

MATHEMATICS SPECIALIST UNIT 1

Section Two: Calculator-assumed

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

Student Number: In figures

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In words

Your name

Time allowed for this section

Reading time before commencing work: ten minutes

Working time for this section: one hundred minutes

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 the WACE examinations

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 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.

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	8	8	50	52	35
Section Two: Calculator-assumed	12	12	100	98	65
Total				150	100

Instructions to candidates

- The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2015*. Sitting this examination implies that you agree to abide by these rules.
- Write your answers in this Question/Answer Booklet.
- 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.
- 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.
- 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.
- It is recommended that you **do not use pencil**, except in diagrams.
- The Formula Sheet is **not** to be handed in with your Question/Answer Booklet.

Section Two: Calculator-assumed

(98 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.

Question 9

(9 marks)

Vectors **a** and **b** are as shown on the grid below.



- (a) On the grid above, sketch and label the vectors **p**, **q** and **r** where

$$\begin{aligned} \mathbf{p} &= \mathbf{a} + 2\mathbf{b} \\ \mathbf{q} &= 2\mathbf{a} - \mathbf{b} \\ \mathbf{r} &= -2\mathbf{b} - 0.5\mathbf{a} \end{aligned}$$

(4 marks)

- (b) Two vectors have magnitudes of 45 N and 60 N and the angle between their directions is 130° . Sketch a diagram to show their sum and use trigonometry to calculate the magnitude of the resultant and the angle it makes with the smaller vector. (5 marks)

Question 10**(8 marks)**

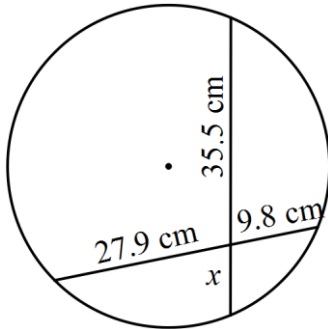
- (a) Of 56 people interviewed on their means of transportation to work over the past month, 38 had used a bus, 19 had cycled and 24 had used a car. On further analysis it was found that 12 had taken the car and also cycled, 16 had used both bus and car, 4 had used all three means and 5 said they did not use any of them.
- (i) Explain why it follows from the above information that 51 people either caught a bus, cycled or used a car to get to work. (1 mark)
- (ii) Determine how many people used both bus and cycle to get to work over the time period. (3 marks)
- (b) A box contains 630 coloured cubes in equal numbers of red, blue, green, orange, black and yellow. How many cubes must be selected from the box to ensure that at least five of one colour are in the selection? Justify your answer. (2 marks)
- (c) 47 students answered a spelling quiz. One student made seven errors, with the rest making fewer errors than this student. Prove that at least seven of the students made an equal number of errors. (2 marks)

Question 11

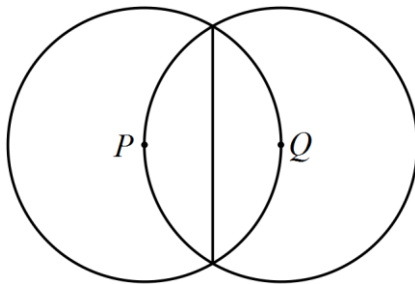
(8 marks)

(a) Evaluate the length of x , correct to one decimal place.

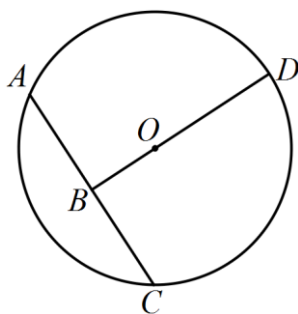
(2 marks)



(b) Two circles with the same radius and centres P and Q intersect as shown. The length of the common chord joining the points of intersection is 20 cm. Determine the exact radius of the circles. (3 marks)



(c) In the circle shown below with centre O and radius 30 cm, the lengths AB and CB are equal, as are the lengths AC and BD . Determine the length OB . (3 marks)



Question 12

(7 marks)

(a) Use the scalar product to show that

(i) the vectors (3, -2) and (4, 6) are perpendicular. (1 mark)

