

Trial Examination 2020

VCE Further Mathematics Units 3&4

Written Examination 2

Question and Answer Booklet

Reading time: 15 minutes

Writing time: 1 hour 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of booklet

Section A – Core	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
	8	8	45
Section B – Modules	<i>Number of modules</i>	<i>Number of modules to be answered</i>	<i>Number of marks</i>
	4	1	15
			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 booklet of 34 pages

Formula sheet

Working space is provided throughout the booklet.

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page.

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

All written responses must be in English.

At the end of the examination

You may keep the formula sheet.

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

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2020 VCE Further Mathematics Units 3&4 Written Examination 2.

SECTION A – CORE**Instructions for Section A**

Answer **all** questions in the spaces provided.

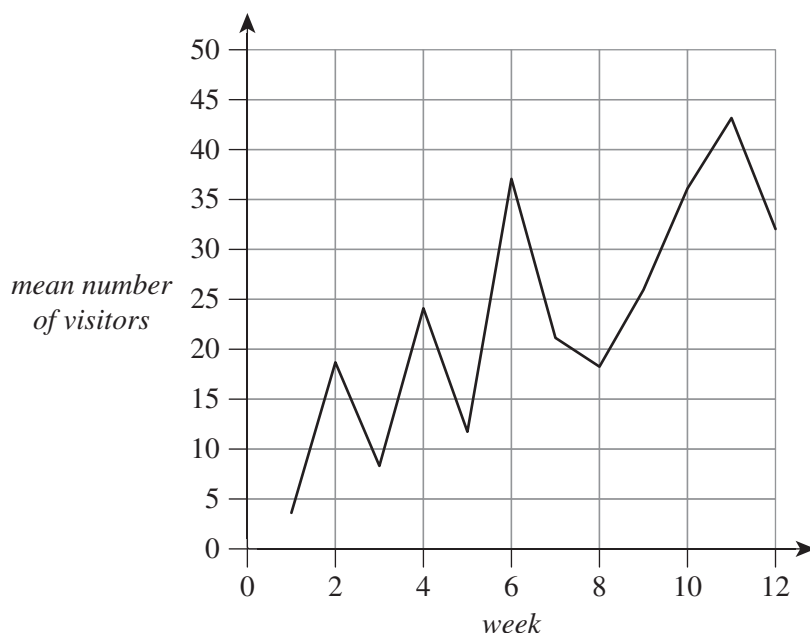
You need not give numerical answers as decimals unless instructed to do so. Alternative forms may include, for example, π , surds or fractions.

In ‘Recursion and financial modelling’, all answers should be rounded to the nearest cent unless otherwise instructed.

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

Data analysis**Question 1** (12 marks)

A new museum was opened and the *mean number of visitors* per week over the first 12 weeks is displayed in the graph below.



- a. What is the name for the type of graph above? 1 mark
- _____
- b. Draw the smoothed time-series curve using the three-point moving median method on the graph above. 2 marks

- c. To improve the museum's customer experience, a random survey was taken of one hundred guests, both *first-time visitors* and *repeat visitors*, that asked the question "Would you be interested if we created a museum membership?". The results of the survey are shown in Table 1 below.

Table 1

	<i>First-time visitors</i>	<i>Repeat visitors</i>	<i>Total</i>
<i>Yes</i>	10	8	18
<i>Maybe</i>	26	6	32
<i>No</i>	42	8	50
<i>Total</i>	78	22	100

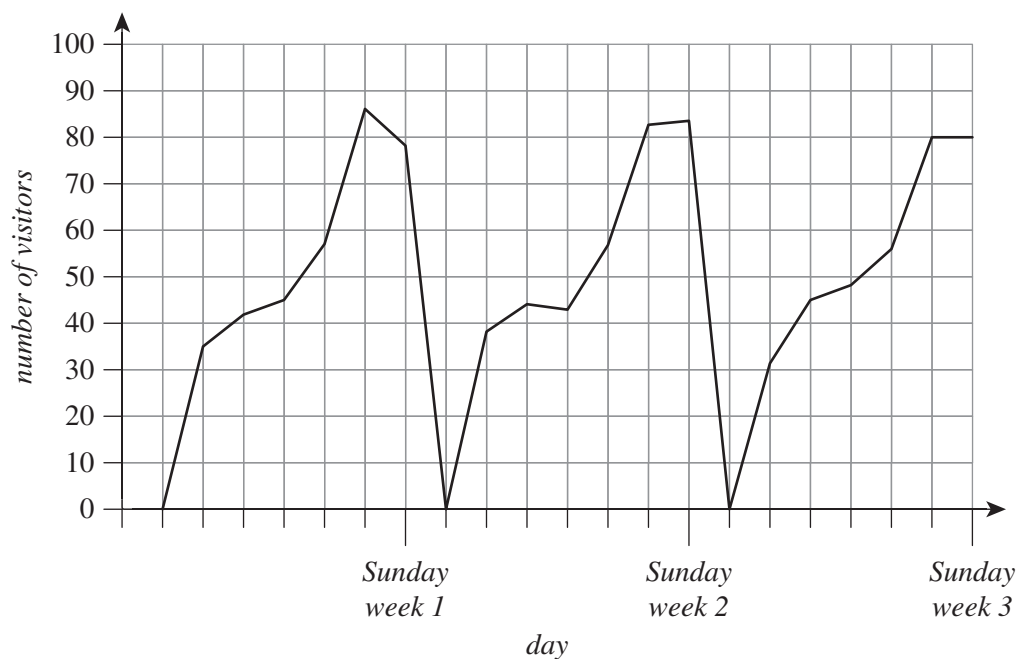
- i. What percentage of *first-time visitors* answered 'No'? Give your answer to one decimal place.

