MATHEMATICS APPLICATIONS

MAWA Semester 2 (Units 3 & 4) Examination 2019

Calculator-free

Marking Key

The release date for this exam and marking scheme is

- **the end of week 1 of term 4, 2019**

Section One: Calculator-free   **(50 Marks)**

Question 1 (a)   **(3 marks)**

Solution	
(i) $\quad x = 20$	
(ii) $\quad x = \pm 12$	
Marking key/mathematical behaviours	Marks
• identifies correct value for x	1
• identifies rate of 12	1
• identifies rate of -12	1

Question 1 (b)   **(3 marks)**

Solution	
(i)	$T_8 = T_5 + 3d$ $32 = 56 + 3d$ $-24 = 3d$ $d = -8$ $T_5 = T_1 + 4d$ $56 = T_1 - 32$ $T_1 = 88$
(ii)	$T_n = a + (n-1)d$ $T_n = 88 + (n-1)(-8)$ $T_n = 88 - 8n + 8$ $T_n = 96 - 8n$ Therefore $b = 96$ and $c = -8$
Marking key/mathematical behaviours	Marks
• substitutes correct values	1
• rearranges values to find general term equation	1
• states correct value for b and c	1

Question 2 (a)   (2 marks)

Solution

Marking key/mathematical behaviours	Marks
• Adds at least 4 correct connections	1
• Adds all connections correctly (and no extra ones) at any vertex	1

Question 2 (b)   (3 marks)

Solution
While the graph is simple because there are no loops or multiple edges, and it is connected because all vertices are linked (there are no isolated vertices) it cannot be described as planar because the edges cross.

Marking key/mathematical behaviours	Marks
• identifies the graph as not planar and provides a reason	1
• identifies the graph as simple and provides a reason	1
• identifies the graph as connected and provides a reason	1

Question 2 (c) (2 marks)

Solution

Marking key/mathematical behaviours	Marks
• correctly labels at least 10 correct distances on the edges	1
• labels all edges with the correct distances	1

Question 2 (d) (2 marks)

Solution
OABCDEFO 44km or OAEBCDFO 43km (other options exist)

Marking key/mathematical behaviours	Marks
• identifies a route to fit description	1
• determines length of route	1

Question 2 (e) (1 mark)

Solution
Hamiltonian cycle

Marking key/mathematical behaviours	Marks
• identifies a Hamiltonian cycle	1

Question 3 (a)   (2 marks)

Solution
Relationship is moderately strong and positive.

Marking key/mathematical behaviours	Marks
• comments on the strength of correlation	1
• comments on the relationship between variables	1

Question 3 (b)   (2 marks)

Solution	
(i)	Approximately 51.84% of the number of accidents can be attributed to the change in the number of schools.
(ii)	Gradient is 2.21. As such, there is an increase of 2.21 road accidents for every additional school.

Marking key/mathematical behaviours	Marks
• provides an explanation using the coefficient of determination	1
• provides an explanation using the gradient of the least squares regression line	1

Question 3 (c)   (2 marks)

Solution
The relationship as stated in **(a)** is moderately strong and positive, which could be interpreted as "the more schools there are, the greater the number of accidents". In line with this thinking, merging schools would decrease the number of schools, and hence, decrease the number of road accidents.

Marking key/mathematical behaviours	Marks
• identifies a plausible reason	1
• supports this identified reason with justification	1

Question 3 (d)   (2 marks)

Solution
There are many reasons to account for road accidents (e.g. fatigue, inattention, driver experience, alcohol, speed) which have little or no causal connection to the number of schools there are in a city.

Marking key/mathematical behaviours	Marks
• identifies a plausible non-causal explanation	1
• explains this identified explanation with justification	1

Question 4 (a)   (2 marks)

Solution
Sam has the correct values as he has completed the first step for <u>maximising</u>, which is to subtract all values from the highest term (10)   Whereas Ryan has completed the first step for <u>minimising</u>

Marking key/mathematical behaviours	Marks
• stating Sam as correct employee	1
• identifying the subtraction of all scores from highest value (maximising)	1

Question 4 (b)   (5 marks)

Solution
Various line combinations. This is one example of how to find answer.

Location

	A	B	C	D
Contractor 1	0	4	2	2
Contractor 2	3	5	(1)	0
Contractor 3	5	2	5	0
Contractor 4	0	0	0	2

Location

	A	B	C	D
Contractor 1	0	3	1	2
Contractor 2	3	4	0	0
Contractor 3	5	1	4	0
Contractor 4	1	0	0	3

Allocation: Contractor 1: A

Contractor 2: C   Total number of storage spaces: 10+9+8+5

Contractor 3: D   = 32

Contractor 4: B

Marking key/mathematical behaviours	Marks
• subtracts the smallest number from each element in each row	1
• shows min. lines as 3	1
• subtracts lowest number uncovered from each uncovered number and adds to the intersection points	1
• states correct allocations	1
• states correct maximum number of storage spaces	1

Question 5 (a)   (1 mark)

Solution
To smooth out the time series data and determine if it has cycles or trend, and if so, what might the trend be and what the best period or length of the cycle might be.

Marking key/mathematical behaviours	Marks
• correctly states a valid reason for calculating moving averages	1

Question 5 (b)   (4 marks)

Solution
$$\frac{860+830+A}{3}=832 \Rightarrow 1690+A=2496 \Rightarrow A=806$$ $$\frac{(920)+(930)+(880)+(850)+(820)}{5}=\frac{4400}{5}=880$$

Marking key/mathematical behaviours	Marks
• indicates use of the correct data and rule to determine the 3-point MA	1
• calculates A correctly	1
• indicates use of the correct data and rule to determine the 5-point MA	1
• calculates B correctly	1

Question 5 (c)   (2 marks)

Solution
5 pt M.A. as the data clearly has a cycle of 5. or The values in the 5-point moving average column are continually decreasing.

Marking key/mathematical behaviours	Marks
• correctly states the most appropriate moving averages	1
• gives a valid justification	1

Question 5 (d)   (2 marks)

Solution
There is a decreasing/downward trend. The high points at $t=3, t=8$ and $t=13$ are decreasing as are the low points at $t=6, t=11$ and $t=16$ (if A is plotted)

Marking key/mathematical behaviours	Marks
• correctly states the overall trend	1
• correctly refers to the high and low points in the cycles	1

Question 6 (a)   (5 marks)

Solution
(i) $A_{n+1} = 1.09 A_n$, $A_0 = 5000$ where A_n represents value and n = number of years passed $A_n = 5000(1.09)^n$ (ii)   *or*   where A_n represents value and n = number of years passed $A_n = 5450(1.09)^{n-1}$

Marking key/mathematical behaviours	Marks
• correctly determines growth rate	1
• uses correct format for recurrence relation	1
• correctly states A_0	1
• uses correct format for the nth term rule	1
• uses correct values for n^{th} term rule	1

Question 6 (b)   (1 marks)

Solution
Monthly rate $\begin{aligned} &= 0.09 \div 12 \\ &= 0.0075 \end{aligned}$

Marking key/mathematical behaviours	Marks
• identifies monthly interest rate	1

Question 6 (c)   (2 marks)

Solution
At 10 years Yearly Graph ~ $11750   Monthly Graph ~ $14500   Approximate increase of $2750

Marking key/mathematical behaviours	Marks
• identifies approximate change in investment	1
• specifies the change as a growth	1