Government of **Western Australia**
School Curriculum and Standards Authority

**Western Australian Certificate of Education
ATAR course examination, 2016**

Question/Answer booklet

MATHEMATICS APPLICATIONS

Section One: Calculator-free

Student number: In figures

In words

Time allowed for this section
Reading time before commencing work: five minutes
Working time: fifty minutes

Number of additional
answer booklets used
(if applicable):

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	6	6	50	50	35
Section Two: Calculator-assumed	10	10	100	100	65
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian Certificate of Education ATAR course examinations are detailed in the *Year 12 Information Handbook 2016*. 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 answer to the specific question asked and to follow any instructions that are specified to a particular question.

4. 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.

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% (50 Marks)**

This section has **six (6)** questions. Answer **all** questions. Write your answers in the spaces provided.

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.

Working time: 50 minutes.

Question 1 **(7 marks)**

Joe wishes to upgrade his sprinkler system using the least possible length of piping. The weighted graph below shows the existing system. The numbers on the edges indicate the length of each pipe, in metres, between sprinklers A, B, C, D, E, F, G and H.
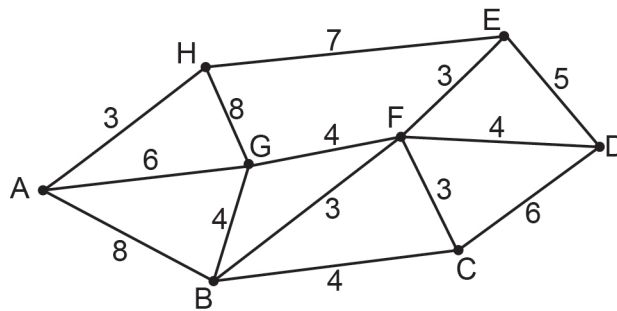
(a) Complete the table below showing connections between each sprinkler. (2 marks)

	A	B	C	D	E	F	G	H
A	–	8						3
B	8	–						
C			–	6				
D			6	–				
E					–	3		7
F					3	–		
G							–	
H	3				7			–

(b) Show the use of Prim's algorithm to establish a minimum spanning tree for the least length of piping required and draw this tree on the diagram below. (5 marks)
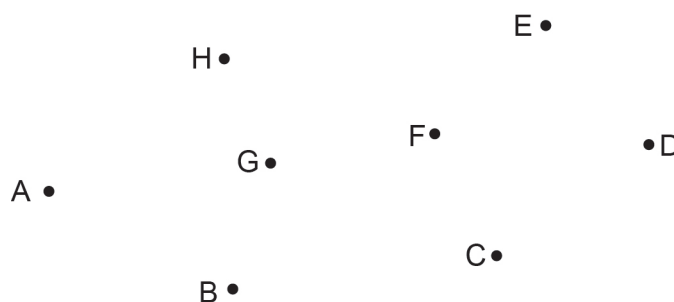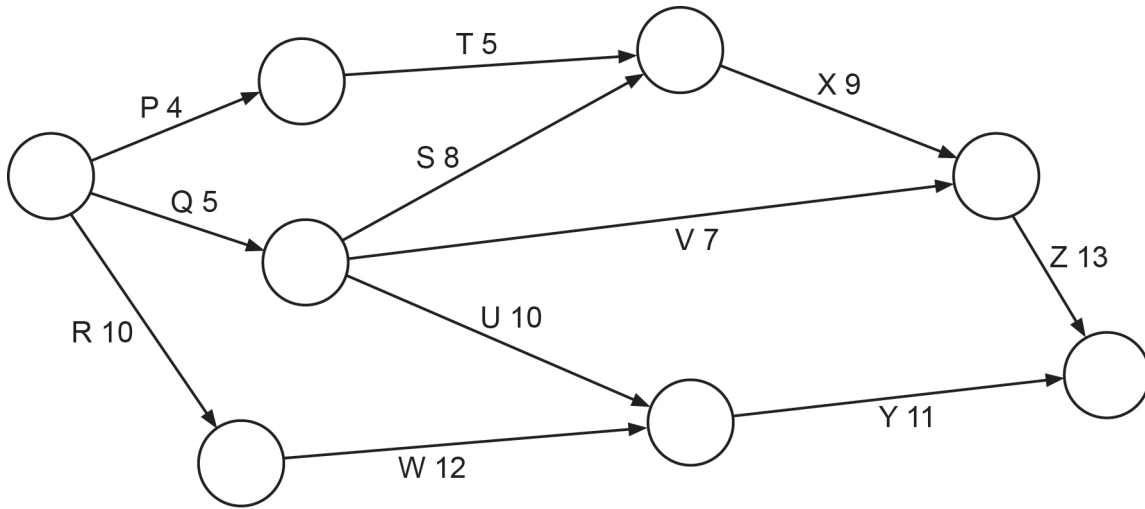