1 mark

- ii. What percentage of visitors who answered 'Yes' are *repeat visitors*? Give your answer to one decimal place.

1 mark

- d. Records of *number of visitors per day* were kept over a three-week period, as shown in the graph below.



- i. What type of variation is shown in the graph above? 1 mark

- ii. On which *day* of the week is the museum closed? 1 mark

- iii. To the nearest whole number, the mean *number of visitors per day* for the six days that the museum is open is 57. The management's policy is to employ one person for every 20 visitors, and so three people were employed per day.

Discuss whether this is the right number of employees for each of the six days that the museum is open.

1 mark

- e. After the museum has been open for three years, the seasonal indices can be calculated using the raw figures shown in Table 2 below.

Table 2

	<i>Summer</i>	<i>Autumn</i>	<i>Winter</i>	<i>Spring</i>	<i>Total</i>	<i>Mean</i>
2017	600	400	300	500	1800	450
2018	720	420	350	510	2000	500
2019	750	450	380	620	2200	550
Total	2070	1270	1030	1630	6000	

- i. Calculate the seasonal index for *summer*. Give your answer to one decimal place. 1 mark
- _____
- _____
- _____
- _____
- ii. The seasonal indices for *autumn* and *winter* are 0.9 and 0.7 respectively. To try and boost figures for 2020 a special promotion was run during the *autumn* and *winter* quarters. The raw figure for visits in *autumn* was 865 and for *winter* was 743. By first de-seasonalising the figures, state which promotion was the most successful. 2 marks
- _____
- _____
- _____
- _____
- f. Calculate the three-point moving mean centred on *winter 2019*. Give your answer to one decimal place. 1 mark
- _____
- _____

Question 2 (6 marks)

Data was generated for the *time spent* in the museum by each visitor on a particular day, as shown in Table 3 below.

Table 3

	<i>First-time visitors (n = 13)</i>	<i>Repeat visitors (n = 11)</i>
<i>Time spent (min)</i>	42, 35, 45, 20, 25, 35, 36, 45, 55, 50, 25, 50, 45	8, 15, 24, 28, 26, 15, 28, 32, 20, 25, 75

- a. Draw a back-to-back stem plot using divisions of 10. 1 mark

- b. State the five-number summary for *first-time visitors*. 1 mark

- c. Calculate the mean for the *repeat visitors* to one decimal place. 1 mark

- d. For the *repeat visitors*, use a calculation to show how the 75 figure is an outlier. 1 mark

- e. Draw a boxplot for the *repeat visitors*, clearly showing the outlier and fence. 1 mark

- f. If there is an outlier present in the data, which of the following statistical measures will be affected? 1 mark

range; IQR; mode; median; mean; five-number summary

Question 3 (4 marks)

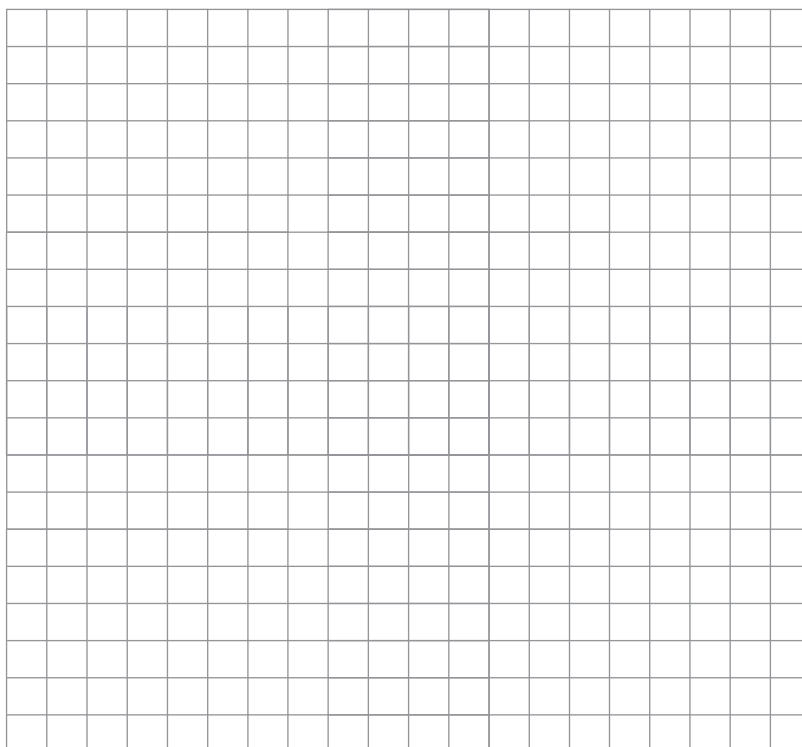
Wanting to attract more tourists passing through town to the museum, discount vouchers were added to the information available at the Tourist Information Centre. Fifty \$2, \$4, \$5 and \$10 discount vouchers to the museum admission price were randomly distributed to 200 tourists. The number of vouchers used is recorded in Table 4 below.

