Swan
Christian College

Semester Two Examination, 2019

Question/Answer booklet

MATHEMATICS APPLICATIONS UNITS 1 AND 2

Section One: Calculator-free

SOLUTIONS

Student number: In figures | | | | | | | | |

In words _____

Your 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.

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

This section has **eight (8)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 50 minutes.

Question 1 **(6 marks)**

(a) Simplify $2 + 4 \times \sqrt{36} - 20 \div 2^2$. (2 marks)

Solution
$2 + 4 \times \sqrt{36} - 20 \div 2^2 = 2 + 4 \times 6 - 20 \div 4$ $= 2 + 24 - 5$ $= 21$
Specific behaviours
✓ indicates several correct steps ✓ correct value

(b) Determine the value of the expression $\frac{x^2 + 2x}{y^2 - 3y}$ when $x = 5$ and $y = -2$. (2 marks)

Solution
$\frac{5^2 + 2(5)}{(-2)^2 - 3(-2)} = \frac{25 + 10}{4 + 6}$ $= \frac{35}{10}$ $= 3.5$
Specific behaviours
✓ indicates several correct steps ✓ correct value

(c) Determine the value of d when $a = 2.8, v = 0.5$ and $d = 6v^2 - 2av$. (2 marks)

Solution
$d = 6 \times 0.5 \times 0.5 - 2 \times 2.8 \times 0.5$ $= 3 \times 0.5 - 2.8$ $= 1.5 - 2.8$ $= -1.3$
Specific behaviours
✓ indicates several correct steps ✓ correct value

See next page

Question 2 **(6 marks)**

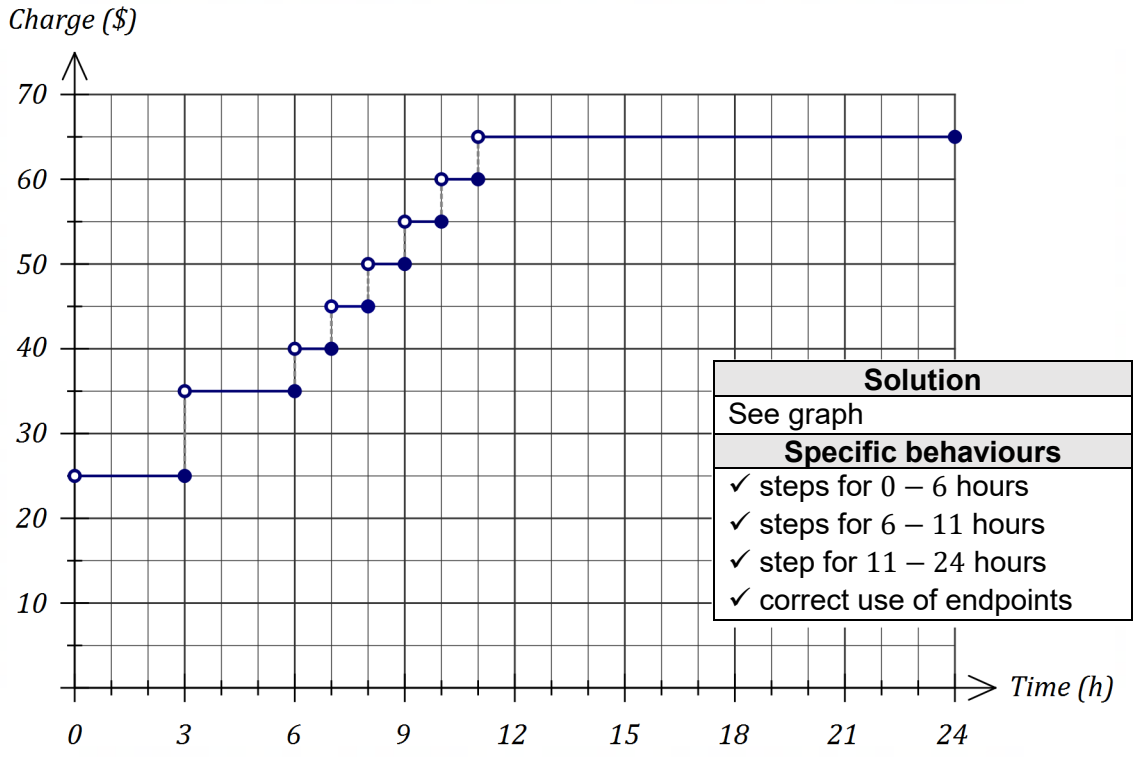
An airport car park charges the amounts shown in the table below for periods not exceeding 24 hours.

