

QQQ – Pure Year 1 – Chapter 11 – Vectors (Version 2)

Total Marks: 25

(25 = Platinum, 23 = Gold, 20 = Silver, 17 = Bronze)

1. [In this question the unit vectors $\mathbf{i}$ and $\mathbf{j}$ are due east and due north respectively.]

A stone slides horizontally across ice.

Initially the stone is at the point $A(-24\mathbf{i} - 10\mathbf{j})$ m relative to a fixed point O .

After 4 seconds the stone is at the point $B(12\mathbf{i} + 5\mathbf{j})$ m relative to the fixed point O .

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

Using the model,

(a) prove that the stone passes through O , (2)

(b) calculate the speed of the stone. (3)

(Total 5 marks)

Edexcel November 2021 Paper 1 Q4

2. The triangle PQR is such that $\overrightarrow{PQ} = 3\mathbf{i} + 5\mathbf{j}$ and $\overrightarrow{PR} = 13\mathbf{i} - 15\mathbf{j}$

(a) Find $\overrightarrow{QR}$ (2)

(b) Hence find $|\overrightarrow{QR}|$ giving your answer as a simplified surd. (2)

The point S lies on the line segment QR so that $QS : SR = 3 : 2$

(c) Find $\overrightarrow{PS}$ (2)

(Total 6 marks)

Edexcel June 2022 Paper 1 Q3

3.

(a) Simplify $2 \begin{pmatrix} 6 \\ -3 \end{pmatrix} - 3 \begin{pmatrix} -1 \\ 2 \end{pmatrix}$. [2]

(b) The vector $\mathbf{a}$ is defined by $\mathbf{a} = r \begin{pmatrix} 6 \\ -3 \end{pmatrix} + s \begin{pmatrix} -1 \\ 2 \end{pmatrix}$, where r and s are constants.

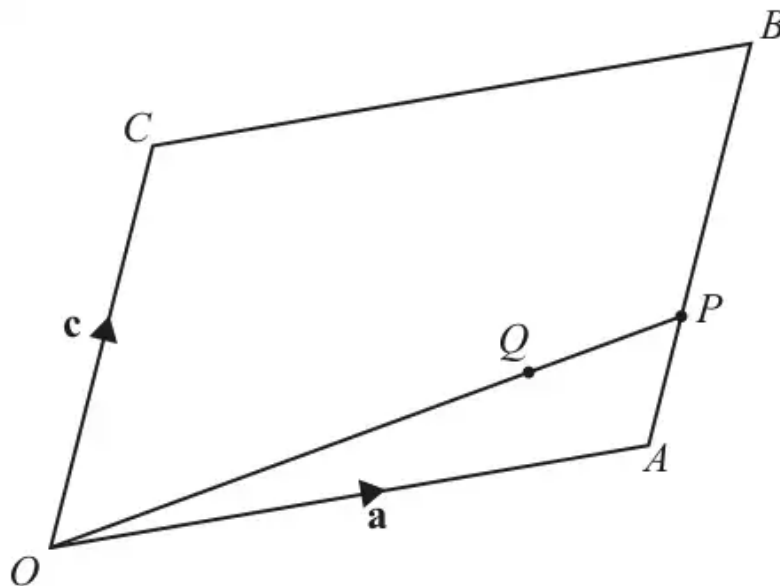
Determine two pairs of values of r and s such that $\mathbf{a}$ is parallel to the y -axis and $|\mathbf{a}| = 3$.

[5]

(Total 7 marks)

OCR A October 2021 Paper 1 Q4

4. In this question you must show detailed reasoning.



The diagram shows a parallelogram $OABC$. The position vectors of A and C are $\mathbf{a}$ and $\mathbf{c}$ respectively.

- The point P lies on AB such that $AP = \frac{1}{3}AB$.
- The point Q lies on OP such that $OQ = \frac{3}{4}OP$.

(a) Show that $\overrightarrow{OQ} = \frac{3}{4}\mathbf{a} + \frac{1}{4}\mathbf{c}$. [4]

(b) Hence show that Q lies on AC . [3]

(Total 7 marks)

OCR A June 2025 Paper 1 Q7

Solutions

1.

Mark scheme (a)

Scheme	Marks	AO
Attempts to compare the two position vectors. Allow an attempt using two of $\overrightarrow{AO}$, $\overrightarrow{OB}$ or $\overrightarrow{AB}$ E.g. $(-24\mathbf{i} - 10\mathbf{j}) = -2 \times (12\mathbf{i} + 5\mathbf{j})$	M1	1.1b
Explains that as $\overrightarrow{AO}$ is parallel to $\overrightarrow{OB}$ (and the stone is travelling in a straight line) the stone passes through the point O .	A1	2.4
	(2)	

Notes

M1: Attempts to compare the two position vectors. Allow an attempt using two of $\overrightarrow{AO}$, $\overrightarrow{OB}$ or $\overrightarrow{AB}$ either way around.

E.g. States that $(-24\mathbf{i} - 10\mathbf{j}) = -2 \times (12\mathbf{i} + 5\mathbf{j})$

Alternatively, allow an attempt finding the gradient using any two of AO , OB or AB

Alternatively attempts to find the equation of the line through A and B proceeding as far as $y = \dots x$

Condone sign slips.

