Student's Name:

Student Number: $\square$


## Teacher's Name:

## ABBOTSLEIGH

## 2020 <br> HIGHER SCHOOL CERTIFICATE Trial Examination

## Mathematics Standard 2

## General Instructions

- Reading time - 10 minutes.
- Working time -2 hours and 30 minutes
- Write using black pen.
- NESA approved calculators may be used.
- NESA approved reference sheet is provided.
- All necessary working should be shown in every question to gain full marks.
- Make sure your Student Number is on the front cover of each section.
- Answer the Multiple-Choice questions on the answer sheet provided.
- In Questions 16-20, show relevant mathematical reasoning and/ or calculations.

Total marks - 100

- Attempt Sections I and II.


## Section I

Pages 3-12

## 15 marks

- Attempt Questions 1-15
- Allow about 25 minutes for this section.


## Section II

Pages 13-42

## 85 marks

- Attempt Questions 16-20
- All questions are of equal value
- Allow about 2 hours and 5 minutes for this section.


## Outcomes to be assessed:

## Standard 2 Mathematics:

## Preliminary Outcomes:

MS11-1 uses algebraic and graphical techniques to compare alternative solutions to contextual problems
MS11-2 represents information in symbolic, graphical and tabular form
MS11-3 solves problems involving quantity measurement, including accuracy and the choice of relevant units
MS11-4 performs calculations in relation to two-dimensional and three-dimensional figures
MS11-5 models relevant financial situations using appropriate tools
MS11-6 makes predictions about everyday situations based on simple mathematical models
MS11-7 develops and carries out simple statistical processes to answer questions posed
MS11-8 solves probability problems involving multistage events
MS11-9 uses appropriate technology to investigate, organise and interpret information in a range of contexts

## HSC Outcomes:

MS2-12-1 uses detailed algebraic and graphical techniques to critically evaluate and construct arguments in a range of familiar and unfamiliar contexts
MS2-12-2 analyses representations of data in order to make inferences, predictions and draw conclusions
MS2-12-3 interprets the results of measurements and calculations and makes judgements about their reasonableness, including the degree of accuracy and the conversion of units where appropriate
MS2-12-4 analyses two-dimensional and three-dimensional models to solve practical problems
MS2-12-5 makes informed decisions about financial situations, including annuities and loan repayments
MS2-12-6 solves problems by representing the relationships between changing quantities in algebraic and graphical forms
MS2-12-7 solves problems requiring statistical processes, including the use of the normal distribution and the correlation of bivariate data
MS2-12-8 solves problems using networks to model decision-making in practical problems
MS2-12-9 chooses and uses appropriate technology effectively in a range of contexts, and applies critical thinking to recognise appropriate times and methods for such use

## SECTION I

15 marks
Attempt Questions 1-15
Use the multiple-choice answer sheet
Select the alternative $A, B, C$ or $D$ that best answers the question. Fill in the response oval completely.
Sample $2+4=$
(A) 2
(B) 6
(C) 8
(D) 9
(A)
(B)
(C) $\bigcirc$
(D) $\bigcirc$

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.
(A)
(B)
(C) $\bigcirc$
(D) $\bigcirc$

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word correct and drawing an arrow as follows.
(A)

(B)

(C) correct
(D) $\bigcirc$

1. The following symbol is used on the floor plan of a 4 bedroom house.


In which room of the house floor plan is this symbol likely to be seen?
A. Kitchen
B. Dining room
C. Bathroom
D. Bedroom
2. Katie has a resting heart rate of 50 beats/minute. When exercising it increases to 80 beats/minute. How many more times would her heartbeat in five minutes when exercising, compared to when resting?
A. 150
B. 160
C. 180
D. 200
3. The table shows income tax payable.

| Taxable income | Tax on this income |
| :--- | :--- |
| $0-\$ 18,200$ | Nil |
| $\$ 18,201-\$ 37,000$ | 19 c for each $\$ 1$ over $\$ 18,200$ |
| $\$ 37,001-\$ 87,000$ | $\$ 3,572$ plus 32.5 c for each $\$ 1$ over $\$ 37,000$ |
| $\$ 87,001-\$ 180,000$ | $\$ 19,822$ plus 37 c for each $\$ 1$ over $\$ 87,000$ |
| $\$ 180,001$ and over | $\$ 54,232$ plus 45 c for each $\$ 1$ over $\$ 180,000$ |

