



WAEP Semester One Examination, 2018

Question/Answer booklet

**MATHEMATICS
APPLICATIONS
UNIT 3**

Section Two:

Calculator-assumed

SOLUTIONS

Student number: In figures

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In words

Your name

Time allowed for this section

Reading time before commencing work: ten minutes
Working time: one hundred minutes

Materials required/recommended for this section

To be provided by the supervisor

This Question/Answer booklet
Formula sheet (retained from Section One)

To be provided by the candidate

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

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper, and up to three calculators approved for use in this examination

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
Total					100

Instructions to candidates

1. 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.
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 Two: Calculator-assumed**65% (98 Marks)**

This section has **ten (10)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 100 minutes.

Question 9**(7 marks)**

(a) The first three terms, in order, of a geometric sequence are 1400, 980 and 686.

(i) Deduce a rule for the n^{th} term of this sequence. _____ (2 marks)

(ii) Calculate the 5^{th} term of the sequence. _____ (1 mark)

(b) The first three terms, in order, of an arithmetic sequence are 2.4, 5.5 and 8.6.

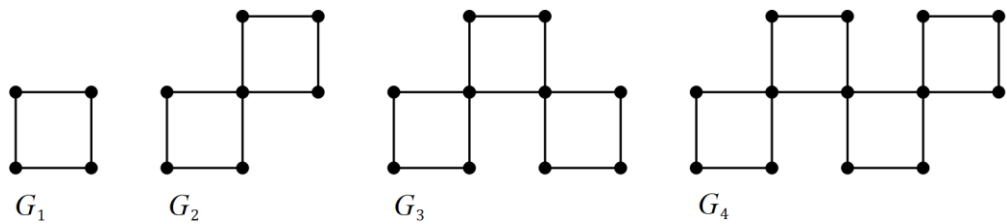
(i) The rule for the n^{th} term of this sequence is $T_n = an + b$. Determine the values of a and b . (3 marks)

(ii) Calculate the 177^{th} term of the sequence. _____ (1 mark)

Question 10

(8 marks)

A sequence of four connected graphs is shown below.



- (a) Complete the missing entries in the table below, where the vertex sum is the sum of the degrees of all the vertices in a graph. (2 marks)

Graph (n)	1	2	3	4
Vertices (V)	4	7	10	13
Vertex sum (S)	8	16	24	32

Assume that the sequence of graphs continues indefinitely.

- (b) A graph in the sequence has 10 faces. What is its vertex sum? (2 marks)

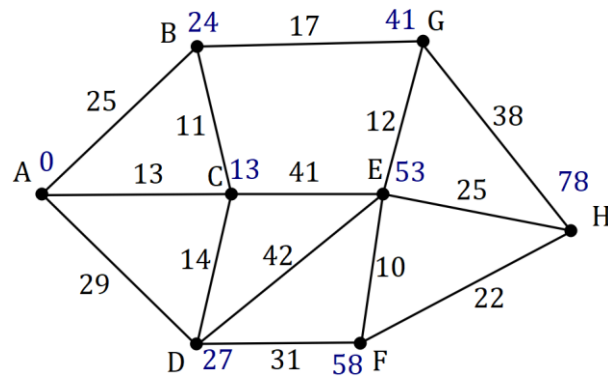
- (c) Deduce the n^{th} term rule for V_n , the number of vertices in graph n . (2 marks)

- (d) A graph in the sequence has 343 vertices. Determine the vertex sum of this graph. (2 marks)

Question 11

(8 marks)

The graph below represents a network of cycle tracks. The weight on each edge is the length, in km, of that track.



(a) State the length of the shortest route from G to D . (2 marks)

(b) Determine the shortest route from A to H , stating the route and its length. (4 marks)

(c) The section of track between A and C is closed for repairs and cannot be used. What effect, if any, does this closure have on the length of the shortest route from A to H ? (2 marks)

Question 12**(10 marks)**

A public relations company was tasked with determining whether a person's support for a sugary drinks tax could be associated with their interest in the news.

The company carried out a telephone survey, where people could respond to two questions as shown in the following table:

Question	Choice of response
Are you interested in the news?	Yes or No
Do you support a sugary drinks tax?	Yes, No or Undecided

The responses to the telephone survey are summarised in this table:

		Support for a sugary drinks tax		
		Yes	No	Undecided
Interest in news	Yes	667	382	210
	No	157	97	102

(a) Calculate the number of people who

(i) answered no to being interested in the news.

