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**School Curriculum and Standards Authority**

WACE
Western Australian Certificate of Education

## Western Australian Certificate of Education Examination, 2015

## Question/Answer Booklet

# MATHEMATICS 3A/3B

## Section Two: Calculator-assumed

Place one of your candidate identification labels in this box.
Ensure the label is straight and within the lines of this box.

Student Number: In figures

In words

### Time allowed for this section

Reading time before commencing work: ten minutes
Working time for section: one hundred minutes

Number of additional answer booklets used (if applicable):

### 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 the WACE examinations

### 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 notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.



Ref: 15-079
MAT3AB-S2

## Structure of this paper

| Section | Number of questions available | Number of questions to be answered | Working time (minutes) | Marks available | Percentage of exam |
|---|---|---|---|---|---|
| Section One: Calculator-free | 6 | 6 | 50 | 50 | 33⅓ |
| Section Two: Calculator-assumed | 12 | 12 | 100 | 100 | 66⅔ |
| | | | | **Total** | 100 |

## Instructions to candidates

1. The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2015.* Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer Booklet.

3. You must be careful to confine your response to the specific question asked and to follow any instructions that are specified to a particular question.

4. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
   - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
   - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

5. **Show all your working clearly.** Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.

6. It is recommended that you **do not use pencil**, except in diagrams.

7. The Formula Sheet is **not** to be handed in with your Question/Answer Booklet.

**See next page**



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Additional working space

Question number: _____

Additional working space

Question number: _____







**Section Two: Calculator-assumed** **66⅔% (100 Marks)**

This section has **12** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

Working time: 100 minutes.

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**Question 7** **(9 marks)**

(a) The line $y = 2x + 7$ is parallel to the tangent to the curve $y = x^3 + 2x^2 + qx - 6$ at $x = 1$. Determine the value of $q$. (3 marks)

(b) For the function $f(x) = (x^2 + 2)(3 - x)$:

(i) show the use of the product rule to determine $f'(x)$ and simplify your answer. (3 marks)

(ii) determine the coordinates of the point(s) on the curve of $f(x)$ where the gradient is $1$. (3 marks)

**See next page**

**Question 8** **(10 marks)**

In order to buy a second-hand scooter, Kim obtained a personal loan of $5000 with monthly repayments of $440 to be paid at the end of each month. The table below shows the amount owing at the start of each month, the interest payable for that month, the repayment and the amount owing at the end of each month for the first six months.

| Month | Amount owing at the start of the month ($) | Interest ($) | Repayment ($) | Amount owing at the end of the month ($) |
|---|---|---|---|---|
| 1 | 5000 | 40 | 440 | 4600 |
| 2 | 4600 | 36.80 | 440 | 4196.80 |
| 3 | 4196.80 | 33.57 | 440 | 3790.37 |
| 4 | 3790.37 | 30.32 | 440 | 3380.70 |
| 5 | 3380.70 | 27.05 | 440 | 2967.74 |
| 6 | 2967.74 | 23.74 | 440 | 2551.48 |

(a) Calculate the annual interest rate. (2 marks)

(b) Write a recursive rule to determine the amount owing at the end of each month. (3 marks)

(c) In which month would Kim pay off the loan? (1 mark)

(d) How much is Kim's final repayment? (2 marks)

(e) How much did Kim actually pay for the scooter? (2 marks)

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Question number: _____

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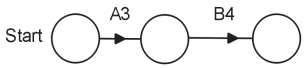
**Question 9** **(10 marks)**

A family decides to add a games room to their house. Details of this project are given in the table below.

| | Activity | Time (days) | Immediate Predecessor(s) |
|---|---|---|---|
| **A** | Lay the foundations | 3 | – |
| **B** | Prepare and pour the concrete floor | 4 | A |
| **C** | Construct the walls | 5 | B |
| **D** | Fit door and window frames | 2 | C |
| **E** | Install electrical fittings | 3 | C |
| **F** | Construct roof | 3 | C |
| **G** | Plaster ceiling | 1 | F |
| **H** | Fit gutters | 2 | F |
| **I** | Paint inside | 2 | D, E, G |

(a) Complete the project network below. (2 marks)




(b) Determine the critical path and minimum completion time. (2 marks)

(c) State the effect on the critical path **and** completion time for each of the following.

