

No other items may be used in this section of the examination. It is your responsibility to ensure that you do not have any unauthorized notes or other items of a non-personal nature in the examination room. If you have any unauthorized material with you, hand it to the supervisor before reading any further.

### **Important note to candidates**

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper, and up to three calculators satisfying the conditions set by the Curriculum Council for this examination.

Standard items: pens, pencils, pencil sharpener, eraser, correction fluid/tape, ruler, highlighters

*To be provided by the candidate*

Materials required/recommended for this section

Section One:  
This Question/Answer Booklet  
Formula Sheet (retained from Section One)

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

Teacher's name \_\_\_\_\_  
Student's name \_\_\_\_\_

**MATHEMATICS 3A/3B**  
**Section Two:**  
**Calculator-assumed**

Question/Answer Booklet  
Semester Two Examination, 2013



**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	7	7	50	50	33
Section Two: Calculator-assumed	12	12	100	100	67
		<b>Total</b>		<b>150</b>	<b>100</b>

**Instructions to candidates**

- 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.
- Write your answers in the spaces provided in this Question/Answer Booklet. 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(s) that you are continuing to answer at the top of the page.
- 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 an answer to any question, ensure that you cancel the answer you do not wish to have marked.
- It is recommended that you **do not use pencil**, except in diagrams.

**Question 19**

(8 marks)

Triangle  $DEF$  has three sides of lengths 6 cm, 13 cm and 15cm.

- (a) Determine the size of the largest angle in triangle  $DEF$ .

(3 marks)

Triangle  $PQR$  has three sides of lengths of 12 cm, 19 cm and 21 cm.

- (b) A student argued that because the three sides of triangle  $PQR$  were all 6 cm longer than the corresponding sides of triangle  $DEF$ , then the two triangles must be similar.

Explain whether this is a valid argument.

(2 marks)

Triangle  $ABC$  has an area of  $350 \text{ cm}^2$  and is such that the length of  $AB$  is 5 cm more than the length of  $BC$  and the size of  $\angle ABC = 30^\circ$ .

- (c) Determine the length of the side  $AB$ .

(3 marks)

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

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

Working time for this section is 100 minutes.

- (a) How many new accounts were created on Day 4? (1 mark)
- The number of new accounts created on a recently launched social networking site increase by a factor of three every day. On Day 1, 140 new accounts were created, on Day 2, 420 new accounts were created and so on.

- (b) Write a recursive rule for  $T_n$ , the number of new accounts created on Day  $n$ . (2 marks)

- (c) On which day did the number of new accounts created first exceed one million and how many new accounts were created on that day, to the nearest thousand? (2 marks)
- (d) The site earns five cents in advertising revenue for each new account. How much did the site earn in the first seven days? (2 marks)

**Question 18** (6 marks)

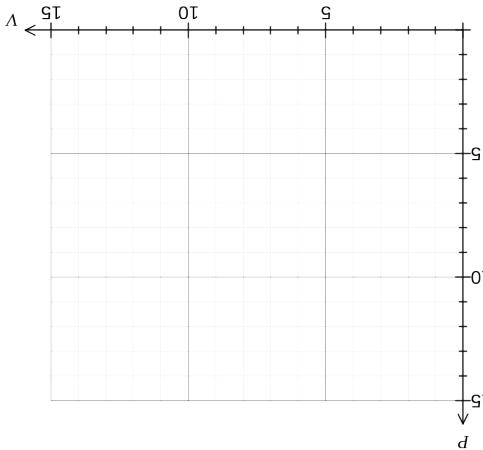
The pressure,  $p$ , in an air bubble varies inversely with the volume,  $V$ , of the bubble.

It is known that  $p = 2.4 \text{ kPa}$  when  $V = 5 \text{ cm}^3$ .

