2012 Senior External Examination

Mathematics A
Paper One — Question book

Monday 29 October 2012
9 am to 12:10 pm

Time allowed
• Perusal time: 10 minutes
• Working time: 3 hours

Examination materials provided
• Paper One — Question book
• Paper One — Resource book
• Paper One — Multiple-choice response sheet
• Paper One — Response book

Equipment allowed
• QSA-approved equipment
• ruler (metric, parallel or rolling)
• protractor
• drawing compass
• set squares
• templates (without formulas)
• non-programmable calculator
• graphing calculator

Not allowed: calculators with computer algebra system (CAS) functionality.

Directions
You may write in this book during perusal time.

Paper One has two parts:
• Part A — Multiple choice (15 questions)
• Part B — Extended response (5 questions)

Attempt all questions.

Suggested time allocation
• Part A: 45 minutes
• Part B: 2 hours 15 minutes

Assessment
Assessment standards are at the end of this book.

After the examination session
Take this book when you leave.
Planning space
Part A — Multiple choice

Part A has 15 questions of equal value. The questions assess Knowledge and procedures (KP) and Modelling and problem solving (MP).

Attempt all questions.

Each question contains four options. Select the option that you think is correct or is the best option. Respond on the multiple-choice response sheet.

Suggested time allocation: 45 minutes.

Question 1
Mary has attempted four tests and obtained the results 11, 12, 13 and 10. In the fifth test, what must Mary score so that her average for the five tests is 13?

A 11
B 12
C 19
D 24

Question 2
Terry worked for $12.40 per hour for eight hours each day on Tuesday and Thursday. On Saturday he worked for six hours at time-and-a-half. How much did Terry earn in total for Tuesday, Thursday and Saturday?

A $173.60
B $210.80
C $272.80
D $310.00

Question 3
Molly buys a pair of shoes and a jacket at a discount sale for a total of $116. The shoes are normally priced at $60. If Molly receives 20% discount on the shoes and 15% discount on the jacket, what is the normal price of the jacket?

A $57.80
B $68.00
C $78.80
D $80.00
Question 4

Builder’s levels are set up between points A and B and points B and C on a building site as shown. Measurements are given in millimetres.

To the nearest degree, what is the average angle the slope makes with the horizontal?

A 11°
B 15°
C 17°
D 18°

Question 5

Tony, Tom and Tina are business partners. Their investment in the business is in the ratio 2:3:1 respectively. If the total amount invested is $495000, how much did Tony invest?

A $82500
B $165000
C $198000
D $247500

Question 6

Sam and Niamh each invest $8000 for three years. Sam’s investment earns simple interest at the rate of 7.5% per annum. Niamh’s investment earns interest at the rate of 7.5% per annum compounding monthly.

At the end of three years, correct to the nearest cent, Sam will have

A $138.38 less than Niamh.
B $138.38 more than Niamh.
C $211.57 less than Niamh.
D $211.57 more than Niamh.
Question 7

The results of a group of 45 students involved in a reading program are displayed below in the form of a pair of boxplots. The data collected shows the reading speed in words per minute of the students both before and after the administration of the program.

![Boxplot](image)

After the program, both medians and interquartile ranges have increased. By how much?

A. Median by 4 and interquartile range by 2
B. Median by 5 and interquartile range by 4
C. Median by 8 and interquartile range by 6
D. Median by 10 and interquartile range by 4

Question 8

In 2001, the bearing of a bridge from a hill was 245° 12´ M.

If the annual change in the magnetic variation is 08´ westerly, the magnetic bearing of the bridge from the hill in 2010 was best approximated by

A. 243° 52´.
B. 244° 0´.
C. 246° 24´.
D. 246° 32´.

Question 9

Two hikers, Kate and Susan, walk in different directions from the same camp. Susan walks for 12 km on a bearing of 135° to a picnic ground and Kate walks for 6 km on a bearing of 045° to a lookout.

To meet Susan at the picnic ground, Kate needs to walk from the lookout on a bearing of

A. 063°.
B. 108°.
C. 162°.
D. 198°.
Question 10

The stemplot (stem-and-leaf plot) representing the daily sales of health bars from a school canteen is displayed below.

<table>
<thead>
<tr>
<th>Stem</th>
<th>Leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P 6 6</td>
</tr>
<tr>
<td>2</td>
<td>0 2 3 4</td>
</tr>
<tr>
<td>3</td>
<td>3 4 4 8</td>
</tr>
<tr>
<td>4</td>
<td>1 3 3</td>
</tr>
<tr>
<td>5</td>
<td>0 2</td>
</tr>
<tr>
<td>6</td>
<td>2 4 7</td>
</tr>
</tbody>
</table>

If the range of sales is 53, what is the value of \( P \)?

