Specific instructions

This paper consists of a core and five modules. Students should answer **all** questions in the Core section and then select **three** modules and answer **all** questions within the modules selected.

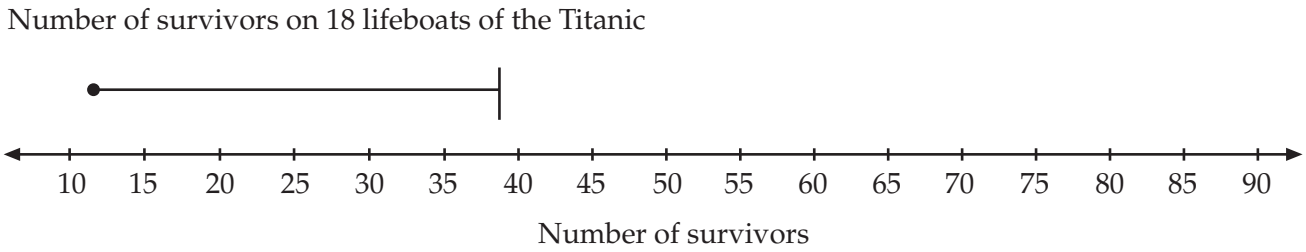
Core: Data analysis

Question 1

On 15th April 1912, the Titanic sank with 854 survivors aboard 18 out of the 20 lifeboats available. The number of survivors on each of the lifeboats were as follows:

12 26 27 28 39 40 41 42 44 50 55 56 56 63 64 70 70 71

a Complete the boxplot for the above data.



[2 marks]

b Complete the calculations for testing of outliers stating whether outlier(s) for the above data exist.

Interquartile Range =

Lower limit =

Upper limit =

[2 marks]

c Describe the distribution for the above boxplot.

[2 marks]

Question 2

The following is a table of survivors and deaths by class (1st, 2nd and 3rd) and group (male, female and child).

	Adult Male Survivors	Adult Male Deaths	Adult Female Survivors	Adult Female Deaths	Child Survivors	Child Deaths	Total Passengers by Class
1st Class	57	118	140	4	6	0	325
2nd Class	14	154	80	13	24	0	285
3rd Class	75	387	76	89	27	52	706
Totals	146	659	296	106	57	52	1316

From the above table, complete the following statements:

a From the groups male, female and child, the group that had the best survival rate was

_____

_____

[1 mark]

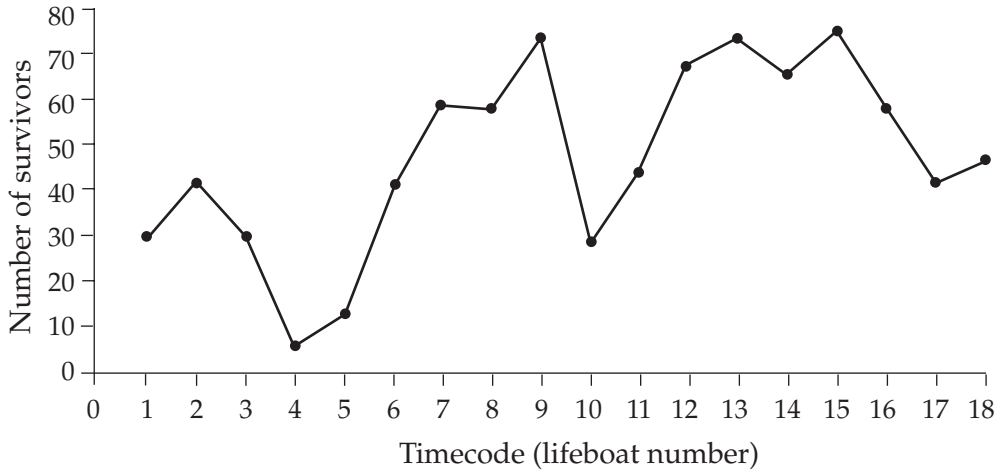
b For the males, the class with the worst survival rate was _____.

[1 mark]

Question 3

The eighteen lifeboats were launched in approximately 5 minute intervals starting at 12:45 a.m. The time series for the number of survivors launched every 5 minutes in a lifeboat is shown in the following graph.

Time series of number of survivors launched into 18 lifeboats



a What type of time series can best describe the number of survivors launched into lifeboats (labelled as 1 to 18) in 5 minute intervals?