Parking time	No more than 3 hours	More than 3 but not exceeding 6 hours	Each additional hour (or part) exceeding 6	Maximum charge for up to 24 hours
Charge	\$25	\$35	\$5	\$65

(a) Explain why the charge to park a car for eight and a half hours is \$50. (2 marks)

Solution
Must pay for 6 hours plus additional 3 hours: $C = 35 + 3 \times 5 = 35 + 15 = \$50$
Specific behaviours
✓ indicates 3 additional hours ✓ shows calculation

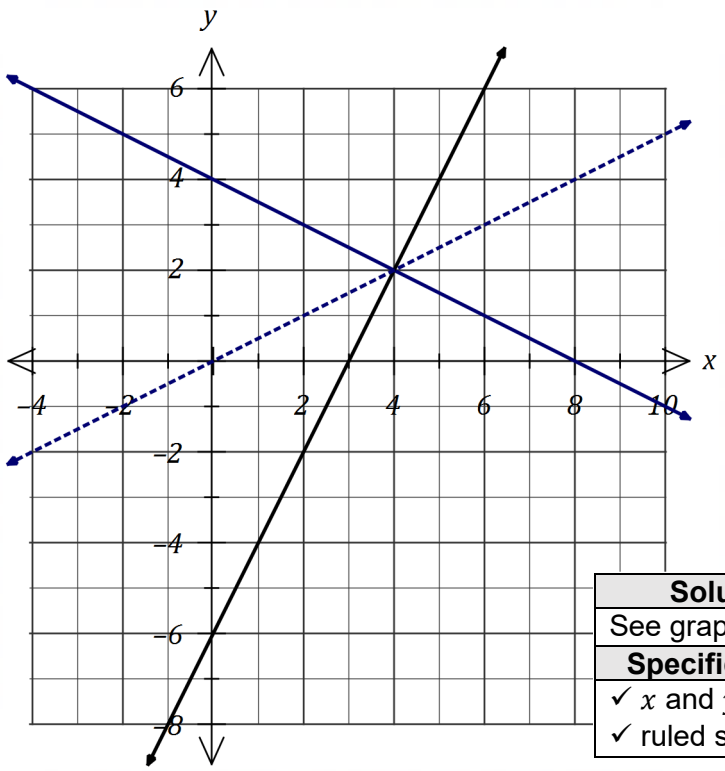
(b) Draw a graph to represent the parking charges on the axes below. (4 marks)



Solution
See graph
Specific behaviours
✓ steps for 0 – 6 hours ✓ steps for 6 – 11 hours ✓ step for 11 – 24 hours ✓ correct use of endpoints

Question 3 **(7 marks)**

The graph of line L_1 with equation $y = ax + b$ is shown below.



Solution (b)(i)
See graph
Specific behaviours
✓ x and y intercepts
✓ ruled straight line

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

Solution
Gradient $= a = 2$. y-intercept $= b = -6$.
Specific behaviours
✓ value of a
✓ value of b

(b) Straight-line L_2 has equation $x + 2y = 8$.

(i) Draw L_2 on the axes above. (2 marks)

(ii) State the gradient of L_2. (1 mark)

Solution
$m = -\frac{1}{2} = -0.5$
Specific behaviours
✓ correct gradient

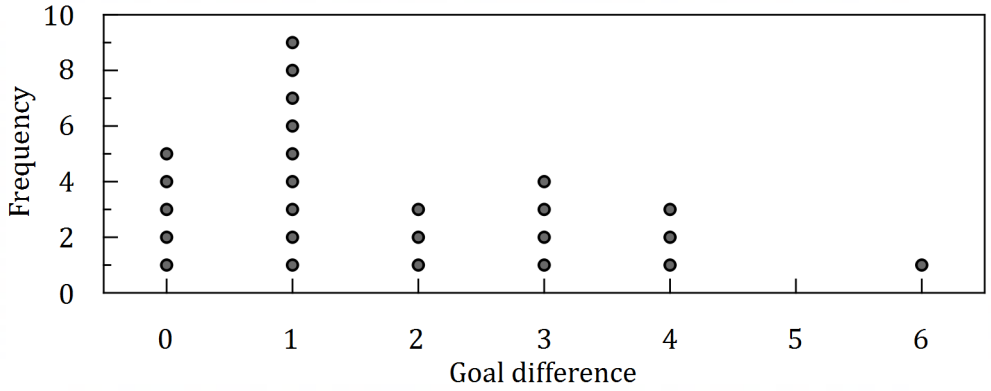
(c) Determine the equation of the straight-line L_3 that passes through the origin and the point of intersection of lines L_1 and L_2. (2 marks)

Solution
$m = \frac{2}{4} = \frac{1}{2} \Rightarrow y = \frac{1}{2}x$
Specific behaviours
✓ indicates correct gradient
✓ correct equation

See next page

Question 4 **(9 marks)**

The dot plot below shows the goal difference between each pair of teams playing in a weekend round of a soccer league.



(a) State the number of games that did not end in a draw. (1 mark)

Solution
$25 - 5 = 20$ games
Specific behaviours
✓ correct number

(b) Classify the type of variable that goal difference is by circling two of the following words: (1 mark)

Categorical. Continuous. **Discrete**. Nominal. **Numerical**. Ordinal.