(1 mark)

(ii) responded to the survey.

(1 mark)

(b) If there was no association between interest in the news and support for a sugary drinks tax, should the company expect a smaller percentage of those who support a sugary drinks tax to be interested in the news compared to those who do not support a sugary drinks tax? Explain your answer. **(2 marks)**

- (c) Complete the two-way table below to show the associated **row** percentages for the previous table, rounding percentages to the nearest whole number. (3 marks)

		Support for a sugary drinks tax		
		Yes	No	Undecided
Interest in news	Yes			
	No			

- (d) What percentage of those who are not interested in the news support a sugary drinks tax? (1 mark)

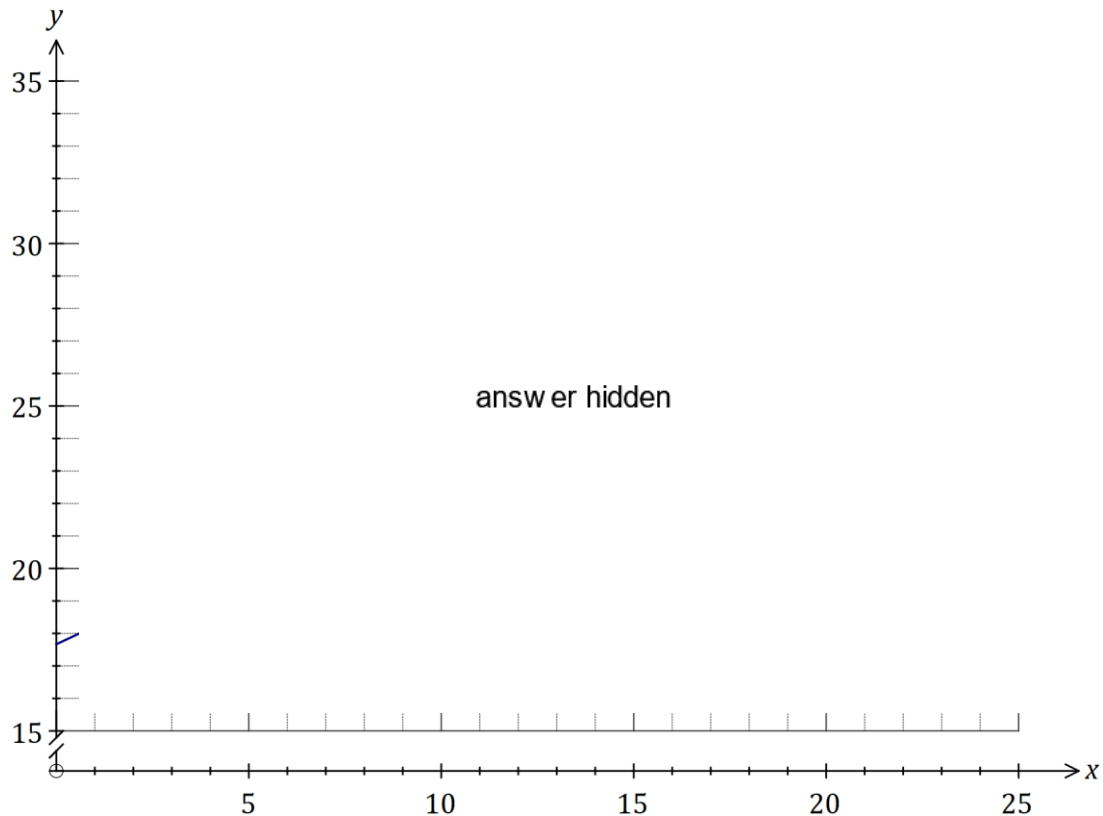
- (e) In the context of the task they were given, how should the public relations company interpret the responses to their survey? (2 marks)

Question 13

(15 marks)

A tomato grower added varying amounts of a liquid fertiliser (x mL) to the irrigation systems of twelve greenhouses and observed the resulting yield of tomatoes per plant (y kg). A sample of the data recorded is shown in the table and scatterplot below.

x (mL)	6	7	8	9	10	11	13	14	16	18	19	21
y (kg)	21	19	22	25	24	22	27	24	29	26	29	28



(a) Name the explanatory variable. (1 mark)

(b) For this data, calculate

(i) the correlation coefficient. (1 mark)

(ii) the values of a and b in the equation of the least-squares line $y = ax + b$. (2 marks)

