

2024 ASSESSMENT REPORT

MTG315123 GENERAL MATHEMATICS

General Comments

The 2024 General Mathematics exam demonstrated students' ability to relate mathematics to real world situations. High achieving students were able to move successfully between using formulas and algebra and their graphics calculators to solve problems. Future students are encouraged to show all relevant working for each question and to take care with rounding and units.

Written Component

Section A: Mathematical and Statistical Models

General Comments

This section was generally well done with many students able to show a satisfactory understanding of the criterion. In this section, markers were looking for responses that indicated sound understanding of the concepts rather than standard responses as these tended not to address the question being asked. Students are encouraged to read questions carefully and be precise with their language as responses to the more difficult questions were often open to interpretation.

Question 1

Very few students gained full marks for this question, with many gaining none or 1.

- a) The increase in the regression line was difficult to see, so markers also accepted any response that suggested no increase. Some students referred to the regression line as indicating a seasonal trend, which was penalised.
- b)
 - i) Any reference to $D=A/I$ was awarded part marks, but many students could not rearrange this equation properly.
 - ii) This part was poorly done. Many students tried to explain why you would use a 3 or 5 pt MA for the data given. A large number of students justified using a MA by referring to the number of points given, but they seemed to be equally split between saying you'd use it for lots of data and a small amount of data.

Question 2

This question was generally well done with only e) seeming to challenge students.

- a) Student were required to define the variables fully with just “weight” and “length” not being awarded marks. A small number of students referred to factors you could change for the experiment such as thickness of wire and how much each weight was worth rather than what was variables that were being recorded.
- b) Very well done. There were many different ways to explain this, all were accepted including explaining why spring length was dependent.
- c) The students who did not receive full marks for this question tended to repeat the question, talk about the slope (instead of spring length) increasing or talk about the spring length “changing” without specifying how it changed. Some were not specific that it lengthened by 4cm and were penalised.
- d) Markers accepted anything referring to initial length or zero weights, however a significant number of students simply defined what a y-intercept is in terms of a graph.
- e)
 - i) Reasonably well done. Students did not need to use extrapolation or interpolation for this question, just show an understanding. A very few students substituted 100 into the formula and said it was reasonable because they got the value given.
 - ii) To get full marks for this part, students needed to comment on the reliability of the equation when interpolating (e.g. not enough data points so not reliable at all or graph indicates strong correlation/ r^2 so reliable for interpolation).

Question 3

- a) This question was very well done.
- b) Many students did not recognise that “equivalent” means the same and chose an equation. A concerning number of students substituted 10 into one equation and confirmed that it “worked” with no supporting evidence.
- c) Very well done. Errors increasing by a percentage were carried through from part a).

Question 4

- a) Many students focussed on the word “necessary” and referred to other ways you could sum a sequence or find the balance of the account, rather than considering if summing was appropriate.
- b) Very poorly done. Students seemed to be confused about what “infinite” meant and agreed with A , some used S^∞ and still agreed with A . Some had excellent explanations but did not use a formula as directed.

Question 5

This question was quite poorly done with many students not addressing the questions or being quite vague in their language when explaining.

- a) Many students selected the wrong model.
- b) Many students simply confirmed the values using the formula or restated the first sentence without acknowledging that the effect of compounding was to increase the overall interest paid. Some even referred to being paid 6% per month.
- c) Students needed to be careful not to imply that the actual watch value decreases, but rather say it does not increase as much as inflation. A concerning number of students stated that inflation also added value to the watch.

Question 6

This question was reasonably well done.

- a) Many students struggled to explain what the regular repayments would be or referred to the lump sum as “winning the lotto” or a relative dying.
- b) This was very well explained with most students recognising the lump sum was to purchase the loan and the repayments were repaying the loan. A number of students thought the lump sum was a deposit to reduce payment amounts.
- c) This was quite poorly done with many students referring to calculating the 5×12 , not decimalising the percentage or referring to negatives being incorrect. Some recognised that the ‘ n ’ value was incorrect, but wanted to use 20 years instead of 15.

Section B: Bivariate Data Analysis

General Comments

This section was generally well done. Students were generally quite well prepared and it appeared that most students had enough time to complete the section as most questions were answered. Students completed the calculations well; however, they needed to ensure they are referring to the mathematical facts presented to address the requirements of explanation questions and written answers. Students need to read the questions highlighting specifics such as rounding to decimal places and check their final answers to make sure units are included. Checking answers and whether an answer is realistic in context would be useful to recognise some incorrect solutions.

Question 7

- This question was very well done.
- This question was quite well done. Most students were able to represent the results correctly using the appropriate information. Full marks were not always given as many forgot to label the % on the y -axis. Many mistakes were also made scaling the y -axis, by either making up their own scale or labelling the given scale incorrectly.
- This question was poorly done. Students found it difficult to understand what the question was asking. This resulted in lots of statements that just rephrased the question. Many referred to the % in the bar chart but did not make a reasonable statement for full marks.

Question 8

- This question was very well done. The main issue was that students did not always recognise that all 3-point moving averages in the table were rounded to whole numbers. So rounding to any other decimal place lead to rounding errors at times.
- This question was well done.
- This question was quite well done. Some students plotted the two points correctly but did not draw in the line, but instead connected the points to the smoothed data for February and November. Many also did not answer this question.

Question 9

- This question was quite well done. Most students were able to calculate the gradient and y -intercept using the calculator correctly; however, rounding to three decimal places was an issue for some. Correct placement of the variables A and B was done well.
- This question was reasonably well done. The calculation of r and r^2 was well done; however, rounding to four decimal places was an issue for many. Many students recognised that the correlation was a moderate positive correlation but failed to explain the evidence associated with the correlation. Many times, the phrase 'increasing evidence' was used instead of 'some evidence'.
- This question was quite well done. Many forgot to include the units in their answer.
- This question was poorly done. It appeared that not all students recognised that the question was asking to discuss the reliability of two different predictions. Many provided an answer for the first prediction only. If students did answer both parts, then many only discussed the

interpolation and being reliable (from part C) but did not identify there was low association which had been calculated previously. Many discussions were made around the 'health and real world' aspect of what the data was showing but did not always refer to mathematical analysis in their answer.

Question 10

- This question was quite well done. The main mistake students made was $\sum x^2 = (\sum x)^2$ resulting in 1936 instead of 324.
- This question was well done. Substitution errors into the formula were the main issue if the correct answer was not given.
- This question was very well done. Some students chose to use their calculator to determine the gradient and y -intercept if they recognised an error in part (b).
- This question was quite well done. Many students did not determine that the Y value for years was 12. Common errors were using 18 (year 10 + 8 years) and 1968 (the year given in the question). Negative answers were calculated when $Y=1968$. This was rarely questioned. Units were missed a lot in the final answer.

Question 11

- This question was well done. The main issue was rounding correctly to two decimal places.
- This question was quite well done. Students were able to identify the year 1970 and that -36.60 was associated with 'less'. At times the negative sign remained in the interpretation which is incorrect. Many students referred to the prediction but not the prediction made by the model/regression equation when explaining the residual.
- This question was quite well done. Many students referred to the residual plot when explaining their choice. Some chose to not refer to the residual plot and either discussed that they believed the trend was exponential (some provided calculations from the data table). Some students calculated the r and r^2 which led to the conclusion it was a good model choice.

Question 12

- This question was quite well done. Most errors were associated with correct rounding of numbers.
- This question was poorly done. Many students did not recognise the highest (= largest) number from the table incorrectly answering this part of the question. Students struggled to explain the significance of the highest deseasonalised value, referring to the seasonal index or relating to real life reasons, such as winter is colder so power costs are higher.
- This question was quite well done. Most students were able to determine that $x = 16$ and calculated the deseasonalised data. Many did not continue with the calculation of finding the actual cost and gave the deseasonalised data as their final answer. Rounding to correct decimal places for money and using units in the final answer was an issue.

Section C: Growth and Decay in Sequences

General Comments

Students were generally well prepared for the examination of this section. Most students attempted every question and appeared to have enough time to complete this section. Students are reminded to carefully read questions so that they can address all the requirements of each question. When using the graphics calculator, the expectation is that the relevant section of the table is copied to show working. Teachers are advised to ensure students know the difference between an explicit and recursive rule. Skills needed for success in this topic include bracket use, order of operations, rounding and ability to work with negative numbers.

Question 13

- a) This question was very well done. A few students used +12 as the common difference rather than -12.
- b) This question was very well done.
- c) This question was quite well done. Some students wrote subtract 12 rather than multiply by -12.
- d) This question was very well done.

Question 14

- a) This question was quite well done. Some students found the reciprocal of r by dividing T_1 by T_2 .
- b) This question was very well done.
- c) This question was reasonably well done. Some students found T_{10} rather than S_{10} . Students are reminded that the final answer must be rounded to a whole number.
- d) This question was generally well done. Some students should have recognised an error when they used an incorrect r value and obtained a negative result.

Question 15

- a) This question was quite poorly done. Some students did not recognise this as an arithmetic sequence and substituted values for both r and d . A common error was to use T_0 when T_1 was appropriate here. Students would have been helped by writing down the first few terms of the sequence.
- b) This question was also quite poorly done, with the same types of errors as question 15a.

Question 16

This question was reasonably well done. Common errors were dividing by 8 instead of 7 when finding the common difference and not answering to one decimal place. Some students did not show enough working for 3 marks.

Question 17

- a) This question was reasonably well done. Students who solved this question using algebra often gained more marks than those who used their graphics calculator due to not enough working shown. More care needs to be taken entering the rule into the graphics calculator as an incorrect entry results in no marks.
- b) This question was quite well done. Some students found the value of T_{47} rather than S_{47} .
- c) This question was quite poorly done. A common error was to confuse the term number and sum.

Question 18

- a) This question was quite well done. The most common error was to use an r value of 0.15 instead of the correct value 0.85.
- b) This question was quite well done. Some students only mentioned that the population decreases and did not refer to it reaching a steady state. Some students incorrectly stated that there was an exponential decrease.
- c) This question was quite well done. A common error was to use an incorrect r value of 0.1 instead of the correct value 0.9.
- d) This question was generally well done. Some students only mentioned that the population increases and did not mention that it reaches steady state.
- e) This question was reasonably well done. Many students successfully found r but did not convert it to a percentage decline.

Section D: Finance

General Comments

Students were generally quite well prepared for the examination of this section. As most students attempted every question, it appeared that most had enough time to complete the section. Students and teachers are reminded that for questions worth more than 1 mark, all working must be shown to obtain full marks. When using the Finance function of the graphics calculator, all input values should be written down including Begin/End. Students are reminded to maintain accuracy by only rounding their answer at the end and not rounding off mid-question. Consideration as to whether an answer is realistic would be useful to recognise some incorrect solutions.

Question 19

- a) This question was quite well done. A few students did not recognise this as a compound interest problem and tried to use depreciation or simple interest.
- b) This question was quite poorly done. Students should have been guided by the space provided and marks allocated to use the interest conversion function on their calculator. While it was acceptable to use the formula, many made errors. Careful reading of the question was needed to give the answer as a percent to 3 decimal places. Some showed a lack of understanding of the concept of effective interest rates by not recognising unreasonable results.
- c)
 - i) This question was very well done.
 - ii) This question was very well done.
 - iii) This question was quite well done. Some students did not show enough working to gain the full 3 marks. There were some errors using an incorrect n value when the effective interest rate was used for i . A few students incorrectly thought that this was an annuities question.

Question 20

- a) This question was well done. A few students misread the question and stated the interest paid rather than the total paid.
- b) There were varied results for this question. Some students were unsure about the late fee - when to add it and how many times. Some were unsure about how to calculate n and a few tried to use simple interest rather than compound interest.

Question 21

- a)
 - i) This question was generally well done. Some students unfortunately did not use the complete formula.
 - ii) This question was quite well done. Students were given credit if they used their incorrect R value from the previous question.

- b)
- i) This question was very well done. Even though most students used the equation instead of reading from the graph, they obtained an acceptable answer.
 - ii) This question was also very well done with many students using the equation rather than reading from the graph.
- c)
- i) This question was quite poorly done. Many students correctly chose the reducing balance method but did not explain why. Some students mixed up their answers to give the higher resale value.
 - ii) This question was also quite poorly done. Students are advised to carefully read information given in the question.
- d) This question was very poorly done. For this 3-mark question, the majority of students did not show enough working or explain their logic for obtaining the final answer. Some students were penalised for not giving their answer to the required 2 decimal places.

Question 22

- a) This question was quite well done. To obtain the full 3 marks, the working expected was substitution into the annuities in advance formula, algebraic manipulation and the correct final answer.
- b) This question was quite well done. A few students made errors finding i and n . Some working using the formula or the financial mode of the calculator was required for full marks.
- c) This question was reasonably well done. Many students were able to correctly find the factor; however, some did not complete the question correctly. Some confused students used the formula instead of the factor table.

Question 23

This question was quite poorly done. While most students used the financial mode of their calculator to solve this problem, the annuities in arrears formula could also have been used. Some students confused the negative values in the calculator to get an incorrect n value and a significant number incorrectly set the calculator to begin. Converting the n value to months and years was a challenge for some students as they incorrectly stated that 0.9 years was 9 months rather than 11 months.