Solution
Discrete and Numerical
Specific behaviours
✓ clearly circles both

(c) Determine

(i) the median goal difference. (1 mark)

Solution
Median is 13^{th} score $= 1$
Specific behaviours
✓ correct median

(ii) the mean goal difference. (2 marks)

Solution
$\frac{0+9+6+12+12+6}{25} = \frac{45}{25}$ $= \frac{9}{5} = 1.8$
Specific behaviours
✓ indicates correct method
✓ correct mean (as fraction or decimal)

See next page

(d) Describe the distribution of the dataset in terms of modality, shape and location. (3 marks)

Solution
The dataset has one peak and hence is unimodal. The shape of the dataset displays positive skew. The dataset is located around the mean of 1.8 goals.
Specific behaviours
✓ indicates unimodal ✓ indicates positive skew ✓ uses mean or median or mode for location

(e) Describe the feature of the dot plot that would suggest the median would be less than the mean of the dataset. (1 mark)

Solution
The positive skew.
Specific behaviours
✓ answer includes positive skew

See next page

Question 5 **(7 marks)**

The number of minutes that a group of students took to complete a task are listed below:

$$29, 26, 17, 29, 18, 26, 31, 25, 26, 35, 33, 28$$

(a) Construct an ordered stem-and-leaf plot to display this data. (3 marks)

Solution
1 | 7 8 **2 | 5 6 6 6 8 9 9** **3 | 1 3 5**
Specific behaviours
✓ stems and leaves aligned in columns ✓ two correct set of leaves ✓ all sets of leaves, correctly ordered

(b) Identify, with justification, any outliers that may be present in the times. (4 marks)

Solution
$Q_1 = 25.5, \quad Q_3 = 30$ $1.5 \times IQR = 1.5 \times 4.5 = 6.75$ $Q_1 - 6.75 = 25.5 - 6.75 = 18.75$ Any times less than 18.75 minutes are outliers. Hence the times of 17 and 18 minutes are both outliers.
Specific behaviours
✓ identifies quartiles ✓ calculates $1.5IQR$ ✓ calculates lower bound ✓ identifies both outliers

See next page

Question 6 **(5 marks)**

(a) Solve the equation $3(x+5)-1=x-2(x-3)$. (2 marks)

Solution
$3x+15-1=x-2x+6$ $4x=-8$ $x=-2$
Specific behaviours
✓ correctly expands ✓ correct solution

(b) Use the formula $A=\frac{1}{2}(a+b)h$ to determine

(i) A when $a=5.6, b=8.4$ and $h=20$. (1 mark)

Solution
$A=\frac{1}{2}(5.6+8.4)\times 20$ $=10\times 14$ $=140$
Specific behaviours
✓ correct value

(ii) b when $A=33, a=4$ and $h=6$. (2 marks)

Solution
$33=\frac{1}{2}(4+b)\times 6$ $33=3(4+b)$ $11=4+b$ $b=7$
Specific behaviours
✓ substitutes and simplifies ✓ correct value of b

See next page

Question 7 **(6 marks)**

(a) Simplify $2\begin{bmatrix}5 & 2\\ -3 & 4\end{bmatrix}-\begin{bmatrix}6 & -1\\ 2 & 7\end{bmatrix}$. (2 marks)

Solution
$\begin{bmatrix}10 & 4\\ -6 & 8\end{bmatrix}-\begin{bmatrix}6 & -1\\ 2 & 7\end{bmatrix}=\begin{bmatrix}4 & 5\\ -8 & 1\end{bmatrix}$
Specific behaviours
✓ correct multiple ✓ correct matrix

(b) Given that $A=\begin{bmatrix}-1 & 2\\ 3 & 1\end{bmatrix}$ determine A^2. (2 marks)

Solution
$\begin{bmatrix}-1 & 2\\ 3 & 1\end{bmatrix}\begin{bmatrix}-1 & 2\\ 3 & 1\end{bmatrix}=\begin{bmatrix}7 & 0\\ 0 & 7\end{bmatrix}$
Specific behaviours
✓ at least two elements correct ✓ correct matrix

(c) Determine the value of x and the value of y given that $\begin{bmatrix}2\\ 5\end{bmatrix}+x\begin{bmatrix}-3\\ 4\end{bmatrix}=\begin{bmatrix}-10\\ 3y\end{bmatrix}$. (2 marks)

Solution
$2-3x=-10\Rightarrow x=4$ $5+4(4)=3y\Rightarrow y=7$
Specific behaviours
✓ value of x ✓ value of y

See next page

Question 8 **(6 marks)**

At the start of the year 2002, the difference in the ages of a mother and her child was 24.

Let the age of the mother be x and the age of her child be y at the start of 2002.

(a) Use the above information to write an equation relating x and y. (1 mark)

Solution
$x - y = 24$
Specific behaviours
✓ correct equation

Three years later, the mother was 5 times as old as her child.

(b) Use this additional information to write another equation relating x and y. (2 marks)

Solution
In 3 years, mother will be $x + 3$ and child will be $y + 3$. $x + 3 = 5(y + 3)$
Specific behaviours
✓ expressions for ages of mother and child in 3 years ✓ correct equation

(c) Determine the age of the child at the start of the year 2019. (3 marks)

Solution
Substitute $x = y + 24$ into second equation: $y + 24 + 3 = 5y + 15$ $4y = 12 \Rightarrow y = 3$ In 2019 child will be $y + 17$ and so child will be 20 years old.
Specific behaviours
✓ substitutes and expands ✓ solves for y ✓ correct age of child

End of questions

Swan Christian College

Semester Two Examination, 2019

Question/Answer booklet

MATHEMATICS APPLICATIONS UNITS 1 AND 2

Section Two: Calculator-assumed

SOLUTIONS

Student number: In figures | | | | | | | | |

In words _____

Your 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 approved for use in this examination

Important note to candidates

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

This section has **thirteen (13)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 100 minutes.

