Christ Church Grammar School

Mathematics Department
Year 11 Mathematics Applications

Semester 2 Examination, 2020

Question/Answer booklet

MATHEMATICS APPLICATIONS

UNITS 1 AND 2

Section One: Calculator-free

Fix student label here

Student name _____

Teacher's name _____

Time allowed for this section

Reading time before commencing work: five minutes
Working time: fifty minutes

Materials required/recommended for this section

To be provided by the supervisor
This Question/Answer booklet
Formula sheet

To be provided by the candidate
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: nil

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of examination
Section One: Calculator-free	8	8	50	52	35
Section Two: Calculator-assumed	13	13	100	98	65
				Total	100

Instructions to candidates

1. The rules for the conduct of the CCGS assessments are detailed in the Reporting and Assessment policy. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. You must be careful to confine your answers to the specific question asked and to follow any instructions that are specific to a particular question.

4. Show all your working clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.

5. It is recommended that you do not use pencil, except in diagrams.

6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

7. The Formula sheet is not to be handed in with your Question/Answer booklet.

See next page

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Section One: Calculator-free **35% (52 Marks)**

This section has **eight** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of the Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Working time: 50 minutes.

Question 1 **(5 marks)**

The table below displays a selection of variables and sample responses from a study dataset.

Visits to clinic	Gender	Height	Blood group	BMI	Feeling happy?	Number of siblings	Income level
2	F	1.66	AB	19.2	Disagree	2	Low
4	M	1.82	O	18.4	Strongly agree	0	High
5	M	1.74	B	32.7	Strongly disagree	1	V High
1	F	1.80	AB	24.1	Agree	2	Medium

(a) Give the name of a variable from the table that is classified as

(i) categorical and nominal. (1 mark)

(ii) numerical and discrete. (1 mark)

(iii) categorical and ordinal. (1 mark)

(b) The BMI variable is to be replaced with a Body Type variable according to the following table:

BMI	< 18.5	$18.5 - 24.9$	$25 - 29.9$	≥ 30
Body Type	Underweight	Normal	Overweight	Obese

Explain whether Body Type will have the same variable classification as BMI. (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 2 **(5 marks)**

The weekly time sheet for a part time worker is shown below.

Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Hours worked	-	-	2.5	4.5	5	4	-

The worker is paid $20 per hour, with time and a half paid for weekend shifts.

(a) Determine the gross weekly pay for this worker. (3 marks)

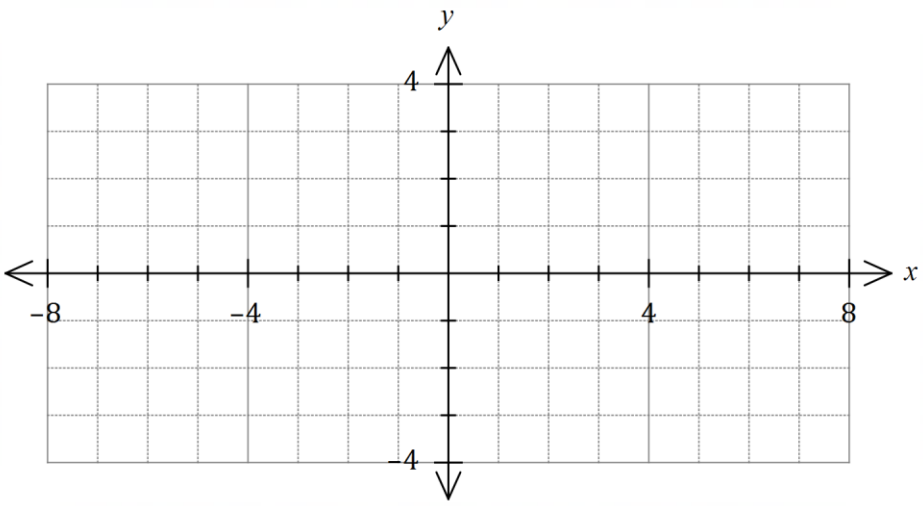
(b) The following week the gross weekly pay for the worker came to $270 but as they met a performance target, they were awarded a 15% bonus. Determine the amount of their bonus. (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

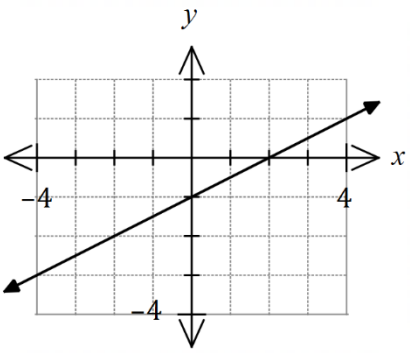
See next page

Question 3 **(7 marks)**

(a) Construct the graph of $x + 2y = 4$ on the axes below. (3 marks)



(b) The graph of $y = a + bx$ is shown at right.