A 4  
B 6  
C 14  
D 16

Question 11

The roof truss shown below has a pitch of 28°. All lengths are given in millimetres.

What is the value of \( x \), correct to the nearest millimetre?

A 3797  
B 6793  
C 6887  
D 7193
**Question 12**

Jaye’s non-stop flight from Perth (32°S, 115°E) to Hong Kong (22°N, 115°E) departed at 4 pm on 1 November 2010. The plane had an average speed of 625 km/h. 

Jaye’s estimated time of arrival was

A 5:47 pm on 1 November 2010.  
B 11:40 pm on 1 November 2010.  
C 1:35 am on 2 November 2010.  
D 2:40 am on 2 November 2010.

**Question 13**

The following network shows the distances, in kilometres, along a series of roads that connect town A to town B.

What is the shortest distance, in kilometres, from town A to town B?

A 10  
B 11  
C 12  
D 14
Question 14

The graph below shows the waiting and service times for customers queued at a petrol station.

What was the median waiting time?

A 2.0 minutes
B 2.4 minutes
C 2.5 minutes
D 3.0 minutes
Question 15

The following network shows the activities needed to complete a project, and their completion times in hours.

If activity G is delayed by 5 hours, then activity L will be delayed by

A 2 hours.
B 4 hours.
C 5 hours.
D 7 hours.

End of Part A
Part B — Extended response

Part B has five questions. Each question assesses Knowledge and procedures (KP), Modelling and problem solving (MP) or a combination of both. Communication and justification (CJ) will be assessed by an overall judgment of your responses to Part B.

Attempt all questions. Write your responses in the response book. Show full working in all responses. Partial credit can only be awarded if working is shown.

Suggested time allocation: 2 hours 15 minutes.

Question 1

a. While shopping on Saturday, Stephanie found a dress priced at $280. On Monday, Stephanie noticed the dress was marked down by 20%.
   i. What is the marked-down price of the dress?
   ii. When Stephanie enquired about the dress, she was offered a further $25 discount off the marked-down price. Stephanie bought the dress. What was Stephanie’s saving as a percentage of the original price of the dress?

b. Marissa Freeman received a credit card statement from her bank. The account has no interest-free period. Simple interest is calculated and charged to the account on the statement date.

<table>
<thead>
<tr>
<th>Marissa Freeman — Credit Card Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit Limit: $5000</td>
</tr>
<tr>
<td>Statement Date: 29 October 2012</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Previous balance</th>
<th>Payments received</th>
<th>Purchases</th>
<th>Interest charged</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1500.00</td>
<td>$1500.00</td>
<td>$2275.45</td>
<td>?</td>
</tr>
</tbody>
</table>

Account activity

<table>
<thead>
<tr>
<th>Date</th>
<th>Purchases</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 October</td>
<td>Gigabyte Technology</td>
<td>$2100.00</td>
</tr>
<tr>
<td>18 October</td>
<td>David Jones Menswear</td>
<td>$175.45</td>
</tr>
</tbody>
</table>

Annual percentage rate: 18.98%
Daily percentage rate: 0.052%

Interest is charged on amounts from (and including) the date of purchase up to (and including) the statement date. Calculate the interest charged to Marissa’s account.

(c. Mal delivers brochures to households for a local advertising company. He is paid 60 cents per bundle of brochures delivered and an allowance of $2.40 per kilometre travelled. Last week Mal travelled four kilometres in delivering the brochures and was paid a total of $165. How many bundles of brochures did he deliver?
Question 2

a. Convert:
   i. 320000 cm to km
   ii. 15 m² to cm².

b. The roof truss shown below is not drawn to scale. All measurements are given in metres. The roof truss is right-angled at $B$ and $D$.

i. Using trigonometry, calculate $\theta$ (the pitch of the roof at $A$). Respond correct to the nearest degree.

ii. Calculate the height of the support upright $BD$, correct to the nearest millimetre.

(KP)

c. An inground swimming pool requires some repairs to the ceramic tiles on the shaded face $ABCDEF$ as shown below.

The shaded face has the following dimensions:

$AB = 1.2$ metres, $BC = 2.5$ metres, $DE = 3.5$ metres, $AF = 8.5$ metres and $FE = 2.0$ metres.

i. Calculate the area of the shaded face.

(KP)

ii. The shaded face is to be tiled using square ceramic tiles with a side length of 15 centimetres. The tiles come in packets of 30 and cost $32 per packet. What is the total cost of the tiles required for this job?