[2 marks]

b The least square regression line without smoothing is given as

Number of survivors = 33 + 1.5 × Timecode (lifeboat number)

On the graph above, draw this line of best fit. [2 marks]

c Using the line of best fit from part **b**, determine how many more passengers could have been saved if the final two lifeboats had been used.

[3 marks]

Total: 15 marks

Module 1 : Number patterns and applications

Question 1

Morris writes poetry for a living. He prefers short poems himself but has been encouraged by his publisher to write poems that are progressively longer. He decides to write a new poem each Sunday that is 3 lines longer than the poem written the previous week. The first poem he writes under this arrangement is 4 lines in length.

a Write down the number of lines in each poem he writes for the first four Sundays.

[1 mark]

b Show that the terms found in part **a** form an arithmetic sequence.

[1 mark]

c Determine an expression for the n^{th} term of the sequence, t_n, in terms of n.

[2 marks]

d On one particular Sunday, Morris writes a poem he is particularly proud of entitled "In his own mind". If this poem has 100 lines, on which Sunday was it written?

[2 marks]

e After one year of writing (52 Sundays), determine the **total** number of lines of poetry that Morris has written.

[2 marks]

Question 2

Some time later, Morris considers an alternative arrangement. He decides that his first poem will contain 3 lines and that each new poem after the first will contain twice the number of lines of the previous poem plus an additional one line.

a A difference equation which describes this situation can be written as $t_n = at_{n-1} + b$ where $t_1 = c$.

Write down the values of a, b and c.

[2 marks]

b Determine the first four terms of the sequence generated by this difference equation. Show that the sequence is neither arithmetic nor geometric.

[2 marks]

c Using the formula provided on the formula sheet, show that the solution to the difference equation is given by $t_n = 4 \times 2^{n-1} - 1$.

[2 marks]

d Using the expression from part **c**, or otherwise, determine the 7^{th} term of the sequence.

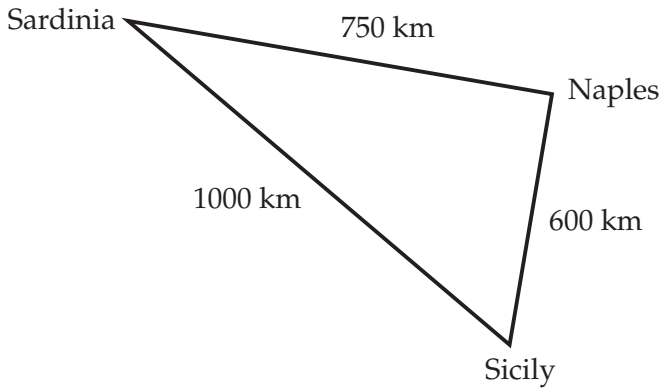
[1 mark]

Total: 15 marks

Module 2 : Geometry and trigonometry

Question 1

As part of an overseas trip that Mark is planning, he decides to spend a period of time in Italy. He will be based in Sicily but will regularly travel by ferry to Sardinia and Naples. Whilst investigating the geography, Mark draws a rough diagram. He is unsure of the distances between each of the places but has made the following estimates.



a Write down the name of a rule, which would enable any of the three angles in the triangle to be calculated.

[1 mark]

b Determine the angle at the port of Naples, i.e. between the 750 km and 600 km sides. Give your answer in degrees, correct to two decimal places.

[2 marks]

c Given that the angle in the triangle at the port of Sardinia is $36.72°$, calculate the remaining angle at the port of Sicily. Give your answer in degrees, correct to two decimal places.

[1 mark]

d Determine the area of the triangular region correct to the nearest hundred square kilometres.

[2 marks]

e To convert your answer in part **d** to square metres, by what factor must you multiply?

[1 mark]

f When Mark travels from Sardinia to Naples, the ferry sets out on a course of 103.28°.

Determine the bearing of Sicily from Sardinia giving your answer to the nearest degree.