(i) Determine the value of the constant a and the value of the constant b. (2 marks)

(ii) State with justification whether the graph of $y = a + bx$ passes through the point with coordinates $(30, 16)$. (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 4 **(8 marks)**

(a) A mixture of linear and non-linear equations are shown below. Using a pencil, draw a circle around each linear equation. (2 marks)

$$2x^2 = 16, \qquad 2x = 6, \qquad 12 - x = 11x, \qquad 3x + 3 = 3^x, \qquad x = 3(x - 10).$$

(b) Solve the equation $3(2x + 1) - 7 = 4 - 5(2 - x)$ for x. (2 marks)

(c) Aya, Bi and Cai are reading the same book. Aya has read x pages, Bi has read 20 fewer pages than Aya, and Cai has read three times as many pages as Bi. The mean number of pages read by the three friends is 15.

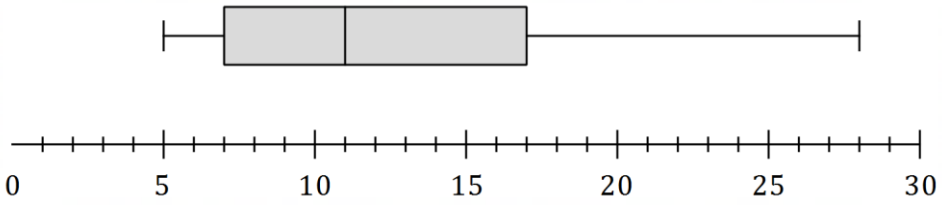
(i) Use the above information to write an equation in terms of x. (2 marks)

(ii) Determine how many pages of the book Aya has read. (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 5 **(7 marks)**

The box plot below represents the distribution of the number of flights per day that were subject to a delayed departure at a large airport.



(a) Determine, for this distribution, the

(i) median. (1 mark)

(ii) range. (1 mark)

(iii) interquartile range. (1 mark)

(b) Describe a feature of the box plot that indicates the mean of the distribution will be greater than the median. (1 mark)

(c) Construct a possible ordered list of seven whole numbers that would result in the box plot shown. (3 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

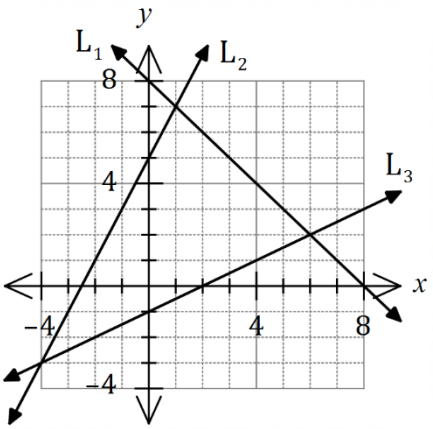
Question 6 **(7 marks)**

(a) Three straight-lines L_1, L_2 and L_3 are shown on the graph at right.

Explain how the graph can be used to solve the simultaneous equations

$y = 0.5x - 1$ and $y = 2x + 5$

and state their solution.



(3 marks)

(b) A cafe can buy disposable coffee cups from two suppliers, A and B. Supplier A charges a delivery fee of $\$9$ plus 2 cents per cup whilst supplier B has no delivery fee but charges 5 cents per cup. Let y be the total cost in cents of buying x cups from a supplier.

(i) Write an equation relating x and y for supplier A. (1 mark)

(ii) Write an equation relating x and y for supplier B. (1 mark)

(iii) Determine the number of cups for which the total cost is the same for both suppliers and state what this total cost is. (2 marks)

See next page

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 7 **(7 marks)**

(a) 150 and 104 purchases were made at a shop in the morning and afternoon respectively. In the morning, half of the purchases were made with EFTPOS, 31 were cash and the remainder using a pay later scheme. In the afternoon, 22 were made with cash and the remainder evenly split between EFTPOS and pay later.

