

it to the supervisor **before** reading any further.  
you do not have any unauthorised material. If you have any unauthorised material with you, hand  
No other items may be taken into the examination room. It is **your responsibility** to ensure that

### **Important note to candidates**

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper,  
and up to three calculators approved for use in this examination

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,  
correction fluid/tape, eraser, ruler, highlighters

### **To be provided by the supervisor**

### **Materials required/recommended for this section**

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

Formula sheet (extracted from Section One)

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Your name  
in words

Student number: in figures

### **Calculator-assumed**

### **Section Two:**

### **UNITS 1 AND 2**

### **METHODS**

### **MATHEMATICS**

If required by your examination administrator, please place your student identification label in this box

### **Question/Answer booklet**

Semester Two Examination, 2019

**Melville Senior High School**



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**Structure of this paper**

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of examination
Section One: Calculator-free	8	8	50	52	35
Section Two: Calculator-assumed	13	13	100	98	65
<b>Total</b>					<b>100</b>

Supplementary page

Question number: \_\_\_\_\_

**Instructions to candidates**

1. The rules for the conduct of examinations are detailed in the school handbook. Sitting this examination implies that you agree to abide by these rules.
2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
3. You must be careful to confine your answer to the specific question asked and to follow any instructions that are specified to a particular question.
4. 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.
5. It is recommended that you do not use pencil, except in diagrams.
6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.
7. The Formula sheet is not to be handed in with your Question/Answer booklet.

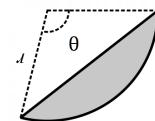
Markers use only		
Question	Maximum	Mark
9	6	
10	8	
11	7	
12	5	
13	7	
14	10	
15	12	
16	7	
17	7	
18	8	
19	7	
20	6	
21	8	
S2 Total	98	
S2 Wt (×0.6633)	65%	

(3 marks)

- (ii) Determine the perimeter of the segment.

(2 marks)

- (i) Determine the area of the segment.



- (b) A segment of a circle of radius 28 cm is shown below, where  $\theta = 108^\circ$ .

(1 mark)

(6 marks)

- (a) Convert  $108^\circ$  to an exact radian measure.

### Question 9

Working time: 100 minutes.  
This section has **thirteen (13)** questions. Answer **all** questions. Write your answers in the spaces provided.

Question number: \_\_\_\_\_

**Question 10**

(8 marks)

From a random survey of telephone usage in 320 households it was found that 48 households had access to a mobile phone but not a landline, 258 households had access to a landline and 188 more households had access to a mobile phone than did not.

- (a) Complete the missing entries in the table below.

(3 marks)

	Mobile	No mobile	Total
Landline			
No landline	48		
Total			320

- (b) If one household is randomly selected from those surveyed, determine the probability that

- (i) it had access to a landline. (1 mark)

- (ii) it had no access to a mobile phone given that it had access to a landline. (1 mark)

- (iii) it had access to a landline given that it no access to a mobile phone. (1 mark)

- (c) Use your answers above to comment on the possible independence of households having access to a mobile phone and households having access to a landline. (2 marks)

**Question 21**

(8 marks)

A fair eight-sided dice numbered 1, 2, 3, 4, 5, 6, 7 and 8 is thrown  $n$  times until it lands on an 8.

- (a) Show that the probability that  $n=3$  is  $\frac{49}{512}$ .

(1 mark)

- (b) Determine the probability that  $n=5$ .

