



PERTH MODERN SCHOOL

Exceptional schooling. Exceptional students.

INDEPENDENT PUBLIC SCHOOL

Semester One Examination, 2022

Question/Answer booklet

MATHEMATICS SPECIALIST UNIT 1

Section One: Calculator-free

Your name _____

Your Teacher's Name _____

Time allowed for this section

Reading time before commencing work: five minutes

Working time: fifty minutes

Materials required/recommended for this section

To be provided by the supervisor

This Question/Answer booklet

Formula sheet

To be provided by the candidate

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

Special items: nil

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 material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Question	Maximum	Marks	Question	Maximum	Marks
1	5		4	11	
2	8		5	8	
3	7		6	8	

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	6	6	50	47	35
Section Two: Calculator-assumed	11	11	100	93	65
Total					100

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.
3. You must be careful to confine your answers to the specific question asked and to follow any instructions that are specific 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.

Section One: Calculator-free**35% (47 Marks)**

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

Working time: 50 minutes.

Question 1**(5 marks)**

Calculate the number of integers from 1 to 168 (inclusive) which are divisible by 4 or 6.

Question 2

(8 marks)

Consider the statement below:

$$\text{If } n = 2, \text{ then } {}^7C_n = 21 .$$

(a) **Show** that the statement is true. (2 marks)

(b) Write the converse of the original statement, and state whether it is true or false, giving a reason. (2 marks)

(c) Write the inverse of the original statement. (2 marks)

(d) Write the contrapositive of the original statement, and state whether it is true or false, giving a reason. (2 marks)

Question 3**(7 marks)**

Consider the vectors $\mathbf{a} = 9\mathbf{i} + 2\mathbf{j}$, $\mathbf{b} = 3\mathbf{i} - 5\mathbf{j}$, $\mathbf{c} = 6\mathbf{i} + 7\mathbf{j}$.

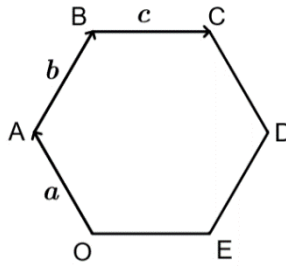
- (a) Determine the vector projection of \mathbf{a} in the direction of \mathbf{b} . (3 marks)

- (b) Express \mathbf{c} in the form $x\mathbf{a} + y\mathbf{b}$. (4 marks)

Question 4

(11 marks)

$OABCDE$ is a regular hexagon. Let $\mathbf{a} = \overrightarrow{OA}$, $\mathbf{b} = \overrightarrow{AB}$ and $\mathbf{c} = \overrightarrow{BC}$ as shown in the diagram below:



- (a) Write expressions for \overrightarrow{OE} , \overrightarrow{ED} and \overrightarrow{DC} in terms of \mathbf{a} , \mathbf{b} and \mathbf{c} . (3 marks)
- (b) Determine expressions for \overrightarrow{AD} and \overrightarrow{OB} in terms of \mathbf{a} , \mathbf{b} and \mathbf{c} . (2 marks)
- (c) Use a **vector method** to prove that \overrightarrow{AD} is perpendicular to \overrightarrow{OB} .
[Hint: the internal angles in a regular hexagon are all 120° .] (5 marks)

Question 5

(8 marks)

- (a) Given vectors $\mathbf{a} = \begin{pmatrix} -16 \\ 6 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} m \\ n \end{pmatrix}$, find a relationship between the components m and n if \mathbf{a} is parallel to \mathbf{b} . (3 marks)

- (b) Two vectors \mathbf{p} and \mathbf{q} are such that $\mathbf{p} = 3\mathbf{i} + 2\mathbf{j}$ and $\mathbf{q} = \mathbf{i} + k\mathbf{j}$. If the scalar projection of \mathbf{p} in the direction of \mathbf{q} is $\frac{1}{\sqrt{2}}$, determine the value of k , given k is an integer.

(5 marks)

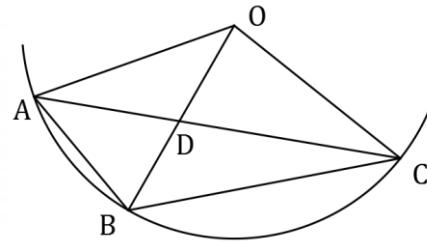
Question 6

(8 marks)

- (a) Points A, B and C lie on an arc of a circle with centre O as shown at right.

Chord AC intersects OB at point D .

The diagram is not drawn to scale.



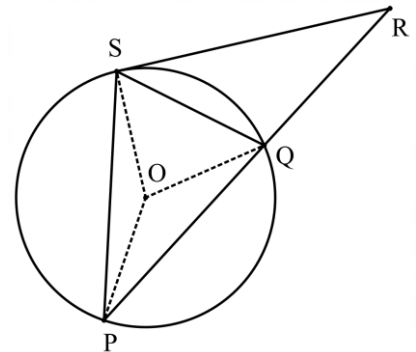
When $\angle ABC = 132^\circ$ and $\angle BCA = 22^\circ$, determine the size of $\angle ADO$.

(4 marks)

- (b) A secant cuts a circle with centre O at points P and Q . Secant PQ is extended beyond Q to point R , where it meets a line that is a tangent to the circle at point S .

Prove that $\angle QRS = \frac{1}{2} (\angle POS - \angle QOS)$

(4 marks)



Supplementary page

Question number: _____

Supplementary page

Question number: _____