Question 24

- a) This question was poorly done. Many students gave incorrect values for r by just giving l and forgetting to add one. Some added 2470 rather than subtracting and some incorrectly used annuities in advance.
- b) This question was also poorly done. It was clear that some students were not prepared to use difference equations in the Finance section. Many students did not show table values for the final payment and some used the financial mode rather than sequences to find the number of months. Many forgot to comment on the final payment being a part payment.

Section E: Networks or Trigonometry

Part 1 – Networks

Question 25

This question was reasonably well done.

- a) Mostly well done; multiple correct answers that received full marks.
- b) Mostly well done; students had difficulty correctly spelling Eulerian.
- c) Mostly well done; most students recognised there were no vertices of odd degree or that all vertices were of even degree. However, mistakes were noted in referring to edges going into the vertex rather than the degree of the vertex itself.
- d) Mostly well done; some students only gave the path from C to C and missed out on half a mark.

Question 26

- a) Mostly well done.
- b) Mostly well done.
- c) Very few drew the graph correctly, and some students couldn't draw a path and missed the instruction to use arrows. Many gave an unnecessary dummy path.

Question 27

- a) Mostly well done, with a few errors in the third box.
- b) Fairly well done; some students did a forward scan rather than a back scan. Many mistakes and errors carried forward.
- c) Very well done, unless they incorrectly identified A as part of the critical path.
- d)
 - i) Mostly well done; some students failed to identify that the changes were on the critical path.
 - ii) Mostly well done; some students incorrectly calculated the new completion time.
- e)
 - i) Mostly well done, some students incorrectly identified the float time.
 - ii) Mostly well done; however, some students copied or claimed the critical path was unchanged.
 - iii) Mostly well done; some errors carried forward allowed for half marks.

Question 28

- a)
- i) Mostly well done. There were very few mistakes other than not labelling on the diagram as instructed; however, if they correctly identified, no marks were deducted.
 - ii) Mostly well done if they knew what a cut was or read the question.
 - iii) Most students did not use units here and unnecessarily lost marks. Most students could identify the correct answer.
 - iv) Well done; however, many students lost marks by not identifying the backwards flow cut. 1 mark was awarded for 330l/m.
- b)
- i) Mostly well done; however, students often did not use units from previous question.
 - ii) Poorly done. Most could only identify one of the three pipes, others wrote the name of the sea animals.
 - iii) Poorly done. Many students didn't answer the question correctly and used excessive words to justify their answer, while many did not talk about cuts, and lost marks. Many only went up to the next minimum of 200l/m.
 - iv) Mostly well done; however, lots of errors carried forward from the previous question.

Question 29

- a) Mostly well done, if answered; however, it appears some students were taught bipartite graphs as tables and many students lost marks. Many students scribbled out their graphs and lost marks because it became an assignment.
- b) Mostly well done, and very few students got this question wrong if attempted.

Question 30

- a) Mostly well done, and very few students got this question wrong if attempted.
 - b) Two possible answers and most students could do one of the two answers well. Some marks were lost due to errors in calculations.
- c)
- i) Some students did well, however many incorrectly identified zeroes in every column or each person has a zero next to them as their answer, rather than the 4 lines used.
 - ii) Very well done, and very few students got this question wrong.

Part 2 – Trigonometry

Very few students chose to attempt Part 2; however, those who did showed sound understanding of the topic.

Question 31

- a) This question was reasonably well done. Students found the angles from the cliff top (parts i) and ii)) much easier to find than the other angles.
- b) Very well done with most students gaining full marks.
- c) Students struggled with this question. Many saw the SAS pattern and used the cosine rule to find the missing side; however, very few students then found the area using Heron's rule correctly.

Question 32

This question was not well done. Most students started by finding an adjacent side; however, some students found the distance from the ruin to the pyramid and some added the 2 adjacent sides instead of subtracting. A few students started by finding the hypotenuse of the small triangle, but none were able to complete this process correctly.

Question 33

- a) Very well done.
- b) Reasonably well done. Most students were able to use the cosine (or sine) rule to find the required angle. A few struggled to find the bearing from there.

Question 34

Many students did not attempt this question.

- a) The calculations for this question were well done, but part i) caused some confusion. Many students referred to "travelling directly" or Great Circle Distance, without recognising that lines of longitude are Great Circles. Some students' responses seemed to refer to the entire trip rather than the first leg.
- b)
 - i) This question was not well done. A significant number of students seemed to skip this question. Some wrote the letters H and F on the diagram but were not clear about which points they were referring to. When asked to mark places, students should place very clear points or crosses.
 - ii) Students who attempted ai) did reasonably well at this question.

Question 35

Students who attempted this question did reasonably well. Common errors included forgetting the negative sign for the south latitude and adding the longitudes together before subtracting from 180.

Question 36

Again, very well done by those who attempted this question.

- a) Some students acknowledged the 4-hour time difference but failed to state which city was ahead.
- b) Very well done.
- c) Communication caused the most problems with this question, particularly if the answer was incorrect. Answers from a) were carried forward; however, if a student failed to state which city was ahead in a) and then used the time difference incorrectly, they were penalised.



Attach your candidate label here

External Assessment 2024

GENERAL MATHEMATICS

MTG315123

Marking Scheme

Section **A** Mathematical and Statistical Models

Pages: 12

Questions: 6

Information Sheet: 1

Preparation time for this exam: 15 minutes

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
- TASC approved calculators are allowed.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- The General Mathematics Information Sheet can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C3	/ 36

Guide to Exam Structure

	Parts	Questions available	Questions to answer	Suggested working time	Marks available
Section A		6	6	36 minutes	36 marks
Section B		6	6	36 minutes	36 marks
Section C		6	6	36 minutes	36 marks
Section D		6	6	36 minutes	36 marks
Section E	Part 1 OR	6	6	36 minutes	36 marks
	Part 2	6	6	36 minutes	36 marks
Totals		36	30	180 minutes (3 hours)	180 marks

Criterion

You **must** make sure your answers address:

- Criterion 3 apply mathematical and statistical models to investigate, represent and analyse real world situations and solve problems.

Question 1 (approximately 3 minutes)

Marker use

Figure 1 is a graph of actual and deseasonalised power costs for a Tasmanian household. The regression line for the deseasonalised data is also shown.

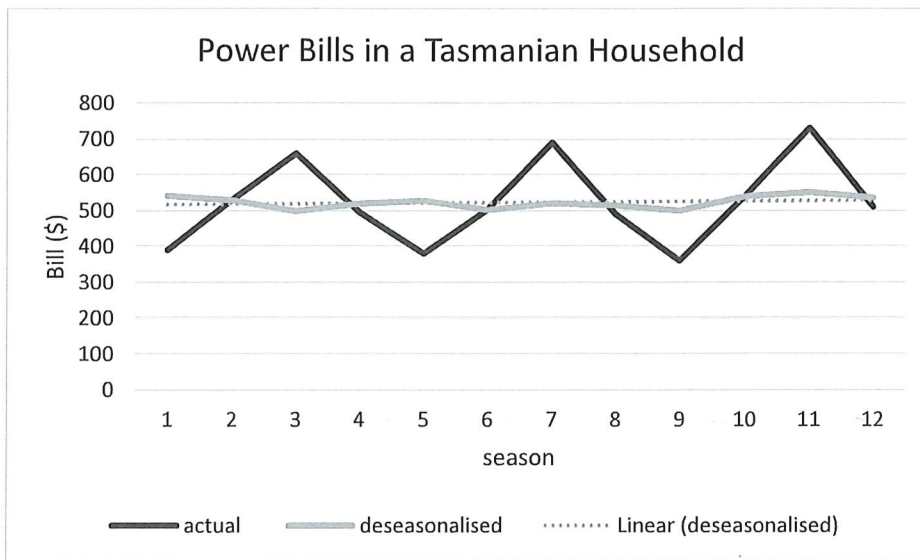


Figure 1: Graph showing power costs for a Tasmanian household.

a) What long term trend does the regression line of the deseasonalised data suggest?

Slight upward trend
 or No long term ↑ or ↓

/1

b) i. When using deseasonalised data to make predictions, the final step is to convert the deseasonalised prediction to actual. How is this achieved?

$A = D \times I$
 multiply by the seasonal index

/1

ii. In what situation would a smoothing process, such as 3 or 5 point averaging, be used instead of deseasonalising?

Non-seasonal data (random/cyclic)

/1

Total Q1 /3

Question 2 (approximately 9 minutes)

Marker use

A student hangs weights on a spring and measures the new length of the spring. Figure 2 shows the setup and a graph of the results. The linear model is $L = 4W + 5$, where L = length and W = the number of weights.

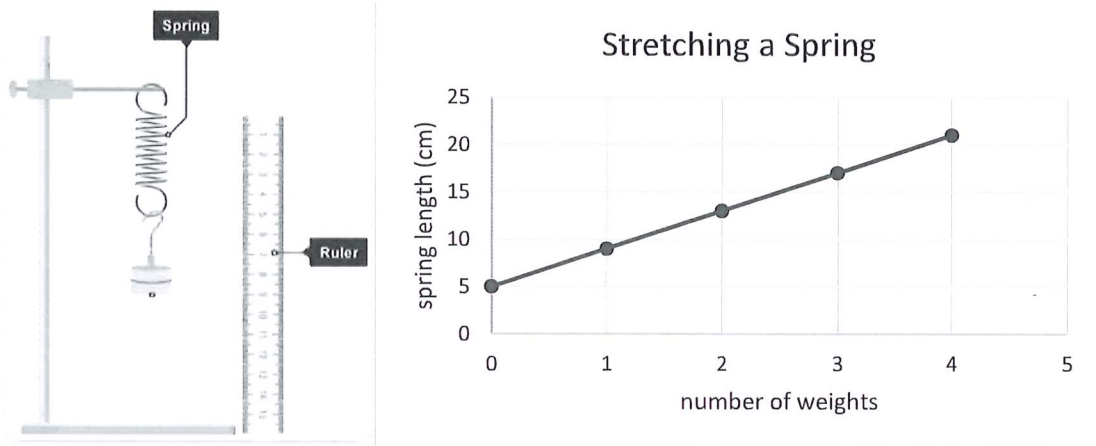


Figure 2: Experimental set-up and the graphed results.

a) Name the **two (2)** variables in this experiment.

..... Spring length
..... Number of weights

/1

b) Why has W (the number of weights) been chosen as the independent variable (and hence graphed as the horizontal axis)?

.....
..... • Weight is the controlled variable
..... • Spring length depends on weight
..... • Spring length is being measured so
..... is dependent

/1

c) The slope is 4 cm per weight. Interpret the meaning of this value.

..... For every weight added, the spring
..... length increases by 4cm

/2

d) The y-intercept is 5 cm. Explain the significance of this value.

..... Starting length of the spring

/1

Questions 2 continues

Question 2 continued

Marker use

e) The student uses the equation to determine that the spring length would be 4.05 metres (405 cm) if 100 weights were used.

i. How reliable is this prediction? Explain.

Unreliable due to extrapolation.

/2

ii. Given your answer in e) i. above, is the equation at all reliable? Explain.

• Could be used reliably for interpolation as the graph indicates an almost perfect correlation

(0-4 weights, possibly 5 or 6)

or • Always unreliable ~~as~~ even for interpolation as there are very few data points measured/given.

/2

Total
Q2

/9

Question 3 (approximately 7 minutes)

Marker use

Below are general questions about the models used to study sequences and series.

- a) i. Growth of organisms in a petri dish follows this sequence: 100, 150, 225, ...
Find an equation to model the sequence.

/2

.....

$$T_n = 100 \times 1.5^{n-1}$$

.....
or

$$T_{n+1} = 1.5T_n, T_1 = 100 \text{ (accept } T_0 = 100)$$

- ii. A herd of 1 500 wildebeest grows by 15% each year, but each year 40 wildebeest are lost to lion attacks. Find an equation to model the situation.

/2

.....

$$T_{n+1} = 1.15T_n - 40, T_0 = 1500$$

(accept $T_1 = 1500$)

- b) The rule for the sequence: 5, 9, 13, 17 ... , is $T_n = 5 + (n - 1) 4$
Using algebra to simplify, it becomes $T_n = 4n + 1$. To find a particular term (e.g. T_{10}), which equation would give the correct answer?

/1

.....
 Both

- c) The price of a calculator is initially \$100. Inflation is 2.3% p.a.
i. What common ratio would be used to find the sequence of expected prices over the next 5 years?

/1

.....
 1.023

- ii. How many times would the ratio need to be applied to progress from T_2 to T_5 ?

/1

.....
 3

Total
Q3
/7

Question 4 (approximately 4 minutes)

Marker use

Below are general questions about series (summing the terms of a sequence).

- a) \$100 is invested in a fund paying 10% p.a. compounding annually. The resulting sequence is, 100, 110, 121, 133.1, ...

Is a summing formula such as $S_n = \frac{a(1-r^n)}{1-r}$ necessary to find the total in the fund after say 10 years? Explain.

No, the terms of the sequence give the total in the fund.

