Mathematics A

2018 Senior External Examination: Assessment report

Statistics

Year	Number of candidates	Level of achievement				
		VHA	HA	SA	LA	VLA
2018	59	14	16	16	10	3
2017	70	11	19	24	12	4
2016	53	12	12	14	11	4
2015	70	10	25	21	9	5
2014	83	7	28	26	13	9

General comments

Candidate communication improved significantly this year, with candidates showing full justification and mathematical working for their solutions. Candidates also made better attempts at the Question 4 topics in both papers. However, in the Managing money topic, candidates demonstrated many gaps in their knowledge of some concepts.

In contrast, fewer candidates provided no response to a question across both papers. Candidates who failed to demonstrate a C standard in *Knowledge and procedures* generally answered insufficient questions across contexts.

Knowledge and procedures

Candidates generally provided good-quality responses to all questions with the exception of Questions 1d, 2c and 3a(i) in Paper Two. Candidates showed a lack of understanding of the core concepts in these questions.

In the optional Navigation and Operations research topics, candidate responses generally showed strong knowledge and understanding of these concepts.

Modelling and problem solving

Candidate responses mostly demonstrated the C standard across the core strands. However, candidates were often unable to correctly analyse and interpret a given situation (e.g. Question 3a in Paper One) with responses commonly stating the values of the required measures rather than comparing the difference between them. A lack of understanding of holiday loading (Question 1c(iii) in Paper One) and shares and dividends (Question 1e in Paper Two) was clearly evident.

In Question 1f(iii) in Paper Two, candidates were unable to show an understanding of the differences between diminishing and straight-line depreciation. Question 3c was incorrectly interpreted, with some candidates unable to demonstrate the understanding required to determine the number of metres, and hence cost, of carpet required for a house given a scale plan (Linking two and three dimensions LE 6).

Many candidates did quite well in recognising the strengths and limitations of models but were unable to correctly interpret the effects on the given scenario in Question 2g(ii) in Paper One.

Communication and justification

Nearly all candidates showed significant improvement in appreciating the need to justify their solutions, providing correct formulas and notation within their responses. Candidates clearly showed working steps and gave concise explanations in written responses. Worded responses were more frequently and appropriately given this year.

Candidates mainly failed in communication and justification when they did not use correct notation (e.g. writing money incorrectly, not using correct units in measurement) and when their extended responses (e.g. Question 1e in Paper Two) lacked organisation of information and mathematical reasoning.

Marker responses

The sample solutions on the following pages show possible ways of successfully responding to the questions. Other approaches and problem-solving strategies may be equally valid.

Paper One

Paper One has **four** extended-response questions. Attempt **all** questions.

Write your responses in the spaces provided. **Show full working in all responses. Partial credit can only be awarded if working is shown.**

Additional pages for responses are at the back of this book.

Question 1

a. Tom bought a ticket for an event for \$30, but could not go, so sold the ticket for \$21.

Calculate the percentage loss on the sale of the ticket. (KP)

Loss = \$30 - \$21
= \$9

$$\% \text{ Loss} = \frac{Loss}{Original} \times 100$$

$$= \frac{\$9}{\$30} \times 100$$

$$= 30\%$$

∴ **Percentage loss** = 30%.

b. Sally worked as security at an event. Her normal rate of pay was \$26.40 per hour. Overtime is paid at time and a half for the first two hours over 38 hours, then double time thereafter.

Calculate Sally's wage in a week when she worked for 60 hours. (KP)

Normal pay:	$38 \times \$26.40$	= \$1003.20
Time-and-a-half:	$2 \times \$26.40 \times 1.5$	= \$79.20
Double-time:	$20 \times \$26.40 \times 2$	= \$1056
Total:		**\$2138.40**

∴ **Sally's total wage for the week was \$2138.40**

c. i. Calculate the gross fortnightly wage for Anne who has annual earnings of \$124 897. (KP)

$$\text{Gross fortnightly wage} = \frac{\$124897}{26}$$

$$= \$4803.73$$

ii. Use the tax table below to calculate the amount of Anne's fortnightly PAYG tax. Include in your calculation the Medicare levy of 2%. (KP)

Taxable income	Tax on this income
0–$18 200	Nil
$18 201–$37 000	19¢ for each $1 over $18 200
$37 001–$87 000	$3572 plus 32.5¢ for each $1 over $37 000
$87 001–$180 000	$19 822 plus 37¢ for each $1 over $87 000
$180 001 and over	$54 232 plus 45¢ for each $1 over $180 000

Tax Payable = $19822 + ($124897 - $87000) × 0.37
= $19822 + $37897 × 0.37
= $33843.89

Medicare Levy = $\frac{2}{100} \times \$124897$
= $2497 94

Fortnightly PAYG Tax = $\frac{Total\ Tax}{26}$

= $\frac{\$33843.89+\$2497.94}{26}$

= $\frac{\$36341.83}{26}$

= **$1397.76**

iii. Anne has planned an overseas trip for her 4 weeks annual leave. The cost of the trip is $9 150. She has paid a deposit of $2 500.

Anne receives 17.5% holiday loading (which is free of tax) on her 4 weeks annual leave. She has weekly expenses of $200.18 and union fees of $11.70 that will continue while she is overseas.

Using only the **net pay** Anne will receive when she goes on her 4 weeks leave, determine if she will have sufficient money to finish paying for her overseas trip **and** have spending money while she is away. (MP)

Remaining cost of trip = $9150 - $2500
= $6650

4 weeks wages = $4803.73 × 2
= $9607.46

Holiday loading = $\frac{17.5}{100} \times \$9607.46$
= $1681.31

Expenses for the 4 weeks = $1397.76 × 2 + $200.18 × 4 + $11.70 × 4
= $2795.52 + $800.72 + $46.80
= $3643.04

Net pay = Earnings - expenses
= $9607.46 + $1681.31 - $3643.04
= $11288.77 - $3643.04
= $7645.73

Remaining money for spending = $7645.73 - $6650
= $995.73

∴ **Anne will have sufficient money to finish paying for her trip and have $995.73 spending money.**

d. Jim sells second-hand cars on commission of 5%. Calculate the amount of commission Jim will receive if he sells cars to a total value of $16 590. (KP)

$$\text{Commission} = \frac{5}{100} \times \$16590$$
$$= \$829.50$$

$\therefore$ **Jim will receive $829.50 commission.**

e. A shop marks its shirts up by 45% of the wholesale price. These shirts were then sold at a 12.5% discount at the sale price of $19. Calculate the original wholesale price of the shirts. (KP)