Table 4

<i>Value of the voucher</i>	\$2	\$4	\$5	\$10
<i>Number of uses</i>	4	5	20	45

- a. What is the dependent variable in this promotion? Justify your response. 1 mark

- b. Choose suitable axes and draw a scatterplot of this data on the grid below. 2 marks



- c. What does the gradient suggest about the relationship between the *value of the voucher* and the *number of uses*? 1 mark

Question 4 (8 marks)

The souvenir kiosk generates additional income for the museum. The income depends upon the number of visitors per week. A random sample of the number of *weekly visitors*, v , and *income from the souvenir kiosk*, I , is shown in Table 5 below.

Table 5

<i>Weekly visitors, v</i>	240	300	350	410	430	500
<i>Income from souvenir kiosk, I</i>	\$1000	\$1400	\$1500	\$2100	\$2200	\$2800

- a. Find the equation of the least squares line in terms of v and I . Write the coefficients to one decimal place.

1 mark

On a different set of weeks, the data produces the following equation for the least square line.

$$I = -600 + 8v \quad r = 0.92$$

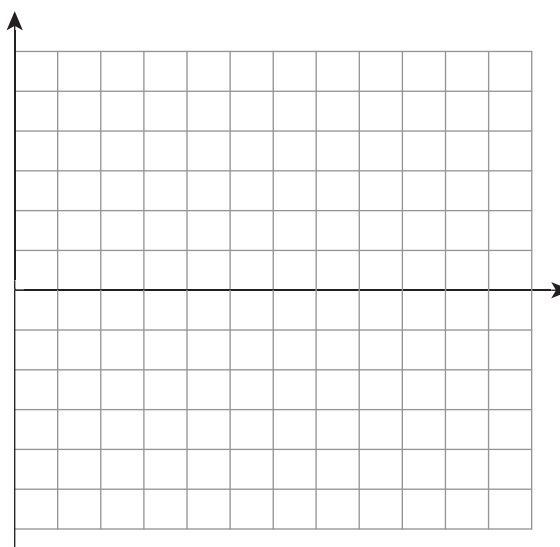
- b. Complete the table of residuals below.

2 marks

<i>Weekly visitors</i>	200	300	400	500	600
<i>Income (actual)</i>	900	2100	2400	3600	3800
<i>Income (predicted)</i>	1000	1800	2600	3200	
<i>Residual</i>	-100	300	-200	400	

- c. Draw a residual plot on the axes below.

2 marks



- d. Comment on what the residual plot shows. 1 mark

- e. In an attempt to boost *visitor numbers*, tickets are discounted over a six-day period. The *visitor numbers* per *day* are shown in Table 6 below.

Table 6

<i>Day</i>	1	2	3	4	5	6
<i>Visitor numbers</i>	10	18	43	82	150	260

In an attempt to linearise the data, both an x^2 and a $\frac{1}{y}$ transformation are separately applied.

Calculate the correlation coefficient for both transformations to two decimal places. State which of the two transformations better linearises the data.

2 marks

Recursion and financial modelling**Question 5** (3 marks)

A puzzle magazine runs a special issue that only contains mathematical puzzles. Three of the puzzles from this special issue are shown below.

- a.** Define the sequence $\{1, 5, 29, 173\}$ by expressing t_{n+1} in terms of t_n . 1 mark

- b.** Given $t_{n+1} = -0.5t_n + 4$; $t_1 = 400$, find t_3 . 1 mark

- c.** What is special about the sequence $t_{n+1} = 3t_n - 2$; $t_1 = 1$? 1 mark

Question 6 (6 marks)

When the magazine started four years ago, the owners took out a loan upon which they have made no repayments. The principal and interest have accrued monthly on the loan, and it is due to be paid at the end of a five-year period. The value of the loan can be found using the equation $A = 125\,000 \times 1.007^n$, where A is the loan value and n is the number of months.

a. Find the value of the

i. original principal.

1 mark

ii. annual interest rate.

1 mark

b. Is the loan adding simple or compound interest?

1 mark

c. What is the total amount that will need to be repaid at the end of the five-year period?

1 mark

After five years, part of the debt is repaid from company profits. However, a new loan of \$80 000 is taken out to pay the remainder. The interest on the new loan is fixed at 5.2% per annum compounding monthly. The loan will be repaid over a ten-year period.

d. Find the monthly repayments.

1 mark

e. At the end of the second year of the loan, the company makes an extra payment of \$20 000 off the principal.