Represent the figures for the time of day and payment type in a labelled 2×3 matrix. (2 marks)

(b) Simplify

(i) $7I - 4\begin{bmatrix} 1 & 3 \\ -2 & 0 \end{bmatrix}$, where I is the 2×2 identity matrix. (3 marks)

(ii) $\begin{bmatrix} 2 & 1 \\ -1 & 1 \end{bmatrix} \times \begin{bmatrix} 3 & -4 \\ -2 & 1 \end{bmatrix}$. (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 8 **(6 marks)**

(a) A formula used to estimate the speed, S km per hour, of a car that skids to a halt is shown below. It uses the length of the skid d m and the friction coefficient f that varies with the type of road and weather.

$$S = 3.5\sqrt{10fd}$$

	f	
Road Type	Wet	Dry
Bitumen	0.56	0.90
Concrete	0.40	0.82
Unsealed	0.35	0.60

Estimate the speed of a car that skidded to a halt over a distance of 16 m on a wet concrete road. (3 marks)

(b) In baseball statistics, slugging average SLG is a measure of the batting productivity of a hitter. It is calculated from the number of singles S, doubles D, triples T, home runs H and at bats AB using the formula

$$SLG = \frac{S + 2D + 3T + 4H}{AB}$$

A hitter who had been at bat 120 times had a slugging average of 0.5. Given that they had hit 2 home runs, 9 doubles and 22 singles, determine their number of triples.

(3 marks)

End of questions

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

© 2020 WA Exam Papers. Christ Church Grammar School has a non-exclusive licence to copy and communicate this document for non-commercial, educational use within the school. No other copying, communication or use is permitted without the express written permission of WA Exam Papers. SN018-163-1.

Christ Church Grammar School

Mathematics Department
Year 11 Mathematics Applications

Semester 2 Examination, 2020

Question/Answer booklet

MATHEMATICS APPLICATIONS

UNITS 1 and 2

Section Two: Calculator-assumed

Fix student label here

Student name _____

Teacher's name _____

Time allowed for this section

Reading time before commencing work: ten minutes
Working time: one hundred minutes

Materials required/recommended for this section

To be provided by the supervisor
This Question/Answer booklet
Formula sheet (retained from Section One)

To be provided by the candidate
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper, and up to three calculators, which can include scientific, graphic and Computer Algebra System (CAS) calculators, are permitted in this ATAR course examination

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of examination
Section One: Calculator-free	8	8	50	52	35
Section Two: Calculator-assumed	13	13	100	98	65
				Total	100

Instructions to candidates

1. The rules for the conduct of the CCGS assessments are detailed in the Reporting and Assessment policy. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. You must be careful to confine your answers to the specific question asked and to follow any instructions that are specific to a particular question.

4. Show all your working clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.

5. It is recommended that you do not use pencil, except in diagrams.

6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

7. The Formula sheet is not to be handed in with your Question/Answer booklet.

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Section Two: Calculator-assumed **65% (98 Marks)**

This section has **thirteen** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of the Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Working time: 100 minutes.

Question 9 **(6 marks)**

The number of shares that three investors A, B and C held in the three companies X, Y and Z is shown in the following matrix M.

$$\begin{array}{c} \\ A \\ B \\ C \end{array} \begin{array}{c} \begin{array}{ccc} X & Y & Z \end{array} \\ \begin{bmatrix} 540 & 520 & 290 \\ 250 & 470 & 330 \\ 350 & 540 & 500 \end{bmatrix} \end{array}$$

The current market value of one share in X, Y and Z is $\$1.40, \$0.40$ and $\$1.65$ respectively.

(a) Represent the market values in matrix V and using your calculator, or otherwise, calculate the matrix product MV and describe what the entries in the product represent. (3 marks)

The dividends per share paid by companies X, Y and Z are $14\text{c}, 5\text{c}$ and 11c respectively.

(b) Use a matrix method to determine the dividend, in dollars, that each investor will receive on their shares. (3 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 10 **(7 marks)**

The blood pressure of $25\,000$ adults in a large medical study is normally distributed with a mean of 121 mmHg and a standard deviation of 13 mmHg.

