

Semester One Examination, 2018

Question/Answer booklet

**MATHEMATICS  
APPLICATIONS  
UNIT 3, 4**

**Section One:  
Calculator-free**

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

Student number: In figures

--	--	--	--	--	--	--	--	--

In words

---

Your name

---

**Time allowed for this section**

Reading time before commencing work: five minutes

Working time: fifty minutes

**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	52	35
Section Two: Calculator-assumed	10	10	100	98	65
<b>Total</b>					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.
3. You must be careful to confine your response to the specific question asked and to follow any instructions that are specified to a particular question.
4. Supplementary pages for the use of planning/continuing your answer to a question have been 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.
5. 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.
6. It is recommended that you do not use pencil, except in diagrams.
7. The Formula sheet is not to be handed in with your Question/Answer booklet.

Section One: Calculator-free

35% (52 Marks)

This section has **eight (8)** questions. Answer **all** questions. Write your answers in the spaces provided.

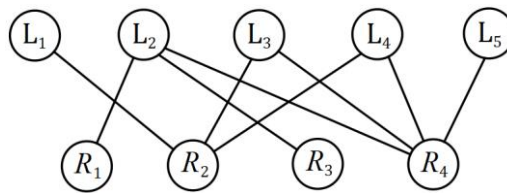
Working time: 50 minutes.

---

Question 1

(5 marks)

Five university lecturers ( $L_1, L_2, L_3, L_4$  and  $L_5$ ) have been allocated four rooms ( $R_1, R_2, R_3$  and  $R_4$ ) to teach in. Only one lecturer will teach in a room at any time. Because some of the lecturers require specialist equipment, not all the rooms can be used by all the lecturers, as shown in the graph below.

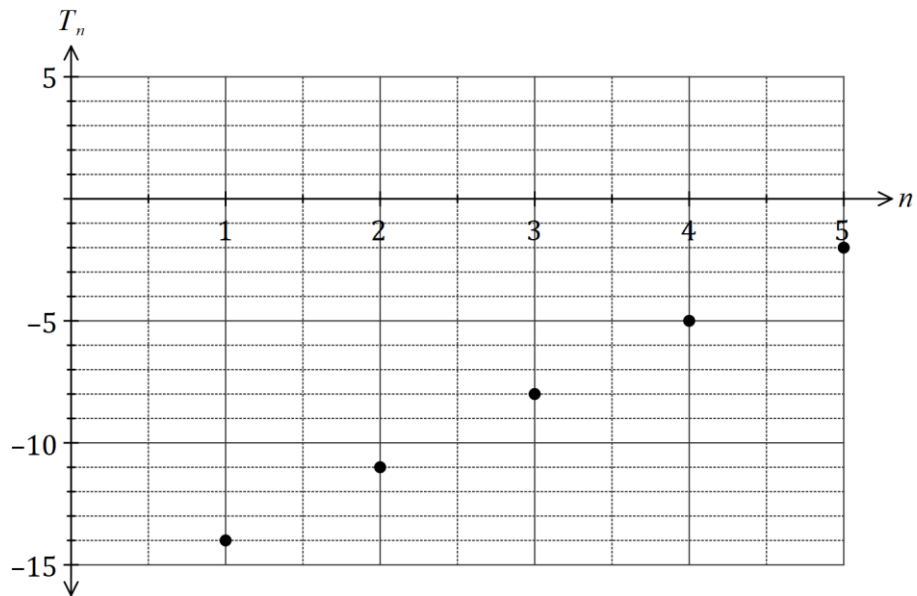


- (a) What is the name of such a graph shown above, where the vertices can be split into two groups so that each edge joins a vertex from one group to a vertex in the other group? (1 mark)
- (b) How many lecturers can use room  $R_4$ ? (1 mark)
- (c) How many rooms can lecturer  $L_2$  use? (1 mark)
- (d) Briefly explain whether
- (i) all five lecturers can teach at the same time? (1 mark)
- (ii) all four rooms could be in use at the same time? (1 mark)

Question 2

(4 marks)

The first five terms of an arithmetic sequence are shown on the graph below.



(a) Deduce a rule for the  $n^{\text{th}}$  term of this sequence.

(2 marks)

(b) Given that the  $k^{\text{th}}$  term of this sequence is 589, determine the value of  $k$ .

(2 marks)

