EXCEL IN MATHSCI
HIGHER MATHEMATICS • TOPIC RESOURCE

2026–27
Portfolio 4

Vectors

PUPIL WORKSHEET

Skills covered: Two- and three-dimensional vectors; position vectors; magnitude; scalar product; collinearity; internal division; three-dimensional angles.

Instructions: Attempt all questions. Show sufficient working to justify your answers. Give exact values unless a degree of accuracy is stated. Each section is separate for targeted revision.

Prerequisite core skills revise earlier learning; *topic practice* develops individual techniques; *exam-style and challenge* combines skills.

Pupil: _____ **Date:** _____

SECTION A | Prerequisite core skills

Question 1

[3 marks]

Given $\mathbf{a} = 2\mathbf{i} - 3\mathbf{j} + \mathbf{k}$ and $\mathbf{b} = -\mathbf{i} + 4\mathbf{j} + 2\mathbf{k}$, express $2\mathbf{a} - \mathbf{b}$ in unit-vector form.

Question 2

[2 marks]

Find the magnitude of $\mathbf{v} = 2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$.

Question 3

[3 marks]

Given $A(1, -2, 3)$ and $B(5, 1, -1)$, find $\overrightarrow{AB}$ and $|\overrightarrow{AB}|$.

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Question 4

[2 marks]

Find $\mathbf{a} \cdot \mathbf{b}$ for $\mathbf{a} = (3, -2, 1)$ and $\mathbf{b} = (2, 4, -1)$.

Question 5

[3 marks]

Find k if $(2, k, -1)$ is perpendicular to $(3, 2, 4)$.

Question 6

[2 marks]

The position vectors of P and Q are $2\mathbf{i} + \mathbf{j} - 3\mathbf{k}$ and $-\mathbf{i} + 5\mathbf{j} + \mathbf{k}$. Find $\overrightarrow{PQ}$.

SECTION B | Topic practice

Question 7

[4 marks]

Show that the points $A(1, 2, 0)$, $B(3, 6, 2)$ and $C(6, 12, 5)$ are collinear.

Question 8

[4 marks]

The points $A(2, -1, 4)$ and $B(8, 5, -2)$ are joined by a line segment. Find the coordinates of the point P which divides AB internally in the ratio $AP : PB = 1 : 2$.

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Question 9 [3 marks]

Find the angle between $\mathbf{a} = (2, 1, 2)$ and $\mathbf{b} = (1, 2, -2)$.

Question 10 [4 marks]

Given $\mathbf{p} = (1, 2, 2)$ and $\mathbf{q} = (2, -1, 2)$, calculate the acute angle between the vectors, to one decimal place.

Question 11 [4 marks]

In a triangle, $A(1, 0, 2)$, $B(5, 2, 1)$ and $C(2, 4, 3)$. Find the coordinates of the midpoint M of BC and $\overrightarrow{AM}$.

Question 12 [3 marks]

Let $\mathbf{a} = 2\mathbf{i} - \mathbf{j} + 2\mathbf{k}$ and $\mathbf{b} = \mathbf{i} + 2\mathbf{j} - 2\mathbf{k}$. Determine whether the vectors are perpendicular.

Question 13 [3 marks]

For $A(1, 3, -2)$, $B(4, 1, 0)$ and $C(6, 5, 1)$, find $\overrightarrow{AB} \cdot \overrightarrow{AC}$.

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Question 14

[3 marks]

Write $\mathbf{u} = (3, -4, 12)$ as a unit vector in the direction of $\mathbf{u}$.

SECTION C | Exam-style and challenge

Question 15

[5 marks]

For $A(0, 1, 2)$, $B(4, 3, 0)$ and $C(1, 5, 4)$, calculate $\angle BAC$ to one decimal place.

Question 16

[4 marks]

The points $A(2, 1, -1)$, $B(8, 7, 5)$, and $P(t, 4, 2)$ lie on the same straight line. Find t.

Question 17

[5 marks]

The points $O = (0, 0, 0)$, $A = (4, 0, 0)$, $B = (0, 3, 0)$, and $P = (2, 1, 6)$ are vertices of a tetrahedron. Find $\angle APB$ to one decimal place.

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Question 18

[5 marks]

A point R divides the line segment from $P(-2, 4, 1)$ to $Q(7, -2, 10)$ in the ratio $PR : RQ = 2 : 1$. Find R. Hence calculate $|\overrightarrow{PR}|$.

— End of pupil worksheet —

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