



JUNE 2016

NUMBER & LOGIC

Instructions to candidates:

- a) Time allowed: Three hours (plus an extra ten minutes' reading time at the start – do not write anything during this time)
- b) Answer any FIVE questions
- c) All questions carry equal marks. Marks for each question are shown in []
- d) In numerical questions, candidates must show and explain the method of working to obtain full marks
- e) Non-programmable calculators are permitted in this examination. Calculators should be used in all the non-binary questions. However, ensure that you write down all intermediate values obtained from a calculator. Always explain in words what you are calculating
- f) Ensure that you leave numeric answers in the format required by the question
- g) Ensure that you pay particular attention to words underlined, in CAPITALS or in **bold**. FEW OR NO MARKS will be awarded to any question where these are ignored
- h) No computer equipment, books or notes may be used in this examination

1. a) With relevance to a list of numbers, write **definitions** for the following terms: [4]
- i Mean
 - ii Median
 - iii Mode
 - iv Range
- b) Find the median of EACH of the following sets of numbers:
- i 9, 3, 44, 17, 15
 - ii 8, 3, 44, 17, 12, 6
- [3]
- c) Show how to find the mean of the data 31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 31 using an assumed mean method. Give your answer to two decimal places. [4]
- d) A product sells the following quantities for each of 5 months: 87, 95, 76, 82, 56. Product sales need to average 80 in order to meet targets for the half-year (6 months). Calculate the minimum number that must be sold next month to meet the target. Show your working. [5]
- e) The table below shows the results of a dice being rolled 20 times:

Value	1	2	3	4	5	6
Frequency	3	5	2	4	3	3

Calculate the **mean**, **median**, **mode** and the **range** for this set of data. [4]

2. a) A person opens an account with capital of £200. The account pays an annual interest rate of 5% for 2 years but the interest rate then drops to 4%. If the money is left in the account for a full five years, calculate the value of the investment at the end of the fifth year. Assume interest is paid at the end of each year and reinvested in the account. [5]
- b) £200 is invested for 8 years in a scheme which pays 5% interest. Write down the **calculation** to determine the TOTAL amount which would be paid back at the end of this period if invested at:
- i simple interest with the annual interest paid back each year
 - ii compound interest
- [2]
- c) For tax assessment, a person is allowed to offset the expense of the value of his car each year. However, the car is assumed to lose, each year, one quarter of its value of the previous year. Assuming the car originally cost £5,000, determine:
- i the amount the person may claim in the fourth year
 - ii the value of the car at the end of the fourth year, expressed as a percentage of its original cost
- [5]

- d) i Consider the following production situation and write down the inequalities:
 Products A and B are made. Each product A takes 2 hours to make and each project B takes 3 hours. A maximum of 300 hours are available in a given month for making these products. In addition, product A needs 30 minutes on a drilling machine and product B needs 1 hour. The drilling machine is only available for 200 hours. [5]
- ii The profit on each product A is £4, whereas on product B it is £3. Write down a profit equation. [3]

3. Matrices A, B, C and D are defined as:

$$A = \begin{vmatrix} 6 & 8 \\ -3 & 2 \\ -1 & 6 \end{vmatrix} \quad B = \begin{vmatrix} 5 & 3 \\ 9 & 4 \end{vmatrix} \quad C = \begin{vmatrix} 4 & 6 & 3 \\ -3 & 2 & -2 \end{vmatrix} \quad D = \begin{vmatrix} -4 & 6 \\ 2 & 3 \\ 5 & 2 \end{vmatrix}$$

- a) Add the matrices A and D [3]
 b) Subtract matrix D from matrix A [3]
 c) Perform the matrix calculation A.C [6]
 d) Perform the matrix calculation C.D [6]
 e) State whether A.B is possible – justify your answer [2]

4. A, B and C represent the following binary integers:

$$A = 111\ 100 \quad B = 1\ 111 \quad C = 10\ 111$$

Showing all stages of working, perform the following calculations IN BINARY. You are advised to space out numbers so that they are in strict columns.

- a) Find $A + B + C$ [3]
 b) Find $A - C$ [2]
 c) Find $B \times C$ [4]
 d) Find A / C . Leave your answer accurate to 3 binary places. [4]
 e) Convert A and C to decimal and show that your answers to b) and d) are correct. [4]
 f) If the decimal number 24.68 is to be converted to binary as accurately as possible, how many BINARY places would be needed? Explain your answer. [3]

5. a) A survey in a school asked 63 children whether they like Asparagus, Broccoli and Carrots. 33 like Broccoli, 25 Carrots and 26 Asparagus. 10 like Broccoli and Carrots, 9 like Asparagus and Carrots while 8 like both Broccoli and Asparagus. Equal numbers like all three vegetables as those who like none of the three.

Draw a Venn diagram to answer the following questions:

- i How many like all three vegetables?
 ii How many like only one of the three vegetables? [10]
- b) A group of people were asked about whether they take part in team sports or individual sports. 25% are involved in team sports, 45% do individual sporting activities and 40% do not take part in sports.
- i Draw a Venn diagram to determine the percentage of people who take part in both team and individual sports. [5]
 ii One of the group is selected at random – find the probability that this person only plays team sports. [5]

6. P, Q and R represent binary numbers as follows:

$$P = 1111 \quad Q = 100011101 \quad R = 10001001$$

- a) Convert these numbers to OCTAL – show your methods. [5]
 b) Showing all relevant working, carry out the following calculations **entirely in octal**:
 i $P + Q + R$ [2]
 ii $P * Q$ [4]
 iii Q / P [5]
 c) Show how R would be represented in BCD. [2]
 d) Convert Q to hexadecimal. [2]

Note – you must show your working in both part a) and part b) to gain full marks.

7. a) Write a formula for calculating the value of any term in an arithmetic sequence. [2]
- b) The first term of an arithmetic sequence is 40 and the common difference is -2.5.
- i Find the 28th term [3]
- ii The r th term of the sequence is 0, find the value of r [7]
- c) The sum of the first ten terms of an arithmetic progression is 400 and the sum of the next ten terms is 1000. Find the first term and the common difference. [8]
8. a) Write down the method for converting a decimal number to 2's complement representation. [3]
- b) Convert the following decimal numbers to binary using 6-bit 2's complement representation:
- i -16_{10}
- ii 13_{10}
- iii -3_{10}
- iv -10_{10}
- v 26_{10}
- vi -31_{10} [2 each]
- c) X and Y are single **unsigned** byte registers. Sometimes these two registers are used together to create a single 2-byte register. X is the more significant one and is considered to be to the left of Y.
- If X holds DECIMAL values of 184 and Y holds 59, calculate the value of this 2-byte register XY in:
- i decimal
- ii binary [5]