For all Queensland schools

2014 Senior External Examination

Mathematics A
Paper One — Question book

Thursday 30 October 2014
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 — Response book

Equipment allowed

- QCAA-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 **four** extended-response questions. Attempt **all** questions.

Assessment

Paper One assesses the following assessment criteria:

- Knowledge and procedures (KP)
- Modelling and problem solving (MP)
- Communication and justification (CJ)

Assessment standards are at the end of this book.

After the examination session

Take this book when you leave.
Planning space
Question 1

a. Alan is paid a normal hourly rate of $19.40 for a 35-hour working week. Overtime is paid at a rate of time-and-a-half and can only be worked in whole hours.

i. Calculate Alan’s gross pay for a normal working week.

ii. What is the hourly rate earned by Alan when he works overtime?

iii. Calculate the number of overtime hours that Alan will need to work in order to earn a gross income in excess of $1000 for his working week.

(KP)

b. Lucy pays $825.00 (including GST) for a camera when she is going overseas. She is able to claim the GST back at Brisbane Airport before leaving on her flight. How much did she get back?

(KP)

c. Jack works in sales and is paid a retainer which is equivalent to a salary of $52000 p.a. He also earns commission of 1.6% of his sales. Last fortnight, his sales totalled $45500. What was his pay for this fortnight?

(KP)

d. The table below shows Bella’s fortnightly budget.

<table>
<thead>
<tr>
<th>Income</th>
<th>Expenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages $1750</td>
<td>Rent $580</td>
</tr>
<tr>
<td></td>
<td>Bills $175</td>
</tr>
<tr>
<td></td>
<td>Health fund $90</td>
</tr>
<tr>
<td></td>
<td>Groceries $280</td>
</tr>
<tr>
<td></td>
<td>Clothing $100</td>
</tr>
<tr>
<td></td>
<td>Entertainment $80</td>
</tr>
<tr>
<td></td>
<td>Car costs $270</td>
</tr>
<tr>
<td></td>
<td>Savings ?</td>
</tr>
</tbody>
</table>

| TOTAL $1750 | TOTAL $1750 |

i. Calculate the amount that should be entered in the budget under savings.

(KP)

ii. Bella has already saved $1000 of the $5500 she needs for a holiday she plans to take next year. Determine if Bella will have enough money to go on her holiday in exactly one year’s time. Discuss the strengths and limitations of Bella’s savings plan.

(MP)
e. Catalina earned $96000 last year and paid $25400 in PAYG tax. She had other income of $1400 from investments and has tax deductions totalling $2480.

i. What was her taxable income for last year?

ii. The Medicare levy is charged at 1.5% of taxable income.

How much should she have paid as her Medicare levy?

iii. Determine the total amount of tax, including the Medicare levy, she should have paid for the year.

<table>
<thead>
<tr>
<th>Taxable income</th>
<th>Tax on this income</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0 – $18200</td>
<td>Nil</td>
</tr>
<tr>
<td>$18201 – $37000</td>
<td>19c for each $1 over $18200</td>
</tr>
<tr>
<td>$37001 – $80000</td>
<td>$3572 plus 32.5c for each $1 over $37000</td>
</tr>
<tr>
<td>$80001 – $180000</td>
<td>$17547 plus 37c for each $1 over $80000</td>
</tr>
<tr>
<td>$180001 and over</td>
<td>$54547 plus 45c for each $1 over $180000</td>
</tr>
</tbody>
</table>

iv. Calculate the amount of her tax refund or bill for the year. (KP)

f. A shop purchased DVDs for $360 and marked them up by 40% to sell. Unfortunately, none of the DVDs sold so they were discounted by 40% of the marked price.

Determine the overall percentage loss or gain made on the sale of these DVDs after all the DVDs were sold at the discounted price. (MP)
Question 2

a. Two towers are located on a beach at positions A and B, as shown below. Tower A is 40 m due west of Tower B. A swimmer in trouble (at S) is sighted by a lifeguard at Tower A and is located in a direction of 026° T. At the same time the lifeguard at Tower B spots the swimmer at a bearing of 296° T.

i. Mark all the relevant information on the diagram in your response book.

ii. Determine the size of the angle ASB.

iii. How far is the swimmer from Tower B? (KP)

b. A tree casts a shadow 4.5 m long. At the same time, a metre ruler casts a shadow 80 cm long.

Determine the height of the tree. (KP)

c. The diagram below shows a building and a communications tower. From the top of the building, the angle of elevation of the top of the tower is 32°. Determine the height of the tower, correct to the nearest metre. (KP)
d. A greenhouse is in the shape of the symmetrical prism shown below. It has a metal frame holding the glass walls and roof.

![Diagram of greenhouse](image)

i. Determine the surface area of glass that makes up the walls and roof of the greenhouse. (Assume the metal frame has negligible thickness.)

ii. A cylindrical water tank with a diameter of 3.6 metres and a height of 2.2 metres is positioned next to the greenhouse. If the tank fills with rainwater at a rate of 400 L/h, how many hours would it take to fill the tank? (Give your answer to the nearest hour.)

