



WA Exams Practice Paper D, 2016

Question/Answer Booklet

**MATHEMATICS  
APPLICATIONS  
UNIT 3**

**Section One:  
Calculator-free**

**SOLUTIONS**

Student Number: In figures

|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|
|  |  |  |  |  |  |  |  |
|--|--|--|--|--|--|--|--|

In words

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Your name

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**Time allowed for this section**

Reading time before commencing work: five minutes

Working time for 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:<br>Calculator-free    | 7                             | 7                                  | 50                     | 52              | 35                 |
| Section Two:<br>Calculator-assumed | 12                            | 12                                 | 100                    | 97              | 65                 |
| <b>Total</b>                       |                               |                                    |                        | 149             | 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. 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.
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)

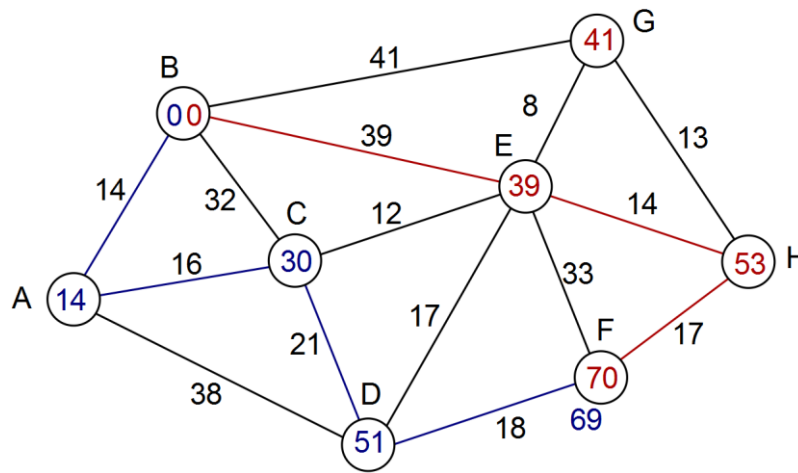
This section has **seven (7)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time for this section is 50 minutes.

Question 1

(5 marks)

The number of days it takes a company to transport shipping containers between global depots with a direct link is shown on the edges of the weighted graph below.



Determine the length of the open path that minimises the number of days to transport a container from depot B to depot F if

- (a) the container must pass through E. (3 marks)

|                    |
|--------------------|
| B E H F<br>70 days |
|--------------------|

- (b) there are no restrictions on the route the container must take. (2 marks)

|                      |
|----------------------|
| B A C D F<br>69 days |
|----------------------|

**Question 2**

**(7 marks)**

A group of students were asked to investigate whether time spent working at a part-time job in Year 12 decreased the amount of time spent doing homework during the year.

- (a) One student planned to ask each of the students in his class the question 'Do you think having a part-time job affects your homework?' Comment on how useful responses to this question would be to his investigation. (2 marks)

Question is of little use:

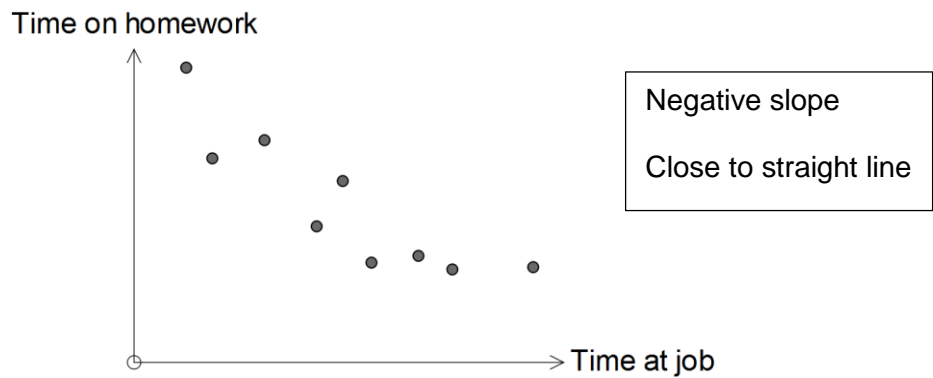
- Question is vague
- 'affects' could be interpreted as doing more or less than usual
- having a part-time job doesn't reflect time spent at job
- Limited responses such as yes, no, maybe, don't know

- (b) Another student planned to ask nine of her friends how long they worked each week at their part-time job and how long they spent doing homework.