Question 9 **(6 marks)**

A person who moved to Australia exchanged $80\,000$ euros for Australian dollars and placed the proceeds into a 3-month term deposit.

At the time of the exchange, 1 euro bought 1.6067 Australian dollars.

(a) Determine the amount the person deposited in the term deposit. (1 mark)

Solution
$80\,000 \times 1.6067 = \$128\,536$
Specific behaviours
✓ correct amount

(b) The term deposit paid simple interest of 1.5% per annum. Calculate the interest earned in the deposit over the 3 months. (2 marks)

Solution
$I = 128536 \times 0.015 \times \frac{1}{4}$ $= \$482.01$
Specific behaviours
✓ indicates use of correct rate and time ✓ correct interest

(c) After another currency exchange, the person placed $\$75\,000$ into a savings account paying 2.6% interest compounded monthly. Determine the interest that accumulated in this account during the first 6 months. (3 marks)

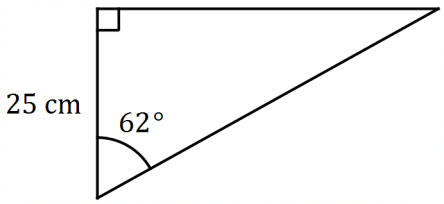
Solution
$F = 75\,000\left(1 + \frac{2.6}{100 \times 12}\right)^6$ $= 75\,000(1.00216)^6$ $= 75\,980.30$ $I = 75\,980.30 - 75\,000 = \$980.30$
Specific behaviours
✓ substitutes into future value formula ✓ correct future value ✓ correct interest, rounded to nearest cent

See next page

Question 10 **(6 marks)**

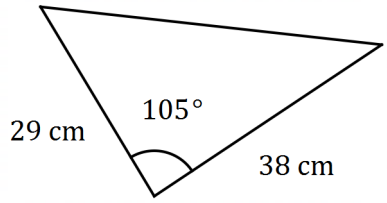
Determine, with justification, the area of each of the following triangles.

(a) (2 marks)



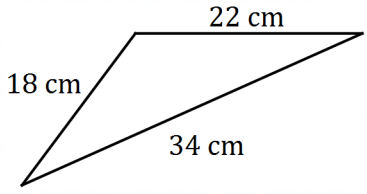
Solution
$\text{Opp} = 25 \times \tan 62° = 47.0 \text{ cm}$ $A = \frac{1}{2} \times 25 \times 47$ $= 588 \text{ cm}^2$
Specific behaviours
✓ determines side opposite angle ✓ correct area

(b) (2 marks)



Solution
$A = \frac{1}{2}(29)(38)\sin 105°$ $= 532 \text{ cm}^2$
Specific behaviours
✓ substitutes correctly ✓ correct area

(c) (2 marks)



Solution
$s = \frac{18 + 22 + 34}{2} = 37$ $A = \sqrt{37(37-18)(37-22)(37-34)}$ $= 178 \text{ cm}^2$
Specific behaviours
✓ calculates semi-perimeter ✓ correct area

See next page

Question 11 **(7 marks)**

A survey of the ages, x, of 300 football fans at a recent match gave rise to the following data.

Age group	Frequency
$18 \leq x < 30$	54
$30 \leq x < 40$	60
$40 \leq x < 50$	63
$50 \leq x < 60$	75
$60 \leq x < 80$	48

(a) Explain why it is necessary to use the interval midpoint of each age group when calculating the mean age of the fans. (1 mark)

Solution
Ages have been grouped and so it is assumed that all fans in each group have the age of the interval midpoint.
Specific behaviours
✓ reasonable explanation

(b) State the interval midpoint for the age group $60 \leq x < 80$. (1 mark)

Solution
Interval midpoint is 70 years.
Specific behaviours
✓ correct value

(c) Determine the mean and standard deviation of the ages of the fans in the survey, rounding your values to 2 decimal places. (3 marks)

Solution
$\bar{x} = 45.72, \quad \sigma_x = 14.96$
Specific behaviours
✓ mean ✓ sd ✓ correctly rounds

It was later discovered that of the 48 fans aged 60 or more, one was aged 75 and all the others were younger than 64.

(d) Use this information to determine better estimates for the mean and standard deviation of the ages of the fans in the survey. (2 marks)

Solution
Modify last class to $60 - 64, f = 47$ and add class $75, f = 1$. $\bar{x} = 44.48, \quad \sigma_x = 13.13$
Specific behaviours
✓ new mean ✓ new sd

See next page

Question 12 **(11 marks)**

Every month a small business runs 15 information seminars for prospective customers. The number of people attending the seminars in two consecutive months is summarised below, where the largest turnout for a June seminar was 82 people.

