



Semester Two Examination, 2020

Question/Answer booklet

**MATHEMATICS
APPLICATIONS
UNITS 1&2**

**Section One:
Calculator-free**

If required by your examination administrator, please place your student identification label in this box

WA student number: In figures

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In words

Your name

Time allowed for this section

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

Number of additional answer booklets used (if applicable):

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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.

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

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

Working time: 50 minutes.

Question 1**(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)**

Question 2

(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

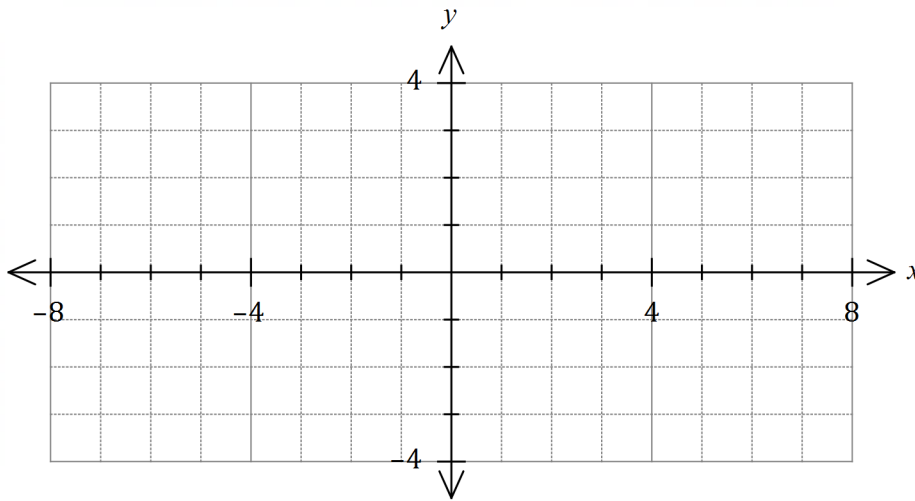
Explain whether Body Type will have the same variable classification as BMI. (2 marks)

Question 3

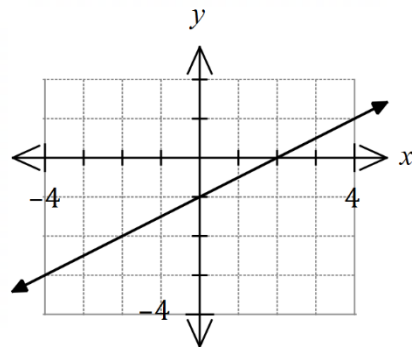
(7 marks)

(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)**

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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)

$$2x = 9, \quad x^2 = 9, \quad 2(x + 1) = 3^x, \quad 3x = 2(x + 1), \quad x - 2 = 5x.$$

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

- (c) Ana, Bo and Cole are reading the same book. Ana has read x pages, Bo has read 30 more pages than Ana and Cole has read twice as many pages as Bo. The mean number of pages read by the three friends is 42.

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

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

Question 5

(7 marks)

- (a) 120 and 86 purchases were made at a shop in the morning and afternoon respectively. In the morning, half of the purchases were made with EFTPOS, 23 were cash and the remainder using a pay later scheme. In the afternoon, 16 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) $12I - 3 \begin{bmatrix} 4 & 1 \\ -5 & 0 \end{bmatrix}$, where I is the 2×2 identity matrix. (3 marks)

(ii) $\begin{bmatrix} 1 & -2 \\ 3 & 1 \end{bmatrix} \times \begin{bmatrix} 5 & -2 \\ -1 & 4 \end{bmatrix}$. (2 marks)

Question 6

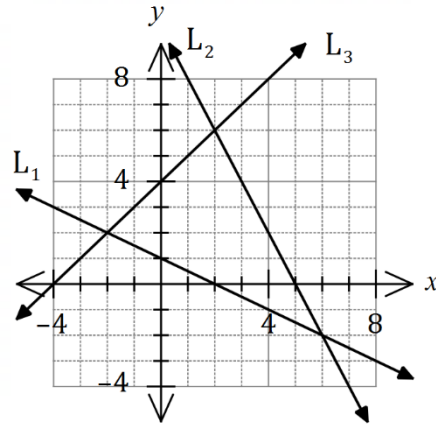
(7 marks)

- (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

$$y = -2x + 10 \text{ and } y = x + 4$$

and state their solution.