/2

- b) Two friends are discussing this series: $100 + 50 + 25 + 12.5 + \dots$

Friend A comments: "If you keep adding the terms on and on forever your answer will be infinity because you are adding an infinite amount of numbers."

Friend B says: "There will be a limit above which you can never go, no matter how many numbers you add."

Which friend do you agree with? Use a formula to support your answer.

Friend B

$|r| < 1 \therefore S_{\infty}$ exists

$$S_{\infty} = \frac{100}{1-\frac{1}{2}} = 200$$

/2

Total
Q4

/4

Question 5 (approximately 7 minutes)

Marker use

Below are general questions about models and concepts involved with the finance topic.

a) For the financial scenarios described in i, ii and iii below, choose the most appropriate financial model from Table 1.

i. A person is repaying a loan in fortnightly instalments. The loan is subject to interest compounding monthly.

I (Annuity in arrears)

/1

ii. The book value of a farm machine decreases by 15% of the cost price each year.

C (Straight line depreciation)

/1

iii. The interest on a credit card is calculated daily. The interest from each day affects the calculation of interest for the next day.

B (compound interest)

/1

A	Simple interest
B	Compound interest
C	Straight line depreciation
D	Unit cost depreciation
E	Reducing value depreciation
F	Effective interest
G	Annuities in advance
H	Present value of annuity
I	Annuities in arrears
J	Perpetuities

Table 1: Financial models

b) 6% p.a. compounding monthly is equivalent to an effective rate of 6.17% p.a. Explain.

When 6% p.a. is compounded, you earn interest on your interest. If compounded monthly, this mean you ^{actually/effectively} earn 6.17% in a year / compounded yearly

/2

Question 5 continues

Question 5 continued

Marker use

- c) Jackie has purchased an antique watch as an investment. It is growing in value at 2.5% each year. Inflation is expected to average 3% p.a. over the period she owns the watch. Explain whether or not this is a good investment.

/2

.....
This is not a good investment as
the growth in value does not match
inflation.
.....

Total
Q5
/7

Question 6 (approximately 6 minutes)

Marker use

Below are general questions about annuities.

- a) Annuity in Advance means the 'regular payments' happen before the 'lump sum' of money is delivered or achieved. Explain how a savings account might fall into this category.

/2

You deposit a certain amount each pay & don't withdraw it until you have reached your goal (saving toward a large purchase)

- b) Annuity in Arrears means the 'lump sum' of money is delivered before the regular payments happen. Explain how a housing loan might fall into this category.

/2

The lump sum is used to buy the house & then you make regular payments (loan payments) until the debt is repaid

- c) Alex is trying to calculate how much they will still owe on their home loan after 5 years. They repay \$900 each month, interest is 7% p.a. compounding monthly and the loan is calculated to last a total of 20 years. Below is their calculation. What (common) error have they made?

/2

$$P = \frac{900 \left[1 - \left(1 + \frac{0.07}{12} \right)^{-5 \times 12} \right]}{\frac{0.07}{12}}$$

'n' for arrears is the number of payments left (15) & Alex has used the number of payments made (5)

Total
Q6

/6

End of Section A
Blank Page



TASMANIAN
ASSESSMENT, STANDARDS
& CERTIFICATION

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GENERAL MATHEMATICS

MTG315123

Section **B** Bivariate Data Analysis

Pages: 16

Questions: 6

Information Sheet: 1

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
 - Spare diagrams have been provided at the end of each section. Indicate using the box provided if you have used the spare diagram.
- TASC approved calculators are allowed.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- The General Mathematics Information Sheet can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C5	/ 36 ✓

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Guide to Exam Structure

	Parts	Questions available	Questions to answer	Suggested working time	Marks available
Section A		6	6	36 minutes	36 marks
Section B		6	6	36 minutes	36 marks
Section C		6	6	36 minutes	36 marks
Section D		6	6	36 minutes	36 marks
Section E	Part 1	6	6	36 minutes	36 marks
	OR				
	Part 2	6	6	36 minutes	36 marks
Totals		36	30	180 minutes (3 hours)	180 marks

Criterion

You **must** make sure your answers address:

- Criterion 5 interpret concepts and apply mathematical techniques to solve problems involving bivariate data analysis and time series analysis using the statistical investigation process.

Question 7 (approximately 5 minutes)

Marker use

Table 1 shows the results from two Australian territories in a national vote. The reason for the vote is irrelevant here.

	ACT	NT	Total
Yes	176 000	43 000	219 000
No	111 000	65 000	176 000
Total	287 000	108 000	395 000

Table 1

a) Complete the percentage table below.

	ACT (%)	NT (%)
Yes	61.3	39.8
No	38.7	60.2
Total	100	100

Table 2

b) Complete a bar chart below to represent your percentages.

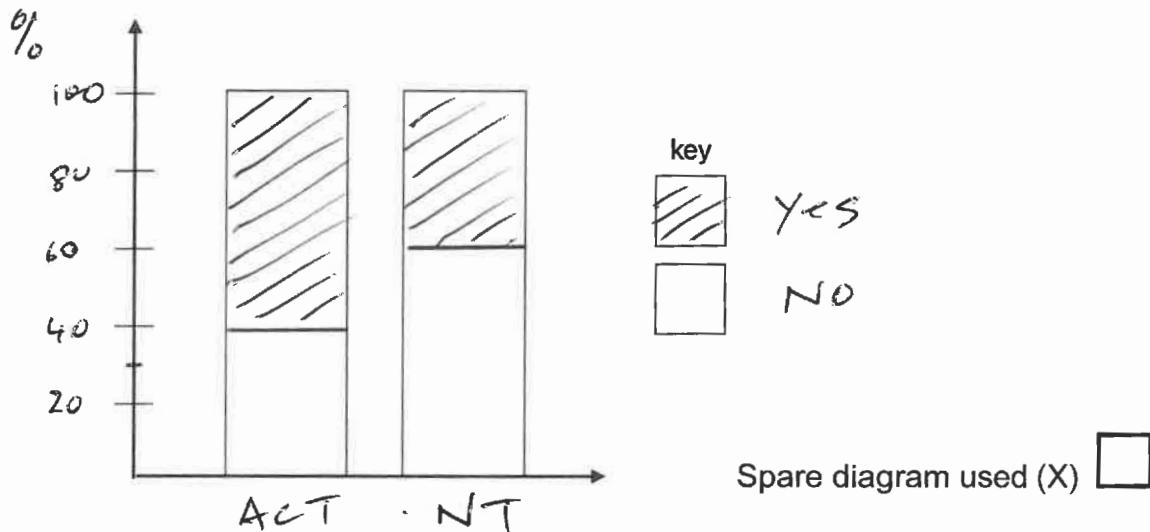


Figure 3: Bar chart to sketch your answer to Question 7 b).

c) What is meant by the following statement: "there appears to be some association between these two variables"?

We mean there is a link between which of these two territories people live in, and how they vote on this issue. (knowing the territory of origin, we can predict with some certainty, how they would vote)

Total Q7

1/5

Question 8 (approximately 3 minutes)

Marker use

Table 3 shows rainfall data recorded by a homeowner on Tasmania’s east coast during 2023.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	3	54	19	45	26	46	17	4	20	62	22	29
3-point moving average		25	39	30	39	30	22	14	29	35	38	

Table 3

- a) Complete the ‘3-point moving average’ row of Table 3. There are **two (2)** values missing.
- b) Add your values from Part a) to the graph in Figure 4, to complete it.

/1

/1

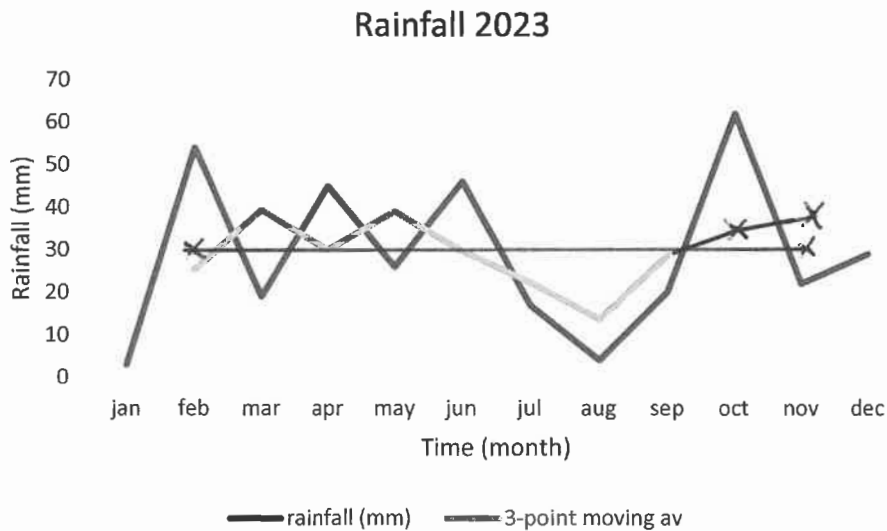


Figure 4: Graph showing Rainfall 2023

Spare diagram used (X)

- c) The equation of the ‘line of best fit’ for the smoothed data is $R = 0.006M + 30.1$, where R = ‘3-point moving average’ of rainfall, and M = the number of months since December 2022.

/1

Two points on this line are (2, 30.1), (11, 30.2). Add these points to the graph in Figure 4 and draw in the line.

Total Q8

/3

Question 9 (approximately 9 minutes)

Marker use

Table 4 shows a measure of blood pressure for a random selection of people of different ages.

Age (years)	17	20	25	29	34	39	42	46
Blood Pressure (mmHg)	114	116	125	130	110	120	124	142

Table 4

- a) Assuming 'Age' to be the independent (x) variable, use the regression function on your calculator to find a linear equation representing this data. Use variables A (age) and B (blood pressure). Use 3 decimal places in your equation.

$$B = 0.532A + 105.878$$

/2

- b) Find r and r^2 to four decimal places and interpret the correlation coefficient (r).

$$r = 0.5505, r^2 = 0.3031$$

/3

There is a moderate, positive correlation between the variables. There's some evidence that the greater the age, the greater the blood pressure.

- c) Use your equation from Part a) to predict the blood pressure of a 22 year old.

$$B = 0.532 \times 22 + 105.878$$

/1

$$= 117.6 \text{ mm Hg}$$

Question 9 continues

Question 9 continued

Marker use

- d) The equation predicts that a 60 year old will have blood pressure of 138 mmHg.
Discuss the reliability of this prediction, and your prediction in Part c).

/3

part c: $r^2 = 30.3\%$ (low association)

amount of data: low

interpolation (reliable)

overall, not a reliable prediction

part d: extrapolation: assuming the

trend in original data continues

overall, not a reliable prediction

Total
Q9
/9

Question 10 (approximately 6 minutes)

Marker use

Table 5 shows the women's Olympic 400 m freestyle winning time (in seconds) from 1924 to 1960. The table has columns added to allow calculations of values for a regression formula. (Note: there were no Olympic games in 1940 or 1944, but this does not affect the calculation)

	Year (x)	Time (y)	xy	x^2
1924	1	362	362	1
1928	2	343	686	4
1932	3	329	987	9
1936	4	326	1304	16
1948	7	324	2268	49
1952	8	312	2496	64
1956	9	295	2655	81
1960	10	290	2900	100
Totals (Σ)	44	2581	13658	324

Table 5

a) Calculate the two missing values, and complete the table.

/1

b) Use the regression formula from your Information Sheet, and use $n=8$ to calculate values for a and b (the slope and y -intercept of the regression line). Give values to 2 decimal places.

/2

$$a = \frac{n \Sigma xy - \Sigma x \Sigma y}{n \Sigma x^2 - (\Sigma x)^2} = \frac{8 \times 13658 - 44 \times 2581}{8 \times 324 - 44^2}$$

$$= -6.55$$

$$b = \frac{\Sigma y - a \Sigma x}{n} = \frac{2581 - (-6.55) \times 44}{8}$$

$$= 358.65$$

Question 10 continues

Question 10 continued

Marker use

c) Write the regression equation using variables Y (year) and T (time).

.....
 $T = -6.55Y + 358.65$
.....

/1

d) Predict the women's Olympic 400 m freestyle winning time for 1968.

.....
 $T = -6.55 \times 12 + 358.65$
.....
 $= 280 \text{ sec.}$
.....

/2

Total
Q10

/6

Question 11 (approximately 6 minutes)

Table 6 and Figure 5 show the population of India from the year 1950 to 2000. A 'residual' column is included in Table 6. A regression line is included in the first graph in Figure 5. The second graph is of Residual values.