(ii) the vectors $\begin{bmatrix} -1 \\ 3 \end{bmatrix}$ and $\begin{bmatrix} 0.5 \\ -1.5 \end{bmatrix}$ are parallel. (2 marks)

(b) Determine

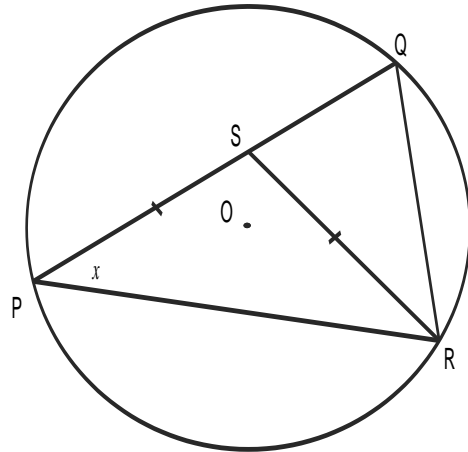
(i) the vector projection of a force of 46N on bearing 015° onto a force of 87N on a bearing 075° . (2 marks)(ii) the vector projection of $3\mathbf{i} - \mathbf{j}$ onto $-4\mathbf{i} + 3\mathbf{j}$. (2 marks)

Question 13

(6 marks)

The three vertices of $\triangle PQR$ lie on a circle with centre O .

Point S lies on PQ such that the lengths PS and RS are equal and $\angle QPR = x$.



(a) Explain why $\angle QOR = 2x$.

(1 mark)

(b) Prove that $QROS$ is a cyclic quadrilateral.

(3 marks)

(c) Calculate the area of $\triangle QRS$ given the area of $\triangle PRS$ is 30 cm^2 and the ratio of lengths $QS : QP = 2 : 5$.

(2 marks)

Question 14**(9 marks)**

- (a) The letters of the word CLASSICS are to be arranged in a row.
- (i) Determine the number of ways in which this can be done. (2 marks)
- (ii) How many of the arrangements end with a letter other than S? (2 marks)
- (b) Even numbers are to be formed using some, or all, of the digits 5, 6, 7, 8 and 9.
- (i) How many even numbers can be formed in this way, if repetition of digits is not allowed? (3 marks)
- (ii) What fraction of the even numbers in (i) start with a 9? (2 marks)

Question 15**(8 marks)**

At 8 am one morning two ships, A and B, have position vectors \mathbf{r} km and velocity vectors \mathbf{v} km/h as follows:

$$\mathbf{r}_A = 80\mathbf{i} - 20\mathbf{j} \quad \mathbf{v}_A = -5\mathbf{i} + 14\mathbf{j} \quad \mathbf{r}_B = -20\mathbf{i} + 30\mathbf{j} \quad \mathbf{v}_B = 15\mathbf{i} + 6\mathbf{j}$$

(a) Relative to ship B,

(i) determine the position of ship A at 8 am. (1 mark)

(ii) determine the velocity of ship A. (1 mark)

(iii) Explain why it is not necessary to know the time to obtain your answer in (ii). (1 mark)

(b) Determine the distance between ship A and ship B later the same day at

(i) 2 pm. (2 marks)

(ii) 6 pm. (1 mark)

(c) Is the distance between the two ships always increasing after 8 am on this day? Justify your answer. (2 marks)

Question 16**(7 marks)**

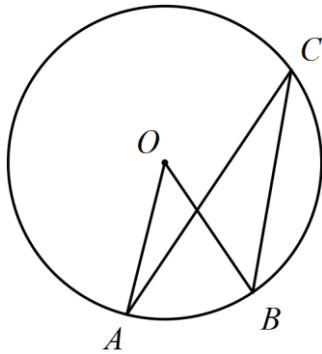
A retailer has discounted the prices on 32 different music CD's, with 11 of them priced at \$8 each and the rest on sale at \$12 each.