- (a) Find the value of  $p$  when  $V = 2.5 \text{ cm}^3$ . (1 mark)

- (ii) the value of  $V$  when  $p = 10 \text{ kPa}$ . (1 mark)

- (c) On the axes below, draw a graph to show how  $p$  varies with  $V$ . (3 marks)



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**Question 8** (7 marks)

- (a) How many new accounts were created on Day 4? (1 mark)

- (b) Determine

- (i) the value of  $p$  when  $V = 2.5 \text{ cm}^3$ . (1 mark)

- (c) On the day which did the number of new accounts created first exceed one million and how many new accounts were created on that day, to the nearest thousand? (2 marks)

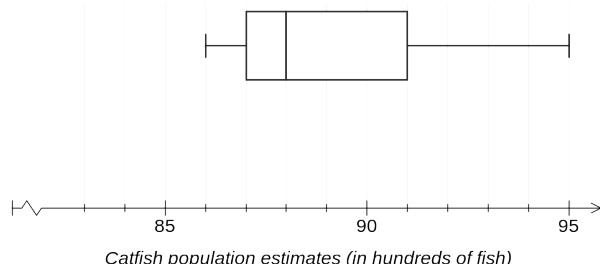
- (d) The site earns five cents in advertising revenue for each new account. How much did the site earn in the first seven days? (2 marks)

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

200 tagged catfish were released into a stretch of river. The next day at the same stretch of river, a sample of 140 catfish was caught of which 3 were tagged.

- (a) Use this information to calculate an estimate for the number of catfish in the river at this location, to the nearest one hundred fish. (3 marks)

Over the next few days this method of estimating the population of catfish to the nearest one hundred was repeated another ten times at the same location. The population estimates are summarised in the box and whisker plot below.



- (b) State the median and interquartile range for this set of data. (2 marks)

The same sampling procedure was also carried out at a spot 500 m upriver from the first location, giving rise to a second set of population estimates, in hundreds of fish:

84, 93, 85, 93, 88, 91, 89, 83, 88, 89 and 88

- (c) Construct a box and whisker plot for the second set of data on the diagram above. (3 marks)

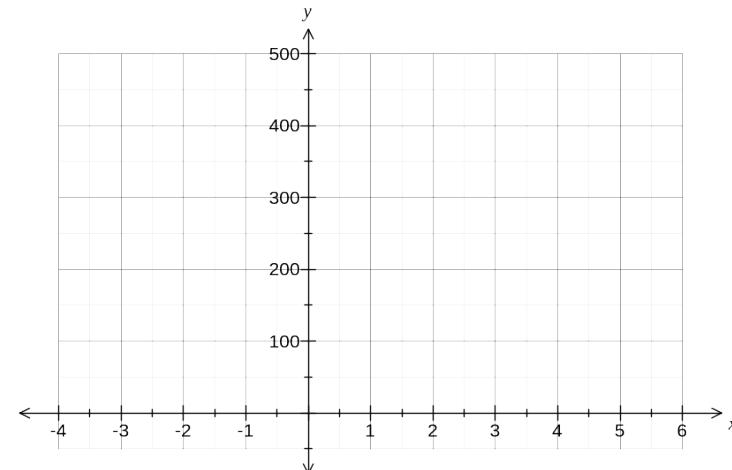
- (d) Which location, the original spot or 500 m upriver, produced the most consistent population estimates? Justify your answer. (2 marks)

**Question 17****(10 marks)**

A function is given by  $f(x) = 200 + 32x^2 - x^4$  for  $-3 \leq x \leq 5$ .

- (a) Use calculus techniques to determine the coordinates of both stationary points of the function for the given domain. (4 marks)

- (b) Sketch the graph of  $f(x)$  for  $-3 \leq x \leq 5$  on the axes below. (4 marks)



- (c) Does the graph above have any inflection points? If so, how many and where(approx.)? (2 marks)

Question 16	8 marks
A variety of coffee blends are made by mixing together Brazilian beans that cost \$31 per kg with Arabica beans that cost \$45 per kg.	
(a) Blend X is made by mixing together 8 kg of Brazilian beans with 12 kg of Arabica beans. What is the cost per kg of this blend? (2 marks)	
(i) How many standard deviations from the mean is the length of this pipe? (1 mark)	
(ii) The lengths, $X$ , of plastic pipes produced by a machine are normally distributed with a mean of 302 cm and a standard deviation of 1.5 cm. 95% of the pipes produced by the machine will lie within $k$ cm of the mean. Use the 68%, 95%, 99.7% rule to determine the value of $k$ . (1 mark)	

