
   So c_1 =
   For the upper tail:
   $P(X \geq 12) = 1 - P(X \leq 11) = 1 - 0.9437 = 0.0563 > 0.05$
   $P(X \geq 13) = 1 - P(X \leq 12) = 1 - 0.9790 = 0.0210 < 0.05$
   So $c_2 = 13$ **(A1)**
   The critical regions are $0 \leq X \leq 3$ and $13 \leq X \leq 20$.
   The observed value of 5 does not lie in a critical region so H_0 is not rejected. **(A1)**

Preview of Answers Ends Here