(i) Bricklayers take an extra two days to construct the walls. (2 marks)

(ii) The electrician is held up for three days on another job. (2 marks)

(iii) Fitting gutters with downpipes adds an extra two days. (2 marks)

**See next page**

**Question 10** **(8 marks)**

Jerry and Sarah decide to go for a walk. They both set off from the same starting point at 10 am. Jerry heads due north at 1.5 metres per second and Sarah heads on a bearing of 054° at 3.5 kilometres per hour. They both maintain these speeds and directions for the duration of their walk.

(a) Draw a diagram to represent this information. (2 marks)

(b) Convert Jerry's speed to kilometres per hour. (1 mark)

(c) Calculate the distance (in kilometres) between Jerry and Sarah after they have been walking for one hour. (2 marks)

(d) After a further 30 minutes Sarah injures herself and phones Jerry to assist her. If Jerry jogs at 9.5 kilometres per hour directly towards Sarah, at what time after 10 am will Jerry reach her? (3 marks)

**See next page**







Additional working space

Question number: _____

**Question 18** **(4 marks)**

Prove that one more than $(n+1)^2 - (n-1)^2$ is always odd, where $n$ is a positive integer.

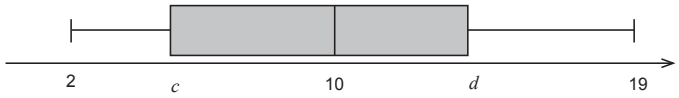
**End of questions**





**Question 11** **(8 marks)**

Eight data points generate the boxplot shown below.




The ordered data points are: 2, $a$, 7, 8, $b$, 12, 16, 19 with an interquartile range of 9.

(a) Determine the values of $a$, $b$, $c$ and $d$. (4 marks)

(b) Two more data points, 36 and –16, are added to the list.

(i) Write down the new interquartile range. (1 mark)

(ii) Would these two data points be considered as outliers? Show your reasoning. (3 marks)

**See next page**

**Question 12** **(9 marks)**

A Fishing, Camping and Four Wheel Drive Show is open Friday, Saturday and Sunday of the same week each year. The attendances for the years 2011 to 2015 are shown in the table below.

| Year | Day | Time Period ($x$) | Attendance | Moving Average ($y$) | Residual |
|---|---|---|---|---|---|
| 2011 | Friday | 1 | $C$ | – | – |
| | Saturday | 2 | $B$ | 5110.7 | $A$ |
| | Sunday | 3 | 6971 | 5250 | 1721 |
| 2012 | Friday | 4 | 4020 | 5204.3 | –1184.3 |
| | Saturday | 5 | 4622 | 5253.3 | –631.3 |
| | Sunday | 6 | 7118 | 5341 | 1777 |
| 2013 | Friday | 7 | 4283 | 5644.7 | –1361.7 |
| | Saturday | 8 | 5533 | 5742.7 | –209.7 |
| | Sunday | 9 | 7412 | 5985 | 1427 |
| 2014 | Friday | 10 | 5010 | 5973 | –963 |
| | Saturday | 11 | 5497 | 6138.3 | –641.3 |
| | Sunday | 12 | 7908 | 6015.3 | 1892.7 |
| 2015 | Friday | 13 | 4641 | 6270.7 | –1629.7 |
| | Saturday | 14 | 6263 | 6387.7 | –124.7 |
| | Sunday | 15 | 8259 | – | – |

(a) The seasonal component for Saturday is –391.7.

