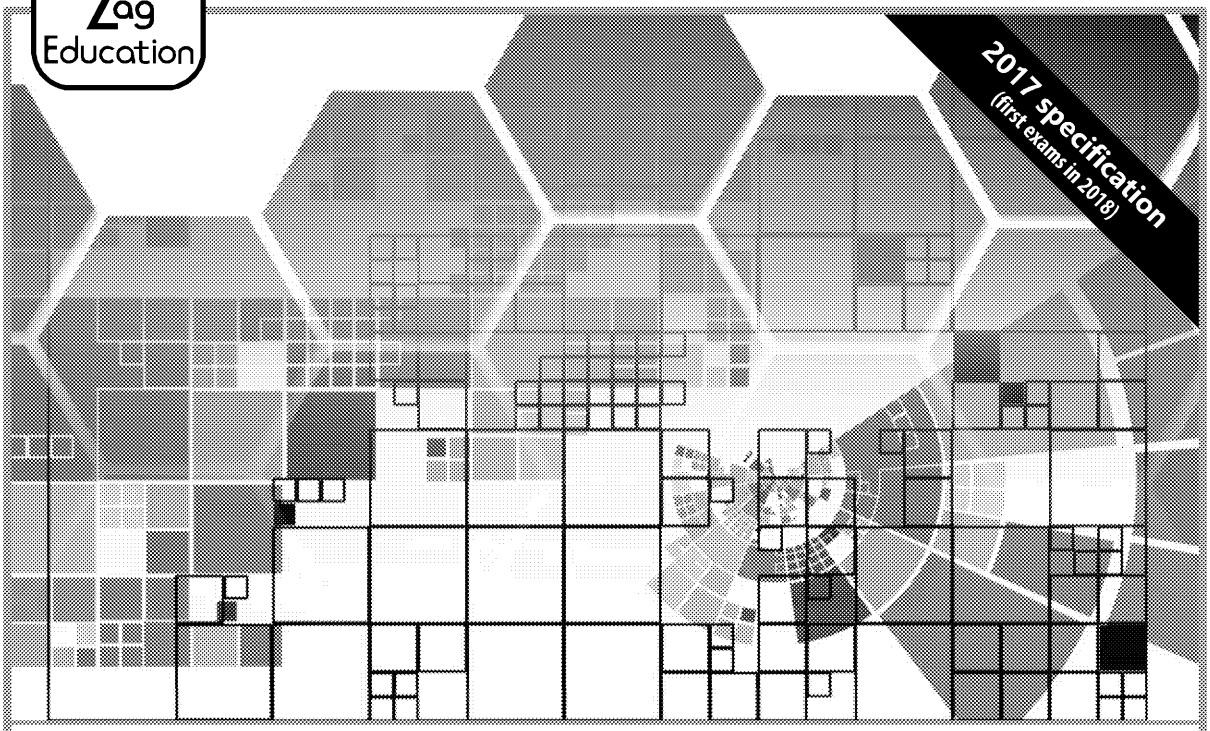
Zig Zag Education

**Maths** **AS / A Level | AQA | 7356/7357**




# Topic Tests: Expert Tests – Set A

## For AS / A Level Year 1 AQA Statistics and Mechanics

**zigzageducation.co.uk**

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# Contents

# Teacher's Introduction

## Content

This pack contains 9 expert level topic tests and solutions for the AQA 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.

## Timings

The recommended times for students to complete each test are given at the top of individual tests.

## 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 AQA. This data set contains data on household food and drink purchases from various locations in England between 2001 and 2014. 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.

For each collection of Set A tests we also offer a corresponding collection of Set B duplicated tests with the same styles of questions but 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.

For total flexibility, the Set A and Set B tests of all three levels can be run on a rolling basis, using the fundamentals tests as starters, with a time interval between them, leaving one expert level test to use at the end of the course for topic revision.