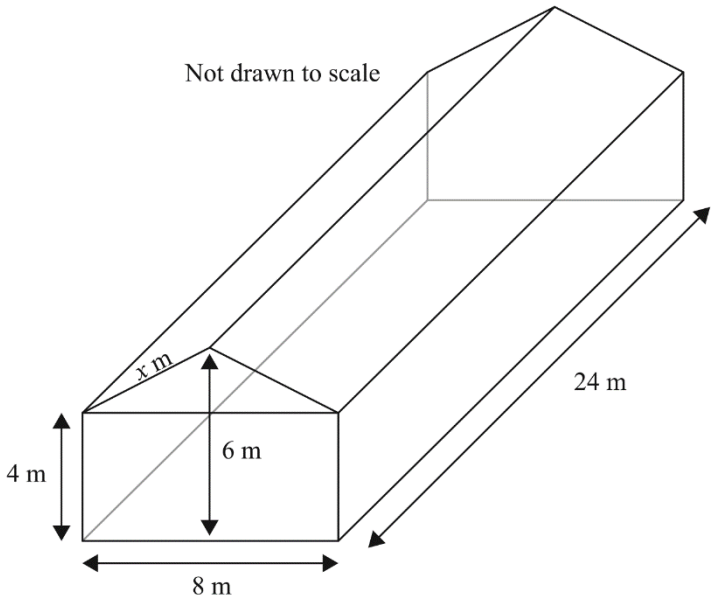
$$\text{Mark-up price} = \frac{\$19}{0.875}$$
$$= \$21.71$$

$$\text{Wholesale price} = \frac{\$21.71}{1.45}$$
$$= \$14.97$$

$\therefore$ **the original wholesale price of the shirts is $14.97.**

Question 2

a. The building shown in the diagram is 8 metres wide and 24 metres long. The side walls are 4 metres high. The peak of the roof is 6 metres vertically above the ground.



i. Use Pythagoras' theorem to calculate the width of the roof panel x. (KP)

$$c^2 = a^2 + b^2$$
$$x^2 = 4^2 + 2^2$$
$$x^2 = 20$$
$$x = \sqrt{20}$$
$$x = 4.472136\,m$$

$\therefore$ **the width of the roof is 4.47 metres.**

ii. Calculate the total area of material needed to make the roof and all of the walls of this building. (KP)

$$\begin{aligned}\text{Amount of material} &= 2 \text{ ends} + 2 \text{ sides} + 2 \text{ roofs}\\ &= 2(\tfrac{1}{2} \times 8 \times 2) + (4 \times 8)) + 2(4 \times 24) + 2(4.47 \times 24)\\ &= 2(\quad 8 \quad + \quad 32 \quad) + \quad 2(96) \quad + \quad 2(107.28)\\ &= \quad 80 \quad\quad\quad + \quad 192 \quad + \quad 214.56\\ &= 486.56\ m^2\end{aligned}$$

$\therefore$ **$486.56\ m^2$ of material is needed to make this building.**

b. A ramp to an entrance is 6 metres in length. The rise of the ramp is 70 centimetres.

Calculate the angle the ramp makes with the ground. (KP)

$$\sin\theta = \frac{opp}{hyp}$$

$$\sin\theta = \frac{0.7}{6}$$

$$\theta = \sin^{-1}\left(\frac{0.7}{6}\right)$$

$$\theta = 6.7°$$

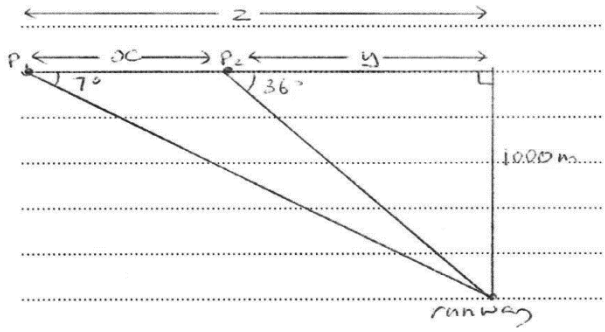
$$\theta = 7°$$

$\therefore$ **the ramp makes an angle of 7° with the ground.**

c. A plane at a height of 1 000 metres sights the runway at an angle of depression of 7°.

The plane continues flying at the same height towards the runway, which is later sighted at an angle of depression of 36°.

Calculate the distance that the plane travelled between sightings. (KP)



To calculate z:

$$\tan 7° = \frac{opp}{adj}$$

$$\tan 7° = \frac{1000}{z}$$

$$z = \frac{1000}{\tan 7°}$$

$$z = 8144.35\ m$$

To calculate y:

$$\tan 36° = \frac{opp}{adj}$$

$$\tan 36° = \frac{1000}{y}$$

$$y = \frac{1000}{\tan 36°}$$

$$y = 1376.38\ m$$

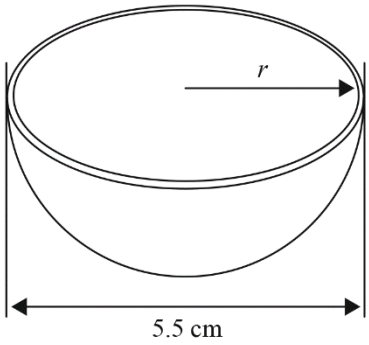
$$\begin{aligned}\text{Distance travelled} &= z - y\\ &= 8144.35 - 1376.38\\ &= 6767.96 \text{ m}\end{aligned}$$

$\therefore$ **the distance the plane travelled between sightings is 6767.96 m.**

d. A chocolate egg in the shape of a **sphere** has an external diameter of 5.5 cm. The chocolate has a thickness of 2 mm and the egg is hollow inside. The diagram below shows the egg cut in half.

Not drawn to scale.

The chocolate is 2 mm thick.



i. What is the internal radius of the egg? (KP)

$$\text{Internal radius} = \frac{5.5-2(0.2)}{2}$$
$$= \frac{5.1}{2}$$
$$= 2.55 \text{ cm}$$

ii. Calculate the volume of chocolate needed to make the whole egg. (KP)

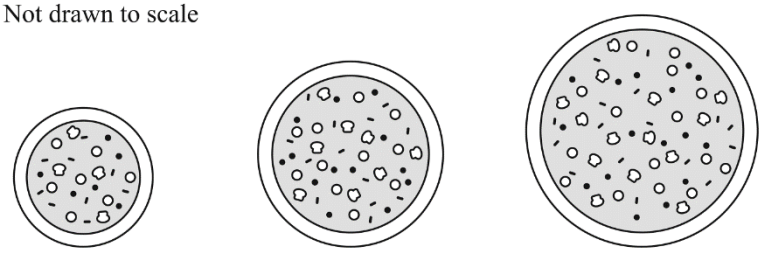
$$\text{Inside volume} = \frac{4}{3}\pi r^3 \qquad \text{Outside volume} = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3} \times \pi \times 2.55^3 \qquad = \frac{4}{3} \times \pi \times (\frac{5.5}{2})^3$$
$$= 69.45590118\ cm^3 \qquad = 87.11374629\ cm^3$$

$$\text{Volume of shell} = \text{Outside volume} - \text{Inside volume}$$
$$= 87.11374629 - 69.45590118$$
$$= 17.65784511\ cm^3$$

$\therefore$ 17.66 cm^3 of chocolate is needed to make this egg.

e. Three different pizza sizes and their diameters are shown below. Every pizza has a height of 5 cm.

