TRINITY COLLEGE

Semester One Examination, 2020

Question/Answer booklet

MATHEMATICS APPLICATIONS UNIT 3

Section One: Calculator-free

If required by your examination administrator, please place your student identification label in this box

WA student number: In figures | | | | | | | | |

In words _____

Your name _____

Time allowed for this section

Reading time before commencing work: five minutes
Working time: fifty minutes

Number of additional answer booklets used (if applicable): | |

Materials required/recommended for this section

To be provided by the supervisor

This Question/Answer booklet
Formula sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: nil

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of examination
Section One: Calculator-free	8	8	50	53	35
Section Two: Calculator-assumed	13	13	100	100	65
				Total	100

Instructions to candidates

1. The rules for the conduct of Trinity College examinations are detailed in the *Instructions to Candidates* distributed to students prior to the examinations. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. You must be careful to confine your answer to the specific question asked and to follow any instructions that are specified to a particular question.

4. Show all your working clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.

5. It is recommended that you do not use pencil, except in diagrams.

6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

7. The Formula sheet is not to be handed in with your Question/Answer booklet.

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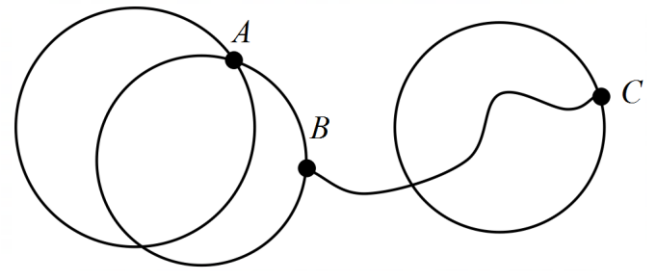
Section One: Calculator-free **35% (53 Marks)**

This section has **eight** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 50 minutes.

Question 1 **(6 marks)**

Consider the following graph G.



(a) Draw G in the plane, to clearly show that it is planar. (2 marks)

(b) State the degree of each vertex and the degree sum for G. (2 marks)

(c) Explain how to recognise a bridge in a connected graph and state, with justification, whether G contains a bridge. (2 marks)

See next page

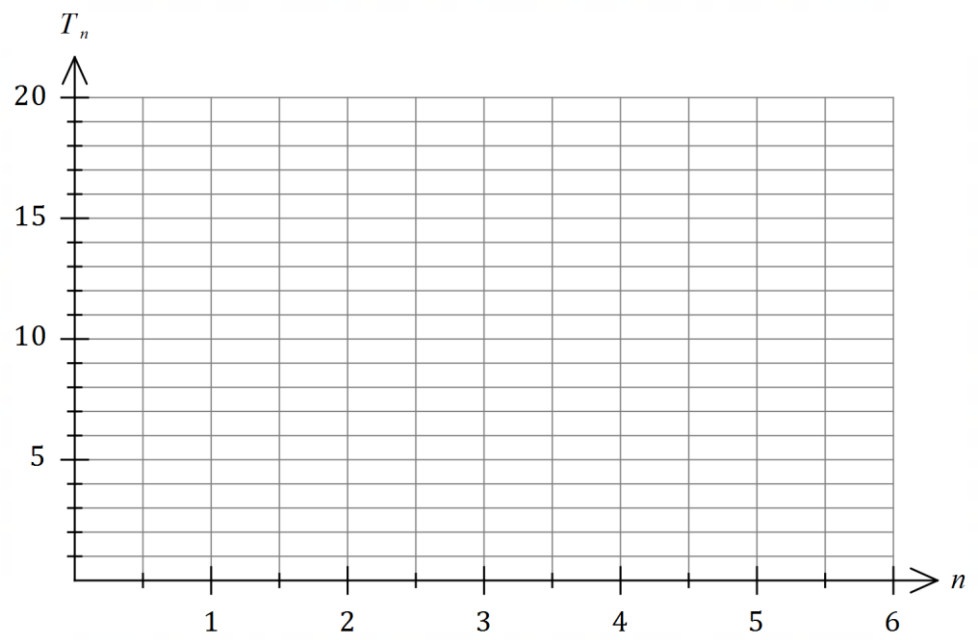
Question 2 **(6 marks)**

A recursive rule for a sequence is $T_{n+1} = T_n - 2.5,\ T_3 = 11.5$.

