

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.

### Important note to candidates

Special items: nil

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

### To be provided by the candidate

Formula Sheet

This Question/Answer Booklet

### To be provided by the supervisor

### Materials required/recommended for this section

Working time for section: fifty minutes  
Reading time before coming work: five minutes

Your name \_\_\_\_\_  
In words \_\_\_\_\_



Student Number: In figures \_\_\_\_\_

Calculator-free

Section One:

METHODS  
UNIT 1  
MATHEMATICS

**SOLUTIONS**

Question/Answer Booklet

Semester One Examination, 2016

Rossmyne 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 exam
Section One: Calculator-free	7	7	50	50	35
Section Two: Calculator-assumed	13	13	100	99	65
<b>Total</b>			149	100	

**Additional working space**

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.
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.

**Question 1**

Solve the following equations for  $x$ .

(a)  $x^2 = 4x$  (2 marks)

(b)  $x^3 - 2x^2 - 3x = 0$  (3 marks)

(c)  $\frac{3}{x-1} + \frac{4}{x+1} + 3 = 0$  (3 marks)

Specific behaviours	$x = -5$
Solution	$7x = -35$
Multiples through by common denominator	$4x - 4 + 3x + 3 = -36$
Expands and simplifies	$4(x - 1) + 3(x + 1) + 36 = 0$
States solution	$x = -5$

Specific behaviours	$x = 0, -1, 3$
Solution	$x(x + 1)(x - 3) = 0$
Factors out $x$	$x(x^2 - 2x - 3) = 0$
Factors quadratic	$x(x + 1)(x - 3) = 0$
States solutions	$x = 0, -1, 3$

Specific behaviours	$x = 0, 4$
Solution	$x(x - 4) = 0$
Determines values of $x$	$x^2 - 4x = 0$
Re-writes equal to zero and factors	$x(x - 4) = 0$
States solutions	$x = 0, 4$

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

Additional working space

This section has **seven (7)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time for this section is **50 minutes**.

Section One: Calculator-free      35% (50 Marks)

(8 marks)

- (a) A function is defined by  $f(x) = (x - 2)^2(x + 1)$ .

- (i) Determine the coordinates of the  $y$ -intercept of the graph of  $y = f(x)$ . (1 mark)

**Solution**

$$f(0) = (-2)^2(1) = 4 \quad \text{At } (0, 4)$$

**Specific behaviours**

✓ substitutes  $x=0$  and writes as coordinate

- (ii) Expand and simplify  $f(x)$ . (2 marks)

**Solution**

$$\begin{aligned} f(x) &= (x^2 - 4x + 4)(x + 1) \\ &= x^3 - 4x^2 + 4x + x^2 - 4x + 4 \\ &= x^3 - 3x^2 + 4 \end{aligned}$$

**Specific behaviours**

- ✓ expands quadratic factor correctly  
✓ expands and simplifies rest of function

- (iii) The coordinates of one of the turning points of the graph of  $y = f(x)$  can be read from the function definition. State the coordinates of this turning point. (1 mark)

**Solution**

$$(2, 0)$$

**Specific behaviours**

✓ states coordinates

- (b) Consider the function  $g(x) = x^3 - 3x^2 - 10x + 24$ .

- (i) Determine  $g(2)$ . (1 mark)

**Solution**

$$g(2) = 8 - 12 - 20 + 24 = 0$$

**Specific behaviours**

✓ substitutes correctly

- (ii) Factorise  $g(x)$ . (3 marks)

**Solution**

$$g(x) = (x - 2)(x^2 + ax - 12)$$

From  $x^2$  term:  $a - 2 = -3 \Rightarrow a = -1$

$$\begin{aligned} g(x) &= (x - 2)(x^2 - x - 12) \\ &= (x - 2)(x - 4)(x + 3) \end{aligned}$$

**Specific behaviours**

- ✓ uses root from (i) to determine one factor  
✓ determines remaining quadratic  
✓ factorises fully

Question 7

(5 marks)

- (a) Simplify  $\cos \frac{11\pi}{3} \cos \frac{10\pi}{3} + \sin \frac{11\pi}{3} \sin \frac{10\pi}{3}$ . (2 marks)

**Solution**

$$\begin{aligned} \cos \frac{11\pi}{3} \cos \frac{10\pi}{3} + \sin \frac{11\pi}{3} \sin \frac{10\pi}{3} &= \cos\left(\frac{11\pi}{3} - \frac{10\pi}{3}\right) \\ &= \cos \frac{\pi}{3} \\ &= \frac{1}{2} \end{aligned}$$

**Specific behaviours**

- ✓ uses difference formula  
✓ simplifies

- (b) Show that the exact value of  $\tan\left(\frac{\pi}{12}\right)$  is  $\frac{\sqrt{3}-1}{\sqrt{3}+1}$ . (3 marks)

**Solution**

$$\begin{aligned} \tan\left(\frac{\pi}{12}\right) &= \tan\left(\frac{\pi}{3} - \frac{\pi}{4}\right) \\ &= \frac{\tan \frac{\pi}{3} - \tan \frac{\pi}{4}}{1 + \tan \frac{\pi}{3} \tan \frac{\pi}{4}} \\ &= \frac{\sqrt{3} - 1}{1 + \sqrt{3}} = \frac{\sqrt{3} - 1}{\sqrt{3} + 1} \end{aligned}$$

