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**General Certificate of Education
Advanced Subsidiary Examination
June 2014**

Statistics

Unit Statistics 3

SS03

Thursday 12 June 2014 1.30 pm

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.
- You may use a graphics calculator.**

TIME ALLOWED

- 1 hour 30 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

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INSTRUCTIONS

- **Use black ink or black ball-point pen. Pencil should only be used for drawing.**
- **Answer ALL questions.**
- **Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.**
- **You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do NOT use the space provided for a different question.**
- **Show all necessary working; otherwise marks for method may be lost.**
- **Do all rough work in this book. Cross through any work that you do not want to be marked.**
- **The FINAL answer to questions requiring the use of tables or calculators should normally be given to three significant figures.**

INFORMATION

- **The marks for questions are shown in brackets.**
- **The maximum mark for this paper is 75.**

ADVICE

- **Unless stated otherwise, you may quote formulae, without proof, from the booklet.**
- **You do not necessarily need to use all the space provided.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions.

Answer each question in the space provided for that question.

- 1 Kalia, a sports researcher, wished to investigate the correlation between an athlete's ability to sprint and ability to run longer distances.

She selected, at random, 8 schoolboy county athletes from those who took part in both 400-metre sprint races and cross-country races during 2012.

TABLE 1 shows, for these races, the RANK ORDER for the overall performance of each schoolboy in the 400-metre county sprint races together with the POSITION of each schoolboy in the county cross-country race final.

TABLE 1

| | SCHOOLBOY | | | | | | | |
|--------------------------|-----------|---|----|---|----|----|----|----|
| | A | B | C | D | E | F | G | H |
| 400-metre (rank) | 3 | 4 | 7 | 5 | 1 | 2 | 8 | 6 |
| Cross-country (position) | 28 | 1 | 12 | 9 | 68 | 30 | 15 | 19 |

- (a) Explain why Spearman's rank correlation coefficient, rather than the product moment correlation coefficient, is the appropriate measure of correlation for these data. [1 mark]
- (b) Calculate the value of the Spearman's rank correlation coefficient, r_s , between overall performance in 400-metre races and position in the cross-country race final. [5 marks]

- (c) Carry out a hypothesis test, at the 5% level of significance, to determine whether your value of r_s calculated in part (b) indicates a correlation between overall performance in 400-metre races and position in the cross-country race final. [4 marks]
- (d) Explain, in the context of this question, the meaning of a Type II error. [2 marks]

[Question 1 continues on the next page]

(e) Kalia decided to investigate further and so obtained, for each of the 8 schoolboys, his best time, in seconds, in a 400-metre race during 2012 and also his time taken, in minutes, to complete the 2012 county cross-country race final. These times are given in TABLE 2 on page 6.

(i) Calculate the value of the product moment correlation coefficient between the times taken for the two races.

(ii) Comment on your value in the context of this question.

[4 marks]

TABLE 2

| | | Race times | |
|-----------|---|------------|---------------|
| | | 400-metre | Cross-country |
| Schoolboy | A | 53.3 | 21.18 |
| | B | 54.7 | 17.02 |
| | C | 55.3 | 18.41 |
| | D | 54.9 | 18.18 |
| | E | 52.3 | 24.94 |
| | F | 53.2 | 22.64 |
| | G | 55.6 | 18.73 |
| | H | 55.1 | 18.97 |

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- 2 Dana, a researcher in the USA, investigated game-related stress for sports officials in inter-school baseball, basketball and soccer.

The 1250 officials involved in this investigation were categorised as either adopting an approach (AP) coping style or an avoidance (AV) coping style when dealing with game-related stress.

TABLE 3 summarises the results of this investigation.

TABLE 3

| | | COPING STYLE | |
|-------|------------|--------------|----|
| | | AP | AV |
| SPORT | Baseball | 22% | 4% |
| | Basketball | 38% | 6% |
| | Soccer | 28% | 2% |

You may assume that the 1250 officials involved in this investigation represent a random sample.