(3 marks)

- (b) A cafe can buy disposable coffee cups from two suppliers, P and Q . Supplier P charges a delivery fee of \$8 plus 3 cents per cup whilst supplier Q 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 P . (1 mark)

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

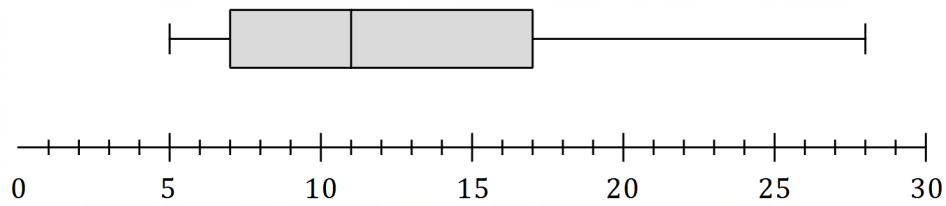
(iii) Determine the number of cups for which the total cost is the same for both suppliers and state what this total cost is. (2 marks)

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Question 7

(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)

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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.

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

Road Type	f	
	Wet	Dry
Bitumen	0.50	0.90
Concrete	0.45	0.85
Unsealed	0.35	0.60

Estimate the speed of a car that skidded to a halt over a distance of 13.5 m on a dry unsealed 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 40 times had a slugging average of 0.4. Given that they had hit one home run, one triple, and five singles, determine their number of doubles. (3 marks)

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Semester Two Examination, 2020

Question/Answer booklet

**MATHEMATICS
APPLICATIONS
UNITS 1&2
Section Two:
Calculator-assumed**

If required by your examination administrator, please place your student identification label in this box

WA student number: In figures

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In words

Your name

Time allowed for this section

Reading time before commencing work:
Working time:
minutes

ten minutes
one hundred

Number of additional
answer booklets used
(if applicable):

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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 approved for use in this examination

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Section Two: Calculator-assumed

65% (98 Marks)

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

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 .

$$\begin{array}{c} X \quad Y \quad Z \\ A \quad \begin{bmatrix} 510 & 510 & 360 \end{bmatrix} \\ B \quad \begin{bmatrix} 240 & 390 & 530 \end{bmatrix} \\ C \quad \begin{bmatrix} 310 & 220 & 490 \end{bmatrix} \end{array}$$

The current market value of one share in X , Y and Z is \$1.15, \$2.35 and \$1.90 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 $9c$, $23c$ and $5c$ respectively.

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

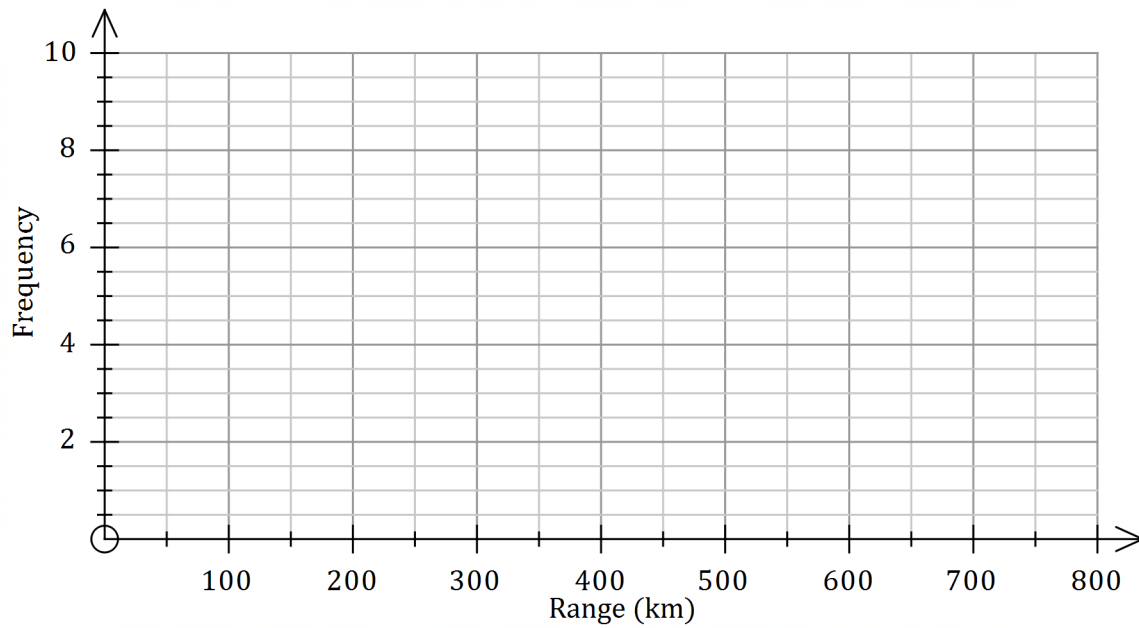
Question 10

(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)

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Question 11**(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)