See next page

Question 2 **(7 marks)**

A project consists of 11 activities, P to Z. The project network representing the scheduling of these activities is shown below. The times are in days.

(a) State the critical path and the minimum completion time for this project. (2 marks)

(b) Determine the:

(i) earliest starting time for activity Y. (1 mark)

(ii) latest starting time for activity V. (1 mark)

(iii) float time for activity U. (1 mark)

See next page

(c)   Activity W is delayed by three days. How, if at all, will this affect the critical path and minimum completion time for this project? A copy of the network is given below. (2 marks)

See next page
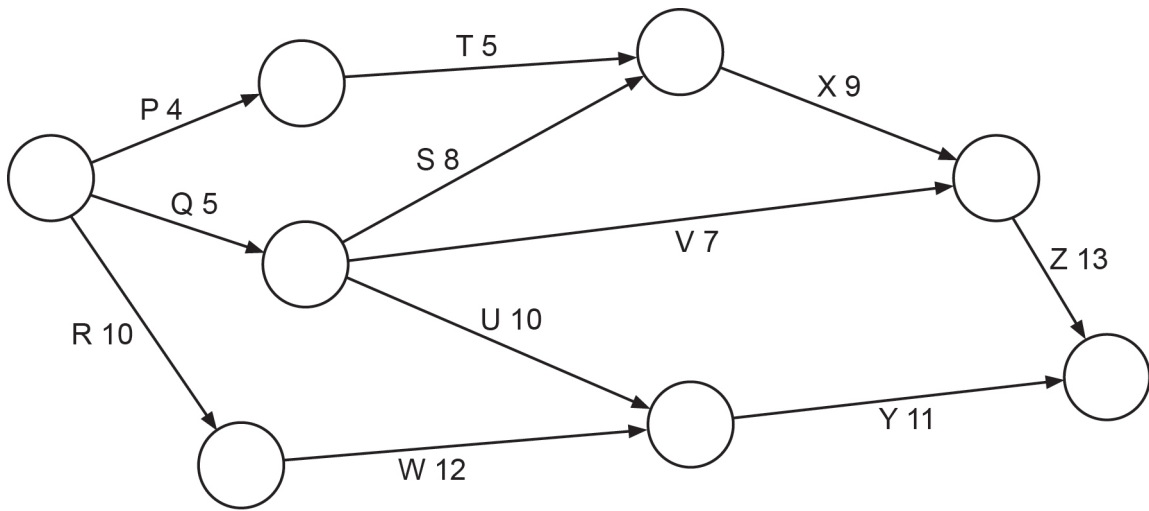
Question 3 (8 marks)