Year	Population (million)	Residual (million)
1950	357	44.19
1960	446	-7.55
1970	558	-36.30
1980	697	-38.04
1990	870	-5.78
2000	1060	43.48

Table 6

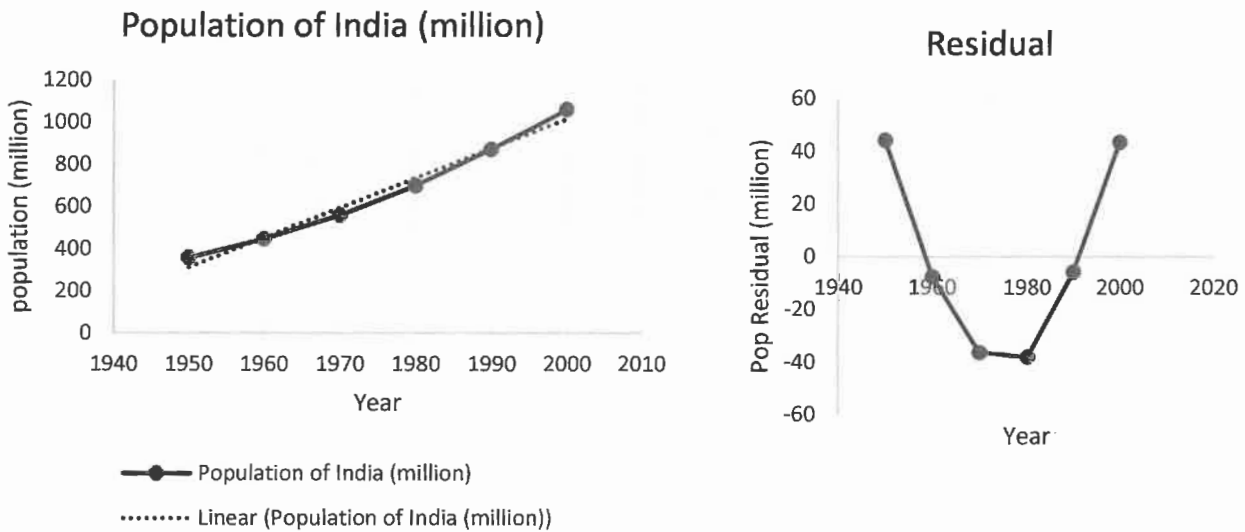


Figure 5: Graphs showing Population of India (million) and residual values.

- a) Use your calculator to complete the Residuals column of Table 6. Give answers to 2 decimal places.
- b) Interpret the residual point (1970, -36.30).

In 1970 the actual population was 36.3 million less than the value predicted by the regression equation.

/2

/2

Question 11 continues

Question 11 continued

Marker use

c) Is the linear model an appropriate choice? Explain.

The residual plot is not balanced (2 pos, 4 neg)

The distribution is not random. There is an obvious curve and a + - + pattern

∴ Linear model not appropriate.

1/2

Total
Q11
/6

Question 12 (approximately 7 minutes)

Table 7 shows quarterly power costs for a Tasmanian household. The process of deseasonalising the data has almost been completed.

Power Costs (\$) for Tasmanian Household

	Summer	Autumn	Winter	Spring	average
2021	390	530	660	495	519
2022	380	503	690	490	516
2023	360	540	730	510	535

2021	0.751	1.021	1.272	0.954
2022	0.736	0.975	1.337	0.950
2023	0.673	1.009	1.364	0.953
index	0.720	1.002	1.324	0.952

Deseasonalised Data

2021	542	529	498	520
2022	528	502	521	515
2023	500	539	551	536

Table 7

- a) Find the **four (4)** numbers missing from the tables in Table 7.
- b) Which season of which year has the highest deseasonalised value? Explain the significance of this.

/2

/2

Winter of 2023
 When all of the seasons are compared to expected, winter 2023 is highest (cost).
 (The bill for winter 2023 was higher than expected; more so than any other season.)

Question 12 continues

Question 12 continued

Marker use

- c) Figure 6 is a graph of the actual and the deseasonalised data, and a regression line for the deseasonalised data. The equation of the regression line for the deseasonalised data is, $D = 1.0459x + 516.33$ where x is the season number from Spring 2020. Predict the **actual** power cost for Spring of 2024.

/3

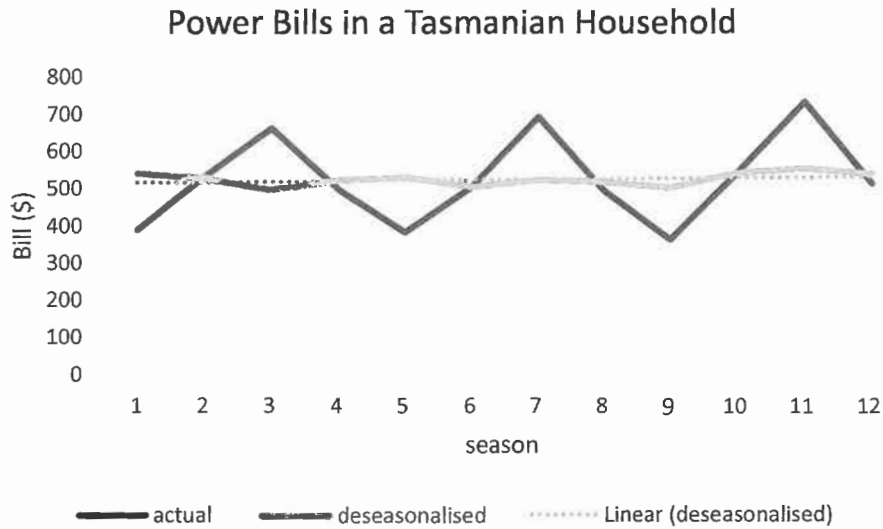


Figure 6: Graph showing original and deseasonalised data.

$$D = 1.0459 \times 16 + 516.33$$

$$= 533.06$$

$$A = D \times I$$

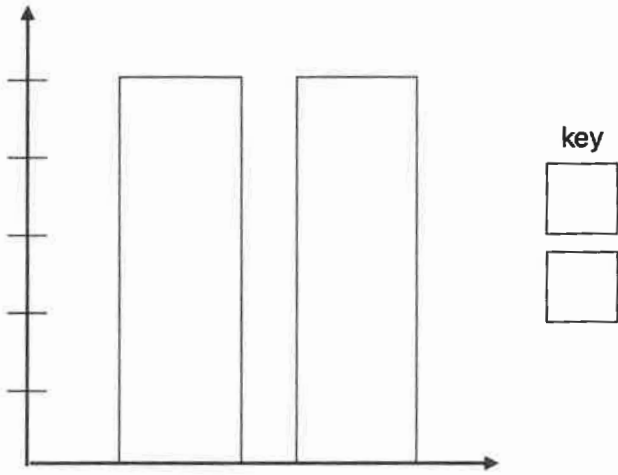
$$= 533.06 \times 0.952$$

$$= \$507.47$$

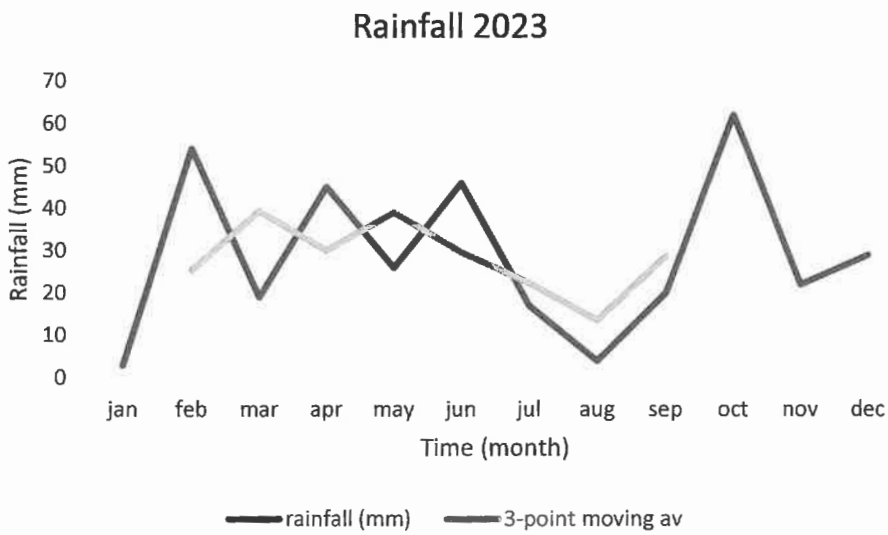
Total
Q12
/7

Spare Diagrams

Question 7 b)



Question 8 b) and c)



End of Section B
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GENERAL MATHEMATICS

MTG315123

Section **C** Growth and Decay in Sequences

Pages: 12

Questions: 6

Information Sheets: 1

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
- TASC approved calculators are allowed.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
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Marker use	
C6	/ 36

Question 13 (approximately 5 minutes)

Marker use

A conservationist has bought 200 hectares of land in central Tasmania that is covered in gorse, a hardy, prickly weed. They expect to be able to clear 12 hectares per year.

- a) Given that the first term is 200, find the next **three (3)** terms in the sequence representing the amount of uncleared land at the beginning of each year.

200, 188, 176, 164

/1

- b) Is this sequence arithmetic or geometric?

Arithmetic

/1

- c) Find the (explicit) rule for the sequence.

$t_n = a + (n-1)d$

$t_n = 200 + (n-1)(-12)$

$t_n = -12n + 212$

/2

- d) Use the rule to find the 15th term (the amount of uncleared land at the beginning of the 15th year).

$n = 15 \quad t_{15} = -12 \times 15 + 212$

$= 32$

/1

Total
Q13

/5

Question 14 (approximately 8 minutes)

Marker use

Table 9 shows the declining number of births per year in a large country.

2021	2022	2023
15 644 946 (T_1)	15 269 467 (T_2)	14 903 000 (T_3)

Table 9

a) Is the sequence arithmetic or geometric? Show working out.

$T_2 - T_1 = -375\,479$ $T_3 - T_2 = -366\,467$ no common diff so not arithmetic /2
 $\frac{T_2}{T_1} = \frac{15\,269\,467}{15\,644\,946} = 0.9760$ $\frac{T_3}{T_2} = \frac{14\,903\,000}{15\,269\,467} = 0.9760$
 There is a common ratio, so it is a Geometric sequence.

b) Find the (explicit) rule for this sequence.

$T_n = ar^{n-1}$ /2
 $T_n = 15\,644\,946 \times 0.9760^{n-1}$

c) Use a formula to predict the total number of births over the 10 years from 2021 (including 2021). Give a final answer correct to the nearest whole number.

$S_n = \frac{a(1-r^n)}{1-r}$ /2
 $S_{10} = \frac{15\,644\,946(1-0.9760^{10})}{1-0.9760}$
 $= 140\,590\,161$ births

d) By continually adding the number of births in this sequence, on and on forever, what is the answer?

$S_\infty = \frac{a}{1-r}$ /2
 $S_\infty = \frac{15\,644\,946}{1-0.9760}$
 $= 651\,872\,750$ births

Total Q14 /8

Question 15 (approximately 4 minutes)

Marker use

Following are two sequence rules in explicit form. Find the recursive form (difference equation) of each rule.

a) $T_n = 12 + (n - 1) 16$

$T_{n+1} = T_n + 16 \quad T_1 = 12$

/2

b) $T_n = 0.5 \times (-3)^{n-1}$

$T_{n+1} = -3T_n \quad T_1 = 0.5$

/2

Total
Q15
/4

Question 16 (approximately 3 minutes)

Marker use

Table 10 shows Tasmania's population in 2015 and 2022.

Year	Population
2015	515 000 (T_1)
2022	572 000 (T_8)

Table 10

Assuming that our population, year by year, follows an arithmetic sequence, find the (explicit) rule for the sequence. Give values in your final answer with **one (1)** decimal place.

/3

$$T_n = a + (n-1)d$$

$$a = 515\,000$$

$$T_1 \rightarrow T_8 \quad \text{So } 7d = 572\,000 - 515\,000$$

$$7d = 57\,000$$

$$d = 8142.9$$

$$T_n = 515\,000 + (n-1)8142.9$$

$$T_n = 8142.9n + 506\,857.1$$

Total
Q16

/3

Question 17 (approximately 7 minutes)

Marker use

The (explicit) rule for an arithmetic sequence is $T_n = 22 - 6n$

- a) The number -260 is a term of this sequence. Determine which term this is.

$$-260 = 22 - 6n$$

$$-6n = -282$$

$$n = 47$$

The 47th term is -260

/3

- b) If the first term is 16, find the sum of the first 47 terms.

$$S_n = \frac{n}{2}(a+l)$$

$$\text{or } S_n = \frac{n}{2}(2a + (n-1)d)$$

$$S_{47} = \frac{47}{2}(16 + -260)$$

$$S_{47} = \frac{47}{2}(2 \times 16 + 46 \times -6)$$

$$= -5734$$

$$= -5734$$

/2

- c) How many terms of this sequence must be added to achieve a total of -110 ?

$$S_9 = -72$$

$$S_{10} = -110$$

So 10 terms

$$S_{11} = -154$$

/2

Total
Q17

/7

Question 18 (approximately 9 minutes)

Marker use

A mining town with a population of 5 000, is declining at the rate of 15% per year as mine workers depart. Simultaneously, the introduction of tourism, including mountain bike trails in the surrounding hills, has caused an increase of 600 people per year.

- a) Find a difference equation to represent the town's population, year by year.

$$T_{n+1} = 0.85T_n + 600 \quad T_0 = 5000$$

/2

- b) What happens to the town's population in the long term?

The population decreases until it reaches a steady state of 4000 people.

/2

The town council wants to help redundant workers from the mine industry to find jobs in tourism and stay. The rate of decline decreases to 10%. Assume other variables remain unchanged.