John's taxable income is $\$ 102000$. What is the tax payable on John's income?
A. $\$ 5550$
B. $\$ 19822$
C. $\$ 25372$
D. $\$ 37740$
4. Tom works in a restaurant and below is his wage sheet for last week.

| Employee | Hourly <br> Rate | Normal hours <br> worked | Double hours <br> worked |
| :---: | :---: | :---: | :---: |
| Tom | $\$ 22$ | $x$ | 5 |

If his total wage for last week was $\$ 770$, what is the value of $x$ ?
A. 20
B. 25
C. 30
D. 35
5. In the following graph, which vertex has the largest degree?

A. $A$
B. $B$
C. $C$
D. $D$
6. Tania lives in New York, USA (UTC -5) and Margaret lives in Sydney, NSW (UTC +10).

Margaret makes a call to Tania at $12: 30 \mathrm{pm}$ on Wednesday $26^{\text {th }}$ February.

February is a month when NSW has daylight saving time and the USA does not.

What is the time in New York when Tania receives the call?
A. $\quad 2: 30$ am Thursday $27^{\text {th }}$ February
B. $4: 30$ am Thursday $27^{\text {th }}$ February
C. $10: 30 \mathrm{pm}$ Tuesday $25^{\text {th }}$ February
D. $\quad 8: 30 \mathrm{pm}$ Tuesday $25^{\text {th }}$ February
7. The activity chart below shows the immediate prerequisite(s) and duration for each activity in a project.

| Activity | Immediate Prerequisites | Time (days) |
| :---: | :--- | :---: |
| A | - | 2 |
| B | A | 3 |
| C | A | 3 |
| D | B, C | 3 |
| E | A | 5 |
| F | B, C | 8 |
| G | D, E | 4 |
| H | F, G | 2 |

Which network could be drawn from the activity chart?
A.

B.

C.

D.

8. The formula below gives the blood alcohol concentration for a male.

$$
B A C_{\text {Male }}=\frac{10 \mathrm{~N}-7.5 \mathrm{H}}{6.8 M}
$$

where $N$ is the number of standard drinks consumed, $H$ is the number of hours of drinking, and $M$ is the person's weight in kilograms. Harry weighs 80 kg and consumes 6 standard drinks in 3 hours. What is his BAC, correct to 1 significant figure?
A. 0.04
B. 0.05
C. 0.06
D. 0.07
9. Sally is concerned about the parrot population in her town. She gathers 170 parrots and tags them. A couple of months later she gathers 32 parrots and finds 10 of them tagged.

What is Sally's estimate of the parrot population?
A. 588
B. 572
C. 544
D. 524
-10. The triangle shown has one angle of $127^{\circ}$ and another of $18^{\circ}$.


What is the length of $C E$, correct to the nearest whole number?
A. 10
B. 31
C. 39
D. 67
11. The scale on an aerial photograph is given as $1 \mathrm{~mm}=200 \mathrm{~m}$.

If the length of land is 1350 m , then the length on the map between these points would be?
A. $\quad 1.48 \mathrm{~mm}$
B. $\quad 6.75 \mathrm{~mm}$
C. $\quad 6.75 \mathrm{~cm}$
D. $\quad 14.8 \mathrm{~cm}$
12. On a recent assessment task, the results were normally distributed.

Rob achieved a score of $68 \%$ with a $z$-score of 0.5 and Steve achieved a score of $82 \%$ with a $z$-score of 2.25 on the task. What was the mean (\%) score?
A. 64
B. 62
C. 60
D. 58
13. Kathy plans on switching to a new internet provider that helps her save $\$ 50$ on expenses every month. Her contract is set for 5 years and the interest rate is $6 \%$ per annum. Using Microsoft Excel how would she calculate the present value?
A. $=P V(0.06,5,-50)$
B. $=P V(0.005,5,-50)$
C. $=\operatorname{PV}(0.005,60,-50)$
D. $=P V(0.06,60,-50)$
14. The spinner shown contains equal sized sections labelled with the numbers from 1 to 5 .


| Outcome | Frequency |
| :---: | :---: |
| 1 | 19 |
| 2 | 21 |
| 3 | 25 |
| 4 | 15 |
| 5 | 20 |

The table represents the outcomes of an experiment involving 100 spins.

