Applecross Senior High School
SPECIALIST MATHEMATICS UNIT 1 & 2

TEST 2, 2021

Section A:	
	25

55

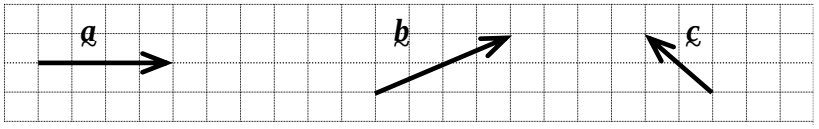
Name: _____

Section A – Calculator Free – Time Allowed: 25 minutes

1. [1, 1, 2 =4 marks]

Given the vectors $\underset{\sim}{a}$, $\underset{\sim}{b}$ and $\underset{\sim}{c}$ shown in the diagram below, represent the resultant of:

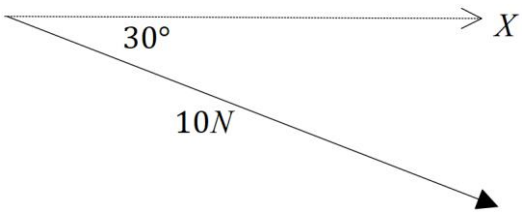
(a) $-\underset{\sim}{a} + 2\underset{\sim}{b}$ (b) $2\underset{\sim}{c} - \underset{\sim}{b}$



(c) Express $\underset{\sim}{a}$ in terms of $\underset{\sim}{b}$ and $\underset{\sim}{c}$.

2. [3 marks]

Express the following vector in the form $a\underset{\sim}{i} + b\underset{\sim}{j}$. Give a and b as exact rationalised values.



3. [1, 2, 3, 2= 8 marks]

Given $\underset{\sim}{a} = -3\underset{\sim}{i} + 2\underset{\sim}{j}$ and $\underset{\sim}{b} = 5\underset{\sim}{i} - \underset{\sim}{j}$ determine exactly:

(a) $-2\underset{\sim}{a} + 3\underset{\sim}{b}$

(b) $|\underset{\sim}{a} + \underset{\sim}{b}|$

(c) $|\underset{\sim}{a}| + |\underset{\sim}{b}|$ in the form $\sqrt{x}\left(\sqrt{y} + \sqrt{z}\right)$

(d) A vector that is parallel but opposite to $\underset{\sim}{a}$ with a magnitude of 5.

4. [2 marks]

The "SS Aardvark" is at position $\langle 20,10 \rangle$ at 2 p.m.
It now begins to move with a velocity vector of $7\underset{\sim}{i} - \underset{\sim}{j}$ km/h. If it continues with this velocity what will be its position at 1700?

5. [4 marks]

Vectors **a**, **b**, and **c** are such that $\boldsymbol{a} = 3\boldsymbol{i} + 4\boldsymbol{j}, \boldsymbol{b} = x\boldsymbol{i} - 8\boldsymbol{j}$ *and* $\boldsymbol{c} = y\boldsymbol{i} + 7\boldsymbol{j}$. Given that **a** and **b** are parallel and **b** and **c** have equal magnitudes find the values of x and y.

6. [1, 1, 2=4 marks]

OAB is a triangle with C a point on $\overrightarrow{AB}$ such that $\overrightarrow{AC} = \frac{3}{4}\overrightarrow{AB}$. If $\overrightarrow{OA} = \boldsymbol{a}$ *and* $\overrightarrow{OB} = \boldsymbol{b}$, express in terms of $\boldsymbol{a}$ and or $\boldsymbol{b}$:

(a) $\overrightarrow{AB}$

(b) $\overrightarrow{CB}$

(c) $\overrightarrow{OC}$

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Section B:
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30

Name: _____

<u>Section B – Calculator and Notes Allowed</u> – Time Allowed: 30 minutes

1. [1, 2, 2 = 5 marks]

   The angle between vectors $\boldsymbol{a}$ and $\boldsymbol{b}$ is 50°. Given that $|\boldsymbol{a}| = 20$ metres and $|\boldsymbol{b}| = 15$ metres:
   (a) make a sketch of the situation in the space provided.

   (b) use the rules of trigonometry to find $|\boldsymbol{a} + \boldsymbol{b}|$.

   (b) Find the size of the angle between $\boldsymbol{a} + \boldsymbol{b}$ and $\mathbf{a}$.

2. [5 marks]

A student wishes to paddle her canoe West across the river from Point A on one bank to the jetty which is on the opposite bank, directly opposite A. The student can paddle at a steady 5 km/h in still water. However, today the river is flowing South at 2 km/h. If the river is 500 m wide at that point, find the direction she should paddle and the time it will take to cross the river.
A clearly labelled diagram is needed for full marks.

3. [5 marks]

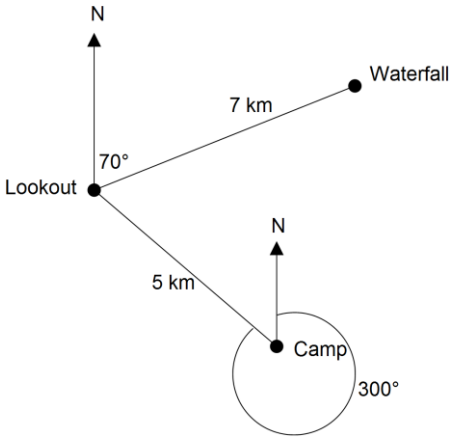
Using $\boldsymbol{a} = 2\boldsymbol{i} + 3\boldsymbol{j}$ and $\boldsymbol{b} = 4\boldsymbol{i} - \boldsymbol{j}$,express $6\boldsymbol{i} - 4\boldsymbol{j}$ in the form $\lambda\boldsymbol{a} + \mu\boldsymbol{b}$ leaving λ and μ as fractions.

4. [4 marks]

$\boldsymbol{F}_1, \boldsymbol{F}_2$ and $\boldsymbol{F}_3$ are all forces that act simultaneously on a body. $\boldsymbol{F}_1$ is measured at $\binom{2}{3}$ N, $\boldsymbol{F}_2$ at $\langle 4,3 \rangle$ N and $\boldsymbol{F}_3 = 2\mathbf{i} - 4\mathbf{j}$ N. Find the exact magnitude of the resultant force acting on the body and it's direction correct to the third decimal place. Use North as the direction of **j.**

5. [4 marks]

Carefully study the diagram that shows a journey taken by a hiker from camp to a waterfall, via a scenic lookout. Find the direct distance of the waterfall from camp **and** the bearing of the camp from the waterfall.



6. [3 marks]

Arnie has parked his car and trailer on a hill which is sloping at 15° to the horizontal. He intends to unhitch the trailer from the car and push the trailer up the hill himself.
The trailer exerts a force due to gravity of 2000N vertically and Arnie can push with a force of 700N parallel to the hill. Will he be able to move the trailer? Justify your answer.

7. [3 marks]

Janine was travelling due north at 60 km/h and turned (taking 5 seconds) so that she is now travelling due East at 80 km/h. Find the direction and magnitude of her acceleration.