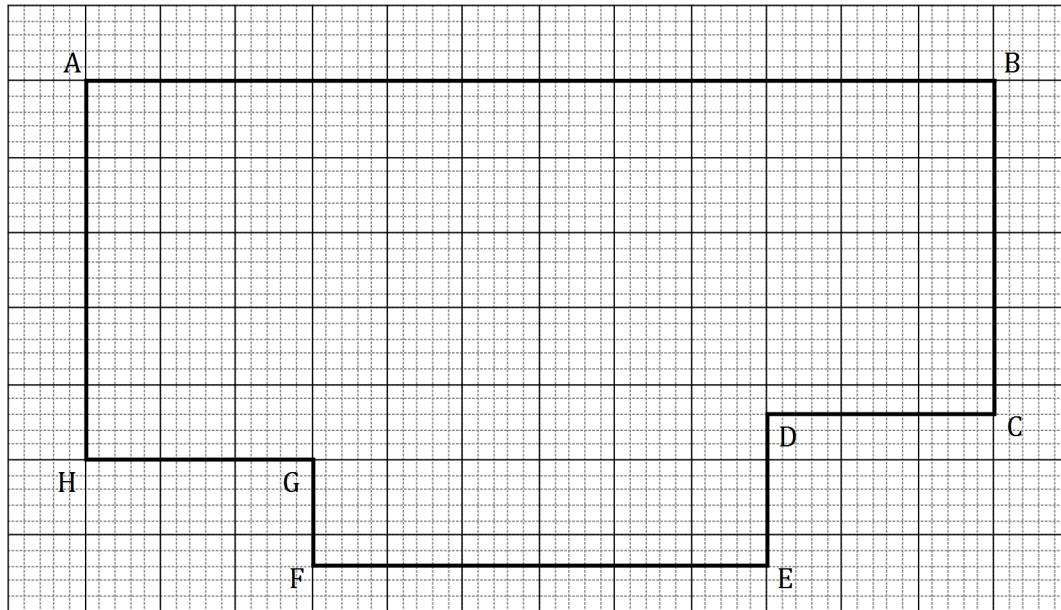
- (ii) between 110 and 130 mmHg. (1 mark)

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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 AB is 6 m and calculate the length of the slab edge BC . (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 AC should measure. (2 marks)

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- (c) Determine the volume, in cubic metres, of concrete required for the slab if it must have a uniform thickness of 16 cm. (4 marks)

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Question 13

(10 marks)

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

Class <i>M</i>		Class <i>N</i>
	2 8	2 5
	5 7	1 6 7
7 3 3 1	6 6	0 2 6 6 9
8 7 5 4 3 2 0	5 5	2 5 7 9
9 8 7	4 4	1 5 9
9	3	

For the 17 students in Class *M*, the mean and standard deviation of their scores were 57.2 and 10.3 respectively.

- (a) State, with justification, which class had the greater range. (2 marks)
- (b) State the number of students in Class *N* and calculate the mean and standard deviation of the scores of these students. (3 marks)
- (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)

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

(2 marks)

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Question 14

(7 marks)

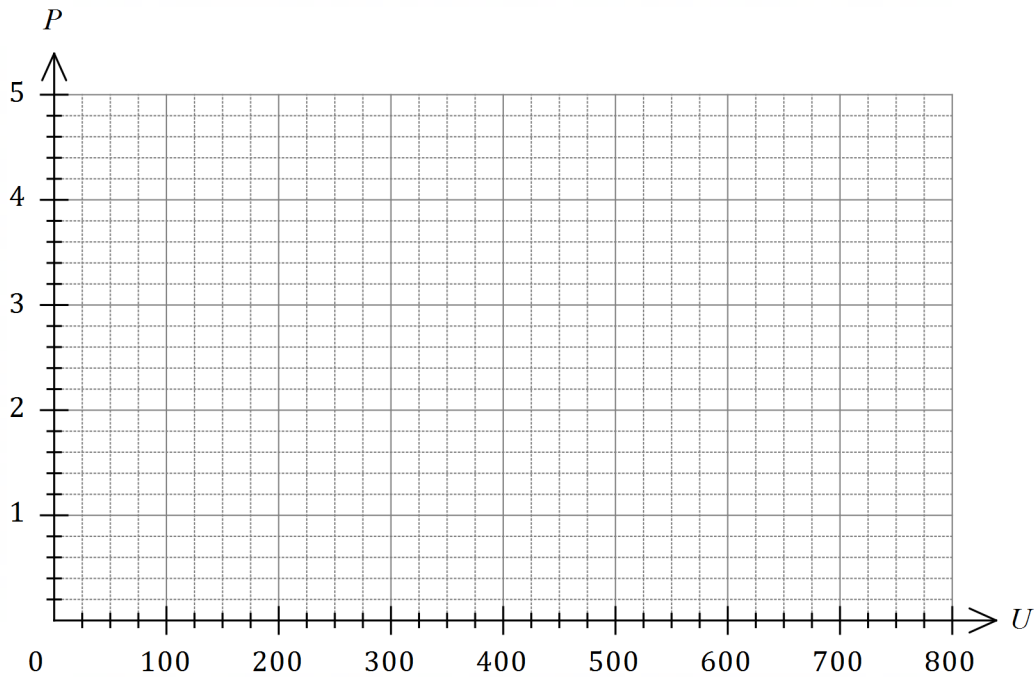
The price that a corporation charges its customers for the water they use is shown in the table below.

