

Semester One Examination, 2017

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

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: 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	7	7	50	52	35
Section Two: Calculator-assumed	11	11	100	98	65
Total					100

Instructions to candidates

- The rules for the conduct of examinations are detailed in the school handbook. 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 specified to a particular question.
- Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space 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.

MARK ALLOCATION AND RECORDS:

Section	Question	Marks	Awarded
ONE	1	4	
	2	5	
	3	7	
	4	13	
	5	6	
	6	6	
	7	11	
	Total	52	

See next page

Section One: Calculator-free

35% (52 Marks)

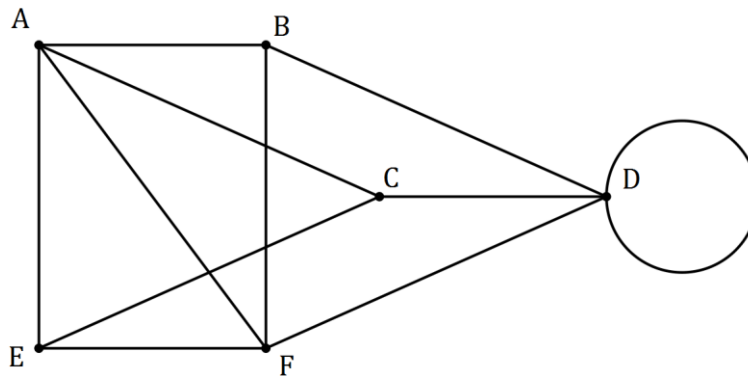
This section has **seven (7)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 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)

