Additional Assessment Materials

Summer 2021

Pearson Edexcel GCE in As Mathematics

8MA0_01 (Public release version)

Resource Set 1: Topic 9

Vectors

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an optional part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1.

Given that the point A has position vector $4\mathbf{i} - 5\mathbf{j}$ and the point B has position vector $-5\mathbf{i} - 2\mathbf{j}$,

(a) find the vector $\overrightarrow{AB}$, $\overrightarrow{AB} = \underline{b} - \underline{a}$

$= (-5\mathbf{i} - 2\mathbf{j}) - (4\mathbf{i} - 5\mathbf{j})$ (2)

(b) find $|\overrightarrow{AB}|$. $\overrightarrow{AB} = -9\mathbf{i} + 3\mathbf{j}$

Give your answer as a simplified surd.

$|\overrightarrow{AB}| = \sqrt{a^2 + b^2} = \sqrt{(-9)^2 + 3^2}$ (2)

$= \sqrt{81 + 9} = \sqrt{90} = \sqrt{9}\sqrt{10} = 3\sqrt{10}$

(Total for Question 1 is 4 marks)

2.

Given that the point A has position vector $3\mathbf{i} - 7\mathbf{j}$ and the point B has position vector $8\mathbf{i} + 3\mathbf{j}$,

(a) find the vector $\overrightarrow{AB}$ $\overrightarrow{AB} = \underline{b} - \underline{a} = (8\mathbf{i} + 3\mathbf{j}) - (3\mathbf{i} - 7\mathbf{j})$

$= 5\mathbf{i} + 10\mathbf{j}$ (2)

(b) Find $|\overrightarrow{AB}|$. Give your answer as a simplified surd.

$\sqrt{5^2 + 10^2} = \sqrt{25 + 100} = \sqrt{125} = 5\sqrt{5}$ (2)

(Total for Question 2 is 4 marks)

3.

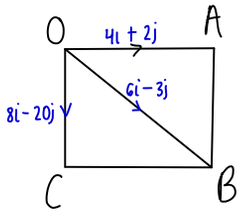
The quadrilateral $OABC$ has $\overrightarrow{OA} = 4\mathbf{i} + 2\mathbf{j}$, $\overrightarrow{OB} = 6\mathbf{i} - 3\mathbf{j}$ and $\overrightarrow{OC} = 8\mathbf{i} - 20\mathbf{j}$.

(a) Find $\overrightarrow{AB}$.

(2)

(3) a) $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = (6\mathbf{i} - 3\mathbf{j}) - (4\mathbf{i} + 2\mathbf{j})$

$= 2\mathbf{i} - 5\mathbf{j}$



(b) Show that quadrilateral $OABC$ is a trapezium.

(2)

b) OABC is a trapezium if two opposite sides are parallel to each other i.e. are multiples of each other

$\overrightarrow{OC} = 8\mathbf{i} - 20\mathbf{j}$ and $\overrightarrow{AB} = 2\mathbf{i} - 5\mathbf{j}$

$\Rightarrow 4(2\mathbf{i} - 5\mathbf{j}) = 8\mathbf{i} - 20\mathbf{j} = \overrightarrow{OC}$

$\Rightarrow \overrightarrow{OC} = 4(\overrightarrow{AB})$ hence $\overrightarrow{OC}$ and $\overrightarrow{AB}$ are parallel, so OABC is a trapezium.

(Total for Question 3 is 4 marks)

4.

[*In this question the unit vectors* **i** *and* **j** *are due east and due north respectively.*]

A coastguard station O monitors the movements of a small boat.

At 10:00 the boat is at the point $(4\mathbf{i} - 2\mathbf{j})$ km relative to O.

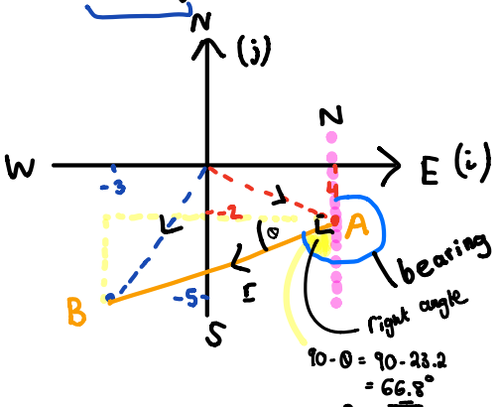
At 12:45 the boat is at the point $(-3\mathbf{i} - 5\mathbf{j})$ km relative to O.

The motion of the boat is modelled as that of a particle moving in a straight line at constant speed.

(a) Calculate the bearing on which the boat is moving, giving your answer in degrees to one decimal place.

(3)

- $4i - 2j$ will be the point 4 units East and 2 units South (negative North)
- $-3i - 5j$ will be the point 3 units West and 5 units South.

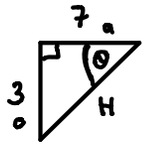


Then denote the point $4i-2j$ by A and B denote the point $-3i-5j$.

Then we know that the boat moves from A to B, which is written as AB. We then find the vector, denote it $\underline{r}$, by doing: $\underline{r} = AB = B - A$ (orange line between A and B)

$= (-3i-5j) - (4i-2j)$

$= -7i-3j$



$\tan\theta = \frac{o}{a} = \frac{3}{7}$

$\Rightarrow \theta = \tan^{-1}(3/7) = 23.2°$

The blue circle shows the bearing $\Rightarrow$ Bearing $= 180° + (90° - 23.2°) = 246.8°$

(b) Calculate the speed of the boat, giving your answer in km h^{-1}

(3)

Total Distance Travelled is the distance AB, which will be the magnitude of AB, which is $\sqrt{(-7)^2 + (-3)^2} = \sqrt{58} \approx 7.6$ km

We know the time is 10:00 $\rightarrow$ 12:45 which is 2 hours 45 minutes, which is equivalent to 2.75 hours.

$\Rightarrow$ Speed $= \frac{\text{distance}}{\text{time}} = \frac{7.6}{2.75} = 2.763\ldots = 2.8$ km h^{-1}

(Total for Question 4 is 6 marks)

5.

(i) Two non-zero vectors, **a** and **b**, are such that

$$|\mathbf{a} + \mathbf{b}| = |\mathbf{a}| + |\mathbf{b}|$$

Explain, geometrically, the significance of this statement.

(1)

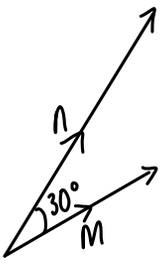
(ii) Two different vectors, **m** and **n**, are such that $|\mathbf{m}| = 3$ and $|\mathbf{m} - \mathbf{n}| = 6$
The angle between vector **m** and vector **n** is 30°

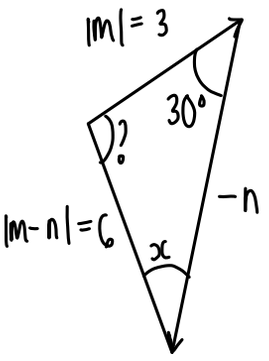
Find the angle between vector **m** and vector **m** – **n**, giving your answer, in degrees, to one decimal place.

(4)

(5) i) a and b lie in the same direction / are parallel to each other

ii)





$|m-n| = \overrightarrow{NM}$

* use sine rule to find angle x

$$\frac{\sin(30)}{6} = \frac{\sin(x)}{3}$$

$$\Rightarrow \sin x = \frac{3\sin(30)}{6}$$

$$x = 14.5°$$

$$\text{then, } ? = 180 - 30 - 14.5$$

$$= 135.5°$$