(a) Briefly explain which feature of the recursive rule indicates that the sequence is arithmetic. (1 mark)

(b) Determine T_4 and T_1. (2 marks)

(c) Graph the first six terms of the sequence on the axes below. (2 marks)



(d) What feature of the graph indicates that the sequence is arithmetic? (1 mark)

See next page

Question 3 **(6 marks)**

(a) Connected planar graph G_1 has 2 vertices and 5 edges.

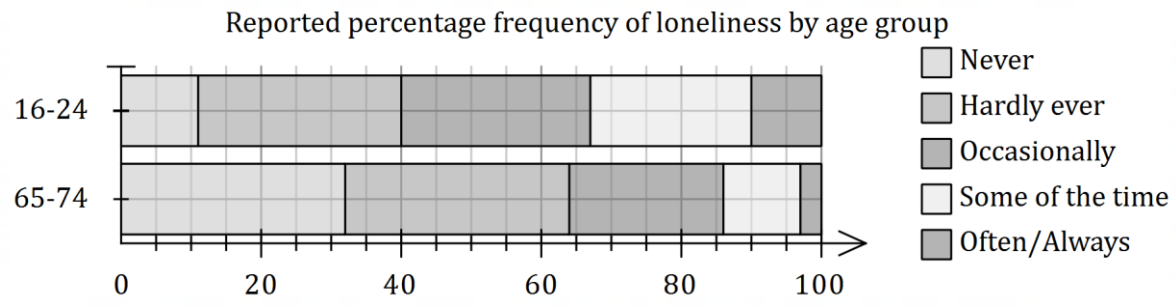
(i) Determine the number of faces in G_1. (2 marks)

(ii) Sketch a possible graph G_1. (2 marks)

(b) Graph G_2 has 4 vertices and is Eulerian. The length of the Euler cycle is 6. Sketch a possible graph G_2. (2 marks)

Question 4 **(7 marks)**

A recent survey asked people their age and the question "How often do you feel lonely?". The responses for the age groups 16-24 years and 65-74 years are shown below. The categories in the key are shown from left to right in the stacked percentage frequency graph.



(a) State the second largest category for the 16-24 age group. (1 mark)

(b) State the percentage of those

(i) in the 16-24 age group who responded with 'Some of the time'. (1 mark)

(ii) in the 65-74 age group who responded with 'Hardly ever' or 'Occasionally'. (1 mark)

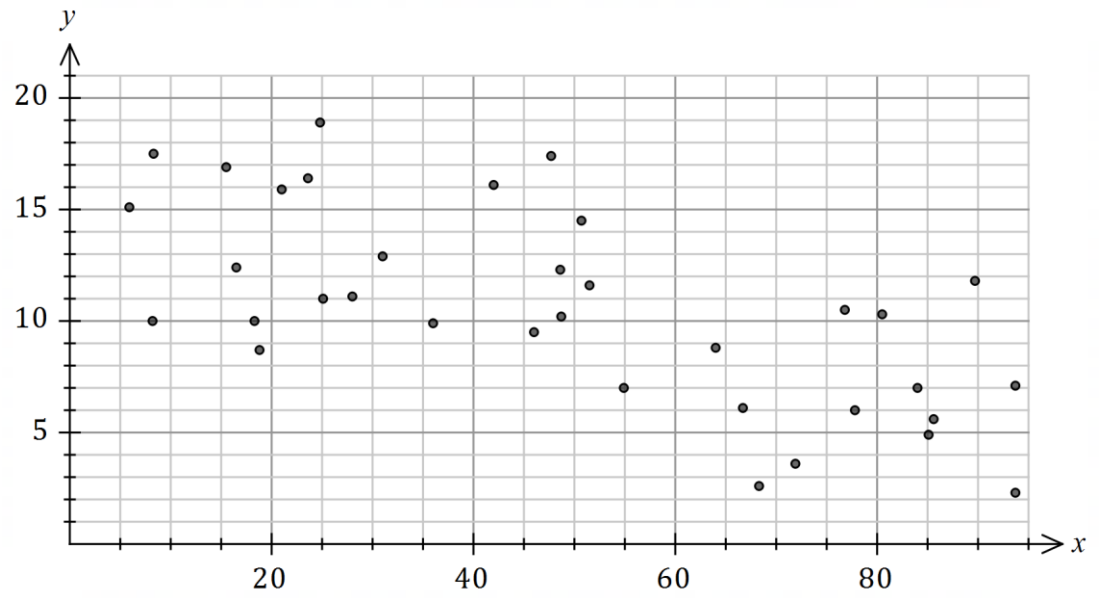
(c) Use the graph to explain why the data suggests an association exists between feeling lonely and age. (2 marks)