(1 mark)

- (c) Write an expression in terms of  $n$  for the probability that the first 8 is thrown on the  $n^{\text{th}}$  throw and explain why the probabilities form a geometric sequence. (2 marks)

- (d) Determine the probability that the first 8 is thrown in 10 or less attempts. (2 marks)

- (e) The probability that the first 8 is thrown in  $k$  or less attempts must be at least 95 %. Determine the least value of integer  $k$ . (2 marks)

(7 marks)

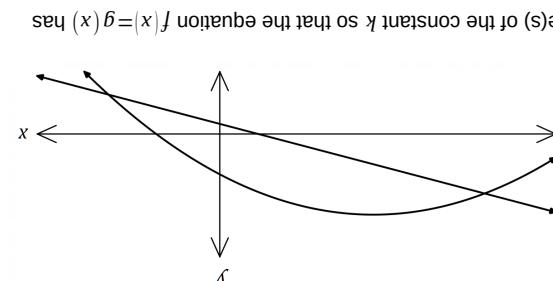
- A drone is flying in a straight line and at a constant height  $h$  m above a level pitch towards a thin goal post. It maintains a constant speed of  $1.5 \text{ ms}^{-1}$ . Initially, the angle of depression from the drone to the base of the post is  $9^\circ$ . Exactly 5 seconds later this angle has increased to  $16^\circ$ .

- (a) Sketch a diagram to show the two angles of depression from the drone to the base of the post. (1 mark)

- (b) Determine the value of  $h$  and calculate the time after leaving its initial position that the drone will collide with the post. (6 marks)

(1 mark)

The graphs of  $y = f(x)$  and  $y = g(x)$  are shown below where  $f(x) = 2 - 4x - 2x^2$  and  $g(x) = k - 2x$ .



(5 marks)

Determine the value(s) of the constant  $k$  so that the equation  $f(x) = g(x)$  has

(a) one solution.

(b) two solutions.

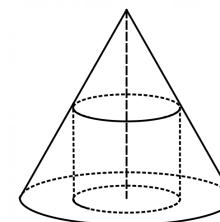
**Question 12**

A geometric sequence has a second term of  $-28.8$  and a sum to infinity of  $30$ .

Determine the sum of the first 3 terms of the sequence.

**Question 19**

A right circular cone of base radius  $10$  cm and height  $25$  cm stands on a horizontal surface. A cylinder of radius  $x$  cm and volume  $V$   $\text{cm}^3$  stands inside the cone with its axis coincident with that of the cone and such that the cylinder touches the curved surface of the cone as shown.



- (a) Show that  $V = 25\pi x^2 - 2.5\pi x^3$ .

(3 marks)

- (b) Given that  $x$  can vary, use a calculus method to determine the maximum value of  $V$ .

(4 marks)

(2 marks)

approaches as  $h$  becomes closer and closer to 0 and state what this value represents.

- (c) Determine an estimate, correct to 3 decimal places, for the value that  $\frac{f(1+h)-f(1)}{h}$

(2 marks)

$$(iii) P(A|B)=0.04.$$

(1 mark)

(b) Name the feature of the graph above that the values you calculated in part (a) represent.

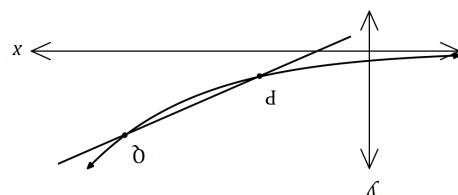
$h$	$\frac{f(1+h)-f(1)}{h}$
1	
0.1	
0.01	
0.001	

(4 marks)

where necessary.

- (a) Complete the second column in the table below, rounding values to 4 decimal places

P has coordinates  $(1, 2)$  and Q has coordinates  $(1+h, f(1+h))$  where  $0 < h \leq 1$ .



The graph of  $y=f(x)$  is shown below, where  $f(x)=x^2$ , together with the secant to the curve

(7 marks)

through the points P and Q.

$$(a) \text{Determine } P(A \cup B) \text{ when } x=0.12.$$

Two events A and B are such that  $P(A \cup B)=x$ ,  $P(A)=0.2$  and  $P(\bar{A} \cup B)=0.6$ .

(2 marks)

(2 marks)

(iii) A and B are independent.

(1 mark)

(ii) A and B are mutually exclusive.

(c) Determine the value of  $x$  when

(1 mark)

(b) Determine an expression for  $P(A \cup B)$  in terms of  $x$ .