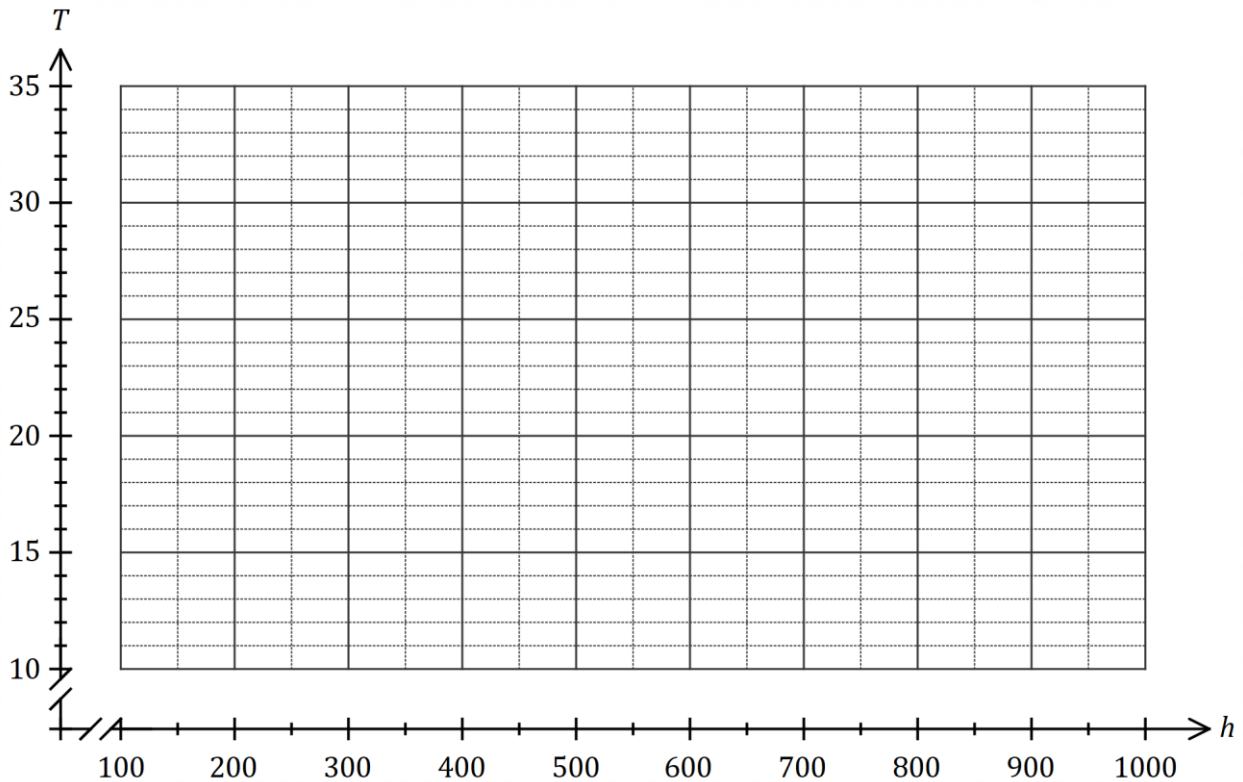
**Question 3**

**(8 marks)**

The average maximum temperature,  $T$  °C, was recorded for ten weather stations, together with the altitude of the station,  $h$  metres. The data is shown in the table below.

Altitude, $h$	115	250	301	342	442	525	627	774	896	934
Temperature, $T$	26	25	28	29	25	22	23	22	16	16

- (a) Construct a scatterplot on the axes below that can be used to identify whether an association exists between altitude and temperature. (3 marks)



- (b) Describe the features of the scatterplot that indicate a negative, strong linear association exists between altitude and temperature. (2 marks)

- (c) Estimate a value for

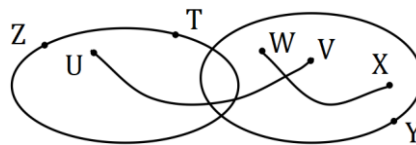
(i) the temperature at an altitude of 700 metres. (1 mark)

(ii) the value of the correlation coefficient between the two variables. (2 marks)

Question 4

(7 marks)

Graph  $G_1$  is shown below, with vertices  $T, U, V, W, X, Y$  and  $Z$ .

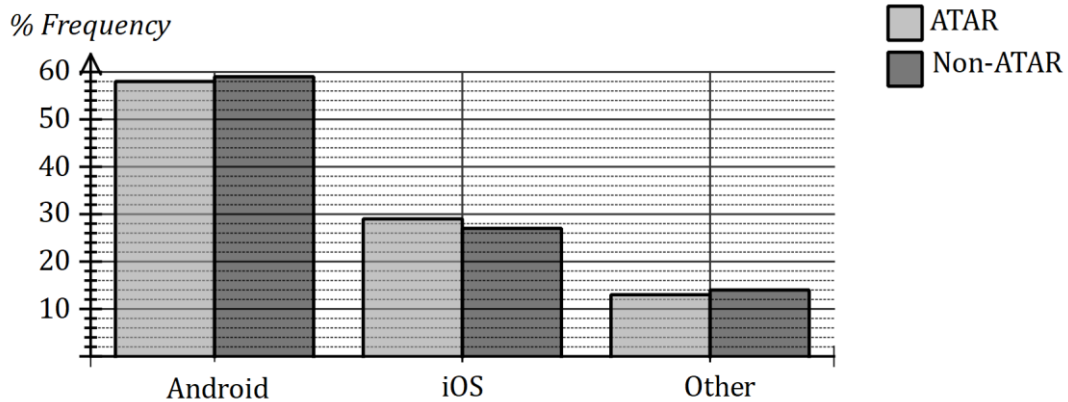


- (a) In graph theory, a planar graph is a graph that can be drawn in the plane. Describe how to draw the edges of such a graph to clearly show that it is planar. (1 mark)
- (b) Redraw graph  $G_1$  to clearly show that it is planar. (2 marks)
- (c) State the number of loops graph  $G_1$  contains. (1 mark)
- (d) Show that Euler's formula does **not** apply to graph  $G_1$ . (3 marks)

**Question 5**

**(6 marks)**

Mobile phone users who responded to a survey were asked which type of operating system their current phone used (Android, iOS or other) and whether they followed an ATAR or non-ATAR pathway at school. A breakdown of the results is shown in the graph below.

