MATHEMATICS SPECIALIST UNIT 1

Section Two:
Calculator-assumed

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

WA student number: In figures

In words _____

Time allowed for this section

Reading time before commencing work: ten minutes
Working time: 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 this examination

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.

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	15	15	100	98	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.
   Do not use erasable or gel pens.

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.

Markers use only		
Question	Maximum	Mark
9	6	
10	4	
11	9	
12	8	
13	7	
14	8	
15	3	
16	6	
17	4	
18	5	
19	8	
20	8	
21	8	
22	9	
23	5	
S2 Total	98	
S2 Wt (×0.6633)	65%	

SN085-151-6

DO NOT WRITE IN THIS AREA AS IT WILL BE CUT OFF

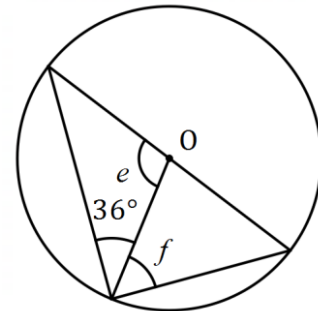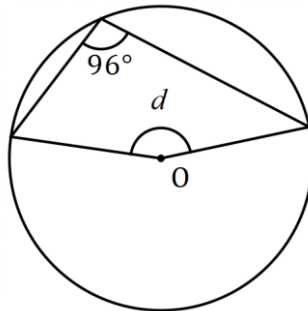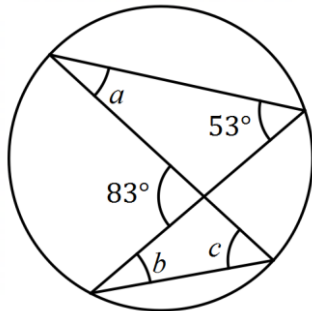**Section Two: Calculator-assumed**   **65% (98 Marks)**

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

Working time: 100 minutes.

Question 9   **(6 marks)**

Determine the size of the angles marked a, b, c, d, e and f shown in the circles below. Where marked, O is the centre of the circle.

Question 10   **(4 marks)**

A coastguard boat is travelling at a velocity of $24\boldsymbol{i} - 10\boldsymbol{j}$ km/hr. It is heading in the same direction as a fishing vessel. If the coast guard is gaining on the fishing boat by 15 km/hr, find the velocity of the fishing vessel in component form.
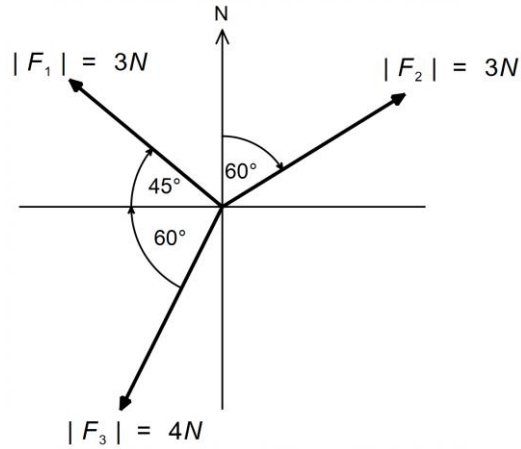
Question 11   **(9 marks)**

A Physics teacher has a three way tug–of–war rope.
He is experimenting with his class.

The first experiment involves forces being applied to the rope as shown in Diagram 1.

(a)   Determine the direction, correct to the nearest degree, of the resultant force experienced by the origin of the system.   (5 marks)