(b) Blend Y is made by mixing together $b$ kg of Brazilian beans with 3 kg of Arabica beans. Write an expression for the cost per kg of blend Y and hence determine $b$ , given that blend Y costs \$32.40 per kg. (2 marks)	
(c) One kilogram of blend Z contains $a$ kg of Arabica beans. Show that the cost of one kg of blend Z is $31 + 14a$ . (2 marks)	
(d) An average of one out of every eight pipes produced by the machine exceeds $l$ cm. Determine the value of $l$ , rounding your answer to four significant figures. (2 marks)	

(i) Blended Z costs \$38.70 per kg. Determine the weight of Brazilian beans in a 300 g bag of blend Z. (2 marks)	
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(v) Blended Z costs \$38.70 per kg. Determine the weight of Brazilian beans in a 300 g bag of blend Z. (2 marks)	

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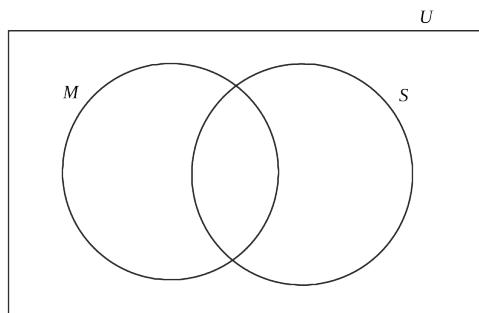
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**Question 11****(10 marks)**

Two subsets,  $M$  and  $S$ , belong to a universal set of 200 students. Students belonging to subset  $M$  have attended a math revision seminar and students belonging to subset  $S$  have attended a science revision seminar.

It is known that  $n(M) = 58$ ,  $n(S) = 40$  and  $n(M \cup S) = 81$ .

- (a) Use this information to complete all regions of the Venn diagram below. (3 marks)



- (b) How many students from the group attended just one of the revision seminars? (1 mark)

- (c) What is the probability that a student selected at random from the group

- (i) attended both revision seminars? (1 mark)

- (ii) only attended a math revision seminar? (1 mark)

- (d) If a student is selected at random from the group, determine

- (i)  $P(\bar{M} \cup S)$  (2 marks)

- (ii)  $P(\bar{M} | \bar{S})$  (2 marks)

- (c) Determine the equation of the linear regression line that can be used to predict the moving average,  $M$ , from time,  $T$ . (2 marks)

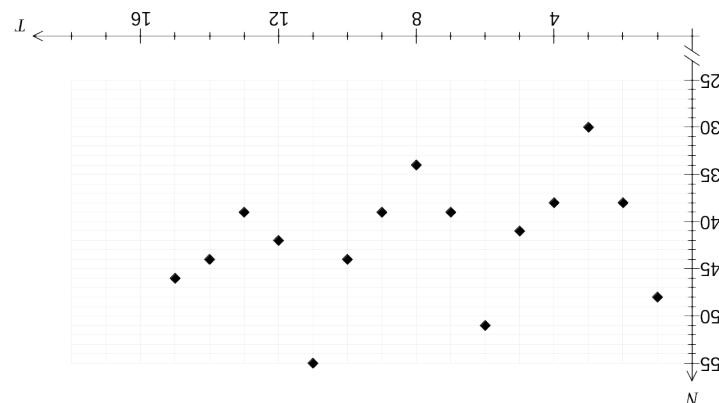
- (d) Draw the line of regression calculated in (c) on the graph. (2 marks)

- (e) Calculate the seasonal component for the number of calls on Monday. (2 marks)

- (c) If job B was delayed by two weeks and job C delayed by three weeks, what effect does this have on the critical path and minimum completion time for the project? (2 marks)

- (b) Write down the calculation that was used to determine the five-point moving average for Tuesday of Week 2. (1 mark)

- (a) What is noticeable about the number of calls to the enquiry line on Wednesday? (1 mark)



- (a) Draw a project network to represent the above information. (3 marks)

- C and D cannot start until A has finished
- F must wait until B has finished
- E must wait until C and D are finished
- G must wait until E and F are finished.