- c) Find a new difference equation to represent the town's population, year by year.

$$T_{n+1} = 0.9T_n + 600 \quad T_0 = 5000$$

/1

- d) Now what happens to the town's population in the long term?

The population increases until it reaches a steady state of 6000 people.

/2

- e) What rate of decline should the council aim for if they want to maintain a steady population of 5 000?

$$A_{\text{sum}} = \frac{d}{1-r} \quad \text{or} \quad \text{Decline} = \frac{600}{5000}$$

/2

$$5000 = \frac{600}{1-r} \quad = 0.12$$

$$5000(1-r) = 600 \quad = 12\%$$

$$5000 - 5000r = 600$$

$$r = 0.88$$

So a 12% rate of decline

Total Q18

/9

End of Section C
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Solutions

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GENERAL MATHEMATICS

MTG315123

Section **D** Finance

Pages: 12
Questions: 6
Information Sheet: 1

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
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Marker use	
C7	/ 36

Question 19 (approximately 9 minutes)

Marker use

A business owner predicts that in 3 years' time the business will have grown so much they will need to purchase a forklift (lifting machine).

- a) If the required new machine costs \$65 000 now, how much will it cost in 3 years, if inflation is expected to average 2.3% p.a.?

$$FV = PV(1+i)^n$$

$$FV = 65000(1+0.023)^3$$

$$= \$69\,588.95$$

/2

- b) The business owner investigates some saving options. Complete Table 11 and decide which interest arrangement would accumulate the most interest. Give answers to **three (3)** decimal places.

Interest Offered	Effective Rate (% p.a.)	Which gives most interest (tick ✓)
3.1% p.a. compounding daily	3.148	
3.2% p.a. compounding weekly	3.251	
3.3% p.a. compounding fortnightly	3.353	✓

Table 11

/2

- c) The owner decides to use the finance company offering 3.3% p.a. compounding fortnightly.

- i. How many interest periods are there each year?

$$26$$

/1

- ii. How many interest periods are there in total over 3 years?

$$3 \times 26 = 78$$

/1

- iii. How much will need to be invested in the account initially to have \$70 000 in 3 years' time?

$$PV = \frac{FV}{(1+i)^n}$$

$$PV = \frac{70\,000}{\left(1 + \frac{3.3}{2600}\right)^{78}} = \$63\,405.97$$

/3

Total Q19

/9

Question 20 (approximately 4 minutes)

Marker use

Casey has been working hard. They find a holiday package deal for 1 week in Bali and pay \$2 500 using their credit card. Purchases on the credit card are interest free until the date the first payment is due. If a payment is missed there is a \$25.00 fee. Interest is 20.99% p.a. compounding daily.

a) How much will Casey pay if they pay the total owing before the due date?

..... \$2500

/1

b) How much will Casey pay, in total, if they neglect to make the first **three (3)** payment dates? They pay interest for 70 days when they finally pay.

.....

$$FV = PV(1+i)^n$$

$$FV = 2500 \left(1 + \frac{20.99}{365 \times 100} \right)^{70}$$

$$= 2602.66$$

.....

$$\text{Total} = 2602.66 + 3 \times 25$$

$$= \$2677.66$$

.....

/3

Total
Q20

/4

Question 21 (approximately 8 minutes)

The owner of a small business buys a ute (small truck) for \$45 000. The vehicle is expected to last for 320 000km and has an expected 'scrap value' of \$800.

a) Using the Unit Cost Depreciation method:

i. Find R, the depreciation per km, correct to **three (3)** decimal places.

$$R = \frac{45000 - 800}{320000}$$

$$R = \$0.138 \text{ per km}$$

/1

ii. Find the Book Value after 100 000km.

$$V = -Rn + C$$

$$V = -0.138 \times 100000 + 45000$$

$$V = \$31200$$

/1

Figure 7 shows the Book Value of the \$45 000 ute using two different depreciation methods. For Straight Line depreciation, the equation is $V = -3214n + 45000$. For Reducing Balance depreciation, the equation is $V = 45000(1 - 0.12)^n$.

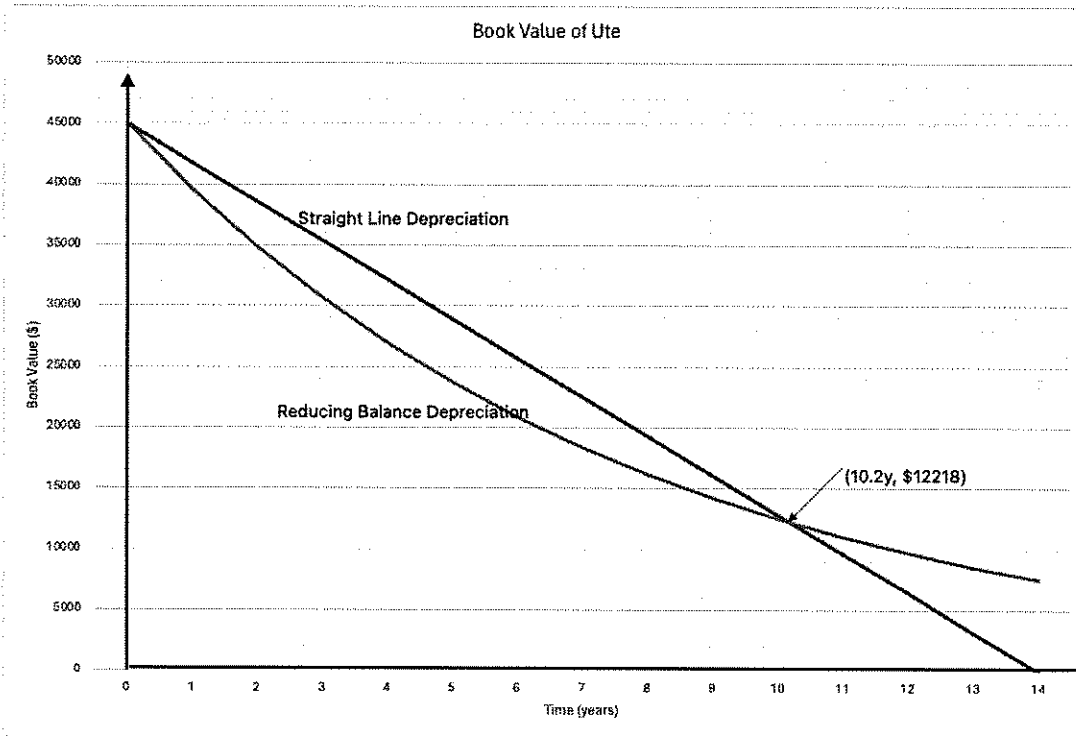


Figure 7: Graph showing Book Value.

Question 21 continues

Question 21 continued

Marker use

b) Use the graph in Figure 7 to estimate the Book Value of the ute after 5 years.

i. Using Straight Line Depreciation.

$\$29,000$ (exact value 28930)

/0.5

ii. Using Reducing Balance Depreciation.

$\$23,500$ (exact value 23748)

/0.5

c) A tax specialist advises the owner to use the method that will predict more depreciation. **Explain** which method they should use:

i. If they plan to keep the car for 5 years.

Reducing balance method.

/1

The vehicle will have the greater depreciation.

ii. If they plan to keep the car for 12 years.

Straight line method

/1

The lower book value means greater depreciation.

d) If the Straight Line method involved a reduction in value of \$4 000 (instead of \$3 214) each year, and all other values were unchanged, determine how many years before the two methods predict the same value (other than initially). Give your answer in years to **two (2)** decimal places.

/3

$V = -4000n + 45000$ and $V = 45000(1-0.12)^n$

Solve $-4000n + 45000 = 45000(1-0.12)^n$

$n = 6.08$ years

or graph



Total Q21

/8

Question 22 (approximately 8 minutes)

Marker use

Imagine, in your future working life, that you want to save \$6 000 over 2 years. Your savings account pays 3% p.a. compounding monthly.

- a) Use a formula and algebra to find how much you would have to deposit each month.

$$F = \frac{R(1+i)[(1+i)^n - 1]}{i}$$

$$6000 = \frac{R\left(1 + \frac{3}{1200}\right)\left[\left(1 + \frac{3}{1200}\right)^{24} - 1\right]}{\left(\frac{3}{1200}\right)}$$

$$6000 = 24.7646 R$$

$$R = \$242.28$$

- b) Calculate the 'Present Value' of your future savings (\$6 000).

$$PV = \frac{FV}{(1+i)^n}$$

$$PV = \frac{6000}{\left(1 + \frac{3}{100}\right)^{24}}$$

$$PV = \$5651.01$$

/3

/2

Question 22 continues

Question 22 continued

Marker use

c) Use an Interest Factor from Table 12, to confirm your answer to Part a).

Annuities in advance interest factor table: $f = \frac{(1+i)[(1+i)^n-1]}{i}$

/3

int per period i =	0.00083	0.00167	0.00250	0.00333	0.00417	0.00500	0.00583	0.00667
1	1.0008	1.0017	1.0025	1.0033	1.0042	1.0050	1.0058	1.0067
2	2.0025	2.0050	2.0075	2.0100	2.0125	2.0150	2.0175	2.0200
3	3.0050	3.0100	3.0150	3.0200	3.0251	3.0301	3.0351	3.0402
4	4.0083	4.0167	4.0251	4.0334	4.0418	4.0503	4.0587	4.0671
5	5.0125	5.0251	5.0376	5.0502	5.0628	5.0755	5.0882	5.1009
6	6.0175	6.0351	6.0527	6.0704	6.0881	6.1059	6.1237	6.1416
7	7.0234	7.0468	7.0704	7.0940	7.1176	7.1414	7.1653	7.1892
8	8.0301	8.0602	8.0905	8.1209	8.1515	8.1821	8.2129	8.2438
9	9.0376	9.0753	9.1133	9.1513	9.1896	9.2280	9.2666	9.3054
10	10.0459	10.0921	10.1385	10.1852	10.2321	10.2792	10.3265	10.3741
11	11.0552	11.1106	11.1664	11.2225	11.2789	11.3356	11.3926	11.4499
12	12.0652	12.1308	12.1968	12.2632	12.3300	12.3972	12.4649	12.5329
24	24.2516	24.5064	24.7646	25.0260	25.2909	25.5591	25.8308	26.1061
36	36.5604	37.1319	37.7146	38.3088	38.9148	39.5328	40.1630	40.8058
48	48.9929	50.0122	51.0585	52.1328	53.2358	54.3683	55.5313	56.7256
60	61.5503	63.1524	64.8083	66.5200	68.2894	70.1189	72.0105	73.9667
72	74.2338	76.5579	78.9763	81.4933	84.1133	86.8409	89.6810	92.6388
84	87.0448	90.2340	93.5753	97.0767	100.7467	104.5943	108.6290	112.8607
96	99.9844	104.186	108.618	113.295	118.231	123.443	128.947	134.761
108	113.054	118.420	124.119	130.174	136.610	143.454	150.733	158.479
120	126.255	132.941	140.091	147.741	155.929	164.699	174.094	184.166
240	265.782	295.288	329.123	367.997	412.746	464.351	523.965	592.947
360	419.978	493.547	584.194	696.362	835.725	1009.54	1227.09	1500.30

Table 12

$i = \frac{3}{1200}$

$i = 0.0025$ $F = R F$

$n = 24$ $R = \frac{F}{F}$

$F = 24.7646$ F

$R = \frac{6000}{24.7646}$

$R = \$242.28$

Total
Q22
/8

Question 24 (approximately 4 minutes)

Marker use

A couple has borrowed \$400 000 to purchase a house. Their bank charges 6.3% p.a. interest compounding monthly. The couple plans to make monthly payments of \$2 470.

- a) Write a difference equation to represent this. Your 'r' value should either include a fraction, or have at least **six (6)** decimal places.

/2

$$t_{n+1} = r t_n - d \quad t_0 = a \quad \left| \begin{array}{l} i = 6.3 \div 1200 = 0.00525 \\ r = 1.00525 \end{array} \right.$$

$$t_{n+1} = 1.00525 t_n - 2470 \quad t_0 = 400\,000$$

or $t_{n+1} = \left(1 + \frac{6.3}{1200}\right) t_n - 2470 \quad t_0 = 400\,000$

- b) Use your difference equation to determine how long it will take to pay back the loan. Give your answer in months, and comment on the final payment.

/2

$$t_{362} = 1382.03$$

$$t_{363} = -1080.71$$

It will take 363 months to repay the loan.

The final payment will be a part payment.

