



Semester One Examination, 2017

Question/Answer Booklet

MATHEMATICS APPLICATIONS

UNITS 3 and 4

Section One:

Calculator-free

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

Student Number: In figures

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In words

Your name

Time allowed for this section

Reading time before commencing work: five minutes

Working time for this section: 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 notes or other items of a non-personal nature in the examination room. 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 exam
Section One: Calculator-free	7	7	50	50	35
Section Two: Calculator-assumed	11	11	100	101	65
Total				151	100

Instructions to candidates

- 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.
- Write your answers in this Question/Answer Booklet.
- You must be careful to confine your response to the specific question asked and to follow any instructions that are specific to a particular question.
- Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
 - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
 - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.
- 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.
- It is recommended that you **do not use pencil**, except in diagrams.
- The Formula Sheet is **not** to be handed in with your Question/Answer Booklet.

Section One: Calculator-free

35% (50 Marks)

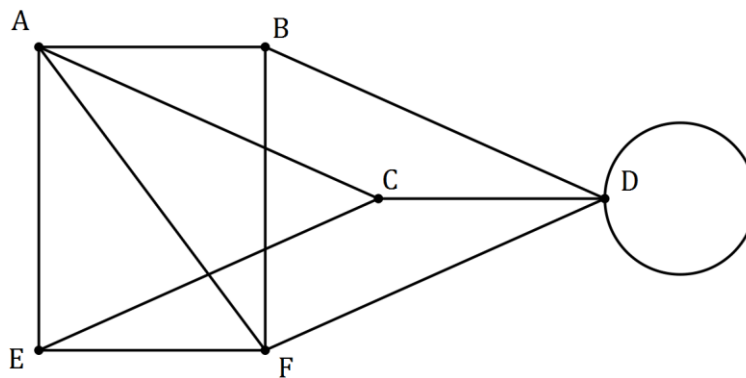
This section has **seven (7)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time for this section is 50 minutes.

Question 1

(4 marks)

A graph is shown below.



(a) Redraw the graph to clearly demonstrate that it is planar.

(2 marks)

(b) Verify Euler's formula for the graph.

(2 marks)