Usage (U kL)	Up to 150	150 – 500	Over 500
Price per kL (P \$)	1.92	2.56	4.78

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 135 kL and at the end it had increased to 208 kL. Calculate the cost of their water usage for this period.

(3 marks)

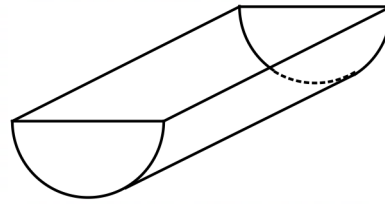
- (c) Give a brief reason why the corporation might use these pricing tiers.

(1 mark)

Question 15**(7 marks)**

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

Oil drum P has a radius of 18 cm and a height of 55 cm.



- (a) The interior of the trough made from the oil drum P 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 Q is a similar figure to oil drum P but with a height of 77 cm.

- (b) Obtain a scale factor for the size of the drum Q relative to the drum P . (2 marks)

- (c) Determine the capacity of a water trough made from drum Q , given that the capacity of the trough made from the drum P is 28 L. (2 marks)

Question 16**(8 marks)**

- (a) A borrower secures a short term loan for an amount of \$2 350 for 28 days at a simple interest rate of 12.97% pa. Determine the amount that must be repaid. **(3 marks)**

- (b) Another borrower is considering a loan of \$18 500 for 3 years to use as part payment for a car. The car dealership offer the borrower a loan at 7.94% pa compounded monthly. The borrowers bank offer a loan at 8.19% pa compounded annually.

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

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)**

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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	200	80	40
Wholesale cost price per carton (\$)	256.00	236.00	212.00
Retail selling price per pack (\$)	3.55	5.75	10.95

- (a) Calculate the percentage profit that the store makes selling a pack of 25 tea bags. (2 marks)
- (b) All prices shown in the table include GST at 10%. Determine the cost price of a pack of 50 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 40% discount. (3 marks)

Question 19

(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)

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Question 20

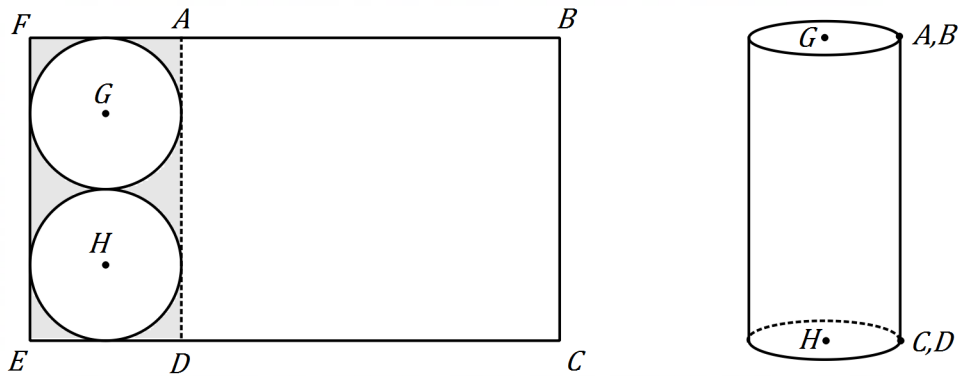
(9 marks)

A company fabricates cylindrical storage tanks.

A thin rectangular sheet of steel $FBCE$ with $FB = 4.97$ m and $FE = 2.40$ m is cut into two rectangles along AD , where $AF = \frac{1}{2}FE$.

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

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



- (a) Determine the area of the sheet $FBCE$ that is not used in the fabrication of a tank. (3 marks)

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(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 \$45.75 for the sheet *FBCE*, \$4.50 per metre for all cuts that must be made and \$9.50 per metre for all welds needed to join edges together. Determine the cost of fabricating one tank. (4 marks)

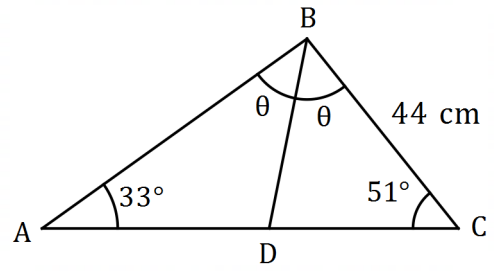
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Question 21

(8 marks)

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

The length of BC is 44 cm, $\angle BAC = 33^\circ$ and $\angle BCA = 51^\circ$.



(a) Determine the length of AB . (2 marks)

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

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

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