(i) What is the significance of this seasonal component being negative? (1 mark)

(ii) Calculate the value of $A$ in the table. (2 marks)

**See next page**





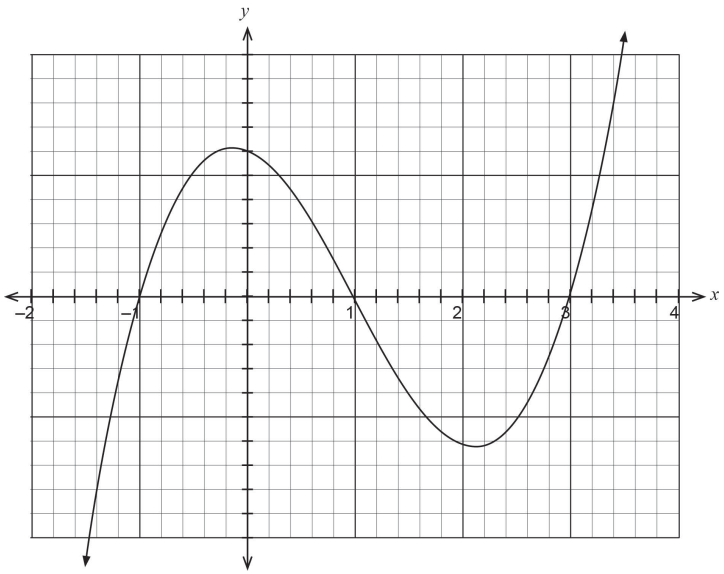
(b) Given the domain $-1 \leq x \leq 3$, for what values of $x$ is the function concave down, given that $(1, 0)$ is a point of inflection? (2 marks)

(c) The function is transformed to produce the function $g(x) = -f(x + 1)$. Sketch $g(x)$ on the same set of axes as $f(x)$. (2 marks)

**See next page**

**Question 17** **(7 marks)**

The cubic function $y = f(x)$ is shown below.




(a) The function is in the form $f(x) = a(x - 1)(x + b)(x + c)$. If the coordinates of the $y$-intercept are $(0, 6)$, determine the values of $a$, $b$ and $c$. (3 marks)







(b) Calculate the values of $B$ and $C$ in the table. (2 marks)

(c) The local council has informed event organisers that once the attendance on any one day exceeds 10 000, a permit to conduct this event the following year at the current location will no longer be approved due to overcrowding. On the basis of the data in the table, predict the day and year when the attendance will first exceed 10 000.

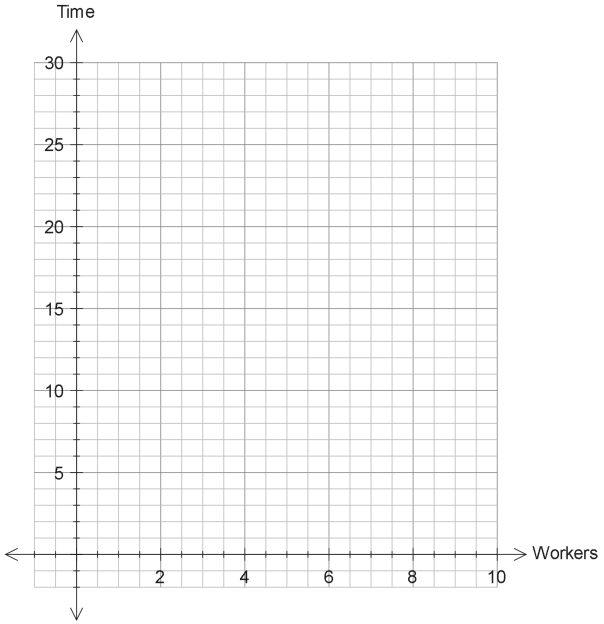
The trend line for moving average against time is $y = 111.37x + 4825.7$. (4 marks)

**Question 13** **(7 marks)**

A shire council required a specific task to be completed and gathered the following information.

| Number of workers | Time to complete the task (days) |
|---|---|
| 2 | 24 |
| 4 | 12 |
| 6 | 8 |
| 8 | 6 |

(a) Plot the data on the following set of axes and join the points with a smooth curve. (2 marks)




(b) (i) State, in words, the relationship between the number of workers and the time taken to complete the task. (1 mark)







**Question 16** **(8 marks)**

A farmer has bought fencing to make three holding paddocks for his sheep. The paddocks are to be identical rectangles within a larger rectangle, as shown below, with $x$ and $y$ in metres.


(a) The farmer is restricted to 4000 metres of fencing.

