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Government of **Western Australia**
School Curriculum and Standards Authority

WACE
Western Australian Certificate of Education

Western Australian Certificate of Education Examination, 2013

Question/Answer Booklet

MATHEMATICS 3A/3B

Section Two: Calculator-assumed

Please place your student identification label in 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: 13-085
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	9	9	50	50	33⅓
Section Two: Calculator-assumed	13	13	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 2013*. 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** handed in with your Question/Answer Booklet.

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Additional working space

Question number: _____

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Question number: _____

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

This section has **13** 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.

Question 10 **(4 marks)**

Prove algebraically that if you add the squares of three consecutive numbers and then subtract 2, you always get a multiple of three.

See next page

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Question 11 **(8 marks)**

(a) In triangle ABC, $c = 7.2$ cm, $a = 8.4$ cm and $\angle B = 61°$.

(i) Calculate the length of the side AC. (1 mark)

(ii) Calculate the size of the angle ACB. (1 mark)

(iii) If Q is the midpoint of BC and $AR = \frac{1}{2}RB$, draw a diagram, indicating clearly the lengths of the sides AR, RB, BQ and QC. (2 marks)

(iv) Calculate the area of the quadrilateral $ARQC$. (1 mark)

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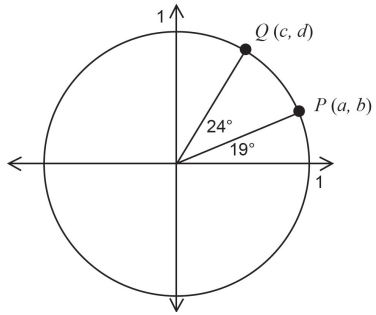
(b) Use the unit circle shown below to determine each of the following, giving your answers in terms of either a, b, c or d.



(i) sin 19° (1 mark)

(ii) cos 43° (1 mark)

(iii) sin 161° (1 mark)

See next page

Question 12 **(7 marks)**

Robert buys a car for $72 000. He pays a deposit of $12 000 from his savings and borrows the remaining amount from his bank. The interest on the loan is 7.5% per annum and Robert can afford to make monthly repayments of $1800.

The spreadsheet below shows the balance and interest of the loan for the first 6 months and the last 3 months.

Month	Opening balance at the start of each month	Interest
1	60 000.00	375.00
2	58 575.00	366.09
3	57 141.09	357.13
4	**A**	**B**
5	54 246.34	339.04
6	52 758.38	330.89
. .	. .	. .
36	4 442.52	27.77
37	2 670.28	16.69
38	886.97	

(a) Calculate the values of A and B, correct to two decimal places. (2 marks)

(b) One of the opening balances for the first 6 months is incorrect. Identify which entry is incorrect and state the correct value of the balance. (2 marks)

(c) How long will it take for the amount owing to fall below $10 000? (1 mark)

(d) Calculate the amount of Robert's final payment. (1 mark)

(e) What is the total amount of interest that Robert has paid? (1 mark)

See next page

Question 22 **(9 marks)**

In England, motor vehicle licence plates consist of two letters followed by two digits followed by three letters (e.g. VW45PRT).

(a) How many different licence plates are possible if

(i) there is no restriction on the number of times each letter and each digit is used? (2 marks)

(ii) the first two letters must be vowels and no letter and no digit may be repeated? (2 marks)

(b) In a batch of licence plates only the digits 1, 2, 3 and 4 and the letters A, B, C, D, E and F have been used. If one licence plate is chosen at random from the batch and no letter or digit may be repeated, determine the following probabilities. Leave your answers as fractions.

(i) The licence plate is DF21BAE. (1 mark)

(ii) The letters A and B are next to each other. (2 marks)

(iii) The last three letters are B, D and F, given that the two-digit number is 21. (2 marks)

End of questions

Question 21 **(9 marks)**

A square based pyramid is constructed such that the sum of the perimeter of the base and the perpendicular height is 48 cm.