A foreman in a factory has four workers, Adam, Ben, Cate and Demi, and four jobs to complete. The time, in hours, each worker can complete a particular job is given in the weighted bipartite graph below.
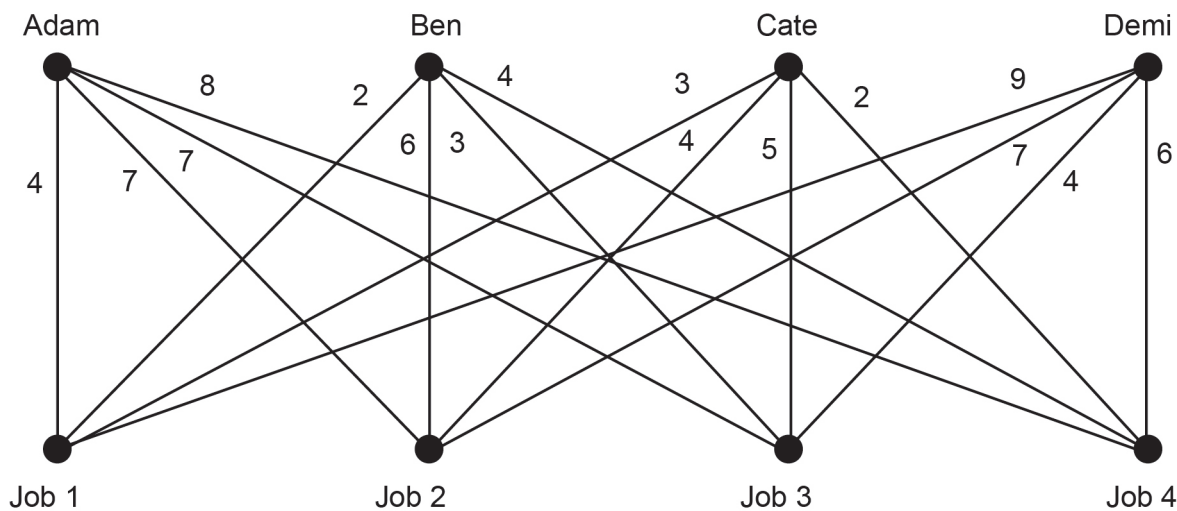
(a) Complete the matrix associated with the bipartite graph above. (2 marks)

$$\begin{array}{c} \\ A \\ B \\ C \\ D \end{array} \begin{array}{cccc} J1 & J2 & J3 & J4 \\ \end{array} \\ \begin{pmatrix} 4 & & 7 & \\ & 6 & 3 & \\ 3 & & & 2 \\ & 7 & & 6 \end{pmatrix}$$

(b) Using the Hungarian algorithm, determine which job the foreman should assign to each of his workers so that the total time is minimised.   (6 marks)

Question 4 **(12 marks)**

(a)   Given the sequence 256, 128, 64, 32, …

(i)   Write a recursive rule for the sequence. (2 marks)

(ii)   Deduce a rule for the nth term of this sequence. Hence, calculate the 15th term, leaving your answer as a fraction. (3 marks)

(b)   Use the recursive definitions given to state the first **three** terms of each of the following sequences.

(i) $T_{n+1} = T_n + 7,\ T_1 = 11$ (2 marks)

(ii) $T_{n+1} = 1.5T_n,\ T_2 = 7.5$ (2 marks)

(c)   Consider the sequence 12, 7, 2, –3, …

By deducing a rule for the nth term, or otherwise, determine which term of the sequence is –168. (3 marks)

Question 5 **(9 marks)**

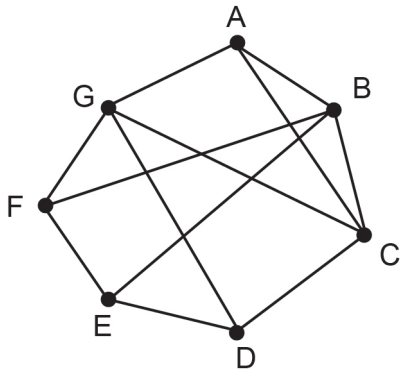(a) Redraw the following graphs as planar graphs.

(i) (1 mark)
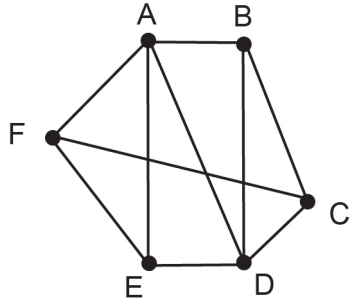
(ii) (2 marks)
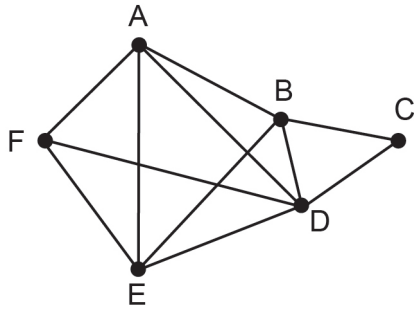
(iii) (2 marks)

