Level 3 Data representation and manipulation (7540-045)

Systems and Principles
Assignment guide for Candidates
Assignment B

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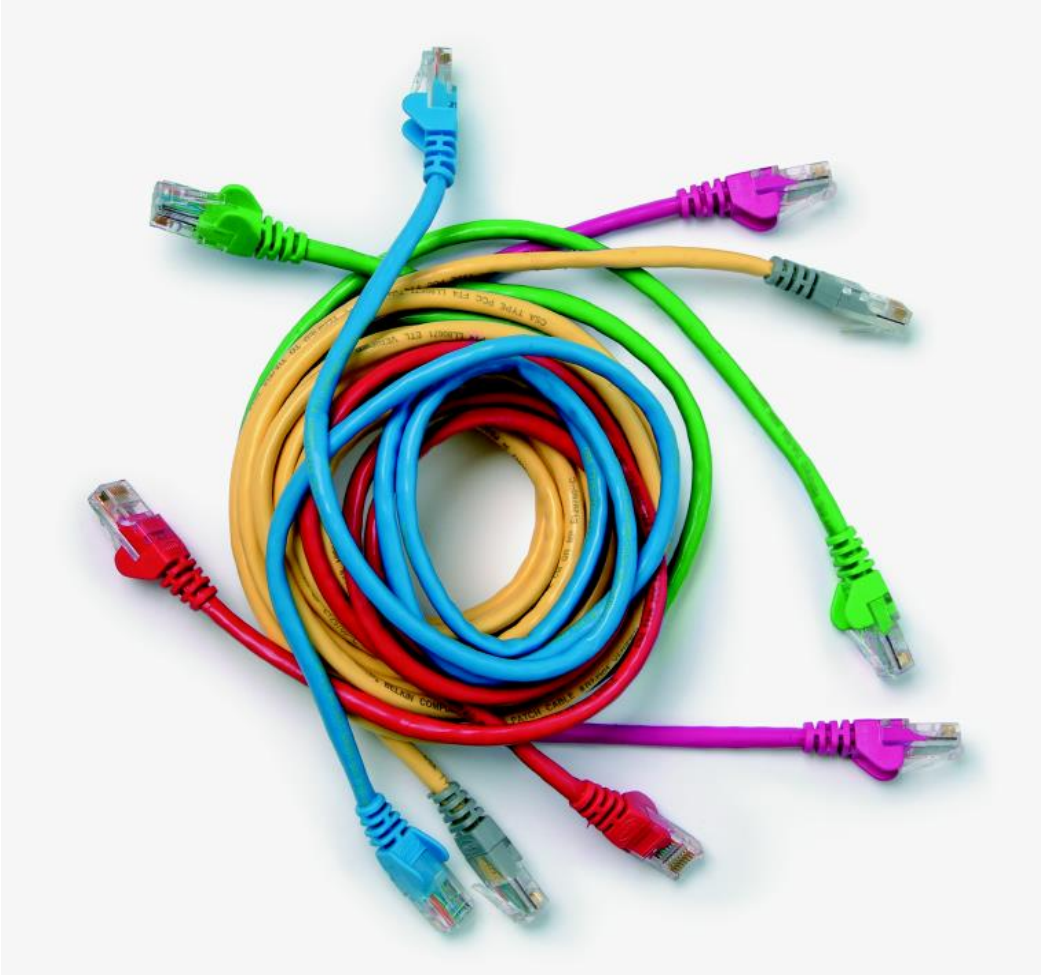

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Contents

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**:

Matrix **J** $\begin{pmatrix} 4 & 2 & 5 \\ 1 & 7 & 6 \\ 0 & 3 & 2 \end{pmatrix}$ Matrix **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 4x**J.**

6 Find the value of a matrix **F** that is derived from $\mathbf{F} = \mathbf{M} \times \mathbf{N}$.

Matrix **M** $\begin{pmatrix} 3 & 4 \\ 5 & 2 \end{pmatrix}$ Matrix **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 $\mathbf{U}^{-1}$:

Vector **U**

$\begin{pmatrix} 2 \\ 4 \end{pmatrix}$

11 Plot the simple shape on graph paper whose coordinate vertices are given by the position vectors **A₁**, **A₂**, **A₃**, and **A₄** found below. Ensure that the graph includes the zero point (0,0).

Use the **B** matrix given to rotate the position vectors about zero and derive the resulting position vectors **W₁**, **W₂**, **W₃**, and **W₄**.

Plot the simple shape on graph paper whose coordinate vertices are given in the resulting position vectors **W₁**, **W₂**, **W₃**, and **W₄**.

Show that the plotted shape of the position vectors **W₁**, **W₂**, **W₃**, and **W₄** is a $\pi/3$ transposed image of **A₁**, **A₂**, **A₃**, and **A₄**. 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 **B** matrix used above to rotate the coordinates of the transposed image OF **A₁**, **A₂**, **A₃**, and **A₄**. Show your workings.

Position vectors:

A₁ **A₂** **A₃** **A₄**

$$\begin{pmatrix}1\\0\end{pmatrix}\ \begin{pmatrix}5\\0\end{pmatrix}\ \begin{pmatrix}5\\4\end{pmatrix}\ \begin{pmatrix}1\\4\end{pmatrix}$$

Transposing matrix **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 **I**, give a functional expression for the addition of this series:

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

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

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

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:

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

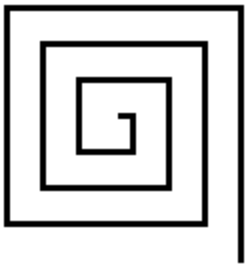
4 A fair eight-sided die is thrown. What is the probability of a multiple of 4 being thrown? Express the answer as a fraction.

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

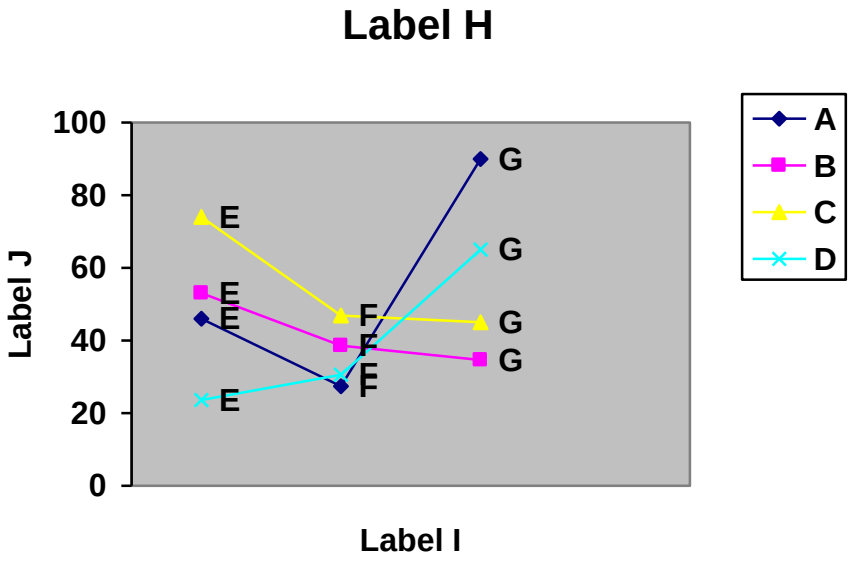
```
start
to r_spiral: line
forward: line right 90
r_spiral sum: line 3
if line greater than 42 stop
end
```

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.

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



2 Explain the characteristics of undirected, directed and mixed graphs.

3 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 Game types	PC Sales	Gamer Co	Rev-Up	Budget Buy
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

4 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

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