If the company does not wish to change the length of the loan, how much will the new monthly repayments be?

1 mark

Question 7 (3 marks)

The owners of the magazine depreciate their office furniture at a flat rate according to

$$V_{n+1} = V_n - 3200, V_0 = 25\,000.$$

- a. i.** Find the value of the office furniture after three years. 1 mark

- ii.** The furniture will be sold and replaced when the value reaches \$9000.
How many years will the furniture be kept? 1 mark

- b.** An alternative method of depreciation is the reducing balance method, where
 $V_{n+1} = 0.8V_n$, $V_0 = 25\,000$.
At the end of what year does the value of the furniture first drop below \$9000? 1 mark

Question 8 (3 marks)

After all the loans are paid off and the company is running debt free, the magazine is sold off by the joint owners Bob and Charli for \$1 200 000. The money is shared evenly and invested in different ways.

- a. Bob invests all his money in a three-year term deposit which is paying 2.8% per annum, credited annually.

How much will Bob have after the three-year period?

1 mark

- b. Charli buys a new car for \$65 000 and then invests the remainder for three years at 4.5% per annum, compounding monthly.

How much money will Charli have after the three-year period?

1 mark

- c. Charli also decides to sell her car, which depreciated in value by 18% in the first year and 12% in each of the following two years.

What is the value of her car after this time?

1 mark

END OF SECTION A

SECTION B – MODULES**Instructions for Section B**

Select **one** module and answer **all** questions within the selected module.

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

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Module 1 – Matrices**Question 1** (5 marks)

BeneFITial is a new gym that offers a range of membership options: Peak (P), Off-peak (O) and Concession (C). The prices per week of the memberships are shown in the matrix M below.

$$M = \begin{matrix} & P & O & C \\ \begin{bmatrix} 45 & 30 & 20 \end{bmatrix} \end{matrix}$$

- a. What is the order of matrix M . 1 mark

- b. Write a matrix calculation to calculate the cost for each membership per year. 1 mark

The numbers of each type of member in January 2019 are outlined in the matrix N below.

$$N = \begin{matrix} \begin{bmatrix} 1300 \\ 900 \\ 1400 \end{bmatrix} & \begin{matrix} P \\ O \\ C \end{matrix} \end{matrix}$$

- c. Write a matrix calculation to calculate the total income from membership per week. 1 mark

- d. What is the total income for membership in 2019? 1 mark

- e. The membership team has a target to increase membership by 5% each year.
How many Concession members will there be expected to be in January 2021?
Give your answer to the nearest member. 1 mark

Question 2 (8 marks)

BeneFITial offers the opportunity to change membership options. The transition matrix T shows the changes between types of membership each year. Matrix N shows the number of members in January 2019.

$$T = \begin{array}{c} \begin{array}{ccc} & \text{this year} & \\ & P & O & C \\ \begin{bmatrix} 0.70 & 0.05 & 0.25 \\ 0.10 & 0.90 & 0.15 \\ 0.20 & 0.05 & 0.60 \end{bmatrix} & \begin{array}{l} P \\ O \text{ next year} \\ C \end{array} \end{array} \end{array} \quad N_{2019} = \begin{bmatrix} 1300 \\ 900 \\ 1400 \end{bmatrix} \begin{array}{l} P \\ O \\ C \end{array}$$

- a.** Explain, in the context of this question, what t_{13} represents. 1 mark

- b.** In January 2020, there are expected to be 1150 Off-peak members.
Complete the calculation below to show this. 1 mark

$$\left[\quad \right] \times 1300 + \left[\quad \right] \times 900 + \left[\quad \right] \times 1400 = 1150$$

- c.** In the long term, how many Peak members is the gym expected to have without any new members joining? Give your answer to the nearest member. 1 mark

The gym noted that, on average, people joining or leaving per year could be displayed in the matrix B .

$$B = \begin{bmatrix} 130 \\ 70 \\ -20 \end{bmatrix} \begin{matrix} P \\ O \\ C \end{matrix}$$

Membership by each type for future years can be modelled using the formula $N_{n+1} = TN_n + B$.

- d. How many Peak members were there in January 2018? Give your answer to the nearest member.

1 mark

- e. If these figures continue to rise at the same rate, calculate whether the gym will meet its 5% annual increase-in-membership target for January 2020.

2 marks

- f. How many Off-peak members are there expected to be in January 2022? Give your answer to the nearest member **and** show your working.