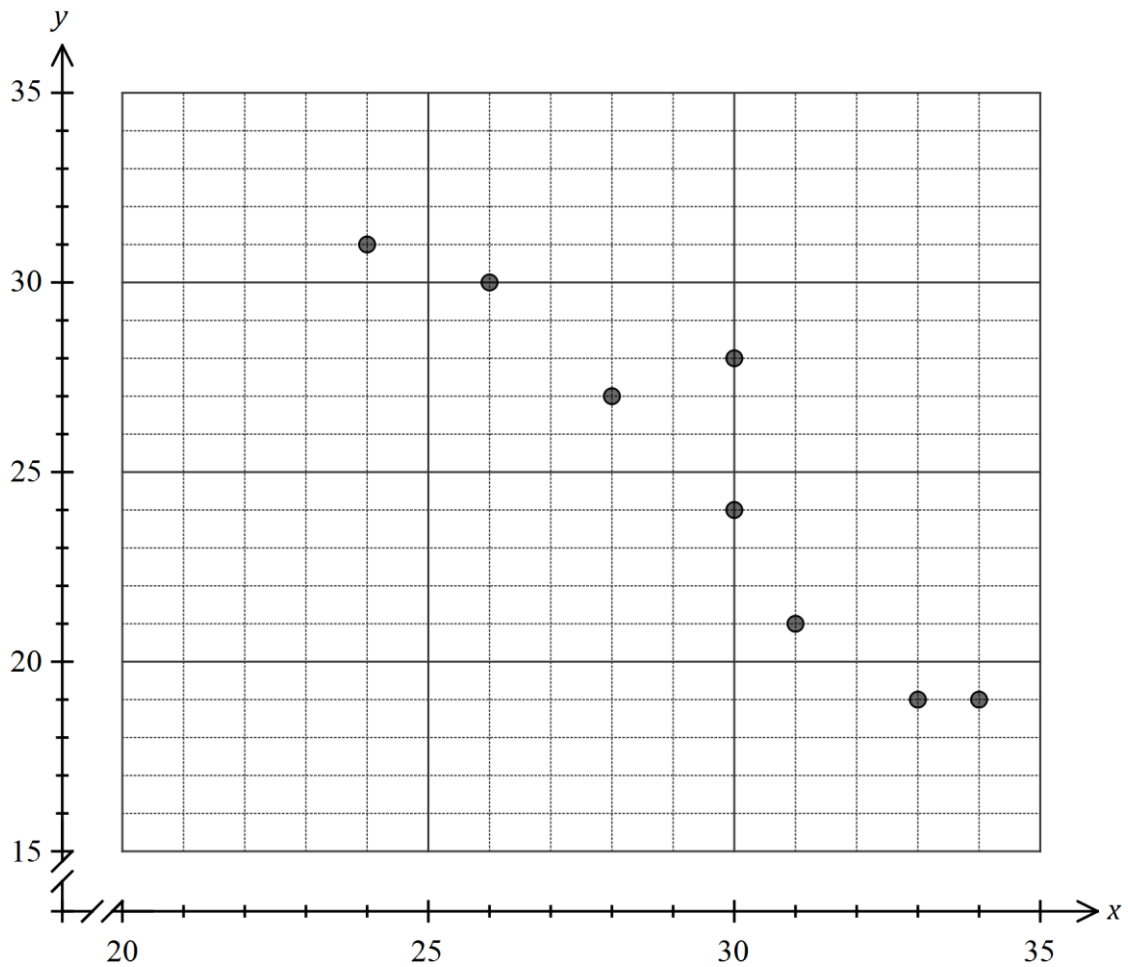
Question 2

(4 marks)

Ten students were set a challenge in which they had to run through an obstacle course and solve problems at various locations along the way to score points. Their times, in minutes, and total scores are shown in the table below.

Student	1	2	3	4	5	6	7	8	9	10
Time (x)	34	33	24	26	30	28	31	30	23	25
Score (y)	19	19	31	30	24	27	21	28	33	34

- (a) A scatterplot has been constructed on the axes below that can be used to identify whether any association exists between the variables. Add the scores for students' 9 and 10 to the scatterplot and highlight them. (2 marks)

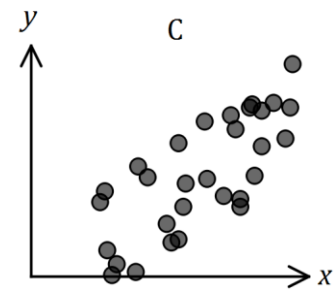
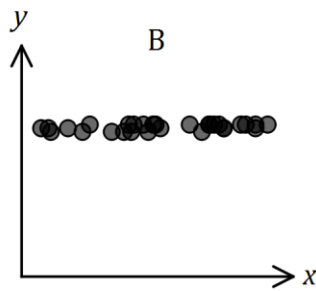
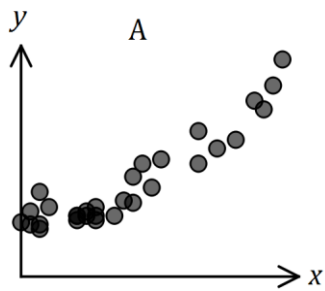


- (b) Describe the association between the two variables, x and y . (2 marks)

Question 3

(6 marks)

The scatterplots for three sets of data, A , B and C are shown below.



- (a) Order the data sets, from strongest to weakest, in terms of the strength of the linear correlation coefficient between the variables. Explain your answer. (2 marks)

- (b) One of the relationships appears to be non-linear. Identify this data set and explain your choice. (2 marks)

- (c) Give one example of a pair of possible variables for dataset B , explaining your choice. (2 marks)

Question 4

(13 marks)

Consider the recursive rule $T_{n+1} = aT_n + b$, $T_1 = 32$, where a and b are both constants.

(a) If $a = \frac{1}{2}$ and $b = 0$, determine

(i) T_3 . (1 mark)

(ii) a rule for the n^{th} term of the sequence. (2 marks)

(iii) the value of n if $T_n = \frac{1}{4}$. (1 mark)

(b) If $a = 1$ and $b = 4$, determine

(i) T_2 , T_3 and T_4 . (2 marks)

(ii) a rule for the n^{th} term of the sequence. (2 marks)

(iii) T_{101} . (1 mark)

(c) If $a = \frac{1}{2}$ and $b = 4$, determine

(i) T_2 and T_5 .