When considering the probability of the outcome being an even number, which of the following statements is correct?
A. The theoretical probability is the same as the relative frequency.
B. The theoretical probability is greater than the relative frequency.
C. The theoretical probability is less than the relative frequency.
D. The theoretical probability cannot be determined from the information given.
15. The capacity of a cone with a height of 25 cm is 2 litres.

Find the radius ( $r$ ) of the circular base, in centimetres correct to 2 decimal places.

A. $\quad 2.76 \mathrm{~cm}$
B. $\quad 5.05 \mathrm{~cm}$
C. $\quad 8.74 \mathrm{~cm}$
D. $\quad 76.39 \mathrm{~cm}$

## End of Section I

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|  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Student Number |  |

## Section II

85 marks<br>Attempt Questions 16-20<br>Allow about 2 hours and 5 minutes for this section

Answer the questions in the spaces provided.
These spaces provide guidance for the expected length of response.

Your responses should include relevant mathematical reasoning and/or calculations.

Extra writing space is provided on pages 18, 24, $30,35,41$. If you use this space, clearly indicate which question you are answering.

## Question 16 (17 marks)

(a) The ratio of trees to shrubs in a park is 2:7. If there are 14 trees, how many shrubs are there?
(b) The network diagram shows seven campsites, $F, G, H, I, J, K$ and $L$, which are joined by tracks. The numbers next to the paths show lengths (in km ) of that section of track.

(i) On the above diagram highlight the minimum spanning tree of the network.
(ii) A telephone cable is to be laid along as few of the existing tracks as possible. What is the minimum length of cable necessary to complete this task?
$\qquad$
$\qquad$
$\qquad$

## Question 16 continued on page 15

## Question 16 (continued)

(c) A solar panel system exports 21.4 kWh per day of energy to the grid. An energy retailer pays $\$ 0.079$ per kWh for energy. What is the expected saving from the solar panel system for the year? Answer correct to the nearest cent.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
(d) The number of students absent from year 12 for the past nine days was as follows:

$$
17,23,20,21,16,15,32,18,21
$$

(i) What is the mean? Give your answer correct to one decimal place.
$\qquad$
(ii) Find the interquartile range.
$\qquad$
$\qquad$
(iii) Is 32 an outlier for this set of data? Justify your answer with calculations.
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Question 16 (continued)

(e) The speeds of a vehicle are shown in the cumulative frequency histogram below.

(i) What is the frequency of $75 \mathrm{~km} / \mathrm{h}$ ?
$\qquad$
$\qquad$
(ii) Construct a cumulative frequency polygon (or ogive) on this graph.
(iii) Use the graph to estimate the median.
$\qquad$
$\qquad$
$\qquad$

## Question 16 (continued)

(f) Tran's industrial unit produces aluminium rods. In the past week the industrial unit has produced aluminium rods with a mean weight of 12.5 kilograms and a standard deviation of 0.5 kilograms.
(i) Quality control requires any aluminium rod with a $z$-score less than -1 to be rejected. What is the minimum weight that will be accepted?
$\qquad$
$\qquad$
(ii) Aluminium rods with a $z$-score greater than 2 are also rejected.

What is the maximum weight that will be accepted?
$\qquad$
$\qquad$
(g) Kiara takes out a loan for $\$ 58000$ at an interest rate of $6 \%$ per annum compounding monthly.

Using the recurrence relation $V_{n+1}=V_{n} \times(1+r)-D$, determine the balance of the loan after 2 months.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
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$\qquad$

## End of Question 16

## Section II Extra writing space

If you use this space, clearly indicate which question you are answering.

|  |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

(a) The graph below shows the line $y=3 x-3$.

(i) On the same set of axes, draw the line $y=7-2 x$.
(ii) What is the solution to the simultaneous equations below?

$$
\begin{aligned}
& y=3 x-3 \\
& y=7-2 x
\end{aligned}
$$

(b) Calculate the percentage error in a measurement of 2.75 metres.