2 marks

Question 3 (2 marks)

BeneFITial want to install new gym equipment in three branches. They buy a number of treadmills (t), rowing machines (r) and cross trainers (x). The amount of machines purchased by each branch is shown in matrix P .

$$P = \begin{array}{ccc|l} & t & r & x \\ \begin{bmatrix} 8 & 2 & 0 \\ 1 & 6 & 0 \\ 4 & 1 & 3 \end{bmatrix} & A & B & C \end{array}$$

The cost of these orders by the branch is shown in matrix F .

$$F = \begin{bmatrix} 10 & 490 \\ 9591 \\ 10 & 342 \end{bmatrix}$$

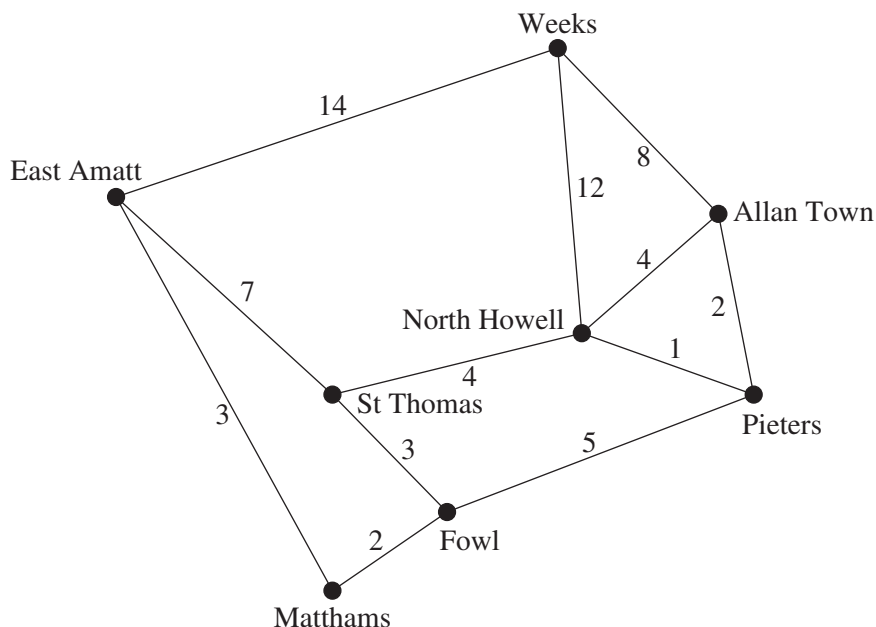
- a. How many treadmills were bought in total? 1 mark

- b. Calculate the cost of one rowing machine. 1 mark

END OF MODULE 1

Module 2 – Networks and decision mathematics**Question 1** (7 marks)

Holidaze is a tour agency offering multi-city tours of Little Peake. Below is a map of the destinations on offer and the travel times, in hours, between them.



- a. Molly wants to book a trip starting in St Thomas and ending in Allan Town.

What route should she take to minimise the amount of travel time?

1 mark

- b. Satinder would like to start and end in Matthams and to visit every destination once.

- i. What is the name of the type of route that Satinder would like to complete?

1 mark

- ii. How many hours will Satinder spend travelling on this trip if she aims to minimise the length of time travelling?

1 mark

- c. Ernest would like to take every possible route on offer with Holidayze. He would like to complete each journey once.

i. What is the name of the type of route Ernest would like to take? 1 mark

ii. Explain why Ernest's trip is **not** currently possible. 1 mark

- d. Holidayze is eager to meet all customer needs and will create new routes to make Ernest's trip possible.

What is the minimum number of new routes that they need to add? 1 mark

- e. Dijkstra's algorithm was used to find the shortest path between Matthams and Allan Town. The results are shown in the table below.

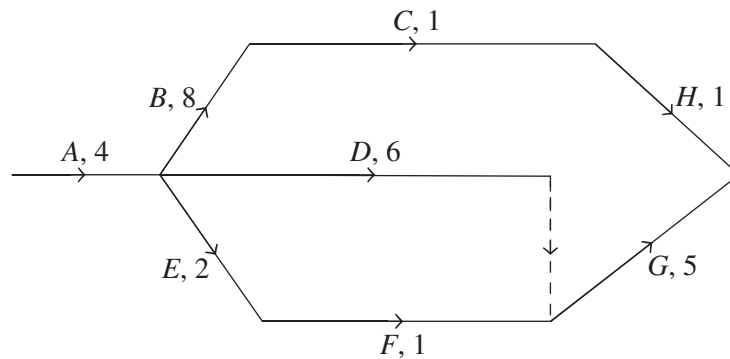
	East Amatt	Fowl	St Thomas	North Howell	Pieters	Weeks	Allan Town
Matthams	3	2	–	–	–	–	–
Fowl	3	2	5	–	7	–	–
East Amatt	3	2	5	–	7	17	–
St Thomas	3	2	5	9	7	17	9
Pieters	3	2	5	8	7	17	9
North Howell	3	2	5	8	7	17	9

Using the information from the table, what is the shortest route from Matthams to Allan Town?

1 mark

Question 2 (6 marks)

To offer the new routes, Holidayze have a number of tasks to complete. The number of days taken to complete them is shown in the diagram below.



- a. Complete the predecessor table below.

1 mark

Task	Immediate predecessor(s)
<i>A</i>	
<i>B</i>	
<i>C</i>	
<i>D</i>	
<i>E</i>	
<i>F</i>	
<i>G</i>	
<i>H</i>	

- b. What is the earliest day task *G* can start?

1 mark

- c. Work starts to create the extra routes on 24 April. Ernest is keen to start his trip as soon as possible.

Using this schedule, on what date will his holiday start?