(i) Using this information, write an equation involving $x$ and $y$. (2 marks)

(ii) Rewrite this equation for $y$ in terms of $x$. (1 mark)

(b) (i) Show that the area of each paddock is given by $A = \frac{2000x}{3} - \frac{2x^2}{3}$. (2 marks)

(ii) Use calculus techniques to determine the largest possible area of each of the three paddocks, and state the dimensions of each paddock. (3 marks)

**Question 15** **(8 marks)**

(a) The heights of the Year 12 cohort at a particular school were normally distributed, with a mean height of 175 cm and a standard deviation of 5 cm.

(i) Determine the percentage of students that were at least 181 cm tall. (2 marks)

(ii) What is the probability that a Year 12 student selected at random will be between 173 cm and 178 cm tall? (1 mark)

(iii) Calculate the maximum height of the middle 75% of Year 12 students, correct to three significant figures. (3 marks)

(b) At another school, 54 Year 11 students had heights between one and two standard deviations above the mean. Given that the heights were normally distributed, calculate how many students were in Year 11. (2 marks)

**See next page**







(ii) State the mathematical relationship between the number of workers and the time taken to complete the task. (1 mark)

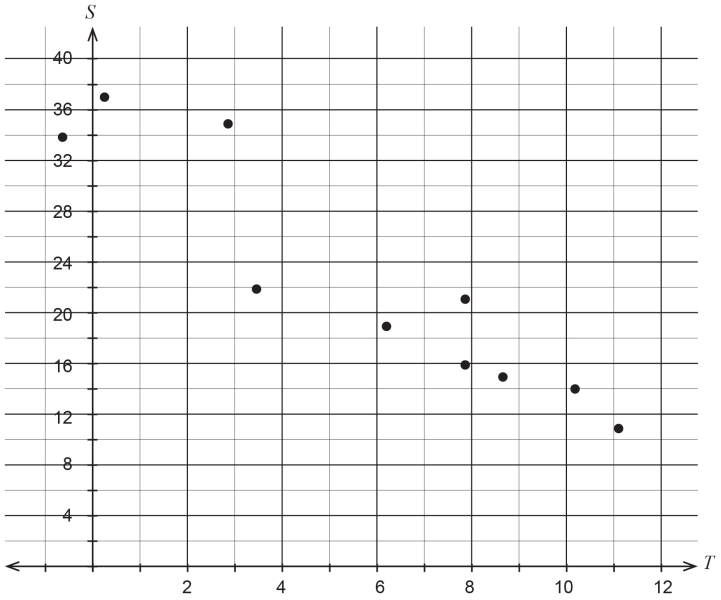
(c) If $w$ represents the number of workers and $d$ represents the number of days required to complete the task, determine a mathematical equation for $w$ in terms of $d$. (2 marks)

(d) What is the minimum number of workers required to finish the task in less than 14 days? (1 mark)

**See next page**

**Question 14** **(12 marks)**

Over a 10-day period last winter, a company that supplies home gas heating appliances noted from its records the minimum overnight temperature ($T$° Celsius) and the number of service calls ($S$) on each day. This information is shown on the scatter plot below.




(a) The least squares regression line for this data is $S = -2.2T + 34.9$. Sketch this line on the scatter plot. (2 marks)

(b) The data for days 11 and 12 are (1.4, 30) and (4.6, 26) respectively. Plot these two points on the scatter plot. (2 marks)







(c) The correlation coefficient $r_{TS}$ for the first 10 days is –0.93. What is the effect on the value of $r_{TS}$ with the inclusion of the two extra data points? Does $r_{TS}$ increase, decrease or stay the same? Justify your answer. (2 marks)

(d) Comment briefly on what the correlation coefficient, $r_{TS}$ for this data set is actually measuring. (2 marks)

(e) Use the regression line to predict the number of service calls for an overnight temperature of $11.4°C$. Comment on the reliability of your prediction. (3 marks)

(f) Estimate and mark clearly on the scatter plot the position of the point $(\overline{T}, \overline{S})$ for the 12 plotted points. (1 mark)