The second experiment involves keeping the rope in equilibrium using the forces as shown.
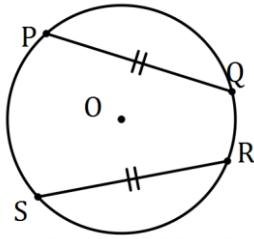Note that the diagram has not been drawn to scale.
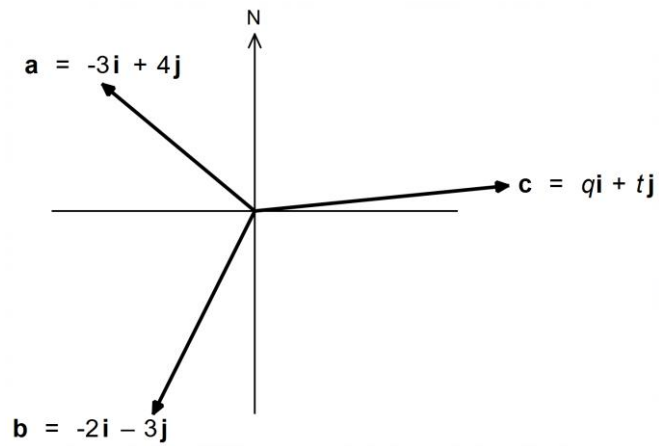
(b) Determine the magnitude and direction, to the nearest degree, of **c**. (4 marks)

Question 12 **(8 marks)**

(a) Prove that chords of equal length subtend equal angles at the centre of a circle.

(3 marks)

(b) Points A and B lie on a circle of radius 9.7 cm so that $AB = 13$ cm. Determine

(i) the distance of chord AB from the centre of the circle. (3 marks)

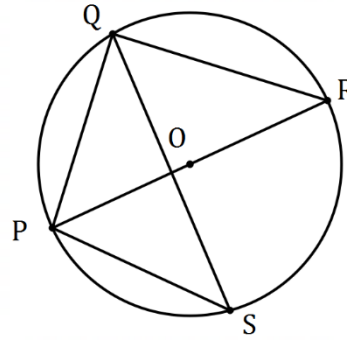(ii) the angle subtended by chord AB at the centre of the circle. (2 marks)

See next page

Question 13   **(7 marks)**

(a)   The diagram shows points P, Q, R and S that lie on the circumference of a circle centre O. PR is a diameter and the size of $\angle PSQ = 53°$.
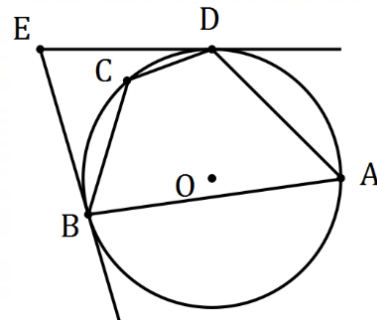
Determine, with reasons, the size of $\angle QPR$.   (3 marks)

(b)   In the diagram shown, A, B, C and D are points on the circumference of a circle with centre O. Tangents to the circle at B and D intersect at E.

Determine, with justification, the size of $\angle BED$ when $\angle BCD = 134°$.   (4 marks)

Question 14 **(8 marks)**

(a)   An art gallery plans to display 5 paintings in a row. Determine how many arrangements of paintings are possible if they have a selection of 12 different paintings to choose from.

(2 marks)

(b)   In another room, the gallery have already selected 7 different paintings to hang in a row. If 3 of the paintings are by the artist Tyler, determine the number of different arrangements of these 7 paintings that are possible when

   (i)   the paintings by Tyler must be next to each other.   (2 marks)

   (ii)   a painting by Tyler must be at each end.   (2 marks)

   (iii)   the paintings by Tyler must be apart and not at the ends.   (2 marks)

Question 15 **(3 marks)**

A calculator can generate random integers from 13 to 30. Use the pigeonhole principle to explain why 37 random integers should be generated to be certain that at least 3 of these integers are the same.

Question 16 **(6 marks)**

Given m is a vector of magnitude 6 units and on a bearing of 080° and n is a vector of magnitude 12 units and on a bearing of 150°. Find the magnitude and direction (to one decimal place) of the following vectors.
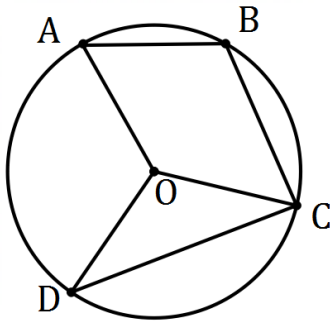
(a) $m + n$ (3 marks)

(b) $-n + m$ (3 marks)

Question 17   **(4 marks)**

The vertices of quadrilateral $ABCD$ lie on the circumference of a circle centre O shown below. Given that $\angle ABC = 105°$ and $\angle ODC = 54°$, determine with reasoning the size of $\angle AOD$.