Not drawn to scale



Mini
15 cm diameter

Standard
20 cm diameter

Large
25 cm diameter

A standard pizza box used for the large-size pizza has the dimensions shown.

Not drawn to scale

i. Calculate the volume of empty space when a large pizza is put in the pizza box. (KP)

Volume box $= L \times W \times H$
$= 30 \times 30 \times 5$
$= 4500\ cm^3$

Volume of pizza $= \pi r^2 h$
$= \pi \times 12.5^2 \times 5$
$= 2454.369261\ cm^3$

Leftover space = Volume of box - Volume of pizza
= 4500 - 2454.369261
= 2045.63 cm^3

$\therefore$ 2045.63 cm^3 of leftover space when the pizza is in the box.

ii. If a pizza box must have a height of 5 cm and a square base, determine the base dimensions of a box that could be used for the mini pizza that would have the same percentage of empty space as the large pizza. (MP)

$$\begin{aligned}\%\text{ of leftover space in large pizza box} &= \frac{leftover\ space}{volume\ of\ box} \times 100\\ &= \frac{2045.63}{4500} \times 100\\ &= 45.458\ \%\end{aligned}$$

$$\begin{aligned}\text{Volume of mini pizza} &= \pi r^2 h\\ &= \pi \times 7.5^2 \times 5\\ &= 883.5729338\ cm^3\end{aligned}$$

$$\begin{aligned}54.54\ \%\text{ of pizza box} &= 883.5729338\\ 0.5454 \times \text{pizza box} &= 883.5729338\\ \text{pizza box} &= \frac{883.5729338}{0.5454}\\ \text{pizza box} &= 1620\ cm^2\end{aligned}$$

$$\begin{aligned}\text{Volume of mini pizza box} &= s^2 \times h\\ 1620 &= s^2 \times 5\\ s^2 &= \frac{1620}{5}\\ s^2 &= 324\\ s &= \sqrt{324}\\ s &= 18\text{ cm}\end{aligned}$$

∴ the mini pizza box must have a square base of side lengths 18 cm.

f. i. Find the distance to the nearest kilometre between Washington DC (39° N, 77° W) in the United States and Lima (12° S, 77° W) in Peru. (KP)

$$\begin{aligned}\text{Angle difference} &= 39° + 12°\\ &= 51°\end{aligned}$$

$$\begin{aligned}\text{Distance} &= \text{angle difference} \times 111.2\\ &= 51 \times 111.2\\ &= 5671.2\text{ km}\end{aligned}$$

∴ there are 5671 km between Washington and Lima.

ii. Toni lives in Vancouver (50° N, 122° W) and wants to ring her mother who lives in Lima. If Toni rings her mother at 8 am Vancouver time, what time is it in Lima? (KP)

$$\begin{aligned}\text{Angle difference} &= 122° - 77°\\ &= 45°\end{aligned}$$

$$\begin{aligned}\text{Time difference} &= 45 \times 4\\ &= 180\text{ mins}\\ &= 3\text{ hours}\end{aligned}$$

$$\begin{aligned}\text{Time in Lima} &= 8\text{am} + 3\text{ hours}\\ &= 11\text{am same day}\end{aligned}$$

∴ it is 11am in Lima.

g. A flight leaves Perth (32° S, 120° E) at 3 pm Wednesday bound for Cape Town (33° S, 15° E).

It is an 8-hour flight time and arrives in Cape Town on schedule.

i. Calculate the arrival time of the plane in Cape Town. (KP)

Perth time = 3pm Wednesday + 8 hours
= 11pm Wednesday

Time difference = $(120 - 15) \times 4$
= 105×4
= 420 mins
= 7 hours

Cape Town arrival time = 11pm Wednesday - 7 hours
= 4pm Wednesday

The pilot leaves Cape Town exactly 26 hours after he arrived for the return flight to Perth. Because of tailwinds, this flight time is only 7 hours.

A passenger on this return flight has a meeting in Perth at 9 am Friday.

ii. Determine if the passenger will be on time for the meeting. Fully justify your decision with mathematical reasoning.

List **one strength** and **one limitation** of this scenario. (MP)

Plane leaves Cape Town at 6pm Thursday

Arrival time (Cape Town time) = 6pm Thursday + 7 hours
= 1am Friday

Perth arrival time = 1am Friday + 7 hours
= 8am Friday

∴ **As meeting at 9am Friday the passenger has 1 hour to make the meeting.**

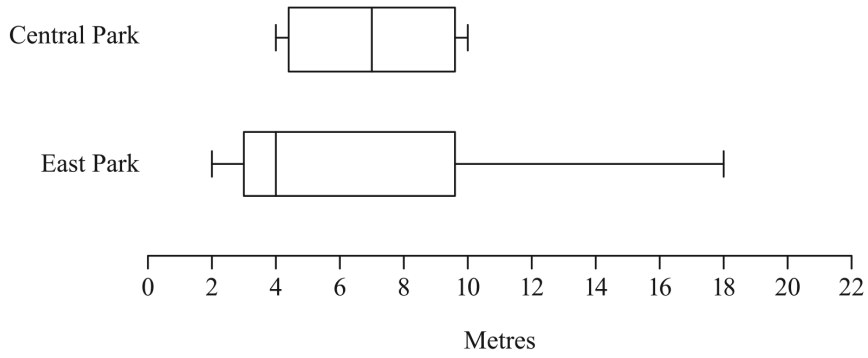
Strength: Can calculate expected time of arrival in Perth

Limitation:

- The flight path would need to be straight with no deviations or curves and no tail winds so the flight takes exactly 7 hours.
- To arrive in time for the meeting the plane must leave Cape Town at exactly 6pm on Thursday.
- There are no stopovers during the flight.

Question 3

a. The heights of trees in two large parks were measured and the data represented in the boxplots below.



