

# Level 3 Data representation and manipulation (7540-045)

**Systems and Principles**  
**Assignment guide for Candidates**  
Assignment B



## **About City & Guilds**

City & Guilds is the UK's leading provider of vocational qualifications, offering over 500 awards across a wide range of industries, and progressing from entry level to the highest levels of professional achievement. With over 8500 centres in 100 countries, City & Guilds is recognised by employers worldwide for providing qualifications that offer proof of the skills they need to get the job done.

## **City & Guilds Group**

The City & Guilds Group includes City & Guilds, ILM (the Institute of Leadership & Management) which provides management qualifications, learning materials and membership services, NPTC which offers land-based qualifications and membership services, and HAB (the Hospitality Awarding Body). City & Guilds also manages the Engineering Council Examinations on behalf of the Engineering Council.

## **Equal opportunities**

City & Guilds fully supports the principle of equal opportunities and we are committed to satisfying this principle in all our activities and published material. A copy of our equal opportunities policy statement is available on the City & Guilds website.

## **Copyright**

The content of this document is, unless otherwise indicated, © The City and Guilds of London Institute 2010 and may not be copied, reproduced or distributed without prior written consent.

However, approved City & Guilds centres and learners studying for City & Guilds qualifications may photocopy this document free of charge and/or include a locked PDF version of it on centre intranets on the following conditions:

- centre staff may copy the material only for the purpose of teaching learners working towards a City & Guilds qualification, or for internal administration purposes
- learners may copy the material only for their own use when working towards a City & Guilds qualification

The *Standard Copying Conditions* on the City & Guilds website also apply.

Please note: National Occupational Standards are not © The City and Guilds of London Institute. Please check the conditions upon which they may be copied with the relevant Sector Skills Council.

## **Publications**

City & Guilds publications are available on the City & Guilds website or from our Publications Sales department at the address below or by telephoning +44 (0)20 7294 2850 or faxing +44 (0)20 7294 3387.

Every effort has been made to ensure that the information contained in this publication is true and correct at the time of going to press. However, City & Guilds' products and services are subject to continuous development and improvement and the right is reserved to change products and services from time to time. City & Guilds cannot accept liability for loss or damage arising from the use of information in this publication.

## **City & Guilds**

**1 Giltspur Street**

**London EC1A 9DD**

**T +44 (0)844 543 0000 (Centres)**

**T +44 (0)844 543 0033 (Learners)**

**[www.cityandguilds.com](http://www.cityandguilds.com)**

**[learnersupport@cityandguilds.com](mailto:learnersupport@cityandguilds.com)**

# Contents

## Data representation and manipulation (7540-045)

Assignment B

|   |   |
|---|---|
| Introduction – Information for Candidates | 2 |
| Candidate Instructions                    | 3 |

---

# Level 3 Data representation and manipulation (7540-045)

## Assignment B

### Introduction – Information for Candidates

#### About this document

This assignment comprises all of the assessment for Level 3 Data representation and manipulation (7540-045).

---

#### Health and safety

You are asked to consider the importance of safe working practices at all times.

You are responsible for maintaining the safety of others as well as your own. Anyone behaving in an unsafe fashion will be stopped and a suitable warning given. You will **not** be allowed to continue with an assignment if you compromise any of the Health and Safety requirements. This may seem rather strict but, apart from the potentially unpleasant consequences, you must acquire the habits required for the workplace.

#### Time allowance

The recommended time allowance for this assignment is **3 hours**.

# Level 3 Data representation and manipulation (7540-045)

## Candidate Instructions

**Time allowance: 3 hours**

### Assignment set up:

This assignment is made up of **three** tasks:

- Task A – Using Matrices in programmes that draw shapes
- Task B – Using Series, Probability and Recursions in interactive software
- Task C – Graphical representation of data series.

### You should have the following for this assessment

- a pen with black or blue ink
  - a pencil and eraser
  - a 30cm ruler
  - graph paper
  - a calculator
- 
- You may use a protractor.
  - You may use a dictionary.

### Scenario

You are employed in the technical support team of an organisation that represents medium sized businesses. The team is being re-organised according to the different functions undertaken and you want to work in the team supporting computer programming for business and industry. In order to do this, you have to demonstrate your understanding of some of the basic mathematics that may be involved in computer programming. There are a series of questions that you need to correctly answer and also show your working out.

### Task A – Using Matrices in programmes that draw shapes

- 1 Matrices are a method of representing ordered data. Explain what ordered data means and what the relationship between matrices and variable arrays are in computer programs.