Give your answer correct to 2 decimal places.
$\qquad$
$\qquad$
$\qquad$

## Question 17 (continued)

(c) In a board game there are 50 cards in a pile which are picked up two at a time by the players. Of these cards, 20 have a good outcome for the player, 16 have a bad outcome and the remainder have neutral outcomes.

(i) Complete the three missing probabilities on the tree diagram above for the first player's draw from the deck.
(ii) What is the probability that the first two cards drawn are both neutral outcomes?
$\qquad$
$\qquad$
(iii) What is the probability that the first two cards drawn are NOT both neutral outcomes?
$\qquad$
$\qquad$

## Question 17 (continued)

(d) The Home Furniture Company makes an occasional chair that they sell to stores.

The lines on the set of axes below shows the cost of manufacturing and purchasing up to 12 chairs on a given day. The graphs are drawn as continuous lines, for convenience.

(i) What is the equation of the line representing the cost of manufacture?
(ii) How many chairs need to be sold to break even?
(iii) What is the profit made when 10 chairs are sold?

## Question 17 (continued)

(e) The table below gives the future value of an annuity of $\$ 1$ per period for various periods and interest rates.

| Table of Future Value Interest Factors |  |  |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $n \quad r$ | 0.0025 | 0.0030 | 0.0035 | 0.0040 | 0.0045 | 0.0050 | 0.0055 | 0.0060 |
| 53 | 56.5961 | 57.3530 | 58.1230 | 58.9063 | 59.7033 | 60.5141 | 61.3391 | 62.1785 |
| 54 | 57.7376 | 58.5250 | 59.3264 | 60.1419 | 60.9719 | 61.8167 | 62.6765 | 63.5516 |
| 55 | 58.8819 | 59.7006 | 60.5340 | 61.3825 | 62.2463 | 63.1258 | 64.0212 | 64.9329 |
| 56 | 60.0291 | 60.8797 | 61.7459 | 62.6280 | 63.5264 | 64.4414 | 65.3733 | 66.3225 |
| 57 | 61.1792 | 62.0624 | 62.9620 | 63.8786 | 64.8123 | 65.7636 | 66.7329 | 67.7204 |
| 58 | 62.3322 | 63.2485 | 64.1824 | 65.1341 | 66.1040 | 67.0924 | 68.0999 | 69.1267 |
| 59 | 63.4880 | 64.4383 | 65.4070 | 66.3946 | 67.4014 | 68.4279 | 69.4744 | 70.5415 |
| 60 | 64.6467 | 65.6316 | 66.6359 | 67.6602 | 68.7047 | 69.7700 | 70.8565 | 71.9647 |
| 61 | 65.8083 | 66.8285 | 67.8692 | 68.9308 | 70.0139 | 71.1189 | 72.2463 | 73.3965 |
| 62 | 66.9729 | 68.0290 | 69.1067 | 70.2065 | 71.3290 | 72.4745 | 73.6436 | 74.8369 |
| 63 | 68.1403 | 69.2331 | 70.3486 | 71.4874 | 72.6499 | 73.8368 | 75.0487 | 76.2859 |
| 64 | 69.3106 | 70.4408 | 71.5948 | 72.7733 | 73.9769 | 75.2060 | 76.4614 | 77.7436 |
| 65 | 70.4839 | 71.6521 | 72.8454 | 74.0644 | 75.3098 | 76.5821 | 77.8820 | 79.2101 |
| 66 | 71.6601 | 72.8670 | 74.1004 | 75.3607 | 76.6487 | 77.9650 | 79.3103 | 80.6854 |

(i) Alice invests $\$ 600$ per month in an annuity which pays $4.2 \%$ p.a. compounding monthly. What will be the value of the annuity after 62 months?
$\qquad$
$\qquad$
(ii) An annuity has a value of $\$ 49738$ after being invested for five and a half years at a rate of $4.8 \%$ p.a. compounded monthly. How much was invested in the annuity each month?
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Question 17 (continued)

(f) In the diagram below, $T V=7.5 \mathrm{~m}, V U=4.8 \mathrm{~m}$ and $T U=10.4 \mathrm{~m}$.


