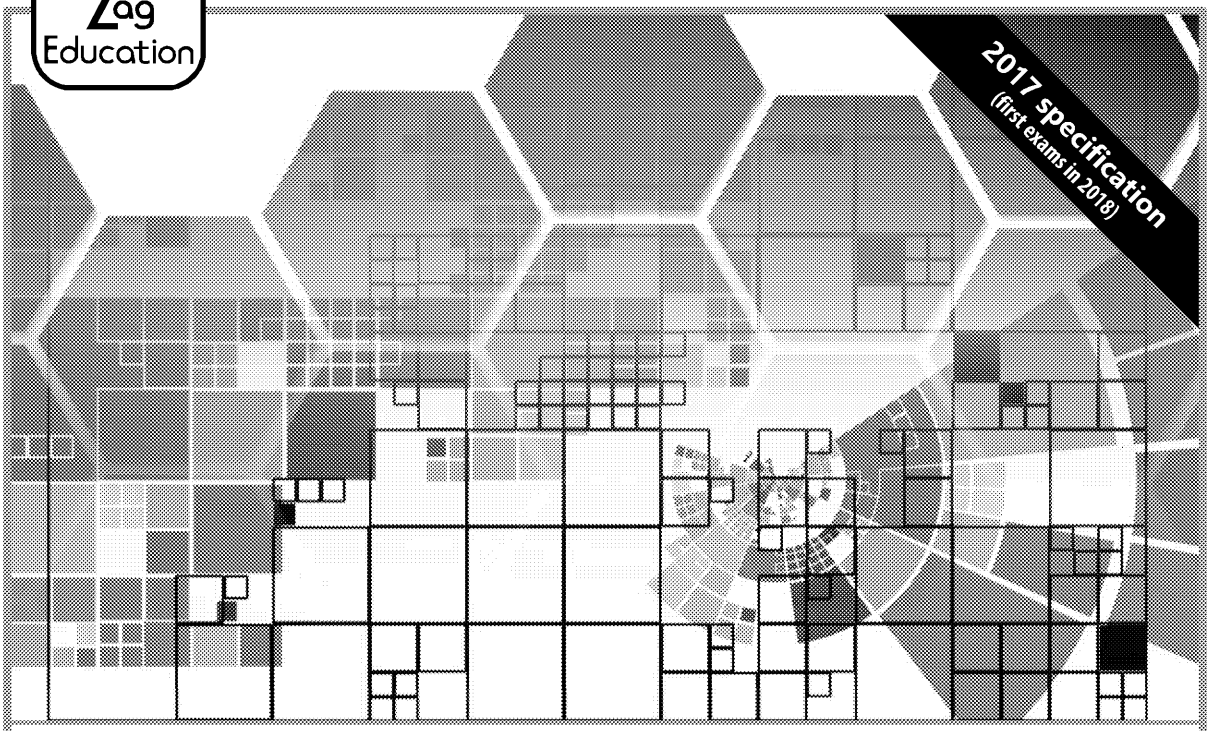
Zig Zag Education

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



Topic Tests:
Expert Tests – Set A

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

zigzageducation.co.uk

POD 8687

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.

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 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.

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	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

Probability – Test A (32 mins)

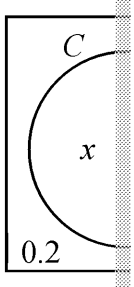
Subtopics: Calculations, mutually exclusive and independent events, Venn d

1. In a class of students, the probability that a randomly selected student likes rock music (R) is 0.3. The probability that they like pop music (P) is 0.6. Given that these events are **independent**, copy and complete the Venn diagram shown by finding the values of a, b, c, and d. **[3]**

2. Isaac randomly shuffles a deck of 52 cards. Half the cards are red and h card from the deck, notes its colour, and does **not** r[illegible]lace it. He then d deck, and notes its colour.
   a) Draw a tree diagram to repre[illegible] outcomes of this experiment.
   b) Find the probability that a[illegible] one of the cards is red.