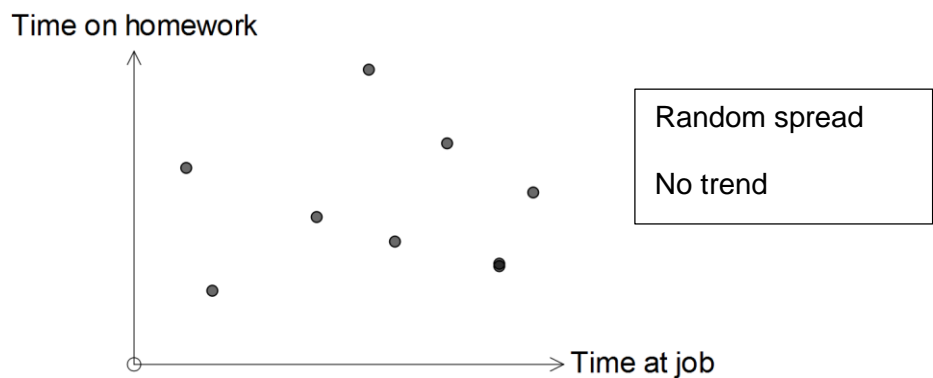
- (i) State one way in which she could improve her data collection. (1 mark)

- Use random sampling from all year 12's
- Take larger sample

- (ii) Sketch a scatterplot of the results this student might obtain if the topic of their investigation was true and the coefficient of determination was 0.8. (2 marks)



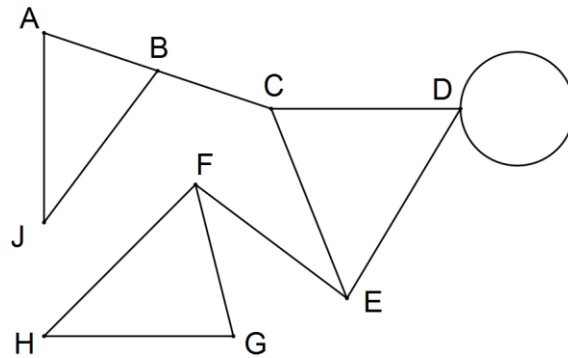
- (iii) Sketch a scatterplot of the results this student might obtain if no association between the two variables was found. (2 marks)



Question 3

(7 marks)

A graph is shown below.



- (a) Verify that the graph obeys Euler's formula. (2 marks)

9 vertices, 5 faces and 12 edges:  
 $9 + 5 = 12 + 2$   
 $14 = 14 \Rightarrow$  obeys rule

- (b) List the vertices that are of an odd degree. (2 marks)

B, C, E and F.

- (c) State which edges in the graph, if any, are bridges. (1 mark)

BC and EF

- (d) If edges CD and DE were removed from the graph, would the remaining graph obey Euler's formula? Explain your answer. (2 marks)

No.  
 Euler only applies to connected planar graphs but graph is now disconnected.

Question 4

(9 marks)

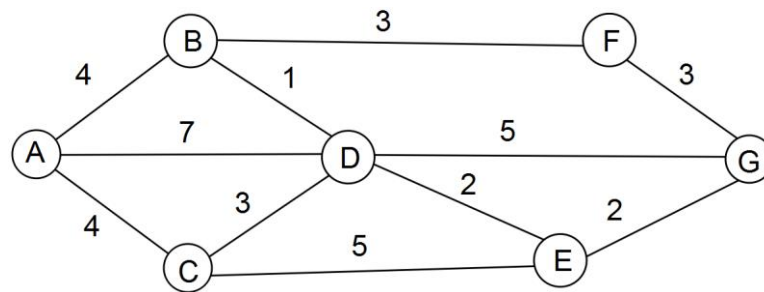
The table below shows the distances, in kilometres, along direct footpaths between the checkpoints A, B, C, D, E, F and G at a national park.

|   | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| A | 4 | 4 | 7 | - | - | - |
| B |   | - | 1 | - | 3 | - |
| C |   |   | 3 | 5 | - | - |
| D |   |   |   | 2 | - | 5 |
| E |   |   |   |   | - | 2 |
| F |   |   |   |   |   | 3 |

(a) Complete the graph below to show this information.

(3 marks)

Must include distances on edges.



A park worker is at Checkpoint D and needs to visit all the other checkpoints just once and then return to D.

(b) The worker leaves Checkpoint D, walks to Checkpoint A and then visits the rest of the checkpoints just once before returning to D. List the other checkpoints visited, in order, and state the total length of this route. (2 marks)

(D-A)-**B-F-G-E-C**-(D) or (D-A)-**C-E-G-F-B**-(D).  
Total length is 25 km.

(c) Is the trail in (b) a Hamiltonian path or cycle? Explain your answer. (2 marks)

Trail is a Hamiltonian **cycle**, as it visits all vertices just once, starting and finishing at the same vertex.