Use the cosine rule to calculate the size of $\angle T V U$ correct to the nearest degree.
$\qquad$
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$\qquad$
$\qquad$
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$\qquad$
$\qquad$

## Section II Extra writing space

If you use this space, clearly indicate which question you are answering.
(a) Amanda and Kylie are twins and are given $\$ 2000$ each by their grandparents for their $18^{\text {th }}$ birthdays. On the day after their birthday, they both invest their money.
(i) Amanda uses her $\$ 2000$ to buy a piece of antique jewellery which is predicted to appreciate at $6 \%$ p.a. What is the expected value of the jewellery after 6 years?
$\qquad$
$\qquad$
$\qquad$
(ii) Kylie invests her $\$ 2000$ in shares which cost $\$ 8.00$ each and are predicted to pay a dividend of 60 cents per share, once each year. The dividends are paid into a transaction account which pays no interest.
Whose investment will be worth more after 6 years, and by how much?
$\qquad$
$\qquad$
$\qquad$
$\qquad$
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## Question 18 continued

(b) Short of time in the morning, a student gets a coffee and muffin on their way to school. On average, a coffee and a muffin give 506 kJ and 447 kJ of energy respectively.
(i) If it takes the student 5 minutes of running to burn off 146 kJ of energy, how many minutes will the student need to run to consume the energy from the coffee and muffin? Round your answer to the nearest whole minute.
$\qquad$
$\qquad$
$\qquad$
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$\qquad$
(ii) The conversion rate between calories and kilojoules is 1 calorie $=4.184$ kilojoules. Determine the number of calories in the coffee, giving your answer correct to four significant figures.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Question 18 continued

(c) Miriam bought a car for $\$ 32000$ on $31^{\text {st }}$ January 2016.

It depreciates at a rate of $20 \%$ p.a. using the declining-balance method.
(i) What was the value of the vehicle on $31^{\text {st }}$ January 2019?
$\qquad$
$\qquad$
$\qquad$
(ii) How much will the value of the vehicle drop between $31^{\text {st }}$ January 2019 and $31^{\text {st }}$ January 2020?
$\qquad$
$\qquad$
$\qquad$
(d) The ages of the residents who live in Hudson Creek are normally distributed.

The mean age is 56 years and the standard deviation is 14 . If there are 1400 residents in Hudson Creek, how many are younger than 70?
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Question 18 continued

(e) Adam completes a survey of trip times (in minutes) for commuters using two different methods of transport.

A five-number summary of his results for train commuters are shown below.
Train Commuters five-number summary: $19,26,35,50,75$
A box and whisker plot for his results for car commuters is shown below.

(i) On the grid above, draw a box and whisker plot for the Train Commuters.
(ii) By comparing two statistical measures or features that can be found from the two plots, compare the data for the two types of transport.
$\qquad$
$\qquad$
$\qquad$
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$\qquad$

## Question 18 continued

(f) Two buildings, called $M$ and $X$, are situated 56 metres apart on level ground.

From point $C$, the angle of elevation of point $A$ is $57^{\circ}$.
From point $B$, the angle of depression of point $A$ is $34^{\circ}$.


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Calculate the height of Building $M$ (correct to 1 decimal place).
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$\qquad$
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$\qquad$
$\qquad$
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## Section II Extra writing space

If you use this space, clearly indicate which question you are answering.
(a) A bulk gas container consists of a cylindrical section topped with a hemisphere.

It is made entirely of sheet metal, including the circular base of the cylinder.


Calculate the area of sheet metal needed to manufacture the container.
Give your answer correct to the nearest square metre.
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Question 19 continued

(b) The cost of preparing meals in a school canteen is linearly related to the number of meals prepared. To help the caterers predict the costs, data was collected on the cost of preparing meals for different levels of demand. The data is shown below.

| Number $($ n $)$ (meals) | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Cost $($ C $)$ (dollars) | 138 | 154 | 159 | 182 | 198 | 198 | 214 | 208 | 238 | 234 | 244 |

(i) Calculate the value of the Pearson's correlation coefficient.

Give your answer correct to four decimal places.
(ii) Using your answer from (i) describe the relationship between the number of meals and the cost in dollars.
$\qquad$
$\qquad$
(iii) Using your calculator find the equation of the least-squares line of best fit. Answer correct to one decimal place.
$\qquad$
$\qquad$
(iv) What is the predicted cost of producing 48 meals?
$\qquad$
$\qquad$
(v) Matthew would like to predict the cost of 120 meals. Would he be interpolating or extrapolating? Justify your answer.
$\qquad$
$\qquad$
$\qquad$

## Question 19 continued

(c) A radial survey of a field is shown.