 

# Cross-referencing Grid

| Topic | AQA spec. points | Sub-topics | Edexcel Pearson textbook [ISBN: 9781292232539] |
|---|---|---|---|
| Data Collection | K1 | Populations, samples, sampling, non-random sampling, types of data, the large data set | 1 |
| Measures of Location and Spread | L3 | Measures of central tendency, other measures of location, measures of spread, variance and standard deviation, *coding (Edexcel only)* | 2 |
| Representations of Data & Correlation | L1 – L2, L4 | Outliers, box plots, cumulative frequency, histograms, comparing data, correlation, linear regression | 3 - 4 |
| Probability | M1 | Calculations, mutually exclusive and independent events, Venn diagrams, tree diagrams | 5 |
| Statistical distributions | N1 | Probability distributions, binomial distribution, cumulative probabilities | 6 |
| Hypothesis testing | O1 – O2 | Hypothesis testing, finding critical values, one-tailed tests, two-tailed tests | 7 |
| Constant Acceleration | Q1 – Q3, R3 | Displacement-time graphs, velocity-time graphs, constant acceleration formulae, vertical motion under gravity | 9 |
| Modelling in Mechanics & Forces and Motion | P1, R1 – R4 | Force diagrams, forces as vectors, forces and acceleration, motion in 2 dimensions, connected particles, pulleys | 8, 10 |
| Variable Acceleration | Q4 | Functions of time, using differentiation, maxima and minima problems, using integration, constant acceleration formulae | 11 |

## Constant Acceleration – Test A (21 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 horse running i straight line. Find:
   a) The **displacement** of the horse from its starting position after 10 seconds
   b) The average **velocity** of the horse in the first 5 seconds

2. The diagram shows the displacement–time graph for a car travelling al
   a) State the **displacement** of the car after 8 second
   b) Find the **distance travelled** by the car in a 8 seconds.
   c) Find the average **velocity** of the during these 8 seconds.
   d) Find the average **spee** during these 8 seconds.

3. A particle mo a straight line. The particle starts from rest at p accele 0.8 m s$^{-2}$ for 20 seconds. The velocity the particle has rea maintained for $T$ seconds. The particle then decelerates constantly for point $B$.
   a) Sketch a **velocity–time graph** to illustrate the motion of the partic
   b) Given that the distance from $A$ to $B$ is 960 m, find the value of $T$.

4. A car is travelling along a straight road from point $X$ to point $Z$ via poi constant acceleration. The velocity of the car at point $X$ is 25 m s$^{-1}$, an point $Y$ is 34 m s$^{-1}$. The car takes 6 seconds to travel from $X$ to $Y$.
   a) Find the **acceleration** of the car.
   b) Given that the velocity of the car at point $Z$ is 40 m s$^{-1}$, find the **di**

5. Two boats $M$ and $N$ are moving in the same direction along a straight c both pass a signpost $S$. Boat $M$ travels at a constant speed of 1.2 m s$^{-1}$ 0.8 m s$^{-1}$ and constant acceleration 0.2 m s$^{-2}$. Find the time when $N$ **o**

6. Fiona is walking along a straight horizontal road with constant acceler $a$ m s$^{-2}$. After $T$ seconds she has a velocity $V$ m s$^{-1}$, having travelled a $D$ metres during these $T$ seconds. Using the velocity–time graph for F motion for $0 \le t \le T$, show that $D = VT - \frac{1}{2}aT^2$.

7. A ball $A$ is thrown vertically downwards with speed 8 m s$^{-1}$ from the r block. At the same time, another ball $B$ is thr ve tically upwards f 16 m s$^{-1}$. The balls collide. Find the ig. **bove the ground** where

8. The diagram shows a ity- ime graph for part of a train's journey. The train trav straight line, and its total distance travelled after 50 sec 1000 m.
   a) Fi e velocity marked on the graph as $v$.
   b) Find the acceleration of the train **between $t = 20$ s and $t = 30$ s**.

9. Adrian projects a ball vertically upwards from a point 1 m above the g 12 m s$^{-1}$. Find:
   a) The **greatest** height of the ball above its point of projection
   b) The **total time of flight** of the ball, assuming it hits the ground

## Preview of Questions Ends Here

## Solutions to Hypothesis Testing – Test A

1. Assume $H_0$ is true, then $X \sim B(9, 0.25)$ **A1**
   $P(X \geq 4) = 1 - P(X \leq 3) = 1 - 0.8343 = 0.1657$ **M1**
   $P(X \geq 5) = 1 - P(X \leq 4) = 1 - 0.9511 = 0.0489$ **M1**
   The critical region is $5 \leq X \leq 9$ **A1**