- 2 Use index notation to reference the elements 1 and 7 in matrix **J**:

$$\text{Matrix } \mathbf{J} \begin{pmatrix} 4 & 2 & 5 \\ 1 & 7 & 6 \\ 0 & 3 & 2 \end{pmatrix} \quad \text{Matrix } \mathbf{K} \begin{pmatrix} 3 & 2 & 5 \\ 1 & 6 & 5 \\ 3 & 0 & 2 \end{pmatrix}$$

- 3 Find the value of a matrix **C** that is derived from  $\mathbf{C} = \mathbf{J} + \mathbf{K}$ .
- 4 Find the value of a matrix **D** that is derived from  $\mathbf{D} = \mathbf{J} - \mathbf{K}$
- 5 Find the value of a matrix **E** that is derived from  $4\mathbf{J}$ .
- 6 Find the value of a matrix **F** that is derived from  $\mathbf{F} = \mathbf{M} \times \mathbf{N}$ .

$$\text{Matrix } \mathbf{M} \begin{pmatrix} 3 & 4 \\ 5 & 2 \end{pmatrix} \quad \text{Matrix } \mathbf{N} \begin{pmatrix} 6 & 1 \\ 3 & 0 \end{pmatrix}$$

- 7 Find the inverse of matrix **N**.
- 8 Find the transposition of matrix **M**.
- 9 Solve for **W** and **Z** using matrix techniques, the simultaneous equations given below:

$$4\mathbf{W} + 2\mathbf{Z} = 18 \text{ and } 7\mathbf{W} - \mathbf{Z} = 22.5$$

- 10 The two-dimensional vector **U** is rotated 90 degrees, use matrix transformation methods to find  $\mathbf{U}^{-1}$ :

$$\text{Vector } \mathbf{U} \begin{pmatrix} 2 \\ 4 \end{pmatrix}$$

- 11 Plot the simple shape on graph paper whose coordinate vertices are given by the position vectors  $\mathbf{A}_1$ ,  $\mathbf{A}_2$ ,  $\mathbf{A}_3$ , and  $\mathbf{A}_4$  found below. Ensure that the graph includes the zero point (0,0).

Use the  $\mathbf{B}$  matrix given to rotate the position vectors about zero and derive the resulting position vectors  $\mathbf{W}_1$ ,  $\mathbf{W}_2$ ,  $\mathbf{W}_3$ , and  $\mathbf{W}_4$ .

Plot the simple shape on graph paper whose coordinate vertices are given in the resulting position vectors  $\mathbf{W}_1$ ,  $\mathbf{W}_2$ ,  $\mathbf{W}_3$ , and  $\mathbf{W}_4$ .

Show that the plotted shape of the position vectors  $\mathbf{W}_1$ ,  $\mathbf{W}_2$ ,  $\mathbf{W}_3$ , and  $\mathbf{W}_4$  is a  $\pi/3$  transposed image of  $\mathbf{A}_1$ ,  $\mathbf{A}_2$ ,  $\mathbf{A}_3$ , and  $\mathbf{A}_4$ . To do this assume the xy plane is to be rotated by  $\theta = \pi/3$  radians. Use  $x = r\cos\theta$  and  $y = r\sin\theta$ ; where  $r$  is a radius to some arbitrary point  $P(X_1, Y_1)$  to derive the  $\mathbf{B}$  matrix used above to rotate the coordinates of the transposed image OF  $\mathbf{A}_1$ ,  $\mathbf{A}_2$ ,  $\mathbf{A}_3$ , and  $\mathbf{A}_4$ . Show your workings.

Position vectors:

$$\begin{array}{cccc} \mathbf{A}_1 & \mathbf{A}_2 & \mathbf{A}_3 & \mathbf{A}_4 \\ \begin{pmatrix} 1 \\ 0 \end{pmatrix} & \begin{pmatrix} 5 \\ 0 \end{pmatrix} & \begin{pmatrix} 5 \\ 4 \end{pmatrix} & \begin{pmatrix} 1 \\ 4 \end{pmatrix} \end{array}$$

Transposing matrix  $\mathbf{B}$

$$\begin{pmatrix} 0.5 & -0.866 \\ 0.866 & 0.5 \end{pmatrix}$$

## Task B – Using Series, Probability and Recursions in interactive software

- 1 For the series  $\mathbf{I}$ , give a functional expression for the addition of this series:

$$L_1 + L_2 + L_3 + L_4 + \dots + L_n$$

- 2 An **A.P.** (Arithmetic Progression) series shown below starts with the first term ( $\mathbf{x}$ ) and ends with the last term ( $\mathbf{z}$ ). Derive a formula for the sum of these terms.