Compare the range, median and interquartile distance of these two sets of data. (MP)

Range Central Park = 10 - 4 = 6

Range East Park = 18 - 2 = 16

Median Central Park = 7

Medium East Park = 4

IQR East Park = $Q_3 - Q_1$ = 9.5 - 4.5 = 5

IQR Central Park = $Q_3 - Q_1$ = 9.5 - 3 = 6.5

- Q_3 same for both parks
- Range for East Park greater than range for Central Park
- IQR for East Park greater than IQR for Central Park
- Median for Central Park higher than median for East Park

b. A group of people were surveyed and the results are summarised in the following table.

	Play tennis	Do not play tennis	Totals
Right-handed	53	81	134
Left-handed	22	29	51
Totals	75	110	185

i. Complete the Totals row and column in the above table. (KP)

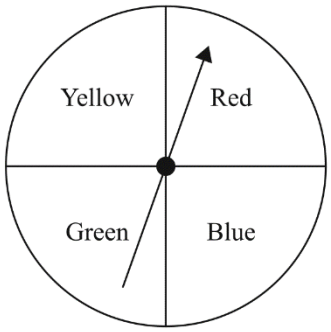
ii. Calculate the percentage of left-handed tennis players in this group of people. (KP)

% Left-handed players = $\frac{22}{185} \times 100$

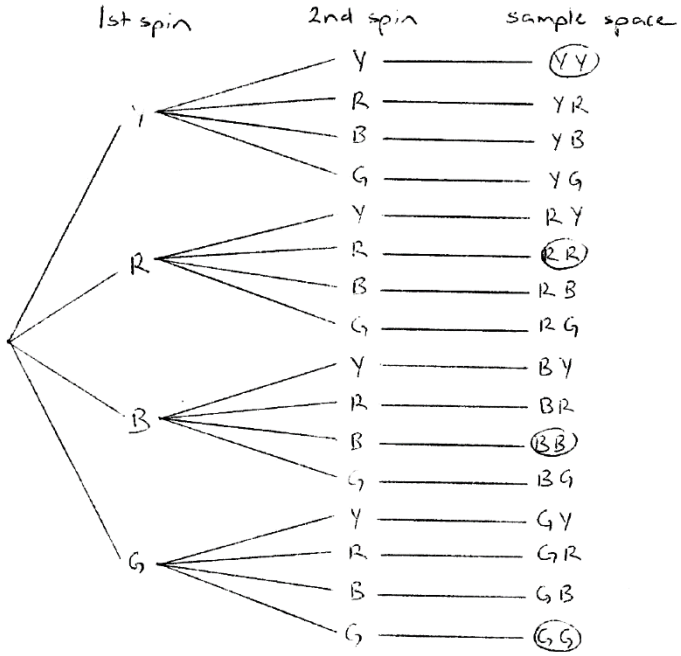
= 11.89%

∴ **there is 12% of left-handed tennis players in the group.**

c. The arrow is spun and will point to one of the four colours when it stops.



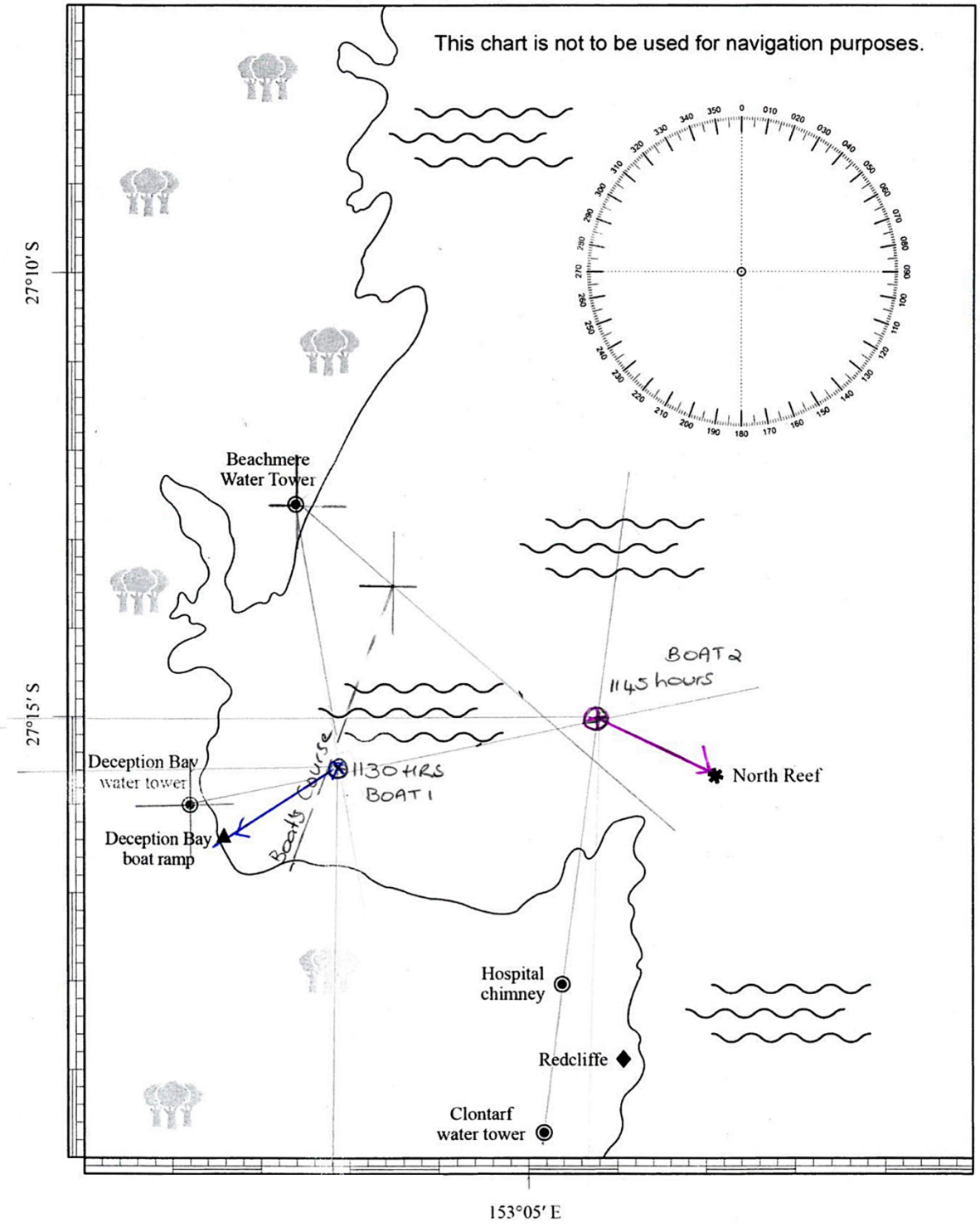
i. Draw a tree diagram to represent the outcomes when the arrow is spun twice. (KP)



ii. What is the probability that the arrow points to the same colour both times it stops? (KP)

$$\text{P(same colour)} = \frac{4}{16}$$
$$= \frac{1}{4}$$

Question 4



Question 4

a. i. A fishing boat was travelling on a course of 200° T at 2 knots. At 1030 hours, the water tower at Beachmere is sighted at a bearing of 310° T.