(a) The blood pressure of adult A was 153 mmHg and 115 mmHg for adult B. Calculate the standard scores for each adult and hence explain which adult had unusual blood pressure. (3 marks)

(b) Using the 68%, 95%, 99.7% rule determine the number of adults in the study with blood pressure between 108 and 134 mmHg. (2 marks)

(c) Determine the probability, to three decimal places, that a randomly selected adult from the study had blood pressure of

(i) at least 100 mmHg. (1 mark)

(ii) between 110 and 130 mmHg. (1 mark)

See next page

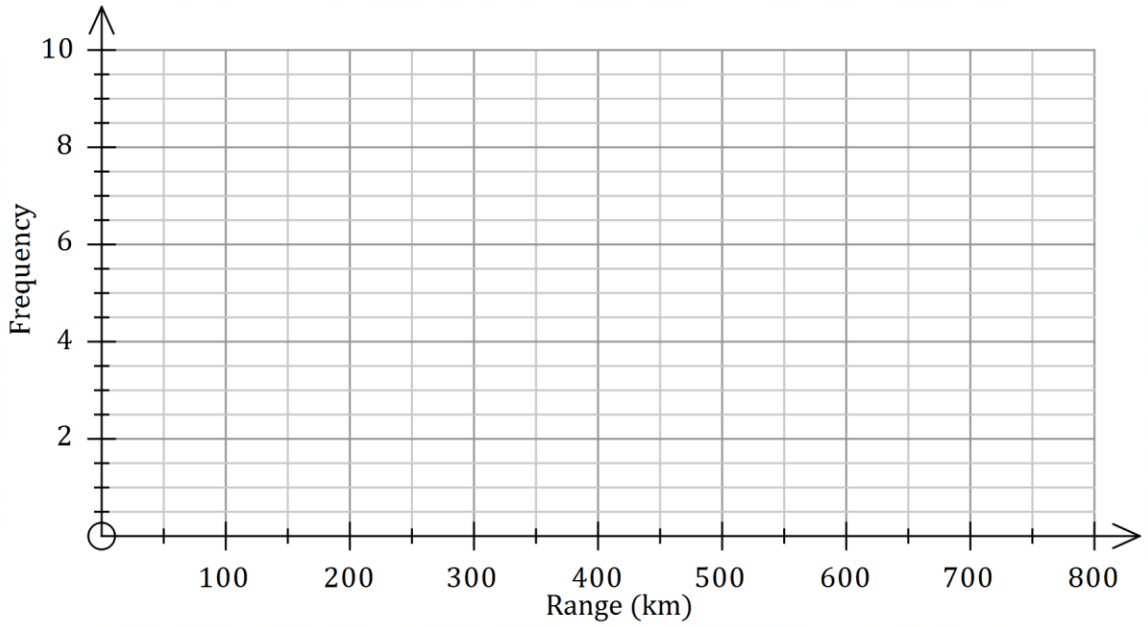
DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 11 **(7 marks)**

The results of a recent investigation into the range of consumer electric vehicles are summarised in the following table.

Range of EV (km)	Frequency
$0 \leq x < 100$	1
$100 \leq x < 200$	0
$200 \leq x < 300$	3
$300 \leq x < 400$	4
$400 \leq x < 500$	6
$500 \leq x < 600$	9
$600 \leq x < 700$	5

(a) Construct a histogram of this data on the axes below. (3 marks)



(b) Calculate the mean and standard deviation of the range. (2 marks)