**Specific behaviours**

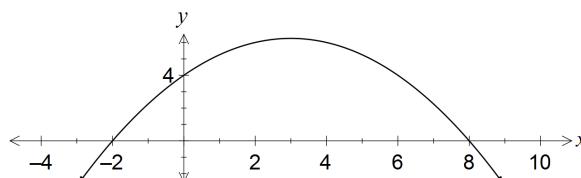
- ✓ splits angle  
✓ uses difference formula  
✓ substitutes exact values and simplifies

	<p>(c) Expand whether the line through A and B will intersect the line with equation <math>3x + 4y + 5 = 0</math>. (2 marks)</p> <p><b>Solution</b></p> <p><math>m_A = \frac{-4 - 10}{-2 - 6} = -\frac{3}{4} \leftarrow m = \frac{3}{4}</math></p> <p><math>y - (-10) = \frac{3}{4}(x - 6)</math></p> <p><math>y = \frac{3}{4}x - 18</math></p> <p>calculates gradient of AB states perpendicular gradient calculates <math>y</math>-intercept and writes equation states parallel but not coincident states no with reason</p>	
	<p>(d) Determine the equation of the line through A that is perpendicular to AB. (3 marks)</p> <p><b>Solution</b></p> <p><math>m_{AB} = \frac{-4 - 10}{-2 - 6} = -\frac{3}{4} \leftarrow m = \frac{3}{4}</math></p> <p><math>y - (-10) = \frac{3}{4}(x - 6)</math></p> <p><math>y = \frac{3}{4}x - 18</math></p> <p>calculates gradient of AB states perpendicular gradient calculates <math>y</math>-intercept and writes equation states parallel but not coincident states no with reason</p>	
	<p>(e) Expand and simplify <math>(a+b)^2</math>. (1 mark)</p> <p><b>Solution</b></p> <p><math>a^2 + 2ab + b^2</math></p>	
	<p>(f) Evaluate <math>\frac{14!}{13!} \times \frac{8!5!}{6!5!} \times \frac{13!}{14!} \times 3! \times 8! \times 5!</math>. (3 marks)</p> <p><b>Solution</b></p> <p><math>= \frac{14}{6} = \frac{7}{3}</math></p>	
	<p>(g) If B is the midpoint of A and C, determine the coordinates of C. (2 marks)</p> <p><b>Solution</b></p> <p><math>C(x, y)</math></p> <p><math>\frac{6+x}{2} = -2 \Rightarrow x = -10</math></p> <p><math>\frac{2+y}{2} = -4 \Rightarrow y = -10</math></p> <p>determines x-coordinate determines y-coordinate specific behaviours</p>	
	<p>(h) Consider the points A(6, -10) and B(-2, -4). Determine the coordinates of C. (7 marks)</p> <p><b>Question 3</b></p> <p><b>Calculator-free</b></p>	

(7 marks)

**Question 4**

- (a) Part of the graph of
- $y = ax^2 + bx + 4$
- is shown below.

Determine the values of the coefficients  $a$  and  $b$ .

(3 marks)

**Solution**

$$y = a(x+2)(x-8)$$

$$(0, 4) \Rightarrow 4 = a(2)(-8) \Rightarrow a = -\frac{1}{4}$$

$$y = -\frac{1}{4}(x^2 - 6x - 16)$$

$$= -\frac{1}{4}x^2 + \frac{3}{2}x + 4 \Rightarrow a = -\frac{1}{4}, b = \frac{3}{2}$$

**Specific behaviours**

✓ uses roots to express in factored form

✓ uses y-intercept to find  $a$ ✓ expands and states  $b$ 

- (b) A quadratic has equation
- $y = x^2 - 6x + 2$
- . Determine

- (i) the coordinates of its turning point.

(2 marks)

**Solution**

$$x^2 - 6x + 2 = (x-3)^2 - 3^2 + 2$$

$$= (x-3)^2 - 7$$

At  $(3, -7)$ **Specific behaviours**✓ completes square, or uses  $x = -b/2a$ 

✓ states coordinates

- (ii) the exact values of the zeros of the quadratic.

(2 marks)

**Solution**

$$(x-3)^2 - 7 = 0$$

$$x-3 = \pm\sqrt{7}$$

$$x = 3 \pm \sqrt{7}$$

**Specific behaviours**

✓ uses quadratic formula or completes square

✓ states both roots in exact form

**Question 5**

(8 marks)

- (a) A circle of radius 5 has its centre at
- $(6, -4)$
- .

- (i) Determine the equation of this circle.

(2 marks)

**Solution**

$$(x-6)^2 + (y+4)^2 = 25$$

**Specific behaviours**

✓ uses standard circle form with correct radius

✓ correct equation

- (ii) State, with justification, whether the point
- $(9, -8)$
- lies on the circle.

(1 mark)

**Solution**

$$(9-6)^2 + (-8+4)^2 = 9+16=25 \Rightarrow \text{Does lie on circle}$$

**Specific behaviours**

✓ substitutes point into equation from (a) and interprets

- (b) Determine the centre and radius of the circle with equation
- $x^2 + y^2 - 4x + 6y + 9 = 0$
- .

(3 marks)

**Solution**

$$(x-2)^2 - 4 + (y+3)^2 - 9 + 9 = 0$$

$$(x-2)^2 + (y+3)^2 = 4 = 2^2$$

Hence centre at  $(2, -3)$  and radius 2**Specific behaviours**✓ factors  $x$  terms✓ factors  $y$  terms

✓ states centre and radius

- (c) Determine the coordinates of the vertex and the equation of the axes of symmetry of the curve with equation
- $2y^2 = x + 3$
- .

(2 marks)

**Solution**Vertex at  $(-3, 0)$  and symmetrical about  $y = 0$ .**Specific behaviours**

✓ states vertex

✓ states equation of line of symmetry