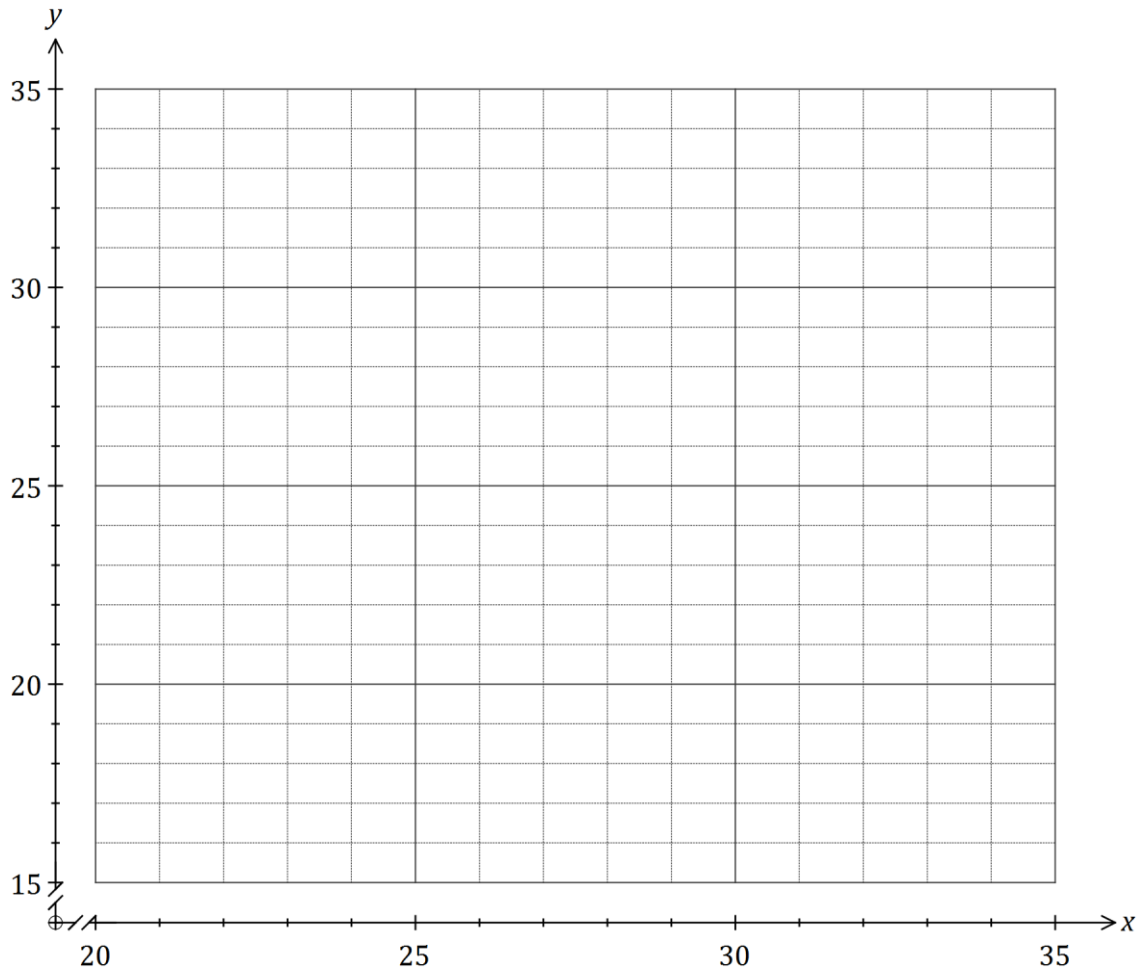
Question 2

(5 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) Construct a scatterplot on the axes below that can be used to identify whether any association exists between the variables. (3 marks)

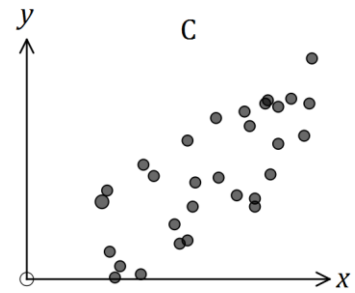
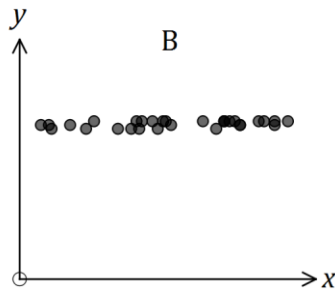
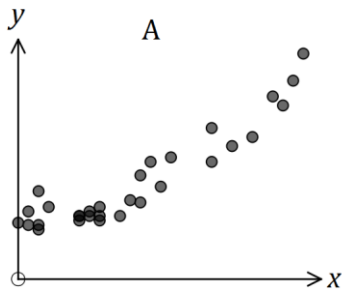


- (b) Describe the association between the two variables, x and y . (2 marks)

Question 3

(7 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. (3 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

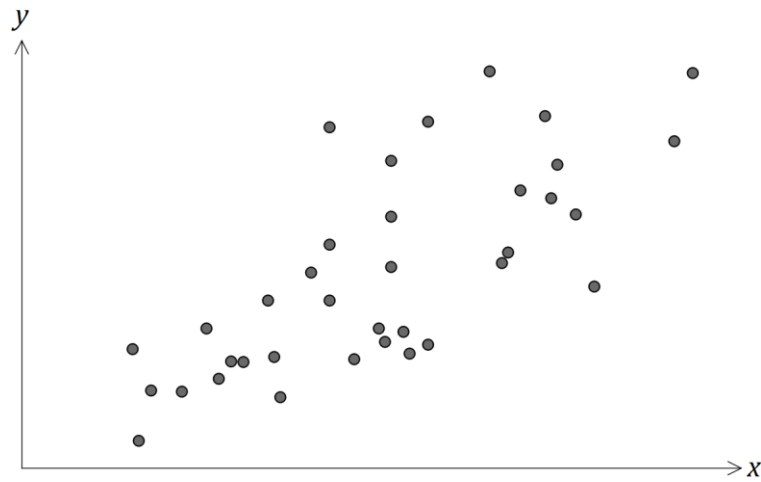
(i) Draw a bipartite graph to represent the adjacency matrix. (2 marks)

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

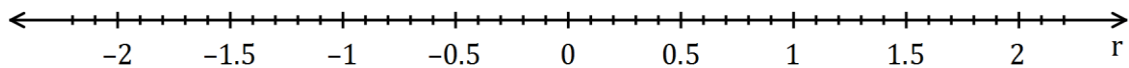
Question 6

(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)

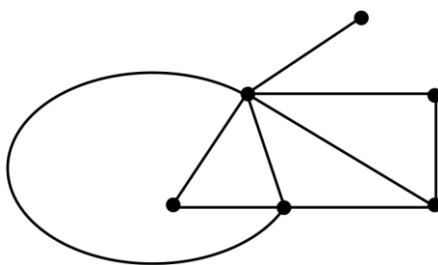


- (b) Is it reasonable to conclude from the scatterplot that sending fewer firefighters to a fire will decrease the cost of the damage? Explain your answer. (2 marks)
- (c) Identify and explain a possible non-causal explanation for the observed association between the number of firefighters and the cost 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: _____

Additional working space

Question number: _____

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