End of Section D

Total
Q24

/4



TASMANIAN
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& CERTIFICATION

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GENERAL MATHEMATICS

MTG315123

Section Networks or Trigonometry

Pages: 28

Questions: 12

Information Sheet: 1

Suggested working time: 36 minutes

Instructions:

- There are **two (2)** parts to this section. Answer **all** questions in **one (1)** part. Either:
 - **Part 1** – networks and decision mathematics

OR

 - **Part 2** – trigonometry and Earth geometry – Part 2 commences on page 14.
- Write your answers in the spaces provided in this exam paper.
 - Spare diagrams have been provided at the end of each section. Indicate using the box provided if you have used the spare diagram.
- TASC approved calculators are allowed.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- The General Mathematics Information Sheet can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C8	/ 36

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Guide to Exam Structure

	Parts	Questions available	Questions to answer	Suggested working time	Marks available
Section A		6	6	36 minutes	36 marks
Section B		6	6	36 minutes	36 marks
Section C		6	6	36 minutes	36 marks
Section D		6	6	36 minutes	36 marks
Section E	Part 1	6	6	36 minutes	36 marks
	OR				
	Part 2	6	6	36 minutes	36 marks
Totals		36	30	180 minutes (3 hours)	180 marks

Criterion

You **must** make sure your answers address:

- **Criterion 8** interpret concepts and apply mathematical techniques to represent, analyse and solve practical problems in the two-dimensional plane.

Part 1 – Networks

Marker use

- Either answer **all** questions in this part **OR all** questions in Part 2.

Question 25 (approximately 5 minutes)

Figure 8 is a diagram representing footpaths at a wildlife sanctuary. Distances are shown in metres.

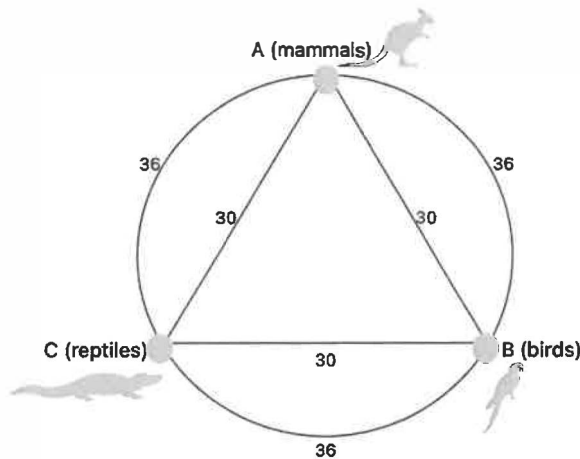


Figure 8: Diagram representing footpaths at a wildlife sanctuary.

- a) Find a trail starting at A, the mammals, that uses all of the footpaths once and returns to A. Write your answer as a sequence of letters.

..... *ABCBCA*

.....

/2

- b) What is the term given to this kind of trail?

..... *Eulerian*

.....

/1

- c) How can you tell that such a trail is possible, before actually finding it?

..... *No vertex has odd degree*

.....

.....

/1

- d) Find the length of the shortest closed Hamiltonian Path, starting and finishing at C, the reptiles.

..... *90 m*

/1

Total
Q25

/5

Question 26 (approximately 4 minutes)

Marker use

Table 12 represents tasks in a renovation project.

Task	Task symbol	Immediate Predecessor
Fix foundations	A	-
Fix electrical	B	A
Renovate kitchen	C	A
Renovate bathroom	D	B
Paint	E	C, D

Table 12

a) What must happen before 'Fix electrical'?

..... *Fix Foundations (A)*

.....

/1

b) Which task cannot happen until both 'Renovate kitchen' and 'Renovate bathroom' are complete?

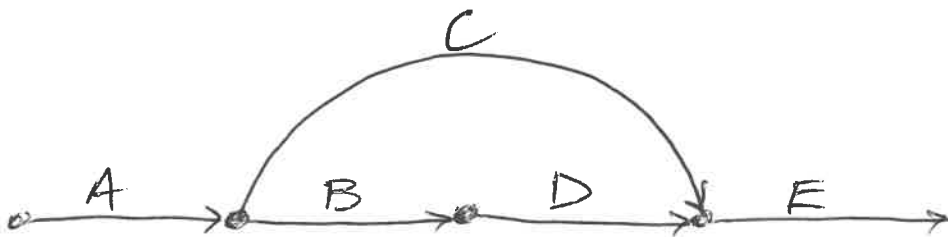
..... *Paint (E)*

.....

/1

c) Draw the precedence graph represented by Table 12. Each task will be represented by an arrow.

/2



Total
Q26

/4

Question 27 (approximately 8 minutes)

The following questions are about the process of Critical Path Analysis.

- a) Figure 9 is part of a precedence graph for a project. Fill in the top part of each of the the 'time-keeper' boxes by completing a 'forward scan'.

/2

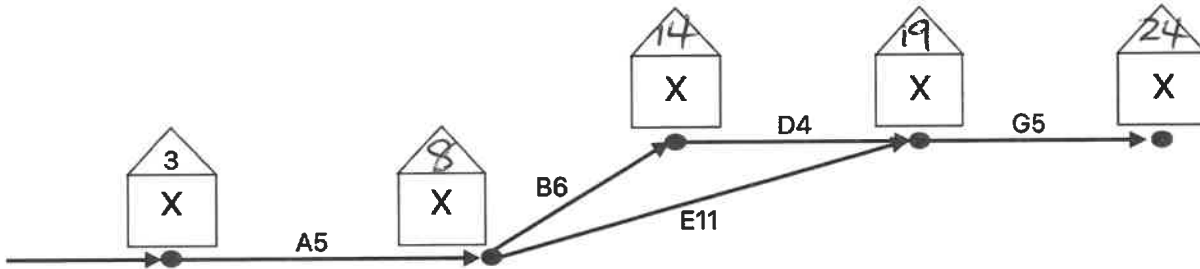


Figure 9: Precedence graph for Question 27 a).

Spare diagram used (X)

- b) Figure 10 is part of a precedence graph for a different project. Fill in the lower part of the time-keeper boxes by completing a 'backwards scan'.

/2

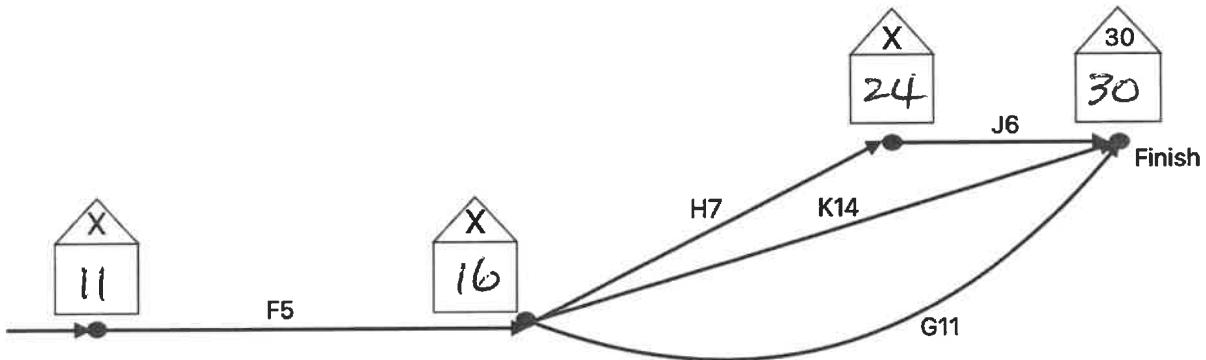


Figure 10: Precedence graph for Question 27 b).

Spare diagram used (X)

Question 27 continues

Question 27 continued

Marker use

Figure 11 is a precedence graph for the construction of a large shed. The times shown are in weeks.

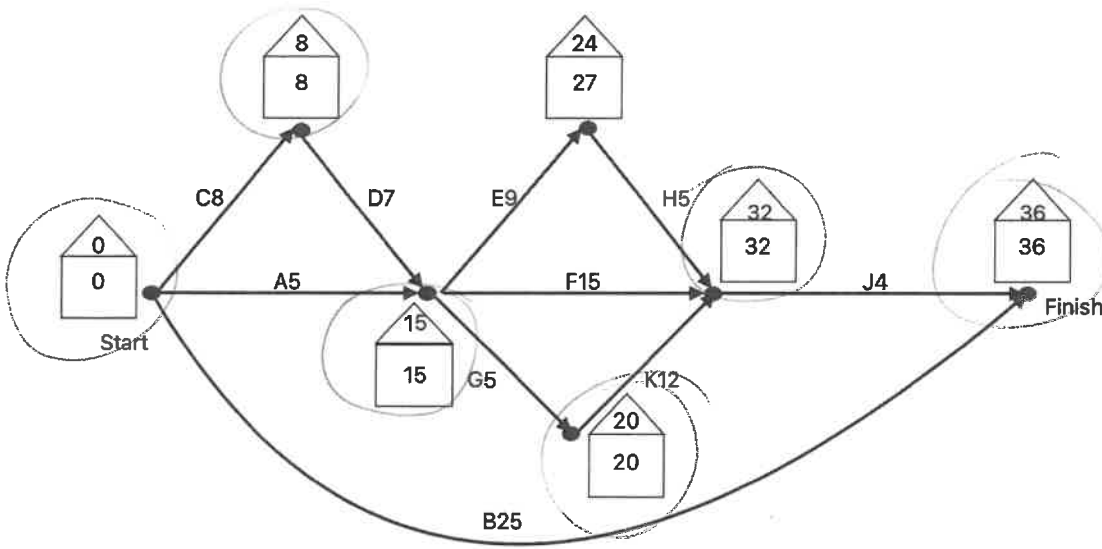


Figure 11: Precedence graph for the construction of a large shed.

c) Write the Critical Path as a sequence of letters.

..... CDGKJ

/1

d) Calculate the 'float' for task G, and use it to determine how the project completion time will be affected if this task requires four weeks more than expected:

i. Float for task G.

..... 20 - 5 - 15 = 0 (critical)

/0.5

ii. New project completion time.

..... 40 weeks

/0.5

e) Calculate the 'float' for task E, and use it to determine how the project Critical Path and completion time will be affected if this task requires four weeks more than expected.

i. Float for task E: 27 - 9 - 15 = 3

/0.5

ii. New project completion time: 37 wk

/0.5

iii. Critical path: CDEHJ

/1

Total Q27

/8

Question 28 (approximately 10 minutes)

Marker use

Figure 12 shows a system of water pipes through a Marine Research Laboratory. The numbers on the pipes represent the capacity, the maximum amount of water the pipe can carry, in litres per minute. Some, but not all 'cuts', have been drawn on the diagram.

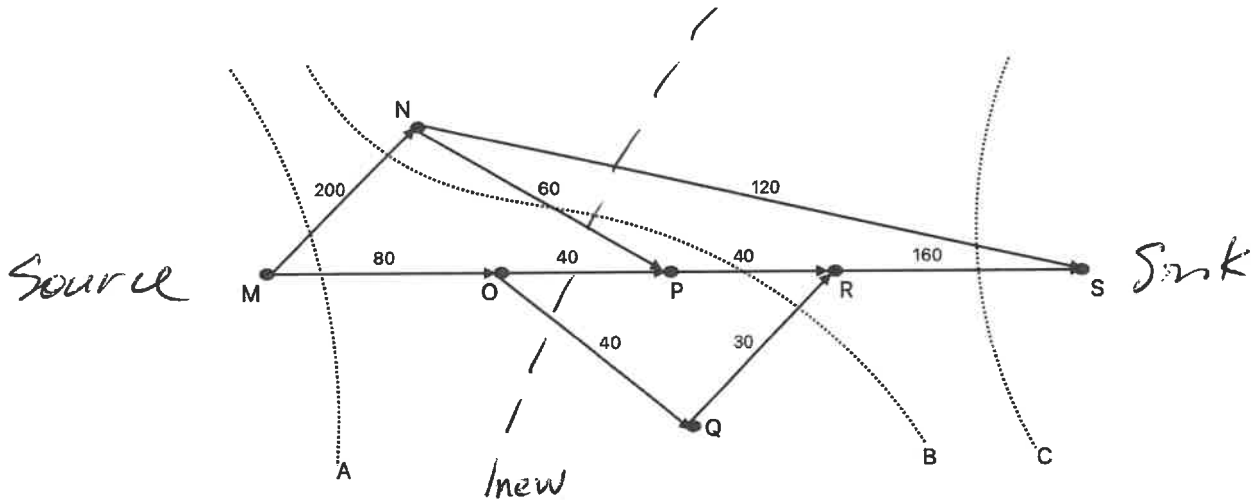


Figure 12: System of water pipes through a Marine Research Laboratory.

Spare diagram used (X)

a)

i. Label the source and sink on the diagram in Figure 12.

/1

ii. Add another (new) cut to the diagram in Figure 12.

/1

iii. What is the capacity of cut A?

280 L/M

/1

iv. What is the capacity of cut B?

270 L/M

/2

Question 28 continues

Question 28 continued

Marker use

b). The cuts required for the following analysis have been drawn for you.