Attendances in May (LHS) and June (RHS)

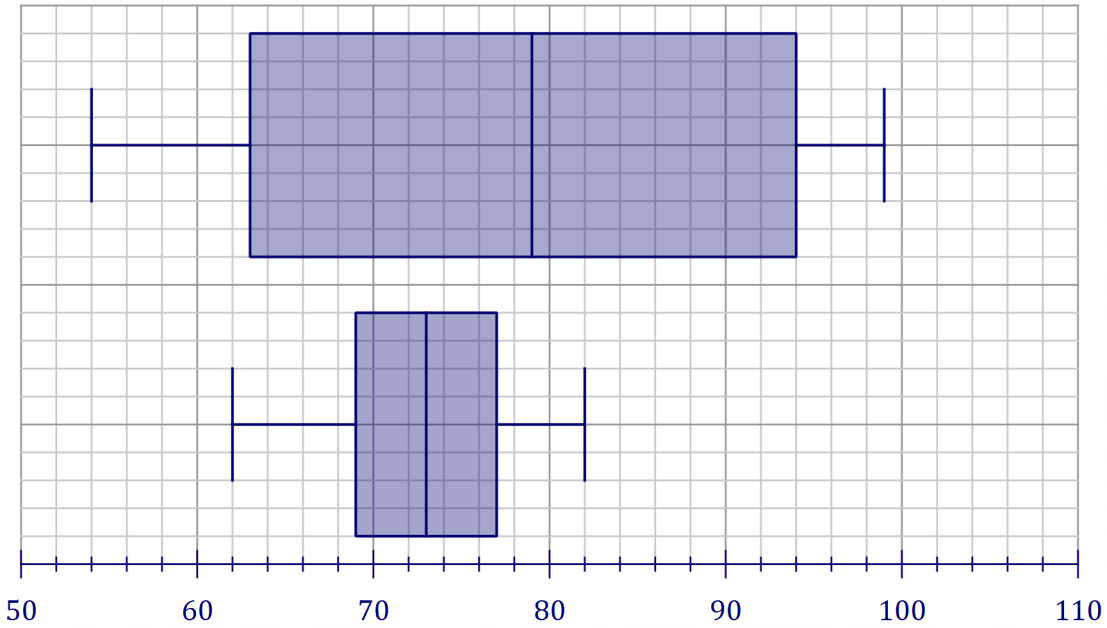
7 4	5	
7 3 2	6	2 4 6 9 9
9 9 7 0	7	1 2 3 4 4 6 7 8
9 5	8	1 2
9 9 7 4	9	

(a) Determine the range of attendance figures for May. (2 marks)

Solution
Range $= 99 - 54 = 45$ people
Specific behaviours
✓ identifies minimum and maximum values
✓ correct range

(b) Construct parallel boxplots for the May and the June attendances on the grid below. (6 marks)

Attendances in May (Top) and June (Bottom)



Solution
See graph
Specific behaviours
✓✓ median and whiskers for each month
✓✓ box for each month
✓ scale shown
✓ key or other indication for each month

See next page

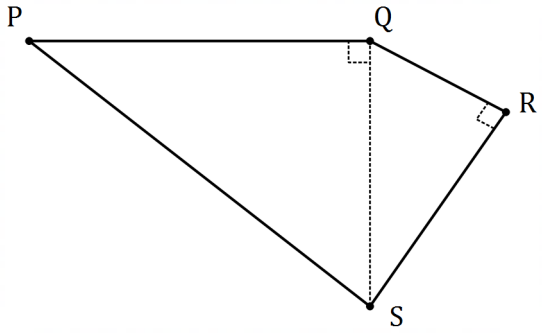
(c) Compare the attendance figures for May with those of June. (3 marks)

Solution
May had higher attendance figures than June as the median for May (79) is higher than the median for June (73). Attendance figures were much more spread out in May than June as the IQR for May (31) was much higher than for June (8). Neither month had any unusual number of attendances as no outliers are evident. The distribution of attendances for both months were fairly evenly spread as evidenced by the lack of skew in the plots.
Specific behaviours
✓ compares location using medians ✓ compares spread using IQR ✓ compares third factor such as outliers or skew

See next page

Question 13 **(7 marks)**

A field is bounded by four straight fences PQ, QR, RS and SP as shown below, where $QR = 120$ m, $RS = 160$ m, $SP = 290$ m and $\angle PQS = \angle QRS = 90°$.



(a) Determine the distance QS. (1 mark)

Solution
$QS = \sqrt{120^2 + 160^2}$ $= 200$ m
Specific behaviours
✓ correct length

(b) The fence around the field needs maintenance at a cost of $\$1.15$ per metre. Determine the cost of this maintenance. (3 marks)

Solution
$PQ = \sqrt{290^2 - 200^2}$ $= 210$ m $P = 120 + 160 + 290 + 210 = 780$ m $C = 780 \times 1.15 = \$897$
Specific behaviours
✓ length PQ ✓ perimeter ✓ cost

(c) The field was recently sprayed with a treatment at a total cost of $\$382.50$. Calculate the cost, in cents per square metre, of this treatment. (3 marks)

Solution
$A_{QRS} = \frac{1}{2} \times 120 \times 160 = 9\,600$ $A_{PQS} = \frac{1}{2} \times 200 \times 210 = 21\,000$ $A = 9\,600 + 21\,000 = 30\,600$ m^2 Cents per m $= 38\,250 \div 30\,600 = 1.25$ c/m^2
Specific behaviours
✓ area of one triangle ✓ area of second triangle and total ✓ cents per square metre

See next page

Question 14 **(8 marks)**

A person is considering a choice of two caterers to supply snacks for an office party. Caterer A charges $\$20$ per person plus a once-off booking fee of $\$150$.