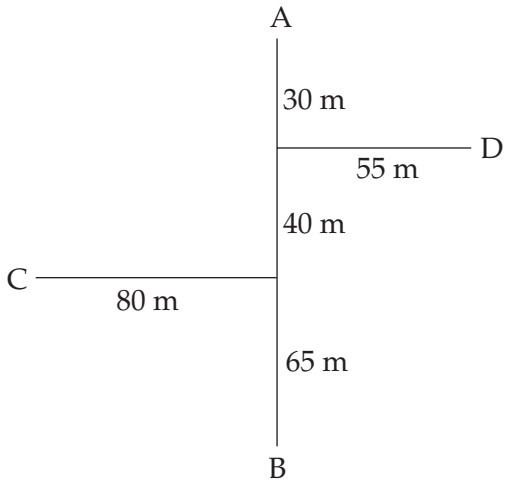
[1 mark]

g Using your result from part **f**, determine the bearing of Sardinia from Sicily. Give your answer to the nearest degree.

[2 marks]

Question 2

Whilst in the small town of Braidi in Sicily, Mark inspects an irregular shaped block of land where it is proposed that a hotel will be built. A traverse survey has been conducted and a field sketch made as shown. The line AB runs north-south.



a Using the surveyor's measurements, determine the distance from C to D. Give your answer, in metres, correct to one decimal place.

[2 marks]

b Determine the magnitude of angle ADB correct to the nearest degree.

[3 marks]

Total: 15 marks

Module 3 : Graphs and relations

Shannon operates a dog boarding kennel and he has found that most of the dogs he boards prefer a diet that is a mixture of soft food and dry food. He is endeavoring to provide this type of diet and is considering the protein and fat contents of two of these types of food:

The soft food contains 50 grams of protein and 50 grams of fat per kilogram and costs $1.50 per kilogram.

The dry food contains 250 grams of protein and 150 grams of fat per kilogram and costs $5.00 per kilogram.

He typically boards 25 medium-sized dogs per day and he estimates that each dog requires at least 30g of protein and 24g of fat each day.

Shannon has also decided that each dog is to have no less than 200g of soft food, and no less than 50g of dry food, each day.

Let x be the number of kilograms of soft food that is needed to feed 25 medium-sized dogs each day.

Let y be the number of kilograms of dry food that is needed to feed 25 medium-sized dogs each day.

Question 1

a **i** If each dog is to have at least 200g of soft food per day, write down the least amount of soft food, in kilograms, that is required for the 25 dogs each day.

_____

[1 mark]

ii In the space provided write the constraint on x associated with the least amount of soft food needed.

Constraint 1 [ ]

[1 mark]

A constraint associated with the least amount of dry food that is needed to feed the 25 dogs is :

Constraint 2 [$y \geq 1.25$]

The constraint associated with the protein requirements for the dogs is

Constraint 3 [$50x + 250y \geq 30 \times 25$]

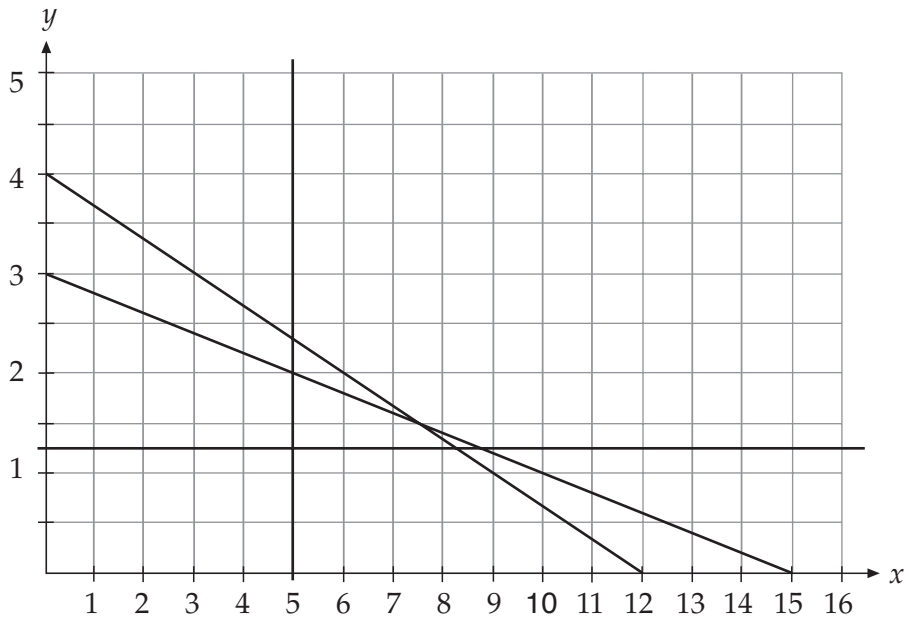
This constraint can be simplified to $x + 5y \geq 15$

b In the space provided below, write down the constraint associated with the fat requirements of the 25 dogs each day. It is not necessary to simplify this expression.