2 marks

- d. There is an option to reduce the time taken to complete certain tasks. The table below shows the options and cost involved.

Task	Maximum reduction to project length (days)	Cost per day (\$)
<i>E</i>	1	\$40
<i>D</i>	4	\$20
<i>G</i>	2	\$10

What is the minimum cost to reduce the project by the most amount of time?

2 marks

Question 3 (2 marks)

The marketing team for Holidayze has four staff members: Priya, Jayden, Amit and Charlotte. There are four tasks that need completing, and the hours taken to complete these tasks are shown in the table below.

	Tickets	Guide book	Itinerary	Meals
Priya	100	60	70	80
Jayden	90	80	40	90
Amit	80	70	60	70
Charlotte	90	80	50	70

In order to allocate the tasks efficiently, the hungarian algorithm was performed on this information. The results are shown in the table below.

	Tickets	Guide book	Itinerary	Meals
Priya	20	0	20	0
Jayden	20	30	0	30
Amit	0	10	10	0
Charlotte	10	20	0	0

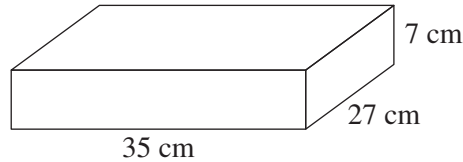
- a. Which task should Priya complete? 1 mark

- b. How many working hours will it take to complete all tasks in the most efficient way? 1 mark

END OF MODULE 2

Module 3 – Geometry and measurement**Question 1** (7 marks)

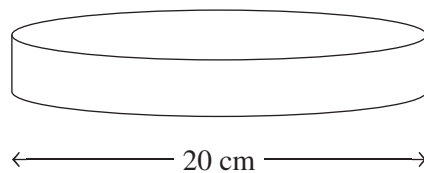
Everyday I'm Puzzling is a games shop based in Vancouver. They create and ship jigsaw puzzles around the world. Their standard packaging box is shown in the diagram below.



- a. What is the total surface area, in square centimetres, of the packaging box? 1 mark

- b. If each dimension were reduced by 20%, by how much would this reduce the volume, in cubic centimetres, of the box? Give your answer to two decimal places. 1 mark

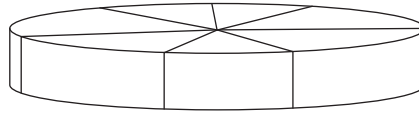
A best-selling game has a cylindrical tin container with a volume of 1570.8 cm^3 , as shown in the diagram below.



- c. Show that the height of the tin is 5 cm. 1 mark

- d. If this game is shipped in one of the company's standard packaging boxes, what percentage of the box is empty? Give your answer to the nearest whole percent. 2 marks

- e. The inside of the tin has seven compartments, as shown in the diagram below. Each compartment has the same area and is wrapped in plastic film when initially packaged. The whole tin is also wrapped in the same film.



How much plastic film is required to cover all seven compartments and the tin?
Give your answer to the nearest cm^2 .

2 marks

Question 2 (2 marks)

The Vancouver office for Everyday I'm Puzzling is 30 km east and 18.2 km south of Vancouver International Airport.

- a.** What is the direct distance between the Vancouver office and the airport? Give your answer to the nearest kilometre. 1 mark

- b.** What is the three-figure bearing of the airport from the office? 1 mark

Question 3 (6 marks)

In order to expand, the business opens three new offices in addition to their existing office in Vancouver (50°N , 123°W). The offices are located at:

- Washington D.C. (39°N , 77°W)
- Lima (12°S , 77°W)
- Barcelona (42°N , 2°E).

- a. Which office is closest to Vancouver? 1 mark

Assume the radius of the Earth is 6400 kilometres.

- b. What is the radius of the small circle at latitude 12°S ? Give your answer to the nearest kilometre. 1 mark

- c. What is the shortest distance between the Washington D.C. and Lima offices? Give your answer to the nearest metre. 1 mark

- d. The opening hours of some of the business's offices, along with the office's of some of their suppliers in Perth and Tokyo, are shown in the table below. All times are local.

Office	Opening times	Time zones
Vancouver	2–10 pm	GMT –8
Perth	9 am–5 pm	GMT +8
Tokyo	9 am–5 pm	GMT +9
Barcelona	6 am–12 pm; 3–5 pm	GMT +1

The managing director wants to hold a video conference with employees from all of these offices during their regular business hours. She is based in Vancouver.

