Year 11 Specialist Mathematics

MELVILLE SENIOR HIGH SCHOOL

Semester 1, March 2021

Test 2: Vectors

Weighting: 7%

[Australian Curriculum Reference Numbers: 1.2.1-1.2.9, 1.2.12, 1.2.14]

Total Time: 50min **Total Marks =** $\overline{52}$

Student Name: _____

Teacher: _____

TO BE PROVIDED BY THE STUDENT

Standard Items: Pens, pencils, eraser, sharpener, correction tape/fluid, highlighters, ruler.

Special Items:

- Drawing instruments, templates
- A maximum of three CAS calculators satisfying the conditions set by the Curriculum Council ***for use in the Calculator Allowed section only***

TO BE PROVIDED TO THE STUDENT

- A formula sheet will be provided

INSTRUCTIONS TO STUDENTS:

You are required to attempt ALL questions.

Write answers in the spaces provided beneath each question.

Marks are shown with the questions.

Show all working clearly, in sufficient detail to allow your answers to be checked readily and for marks to be answered 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.

It is recommended that students **do not use a pencil,** except in diagrams

Part A – Calculator Free (25 minutes) /25

Part B – Calculator Assumed (25 minutes) /27

Final mark /52

Question 1 **5 marks**

Two forces are given by $\mathbf{F_1} = -3\mathbf{i} + 5\mathbf{j}$ N and $\mathbf{F_2} = 2\mathbf{i} - \mathbf{j}$ N. Determine

a) $\mathbf{F_1} - \mathbf{F_2}$. (1 mark)

b) $5\mathbf{F_1} + 10\mathbf{F_2}$. (2 marks)

c) $|\mathbf{F_1}|$. (2 marks)

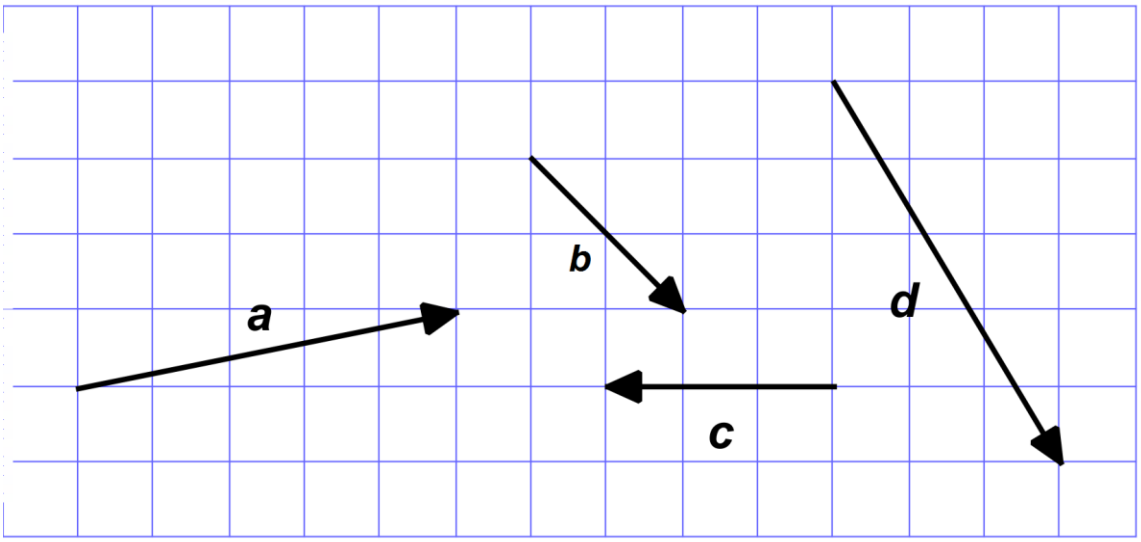
Question 2 **4 marks**

Consider the vectors $\mathbf{p} = \begin{pmatrix} -7 \\ 8 \end{pmatrix}, \mathbf{q} = \begin{pmatrix} 3 \\ -4 \end{pmatrix}$ and $\mathbf{r} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$.

Given that $\mathbf{p} = \lambda\mathbf{q} + \mu\mathbf{r}$, determine the value of λ and the value of μ.

Question 3 **2 marks**

Use the vectors below and the grid provided to draw each of the following vectors:



a) $\boldsymbol{a} + \boldsymbol{d}$ b) $\boldsymbol{c} - 2\boldsymbol{b}$

Question 4 **6 marks**

In triangle ***ABC***, $\overrightarrow{AB} = \boldsymbol{c}$, $\overrightarrow{AC} = \boldsymbol{b}$. ***D*** is the midpoint of AB and ***E*** is the midpoint of CB.

a) Draw a diagram to illustrate all the given information. (2 marks)

b) Express each of the following in terms of ***b*** and/or ***c***. (4 marks)

(i) $\overrightarrow{AD}$ (1)

(ii) $\overrightarrow{CD}$ (1)

(iii) $\overrightarrow{AE}$ (2)

Question 5 **8 marks**

Given $\boldsymbol{a} = 12\boldsymbol{i} + 5\boldsymbol{j}$, $\boldsymbol{b} = (x+1)\boldsymbol{i} + 2\boldsymbol{j}$, $\boldsymbol{c} = -5\boldsymbol{i} + (y-3)\boldsymbol{j}$. Find:

a) The value of x if $\boldsymbol{a} + \boldsymbol{b} = 7\boldsymbol{i} + 7\boldsymbol{j}$ (1 mark)

c) The value(s) of y if **a** and **c** have the same magnitude. (4 marks)

d) A unit vector (in component form) and in the opposite direction for **a.** (3 marks)