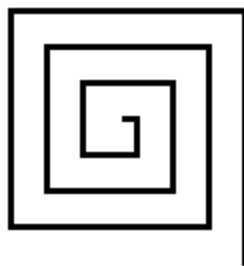
$$x + (x+b) + (x+2b) + (x+3b) \dots + (z-b) + z$$

- 3 Use the series formula shown below to find the sum of 12 terms of an **A.P.** that starts with the number 6 and ends with 15:

$$S_n = \frac{n}{2}(a + l)$$

- 4 A fair eight-sided die is thrown. What is the probability of a multiple of 4 being thrown? Express the answer as a fraction.
- 5 A fair eight-sided die is thrown. What is the probability of a multiple of 3 being thrown? Express the answer as a decimal.
- 6 A fair eight-sided die is thrown. What is the probability of a 5 being thrown? Express the answer as a percentage.
- 7 The software program shown, using recursive techniques draws the square spiral shown in the source document. Use the series formula for the **A.P.** in 2.3 to express the line lengths of this spiral and hence calculate the total spiral length.

Square spiral



Software program

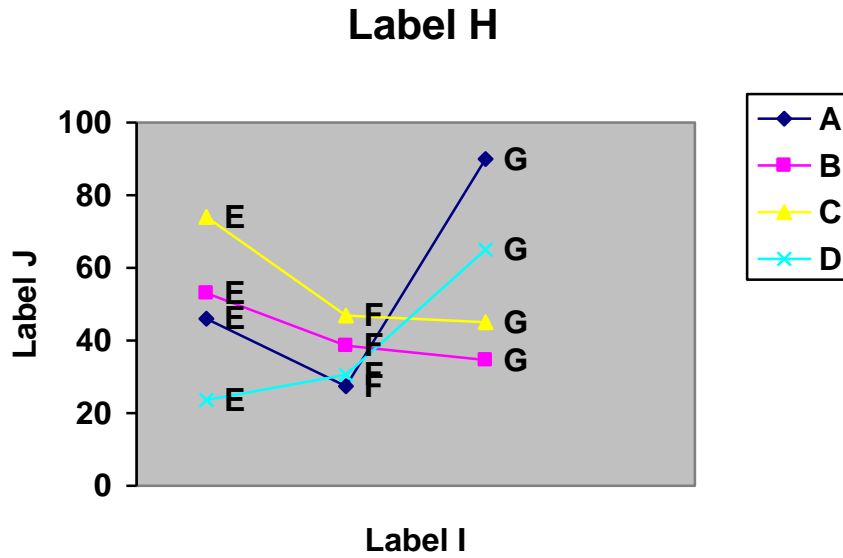
```
start
to r_spiral: line
forward: line right 90
r_spiral sum: line 3
if line greater than 42 stop
end
```

- 8 Amend the square spiral program to reduce each spiral leg by one unit but increase the number of lines by four.
- 9 Write a similar program to produce the original spiral in reverse.



### Task C – Graphical representation of data series.

- Describe the components of the graph labelled and detail the properties of each component.



- Explain the characteristics of undirected, directed and mixed graphs.
- Data was collected for the percentage types of PC games available on sale in four retailers, plot on an appropriate graph the given table of data T.

|             | Retailer | PC Sales | Gamer Co | Rev-Up | Budget Buy |
|-------------|----------|----------|----------|--------|------------|
| Game types  |          |          |          |        |            |
| Shoot-em-up |          | 33       | 12       | 68     | 35         |
| Strategy    |          | 24       | 46       | 8      | 33         |
| Simulation  |          | 25       | 23       | 5      | 21         |
| Role Play   |          | 18       | 19       | 19     | 11         |
| Total       |          | 100      | 100      | 100    | 100        |

- What type of problem can be modelled by a weighted graph?

When you have finished working:

- Sign each document above your name and label all removable storage media with your name.
- Hand all paperwork and removable storage media to your assessor.

If the assignment is taken over more than one period, all paperwork and removable media must be returned to the test supervisor at the end of each sitting.

**End of assignment**

---

**Published by City & Guilds**  
**1 Giltspur Street**  
**London**  
**EC1A 9DD**  
**T +44 (0)844 543 0000 (Centres)**  
**T +44 (0)844 543 0033 (Learners)**  
**[www.cityandguilds.com](http://www.cityandguilds.com)**

**City & Guilds is a registered charity  
established to promote education  
and training**