

Please check the examination details below before entering your candidate information

Candidate surname		Other names
Centre Number	Candidate Number	

Pearson Edexcel Level 3 GCE

Thursday 19 June 2025

Afternoon	Paper reference	9MA0/31
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Mathematics

Advanced

PAPER 31: Statistics

You must have: Mathematical Formulae and Statistical Tables (Green), calculator	Total Marks
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Candidates may use any calculator allowed by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Values from statistical tables should be quoted in full. If a calculator is used instead of tables the value should be given to an equivalent degree of accuracy.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 50. There are 6 questions.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

1. Bag A contains 5 red, 4 yellow and 3 green beads.

Bag B only contains red and yellow beads.

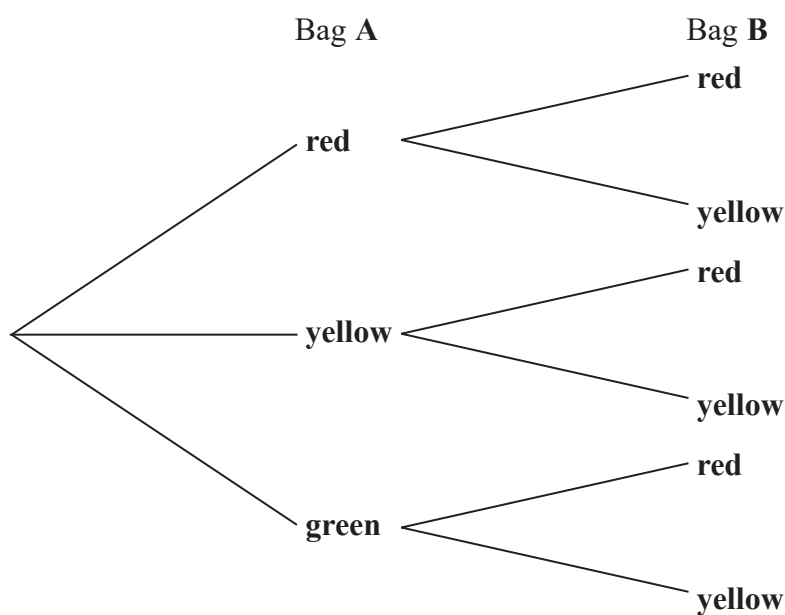
A bead is selected at random from bag A and a second bead is selected at random from bag B

Given that the probability that both beads selected are yellow is $\frac{3}{16}$

- (a) (i) find the probability of selecting a yellow bead from bag B

(2)

- (ii) Hence complete the tree diagram below by finding the probability on each branch.



(2)

- (b) Find the exact probability that at least one of the two beads selected is yellow.

(3)

The event X is that at least one of the beads selected is yellow.

The event W is that a green bead is selected.

- (c) Find the exact value of $P(W|X)$

(2)

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Question 1 continued

(Total for Question 1 is 9 marks)



2. Runners in an athletics club can train with either coach A or coach B for the 400 m race.

Coach A trains 120 runners for the 400 m and records the best time, x seconds, for each runner.

The results are summarised by the following statistics

$$\sum x = 6612 \quad \sum x^2 = 364902$$

- (a) Calculate the mean of the best times for the runners trained by coach A (1)

- (b) Calculate the standard deviation of the best times for the runners trained by coach A (2)

The mean and standard deviation for the best times of the 100 runners trained for the 400 m by coach B are 55.1 seconds and 3.6 seconds respectively.

A 400 m race consists of equal numbers of the fastest runners trained by coach A and by coach B

- (c) State, giving a reason, which coach is more likely to have trained the winner. (2)

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Question 2 continued

(Total for Question 2 is 5 marks)



3. A manufacturer makes components for the car industry.

On average 1.5% of the components made are defective.

- (a) Using a suitable model, find the probability that in a random sample of 36 components there are

- (i) exactly 2 defective components,
(ii) more than 3 defective components.

(3)

Once every six months, the manufacturer tests whether the proportion of defective components has changed using hypotheses $H_0: p = 0.015$ and $H_1: p \neq 0.015$

A random sample of 260 components is taken and 8 are found to be defective.

- (b) Using a 5% level of significance, complete the test.

(3)

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Question 3 continued

(Total for Question 3 is 6 marks)



4. Kay is studying the variables Daily Total Sunshine (x) and Daily Total Rainfall (y) from the large data set for Leeming in 2015

Kay starts with 5th May and then selects every 10th day thereafter.

- (a) State the name of the sampling technique Kay uses. (1)

Kay wants to find the regression line of y on x for these data.

- (b) Using your knowledge of the large data set, explain how Kay might need to clean these data before finding the equation of the regression line. (1)

The equation of the regression line Kay finds is $y = 0.741 + 0.199x$

- (c) Using your knowledge of the large data set,
(i) state the units of the gradient of the regression line,
(ii) give an interpretation of the y -intercept of the regression line. (2)

Kay's teacher claimed that the greater the amount of sunshine in a day the lower the amount of rain there should be.

- (d) State, giving a reason, whether the teacher's claim is true for Kay's data. (1)

The teacher used all the data for these variables from the large data set for Leeming in 2015, as a sample.

The teacher calculated the product moment correlation coefficient for x and y to be -0.160

In a suitable test to determine whether there is evidence to support the teacher's claim, the p -value was 0.015

- (e) Using a 5% level of significance, state the hypotheses and conclusion for this test. (2)

- (f) For the test in part (e) describe

- (i) the sample,
(ii) a possible population. (2)

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Question 4 continued



Question 4 continued

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Question 4 continued

(Total for Question 4 is 9 marks)



5. The heights of men in a tennis club are normally distributed with a mean of 183 cm and a standard deviation of 4.9 cm.

A man from the tennis club is selected at random.

- (a) Find the probability that the man's height is

- (i) more than 186 cm,
- (ii) between 175 cm and 185 cm.

(2)

The heights of women in the tennis club are normally distributed with a mean of μ cm and a standard deviation of σ cm.

Given that 40% of the women are shorter than 170 cm and 15% are taller than 175 cm,

- (b) find the value of μ and the value of σ
Show your working clearly.

(5)

A man from the tennis club and a woman from the tennis club are selected at random.

- (c) Find the probability that both players have heights between 170 cm and 175 cm.

(3)

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Question 5 continued



Question 5 continued

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Question 5 continued

(Total for Question 5 is 10 marks)



6. The discrete random variable R takes even integer values from 2 to $2n$ inclusive.

The probability distribution of R is given by

$$P(R = r) = \frac{r}{k} \quad r = 2, 4, 6, \dots, 2n$$

where k is a constant.

- (a) Show that $k = n(n + 1)$ (4)

When $n = 20$

- (b) find the exact value of $P(16 \leq R < 26)$ (2)

When $n = 20$, a random value g of R is taken and the quadratic equation in x

$$x^2 + gx + 3g = 5$$

is formed.

- (c) Find the exact probability that the equation has no real roots. (5)

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Question 6 continued



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Question 6 continued



Question 6 continued

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(Total for Question 6 is 11 marks)

TOTAL FOR STATISTICS IS 50 MARKS