**Question 14**

(10 marks)

When a manufacturer makes  $x$  litres of a chemical using process  $X$ , the cost in dollars per litre  $C(x)$  varies according to the rule

$$C(x) = \frac{180}{x+12}, 6 \leq x \leq 48.$$

(a) Determine

(i) the cost per litre when 38 L is made.

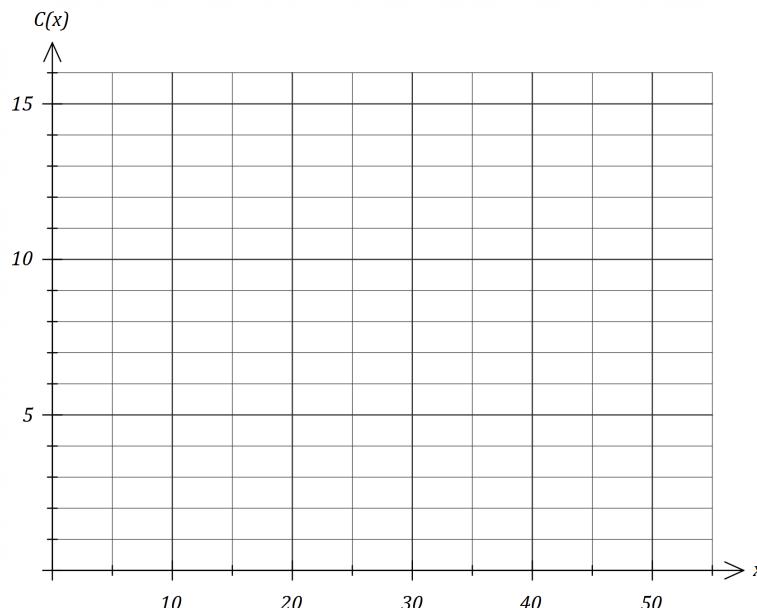
(1 mark)

(ii) the total cost of making 18 L of the chemical.

(2 marks)

(b) Graph the cost per litre over the given domain on the axes below.

(3 marks)

**Question 17**

(7 marks)

The amount of water in a tank,  $W$  litres, varies with time  $t$ , in minutes, and can be modelled by the equation  $W = 200 - 185(1.2)^{-t}$ ,  $t \geq 0$ .

(a) Determine amount of water in the tank

(i) initially.

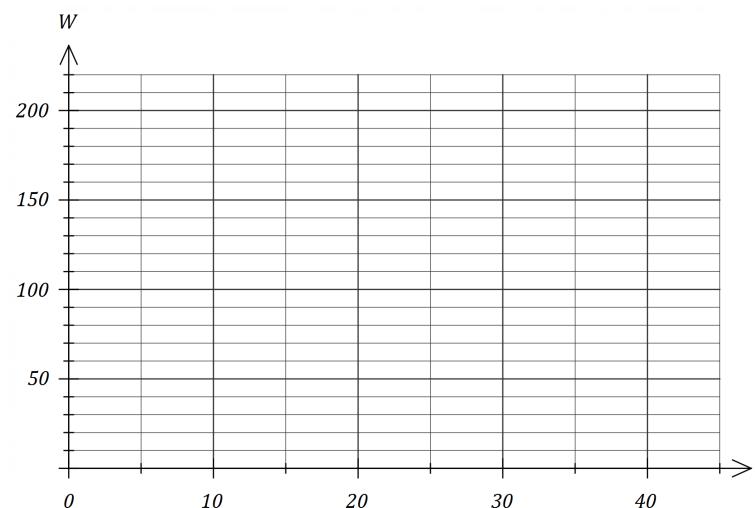
(1 mark)

(ii) after 15 minutes.

(1 mark)

(b) Graph  $W$  against  $t$  for  $0 \leq t \leq 45$  on the axes below.

(3 marks)



(c) Over time, the amount of water in the tank approaches  $v$  litres. State the value of  $v$  and determine the time at which the amount of water in the tank reaches 99% of this value.