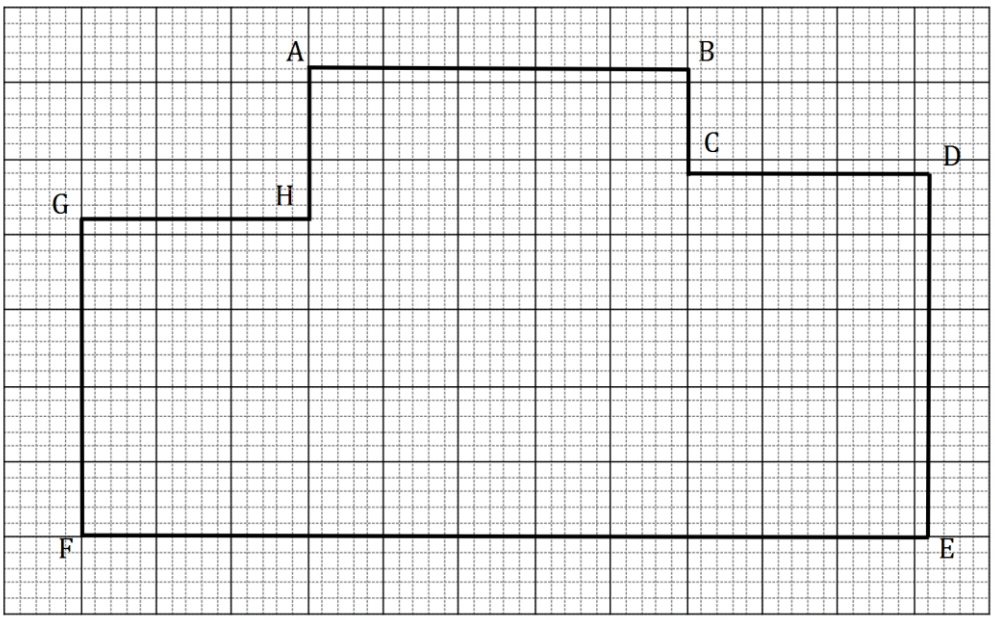
(c) Describe the shape and modality of the distribution of ranges. (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 12 **(8 marks)**

The plan shown below on 2 mm grid paper is a $1:50$ scale drawing of a concrete slab.



(a) Show that the length of the slab edge EF is 5.6 m and calculate the length of the slab edge DE. (2 marks)

(b) When marking out the slab, a builder measures some of the diagonals to check that the corners are square. Determine the length that diagonal DF should measure. (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

(c) Determine the volume, in cubic metres, of concrete required for the slab if it must have a uniform thickness of 15 cm. (4 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 13 **(10 marks)**

The stem plot below shows the percentage scores of students in two classes for the same exam.

Class P		Class Q
9	8	1 5
6 5 2	7	2 6 7
8 7 6 6 5 4 2	6	0 1 5
9 5 2 1	5	2 5 7 9
7	4	2 4 8
	3	9

Key: 4|6 = 46

For the 16 students in Class P, the mean and standard deviation of their scores were 64.6 and 10.3 respectively.

(a) State, with justification, which class had the greater range. (2 marks)

(b) State the number of students in Class Q and determine the mean and standard deviation of the scores of these students. (3 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

(c) State, with justification, which of the two classes performed better on the exam and explain how this is illustrated by a feature of the stem plot. (3 marks)

(d) Compare the spread of scores for the two classes. (2 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 14 **(8 marks)**

(a) A borrower secures a short term loan for an amount of $\$5990$ for 21 days at a simple interest rate of 14.75% p.a. Determine the amount that must be repaid. (3 marks)

(b) Another borrower is considering a loan of $\$14\,750$ for 3 years to use as part payment for a car. The car dealership offer the borrower a loan at 6.95% p.a. compounded monthly. The borrowers bank offer a loan at 7.19% p.a. compounded annually.

Determine which loan will be cheaper for the borrower to repay at the end of the 3 year period and state how much they save compared to the other loan. (5 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

