

2020 Year 11 ViSN Mathematics Specialist Unit 1 Test 3 – Scalar product, relative vectors, proof

Section One – Calculator Free

Mr Daniel Comtesse
Mandurah Catholic College

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Calculator Free: _____/16

Calculator Assumed: _____/23
Result: _____/39 _____%

Student Name: _____

School: _____

Time allowed: Section One - 20 minutes

Section Two – 30 minutes

Assessment Date: 18 June 2020

Material required/recommended

To be provided by the supervisor

This Question/Answer Paper

SCSA Formula Sheet

To be provided by the candidate

Standard items: pens, pencils, pencil sharpener, eraser, correction fluid/tape, ruler, highlighters

Submission Details

Timed Assessments are to be returned to the ViSN teacher by the ViSN mentor (scan completed assessment and email to teacher above) within 24 hours of assessment date (above).

Instructions to Students

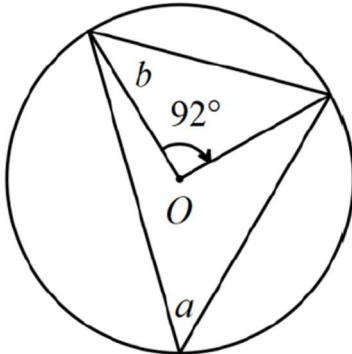
1. **ALL** questions should be attempted.
2. Write your answers in the spaces provided in this Question/Answer Booklet.
3. **SHOW ALL YOUR WORKING CLEARLY.** Your working should be sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Correct answers given without supporting reasoning may not be allocated full marks. Incorrect answers given without supporting reasoning cannot be allocated any marks.
4. If you repeat an answer to any question, ensure that you cancel the answers you do not wish to have marked.
5. It is recommended that you **do not use pencil**, except in diagrams.

Question 1

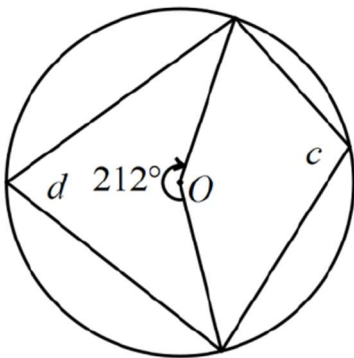
[2, 2, 1 = 5 marks]

In the following diagrams, O is the centre of the circle shown.

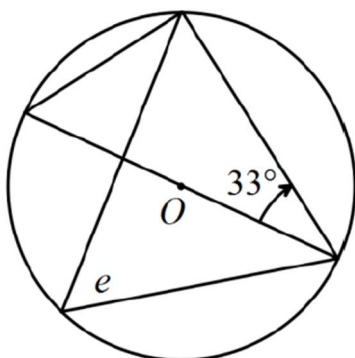
(a) Determine the values of a and b .



(b) Determine the values of c and d .



(c) Determine the value of e .



Question 2**[2, 1 = 3 marks]**

Three points are given by $A(1, 2)$, $B(4, -2)$ and $C(p, 4)$. The lines through AB and BC are perpendicular.

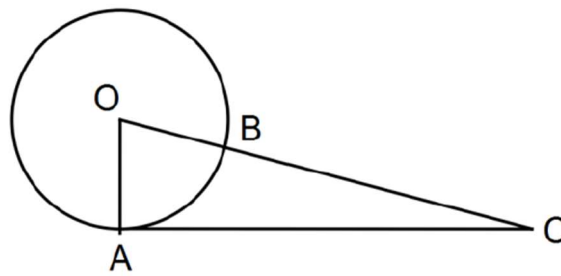
(a) Evaluate the dot product of \overrightarrow{AB} and \overrightarrow{BC} .

(c) Show that $p = 12$.

Question 3

[4, 4 = 8 marks]

(a) In the diagram below, AC is a tangent to the circle at A , OC cuts the circle at B and $BC = 2OB$.



Let $\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$. By using the scalar product of \vec{OA} and \vec{AC} prove that $\mathbf{a} \cdot \mathbf{b} = \frac{|\mathbf{a}|^2}{3}$.

(b) The midpoints of square $ABCD$ are $PQRS$ respectively. Use a vector method to prove that PS is perpendicular to PQ .

End of Section One

Additional working space

Question number: _____

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Section Two – Calculator Assumed

Mr Daniel Comtesse
Mandurah Catholic College

Calculator Assumed: _____/23

daniel.comtesse@cewa.edu.au

Student Name: _____

School: _____

Time allowed: Section One - 20 minutes

Section Two – 30 minutes

Assessment Date: 18 June 2020

Material required/recommended

To be provided by the supervisor

This Question/Answer Paper

SCSA Formula Sheet

To be provided by the candidate

Standard items: pens, pencils, pencil sharpener, eraser, correction fluid/tape, ruler, highlighters

Special Items: scientific and/or CAS calculator, 1 A4 (1 sided) page of unfolded notes

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Question 4

[3, 2 = 5 marks]

A simple type of robot can be programmed to travel in a straight line with constant velocity.