- (a) Use the information in TABLE 3 to complete the contingency table, TABLE 4, on page 15, with frequencies that could be analysed to investigate whether the coping style used by officials is associated with the sport involved. [2 marks]
- (b) Examine, using the 1% level of significance, whether the coping style used by officials is associated with the sport involved. [10 marks]
- (c) By comparing observed and expected frequencies, identify, in context, TWO important facts concerning coping style and sport involved. [2 marks]

Answer space for questions 2(a), 2(b) and 2(c)

2(a)

TABLE 4

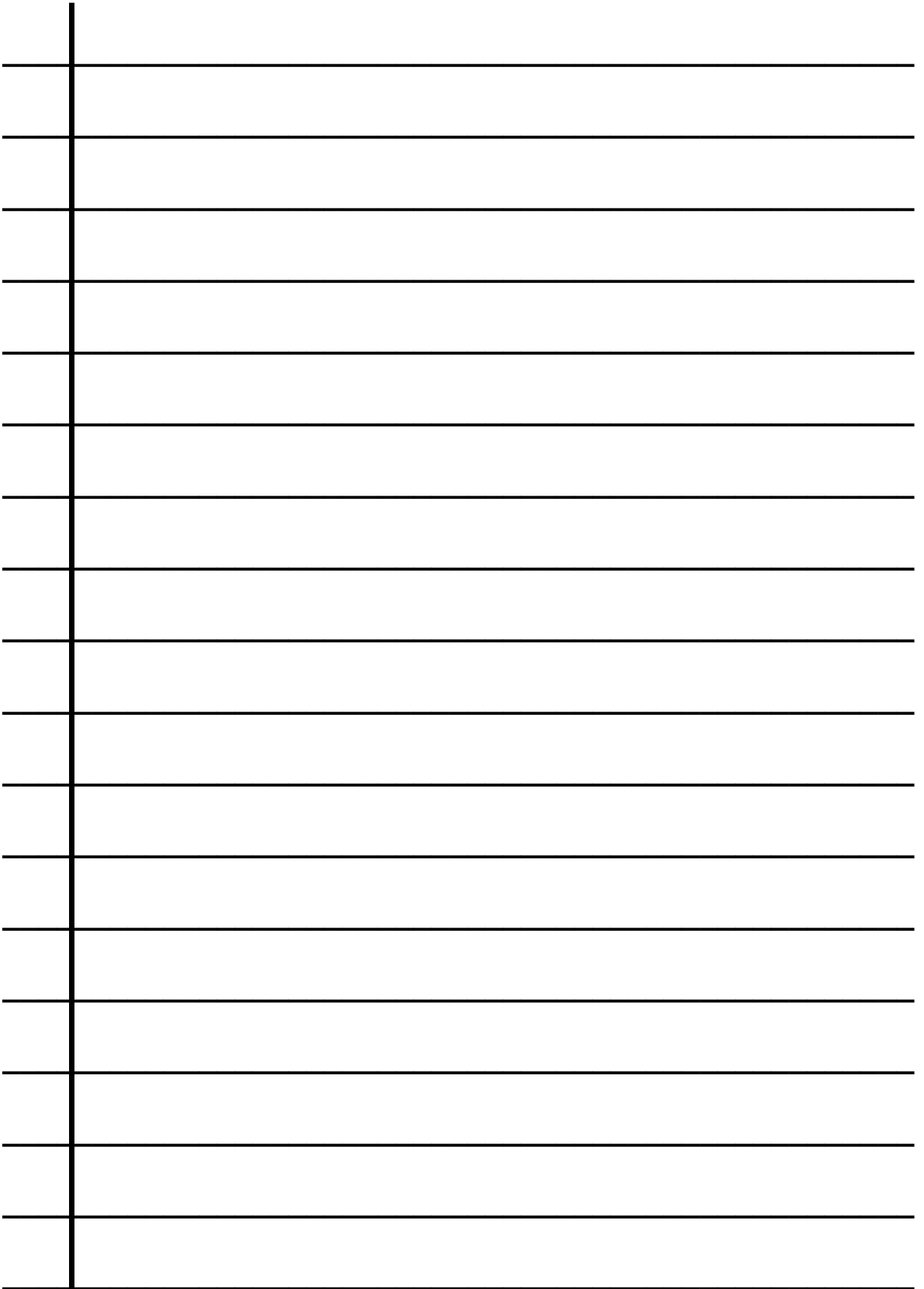
| | | COPING STYLE | |
|--------------|-------------------|---------------------|-----------|
| | | AP | AV |
| SPORT | Baseball | | |
| | Basketball | | |
| | Soccer | | 25 |