Constraint 4

[2 marks]

On the set of axes below the boundary lines for the four constraints have been drawn.



Question 2

a Indicate clearly, on the set of axes, the region that satisfies the four constraints. [2 marks]

b Find the co-ordinates of all the extreme points in your feasible region.

[3 marks]

Shannon is keen to minimize the cost of the food that he provides to the dogs.

The soft food costs \$1.50 per kilogram and the dry food costs \$5.00 per kilogram.

Question 3

a Write down the objective function for the cost, \$C, of the food.

[1 mark]

b Find the quantity of soft and dry food that will give the minimum cost of feeding the 25 dogs.

[2 marks]

c Using the combination of soft and dry food that you found in part **3b** calculate, to the nearest cent, the cost of feeding one of the dogs per day.

[1 mark]

Question 4

Shannon has found that his overhead costs for running the boarding kennel are $207 per day **plus** 80 cents for food for each dog per day. He has found that the business breaks-even if he has 15 dogs boarded.

Use this information to calculate the amount that Shannon is charging to board a dog for the day.

[2 marks]

Total: 15 marks

Module 4 : Business-related mathematics

Mario owns two properties. One is his place of residence and the other is an investment unit. He is selling both of these properties so that he can buy another larger house to use as his place of residence.

Question 1

a He sells his present place of residence for $286 000 and is charged $6 149 in selling fees by the real estate agent.

Calculate the percentage of the selling price that he is paying as selling fees to the estate agent. Give your answer correct to two decimal places.

[1 mark]

b When Mario sold his investment property he made a capital gain of $80 000.

He will need to pay capital gains tax on **half** of the capital gain at the rate of 47%.

Calculate the amount of capital gains tax that Mario will need to pay.

[1 mark]

c Mario bought his new house for $564 000 and will need to pay stamp duty to the State Government on this amount.

Stamp duty is calculated using:

For properties with a value between $115 001 and $870 000:
$2 560 plus 6% of the value in excess of $115 000

Calculate the amount of stamp duty that Mario will need to pay on the purchase of his new property.

[2 marks]

Question 2

When Mario had paid all his debts and charges on the exchange of his properties he found that he still needed to borrow $220 000.

The bank has offered him a reducing balance loan charging 6.48% p.a. with payments over twenty-five years.

Monthly repayments can be determined using the annuities formula:

$$A = PR^n - \frac{Q(R^n - 1)}{R - I}$$

a What values of R and n should be substituted into the annuities formula to determine the monthly payments?

$R =$ $\quad$ $n =$

[2 marks]

b Calculate the monthly repayment amount that Mario will pay if he repays this loan with monthly payments over twenty-five years. Give your answer to the nearest cent.

[1 mark]

c Mario is interested to know the effect of a 1% interest rise on his repayments.

Calculate the extra amount that Mario will pay per month, over the twenty-five years of the loan, if the interest rate increases from 6.48% to 7.48%. Give your answer to the nearest cent.

[2 marks]

d Mario prefers to repay the loan with fortnightly payments, so he is going to pay $750 per fortnight (26 payments per year).

If the interest rate remains at 6.48% for the term of the loan how long will it take to repay the loan? Give your answer in years correct to one decimal place.

[2 marks]

Question 3

Mario intends to buy a new car that has a cost price of $32 500 and he plans to keep it for three years.

He is considering a lease arrangements that requires him to pay $128 per week and after the three years the value of the car will have reduced by $16 500.

a Calculate the total amount of interest that he will pay over the three years.

[1 mark]

b Calculate the annual flat rate of interest being charged in this lease arrangement. Give your answer correct to two decimal places.

[1 mark]

c Calculate the effective rate of interest for this lease arrangement. Give your answer correct to one decimal place.

[2 marks]

Total: 15 marks

Module 5 : Networks and decision mathematics

Question 1

a Construct a network diagram, which represents the following school computer system.

- 2 computer room servers, A and B, are connected to each other.
- Computers C, D, E and F are in the first computer room connected to server A.
- Computers G, H and I are in the second computer room connected to server B.
- 2 printers with printer J connected to server A and printer K connected to computer G.
- Scanner L is connected to computer D.

