THE SCHOOL FOR EXCELLENCE (TSFX)

VCE FURTHER MATHEMATICS UNITS 3 & 4

WRITTEN EXAMINATION 2 – 2018

Reading Time: 15 minutes
Writing Time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Student Number: | | | | | | | | | | **Letter** |

Structure of Book

Section A - Core	*Number of questions*	*Number of questions to be answered*	*Number of marks*
	9	9	36
Section B - Modules	*Number of modules*	*Number of modules to be answered*	*Number of marks*
	4	2	24
			Total 60

- Students are to write in blue or black pen.
- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, one bound reference, one approved technology (calculator or software) and, if desired, one scientific calculator. Calculator memory DOES NOT need to be cleared. For approved computer-based CAS, full functionality may be used.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials Supplied

- Question and answer book of 33 pages.
- Formula sheet.
- Working space is provided throughout the book.

Instructions

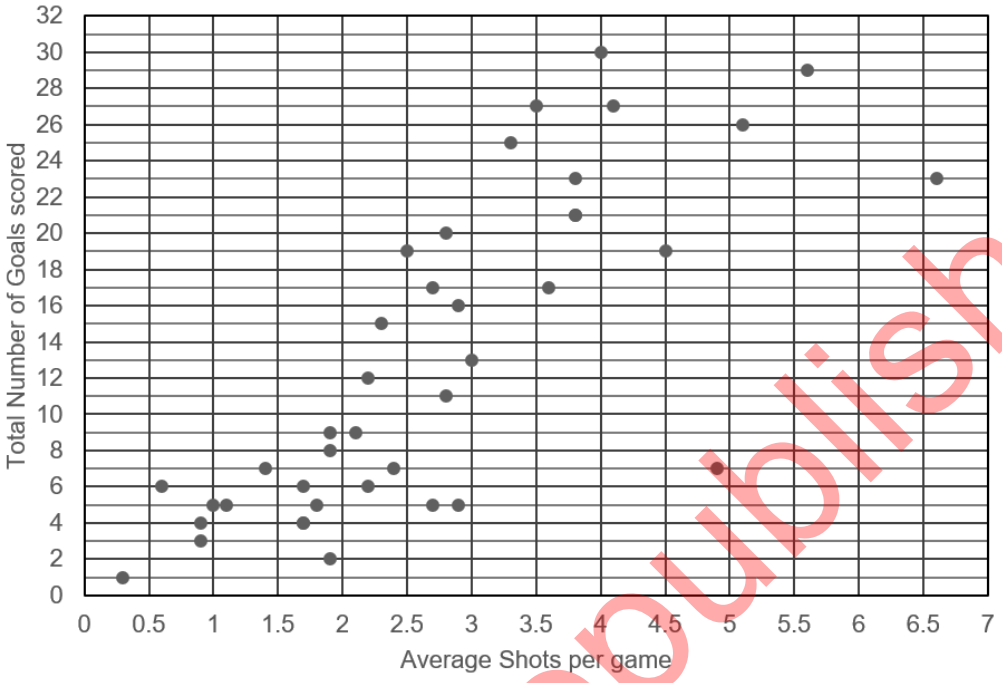
- Write your **name** in the space provided above on this page.
- All written responses must be in English.

Students are **NOT** permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

VIC: Level 3, 99 William Street, Melbourne VIC 3000
Phone: (03) 9663 3311 Fax: (03) 9663 3939
www.tsfx.com.au
admin@tsfx.com.au
NSW: PO Box r1407, Royal Exchange, Sydney NSW 1225
Phone: 1300 364 173 Fax: 1300 364 065

QUESTION 4 (7 marks)

A scatterplot is shown below of the total number of goals scored this season against the average number of shots per game for the top 40 players in the European leagues:



The equation of the least squares regression line, correct to 2 decimal places, for this data is

$$Total\ Number\ of\ Goals\ Scored = -0.12 + 4.81 \times Average\ Shots\ per\ Game$$

The value of the coefficient of determination is 0.5993, correct to 4 decimal places.