Some jobs cannot start until other jobs have finished, as instructed below:

Day	M	T	W	T	F	S	M	T	W	T	F
Time (Weeks)	12	15	7	8	13	17	2				
Job	A	B	C	D	E	F	G				

- The time, in weeks, that each job requires, is shown in the table below.  
A manager of a building company has split a project into seven jobs that need to be completed. A three week period, together with five-point moving averages,  $M$ , and associated residuals,  $R$ , are shown in the table below.

Day	M	T	W	T	F	S	M	T	W	T	F
Time (Weeks)	12	15	7	8	13	17	2				
Job	A	B	C	D	E	F	G				

The table and graph below show  $N$ , the number of calls per week day to a new enquiry line, over a three week period, together with five-point moving averages,  $M$ , and associated residuals,  $R$ .  
A manager of a building company has split a project into seven jobs that need to be completed. A three week period, together with five-point moving averages,  $M$ , and associated residuals,  $R$ , are shown in the table below.

- Question 12  
(7 marks)

**Question 13**

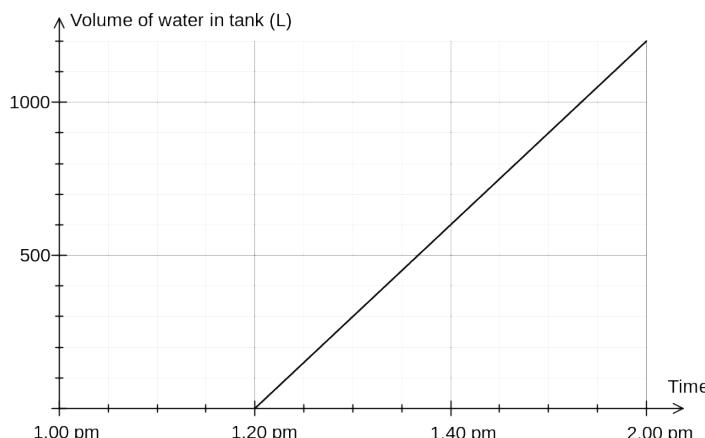
(7 marks)

Two empty water tanks are to be filled with water.

At 1 pm, a hose delivering a steady 30 litres per minute is placed into tank A and left to run for 20 minutes, at which time it is switched from tank A into tank B.

Ten minutes after the hose is switched, a second hose is placed into tank A, this one delivering a steady 15 litres per minute.

The graph below shows the volume of water in tank B for the first hour.



- (a) What volume of water was in tank A at 1.20 pm?

(1 mark)

- (b) On the axes above, draw the graph for the volume of water in tank A during the first hour.

(2 marks)

- (c) Determine the time at which both tanks contained the same volume of water and state what this volume is.

(2 marks)

- (d) Calculate the rate at which the second hose delivered water, in kilolitres per hour, given that there are 1000 litres in one kilolitre.

(2 marks)

**Question 14**

(8 marks)

A young person began saving up for a deposit on a home by paying \$275 at the start of each month into a First Home Saver account. Account interest and government bonuses combined to grow the balance of the account at a rate of 21% per annum, compounded monthly.

The table below shows the amount in the account at the start of each month, the interest added at the end of the month, the next payment and the balance carried forward to the start of the next month.

Month	Amount at the start of month	Interest for month	Payment	Balance carried forward
$n$	$T_n$	$I_n$	$P_{n+1}$	$T_{n+1}$
1	275.00	4.81	275.00	554.81
2	554.81	9.71	275.00	839.52
3	839.52	A	275.00	B
4				

- (a) Calculate the values of entries  $A$  and  $B$  in the table above.

(2 marks)

- (b) Write a recursive rule to determine the amount in the account at the start of each month.

(3 marks)

- (c) The young person has just made their ninth payment.

- (i) How much money is now in their account?

(1 mark)

- (ii) How much interest has been earned to date?

(2 marks)