When the boat anchors at 1130 hours, the same water tower has a bearing of 350° T.

Use the map on the opposite page to plot the position of the boat at 1130 hours and write these coordinates in the space below. (KP)

$D = S \times T$
$D = 2 \times 1$
$D = 2$ n miles

Position at 1130 hours is 27° 15.6'S, 153° 02.8'E

ii. Another fishing boat anchors at 1145 hours and sights the Clontarf water tower and the hospital chimney in transit. At the same time the boat sights the Deception Bay water tower at a bearing of 260° T.

Use the map on the opposite page to plot the position of the second boat and write these coordinates in the space below. (KP)

Position at 1145 hours is 27° 15'S, 153° 05.6'E

iii. At 1400 hours both boats decide to move their positions. The first boat heads directly back to the Deception Bay boat ramp, while the second boat heads to North Reef for some more fishing. Both boats travel at 2 knots.

By comparing distances, determine which boat will reach its destination first. Justify your decision with mathematical reasoning. (KP)

The first boat must travel a distance of 1.5 n miles.

The second boat must travel a distance of 1.4 n miles.

$\therefore$ **the second boat will reach its destination first as it has the shorter distance to travel.**

iv. Calculate the time each boat will reach its destination.

List **two limitations** that may affect the arrival times of these boats. (MP)

1st Boat: Time travel in minutes

$T = \frac{D}{S}$

$T = \frac{1.5}{2}$

$T = 0.75$ hour

$T = 45$ mins

Reach ramp at 1400 + 45 mins = 2.45pm

2nd Boat: Travel time in minutes

$T = \frac{D}{S}$

$T = \frac{1.4}{2}$

$T = 0.7$ hour

$T = 42$ minutes

Reach ramp at 1400 + 42 mins = 2.42pm

Limitations:

- Tides
- Weather conditions
- Boat's speed must remain constant throughout the journey
- Boats must sail in a straight line

End of Paper One

Paper Two

Paper Two has **four** extended-response questions. Attempt all questions.

Write your responses in the spaces provided. **Show full working in all responses. Partial credit can only be awarded if working is shown.**

Additional pages for responses are at the back of this book.

Question 1

a. David invested $80 000 in an account paying 4.8% per annum interest compounding monthly.

i. How much will he have in his account at the end of 15 years? (KP)

$A = P(1 + r)^n$

$A = \$80000(1 + \frac{0.048}{12})^{15 \times 12}$

$A = \$164118.78$

$\therefore$ **David will have $164119 in his account after 15 years**

ii. How much interest will he have earned in that time? (KP)

$I = A - P$

$I = \$164119 - \$80000$

$I = \$84119$

$\therefore$ **David will have earned $84119 in interest.**

b. The purchase price for a car is $15 000.

A deposit of $3 000 is paid and the balance repaid with 36 monthly payments of $400.

Calculate the annual simple rate of interest. (KP)

Balance $= \$15000 - \$3000$
$= \$12000$

Total paid $= 36 \times \$400$
$= \$14400$

Interest $= \$14400 - \$12000$
$= \$2400$

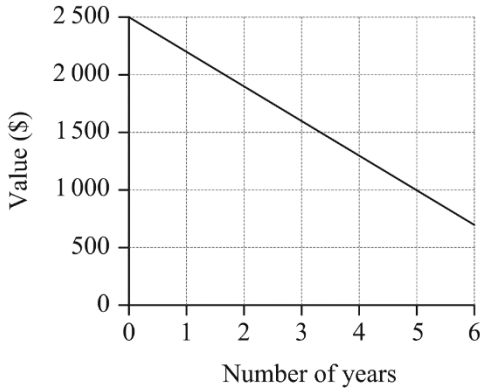
Rate: $R = \frac{100I}{PT}$

$R = \frac{100 \times 2400}{12000 \times 3}$

$R = 6.67\%$

$\therefore$ **the annual rate of simple interest is 6.67% p.a.**

c. A painting was purchased for $2 500 and depreciated in value over six years as shown in the graph below.



Determine the amount of yearly depreciation. (KP)

In 5 years, the painting depreciated by $2500 - $1000 = $1500

Yearly depreciation $= \frac{\$1500}{5}$

$= \$300$

∴ the annual amount of depreciation is $300.

d. A company has decided to distribute $63 million of its after-tax profit as dividends. If the company has issued 210 million shares, calculate the dividend payable on each share. (KP)

Dividend payable $= \frac{Total\ dividends}{Number\ of\ shares}$

$= \frac{\$63000000}{210000000}$

$= \$0.30$

∴ **the dividend payable on each share is $0.30**

e. An investor owns 6 000 50¢ shares. These shares have been paying a steady percentage dividend of 8.82% for many years and that is expected to continue. The shares have maintained the same market value of $1.47 that the investor paid.

The investor also invested $7 500 six years ago in an account earning simple interest and that amount is currently $8 800.

Determine which investment is the best performer for the investor. Justify your decision with mathematical reasoning.

State **one strength** and **one limitation** for each of the given investment situations. (MP)

$$\text{Account interest} = \$8800 - \$7500$$
$$= \$1300$$

$$\text{Annual rate} = \frac{100I}{PT}$$
$$= \frac{100 \times 1300}{7500 \times 6}$$
$$= \frac{130000}{45000}$$
$$= 2.9\% \text{ pa}$$

$$\%\ \text{Dividend} = \frac{Dividend}{Face\ value} \times 100$$
$$8.82 = \frac{Dividend}{\$0.50} \times 100$$
$$\text{Dividend} = \$0.0441$$

$$\%\ \text{yield} = \frac{Dividend}{Market\ price} \times 100$$
$$= \frac{\$0.0441}{\$1.47} \times 100$$
$$= 3\%$$

$\therefore$ **the investment is the worst performer by 0.1%**

Strength:

- % dividend known for shares to continue
- Amount of interest known

Limitation:

- Market value of share may change
- Interest rate of investment may change

f. A company purchased a machine for $60 000. This machine depreciates in value over time. Two methods of depreciation were considered by the company.