[2 marks]

b Suggest a pathway for a printout from computer H.

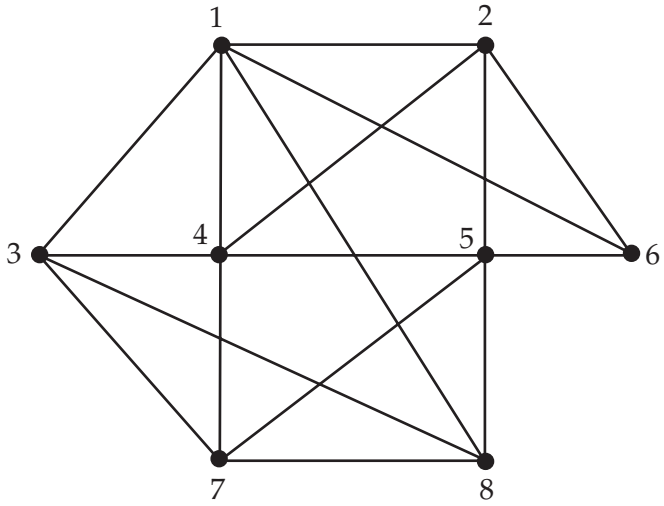
_____

_____

[1 mark]

Question 2

Eight computers are connected via underground cable, as shown in the figure below. Due to considerations of signal interference the cables must be moved so that none of the cables cross each other. **The computers are not to be moved**.



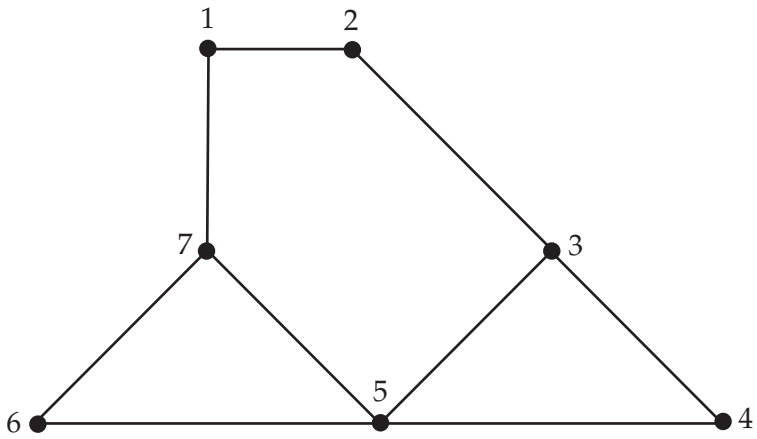
a Redraw the above network so that no cables cross each other.

[2 marks]

b What kind of graph is this now? _____ [1 mark]

Question 3

Consider this network. An Euler **path** needs to be found.



a Which vertex should be the start vertex (may be more than one)?

[1 mark]

b Which vertex should be the end vertex?

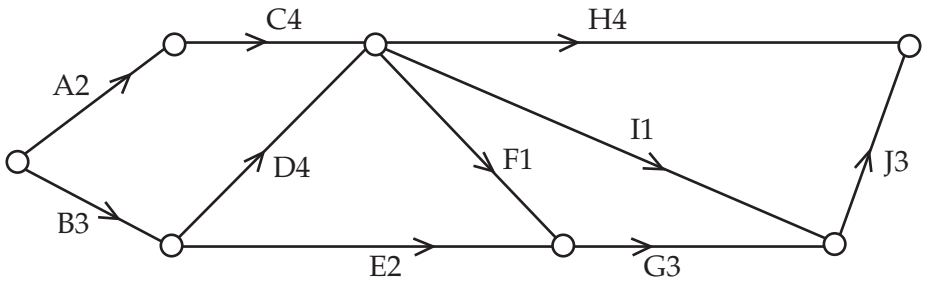
[1 mark]

c Determine an Euler path.

[1 mark]

Question 4

Consider the network shown in the figure below. It represents the data of an activity table for the construction of a new major residential development, with activities A, B, C … and their duration times (in weeks).



a Determine the immediate predecessor(s) for each activity and complete the table below.

Activity	Immediate Predecessor(s)
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	

[2 marks]

b Determine the earliest completion time for the entire project.

[1 mark]

c Determine the critical path.

[1 mark]

d Determine the float times for any non-critical activities.

[2 marks]

Total: 15 marks