

**Year 11 Mathematics Specialist  
Test 2 2019**

Calculator Assumed  
Component Vectors

**STUDENT'S NAME** \_\_\_\_\_

**DATE:** Friday 5<sup>th</sup> April

**TIME:** 50 minutes

**MARKS:** 47

**INSTRUCTIONS:**

Standard Items: Pens, pencils, drawing templates, eraser and notes

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1. (6 marks)

Given that  $\mathbf{a} = 2\mathbf{i} + 3\mathbf{j}$ ,  $\mathbf{b} = -\mathbf{i} + 5\mathbf{j}$  and  $\mathbf{c} = 5\mathbf{i} - 12\mathbf{j}$ , determine:

(a)  $\mathbf{a} - 2\mathbf{c}$  [2]

(b)  $|\mathbf{a} - 2\mathbf{c}|$  [2]

(c)  $\mathbf{a} \cdot \mathbf{b}$  [2]

2. (8 marks)

Given  $\mathbf{a} = \mathbf{i} - \mathbf{j}$ ,  $\mathbf{b} = 3\mathbf{i} + 4\mathbf{j}$  and  $\mathbf{c} = 2\mathbf{i} + 5\mathbf{j}$ , determine:

(a)  $\hat{\mathbf{a}}$ , the unit vector in the same direction as  $\mathbf{a}$  [2]

(b) The vector  $\mathbf{d}$ , which is in the opposite direction as  $\mathbf{a}$  with double the magnitude of  $\mathbf{b}$  [3]

(c) The vector projection of  $\mathbf{a}$  onto  $\mathbf{c}$  [3]

3. (4 marks)

For the two non-parallel vectors  $\mathbf{c}$  and  $\mathbf{d}$ , determine the values of  $\lambda$  and  $\mu$  for which:

$$2\lambda\mathbf{c} - \lambda\mathbf{d} = 10\mathbf{c} + 2\mu\mathbf{d} + \mu\mathbf{c}$$

4. (5 marks)

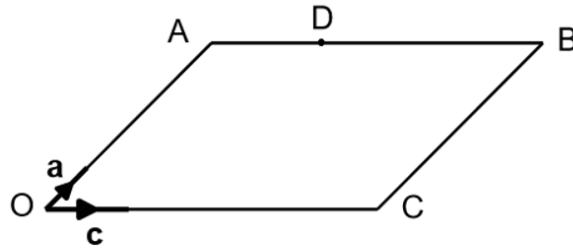
If  $\mathbf{a} = 7\mathbf{i} - 3\mathbf{j}$ ,  $\mathbf{b} = \mu\mathbf{i} + 5\mathbf{j}$ , determine the possible value(s) of  $\mu$  given that:

(a)  $\mathbf{a}$  and  $\mathbf{b}$  are parallel vectors. [2]

(b)  $(\mathbf{a} + \mathbf{b})$  and  $\mathbf{b}$  are perpendicular vectors. [3]

5. (7 marks)

In the parallelogram  $OABC$  below  $\overrightarrow{OA} = 4\mathbf{a}$  and  $\overrightarrow{OC} = 6\mathbf{c}$ .  $D$  is a point on  $AB$  such that  $AD:DB = 1:2$ .



(a) Express the following in terms of  $\mathbf{a}$  and/or  $\mathbf{c}$ .

(i)  $\overrightarrow{AC}$  [1]

(ii)  $\overrightarrow{AD}$  [1]

(iii)  $\overrightarrow{DC}$  [2]

(b)  $M$  is the midpoint of  $AC$ , Express  $\overrightarrow{MD}$  in terms of  $\mathbf{a}$  and/or  $\mathbf{c}$ . [3]

6. (6 marks)

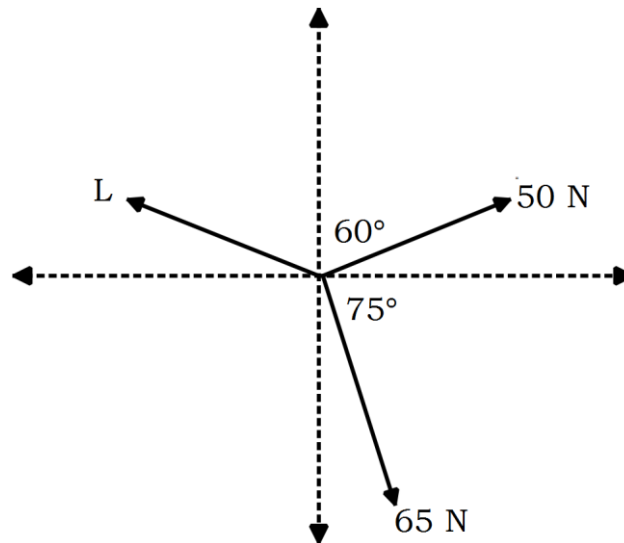
The work done, in joules, by a force  $\mathbf{F}$  Newtons in changing the displacement of an object,  $\mathbf{s}$  metres is given by the scalar product of  $\mathbf{F}$  and  $\mathbf{s}$ .

- (a) Calculate the work done by a force  $\langle 15, 22 \rangle$  N in moving an object  $\langle 3, 2 \rangle$  m. [1]
- (b) Calculate the work done by a force of 25 N that moves an object 6 m if:
- (i) The force acts parallel to the direction of the movement. [1]
- (ii) The force acts perpendicular to the direction of movement. [1]
- (c) The work done by a force in moving an object  $\langle 50, -80 \rangle$  cm is 590 joules. If the force acts on a bearing of  $115^\circ$ , determine the magnitude of the force. [3]

7. (5 marks)

Luke, Yoda and Leia are trying to move an X-Wing fighter.

The diagram below shows the magnitude and direction of the three forces exerted by the three people.



Determine the magnitude and direction of the force that Leia must exert if the three forces are in equilibrium.

8. (6 marks)

The distance between two towns, Charleton and Edensville is given by  $\begin{pmatrix} 162 \\ -2115 \end{pmatrix}$  km. An aircraft is to be flown directly from Charleton to Edenville. This particular aircraft can maintain a steady speed of 257 km/h in still air but for the duration of this flight there is a wind blowing with a constant velocity of  $\begin{pmatrix} 50 \\ 20 \end{pmatrix}$  km/h.

Determine, in the form  $\begin{pmatrix} a \\ b \end{pmatrix}$  km/h, the velocity vector that the pilot must set to fly directly from Charleton to Edenville and determine the time that journey takes.