- i. What time must the managing director's meeting take place? 1 mark

- ii. What is the maximum time that the meeting could be held for? 1 mark

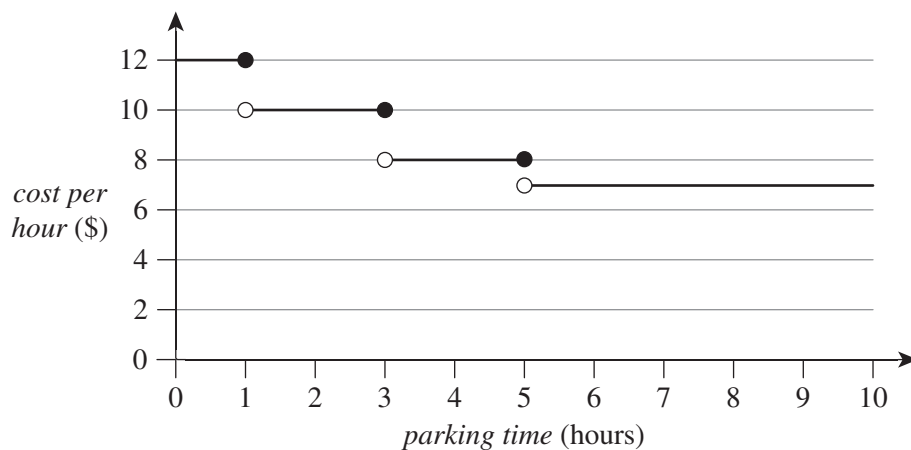
- e. The managing director flies from Vancouver to Perth. She leaves Vancouver at 08.20 on 1 July and lands in Perth at 16.40 on 3 July.

How long, in hours and minutes, did the journey take? 1 mark

END OF MODULE 3

Module 4 – Graphs and relations**Question 1** (4 marks)

Tik is planning a school tour to New Zealand for a group of 15 students and 2 staff, and is organising the budget. At the Kiaora Adventure Park they will need to leave their hire bus in a car park. The charges for the car park are shown in the graph below.



- a. How much will it cost to park the bus for five hours? 1 mark

- b. What is the maximum time that Tik could park the bus for \$30? 1 mark

Inside the park there are two options for student tickets, as shown in the table below. The staff will pay their own expenses.

Ticket	Student price
Explorer pass – no access to rides	\$48
Adventurer pass – unlimited rides	\$80
Individual ride ticket	\$8

- c. If n is the number of single rides taken by a student with an Explorer pass, write an equation to calculate the cost for that student.

1 mark

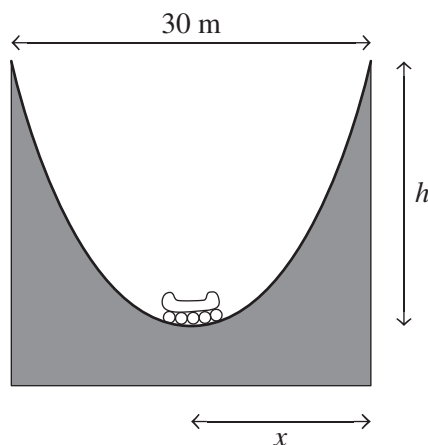
- d. Five students want Adventurer passes and ten students opt for Explorer passes with the option of purchasing individual ride tickets once they have had a close-up look at the rides.

What is the maximum number of individual rides a student purchasing an Explorer pass can take before the Adventurer pass becomes a cheaper option?

1 mark

Question 2 (4 marks)

One of the rides inside the park sits inside a curve with the equation $h = \frac{2}{15}x^2$. A cart rises up to the right and then falls and goes backwards up the left-hand side. As the speed builds up, the cart travels further and further up each side.



- a. Calculate the maximum height of the ride. 1 mark

- b. How far to the right has the cart moved when it has risen to a height of 3 m? Give your answer to one decimal place. 1 mark

- c. A straight safety ladder is to be installed at the back of the ride running from the starting position to the maximum height. What is the gradient of the line that the ladder makes? 1 mark

- d. The owner of the theme park wants a new, scarier ride to replace the existing ride. It must have the same width but needs to be 45 m high at the highest point. The equation is still in the form of $h = kx^2$. Find the value of k . 1 mark

Question 3 (7 marks)

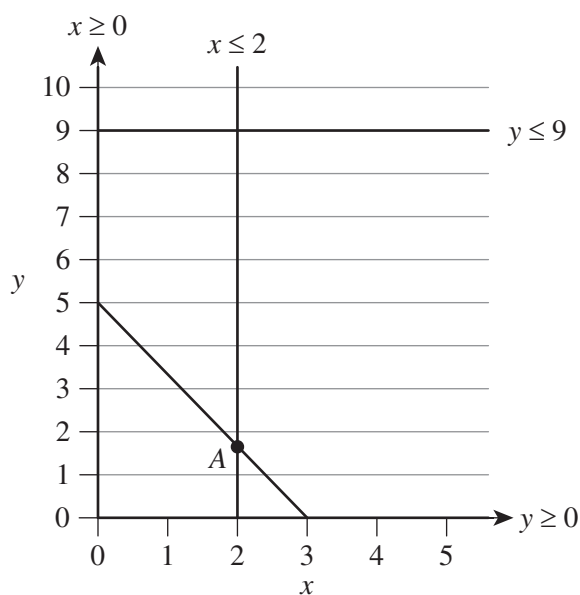
One of the most popular tourist attractions at the park is to take a helicopter over the top of Fox Glacier, and Tik's tour group want to do that. There are 2 five-seater helicopters available at a cost of \$500 each and 9 three-seater helicopters at a cost of \$330 each. The teachers will not participate in order to save money, so the 15 students going cannot share a helicopter with anyone from outside the group except for the pilots, who also act as guides.