(d) A shorter trail, starting and finishing at D, is possible for the worker. List the order the checkpoints should be visited to achieve the smallest total length, and state this length. (2 marks)

**D-C-A-B-F-G-E**-D (or in reverse).  
Shortest trail is 21 km.

## Question 5

(9 marks)

(a) Some consecutive terms of an arithmetic sequence are shown in the table below.

| n     | 4    | 5    | 6    | 7    |
|-------|------|------|------|------|
| $T_n$ | 21.5 | 24.2 | 26.9 | 29.6 |

(i) Determine the eighth term of this sequence. (2 marks)

$$29.6 - 26.9 = 2.7$$

$$T_8 = 29.6 + 2.7 = 32.3$$

(ii) Determine the first term of the sequence. (1 mark)

$$21.5 - 3 \times 2.7 = 21.5 - 8.1 = 13.4$$

(iii) State a rule for the  $n^{\text{th}}$  term of this sequence. (2 marks)

$$T_n = 13.4 + (n-1) \times 2.7$$

(iv) Determine  $T_{101}$ . (1 mark)

$$T_{101} = 13.4 + 100 \times 2.7 = 270 + 13.4 = 283.4$$

(b) The sum of the first three terms of another arithmetic sequence with a common difference of four is 45.

(i) If the first term of this sequence is  $a$ , write down an equation that shows the first three terms of this sequence have a sum of 45. (1 mark)

$$a + a + 4 + a + 8 = 45$$

(ii) Solve your equation and hence determine the sixth term of this sequence. (2 marks)

$$3a + 12 = 45$$

$$3a = 33$$

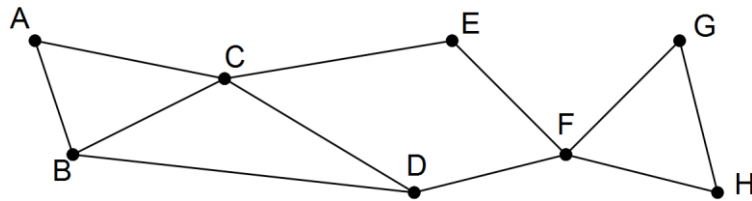
$$a = 11$$

$$T_6 = 11 + 5 \times 4 = 31$$

## Question 6

(6 marks)

A graph is shown below.



- (a) State, with justification, whether or not the graph is planar. (2 marks)

Yes, is planar.  
Graph is drawn with no edges crossing.

- (b) The graph is semi-Eulerian. Clearly explain what this means. (2 marks)

The graph contains an **open trail** that includes **every edge once only**.

- (c) The graph represents a set of footpaths linking monuments together in a park. Is it possible for a person to walk along each footpath once and only once? If you answer yes, state where to start and where to finish. If you answer no, use your knowledge of graphs to explain why not. (2 marks)

Yes.  
Start at B and end at D (or start D and end B).



## Question 7

(9 marks)

(a) The first three terms of a sequence, in order, are 3, 4 and 7.

(i) Show that the sequence is neither arithmetic nor geometric. (2 marks)

$$d_1 = 4 - 3 = 1$$

$$d_2 = 7 - 4 = 3$$

$$d_1 \neq d_2 \Rightarrow \text{Not arithmetic}$$

$$r_1 = 4 \div 3 = 1.\dot{3}$$

$$r_2 = 7 \div 4 = 1.75$$

$$r_1 \neq r_2 \Rightarrow \text{Not geometric}$$

(ii) The sequence can be defined by the recurrence relation  $T_{n+1} = aT_n + b$ ,  $T_1 = 3$ . Determine the values of the constants  $a$  and  $b$ . (3 marks)

$$4 = 3a + b$$

$$7 = 4a + b$$

$$\text{Eqn (2) - (1)} \Rightarrow a = 3$$

$$\text{Sub into (1)}$$

$$4 = 3(3) + b \Rightarrow b = -5$$

(b) Circle **one** of the following recurrence relations that has a long term increasing solution. Explain your reasoning. (2 marks)

$$A_{n+1} = 2A_n - 10, A_1 = -10 \quad B_{n+1} = 0.2B_n - 10, B_1 = -10 \quad C_{n+1} = 2C_n + 10, C_1 = 10$$

Can't be A, as terms will become more and more negative and can't be B as it has a steady state solution.

(c) The sequence given by  $T_{n+1} = 0.25T_n + k$ ,  $T_1 = 3$  has a long term steady state solution of 20. Determine the value of  $k$ . (2 marks)

$$\text{In long term, } T_{n+1} = T_n = 20.$$

$$20 = 0.25(20) + k$$

$$20 = 5 + k$$

$$k = 15$$

End of questions

**Additional working space**

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

**Additional working space**

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

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