This image shows a vertical ledger page with a grid structure. It features a solid vertical line on the left side and 18 horizontal lines spaced evenly down the page. These lines create a series of 18 empty rectangular rows, typical of a ledger or account book page for recording transactions.

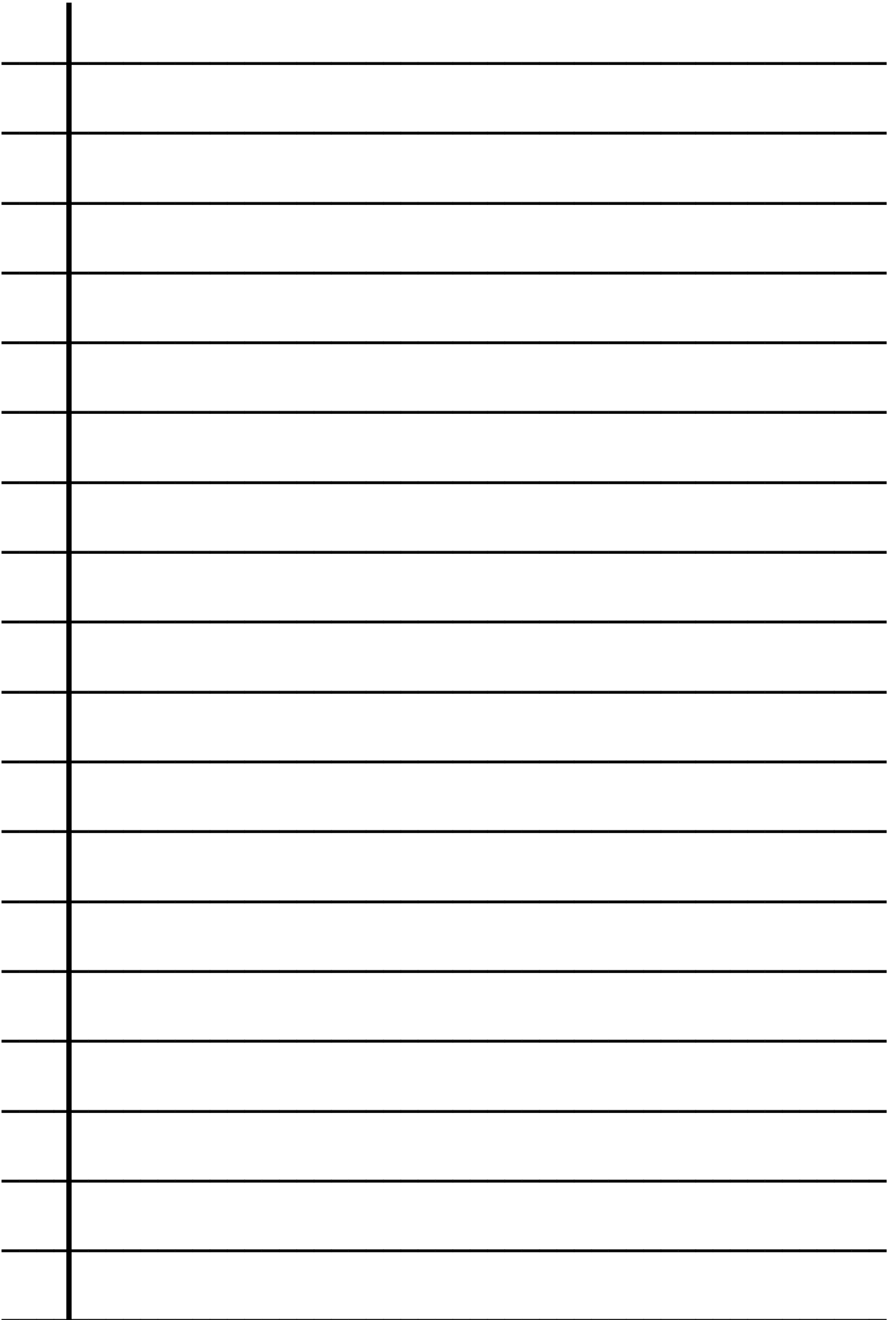
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The page contains a series of 20 horizontal lines, evenly spaced, extending across the width of the page. A vertical line is positioned on the left side, approximately 10% of the way from the left edge, creating a narrow margin. This layout is typical of a ruled page for writing or a form with multiple rows for data entry.