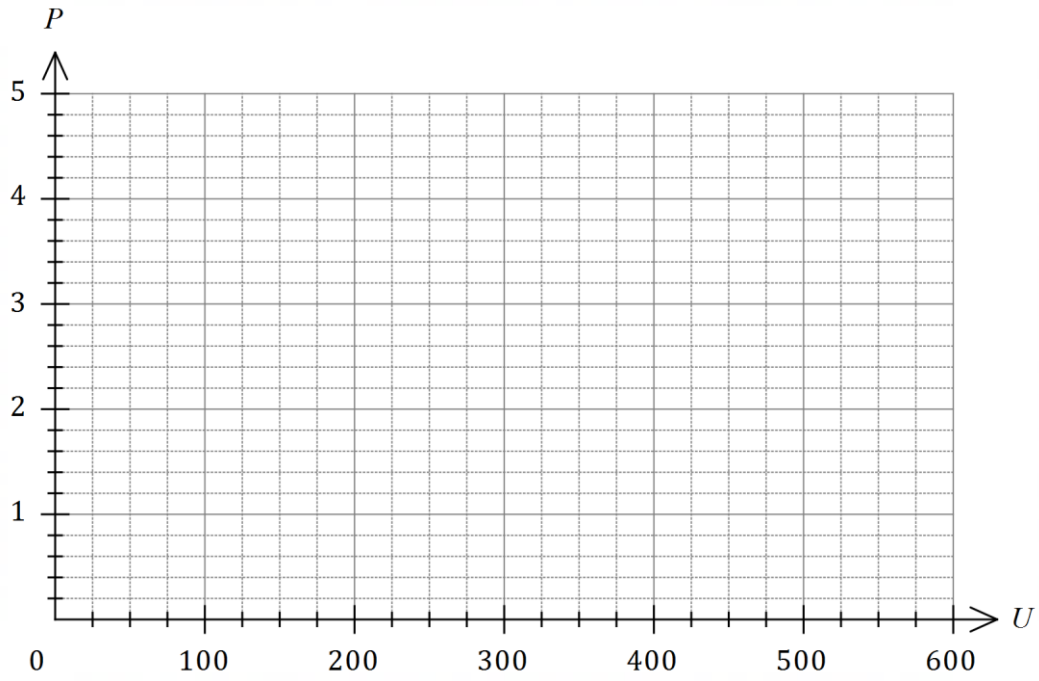
Question 15 **(7 marks)**

The price that a corporation charges its customers for the water they use is shown in the table below.

Usage (U kL)	Up to 125	$125 - 450$	Over 450
Price per kL (P \$)	1.74	2.31	4.33

The usage is based on the customers total usage for the current year. At the end of each year the usage resets to zero.

(a) Draw a graph to show how price P varies with usage U during a year on the axes below. (3 marks)



(b) A customer's usage at the start of the billing period was 95 kL and at the end it had increased to 174 kL. Calculate the cost of their water usage for this period. (3 marks)

(c) Give a brief reason why the corporation might use these pricing tiers. (1 mark)

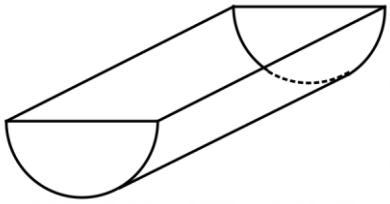
DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 16 **(7 marks)**

A water trough can be made from half of a cylindrical oil drum, as shown.

Oil drum D has a radius of 16 cm and a height of 45 cm.



(a) The interior of the trough made from the oil drum D is to be painted with a waterproofing paint. Calculate the area to be painted, rounded to the nearest 10 square centimetres. (3 marks)

Oil drum E is a similar figure to oil drum D but with a height of 72 cm.

(b) Obtain a scale factor for the size of the drum E relative to the drum D. (2 marks)

(c) Determine the capacity of a water trough made from drum E, given that the capacity of the trough made from the drum D is 18 L. (2 marks)

See next page

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 17 **(7 marks)**

Police in a city have detected that a mobile phone lies within a triangle bounded by three phone towers P, Q and R where tower R lies due east of tower P and tower Q is the most northerly tower. The distances PQ, QR and PR are $650, 540$ and 810 metres respectively.

(a) Use Heron's rule to determine the area of the triangle within which the phone has been located. (3 marks)

(b) Determine the bearing of tower Q from tower P to the nearest degree. (4 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 18 **(7 marks)**

A store can buy cartons containing packs of $10, 25$ and 50 tea bags at the wholesale prices shown below.

Pack size	10	25	50
Packs per carton	150	60	30
Wholesale cost price per carton ($)	198.00	234.00	212.00
Retail selling price per pack ($)	2.75	4.75	9.75

(a) Calculate the percentage profit that the store makes selling a pack of 10 tea bags. (2 marks)

(b) All prices shown in the table include GST at 10%. Determine the cost price of a pack of 25 tea bags without GST. (2 marks)

(c) Use the unit cost method to rank the pack sizes from best to worst value based on their retail prices when the packs of 10 tea bags are sold with a 30% discount. (3 marks)

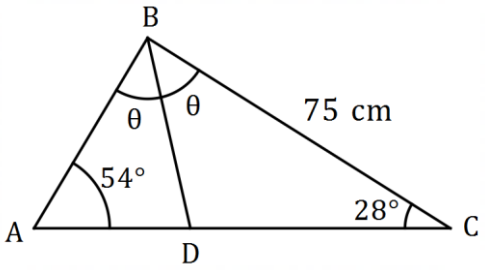
See next page

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Question 19 **(8 marks)**

A triangular logo ABC is to be mounted at the entrance to a company. ΔABC is split into two smaller triangles by line BD that bisects $\angle ABC$, as shown in the sketch. ΔABD is coloured blue and ΔBDC is red.