a. Describe the relationship between *total number of goals scored* and *average shots per game* in terms of strength, direction and form. 1 mark

b. Add the least squares regression line to the scatterplot shown above. 1 mark

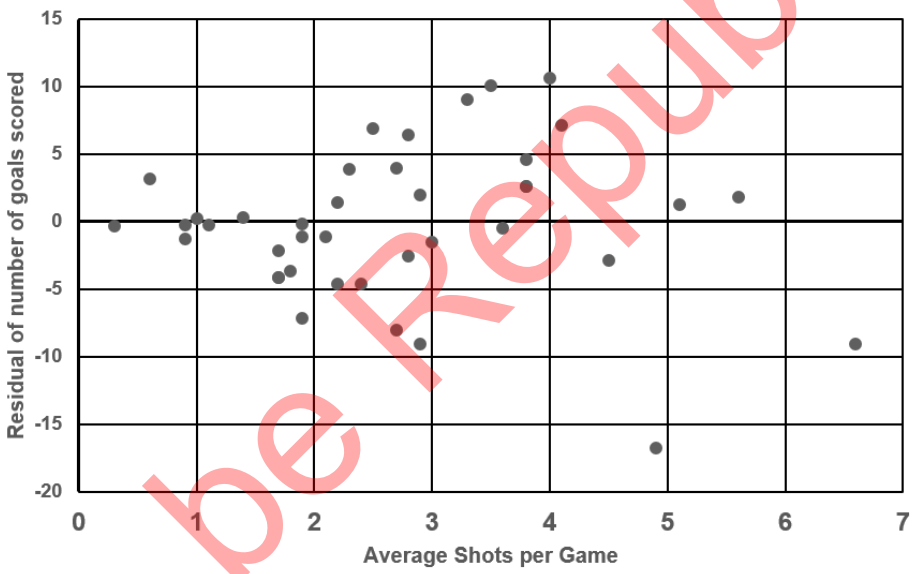
ANSWER ON GRAPH

c. Interpret the slope of the least squares regression line for this relationship. 1 mark

d. Interpret the coefficient of determination for this relationship. 1 mark

e. Calulate the residual of total goals scored for the player who averaged 4.5 shots per game. Give your answer correct to one decimal place. 2 marks

The residual plot for the relationship between number of goals scored and average number of shots per game is shown below:



f. Explain what the residual plot indicates about the relationship between number of goals scored and the average shots per game. 1 mark

QUESTION 9 (5 marks)
Mile is another soccer player who is concerned that his soccer career will not last forever and that he must save for his future. He has savings of $50 000, but he has committed to saving an additional $24 000 every year. He will invest his money in an annuity investment at 3.87% per annum compounding annually and add $24 000 to the account at the end of each year when the interest is calculated.

a. How much money would Mile have in his account after 2 years? 1 mark

Mile knows that he will need at least $650 000 in his account to support his lifestyle after soccer.

b. How long would it take before Mile has at least $650 000? Give your answer correct to the nearest year. 1 mark

Mile has been told that he would be better to compound monthly at the same rate and add $2000 per month to his investment.

c. How much sooner would Mile reach his goal of at least $650 000? Give your answer correct to the nearest month. 2 marks

d. Explain why Mile would achieve his saving goal sooner if he compounds more often. 1 mark

END OF SECTION A

SECTION B – Modules

Instructions for Section B

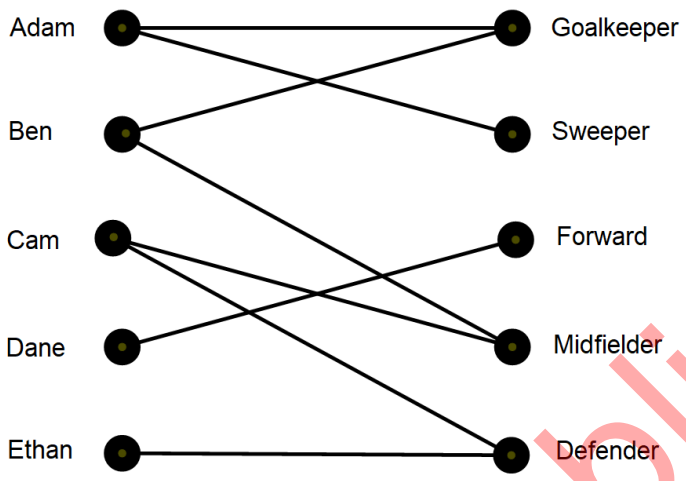
Select **two** modules and answer **all** questions within the selected modules.

You need not give numerical answers as decimals unless instructed to do so. Alternative forms may include, for example, π, surds or fractions.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Contents **Page**

QUESTION 2 (3 marks)
The men's senior soccer team have five players that they have not yet allocated positions for. A bipartite graph is shown below that shows the players and the positions that they could play:



a. One player is required for each of the five positions. Complete the table below of who should play each position. 1 mark

Goalkeeper	
Sweeper	
Forward	
Midfielder	
Defender	

b. Adam has indicated that he could also play Forward. Does this change the allocations made in part a? Explain your answer. 1 mark

Three umpires, Anna, Bronte and Carla, will each attend each of the games played one Saturday. The umpires will be allocated so that the minimum distance is travelled overall. The distances, in km, that each umpire lives from each of the Senior, Reserves and Junior games is listed in Table 1 below:

