TRINITY COLLEGE

Year 11 Mathematics Specialist
Test 2 2022

Section 1 Calculator Free

Vectors

STUDENT'S NAME _____

DATE: Friday 1st April **TIME:** 30 minutes **MARKS**: 30

INSTRUCTIONS:
Standard Items: Pens, pencils, drawing templates, eraser

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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1. (3 marks)

Given $\underset{\sim}{a} = \begin{pmatrix} -2 \\ 6 \end{pmatrix}$ and $\underset{\sim}{b} = \begin{pmatrix} 12 \\ x \end{pmatrix}$. Determine the value of x if $\underset{\sim}{a}$ and $\underset{\sim}{b}$ are perpendicular vectors.

2. (9 marks)

Given the vectors $\underset{\sim}{a} = 4\underset{\sim}{i} - 2\underset{\sim}{j}$, $\underset{\sim}{b} = -3\underset{\sim}{i} + 3\underset{\sim}{j}$ and $\underset{\sim}{c} = x\underset{\sim}{i} - 5\underset{\sim}{j}$, determine the following:

(a) The exact magnitude of $\underset{\sim}{a}$ in simplest surd form. [2]

(b) Vector $\underset{\sim}{d}$, which is a vector twice as long as $\underset{\sim}{c}$, but in the opposite direction. [2]

(c) The angle that $\underset{\sim}{b}$ makes with the positive x axis. [2]

(d) $\underset{\sim}{e}$, given that $\underset{\sim}{e} = 4\underset{\sim}{a} - \underset{\sim}{b}$ [2]

(e) $\underset{\sim}{a}$, a unit vector in the same direction as $\underset{\sim}{a}$. [1]

3. (10 marks)

(a) Given that $|\underset{\sim}{a}| = 4$, $|\underset{\sim}{b}| = 3$ and $\underset{\sim}{a} \cdot \underset{\sim}{b} = -6$

(i) Determine the size of the angle between vectors $\underset{\sim}{a}$ and $\underset{\sim}{b}$. [2]

(ii) Determine the exact value of $|\underset{\sim}{a} - \underset{\sim}{b}|$. [3]

(b) Given $\underset{\sim}{c} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$ and $\underset{\sim}{d} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$. Determine the vector projection of $\underset{\sim}{d}$ onto $\underset{\sim}{c}$. [4]

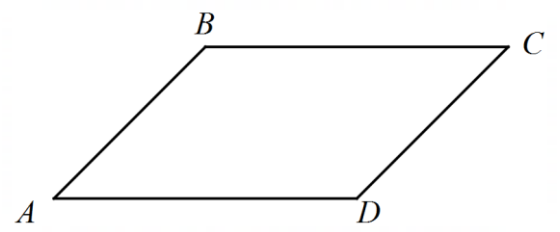
(c) Explain the difference between a vector projection and a scalar projection. [1]

4. (3 marks)

Ship A has a position vector of $\begin{pmatrix} 5 \\ 7 \end{pmatrix}$ km. Relative to a second ship, B, ship A has a position vector of $\begin{pmatrix} -6 \\ 11 \end{pmatrix}$ km. Determine the exact distance of ship B from the origin.

5. (5 marks)

Consider the figure *ABCD* below which is a parallelogram.



Let $\overrightarrow{AB} = \underset{\sim}{b}$ and $\overrightarrow{AD} = \underset{\sim}{d}$

Prove that the diagonals AC and BD are perpendicular only when $|\underset{\sim}{b}| = |\underset{\sim}{d}|$.

TRINITY COLLEGE

Year 11 Mathematics Specialist
Test 2 2022

Section 2 Calculator Assumed

Vectors

STUDENT'S NAME _____

DATE: Friday 1st April **TIME:** 20 minutes **MARKS**: 20

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser

Special Items: Three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment)

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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6. (3 marks)

If $\underset{\sim}{a} \cdot \underset{\sim}{b} = \underset{\sim}{a} \cdot \underset{\sim}{c}$ and $\underset{\sim}{a} \neq 0$ then what is the relationship between the vectors $\underset{\sim}{a}$, $\underset{\sim}{b}$ and $\underset{\sim}{c}$.

7. (8 marks)

Jetties A and B are on opposite banks of a river such that $\overrightarrow{AB} = \begin{pmatrix} 100 \\ 250 \end{pmatrix}$ km. A person travelling on a jet ski can maintain a speed of 70 km/h in still air. During the trip from A to B a wind is blowing with a velocity of $\begin{pmatrix} 5 \\ -2 \end{pmatrix}$ km/h.

(a) Draw a diagram of the above situation. [2]

(b) Determine the velocity vector, in component form, the jet ski rider must set so that he travels directly from jetty A to jetty B. [4]

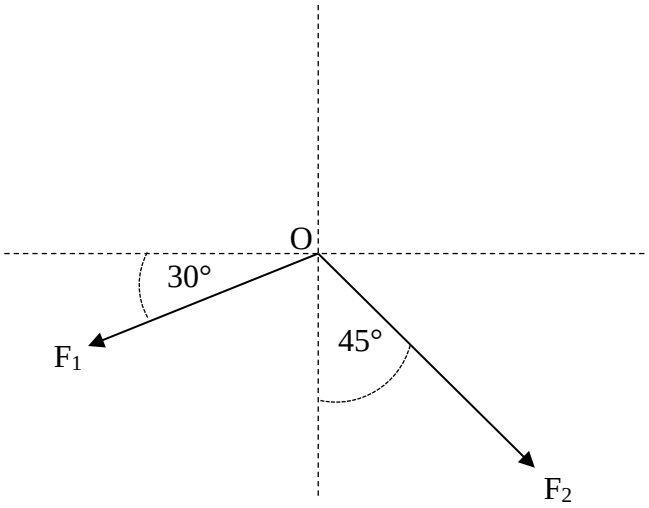
(c) Determine the total time taken, in minutes, to travel from jetty A to B. [2]

8. (5 marks)

Given that $\underset{\sim}{a} = 3i + 5j$ and $\underset{\sim}{b} = xi + yj$ determine x and y if $|\underset{\sim}{b}| = \sqrt{10}$ and the acute angle between the vectors is 60°

9. (4 marks)

The following diagram shows forces F_1 and F_2 acting on point O.



If $|F_1|$ = 1600 N and $|F_2|$ = 900 N, determine the magnitude and bearing of a single force F_3 that would keep the system in equilibrium.