- (c) What percentage of the variation in the yield per plant can be explained by the variation in the amount of liquid fertiliser added? (1 mark)

- (d) If the amount of liquid fertiliser added to the irrigation system in a greenhouse was increased by one millilitre, what increase in the yield of tomatoes per plant can be expected? Explain your answer. (2 marks)

- (e) If no liquid fertiliser was used, what yield of tomatoes per plant does the linear model predict? (1 mark)

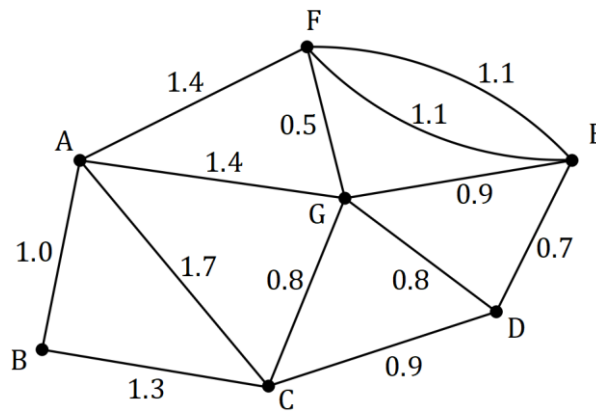
- (f) Use the equation of the least-squares line to calculate the value of y when $x = 5$ and when $x = 20$. (2 marks)

- (g) Use your answers to part (f) to draw the least-squares line on the scatterplot. (2 marks)

- (h) Estimate the yield of tomatoes per plant when 24 ml of liquid fertiliser is added to the irrigation system and comment on the reliability of this value. (3 marks)

Question 14**(10 marks)**

The roads in a suburb are represented in the graph below, where the number on each edge is the length, in km, of the road.



(a) The network contains a semi-Eulerian trail that ends at G .

(i) Explain what semi-Eulerian means. (2 marks)

(ii) At which vertex must the trail start? (1 mark)

(iii) Determine the number of edges in the trail. (1 mark)

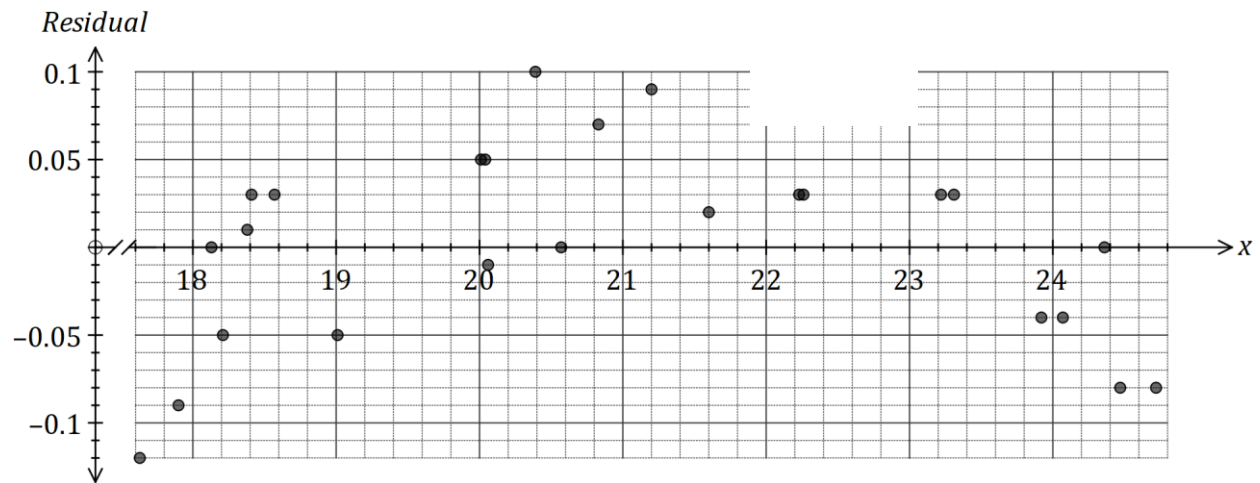
(iv) How many times does the trail pass through vertex C ? (1 mark)

- (b) A worker needs to leave G , travel along each road once to inspect its surface and then return to G . Determine the minimum distance the worker must travel. (3 marks)
- (c) Another worker needs to walk along each road twice, once on each side of the road, as they deliver advertising pamphlets to houses. Determine, with justification, the minimum distance this worker must travel if they start and finish at A and the width of the roads is ignored. (2 marks)

Question 15

(8 marks)

A linear model was fitted to a set of data, resulting in a correlation coefficient of $r = 0.94$ and a least-squares line with equation $\hat{y} = 5.16 + 0.16x$. A residual plot for the linear model is shown below.