End of Section One

Additional working space

Question ____

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Semester 1, March 2021

Part B: Calculator Assumed Section

Time Allowed: 25 minutes

[Australian Curriculum Reference Numbers: 1.2.1-1.2.9, 1.2.12, 1.2.14]

Marks = $\overline{27}$

Student Name: _____

Teacher: _____

INSTRUCTIONS TO STUDENTS:

- You **are allowed** a CAS calculator
- You **are not allowed** any notes
- A formula booklet will be provided

You are required to attempt ALL questions.

Write answers in the spaces provided beneath each question.

Marks are shown with the questions.

Show all working clearly, in sufficient detail to allow your answers to be checked readily and for marks to be answered 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.

It is recommended that students **do not use a pencil,** except in diagrams

1. Given $\boldsymbol{a} = (5, 125°)$, $\boldsymbol{b} = \begin{pmatrix} -2 \\ -6 \end{pmatrix}$ *and* $\boldsymbol{c} = 6\boldsymbol{i} - \boldsymbol{j}$, determine the following, (Answers correct to 2 decimal places)

   a) $2\boldsymbol{a} - 3\boldsymbol{b}$, in component form.

   b) $4(\boldsymbol{c} - 2\boldsymbol{a})$, in polar form, with a positive angle.

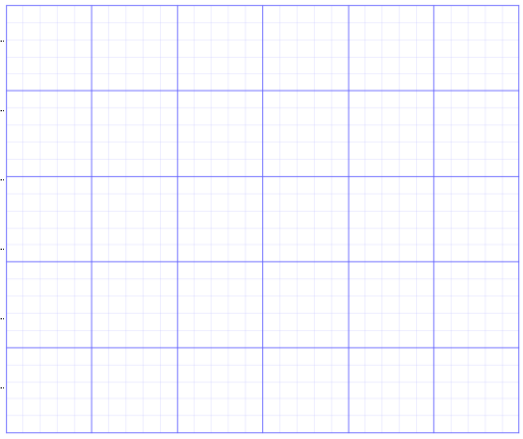
   c) Vector $\boldsymbol{d}$ that has a magnitude of 5 and is in the same direction of $\boldsymbol{a} + \boldsymbol{b} + \boldsymbol{c}$, in terms of $\boldsymbol{i}$ *and* $\boldsymbol{j}$.

[1, 2, 3 = 6 Marks]

2. If $\boldsymbol{a} = -6\boldsymbol{i} + 9\boldsymbol{j}$ and $\boldsymbol{b} = 2\boldsymbol{i} - 3\boldsymbol{j}$, use exact values to show that the vector in the direction of $\boldsymbol{a}$ that has one third the magnitude of $\boldsymbol{b}$ is $-\frac{2}{3}\boldsymbol{i} + \boldsymbol{j}$.

[5 marks]

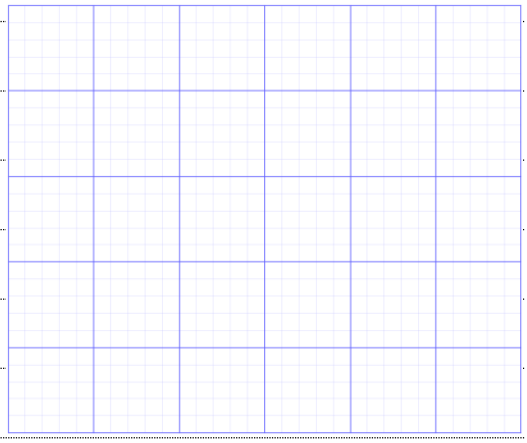
3. Points A and B have position vectors $15i - 7j$ and $12i + 5j$ respectively. Find the position vector of the point that divides AB internally in the ratio 1: 3.



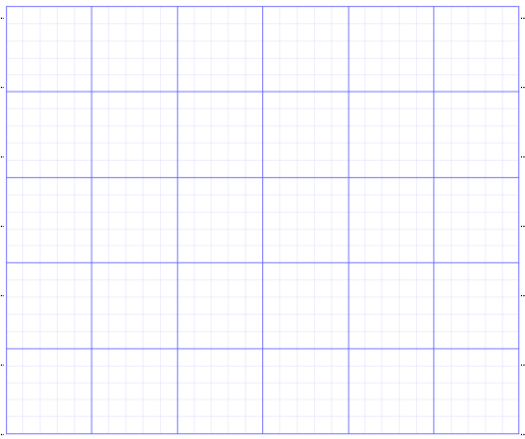
[5 marks]

4. A plane can maintain a speed of 280 km/h in still air. A wind is blowing at 42 km/h from a bearing of 160°.

   a) If the plane flies on a bearing of 036° and is then blown off course by the wind, in what direction (to the nearest degree) does the plane now fly and how far will it travel in 6.5 hours?



   b) If the plane wishes to fly on a bearing of 220° to an airport 420km away, how long will the journey take (to the nearest minute) and in what direction should the aircraft be pointing, to the nearest degree?



[5, 6 = 11 marks]

***** End of Test *****

Extra space for working out