(KP)

Question 2c continues overleaf
iii. The 15-metre long pool (i.e. $FG = 15$ metres) is to be filled using the town water supply. The Queensland Water Commission has special requirements concerning the use of town water for swimming pools.

These requirements are:

- The pool must not take more than 24 hours to fill once filling starts, otherwise a water levy of $500 will be charged.
- The water supplied incurs a non-refundable administration and service fee of $200 plus water charges as outlined below.

<table>
<thead>
<tr>
<th>Water (kilolitres)</th>
<th>Cost per kilolitre</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 49</td>
<td>$0.95</td>
</tr>
<tr>
<td>50 to 99</td>
<td>$1.15</td>
</tr>
<tr>
<td>100 to 249</td>
<td>$1.85</td>
</tr>
<tr>
<td>250 to 999</td>
<td>$2.45</td>
</tr>
</tbody>
</table>

The pumps that fill the pool can deliver a total of 250 litres of water per minute. How much will the pool owner have to pay to fill their pool with town water?

Note: 1 kilolitre of water occupies 1 cubic metre of space.

(MP)
Question 3

Below is a ground floor plan of the Thomas family house drawn to a scale of 1:180.

![House Plan]

a. What are the dimensions of the Thomas family house? State your response in metres. (KP)

b. The Thomas family plans to add a pergola onto the full length of the western wall of their house. A three metre section of the pergola is shown below. A post is required every three metres.

![Pergola Diagram]

<table>
<thead>
<tr>
<th>Timber (mm)</th>
<th>Cost ($ per metre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post 100 × 100</td>
<td>15.20</td>
</tr>
<tr>
<td>Bearer 150 × 50</td>
<td>12.45</td>
</tr>
<tr>
<td>Joist 90 × 45</td>
<td>10.45</td>
</tr>
</tbody>
</table>

Calculate the total cost of timber required to build the pergola. (KP)

Question 3 continues overleaf
c. A city council intends to build a carpark for the showgrounds. You have been asked to draw up plans for the area to be surfaced. The cost of surfacing the carpark will be $12.50 per square metre, and the council budget allows $120000 for the job.
You are required to allow for several rows of 40 parking spaces — each space is 3 metres wide and will accommodate a vehicle 4 metres long.

You decide on a scale of 1:1000 for the plans. Showing all calculations, draw the scale plan of the outside dimensions of the carpark. Do not show individual parking spaces or entrances and exits.

Question 4

a. Neville earns a taxable income of $65250 from his job as an insurance broker.

i. Neville has a second job which pays $2900 gross income per month.
What is Neville’s total annual taxable income from both jobs, assuming he has a total of $6500 in allowable tax deductions?

ii. Using the tax table below, calculate the total tax payable on his income from both jobs.

<table>
<thead>
<tr>
<th>Taxable income</th>
<th>Tax on this income</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1–$6000</td>
<td>Nil</td>
</tr>
<tr>
<td>$6001–$21600</td>
<td>17c for each $1 over $6000</td>
</tr>
<tr>
<td>$21601–$58000</td>
<td>$2652 plus 30c for each $1 over $21600</td>
</tr>
<tr>
<td>$58001–$70000</td>
<td>$13572 plus 42c for each $1 over $58000</td>
</tr>
<tr>
<td>$70001 and over</td>
<td>$18612 plus 47c for each $1 over $70000</td>
</tr>
</tbody>
</table>

b. Sherryn is considering purchasing a new car. A finance company offers her the money she needs over five years at 8% p.a. flat, repaid monthly.
The effective rate of interest on the loan can be calculated using the formula

\[
E = \frac{2 \times R \times n}{(n + 1)}
\]

where \(R\) is the flat rate of interest and \(n\) is the number of instalments.

What is the effective interest rate on Sherryn’s loan?
Question 5

Respond to Question 5a on pages 16 and 17 of your response book.

a. The heights of the 60 members of a youth orchestra were recorded. These results were grouped and then displayed as a cumulative frequency histogram and polygon. The shortest person in the orchestra is 140 cm and the tallest is 190 cm.

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>Number of people</th>
</tr>
</thead>
<tbody>
<tr>
<td>145 - 155</td>
<td>1</td>
</tr>
<tr>
<td>155 - 165</td>
<td>5</td>
</tr>
<tr>
<td>165 - 175</td>
<td>5</td>
</tr>
<tr>
<td>175 - 185</td>
<td>5</td>
</tr>
<tr>
<td>185 - 190</td>
<td>5</td>
</tr>
</tbody>
</table>

Heights of orchestra members

i. Estimate the median from the graph above.

ii. State the interquartile range.

iii. Draw an accurate box-and-whisker plot to represent the data.