- (a) Calculate, and add to the plot above, the residual for the point $x = 22$, $y = 8.76$. (3 marks)

- (b) Use the residual plot to comment on the appropriateness of fitting a linear model to the data. (2 marks)

- (c) Determine the y -coordinate of the point with a residual of 0.07 on the above plot. (3 marks)

Question 16

(9 marks)

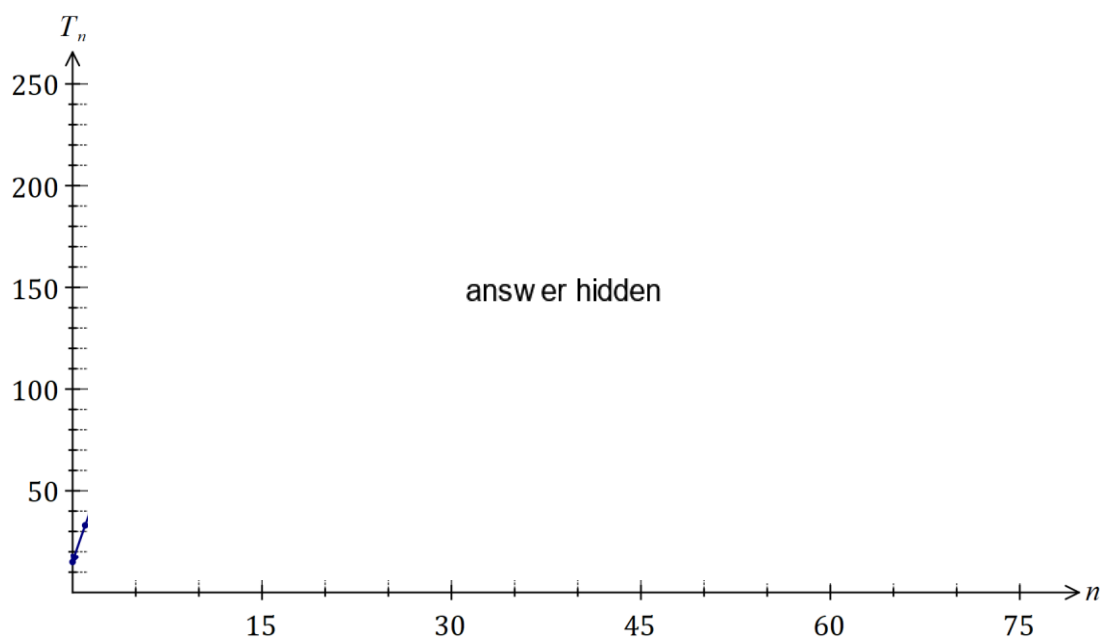
The temperature, T °C, of an industrial oven n minutes after it is turned on can be modelled by

$$T_{n+1} = 0.92T_n + 19.2, \quad T_0 = 15$$

- (a) Use the recurrence relation to complete the table of values below, rounding the temperature to the nearest °C. (2 marks)

n	0	10	20	30	40
T_n					

- (b) Sketch a graph of the temperature of the oven for the first 75 minutes on the axes below. Make sure you add a suitable scale to the vertical axis. (4 marks)



- (c) The manufacturer claims that the oven will reach within 10 °C of its maximum temperature within 30 minutes of being turned on. Comment on this claim. (3 marks)

Question 17**(13 marks)**

When Atarcoin, a new cryptocurrency was launched, one Atarcoin was valued at \$3.00. After one week of trading, the value of Atarcoin had increased to \$3.60, and after another week had increased to \$4.32.