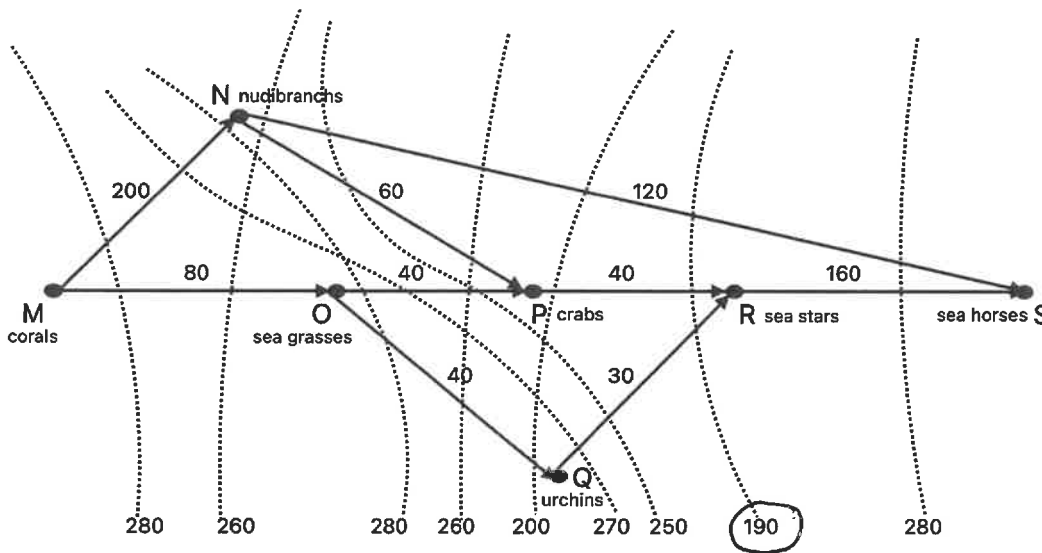


Figure 13: System of water pipes through a Marine Research Laboratory.

i. What is the maximum water flow through this system?

Min cut = Max flow = 190 L/M

/1

ii. Which **three (3)** pipes are possibilities for upgrade to improve the total flow through the system?

QR, PR, NS

/1

iii. The researchers need to improve maximum flow. They are considering upgrading pipe PR. What capacity (size) pipe should PR be? Explain by referring to relevant cuts.

*The next smallest cut, that doesn't go through PR, is 250. $250 - 190 = 60$
 $40 + 60 = 100$ L/M*

/2

iv. What is the new maximum flow through the system?

250 L/M

/1

Total Q28

/10

Exam continues over the page

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Question 29 (approximately 3 minutes)

Marker use

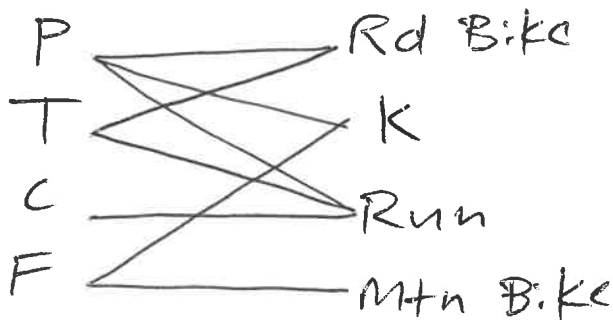
Four friends plan to enter a 'wilderness multi-sport event'. The event requires teams of 4, where one member will complete the road bike leg, one will do the mountain bike leg, one will paddle a kayak and one will run. Table 13 shows the capabilities of the team.

Team Member	Team Member's Skills
Peta	road bike, kayak, run
Taylor	road bike, run
Charlie	run
Frankie	mountain bike, kayak

Table 13

a) Draw a bi-partite graph to represent Table 13.

/2



b) Use your bi-partite graph to assign team members to a sport, or 'leg' of the event.

/1

C - Run
 F - Mtn Bike
 P - Kayak
 T - Rd Bike

Total
Q29

/3

Question 30 (approximately 6 minutes)

Marker use

A class of General Maths students has invented some speed skills so that teams in the class can compete. Shown in Table 14 are the best times, in seconds, for the members of one team.

Team Member	1. Eat bowl of jelly	2. Do 3 head stands	3. Make a paper plane that flies	4. Run around the Maths Block
A	62	40	66	62
B	67	47	61	57
C	62	44	55	57
D	68	45	58	53

Table 14

- a) The team is using the Hungarian Algorithm to determine who will do which activity. Complete the final row of the 'row reduction' shown in Table 15.

22	0	26	22
20	0	14	10
18	0	11	13
23	0	13	8

Table 15

- b) The 'column reduction' has been completed. The result is in Table 16. Complete Table 17 using the Hungarian Method.

4	0	15	14
2	0	3	2
0	0	0	5
5	0	2	0

Table 16

2	0	13	12
0	0	1	0
0	2	0	5
5	2	2	0

Table 17

Spare diagram used (X)

Question 30 continues

Question 30 continued

Marker use

c) Table 18 is the final table, after using the Hungarian Method, for a **different team**.

Team Member	1. Eat bowl of jelly	2. Do 3 head stands	3. Make a paper plane that flies	4. Run around the Maths Block
E	3	14	0	12
F	0	0	0	2
G	3	0	6	0
H	0	6	3	3

Table 18

i. How can it be shown that the process is finished?

It takes min 4 lines to cross out all the zeros, and the matrix is 4x4.

/1

ii. Assign each team member to an activity.

Team Member	Activity
E	3
F	2
G	4
H	1

Table 19

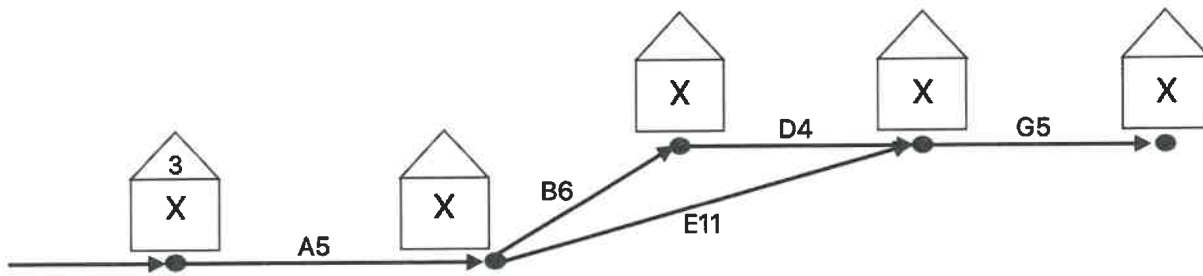
/2

Total Q30

/6

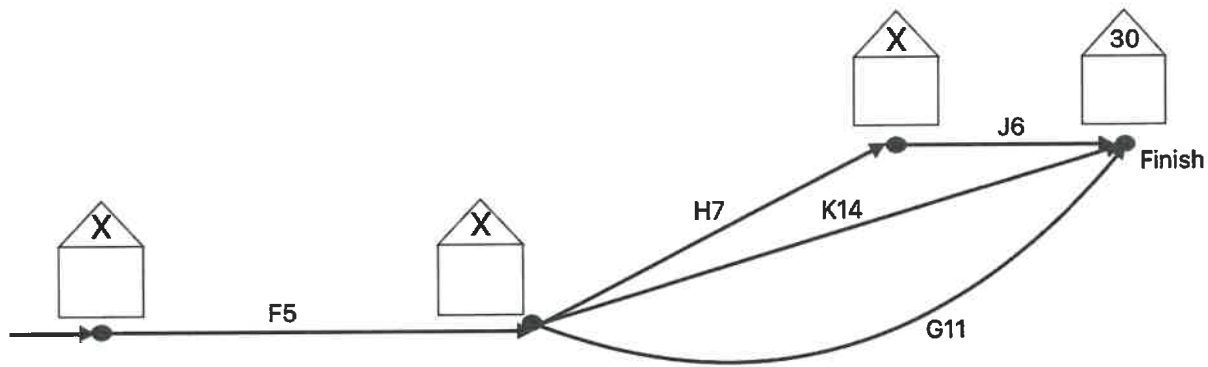
Spare Diagrams

Question 27 a)

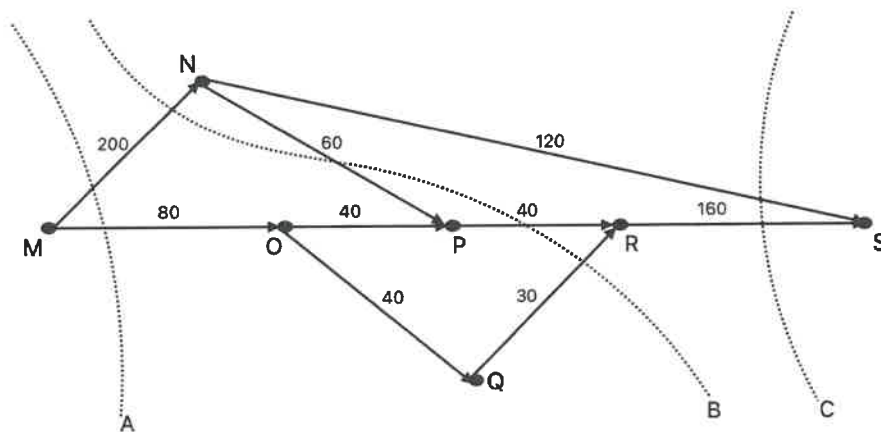


Question 27 b)

do we need fig 27 y figure 9 etc



Question 28 a)



Question 30 b)

Table 17 →

Part 2 – Trigonometry

Marker use

- Either answer **all** questions in this part **OR** all questions in Part 1.

Question 31 (approximately 7 minutes)

The diagram in Figure 14 represents a cliff top, a yacht on the water and a bird above.

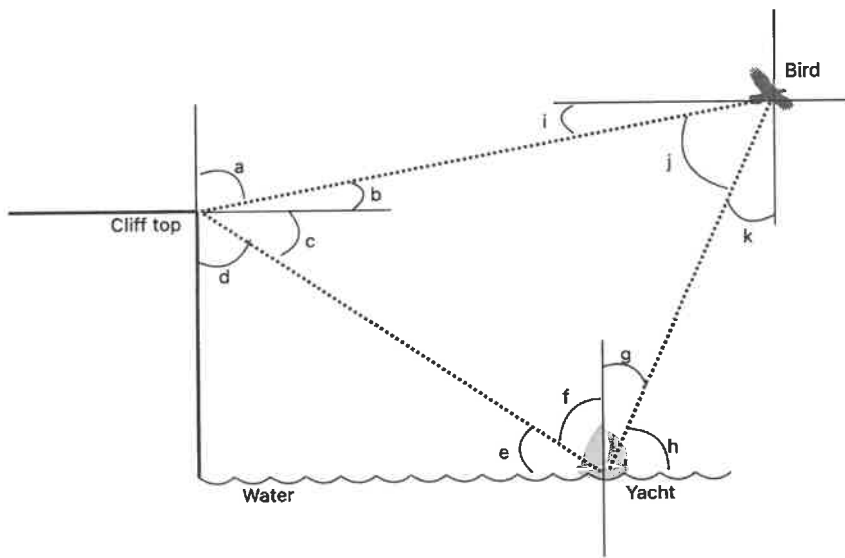


Figure 14: Diagram of a cliff top, a yacht on the water and a bird above.

a) Which letter on the diagram **best** represents:

- i. The angle of elevation of the bird from the cliff top?

b

/0.5

- ii. The angle of depression of the yacht from the cliff top?

c

/0.5

- iii. The angle of elevation of the bird from the yacht?

h

/0.5

- iv. The angle of depression of the cliff-top from the bird?

i

/0.5

Question 31 continues

Question 31 continued

Marker use

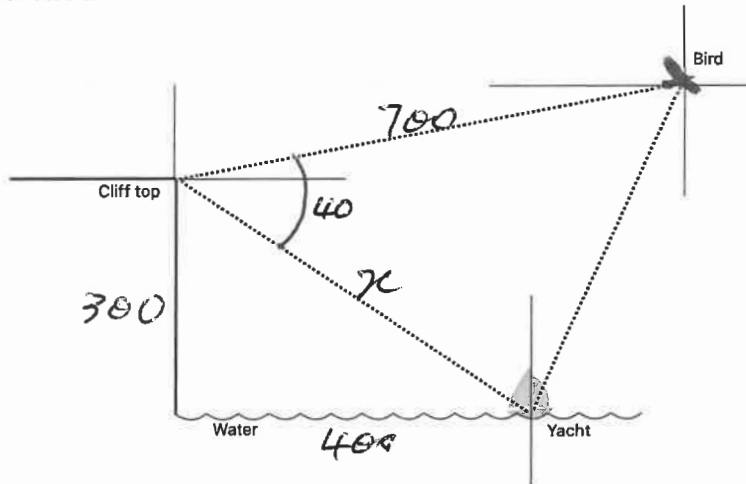


Figure 15: Diagram of cliff top, a yacht on the water and a bird above.

b) Using Figure 15 consider the triangle joining the cliff top, cliff base and the yacht.

- i. If the cliff is 300 m high, and the boat is 400 m from the base of the cliff, use Pythagoras' Theorem to find the straight line distance from the cliff top to the yacht.

/1

$$x = \sqrt{300^2 + 400^2}$$

$$= 500 \text{ m}$$

- ii. Find the angle, e , between the horizontal (water) side and the hypotenuse. Give your answer to 2 decimal places.

/2

$$\tan e = \frac{300}{400}$$

$$e = \tan^{-1}\left(\frac{3}{4}\right)$$

$$= 36.87^\circ$$

- c) If the bird is 700 m from the cliff top, the yacht is 500 m from the cliff top and the angles c and b add to 40° , find the area of the triangle joining cliff top, yacht and bird. (Include units in your answer.)