(2 marks)

(ii) the value T_n approaches as n becomes very large. Justify your answer. (2 marks)

Question 5

(6 marks)

(a) A manager must allocate three new staff members (S_1, S_2, S_3) to four vacant desks (D_1, D_2, D_3, D_4) in an office.

(i) Draw a bipartite graph to show all possible allocations. (2 marks)

(ii) The graph drawn in (i) is an example of a complete bipartite graph. Briefly explain the meaning of complete in this context. (1 mark)

(b) In this adjacency matrix, A, B, C and D represent four drivers and 1, 2, 3 and 4 represent four vehicles they can drive.

	1	2	3	4
A	0	1	1	1
B	0	0	1	0
C	0	0	1	0
D	1	1	1	1

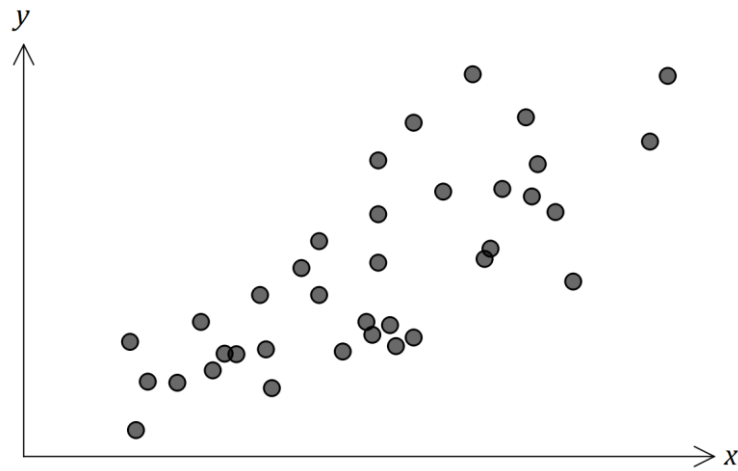
(i) Draw a bipartite graph to represent the adjacency matrix. (2 marks)

(ii) Use your graph to explain why all four drivers cannot all be driving a vehicle at the same time. (1 mark)

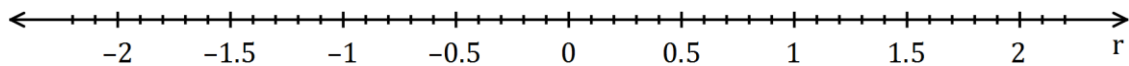
Question 6

(6 marks)

The scatterplot below illustrates how the number of firefighters sent to fires (x) is related to the cost of the damage (y) resulting from the fire, in a large city.



- (a) Place a cross on the scale below for the best estimate of the correlation coefficient between the two variables. Explain your choice. (2 marks)



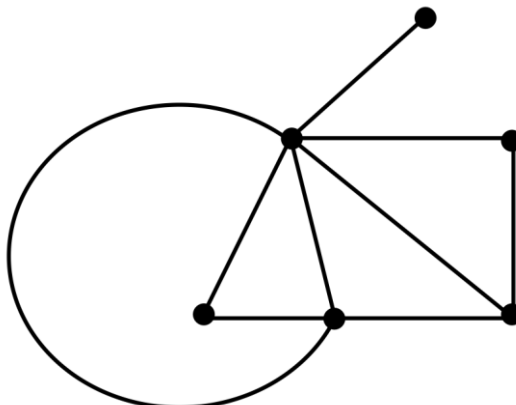
- (b) Is it reasonable to conclude from the scatterplot that sending fewer firefighters to a fire will decrease the cost of the damage? Explain your answer. (2 marks)

- (c) Identify and explain a possible non-causal explanation for the observed association between the number of firefighters and the cost of the damage. (2 marks)

Question 7

(11 marks)

- (a) Next to each vertex on the graph below, write whether it is odd or even. (2 marks)



- (b) Draw, if possible, a connected graph with at least two vertices that has the following properties. If not possible, explain why.

- (i) The sum of the degrees of the vertices is 6. (2 marks)

- (ii) The sum of the degrees of the vertices is 9. (2 marks)

(c) A simple connected graph has seven vertices, one of which has degree x .

(i) State the smallest and largest possible values of x . (2 marks)

(ii) The seven vertices have the degrees shown below.

$$x, x - 1, x - 3, 2x - 5, 2x - 6, 2x - 8, 4x - 14$$

Determine the value of x , justifying your answer. (3 marks)

Additional working space

Question number: _____