(a) Calculate the cost of using caterer A when

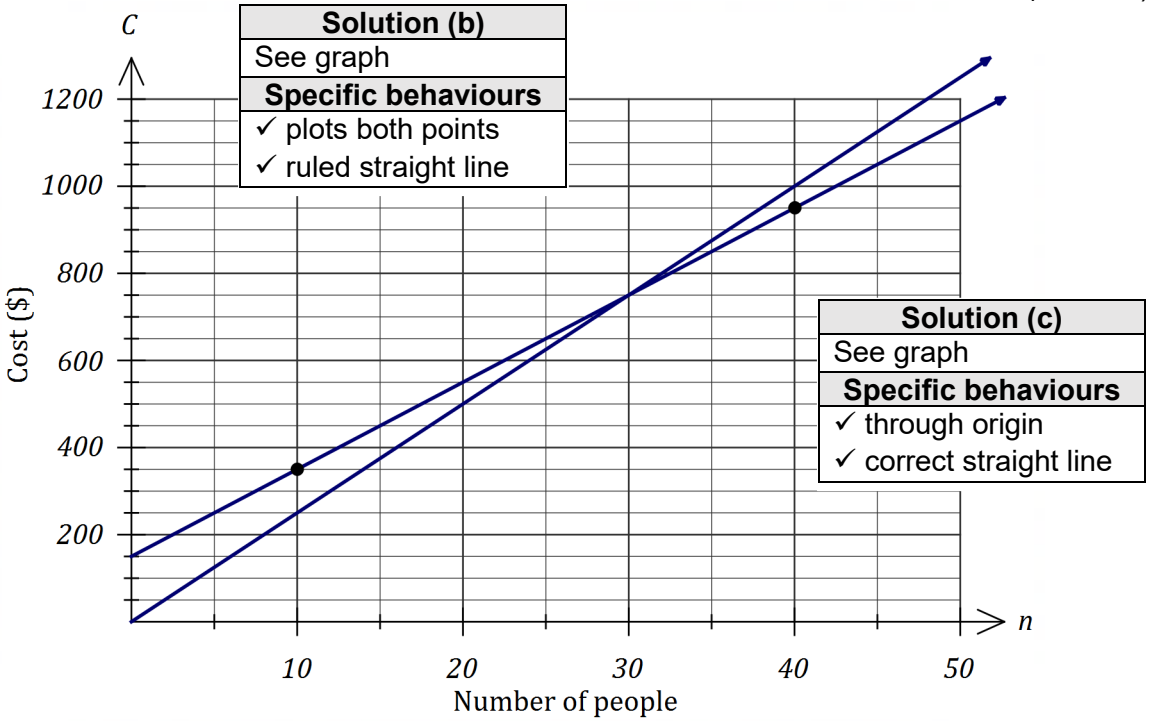
(i) 10 people are expected to attend. (1 mark)

Solution
$C = 20 \times 10 + 150 = \$350$
Specific behaviours
✓ correct cost

(ii) 40 people are expected to attend. (1 mark)

Solution
$C = 20 \times 40 + 150 = \$950$
Specific behaviours
✓ correct cost

(b) Plot the two catering costs from (a) on the axes below and draw a straight line through them. (2 marks)



Solution (b)
See graph
Specific behaviours
✓ plots both points
✓ ruled straight line

Solution (c)
See graph
Specific behaviours
✓ through origin
✓ correct straight line

Caterer B simply charges $\$25$ per person.

(c) Add a line to the graph above to represent the cost of using caterer B. (2 marks)

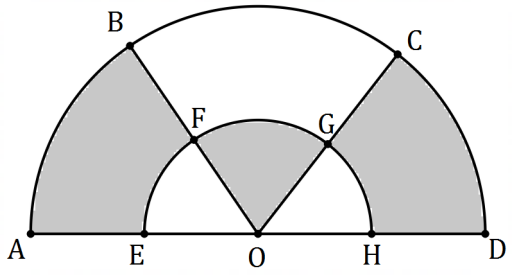
(d) Write a brief statement to the person recommending which caterer to use if minimising the cost was the only consideration. (2 marks)

Solution
Both caterers cost the same for 30 people, but for less than 30 people use B and for more than 30 use A.
Specific behaviours
✓ indicates cost same for 30 people
✓ correct recommendations

See next page

Question 15 **(8 marks)**

The shaded areas in the diagram below form a logo for a business. $OABCD$ is a semicircle with radius $OA = 30$ cm and $\angle AOB = \angle BOC = \angle COD$. The inner semicircle has radius $OE = 14$ cm.