- (a) If a customer spent exactly \$20, how many different combinations of CD's could they have bought? (1 mark)
- (b) If a customer spent exactly \$24, how many different combinations of CD's could they have bought? (2 marks)
- (c) If a customer decides to pick at least one CD and to spend no more than \$24, how many different combinations of CD's could they buy? (4 marks)

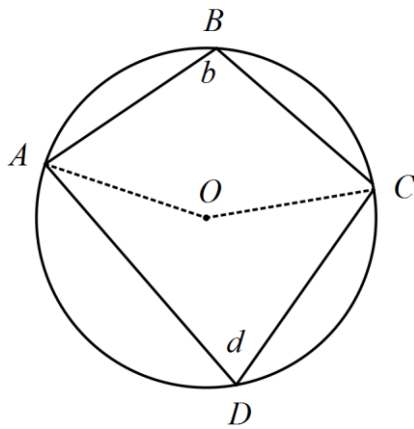
Question 17

(7 marks)

- (a) In the diagram below, where points A , B and C lie on the circumference of a circle with centre O , $\angle ACB = 32^\circ$ and $\angle OAC = 18^\circ$. Determine the size of $\angle OBC$. (2 marks)



- (b) Use proof by contradiction to prove that the opposite angles of a cyclic quadrilateral are supplementary. (5 marks)



Question 18

(9 marks)

The points A , B and C have position vectors $\mathbf{a} = 3\mathbf{i} + 4\mathbf{j}$, $\mathbf{b} = 14\mathbf{i} - 3\mathbf{j}$ and $\mathbf{c} = -5\mathbf{i} + 2\mathbf{j}$.

- (a) Determine the angle between vectors \mathbf{b} and \mathbf{c} , giving your answer rounded to one decimal place. (2 marks)

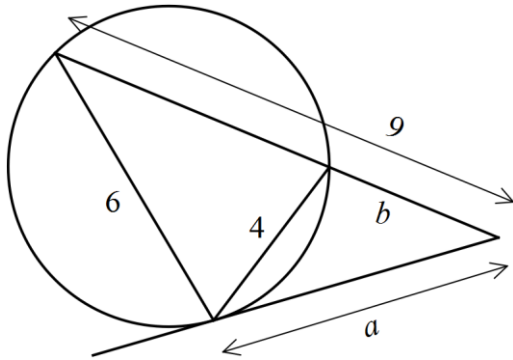
- (b) Find the position vector of point D which divides \overline{AC} internally in the ratio $5:3$. (3 marks)

- (c) Express the vector \mathbf{b} in terms of \mathbf{a} and \mathbf{c} . (4 marks)

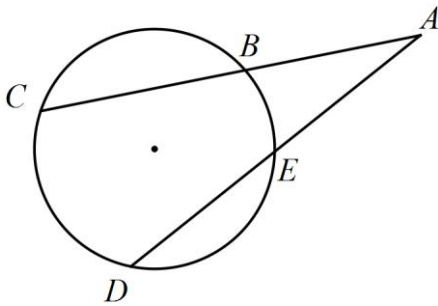
Question 19

(9 marks)

- (a) Determine the lengths a and b in the diagram below. (All dimensions in cm.) (3 marks)



- (b) Two chords of a circle, CB and DE , are extended to meet at A .



- (i) Prove that triangles ADC and ABE are similar. (3 marks)

- (ii) If $AB=10$, $BC=14$, $AE=8$ and $BE=4$ cm, determine the lengths of DE and CD . (3 marks)

Question 20**(11 marks)**

Points A and B lie on level ground with position vectors $-21\mathbf{i} + 10\mathbf{j}$ m and $-489\mathbf{i} + 205\mathbf{j}$ m respectively. A steady wind with velocity $x\mathbf{i} + y\mathbf{j}$ is blowing across the ground.

In order to fly at a fixed height along the direct path from point A to point B, a small drone is programmed to fly with velocity $-30\mathbf{i} + 16\mathbf{j}$ ms⁻¹.

- (a) Show that the relationship between the coefficients x and y is given by $x = -2.4y - 8.4$.
(5 marks)

- (b) Given that the wind has a speed of $\sqrt{37}$ ms⁻¹, calculate all possible wind velocities.
(4 marks)

- (c) Determine all possible times for the drone to fly from A to B.
(2 marks)

Additional working space

Question number: _____

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