A1: States that as $\overrightarrow{AO}$ is parallel to $\overrightarrow{OB}$ or as AO is parallel to OB (and the stone is travelling in a straight line) the stone passes through the point O . Alternatively, shows that the point $(0, 0)$ is on the line and concludes (the stone) passes through the point O .

Alt (a)

Scheme	Marks	AO
Attempts to find the equation of the line which passes through A and B E.g. $y - 5 = \frac{5 + 10}{12 + 24}(x - 12) \quad \left(y = \frac{5}{12}x\right)$	M1	1.1b
Shows that when $x = 0$, $y = 0$ and concludes the stone passes through the point O .	A1	2.4

Mark scheme (b)

Scheme	Marks	AO
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Attempts distance $AB = \sqrt{(12 + 24)^2 + (10 + 5)^2}$	M1	1.1b
Attempts speed = $\frac{\sqrt{(12 + 24)^2 + (10 + 5)^2}}{4}$	dM1	3.1a
Speed = 9.75 ms^{-1}	A1	3.2a
	(3)	
	(5 marks)	

Notes

M1: Attempts to find the distance AB using a correct method.

Condone slips but expect to see an attempt at $\sqrt{a^2 + b^2}$ where a or b is correct

dM1: Dependent upon the previous mark. Look for an attempt at $\frac{\text{distance } AB}{4}$

A1: 9.75 ms^{-1} Requires units

2.

Mark scheme (a)

Scheme	Marks	AO
$\overrightarrow{QR} = \overrightarrow{PR} - \overrightarrow{PQ} = 13\mathbf{i} - 15\mathbf{j} - (3\mathbf{i} + 5\mathbf{j})$	M1	1.1a
$= 10\mathbf{i} - 20\mathbf{j}$	A1	1.1b
	(2)	

Notes

M1: Attempts subtraction either way round. This cannot be awarded for adding the two vectors. If no method shown it may be implied by one correct component.

eg $10\mathbf{i} - 10\mathbf{j}$ on its own can score M1.

A1: Correct answer. Allow $10\mathbf{i} - 20\mathbf{j}$ and $\begin{pmatrix} 10 \\ -20 \end{pmatrix}$ but not $\begin{pmatrix} 10\mathbf{i} \\ -20\mathbf{j} \end{pmatrix}$

Mark scheme (b)

Scheme	Marks	AO
$ \overrightarrow{QR} = \sqrt{“10”^2 + “(-20)”^2}$	M1	2.5
$= 10\sqrt{5}$	A1ft	1.1b

(2)

Notes

M1: Correct use of Pythagoras. Attempts to “square and add” before square rooting. The embedded values are sufficient. Follow through on their $\overrightarrow{QR}$

A1ft: $10\sqrt{5}$ following (a) of the form $\pm 10\mathbf{i} \pm 20\mathbf{j}$

Mark scheme (c)

Scheme	Marks	AO
$\overrightarrow{PS} = \overrightarrow{PQ} + \frac{3}{5}\overrightarrow{QR} = 3\mathbf{i} + 5\mathbf{j} + \frac{3}{5}(\text{“}10\mathbf{i} - 20\mathbf{j}\text{”}) = \dots$ or $\overrightarrow{PS} = \overrightarrow{PR} + \frac{2}{5}\overrightarrow{RQ} = 13\mathbf{i} - 15\mathbf{j} + \frac{2}{5}(\text{“} -10\mathbf{i} + 20\mathbf{j}\text{”}) = \dots$	M1	3.1a
$= 9\mathbf{i} - 7\mathbf{j}$	A1	1.1b
	(2)	
	(6 marks)	

Notes

M1: Full attempt at finding a $\overrightarrow{PS}$. They must be attempting $\overrightarrow{PQ} \pm \frac{3}{5}\overrightarrow{QR}$ or $\overrightarrow{PS} = \overrightarrow{PR} \pm \frac{2}{5}\overrightarrow{RQ}$ but condone arithmetical slips after that.

Cannot be scored for just stating eg $\overrightarrow{PQ} \pm \frac{3}{5}\overrightarrow{QR}$

Follow through on their $\overrightarrow{QR}$. Terms do not need to be collected for this mark. If no method shown it may be implied by one correct component following through on their $\overrightarrow{QR}$

A1: Correct vector as shown. Allow $9\mathbf{i} - 7\mathbf{j}$ and $\begin{pmatrix} 9 \\ -7 \end{pmatrix}$.