(a) Determine the area of the sector OFG. (2 marks)

Solution
Area of inner semicircle $= \frac{1}{2}\pi \times 14^2 = 307.9$ Area of sector $= 307.9 \div 3 = 102.6 \text{ cm}^2$
Specific behaviours
✓ area of semicircle ✓ area of sector

(b) Determine the total shaded area. (3 marks)

Solution
Area of sector $OAB = \frac{1}{2}\pi \times 30^2 \div 3 = 471.2$ Area of $ABFE = 471.2 - 102.6 = 368.6$ Total shaded area $= 2 \times 368.6 + 102.6 = 839.8 \text{ cm}^2$
Specific behaviours
✓ sector area ✓ area of $ABFE$ ✓ total area

(c) Determine the shaded area in a copy of the logo that is enlarged by a scale factor of 5 for use on a flag, giving your answer in square metres. (3 marks)

Solution
New area $= 5^2 \times 839.8$ $= 20995 \text{ cm}^2$ $20995 \div 10\,000 \approx 2.1 \text{ m}^2$
Specific behaviours
✓ indicates area scale factor ✓ area in sq cm ✓ area in sq m

See next page

Question 16 **(7 marks)**

The lifetimes of a type of heating element are normally distributed with a mean of 455 hours and a standard deviation of 32 hours.

(a) State the percentage of elements that are expected to have a lifetime within two standard deviations of the mean. (1 mark)

Solution
95%
Specific behaviours
✓ correct percentage

(b) Determine the standard score for an element that lasts for 433 hours. (2 marks)

Solution
$z = \dfrac{433 - 455}{32}$ $= -0.6875$
Specific behaviours
✓ correct method ✓ correct score

(c) Determine the probability that a randomly selected element will have a lifetime

(i) of less than 433 hours. (1 mark)

Solution
$P = 0.246$
Specific behaviours
✓ correct probability

(ii) of more than 510 hours. (1 mark)

Solution
$P = 0.043$
Specific behaviours
✓ correct probability

(iii) within 25 hours of the mean lifetime. (2 marks)

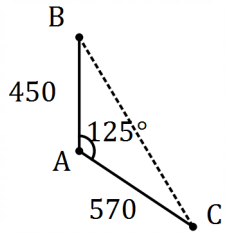
Solution
$455 \pm 25 = [430, 480]$ $P = 0.565$
Specific behaviours
✓ correct bounds ✓ correct probability

See next page

Question 17 **(8 marks)**

Three small huts lie on level ground. Hut B lies 450 m due north of hut A and hut C lies 570 m from hut A on a bearing of $125°$.

(a) Sketch a diagram to show this information. (2 marks)

Solution

Specific behaviours
✓ triangle roughly to scale ✓ correct measurements

(b) The huts are equipped with radios that have a range of 800 m. Showing use of trigonometry, determine whether huts B and C can communicate by radio. (3 marks)

Solution
$BC^2 = 450^2 + 570^2 - 2(450)(570)\cos 125°$ $BC = 906 \text{ m}$ No, cannot communicate as huts are more than 800 m apart.
Specific behaviours
✓ substitutes into cosine rule ✓ calculates distance apart ✓ states huts cannot communicate

(c) Showing use of trigonometry, determine the bearing of hut C from hut B. (3 marks)

Solution
$\frac{906}{\sin 125°} = \frac{570}{\sin B}$ $\angle B = 31°$ Bearing is $180 - 31 = 149°$
Specific behaviours
✓ substitutes into sine rule ✓ calculates angle ✓ correct bearing

See next page

Question 18 **(9 marks)**

A shop usually sells the same brand of AAA batteries in packs of 4, 8 and 14 for $\$7.95, \$13.90$ and $\$19.92$ respectively, but currently has the 4-packs and 8-packs on sale at 20% off.

(a) Determine the total price and hence the average price per battery for 18 batteries when a customer buys a 4-pack and a 14-pack in the sale. (3 marks)

Solution
Price of 4-pack $= 7.95 \times 0.8 = \$6.36$ Total batteries: $= 4 + 14 = 18$ Total price $= 6.36 + 19.92 = 26.28$ Price per battery $= 26.28 \div 18 = \$1.46$
Specific behaviours
✓ sale price for 4-pack ✓ price and battery totals ✓ average price per battery

(b) Use the sale prices to rank the pack sizes in order of value from best to worst. (3 marks)

Solution
4-pack: $6.36 \div 4 = \$1.59$ ea 14-pack: $19.92 \div 14 = \$1.42$ ea 8-pack: $13.9 \times 0.8 = 11.12 \Rightarrow 11.12 \div 8 = \$1.39$ ea Value ranking from best to worst: 8-pack, 14-pack, 4-pack.
Specific behaviours
✓ cost per battery for 4-pack and 14-pack ✓ cost per battery for 8-pack ✓ correct ranking

(c) The shop buys a carton containing 36 of the 14-packs from a wholesaler for $\$420.48$ excluding GST. The shop then adds their profit margin of $k\%$ and another 10% GST to arrive at the advertised pack price above. Determine the value of k. (3 marks)

Solution
Cost of one 14-pack $= 420.48 \div 36 = 11.68$ Let $1 + k\% = r$, so that $11.68 \times r \times 1.10 = 19.92$ Hence $r = 1.550$ and so the profit margin k is 55%.
Specific behaviours
✓ wholesale price of one pack ✓ writes equation to arrive at selling price ✓ correct profit margin

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Question 19 **(6 marks)**

Entry fees at a mini-golf course for children, adults and seniors are $\$6.50, \$12.00$ and $\$7.25$ respectively. The following table shows the breakdown of the number of paying customers at the course over three days.