- (a) Show that the value of Atarcoin increased by 20% each week. (2 marks)

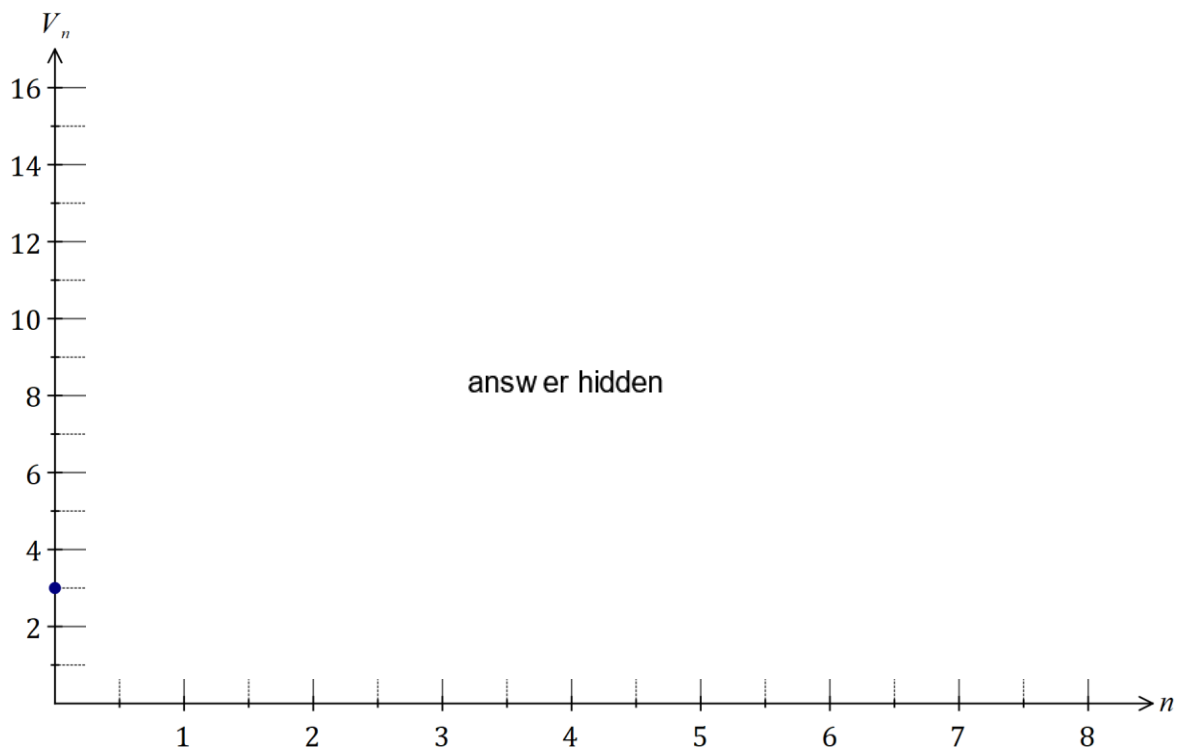
The value of Atarcoin, V_n in dollars, n weeks after its launch date, can be modelled by the recurrence relation $V_{n+1} = 1.2V_n$, $V_0 = 3$.

- (b) Calculate the value of Atarcoin 11 weeks after its launch date. (1 mark)



- (c) At the end of which week did the value of Atarcoin first exceed \$150? (1 mark)

- (d) Graph V_n against n on the axes below. (3 marks)



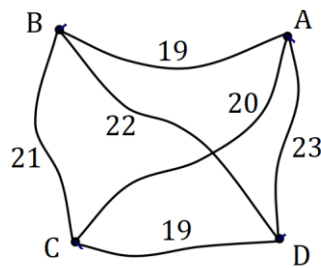
The value of Atarcoin peaked at the end of week 35, and from that time onwards, its value fell by 40% each week.

- (e) Determine the value of Atarcoin at the end of week 36. (2 marks)

- (f) Ignoring any fees involved in buying and selling a cryptocurrency, determine the profit or loss made by a person who bought 150 Atarcoins four weeks after their launch, held them for 35 weeks and then sold them all. (4 marks)

Question 18**(10 marks)**

Oliver is visiting a city that has four museums: A , B , C and D . The weights on the edges of the following graph represent the time, in minutes, that it takes to walk between the museums.



- (a) List, in the order visited, a set of vertices that form a Hamiltonian cycle in the graph. (2 marks)
- (b) Determine the shortest time it would take to leave C , walk to the other museums and return to C . (2 marks)

The time to walk from Oliver's hotel, H , to museums A , B , C and D is 24, 15, 28 and 25 minutes respectively.

- (c) Add vertex H and this information to the graph above. (2 marks)
- (d) Oliver plans to leave his hotel at 9.30 am, visit all the museums and then return to his hotel at 3.30 pm the same day. Determine the maximum total time he can spend inside the museums if he walks between them and describe the route he should take. (4 marks)

Supplementary page

Question number: _____

Supplementary page

Question number: _____

Supplementary page

Question number: _____