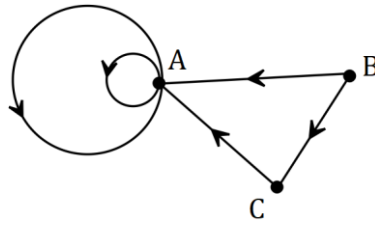


- (a) What percentage of the respondents who followed a non-ATAR pathway had a phone that used iOS? (1 mark)
  
- (b) Assuming that the survey results apply to the population in general,
  - (i) does knowing the operating system of a person's phone help you know the pathway they followed at school? Explain your answer. (2 marks)
  
  - (ii) does knowing the pathway a person followed at school help you know the type of operating system their phone has? (1 mark)
  
  - (iii) is there an association between a person's school pathway and type of operating system their phone has? Explain your answer. (2 marks)

Question 6

(7 marks)

A digraph is shown below.



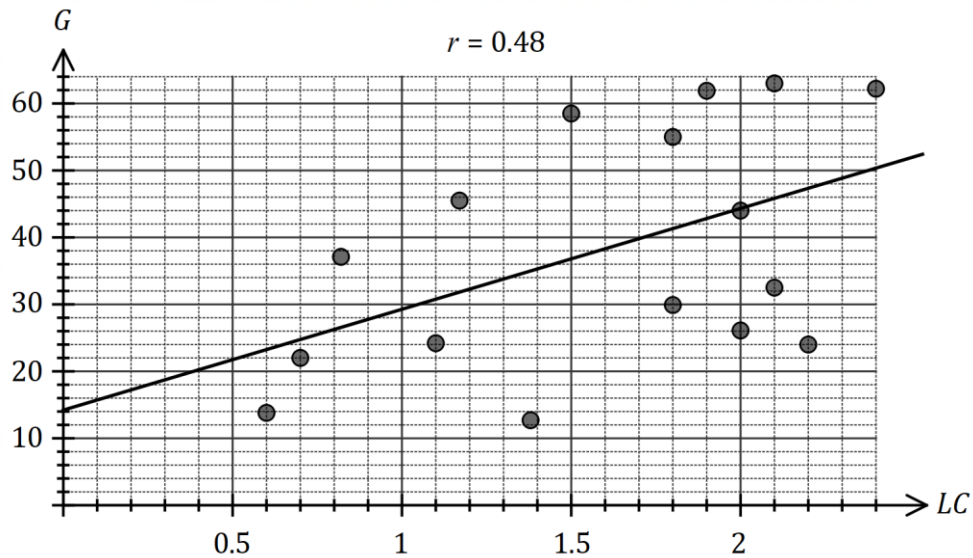
- (a) State, with justification, whether the digraph contains
- (i) a walk of length 8. (2 marks)
  
  
  
  
  
  
  
  
  
  
  - (ii) a Hamiltonian path. (2 marks)
- (b) Using column and row headings in the order  $A - B - C$ , construct the adjacency matrix  $M$  for the digraph and explain why there is a lack of symmetry in the matrix. (3 marks)



Question 7

(7 marks)

A medical study measured the lipoprotein-cholesterol ( $LC$ ) and ghrelin ( $G$ ) levels of a group of patients. The results were displayed in the scatterplot below, together with the least-squares line of best fit and the correlation coefficient between the variables.



- (a) How many patients in the study with a lipoprotein-cholesterol level of less than 1.85 had a ghrelin level of more than 28? (1 mark)
- (b) Determine the upper and lower predicted ghrelin levels for patients with lipoprotein-cholesterol levels between 1.05 and 2.1. (2 marks)
- (c) Comment on the claim that a low lipoprotein-cholesterol level causes a patient to have a low ghrelin level. (2 marks)
- (d) State the number of patients in the study and comment on how the size of the study could influence any explanation for an association between the variables. (2 marks)

**Question 8**

**(8 marks)**

A connected planar graph  $G_2$  has three faces and four vertices.

(a) Determine the number of edges graph  $G_2$  has. (2 marks)

(b) In each of the following, use the additional condition only within that part of the question.

(i) Draw graph  $G_2$  so that it is simple. (2 marks)

(ii) Draw graph  $G_2$  so that it contains a Eulerian trail. (2 marks)

(iii) Draw graph  $G_2$  so that it contains a Hamiltonian path but not a Hamiltonian cycle. (2 marks)

Supplementary page

Question number: \_\_\_\_\_