(a) If the side length of the base of the pyramid is x cm and the perpendicular height of the pyramid is h cm, write an equation connecting the two variables. (1 mark)

(b) Using the equation from part (a), show that the volume (V) of the pyramid is given by the equation $V = \frac{4}{3}x^2(12 - x)$ cm^3. (2 marks)

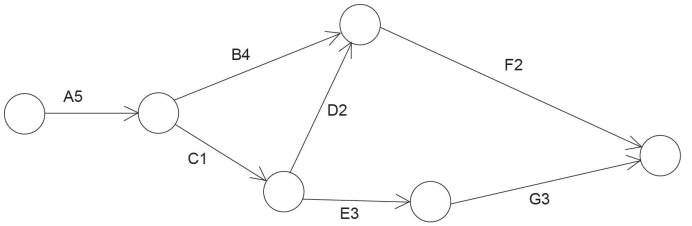
(c) Show the use of the product rule to determine $\frac{dV}{dx}$. (Do not simplify your answer.) (2 marks)

(d) Using calculus techniques, determine the dimensions of this pyramid for maximum volume and state this volume. (4 marks)

See next page

Question 13 **(6 marks)**

The times for tasks A to G shown in the project network below are in days.



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

(b) What is the minimum amount of time two people would take to complete all of the tasks if only one person can be allocated to each task at any one time? (2 marks)

(c) Under what condition(s) would it be possible to complete all of the tasks in the minimum completion time found in part (a)? (2 marks)

See next page

Question 14 **(6 marks)**

(a) Given that B is inversely proportional to c, i.e. $B = \frac{k}{c}$, where k is a constant, describe the effect on B if

(i) c is doubled. (1 mark)

(ii) c is halved. (1 mark)

(b) Boyle's Law states that the volume (V) of a given mass of gas at a fixed temperature varies inversely as the pressure (P), where V is in litres (L) and P is in Pascals (Pa).

(i) Write an equation using k as the constant of proportionality to represent the relationship between V and P. (1 mark)

(ii) Given that $V = 3.4$ L when $P = 9.6$ Pa, calculate the pressure of the gas when the volume is 12.7 L. (3 marks)

See next page

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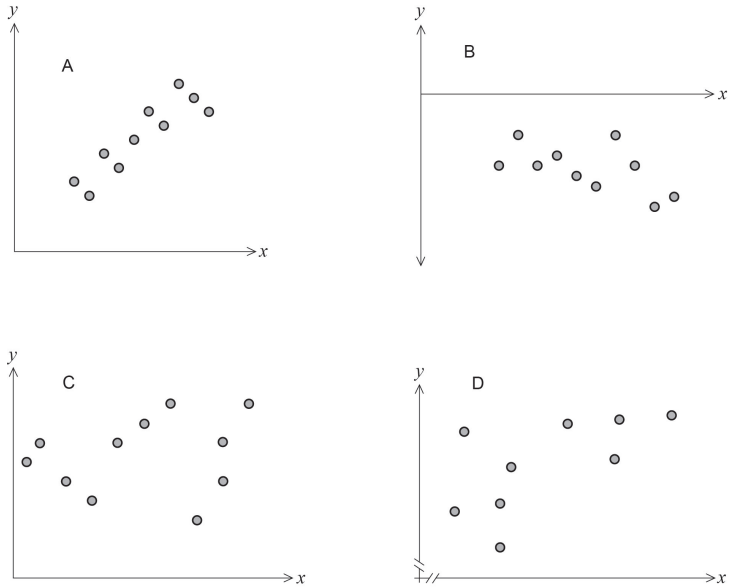
(ii) Using the boxplot labelled A, calculate the smallest positive integer that would be considered an outlier. (3 marks)

(b) Below are the scatterplots for four different sets of bivariate data.



Six possible correlation coefficients for the scatterplots are: 0.2, –0.9, 0.6, 1.3, –0.6, and 0.9.

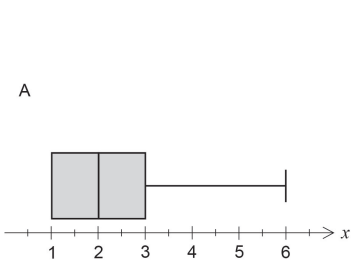
Match each scatterplot with one correlation coefficient. (4 marks)