(i) Find the size of $\angle P O Q$.
(ii) What is the length of $P Q$, correct to the nearest metre?
$\qquad$
$\qquad$
$\qquad$
$\qquad$
(iii) The triangular area $R O Q$ is going to be planted with barley.

What is the size of this area, correct to three decimal places?
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Question 19 continued

(d) Shannon owns a credit card that has no annual fees and charges $18.82 \%$ per annum compound interest on all purchases. The interest is charged daily from the day of purchase and includes the day of payment.
(i) Show that the daily interest rate is $0.052 \%$.
(ii) On the $23^{\text {rd }}$ of March, Shannon bought a painting for $\$ 580$ using her credit card. She paid her credit card account on the $15^{\text {th }}$ of April.

Calculate the total amount Shannon paid for the painting, including interest, correct to the nearest cent.
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$\qquad$
$\qquad$
$\qquad$
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$\qquad$

## End of Question 19

## Section II Extra writing space

If you use this space, clearly indicate which question you are answering.

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| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

(a) The table below shows the present value interest factors for some monthly interest rates and loan periods in months.

| Present value of \$1 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Period | 0.0060 | 0.0065 | 0.0070 | 0.0075 |  |
| 46 | 40.09350 | 39.64965 | 39.21263 | 38.78231 |  |
| 47 | 40.84841 | 40.38714 | 39.93310 | 39.48617 |  |
| 48 | 41.59882 | 41.11986 | 40.64856 | 40.18478 |  |
| 49 | 42.34475 | 41.84785 | 41.35905 | 40.87820 |  |

Terri borrows $\$ 36000$ for a car. She arranges to repay the loan with monthly repayments over 4 years. She is charged $7.8 \%$ per annum interest.
(i) Find Terri's monthly repayment. Answer correct to the nearest cent.
(ii) Calculate the amount of interest Terri will pay over the term of the loan.

Answer correct to the nearest dollar.
$\qquad$
$\qquad$
$\qquad$
$\qquad$

## Question 20 continues on page 38

## Question 20 continued

(b) The cross-section of a piece of artwork is shown below.


The trapezoidal rule with 2 intervals was used to approximate the area of the artwork as $612 \mathrm{~cm}^{2}$. What is the value of $x$ ?
$\qquad$
$\qquad$
$\qquad$
$\qquad$
$\qquad$
(c) The equation of least-squares line of best fit is given by $y=m x+c$

Where $m=r \frac{s_{y}}{s_{x}}$ and $c=\bar{y}-m \bar{x}$
What is the $y$-intercept of the least-squares line of best fit given $m=0.8, \bar{x}=60$ and $\bar{y}=75$ ?
$\qquad$
$\qquad$
$\qquad$

## Question 20 continued

(d) The network diagram for a project is shown below. The duration for each activity is in days.

(i) Write the earliest starting times (ESTs) and latest starting times (LSTs) on the above
network diagram.
(ii) What is the float time at $C$ ?
$\qquad$
$\qquad$
(iii) What is the critical path of the project?
$\qquad$
$\qquad$
(iv) What is the minimum completion time for the project?
$\qquad$
$\qquad$

## Question 20 continued

(e) A four-metre length of cylindrical pipe is shown. The outer radius is 1.5 metres and the inner radius is 1.2 metres.


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(i) What volume of water will flow through this pipe, to the nearest cubic metre?
$\qquad$
$\qquad$
$\qquad$

This four-metre length of pipe is shown in the network diagram below $(X)$, connecting $(B)$ to the sink $(t)$. Weights on the edges are the volume of water each pipe can carry, in cubic metres.

(ii) What is the flow capacity of the current network?
$\qquad$
$\qquad$
(iii) In order to maximise the flow in this network, one more pipe is to be added between the source $(S)$ and $B$. What must this pipe's capacity be, in cubic metres?
$\qquad$
$\qquad$

## Section II Extra writing space

If you use this space, clearly indicate which question you are answering.

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