(2 marks)

Question 16

(a) A doctor prescribes drug  $D$  to two unrelated patients. Determine the probability that is known to be 0.2.

When a patient takes a painkilling drug  $D$ , the probability that they experience some side effects is known to be 0.2.

(b) A doctor prescribes drug  $D$  to two unrelated patients. Determine the probability that neither patient experiences some side effects.

(c) When the manufacturer uses process  $Z$ , the cost in dollars per litre  $K(x)$  is modelled by

$$K(x) = 9 - \frac{8}{x}, 6 \leq x \leq 48.$$

(d) Add this function to the graph and hence determine the production quantities for which process  $X$  is cheaper than process  $Z$ .

(e) one patient experiences some side effects and the other does not.

(2 marks)

(f) neither patient experiences some side effects.

(1 mark)

(g) one patient experiences some side effects and the other does not.

(2 marks)

(h) not switch to another drug.

(i) The doctor prescribes drug  $D$  to three unrelated patients. Determine the probability that at least one of these patients switch to another drug.

(2 marks)

(j) The doctor prescribes drug  $D$  to a patient. Determine the probability that the patient does not switch to another drug.

(2 marks)

(k) Other painkilling drugs are available. Of those who take drug  $D$ , 75% of patients who suffer some side effects will switch to another drug whereas no patient who has no side effects will switch.

(l) The doctor prescribes drug  $D$  to three unrelated patients. Determine the probability that at least one of these patients switches to another drug.

(2 marks)

(m) The doctor prescribes drug  $D$  to three unrelated patients. Determine the probability that at least one of these patients switches to another drug.

(2 marks)

(n) The doctor prescribes drug  $D$  to three unrelated patients. Determine the probability that at least one of these patients switches to another drug.

(2 marks)

(12 marks)

**Question 15**

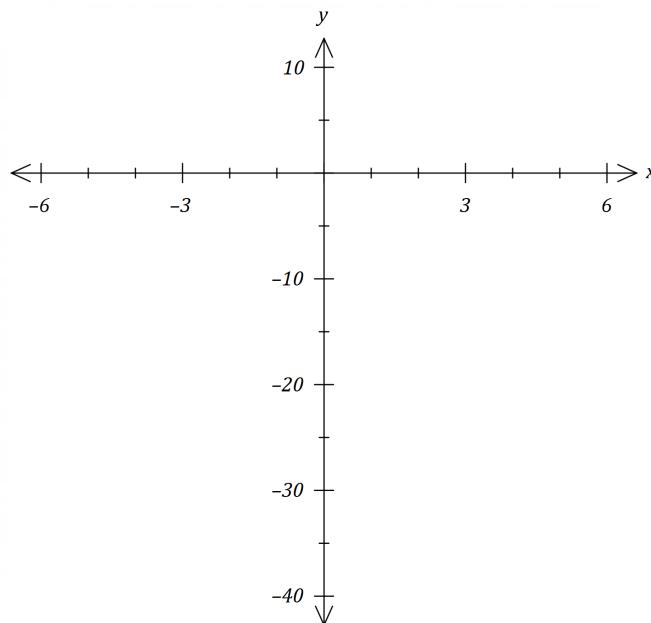
The function  $f$  is defined by  $f(x) = x^3 + ax^2 + bx + c$ , where  $a, b$  and  $c$  are constants.

The graph of  $y=f(x)$  has the following features:

- passes through  $(0, -27)$  and  $(3, 0)$
- has a local maximum at  $(-3, 0)$

(a) Sketch the graph of  $y=f(x)$  on the axes below.

(3 marks)



(b) Determine the value of  $a$ , the value of  $b$  and the value of  $c$ .

(3 marks)

(c) Use a calculus method to determine the exact coordinates of the local minimum of the graph of  $y=f(x)$ . (3 marks)

(d) Determine the coordinates of the point where the tangent to  $y=f(x)$  at  $(0, -27)$  intersects the curve  $y=f(x)$ , other than at the point of tangency. (3 marks)