(KP)
b. Stephen is a political commentator with a major television network. He has been studying the effects of television exposure time on the approval ratings of six politicians. The data he finds is shown in the following table.

<table>
<thead>
<tr>
<th>Politician</th>
<th>Time on television (minutes)</th>
<th>Approval rating (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>B</td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td>C</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>D</td>
<td>70</td>
<td>55</td>
</tr>
<tr>
<td>E</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>F</td>
<td>5</td>
<td>80</td>
</tr>
</tbody>
</table>

i. Calculate the mean time on television and the mean approval rating. (KP)

ii. Prepare a scatter plot of the data given in the table. (KP)

iii. Stephen concludes that a politician “should appear on television as often as possible” to gain a high approval rating. Discuss his conclusion and comment on any limitations of his investigation. (MP)

End of Part B

End of Paper One
### Assessment standards from the Mathematics A Senior External Syllabus 2006

<table>
<thead>
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<tbody>
<tr>
<td>Knowledge and procedures (KP)</td>
<td>The overall quality of a candidate’s achievement across the full range within the contexts of application, technology and complexity, and across topics, <strong>consistently demonstrates</strong>: • accurate recall, selection and use of definitions and rules • use of technology • recall and selection of procedures, and their accurate and proficient use.</td>
<td>The overall quality of a candidate’s achievement across a range within the contexts of application, technology and complexity, and across topics, <strong>generally demonstrates</strong>: • accurate recall, selection and use of definitions and rules • use of technology • recall and selection of procedures, and their accurate use.</td>
<td>The overall quality of a candidate’s achievement in the contexts of application, technology and complexity, <strong>generally demonstrates</strong>: • accurate recall and use of basic definitions and rules • use of some technology • accurate use of basic procedures.</td>
<td>The overall quality of a candidate’s achievement in the contexts of application, technology and complexity, <strong>sometimes demonstrates</strong>: • accurate recall and use of some definitions and rules • use of some technology.</td>
<td>The overall quality of a candidate’s achievement rarely demonstrates knowledge and use of procedures.</td>
</tr>
<tr>
<td>Modelling and problem solving (MP)</td>
<td>The overall quality of a candidate’s achievement across the full range within each context, and across topics <strong>generally demonstrates</strong> mathematical thinking which includes: • interpreting, clarifying and analysing a range of situations, and identifying variables • selecting and using effective strategies • informed decision making ... and generally demonstrates mathematical thinking which includes: • interpreting, clarifying and analysing a range of situations, and identifying variables • selecting and using strategies ... and sometimes demonstrates mathematical thinking which includes: • selecting and using procedures required to solve a wide range of problems • initiative in exploring the problem • recognising strengths and limitations of models.</td>
<td>The overall quality of a candidate’s achievement across a range within each context, and across topics, <strong>generally demonstrates</strong> mathematical thinking which includes: • interpreting, clarifying and analysing a range of situations, and identifying variables • selecting and using strategies ... and sometimes demonstrates mathematical thinking which includes: • selecting and using procedures required to solve a range of problems • informed decision making.</td>
<td>The overall quality of a candidate’s achievement demonstrates mathematical thinking which includes following basic procedures and/or using strategies.</td>
<td>The overall quality of a candidate’s achievement demonstrates mathematical thinking which includes following basic procedures and/or using strategies.</td>
<td>The overall quality of a candidate’s achievement rarely demonstrates mathematical thinking which includes following basic procedures and/or using strategies.</td>
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<tr>
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<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tr>
</tbody>
</table>
| Communication and justification (CJ) | The overall quality of a candidate's achievement across the full range within each context consistently demonstrates:  
- accurate use of mathematical terms and symbols  
- accurate use of language  
- organisation of information into various forms suitable for a given use  
- use of mathematical reasoning to develop logical arguments in support of conclusions, results and/or decisions  
- justification of procedures. | The overall quality of a candidate's achievement across a range within each context generally demonstrates:  
- accurate use of mathematical terms and symbols  
- accurate use of language  
- organisation of information into various forms suitable for a given use  
- use of mathematical reasoning to develop logical arguments in support of conclusions, results and/or decisions. | The overall quality of a candidate's achievement in some contexts generally demonstrates:  
- accurate use of basic mathematical terms and symbols  
- accurate use of basic language  
- organisation of information into various forms  
- use of some mathematical reasoning to develop simple logical arguments. | The overall quality of a candidate's achievement demonstrates evidence of the use of the basic conventions of language and mathematics.                                                                                                                                                                                                 | The overall quality of a candidate's achievement rarely demonstrates use of the basic conventions of language or mathematics.                                                                                       |