



MATHEMATICS SPECIALIST : UNITS 1 & 2, 2023

Test 2 – Vectors; Circle Properties (10%)

1.3.1 – 1.3.9, 1.3.14, 1.1.17; 1.1.6 – 1.1.15

PM

Time Allowed 35 minutes	First Name	Surname	Marks 36 marks
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Circle your Teacher's Name: Ms Chua Mr Koulianos Mr Liu Ms Robinson

Assessment Conditions: (N.B. Sufficient working out must be shown to gain full marks)

- ❖ Calculators: Allowed
- ❖ Formula Sheet: Provided
- ❖ Notes: Not Allowed

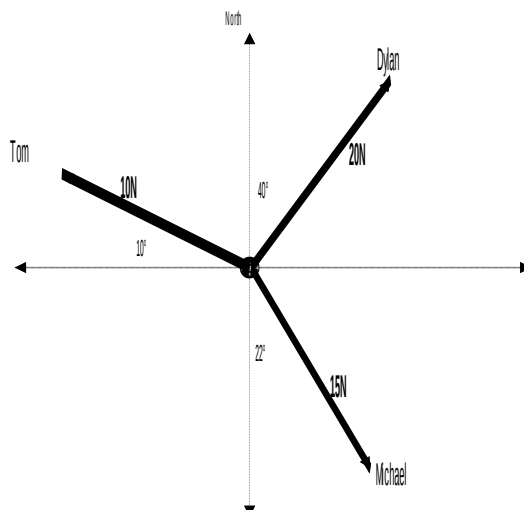
PART B – CALCULATOR ASSUMED

4. (7 marks)

Robert is asleep in his chair and unbeknown to him Tom, Dylan and Michael have each tied ropes around him and begin to pull with the forces and directions shown.

In which direction and with what force does the sleeping Robert move?

Give the direction as a bearing to the nearest degree.



5. (3 marks)

If points A and B have position vectors $-2\mathbf{i} + \mathbf{j}$ and $3\mathbf{i} + 2\mathbf{j}$ respectively, find the position vector of point P such that $\overrightarrow{AP} : \overrightarrow{PB} = 3:1$

6. (4 Marks)

Points K, L and M have position vectors $6\mathbf{i} - \mathbf{j}$, $2\mathbf{i}$ and $14\mathbf{i} - 3\mathbf{j}$ respectively.

Use vectors to prove that K, L and M are collinear.

7. (6, 1 = 7 marks)

A plane needs to travel directly from City A (0, 0) km to City B (– 600, 800) km.

The plane travels at a speed of 75 km/h in still air. The wind's velocity is $-50\mathbf{i} + 20\mathbf{j}$.km/h.

The $\mathbf{j}$ vector faces due North and the $\mathbf{i}$ vector faces due East.

(a) Determine the direction, as a bearing, that the plane should travel towards to fly directly from City A to City B.

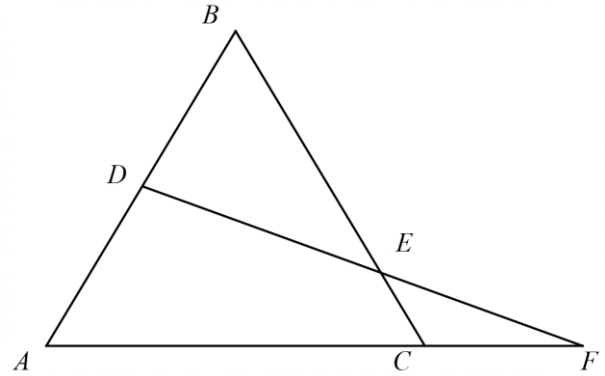
(b) How long does the flight take (to the nearest minute)?

8. (2, 5, 2 = 9 marks)

D is a point in $\overrightarrow{AB}$ such that $\overrightarrow{AD} = \frac{1}{2}\overrightarrow{AB}$

E is a point in $\overrightarrow{BC}$ such that $\overrightarrow{BE} = \frac{3}{4}\overrightarrow{BC}$

Let $\overrightarrow{AB} = \mathbf{a}$ and $\overrightarrow{BC} = \mathbf{b}$



(a) Find expressions for the following vectors in terms of $\mathbf{a}$ and/or $\mathbf{b}$

(i) $\overrightarrow{AC}$

(ii) $\overrightarrow{DE}$

(b) By letting $\overrightarrow{DF} = h \overrightarrow{DE}$ and $\overrightarrow{AF} = k \overrightarrow{AC}$, use the fact that $\overrightarrow{AD} + \overrightarrow{DF} = \overrightarrow{AF}$ to find the values of h and k .

(c) If $|\overrightarrow{AC}| = 12$, what is $|\overrightarrow{CF}|$?

9. (6 marks)

The diagram shows a semi-circle, with diameter SR and centre O , circumscribed by triangle ABC , in which $\angle BAC = 48^\circ$ and $\angle BCA = 36^\circ$.

Determine, with reasons, the size of angles $\angle PRO$ and $\angle PQR$.