/2

$$\text{Area} = \frac{1}{2} ab \sin C$$

$$= \frac{1}{2} \times 700 \times 500 \times \sin 40$$

$$= 112\,487.8 \text{ m}^2$$

Total
Q31

/7

Question 32 (approximately 3 minutes)

Marker use

An archaeologist is trying to determine the location of a burial site (B) from diagrams in ancient documents. From one diagram they note the angle of elevation of the pyramid from a palace ruin (A) is 25° . From another diagram they can see that the angle of elevation of the pyramid from the burial site is 62° , and that the three features are in a straight line. The pyramid has a vertical height of 130m.

In Figure 16 the archaeologist has combined all this information.

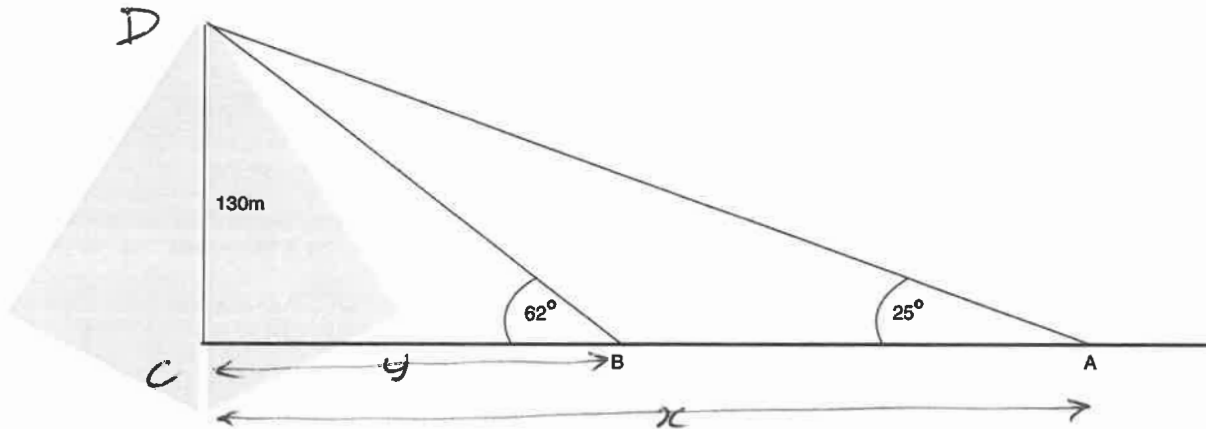


Figure 16: Archaeologist's diagram showing angles of elevation.

How far from the palace ruin should they dig to find the burial site?

$$\begin{aligned} \Delta ACD \quad \tan 25 &= \frac{130}{x} \\ x &= 130 / \tan 25 \\ &= 278.79 \end{aligned}$$

$$\begin{aligned} \Delta BCD \quad \tan 62 &= \frac{130}{y} \\ y &= 130 / \tan 62 \\ &= 69.12 \end{aligned}$$

$$x - y = \underline{\underline{209.67 \text{ m}}}$$

/3

Total
Q32

/3

Question 33 (approximately 6 minutes)

Marker use

A large ship (A) has been asked to direct a rescue boat (B) to the location of an overloaded drifting boat at (C), during the night. Figure 17 summarises this situation.

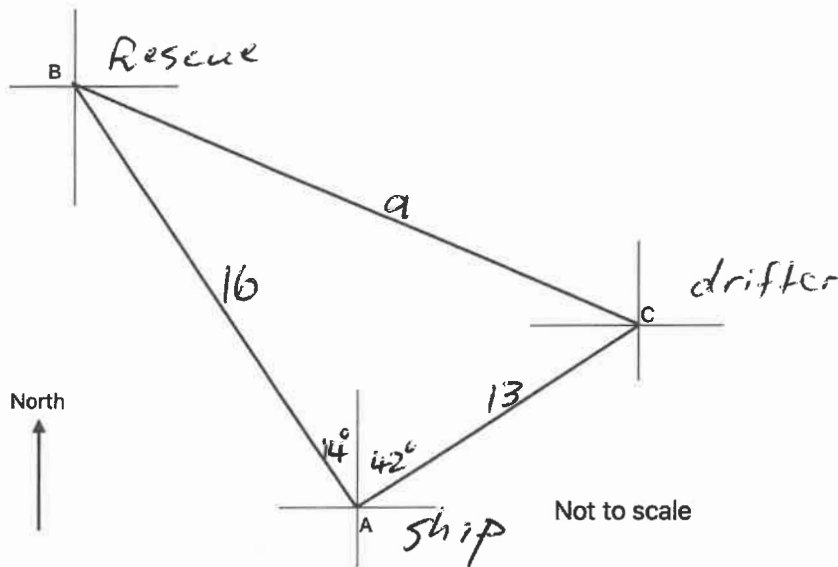


Figure 17: Diagram showing boat locations.

The ship advises: The rescue boat is 16 km from us (A) on a bearing of N14°W. The drifting boat is 13 km from us (A) on a bearing of N42°E.

- a) Find the distance from the rescue boat (B) to the drifting boat (C). Give your answer to 2 decimal places.

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$= 13^2 + 16^2 - 2 \times 13 \times 16 \cos 56$$

$$\therefore a = 13.87 \text{ km}$$

/2

- b) Find the bearing of the drifting boat (C), from the rescue boat (B).

$$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$$

$$= \frac{13.87^2 + 16^2 - 13^2}{2 \times 13.87 \times 16} = 0.629...$$

$$B = 50.99$$

$$\text{Bearing} = 180 - (50.99 + 14) = 115.01^\circ$$

$$\therefore 115^\circ \text{ T (or } 564.99^\circ \text{ E)}$$

/4

Total
Q33

/6

Question 34 (approximately 10 minutes)

Marker use

A yacht owner is planning to sail **due north** from East Cape (the Eastern tip of New Zealand) to Fiji, and then due west to Hinchinbrook Island (Queensland).

a) Consider the first leg of this trip.

i. Will travelling due north be the shortest route from East Cape to Fiji? Explain.

Yes. They will follow the line of longitude which is a Great Circle 1/2

ii. Find the distance they will sail, to the nearest km, using coordinates:

East Cape (38°S, 178°E), Fiji (18°S, 178°E).

$$\begin{aligned}d &= 2\pi R \frac{\theta}{360} \\ &= 2\pi \cdot 6371 \times \frac{38-18}{360} \\ &= 2223.90 \\ &= 2224 \text{ km}\end{aligned}$$
1/2

iii. The GPS coordinates of East Cape, the eastern tip of New Zealand, are (-37.6908, 178.5396). Convert these coordinates to longitude and latitude in degrees and minutes, rounding to the nearest whole minute. 1/2

$$\begin{aligned}0.6908 \times 60 &= 41 \\ 0.5396 \times 60 &= 32 \\ \therefore 37^\circ 41' \text{ S}, 178^\circ 32' \text{ E}\end{aligned}$$

Question 34 continues

Question 34 continued

Marker use

b) Consider the second leg of the trip: Due West from Fiji (F) (18°S , 178°E) to Hinchinbrook Island (H) (18°S , 146°E), (Queensland). See Figure 18.

i. Mark both places, F and H, on the diagram.

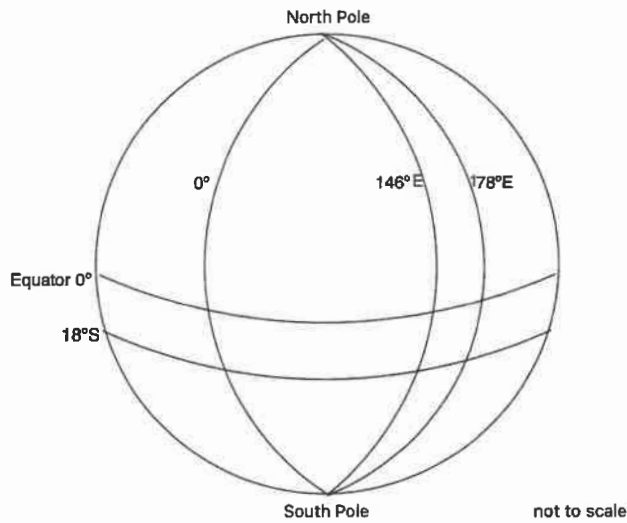


Figure 18: Diagram showing latitude and longitude.

Spare diagram used (X)

ii. Travelling directly west makes compass navigation easier but is not actually the shortest route. Explain why.

Because you follow a line of latitude, which is a small circle

iii. Find the distance they will travel on the second leg.

$$d = 2\pi R \frac{\theta}{360} \cos \phi$$

$$= 2\pi \times 6371 \times \frac{32}{360} \times \cos 18$$

$$= 3384 \text{ km}$$

/1

/1

/2

Total
Q34

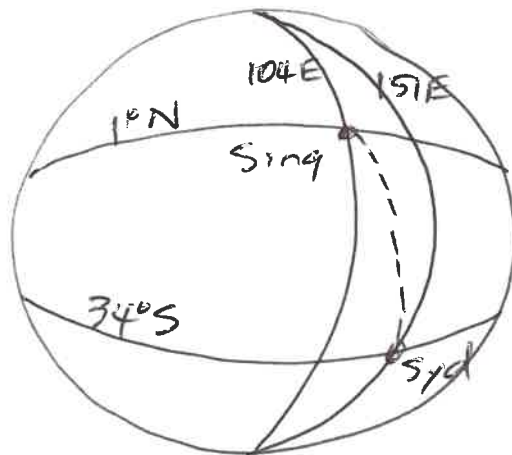
/10

Question 35 (approximately 3 minutes)

Marker use

Find the shortest distance between Sydney (34°S, 151°E) and Singapore (1°N, 104°E).

/3



$$\cos \theta = \sin(\text{lat } P) \sin(\text{lat } Q) + \cos(\text{lat } P) \cos(\text{lat } Q) \cos(\text{long diff})$$
$$= \sin(-34) \sin(1) + \cos(-34) \cos(1) \cos 47$$
$$= 0.555 \dots$$

$$\theta = \cos^{-1}(0.555 \dots) = 56.25^\circ$$

$$d = 2\pi R \frac{\theta}{360}$$
$$= 2\pi \times 6371 \times \frac{56.25}{360}$$

$$= 6255 \text{ km.}$$

Total
Q35

/3

Question 36 (approximately 7 minutes)

Marker use

A plane is to fly from Dubai to Singapore to Perth (WA).

- a) Find the time difference between Dubai (25°N, 55°E) and Perth (32 °S, 116 °E), showing working out and stating which city is ahead.

/2

$$D = \frac{55E}{15} \rightarrow UTC + 4$$

$$P = \frac{116E}{15} \rightarrow UTC + 8$$

Perth is 4 hrs ahead

- b) The Airbus 320 is one of the more common aircraft in international travel. It has an average flight speed of 840 km/h. Calculate the total flying time on the route Dubai, Singapore, Perth, if the distance is 9 745 km. Answer in hours and minutes correct to the nearest minute.

/2

$$SP = d/t$$

$$t = d/SP$$

$$= \frac{9745}{840}$$

$$= 11.601 \text{ hrs} = 11 \text{ h } 36 \text{ m}$$

- c) Strong winds extend flight times. The plane departs Dubai, and flies for 7 hours and 25 minutes to Singapore. It stops in Singapore for 3 hours then continues for 5 hours and 10 minutes to Perth, WA, arriving at 2 a.m. on the 10th of August. Find the time and date of departure from Dubai.

/3

$$\text{Arrival T} = \text{Dept T} + \text{travel time} \pm \text{time diff}$$

$$2 \text{ am } 10/8 = \text{Dept T} + 7:25 + 3 + 5:10 + 4$$

$$2 \text{ am } 10/8 = \text{Dept T} + 19:35$$

$$\text{Dept T} = 2 \text{ am } 10/8 - 24 + 4:25$$

$$= 2 \text{ am } 9/8 + 4:25$$

$$= 6:25 \text{ 9}^{\text{th}} \text{ August}$$

Total
Q36

/7

Question 34 b) i.

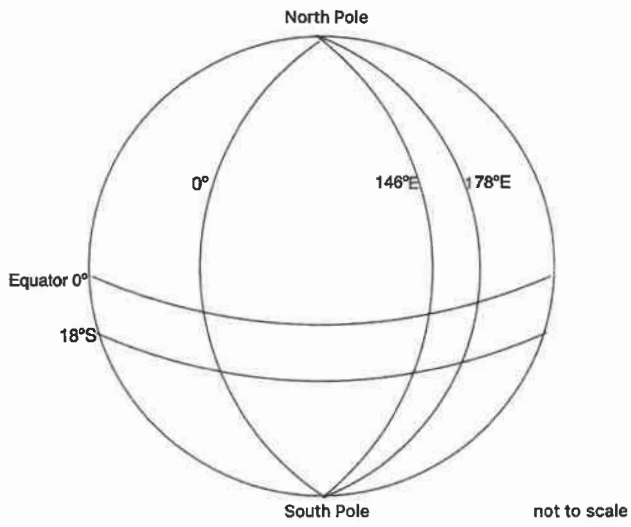


Figure 18

End of Section E
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