Day	Children	Adults	Seniors
Friday	12	63	51
Saturday	35	82	27
Sunday	42	75	33

(a) Use two matrices to write a calculation that will result in matrix M, where M shows the total entry fees collected on each of the three days and determine M. (3 marks)

Solution
$M = \begin{bmatrix} 12 & 63 & 51 \\ 35 & 82 & 27 \\ 42 & 75 & 33 \end{bmatrix} \times \begin{bmatrix} 6.50 \\ 12.00 \\ 7.25 \end{bmatrix} = \begin{bmatrix} 1203.75 \\ 1407.25 \\ 1412.25 \end{bmatrix}$
Specific behaviours
✓ matrix M ✓ price column matrix ✓ result, as matrix

(b) Matrix M can be multiplied by matrix N to produce a 1×1 matrix that shows the sum of all entry fees collected over the three days. Write down N. (1 mark)

Solution
$N = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$
Specific behaviours
✓ correct row matrix

(c) Use two matrices to write a calculation that will result in matrix P, where P shows the total number of patrons in each fee category over the three days and determine P. (2 marks)

Solution
$P = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} \times \begin{bmatrix} 12 & 63 & 51 \\ 35 & 82 & 27 \\ 42 & 75 & 33 \end{bmatrix} = \begin{bmatrix} 89 & 220 & 111 \end{bmatrix}$
Specific behaviours
✓ shows calculation using matrices ✓ result, as matrix

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Question 20 **(7 marks)**

Employees at a card yard can opt to have their gross wage calculated in one of two ways:

- Option A - commission of 1.6% of their weekly sales.
- Option B - commission of 1.1% of their weekly sales plus $\$350$ per week.

(a) Determine the gross weekly wage for an employee choosing

(i) option A in a week when their sales were $\$125\,500$. (1 mark)

Solution
$125500 \times 0.016 = \$2\,008$
Specific behaviours
✓ correct wage

(ii) option B in a week when their sales were $\$78\,250$. (1 mark)

Solution
$78250 \times 0.011 + 350 = \$1\,210.75$
Specific behaviours
✓ correct wage

(b) The gross weekly wage for an employee using option B was $\$812$. Determine the weekly sales this employee made. (2 marks)

Solution
x is weekly sales: $0.011x + 350 = 812$ $x = \$42\,000$
Specific behaviours
✓ writes equation ✓ correct sales figure

(c) Explain which option is best, depending on an employee's weekly sales. (3 marks)

Solution
$0.016x = 0.011x + 350$ $x = \$70\,000$ For weekly sales of $\$70\,000$, both options are the same. For more than this, option A is better and for less, option B is better.
Specific behaviours
✓ forms equation ✓ determines sales for options to be equal ✓ explains which is better

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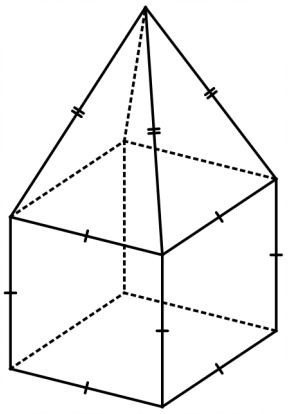
Question 21 **(8 marks)**

A solid monument built on level ground has the form of a pyramid mounted on a cubical base with sides of length 4.8 m as shown below (not to scale). The vertex of the pyramid is 4.5 m directly above the centre of its square base.



(a) Determine the volume of the monument, to the nearest cubic metre. (3 marks)

Solution
$V_{CUBE} = 4.8^3 = 110.592$ $V_{PYR} = \frac{1}{3}(4.8^2)(4.5) = 34.56$ $V = 110.592 + 34.56 = 145.152 \approx 145 \text{ m}^3$
Specific behaviours
✓ volume of cube ✓ volume of pyramid ✓ total volume, rounded

(b) Determine the total surface area of the monument, excluding its square base that rests on the ground. (5 marks)

Solution
Perpendicular height of triangular face: $h^2 = 4.5^2 + 2.4^2$ $h = 5.1 \text{ m}$ $A_{TRI} = \frac{1}{2}(4.8)(5.1) = 12.24$ $A_{SQ} = 4.8^2 = 23.04$ $TSA = 4 \times 12.24 + 4 \times 23.04$ $= 141.12 \text{ m}^2$
Specific behaviours
✓ indicates use of Pythagoras to determine h ✓ correct value of h ✓ area of one triangular face ✓ area of one square ✓ correct total surface area

End of questions