The length of BC is 75 cm, $\angle BAC = 54°$ and $\angle BCA = 28°$.



(a) Determine the length of AB. Round your answer to one decimal place. (2 marks)

(b) Determine the length of BD. (3 marks)

(c) Determine what percentage of the logo is coloured red. (3 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

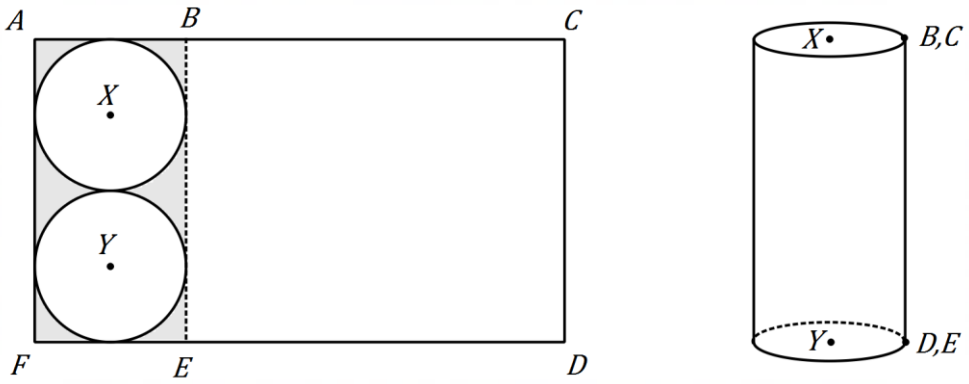
Question 20 **(9 marks)**

A company fabricates cylindrical storage tanks.

A thin rectangular sheet of steel $ACDF$ with $AC = 7.45$ m and $AF = 3.60$ m is cut into two rectangles along BE, where $AB = \frac{1}{2}AF$.

Two circles of radius $\frac{1}{2}AB$ and with centres X and Y are cut out of the smaller rectangle for the ends of the cylinder.

The remaining rectangle $BCDE$ is then rolled up and edge BE is welded to edge CD to form the wall of the cylinder. Finally, the circular ends are welded in place.



(a) Determine the area of the sheet $ACDF$ that is not used in the fabrication of a tank.

(3 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

(b) Calculate the capacity of the finished cylinder in litres, given that 1000 L is equal to one cubic metre. (2 marks)

(c) Fabrication costs are $\$52.75$ for the sheet $ACDF$, $\$3.30$ per metre for all cuts that must be made and $\$7.20$ per metre for all welds needed to join edges together. Determine the cost of fabricating one tank. (4 marks)

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

See next page

Question 21 **(7 marks)**

A person who has a part time job qualifies for a government allowance of $675 per fortnight, but this allowance is reduced by 50 cents in the dollar for fortnightly earnings over $240.

The person, who earns $21.50 per hour, has created the spreadsheet below.

	A	B	C	D	E	F
1	0	0.00	0.00	675.00	675.00	337.50
2	5	215.00	0.00	675.00	890.00	445.00
3	10	430.00	95.00	580.00	1010.00	505.00
4	15	645.00	202.50	472.50	1117.50	558.75
5	20					

Key to columns:
A: Weekly hours worked
B: Fortnightly earnings
C: Reduction in government allowance
D: Allowance received
E: Total fortnightly income (earnings plus allowance)
F: Total weekly income

(a) Using the space below to show all your working, complete row 5 of the spreadsheet. (5 marks)

(b) By referring to the number in a cell in the spreadsheet using its column letter followed by its row number (e.g. E2 refers to the cell containing the number 890.00) write a suitable formula to

(i) calculate the value in B5 from the value in A5. (1 mark)

(ii) calculate the value in F5 from the value in B5. (1 mark)

End of questions

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

Supplementary page

Question number: _____

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

© 2020 WA Exam Papers. Christ Church Grammar School has a non-exclusive licence to copy and communicate this document for non-commercial, educational use within the school. No other copying, communication or use is permitted without the express written permission of WA Exam Papers. SN018-163-2.