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- 3 An investigation was carried out into the effectiveness of two well-known drugs, A and B, in relieving pain for adult arthritis sufferers.

Twelve adult arthritis sufferers each volunteered to record the number of hours of relief from pain gained when taking drug A and when taking drug B.

The adults agreed to take one of the drugs, A or B, on one day and the other drug on another day. The order of taking the drugs was randomly assigned.

The recorded times, in hours, are given in the table.

| | | ADULT | | | | | | | | | | | |
|--------|--|-------|-----|-----|-----|-----|-----|-----|-----|------|-----|-----|------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| DRUG A | | 2·0 | 3·6 | 2·6 | 2·6 | 7·2 | 3·4 | 6·5 | 2·4 | 11·5 | 2·5 | 6·1 | 8·5 |
| DRUG B | | 3·5 | 5·7 | 2·8 | 2·4 | 9·8 | 3·3 | 5·9 | 4·9 | 13·5 | 3·7 | 9·1 | 12·4 |

- (a) Explain the purpose of randomly assigning the order of taking drug A or drug B. [2 marks]
- (b) Carry out a Wilcoxon signed-rank test, at the 2% significance level, to investigate whether or not there is a difference between the average number of hours of relief from pain gained by arthritis sufferers when taking drug A and that when taking drug B. [10 marks]
- (c) Give a reason why your conclusion in part (b) might NOT apply to all adult arthritis sufferers. [1 mark]

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- 5 (a) A Human Resources department in a large company wished to investigate the attitude of middle-level managers to a proposed new company structure.

The department selected, at random, 30 middle-level managers. These managers were asked to state whether they preferred or did not prefer the proposed new company structure to the old company structure or whether they had no opinion on the proposed new company structure.

Out of the 30 managers selected, 5 stated that they had no opinion, 17 stated that they preferred the proposed new company structure to the old company structure and the remainder stated that they did not prefer the proposed new company structure to the old company structure.

The Human Resources department claimed that middle-level managers preferred the proposed new company structure to the old company structure.

- (i) Use a sign test, with the 5% level of significance, to investigate this claim. [6 marks]
- (ii) Explain why it would NOT be possible to use a Wilcoxon signed-rank test to investigate the claim. [1 mark]

Answer space for question 5(a)

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[Question 5 continues on page 40]

- 5 (b) The Human Resources department also wished to investigate whether occupational stress at work varied according to age.

The three age categories used were 'under 40 years', '40–55 years' and 'over 55 years'.

Occupational stress was measured objectively using a standard occupational stress score assessment. The stress score was measured on a scale of 0 to 100 where 100 indicated the highest occupational stress level.

The results are given in the table.

| Under 40 years | 40–55 years | Over 55 years |
|----------------|-------------|---------------|
| 44 | 62 | 46 |
| 41 | 60 | 43 |
| 37 | 57 | 39 |
| 30 | 49 | 34 |
| 25 | 38 | 22 |
| 20 | | 21 |

- (i) Carry out a distribution-free test, using the 5% significance level, to investigate whether there is a difference between the average occupational stress scores for the three age groups. [10 marks]
- (ii) Interpret your conclusion to part (b)(i) in the context of the question. [2 marks]

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| For Examiner's Use | |
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| Examiner's Initials | |
| Question | Mark |
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