Method 1 — Straight line: The machine is depreciated by $6 000 per year.

Method 2 — Diminishing value: The machine is depreciated by 15% per year.

i. Find the value of the machine after 3 years using the diminishing value method. (KP)

$S = V_0 (1 - r)^n$

$S = 60000 (1 - 0.15)^3$

$S = 60000 \times 0.614125$

$S = \$36847.50$

∴ the value of the machine will be $36847.50

ii. Find out how many years it will take for the machine to reach a value of $12 000 using the straight-line method. (KP)

$S = V_0 - D_n$

$12000 = 60000 - 6000 \times n$

$6000n = 48000$

$n = 8$

∴ it will take 8 years to reach a value of $12000

iii. Determine the first year during which the value calculated using straight-line depreciation will be less than the value calculated using diminishing-value depreciation. (MP)

Trial and error may be used.

$$60000 (1 - 0.15)^n = 60000 - n \times 6000$$

$$60000 \times 0.85^n = 60000 - 6000n$$

$$0.85^n = 1 - \frac{n}{10}$$

$$n = 6 \text{ years}$$

Straight line:	Diminishing value:
$n = 6$	$n = 6$
$S = 60000 - 6 \times 6000$	$A = 60000(1 - 0.15)^6$
$S = \$24000$	$A = \$22629$
$n = 7$	$n = 7$
$S = 60000 - 7 \times 6000$	$A = 60000(1 - 0.15)^7$
$S = \$18000$	$A = \$19234.62$
$n = 8$	$n = 8$
$S = 60000 - 8 \times 6000$	$A = 60000(1 - 0.15)^8$
$S = \$12000$	$A = \$16349$

∴ at the end of **7 years** the value will be less using straight line depreciation

Question 2

a. The batting order for a cricket team and the number of runs scored by each player were recorded in the table below.

Batting order	A	B	C	D	E	F	G	H	I	J	K
Number of runs	16	10	11	8	7	4	4	5	3	1	1

Determine:

i. mean (KP)

$\overline{x} = 6.36$

ii. mode (KP)

1 and 4

iii. median (KP)

Median = 5

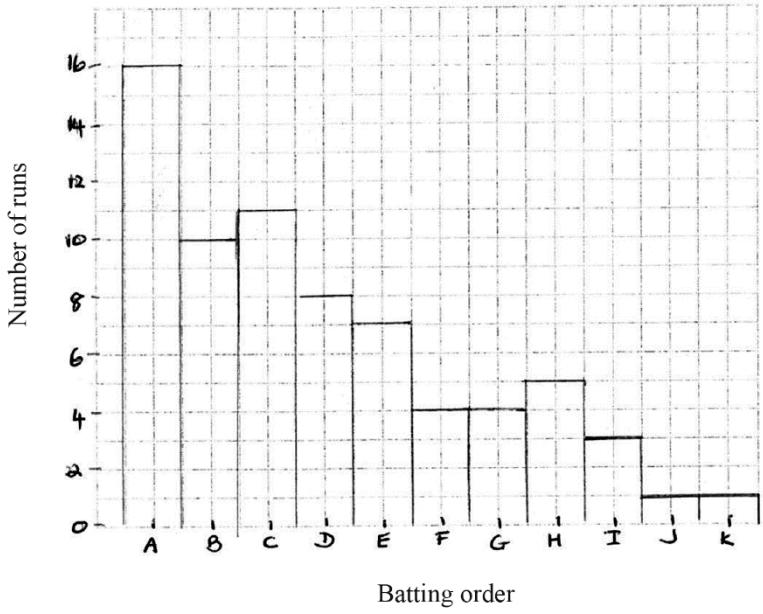
iv. range (KP)

Range = highest - lowest
Range = 16 - 1
Range = 15

v. sample standard deviation correct to two decimal places. (KP)

$S_x = 4.610265226$

vi. Using the grid below, draw a histogram to represent this data. (KP)



b. Identify each of the following types of data as continuous or discrete. (KP)

i. the number of students in your class Discrete

ii. the amount of rainfall that Brisbane received in June Continuous

c. Three of the following questions would be classified as leading or misleading. Circle the letter of the remaining question. (KP)

A Where do you like to party?

B How much can you save by shopping online?

C How many days in the last week did you eat breakfast?

D Do you think the radio or television is the best source of local news?

d. The following back-to-back stemplot shows the results for a class test.

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

Key: 1|2 = 12

i. Calculate the range and interquartile range for each group of boys and girls.

Interquartile range (KP)

Boys:

$IQR = Q_3 - Q_1$
$IQR = 23 - 12$
$IQR = 11$

Girls:

$IQR = Q_3 - Q_1$
$IQR = 25.5 - 13.5$
$IQR = 12$

Range (KP)

Boys:

Range = highest - lowest
Range = 35 - 8
Range = 27

Girls:

Range = highest - lowest
Range = 34 - 6
Range = 28

ii. Determine the five-number summary for each group of boys and girls. (KP)

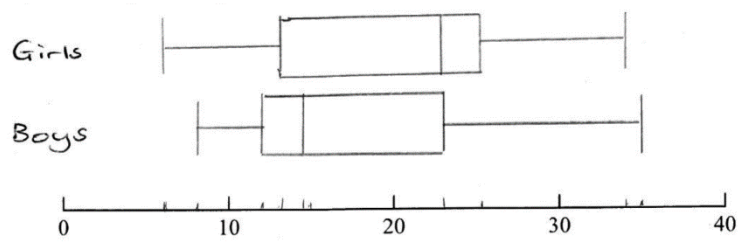
Boys:

8 12 14.5 23 35

Girls:

6 13.5 23 25.5 34

iii. Draw parallel boxplots to represent this data. (KP)



iv. Comment on which gender performed better on the class test. (MP)