   Hint: 1 m³ = 1000 litres.

(e. Homer, Marj and their children are 25 km from home on a road trip. Marj realises that the magazines she purchased for $11.50 the day before have been left at home. If their petrol consumption averages 15 L/100 km, and fuel costs $1.60/litre, would it be cheaper to buy new magazines or go home and get the original ones? Justify your decision showing calculations.

(f. Tayla is sailing across the Pacific Ocean. At 6:30 am on Saturday 18 October, her position was 0°, 170° E and she is heading for Fantasy Island 0°, 150° W.

i. Assuming that she takes the shortest direct course, how far will she need to sail in nautical miles?

ii. At a speed of 15 knots, what will be her expected local day and time of arrival at Fantasy Island? Discuss any limitations that could affect this expected outcome.
Question 3

a. The box-and-whisker plot below shows the results of a test worth 50 marks. Consider the statistical measures of mean, median, interquartile range and range of marks. Determine which statistical measure cannot be found from the plot. Justify your response.

b. For the following set of scores, find the:
   i. mean
   ii. mode
   iii. median
   iv. range.

<table>
<thead>
<tr>
<th>Score</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25</td>
</tr>
</tbody>
</table>

(MP) (KP)
c. The scatter plot below compares the age of a vehicle with the number of mechanical problems it has experienced. A regression line has been drawn.

![Scatter plot](image)

i. Describe the correlation shown on the graph.

ii. Use the regression line to predict the number of problems experienced by a 7-year-old car.

(KP)

d. The points scored by a football team in its home and away games are shown on the stem-and-leaf plot below.

<table>
<thead>
<tr>
<th>Leaf (home games)</th>
<th>Stem</th>
<th>Leaf (away games)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 8 5</td>
<td>0</td>
<td>3 4 5</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>0 8 9</td>
</tr>
<tr>
<td>7 3 2</td>
<td>2</td>
<td>3 4 5 9</td>
</tr>
<tr>
<td>3 0 0</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Key: 2|3 = 23 points

i. Find the mean, median and sample standard deviation of the points scored in the home games and in the away games.

(KP)

ii. Draw a parallel box-and-whisker plot to represent the data.

(KP)

iii. Use the information provided and your calculations to discuss the team’s performance in home games compared with away games.

(MP)
**Question 4**

a. A boat is sailing at 8 knots on a course of 190° T. At 0900 hours the bearing of Ballina Head Light is 220° T. At 1100 hours the bearing of the light is then 320° T.

Use a running fix on the chart in your response book to find the position of the boat at 1100 hours, and give the position coordinates.

Show full working.
b. Yesterday morning at 8:15 am, a trawler was observed from Fishy Point on a bearing of 290° T. At the same time, the navigator on board the trawler observed North Head bearing 125° T. At 9:05 am, from the trawler, King Point was seen to bear 090° T and North Head to bear 020° T. If the trawler maintained the same steady speed and course all morning, give the final position of the trawler at 9:15 am.
Use the chart in your response book and show full working.

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

|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Knowledge and procedures (KP)** | The overall quality of a candidate’s achievement across the full range within the contexts of application, technology and complexity, and across topics, **consistently demonstrates**:  
  - accurate recall, selection and use of definitions and rules  
  - use of technology  
  - recall and selection of procedures, and their accurate and proficient use. | The overall quality of a candidate’s achievement across a range within the contexts of application, technology and complexity, and across topics, **generally demonstrates**:  
  - accurate recall, selection and use of definitions and rules  
  - use of technology  
  - recall and selection of procedures, and their accurate use. | The overall quality of a candidate’s achievement in the contexts of application, technology and complexity, **generally demonstrates**:  
  - accurate recall and use of basic definitions and rules  
  - use of some technology  
  - accurate use of basic procedures. | The overall quality of a candidate’s achievement in the contexts of application, technology and complexity, **sometimes demonstrates**:  
  - accurate recall and use of some definitions and rules  
  - use of some technology. | The overall quality of a candidate’s achievement **rarely demonstrates** knowledge and use of procedures. |
| **Modelling and problem solving (MP)** | The overall quality of a candidate’s achievement across the full range within each context, and across topics **generally demonstrates** mathematical thinking which includes:  
  - interpreting, clarifying and analysing a range of situations, and identifying variables  
  - selecting and using effective strategies  
  - informed decision making  
  - and sometimes **demonstrates** mathematical thinking which includes:  
  - selecting and using procedures to solve a wide range of problems  
  - initiative in exploring the problem  
  - recognising strengths and limitations of models. | The overall quality of a candidate’s achievement across a range within each context, and across topics, **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 range of problems  
  - informed decision making. | The overall quality of a candidate’s achievement **demonstrates** mathematical thinking which includes:  
  - interpreting and clarifying a range of situations  
  - selecting strategies and/or procedures. | The overall quality of a candidate’s achievement **demonstrates** mathematical thinking which includes following basic procedures and/or using strategies. | The overall quality of a candidate’s achievement **rarely demonstrates** mathematical thinking which includes following basic procedures and/or using strategies. |
|-----------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 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 simple 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 **sometimes 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. |