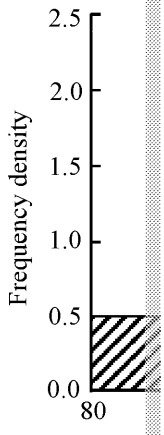
3. Two e[illegible] X and Y, occur with probability P(X) = 0.3 and P(Y) = 0.5 P(X an[illegible]hen:
   a) X and Y are **independent**
   b) X and Y are **mutually exclusive**

4. The Venn diagram represents the probability that a randomly chosen c have purchased: a mobile phone (M), a phone case (C), and phone insu
   a) Given that P(M) = 0.65, copy and complete the Venn diagram. **[3]**
   b) Find the probability that a randomly selected customer purchased **exactly one item**. **[2]**
   c) Find the probability that a randomly selected customer purchased **exactly two items**. **[2]**
   d) Show by calculation that M and I are **not independent**. **[3]**



5. A bag contains 5 red beads, 6 green beads and 9 blue beads. Shannon s one at a time, and notes their colour. Find the probability that all 3 bea
   a) Shannon **replaces** each bead after noting its colour. Give your an
   b) Shannon does **not** replace each bead after noting its colour. Give y

6. Lucille measures the heights of her 50 cla[illegible]tes. She plots the data as a histogram.
   a) Find the probability that a randomly selected student is **10[illegible] or less** in height. **[2]**
   b) E[illegible]e t[illegible] probability that a randomly selected stu[illegible]s **105 cm or more** in height. **[3]**
   c) Why might your estimate for part b) be inaccurate? **[1]**



Preview of Questions Ends Here

1. $y+\frac{1}{10}+\frac{1}{10}+\frac{1}{10}+\frac{4}{10}+\frac{1}{10}=1$ **M1**

$y+\frac{8}{10}=1, \quad \therefore y=1-\frac{8}{10}=\frac{2}{10}=\frac{1}{5}$ or 0.2 **A1**

2. a) **Method 1:** using binomial probability function on calculator

$x=6, n=15, p=0.43$ **M1**

$\mathrm{P}(X=6)=0.200950...=0.201$ (3 s.f.) **A1**

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

$r=6, n=15, p=0.43$

$\mathrm{P}(X=6)=\binom{15}{6}\times 0.43^6\times(1-0.43)^{9}$ **M1**

$=0.200950...=0.201$ (3 s.f.) **A1**

b) $x=15, p=0.43$ **M1**

$\mathrm{P}(X\leq 4)=0.154551...=0.155$ (3 s.f.)

[using binomial cumulative probability function on calculator] **A1**

c) $\mathrm{P}(X>10)=1-\mathrm{P}(X\leq 10)$ **M1**

$x=10, n=15, p=0.43$

$\mathrm{P}(X\leq 10)=0.982590...$

[using binomial cumulative probability function on calculator]

$\therefore \mathrm{P}(X>10)=1-0.982590...=0.0174097...=0.0174$ (3 s.f.) **A1**

d) $n=15, p=0.43$

x	$\mathrm{P}(X\leq x)$
0	$2.17832...\times10^{-4}$
1	$2.68278...\times10^{-3}$
2	0.0156994…
3	0.0582509…

M1

$0.0156994... < 0.05 < 0.0582509...$

$\therefore k=2$ **A1**

3. The dice must be fair, i.e. the probability of each result must be the same **B1**

4. a) $\mathrm{P}(X<6)=\frac{5}{20}=\frac{1}{4}$ or 0.25 **B1**

b) $\mathrm{P}(4<X\leq 10)=\frac{6}{20}=\frac{3}{10}$ or 0.3 **B1**

5. a) $\frac{1}{k}+\frac{2}{k}+\frac{3}{k}+\frac{4}{k}+\frac{5}{k}=1$ **M1**

$\frac{1}{k}(1+2+3+4+5)=1$

$\frac{1}{k}\times 15=1, \quad \therefore k=15$ **A1**

b)

x	1	2	3	4	5
$\mathrm{P}(Z=x)$	$\frac{1}{15}$	$\frac{2}{15}$	$\frac{3}{15}$	$\frac{4}{15}$	$\frac{5}{15}$