(d) Briefly describe a non-causal explanation for the observed association. (2 marks)

See next page

Question 5 **(7 marks)**

The scatterplot below shows the number of PC's per 100 people on the x-axis and the unemployment rate, as a percentage, on the y-axis for a selection of countries in 2016.



(a) Describe the strength and direction of the association between the variables. (2 marks)

(b) The equation of the least-squares line for the data is $y = 15.8 - 0.11x$. Interpret the intercept and the slope of this line. (3 marks)

(c) A newspaper article used the graph to claim that increasing the number of PC's per person in a country caused the unemployment rate to fall. Comment on this claim. (2 marks)

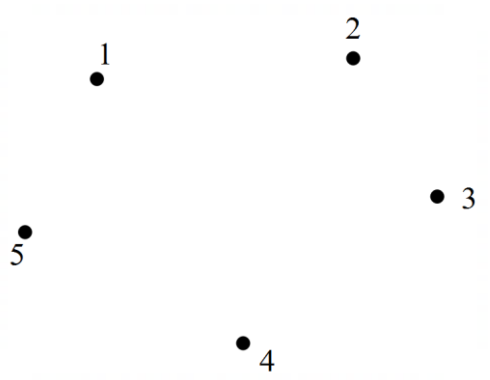
See next page

Question 6 **(7 marks)**

In a set of 5 pages on a website, there are hyperlinks from:

- page 1 to page 2
- page 2 to page 5
- page 3 to page 1
- page 4 to pages 2 and 3
- page 5 to page 4.

(a) Construct digraph D to show the above information, where pages are represented by vertices and links by directed edges. (2 marks)



(b) Complete the adjacency matrix for D. (2 marks)

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{array} \begin{array}{c} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ & & & & \\ & & & & \end{bmatrix} \end{array}$$

(c) List, starting at page 5 and in the order visited, vertices in D that form a

(i) walk of length 2. (1 mark)

(ii) cycle of length 3. (1 mark)

(iii) trail of length 4. (1 mark)

See next page

Question 7 **(7 marks)**

Every day, 10% of the water in a tank is drained for crop irrigation and then the tank is topped up with 40 kL of water. The tank has a maximum capacity of 350 kL.

At the start of Day 1, before water is drained for the crops, the tank contains 50 kL.

(a) Determine the amount of water in the tank at the start of Day 2. (2 marks)

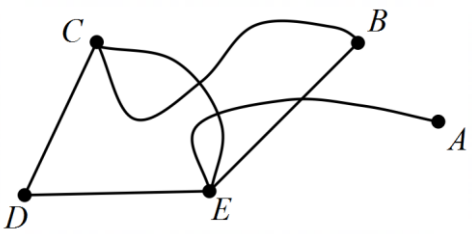
(b) Determine a recursive rule for the amount of water, A_n, in the tank at the start of Day n. (2 marks)

(c) Explain why the tank will never empty. (1 mark)

(d) State, with justification, whether the tank will overflow. (2 marks)

See next page

Question 8 **(7 marks)**



Graph G is shown. G_1 and G_2 are subgraphs of G, so that each subgraph has 5 vertices but one less edge than G.

(a) Is graph G planar? Justify. (2 marks)

(b) G_1 does not satisfy Euler's formula. State which edge must be removed from G, and show that G_1 does not satisfy Euler's formula. (2 marks)

(c) G_2 is bipartite. State which edge must be removed from G, and draw G_2 to clearly show the partite sets. (3 marks)

End of questions

Supplementary page

Question number: _____