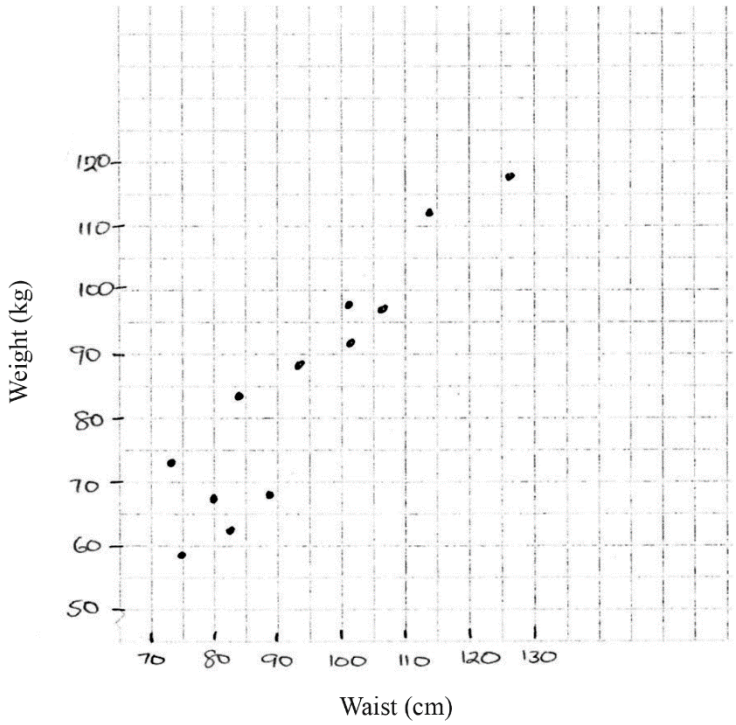
Girls performed better

- Median for girls higher than for boys
- Range for girls higher than for boys
- 50% of girls performed as well or better than the top 25% of the boys

e. The waist measurement (cm) and weight (kg) of 12 people are displayed in the table below.

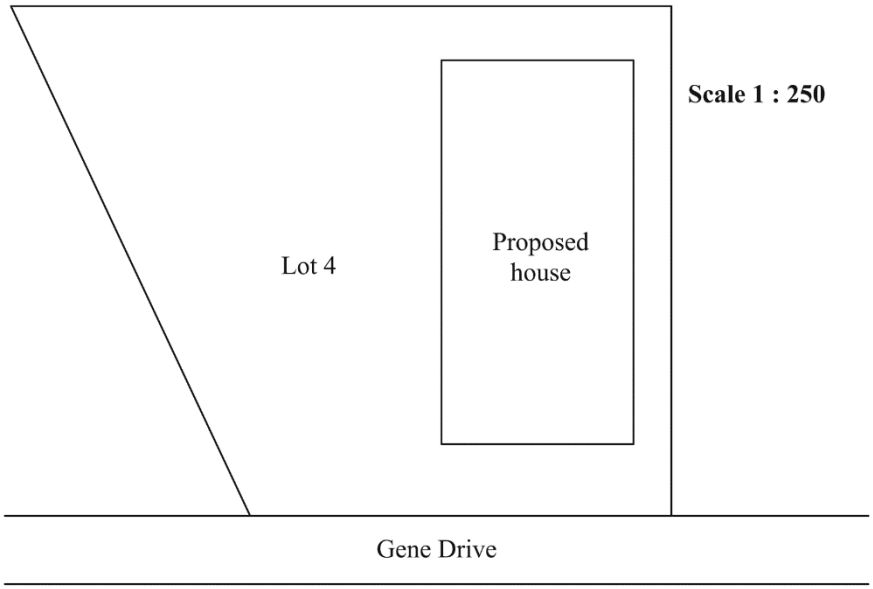
Waist (cm)	74	75	80	82	84	89	94	101	101	106	114	126
Weight (kg)	72	59	67	62	84	67	89	91	98	97	112	117

Using the grid below, display the data on a scatterplot.



Question 3

a. This is a site plan, **drawn to scale**, of Lot 4, Gene Drive.



i. Calculate the volume of concrete required for footings for the house if the footings are 0.5 metres deep and 0.6 metres wide. (KP)

Length of house = 6 cm Using scale, $6 \times 250 = 1500$ cm

Width of house = 3 cm Using scale, $3 \times 250 = 750$ cm

Outside area $= 15 \times 7.5$
$= 112.5\ cm^2$

Inside area $= 13.8 \times 6.3$
$= 86.94\ cm^2$

Volume of concrete $= (112.5 - 86.94) \times 0.5$
$= 25.56 \times 0.5$
$= 12.78\ m^3$

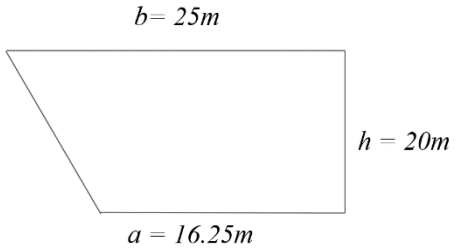
ii. A fence is to be erected along all boundaries of Lot 4 except for the boundary on Gene Drive. How many metres of fencing will be needed to build this fence? (KP)

Distance on plan = 9cm + 10cm + 8cm
= 27cm

Perimeter of fencing = 27 × 250
= 6750 cm
= 67.5 m

∴ 67.5 metres of fencing will be needed to build the fence.

iii. Lot 4 is in the shape of a trapezium. By measurement and calculation, determine the actual area of Lot 4 in square metres. (KP)



a: 6.5cm × 250 = 1625cm = 16.25 m
b: 10cm × 250 = 2500cm = 25 m
c: 8cm × 250 = 2000cm = 25 m

$A = \frac{1}{2}\, h\,(a + b)$

$A = \frac{1}{2} \times 20 \times (25 + 16.25)$

$A = \frac{1}{2} \times 20 \times 41.25$

$A = 412.5\ m^2$

∴ **the area of Lot 4 is $412.5\ m^2$**

b. A sedan car is 5 metres long and 1.5 metres high. Determine the maximum scale that could be used to redraw the rectangular shape of the car on an A3 piece of paper.

An A3 piece of paper measures 297 mm by 420 mm. A margin of at least 7 mm must be drawn around each edge of the paper. (KP)

Landscape:

Usable length of paper = 420 - 2 × 7
= 406 mm

Scale for length: 0.406 : 5
1 : 12.3 ∴ length of car is 5000 ÷ 12.3 = **406.5** mm
∴ width of the car is 1500 ÷ 12.3 = **122** mm

∴ **Scale is 1 : 13**

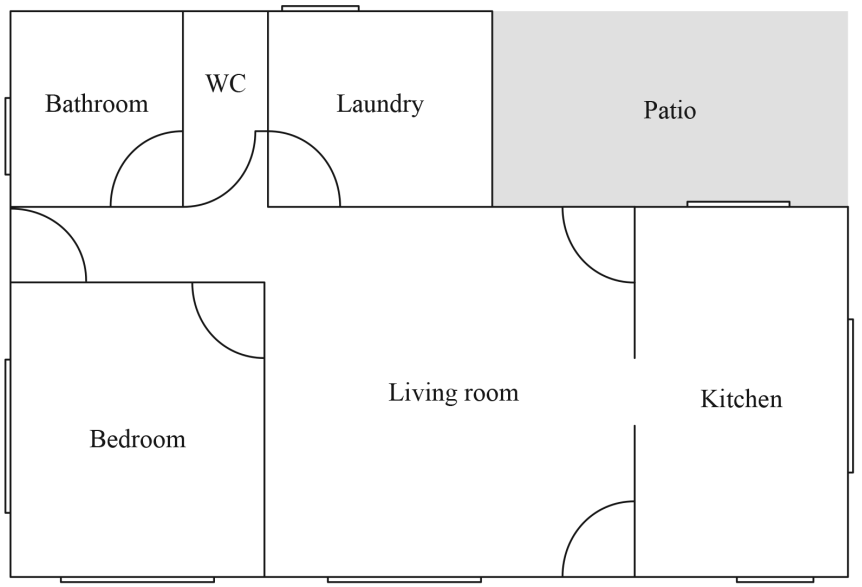
Portrait:

Usable width of paper = 297 - 2 × 7
= 283 mm

Scale for length: 0.283 : 1.5
1 : 5.3 ∴ length of car is 5000 ÷ 5.3 = 943.4 mm
∴ width of the car is 1500 ÷ 5.3 = 283 mm

∴ the car will **not fit the page as portrait**.

c. Consider the house plan **drawn to scale** below.



Scale 1 : 100

Carpet is to be laid in the bedroom, living room and hallway of this house in rolls 4 metres wide. Carpet can be purchased at a cost of \$69.80 per linear metre. A quote for \$1 470 was obtained to purchase the carpet. Show mathematical working to determine if this quote is reasonable. (MP)

Ignoring walls, the area to be carpeted is: Length = 9.8 m, Width = 5.8 m

When laid in orientation:

5.8 m

9.8 m

No. strips $= \frac{9.8}{4}$

$= 3$ strips

Length $= 3 \times 5.8$
$= 17.4$ m

Cost $= 17.4 \times \$69.80$
$= \$1214.52$

When laid in orientation:

5.8 m

9.8 m

No. strips $= \frac{5.8}{4}$

$= 2$ strips

Length $= 2 \times 9.8$
$= 19.6$ m

Cost $= 19.6 \times \$69.80$
$= \$1368.08$

$\therefore$ regardless of orientation **the quote of \$1470 is reasonable** and should be accepted.

Question 4

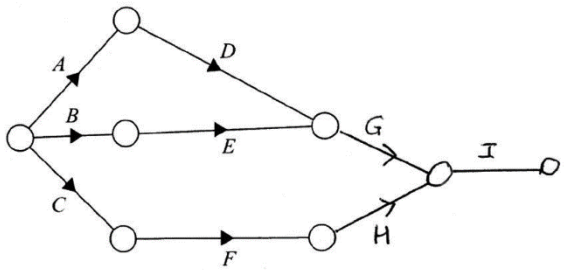
a. Five musicians are to record an album that involves nine activities.

The activities and their immediate predecessors are shown in the table below.

The duration of each activity is not yet known.

Activity	Immediate predecessors
A	—
B	—
C	—
D	A
E	B
F	C
G	D, E
H	F
I	G, H

i. Use the information in the above table to complete the network below by including activities *G*, *H* and *I*. (KP)



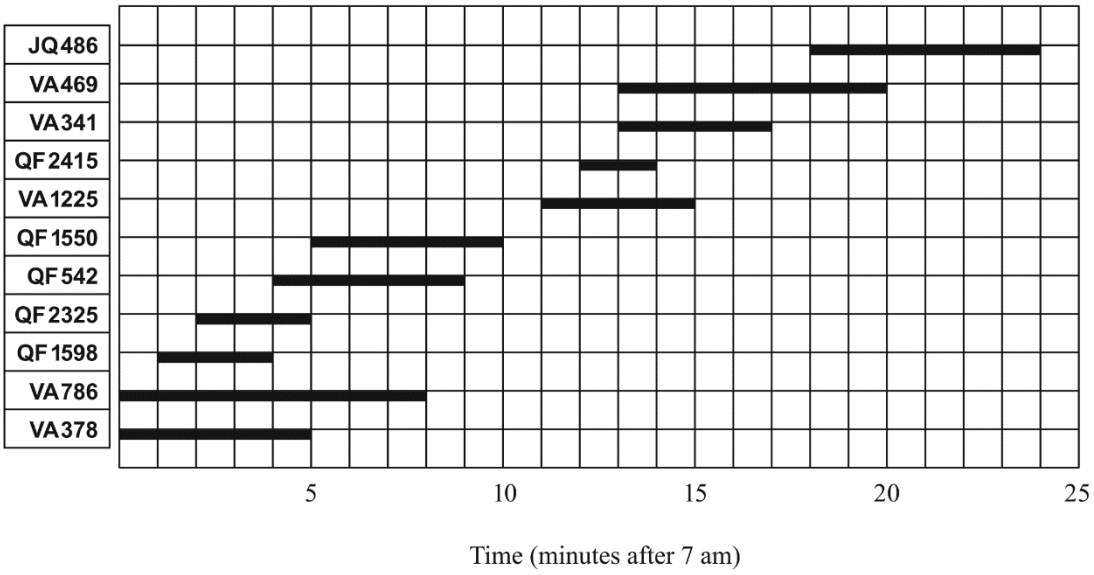
ii. There is only one critical path for this project. Determine how many **non-critical** activities there are. (KP)

3 critical paths possible: A D G I
B E G I
C F H I

Non-critical activities B C E F H
A C D F H
A B D E G

Any one of these paths leave **5 non-critical activities**

b. The graph below displays the **waiting times** for planes from when they first entered Brisbane airspace until they were given clearance to land. Landing (service) times are not shown.



i. Determine which plane had the shortest wait time and state how long that waiting period was. (KP)

QF 2415 had the shortest wait for 2 minutes

ii. What was the maximum number of planes that had to wait for clearance to land at any given time? (KP)

4 planes were the maximum that had to wait for clearance to land at any given time between 2 and 4 minutes and again from 13 to 14 minutes.

c. At a toll booth, cars arrive at a rate of 120 per minute and on average it takes 5 seconds to be served. Determine how many service points would be required in order for the queue not to grow. (MP)

$$\text{Inter-arrival time} = \frac{60}{120}$$
$$= 0.5 \text{ min per car}$$

$$\text{Total service time} = 120 \times 5$$
$$= 600 \text{ seconds}$$

$$\text{Service per minute} = \frac{60}{5}$$
$$= 12 \text{ cars per minute}$$

$$\text{Number of service points} = \frac{120}{12}$$
$$= 10$$

$$\text{Number of service points} = \frac{600}{60}$$
$$= 10$$

$\therefore$ **there are 10 service points needed for queue not to grow.**

End of Paper Two