B1

c) i) $\text{P(odd number)} = \text{P}(Z = 1) + \text{P}(Z = 3) + \text{P}(Z = 5)$ **M1**

$$= \frac{1}{15} + \frac{3}{15} + \frac{5}{15} = \frac{3}{5} = 0.6$$

Model O, the number of random values of Z that are odd, as $O \sim \text{B}(5, 0.6)$

Using calculator, $\text{P}(O = 3) = 0.3456 = 0.346$ (3 s.f.) **A1**

ii) $\text{P(even number)} = \text{P}(Z = 2) + \text{P}(Z = 4)$ **M1**

$$= \frac{2}{15} + \frac{4}{15} = \frac{6}{15} = \frac{2}{5} = 0.4$$

Model E, the number of random values of Z that are even, as $E \sim \text{B}(5, 0.4)$

$\text{P}(E \geq 3) = 1 - \text{P}(E \leq 2)$ **M1**

$\text{P}(E \leq 2) = 0.68256$ [using binomial probability function on calculator]

$\therefore \text{P}(E \geq 3) = 1 - 0.68256 = 0.31744 = 0.317$ (3 s.f.) **A1**

6. a) Binomial distribution
The probability of each light bulb being faulty can reasonably be assumed to be independent
There are only two possible outcomes (faulty / not faulty)
There is a fixed probability of a bulb being faulty (0.1% or 0.001)
There are a fixed number of bulbs being tested (100) **B2** (all points needed)

b) $0.1\% = 0.001$
Model number of faulty bulbs in batch as $F \sim \text{B}(100, 0.001)$ **M1**
$\text{P}(F = 0) = 0.904792... = 0.905$ (3 s.f.) [using calculator binomial probability fu

c) $0.02\% = 2 \times 10^{-4}$
$\text{P}(F > k) = 1 - \text{P}(F \leq k)$ **M1**
$n = 100, p = 0.001$

x	$\text{P}(F \leq x)$	$1 - \text{P}(F \leq x)$
0	0.904792…	0.0952078…
1	0.995361…	$4.63806... \times 10^{-3}$
2	0.999849…	$1.50376... \times 10^{-4}$

M1

$4.63806... \times 10^{-3} > 0.0002 > 1.50376... \times 10^{-4}$

$\therefore k = 2$, as $1 - \text{P}(F \leq 2) = 1.50376... \times 10^{-4} < 2 \times 10^{-4}$ **A1**

7. a) $40\% \times 20 = 8$ shots
Model number of shots on target, T, as $T \sim \text{B}(20, 0.4)$ **M1**
$\text{P}(T \geq 8) = 1 - \text{P}(T \leq 7)$ **M1**
$\text{P}(T \leq 7) = 0.415892...$ [using binomial cumulative probability function on calc
$\therefore \text{P}(T \geq 8) = 1 - 0.415892... = 0.584107... = 0.584$ (3 s.f.) **A1**

b) Model S, number of rounds with at least 40% of shots on target, as binomial dis
rounds) and $p = 0.584107...$ (probability of at least 40% on target)
$S \sim \text{B}(4, 0.584107...)$ **M1**
$\text{P}(S = 4) = 0.116404... = 0.116$ (3 s.f.) using binomial probability function on calculator **A1**

Alte
prob
P(S =

c) $\text{P}(S \geq 3) = 1 - \text{P}(S \leq 2)$ **M1**
$\text{P}(S \leq 2) = 0.552068...$ **M1**
$\therefore \text{P}(S \geq 3) = 1 - 0.552068... = 0.447931... = 0.448$ (3 s.f.) **A1**

Preview of Answers Ends Here