2. **Method 1:**
   Assume $H_0$ is true, then $X \sim B(20, 0.15)$ **M1**
   $P(X \leq 2) = 0.4049$ **A1**
   The test is two-tailed; therefore, we test at significance level 0.05
   $0.4049 > 0.05$ **M1**
   There is not significant 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:
   $P(X = 0) = 0.0388 < 0.05$
   $P(X \leq 1) = 0.1756 > 0.05$
   So $c_1 = 0$ **A1**
   For the upper tail:
   $P(X \geq 6) = 1 - P(X \leq 5) = 1 - 0.9327 = 0.0673 > 0.05$
   $P(X \geq 7) = 1 - P(X \leq 6) = 1 - 0.9781 = 0.0219 < 0.05$
   So $c_2 = 7$ **A1**
   The observed value of 2 does not lie in the critical region so $H_0$ is not rejected. **A1**

3. a) The test statistic is the number of people who drive a black car. **A1**
   b) $H_0$: $p = 0.45$ **A1**
      $H_1$: $p < 0.45$ **A1**
   c) The null hypothesis will be rejected if, assuming that $p = 0.45$, the probability of drive a black car is less than 10%. **A1**

4. a) The number of times the machine fails **A1**
   b) $H_0$: $p = 0.4$ **A1**
      $H_1$: $p < 0.4$ **A1**
   c) $X \sim B(15, 0.4)$ **A1**
      $P(X \leq 3) = 0.0905$
      0.0095 away from 0.1 **M1**
      $P(X \leq 4) = 0.2173$
      0.1173 away from 0.1 **M1**
      3 is the critical value
      So the critical region is $X \leq 3$ **A1**
   d) The actual significance of the test is 0.0905 = 9.05% **A1**

5. $X$ is the number of women who use 'Daisy',
$p$ is the probability a woman uses 'Daisy' **A1**
$H_0 : p = 0.1$, $H_1 : p \neq 0.1$ **A1**
**Method 1:**
Assume $H_0$ is true, then $X \sim B(50, 0.1)$ **A1**
41/50 do not use the perfume, so 9/50 do use the perfume **M1**
$P(X \geq 9) = 1 - P(X \leq 8) = 1 - 0.9421 = 0.0579$ **M1**
$0.0579 > 0.025$
There is not sufficient evidence to reject $H_0$ **A1**
No evidence that the claim is wrong **A1**
**Method 2:**
Let $c_1$ and $c_2$ be the two critical values.
$P(X \leq c_1) \leq 0.025$ and $P(X \geq c_2) \leq 0.025$ **(M1)**
For the lower tail:
$P(X = 0) = 0.0052 < 0.025$
$P(X \leq 1) = 0.0338 > 0.025$
So $c_1 = 0$ **(A1)**
For the upper tail
$P(X \geq 8) = P(X \leq 8) = 1 - 0.9327 = 0.0579 > 0.025$
$P(X \geq 10) = 1 - P(X \leq 9) = 1 - 0.9755 = 0.0245 < 0.025$
So $c_2 = 10$ **(A1)**
The observed value of 9 does not lie in the critical region so $H_0$ is not rejected. **(A2)**

6. a) $X \sim B(25, 0.8)$ where $X$ is the number who recover **A1**
b) **Method 1:** using binomial probability function on calculator
$x = 19$, $n = 25$, $p = 0.8$ **M1**
$P(X = 19) = 0.163345... = 0.163$ (3 s.f.) **A1**

**Method 2:** using binomial probability formula $P(X = r) = \binom{n}{r} p^r (1-p)^{n-r}$

$r = 19$, $n = 25$, $p = 0.8$
$P(X = 19) = \binom{25}{19} \times 0.8^{19} \times (1-0.8)^{25-19}$ **M1**
$= 0.163345... = 0.163$ (3 s.f.) **A1**

c) Let $Z$ be the number of patients out of 40 who recovered
Let $p$ be the probability the new medicine is successful on a patient
$Z \sim B(40, 0.8)$ **A1**
$H_0$: $p = 0.8$ **A1**
$H_1$: $p < 0.8$ **A1**
$P(Z \leq 26) = 0.0194073... = 0.0194$ (3 s.f.) **M1**
$0.0194 < 0.02$ so there is enough evidence to reject $H_0$ **A1**
The percentage of patients who recover after taking the new medicine is lower

## Preview of Answers Ends Here