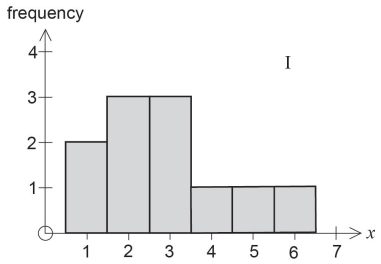
A: _____ B: _____ C: _____ D: _____

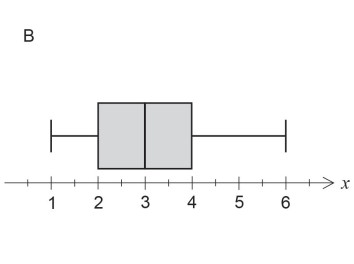
See next page

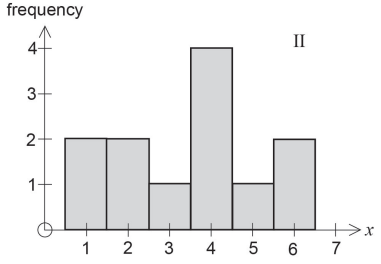
Question 20 **(10 marks)**

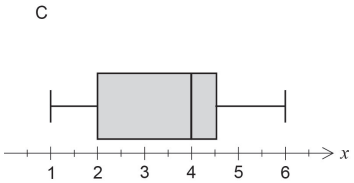
(a) (i) Three sets of data were used to create the frequency histograms and boxplots shown below. Match each frequency histogram with its corresponding boxplot. (3 marks)

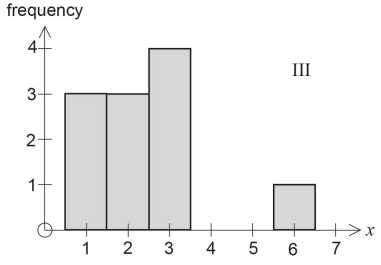












A matches with _____

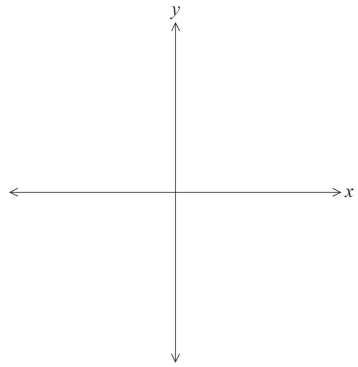
B matches with _____

C matches with _____

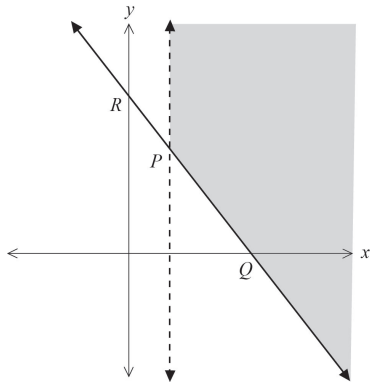
See next page

Question 15 **(6 marks)**

(a) Sketch the inequality $5x - 3y > 15$ on the axes below. (3 marks)



(b) Determine the inequalities that define the shaded region shown on the axes below given that P, Q and R have coordinates $(2, 5)$, $(6, 0)$ and $(0,7.5)$ respectively. (3 marks)



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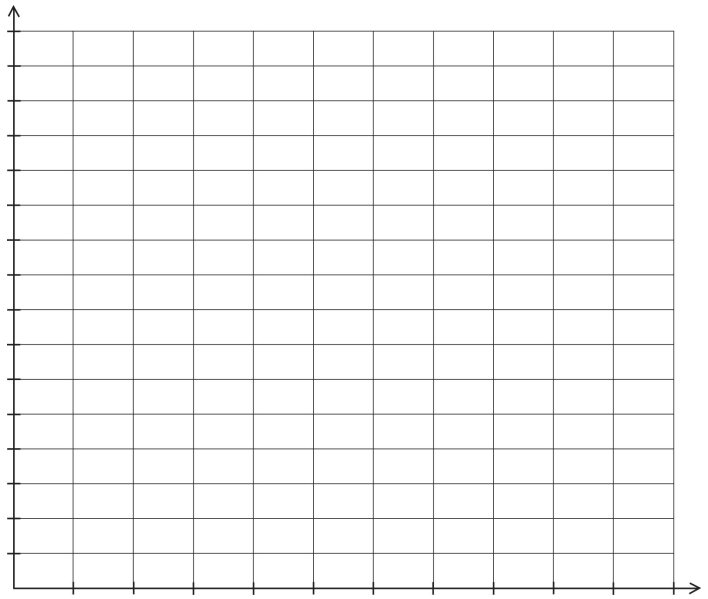
Question 16 **(9 marks)**

A survey of 50 bank accounts, all in credit, revealed the following distribution of the minimum monthly balances (rounded to the nearest dollar).