Question 18   **(5 marks)**

Three vectors are given by $\mathbf{a} = 5\mathbf{i} - 3\mathbf{j}$, $\mathbf{b} = -8\mathbf{i} + \mathbf{j}$ and $\mathbf{c} = x\mathbf{i} - 8\mathbf{j}$, where x is a constant.

Determine the value(s) of x if:

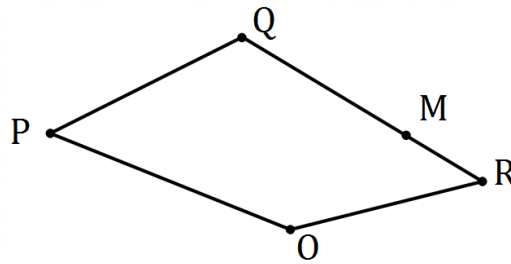(a) $\mathbf{b}$ and $\mathbf{c}$ are perpendicular.   (2 marks)

(b)   the angle between $\mathbf{a}$ and $\mathbf{c}$ is 60°.   (3 marks)

Question 19 (8 marks)

In quadrilateral $OPQR$ shown below, M lies on QR so that $|\overrightarrow{QM}| = 3|\overrightarrow{MR}|$.

(a) If $\overrightarrow{OP} = \mathbf{p}, \overrightarrow{OQ} = \mathbf{q}$ and $\overrightarrow{OR} = \mathbf{r}$, express the following in terms of $\mathbf{p}, \mathbf{q}$ and/or $\mathbf{r}$.

(i) $\overrightarrow{PR}$. (1 mark)

(ii) $\overrightarrow{RM}$. (2 marks)

(iii) $\overrightarrow{PM}$. (2 marks)

(b) If O is the origin and points P, Q and R have coordinates $(-2, 39), (28, -14)$ and $(32, -18)$ respectively, determine the distance PM. (3 marks)

Question 20 **(8 marks)**

Oil platform K lies 95.5 km away from another oil platform M on a bearing of 325°. A steady current of 3.5 km per hour flows between the platforms on a bearing of 040°. A small boat at M, with a cruising speed of 15 km per hour, needs to arrive at K by 5 pm.

Determine the bearing that the boat should steer and the latest time it should depart from M.

Question 21 **(8 marks)**

A school yearbook is produced by a committee of 2 teachers and 6 students. 5 teachers and 16 students have nominated for the committee.

(a) Determine how many different committees could be formed from the nominations.

(2 marks)

(b) The student nominations include two sets of twins. Determine how many different committees could be chosen that do not include a 'complete' set of twins. (4 marks)

(c) Suppose one of the students in the committee will be appointed as treasurer and another student will be appointed as secretary. Determine how many different committees can be formed with this structure. (2 marks)

Question 22 **(9 marks)**

(a) A body is moving at 14 m/s on a bearing of $135°$. Determine the equivalent velocity vector in exact form $a\mathbf{i} + b\mathbf{j}$. (2 marks)

(b) Determine the bearing and speed of a body moving with velocity $-14\mathbf{i} - 5.1\mathbf{j}$ m/s. (2 marks)

(c) The velocity vectors of particles P, Q and R are $\begin{pmatrix} -11 \\ x \end{pmatrix}, \begin{pmatrix} y \\ 5 \end{pmatrix}$ and $\begin{pmatrix} -5.6 \\ 2 \end{pmatrix}$ m/s respectively.

If particles P and Q have the same speed and particles Q and R are moving in the same direction, determine the values of x and y. (5 marks)

Question 23 **(5 marks)**

Solve for n, if $^{n}P_{3} : {}^{n}C_{5} = 1 : 5$

End of questions

Supplementary page

Question number: _____

Supplementary page

Question number: _____

Supplementary page

Question number: _____

Supplementary page

Question number: _____