Table 1

	Senior Game	Reserves Game	Junior Game
Anna	11	23	13
Bronte	12	25	14
Carla	15	26	9

Table 2 shows the same information after the Hungarian Algorithm has been applied:

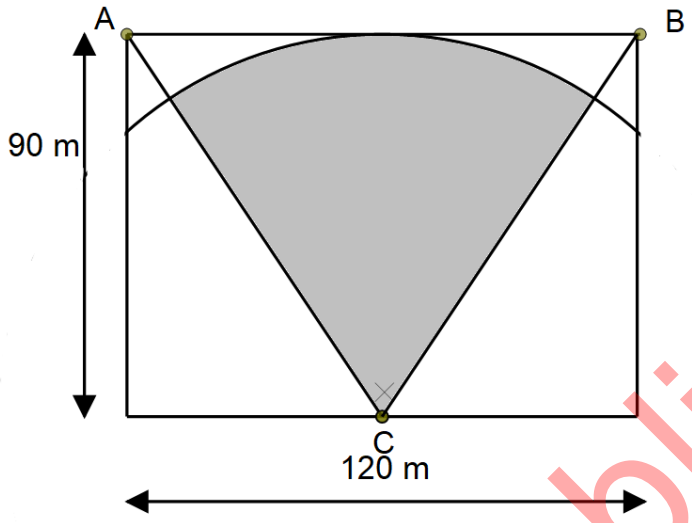
Table 2

	Senior Game	Reserves Game	Junior Game
Anna	0	0	2
Bronte	0	1	2
Carla	6	5	0

c. In Table 2 there is a zero in the row for Carla. When all values in the table are considered, what conclusion about minimum total distance can be made from this zero? 1 mark

QUESTION 3 (4 marks)

The soccer pitch is 90 metres wide and 120 metres long. It is watered using sprinklers that are centred at points A, B and C as shown. Point C is at the midpoint of the sideline.

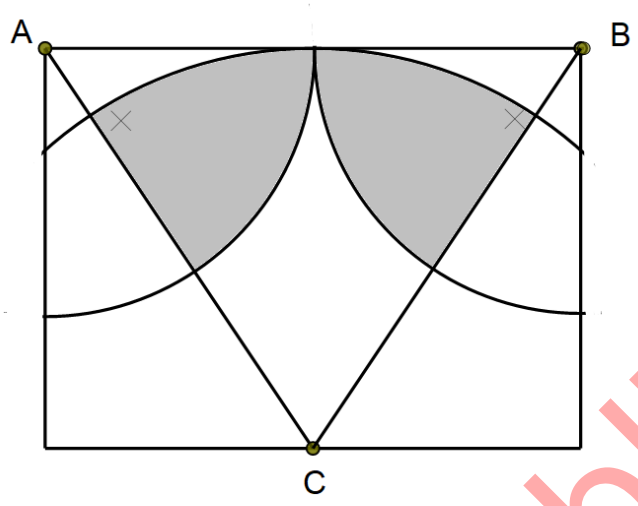


The sprinkler at point C waters the shaded sector shown above with a radius of 90 metres.

a. Show that the area watered by the sprinkler placed at point C is 4763 m^2 correct to the nearest square metre. 2 marks

The sprinklers at A and B also water the soccer pitch. They both spray over a sector with a radius of 60 metres.

A diagram is shown below, where the shaded areas are watered by more than one sprinkler:



b. What area of the soccer pitch is watered by more than one sprinkler? Give your answer in square metres, correct to the nearest whole square metre. 2 marks

QUESTION 3 (4 marks)

The soccer club need to take a team and some officials to a game. They will travel by sharing vehicles, where the number of utes is x and the number of cars is y.

A number of constraints apply to this situation:

Each ute can only take 2 people and each car can take 5 people. At least 15 people need to go to the game.	$2x + 5y \geq 15$
Only 10 people are able to drive, so a maximum of 10 vehicles can go to the game.	$x + y \leq 10$
There are a maximum of 7 utes available to go to the game.	$x \leq 7$
There are a maximum of 8 cars available to go to the game.	$y \leq 8$

A graph showing the lines produced by each of these inequalities:

a. Shade the region that is defined by this set of inequalities. 1 mark

ANSWER ON GRAPH

b. If four utes are driven to the game, what is the minimum number of cars that could also go? 1 mark

There is also a large amount of equipment required at the game, so there now must be at least two utes, forming a new constraint inequality.

The total number of vehicles going to the game must also be minimised. The new constraint must also be considered. The objective function is $N = x + y$.

c. How many of each vehicle should be going to the game if N is to be minimised? Give all possible solutions to this problem. 2 marks

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END OF QUESTION AND ANSWER BOOK