Balance	\$400–\$499	\$500–\$599	\$600–\$699	\$700–\$799	\$800–\$899	\$900–\$999
Frequency	5	15	10	9	6	5

(a) Draw a frequency histogram on the grid below to represent the bank balance data. (4 marks)



Question 19 **(6 marks)**

Four relatives, Rosalind, Adam, Derek and Jennifer, have been left \$45 500 in the will of their great uncle. The condition of the will is that Adam receives $\frac{2}{3}$ as much as Rosalind, Derek receives $\frac{1}{4}$ as much as Adam, and Jennifer receives $\frac{3}{8}$ as much as Derek.

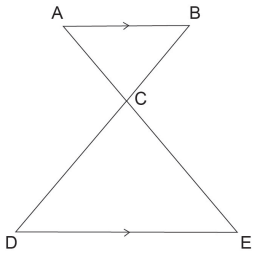
Let x be the amount Rosalind receives.

(a) Write the amount that each person receives in terms of x. Leave your answers as fractions. (3 marks)

(b) Write an equation, solve it for x and hence state the amount, in dollars, each person receives. (3 marks)

Question 18 **(6 marks)**

For the given diagram, AB is parallel to DE.



(a) At each step of the proof below, the statement and reason are provided. Complete the table below. (Note: At each step of the proof, either the statement or the reason may be false, but not both.) (4 marks)

Step	Statement	Reason	True/False
1	∠BCA = ∠DCE	Vertically opposite angles	
2	∠BAC = ∠DEC	Alternate angles	
3	∠ABD = ∠EDB	Corresponding angles	
4	ΔABC is congruent to ΔEDC	Angles in each triangle are equal	

(b) For each false step in the table above, rewrite the correct statement(s) or reason(s) in the table below. (2 marks)

Step	Statement	Reason
1		
2		
3		
4		

(b) Determine the median class and the modal class for the data. (2 marks)

(c) Complete the table below and use it to estimate the mean and standard deviation for the minimum monthly balance. (3 marks)

Balance	$400–$499	$500–$599	$600–$699	$700–$799	$800–$899	$900–$999
Midpoint						
Frequency	5	15	10	9	6	5

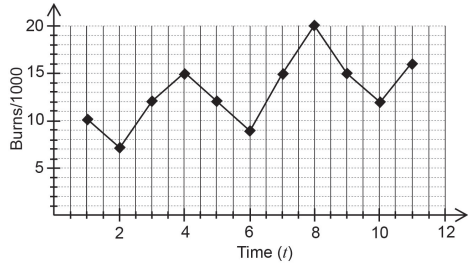
Question 17 **(14 marks)**

The rate of sunburn casualties per 1000 people was collected over a period of three years by the Sandy Beach Surf Club. The data are presented in the table below.

Year	Quarter	Time (t)	Number of burns per 1000 people	Four-point centred moving averages (y)	Residuals
2010	Mar	1	10		
	Jun	2	7		
	Sep	3	12	11.25	0.75
	Dec	4	15	$\boldsymbol{A}$	$\boldsymbol{C}$
2011	Mar	5	12	12.375	–0.375
	Jun	6	9	13.375	–4.375
	Sep	7	15	14.375	0.625
	Dec	8	20	15.125	4.875
2012	Mar	9	15	15.625	–0.625
	Jun	10	12	15.625	–3.625
	Sep	11	16		
	Dec	12	$\boldsymbol{B}$		

(a) Calculate the value of the missing entries marked by $\boldsymbol{A}$, $\boldsymbol{B}$ and $\boldsymbol{C}$. (4 marks)

The graph below shows the number of burns per 1000 people plotted against time.



(b) How does the graph support the choice of a four-point centred moving average? (1 mark)

(c) (i) Using time, t and the four-point centred moving averages, y, determine the equation of the regression line $y = at + b$, stating a and b correct to two decimal places. (2 marks)

(ii) State the correlation coefficient r_{ty}. (1 mark)

(d) Using the regression equation together with the seasonal component for March, predict the number of burn cases per 1000 people for March 2014 to the nearest whole number. (3 marks)

(e) Comment on the reliability of your prediction from part (d). (2 marks)

(f) Suggest **one** factor that could have affected the reliability of your prediction. (1 mark)

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