Relative to an origin O, robot A leaves position $-13\mathbf{i} + 22\mathbf{j}$ m and travels with velocity $3\mathbf{i} - 2\mathbf{j}$ m/s.

One second later, robot B starts from position $5\mathbf{i} + 15\mathbf{j}$ m and travels with velocity $-4\mathbf{i} - \mathbf{j}$ m/s.

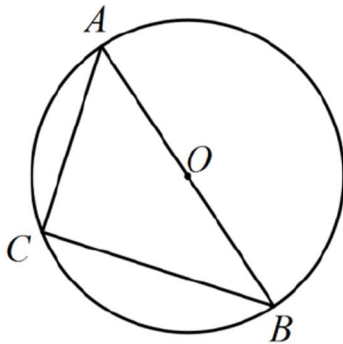
(a) Calculate the position and velocity of robot A relative to robot B at the instant robot B starts.

(b) Robot C, travelling with velocity $8\mathbf{i} - 7\mathbf{j}$ m/s, leave its initial position five seconds after A starts and collides with B, three seconds later. Determine the initial position of robot C.

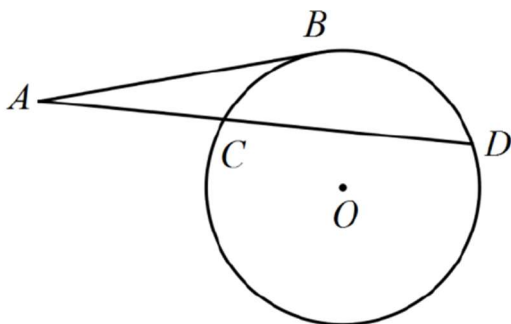
Question 5

[1, 1, 2 = 4 marks]

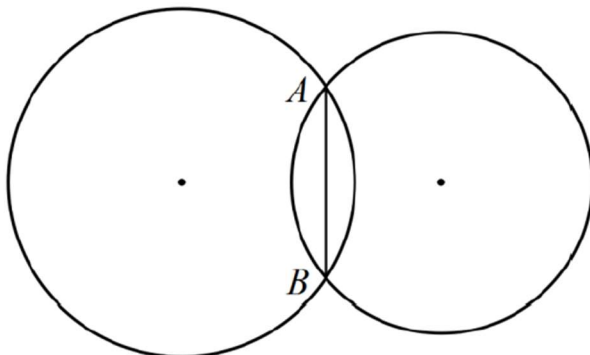
(a) Determine the radius of the circle shown below, given that $AC = 8\text{ cm}$ and $BC = 15\text{ cm}$.



(b) Determine the length of the chord CD given that the length of the tangent AB is 15 cm and the length of the secant $AD = 26\text{ cm}$.



(c) Two circles of radii 18 cm and 24 cm intersect at points A and B . The length of the chord AB is 28 cm . Determine how far apart the centre of the circles lie.

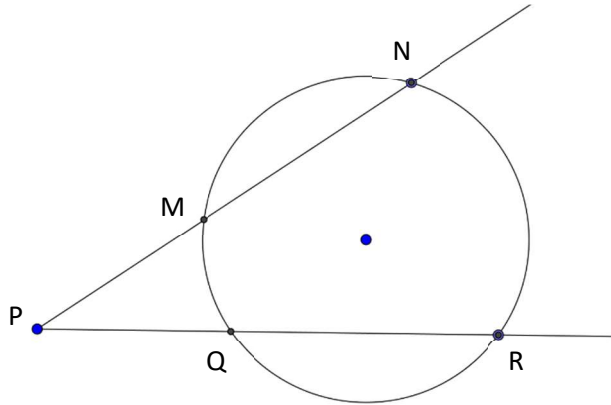


Question 6

[3 marks]

The diagram below shows two secants to a circle, each drawn from the point P, with one cutting the circle at points M and N and the other cutting the circle at points Q and R.

Prove that $PM \times PN = PQ \times PR$.



Question 7

[1, 2, 2, 2 = 7 marks]

(a) Use the scalar product to show that:

(i) the vectors $\langle 3, -2 \rangle$ and $\langle 4, 6 \rangle$ are perpendicular.

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

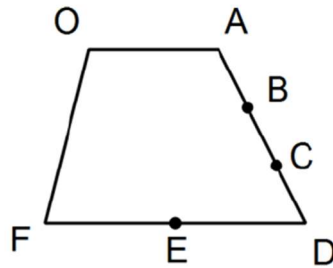
(b) Determine:

(i) the scalar projection of a force of 46 N on a bearing of 015° onto a force of 87 N on a bearing of 075° .

(ii) the vector projection of $3\mathbf{i} - \mathbf{j}$ onto $-4\mathbf{i} + 3\mathbf{j}$.

Question 8**[4 marks]**

The diagram below shows a trapezium in which $\overrightarrow{FD} = 2\overrightarrow{OA}$, E is the midpoint of FD and AD is divided into thirds by points B and C .



Let $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OF} = \mathbf{n}$.

Use a vector method to prove that $\overrightarrow{FB} = k\overrightarrow{EC}$ and determine the value of k .

End of Assessment

Additional working space

Question number: _____