Only withhold the mark for $\begin{pmatrix} 9\mathbf{i} \\ -7\mathbf{j} \end{pmatrix}$ if the mark has not already been withheld in (a) for $\begin{pmatrix} 10\mathbf{i} \\ -20\mathbf{j} \end{pmatrix}$

Alt (c) (Expressing $\overrightarrow{PS}$ in terms of the given vectors) They must be attempting $\frac{2}{5}\overrightarrow{PQ} + \frac{3}{5}\overrightarrow{PR}$

M1: $\left(\overrightarrow{PS} = \overrightarrow{PQ} + \frac{3}{5}\overrightarrow{QR} = \overrightarrow{PQ} + \frac{3}{5}(\overrightarrow{PR} - \overrightarrow{PQ}) \right)$

$\Rightarrow \frac{2}{5}\overrightarrow{PQ} + \frac{3}{5}\overrightarrow{PR} = \frac{2}{5}(3\mathbf{i} + 5\mathbf{j}) + \frac{3}{5}(13\mathbf{i} - 15\mathbf{j}) = \dots$

A1: Correct vector as shown. Allow $9\mathbf{i} - 7\mathbf{j}$ and $\begin{pmatrix} 9 \\ -7 \end{pmatrix}$.

Only withhold the mark for $\begin{pmatrix} 9\mathbf{i} \\ -7\mathbf{j} \end{pmatrix}$ if the mark has not already been withheld in (a) for $\begin{pmatrix} 10\mathbf{i} \\ -20\mathbf{j} \end{pmatrix}$

3.

Mark scheme (a)

Scheme	Marks
$\begin{pmatrix} 15 \\ -12 \end{pmatrix}$ or $15\mathbf{i} - 12\mathbf{j}$	B1 B1
	[2]

Notes

B1 for each element. Allow $\mathbf{i}, \mathbf{j}$ notation without “squiggles”

(corrected from the printed mark scheme: the part total is printed as [1]; the paper and the two B1 marks give [2])

Mark scheme (b)

Scheme	Marks
$6r - s = 0$ $s = 6r$	M1
$0^2 + (9r)^2 = 9$	M1
$81r^2 = 9$	A1
$r = \pm \frac{1}{3}$	A1
$r = \frac{1}{3}$ and $s = 2$ or $r = -\frac{1}{3}$ and $s = -2$	A1
	[5]

Notes

M1: Attempt $|\mathbf{a}|^2 = 9$, or $|\mathbf{a}| = 3$; allow in terms of both r and s

A1: Allow just $r = \frac{1}{3}$

A1: Correctly paired

4.

Mark scheme (a)

Scheme	Marks	AO
DR $\overrightarrow{OP} = \mathbf{a} + \overrightarrow{AP}$ or $\mathbf{c} + \mathbf{a} + \overrightarrow{BP}$	M1	3.1a
$\overrightarrow{OP} = \mathbf{a} + \frac{1}{3}\mathbf{c}$	A1	1.1
$\overrightarrow{OQ} = \frac{3}{4}\overrightarrow{OP} = \frac{3}{4}(\mathbf{a} + \frac{1}{3}\mathbf{c})$	M1	1.1
$= \frac{3}{4}\mathbf{a} + \frac{1}{4}\mathbf{c}$ AG	A1	1.1
	[4]	

Notes

M1: soi

A1: If labelled then must be correctly identified as $\overrightarrow{OP}$

M1: Use of $\overrightarrow{OQ} = \frac{3}{4}\overrightarrow{OP}$ with their $\overrightarrow{OP}$ soi, may use $\overrightarrow{OQ} = 3\overrightarrow{QP}$

A1: Must see an intermediate step, as a minimum $\frac{3}{4}(\mathbf{a} + \frac{1}{3}\mathbf{c})$ oe

Mark scheme (b)

Scheme	Marks	AO
DR $\overrightarrow{AQ} = \frac{3}{4}\mathbf{a} + \frac{1}{4}\mathbf{c} - \mathbf{a} [= \frac{1}{4}\mathbf{c} - \frac{1}{4}\mathbf{a}]$ $[\overrightarrow{AC} = \mathbf{c} - \mathbf{a}]$	M1	1.1
$\Rightarrow \overrightarrow{AQ} = \frac{1}{4}\overrightarrow{AC}$ or $\overrightarrow{AC}$ is a [scalar] multiple of $\overrightarrow{AQ}$ or $\overrightarrow{AQ}$ is parallel to $\overrightarrow{AC}$ or $\overrightarrow{AC} = 4\overrightarrow{AQ}$	A1	2.1
Hence Q lies on AC AG	A1	2.2a
	[3]	

Notes

M1: Or $\overrightarrow{QC} [= -\overrightarrow{OQ} + \overrightarrow{OC}] = -\frac{3}{4}\mathbf{a} - \frac{1}{4}\mathbf{c} + \mathbf{c} [= \frac{3}{4}\mathbf{c} - \frac{3}{4}\mathbf{a}]$

A1: oe, e.g. $\overrightarrow{QC} = \frac{3}{4}\overrightarrow{AC}$

may see ' Q, A, C colinear' but must be justified.

A1: Correct conclusion, dep $\overrightarrow{AQ} = \frac{1}{4}\overrightarrow{AC}$ oe seen www

Other methods may be seen, e.g. using $\overrightarrow{CQ}$ or $\overrightarrow{QA}$

Alternative method

Scheme	Marks
$\frac{3}{4}\mathbf{a} + \frac{1}{4}\mathbf{c}$ is of the form $\alpha\mathbf{a} + (1 - \alpha)\mathbf{c}$	M2
Hence Q lies on AC	A1