(b) Verify Euler's formula for the planar graph obtained in part (a)(i). (2 marks)

(c) One of the planar graphs is semi-Eulerian. State which graph it is, giving a reason for your choice. (2 marks)

See next page

Question 6 **(7 marks)**

Before a fitness campaign at a high school started, 50 students were chosen at random from each year group and asked the following questions:

Question 1: Which one of the following modes of transport do you use to travel to and from school?

Category A: walking/cycling
Category B: public transport
Category C: private car

Question 2: Which year group are you in?

The campaign organisers wished to determine whether age group affected the students' likelihood of walking/cycling to and from school.

The results of the survey are shown in the table below.

	Category A	Category B	Category C	Total
Year 7	19		20	50
Year 8	12	17	21	50
Year 9	13	14	23	50
Year 10	11		21	
Year 11	10	15	25	50
Year 12	8	17	25	50
Total	73		135	300

(a) Complete the missing entries in the table above. (2 marks)

(b) Compare the percentages of students in Year 7 and Year 12 who use Category A as a mode of transport and comment on your results. (2 marks)

The data given in the table for part (a) have been displayed as a divided column graph below.
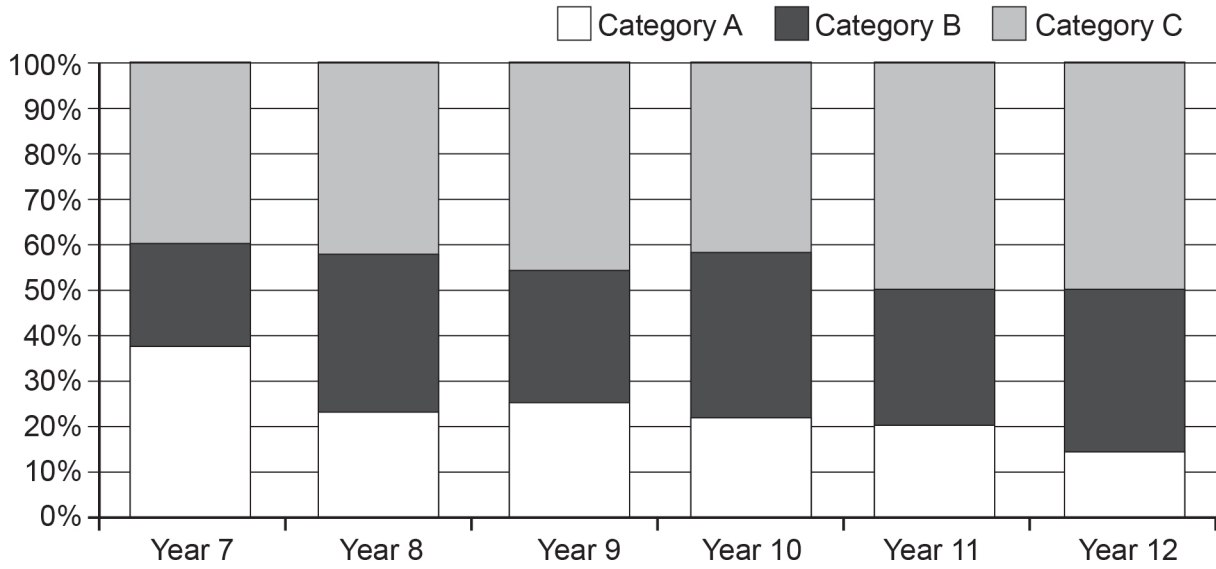
(c)   Using the graph above or another method, comment on:

       (i)   the association between 'Year group' and 'Category A'.   (1 mark)

       (ii)   the association between 'Year group' and 'Category C'.   (1 mark)

       (iii)   the association between 'Category A' and 'Category B and C combined'.   (1 mark)

End of questions

Additional working space

Question number: _____

Additional working space

Question number: _____

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Question number: _____

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