- Let x = the number of five-seater helicopters taken.
- Let y = the number of three-seater helicopters taken.

a. Write the final constraints using x and y , given that $0 \leq x \leq 2$ and $0 \leq y \leq 9$. 1 mark

b. Tik wants to minimise cost.
Write the objective function. 1 mark

The constraints have been graphed on the axes below.



c. On the graph, shade in the feasible region defined by the inequations. 1 mark

d. Find the coordinate of point A. 1 mark

e. Why does point A not represent a feasible solution? 1 mark

f. How many of each type of helicopter should be used to minimise cost? 2 marks

END OF QUESTION AND ANSWER BOOKLET

Trial Examination 2020

VCE Further Mathematics Units 3&4

Written Examinations 1&2

Formula Sheet

Instructions

This formula sheet is provided for your reference.

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

FURTHER MATHEMATICS FORMULAS**Core – Data analysis**

standardised score	$z = \frac{x - \bar{x}}{s_x}$
lower and upper fence in a boxplot	lower $Q_1 - 1.5 \times IQR$ upper $Q_3 + 1.5 \times IQR$
least squares line of best fit	$y = a + bx$, where $b = r \frac{s_y}{s_x}$ and $a = \bar{y} - b\bar{x}$
residual value	residual value = actual value – predicted value
seasonal index	seasonal index = $\frac{\text{actual figure}}{\text{deseasonalised figure}}$

Core – Recursion and financial modelling

first-order linear recurrence relation	$u_0 = a, \quad u_{n+1} = bu_n + c$
effective rate of interest for a compound interest loan or investment	$r_{\text{effective}} = \left[\left(1 + \frac{r}{100n} \right)^n - 1 \right] \times 100\%$

Module 1 – Matrices

determinant of a 2×2 matrix	$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, \quad \det A = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$
inverse of a 2×2 matrix	$A^{-1} = \frac{1}{\det A} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}, \quad \text{where } \det A \neq 0$
recurrence relation	$S_0 = \text{initial state}, \quad S_{n+1} = TS_n + B$

Module 2 – Networks and decision mathematics

Euler's formula	$v + f = e + 2$
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Module 3 – Geometry and measurement

area of a triangle	$A = \frac{1}{2}bc \sin(\theta^\circ)$
Heron's formula	$A = \sqrt{s(s-a)(s-b)(s-c)}$, where $s = \frac{1}{2}(a+b+c)$
sine rule	$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$
cosine rule	$a^2 = b^2 + c^2 - 2bc \cos(A)$
circumference of a circle	$2\pi r$
length of an arc	$r \times \frac{\pi}{180} \times \theta^\circ$
area of a circle	πr^2
area of a sector	$\pi r^2 \times \frac{\theta^\circ}{360}$
volume of a sphere	$\frac{4}{3}\pi r^3$
surface area of a sphere	$4\pi r^2$
volume of a cone	$\frac{1}{3}\pi r^2 h$
volume of a prism	area of base $\times$ height
volume of a pyramid	$\frac{1}{3} \times$ area of base $\times$ height

Module 4 – Graphs and relations

gradient (slope) of a straight line	$m = \frac{y_2 - y_1}{x_2 - x_1}$
equation of a straight line	$y = mx + c$

END OF FORMULA SHEET

VCE Further Mathematics Units 3&4

Written Examination 1

Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out. Marks will **not** be deducted for incorrect answers.

No mark will be given if more than **one** answer is completed for any question.

All answers must be completed like **this** example:

A	B	C	D	E
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Use pencil only

Core: Data analysis ONE ANSWER PER LINE

1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E
6	A	B	C	D	E
7	A	B	C	D	E
8	A	B	C	D	E
9	A	B	C	D	E
10	A	B	C	D	E

11	A	B	C	D	E
12	A	B	C	D	E
13	A	B	C	D	E
14	A	B	C	D	E
15	A	B	C	D	E
16	A	B	C	D	E
17	A	B	C	D	E
18	A	B	C	D	E
19	A	B	C	D	E
20	A	B	C	D	E

Core: Recursion and financial modelling ONE ANSWER PER LINE

21	A	B	C	D	E
22	A	B	C	D	E
23	A	B	C	D	E
24	A	B	C	D	E
25	A	B	C	D	E
26	A	B	C	D	E
27	A	B	C	D	E
28	A	B	C	D	E
29	A	B	C	D	E
30	A	B	C	D	E

Continues over page

Show Module chosen by marking the appropriate box.

Use pencil only

Module:

- ☐ Matrices
☐ Networks and decision mathematics
☐ Geometry and measurement
☐ Graphs and relations

ONE ANSWER PER LINE

1	A	B	C	D	E
2	A	B	C	D	E
3	A	B	C	D	E
4	A	B	C	D	E
5	A	B	C	D	E
6	A	B	C	D	E
7	A	B	C	D	E
8	A	B	C	D	E
9	A	B	C	D	E
10	A	B	C	D	E