



5.21H Vectors: Higher Tier Practice

EDEXCEL Edexcel 1MA1 · Calculator allowed · about 65 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

- 1** Write down the vector from P to Q given $P(2, -1)$ and $Q(-3, 4)$.

(Total for Question 1 is 2 marks)

- 2** Given vectors $a = (3, 1)$ and $b = (-2, 4)$, calculate $2a - 3b$ and give your answer as a column vector.

(Total for Question 2 is 3 marks)

- 3** Vectors p and q are shown on a grid. $p = (4, 0)$ and $q = (1, 3)$.

(a) Write down $p + q$.

(b) Find a scalar k such that $kq = (4, 12)$.

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(2)

(b) Find a scalar k such that $kq = (4, 12)$.

(2)

(Total for Question 3 is 4 marks)

4 On a diagram, A, B and C are points with position vectors relative to origin O: $OA = (2, 1)$, $OB = (-1, 3)$, $OC = (5, 4)$.

(a) Find the vector AB.

(b) Show that the three points are not collinear by using vectors.

(a) Find the vector AB.

(2)

(b) Show that A, B and C are not collinear by using vectors.

(3)

(Total for Question 4 is 5 marks)

5 Vectors u and v satisfy $u = (t, 2)$ and $v = (1, k)$. Given that $u + 2v = (5, 8)$, find t and k .

(Total for Question 5 is 5 marks)

6 Points A and B have position vectors $OA = (2, -1)$ and $OB = (8, 5)$. A point X lies on AB such that $AX : XB = 2 : 1$.

(a) Find the position vector of X.

(b) Verify by vector calculation that X divides AB in the ratio 2 : 1.

(a) Find the position vector of X.

(3)

(b) Verify by vector calculation that X divides AB in the ratio 2 : 1.

(3)

(Total for Question 6 is 6 marks)

7 Vectors a and b satisfy $3a - 2b = (7, 1)$ and $a + b = (3, 2)$.

(a) Solve for a and b.

(b) Hence find $2a - b$.

(a) Solve for a and b.

(4)

(b) Hence find $2a - b$.

(3)

(Total for Question 7 is 7 marks)

- 8** Show that the vectors $(2, -1)$, $(5, 2)$ and $(7, 1)$ are coplanar in $\mathbb{R}^2$ and then determine whether they are linearly dependent by finding constants x, y, z , not all zero, such that $x(2, -1) + y(5, 2) + z(7, 1) = (0, 0)$. Give one nontrivial solution.

(Total for Question 8 is 8 marks)

Mark scheme · 5.21H Vectors: Higher Tier Practice

Question 1

- **M1** Subtract coordinates: $Q - P$ to form vector PQ
- **A1** $PQ = (-5, 5)$ cao
- **Answer:** $(-5, 5)$

Question 2

- **M1** Multiply vectors and form $2a$ and $3b$ components: $2a = (6, 2)$, $3b = (-6, 12)$
- **M1** Subtract components: $(6 - (-6), 2 - 12)$ or show $(6+6, -10)$
- **A1** $(12, -10)$ cao as a column vector
- **Answer:** $[12; -10]$

Question 3

- (a) **M1** Add components: $(4+1, 0+3)$
- (a) **A1** $(5, 3)$ cao
- (a) **Answer:** $(5, 3)$
- (b) **M1** Set $k*(1, 3) = (4, 12)$ and compare components
- (b) **A1** $k = 4$ cao
- (b) **Answer:** 4

Question 4

- (a) **M1** Use $AB = OB - OA$
- (a) **A1** $AB = (-3, 2)$ cao
- (a) **Answer:** $(-3, 2)$
- (b) **M1** Compute $AC = OC - OA = (3, 3)$ and note $AB = (-3, 2)$
- (b) **M1** Attempt to find scalar t with $AB = t*AC$ or $AC = t*AB$ and show no single t fits both components
- (b) **A1** Conclude not collinear since components would need same ratio but $-3/3 \neq 2/3$
- (b) **Answer:** $AC = (3, 3)$, $AB = (-3, 2)$; no scalar t satisfies $AB = tAC$ since $-3/3 \neq 2/3$, so points are not collinear.

Question 5

- **M1** Write $u + 2v = (t, 2) + 2(1, k) = (t + 2, 2 + 2k)$
- **M1** Equate components to $(5, 8)$: $t + 2 = 5$ and $2 + 2k = 8$
- **A1** $t = 3$ cao
- **M1** Solve $2 + 2k = 8 \Rightarrow 2k = 6$
- **A1** $k = 3$ cao
- **Answer:** $t = 3, k = 3$

Question 6

- (a) **M1** Use section formula: $X = OA + (2/3)AB$ since AX is $2/3$ of AB
- (a) **M1** Compute $AB = OB - OA = (6, 6)$
- (a) **A1** $OX = (2, -1) + (2/3)(6, 6) = (2, -1) + (4, 4) = (6, 3)$ cao
- (a) **Answer:** $(6, 3)$
- (b) **M1** Compute $AX = OX - OA = (6, 3) - (2, -1) = (4, 4)$ and $XB = OB - OX = (8, 5) - (6, 3) = (2, 2)$
- (b) **M1** Compare components to show $AX = 2*XB$ in each component
- (b) **A1** Conclude $AX : XB = 2 : 1$ cao
- (b) **Answer:** $AX = (4, 4)$, $XB = (2, 2)$; $AX = 2 XB$ so ratio $2 : 1$.

Question 7

- (a) **M1** Use system: from $a + b = (3,2)$ get $a = (3,2) - b$ and substitute into $3a - 2b$
- (a) **M1** Substitute: $3[(3,2) - b] - 2b = (7,1) \Rightarrow (9,6) - 3b - 2b = (7,1)$
- (a) **M1** Combine $-5b = (7,1) - (9,6) = (-2, -5)$ so $b = ((-2)/-5, (-5)/-5)$
- (a) **A1** $b = (2/5, 1)$ and then $a = (3,2) - b = (13/5, 1)$ cao
- (a) **Answer: $a = (13/5, 1), b = (2/5, 1)$**
- (b) **M1** Substitute a and b: $2a - b = 2(13/5, 1) - (2/5, 1)$
- (b) **M1** Compute components: $(26/5 - 2/5, 2 - 1) = (24/5, 1)$
- (b) **A1** $2a - b = (24/5, 1)$ cao
- (b) **Answer: $(24/5, 1)$**

Question 8

- **M1** Note that in $\mathbb{R}^2$ any three vectors are coplanar; state this or show they lie in $\mathbb{R}^2$
- **M1** Set up equations for linear dependence: $2x + 5y + 7z = 0$ and $-x + 2y + z = 0$
- **M1** Solve system: eliminate x using $x = 2y + z$ from second equation or solve by elimination
- **M1** Substitute $x = 2y + z$ into first: $2(2y+z) + 5y + 7z = 0 \Rightarrow 4y + 2z + 5y + 7z = 0$
- **M1** Combine to get $9y + 9z = 0$ so $y = -z$
- **M1** Choose $z = 1$ then $y = -1$ and $x = 2y + z = 2(-1) + 1 = -1$
- **A1** Provide nontrivial solution $x = -1, y = -1, z = 1$ and conclude vectors are linearly dependent
- **A1** State that the vectors are coplanar (in $\mathbb{R}^2$) and linearly dependent since a nonzero solution exists
- **Answer: Coplanar in $\mathbb{R}^2$. One nontrivial solution is $x = -1, y = -1, z = 1$ since $-1*(2,-1) + -1*(5,2) + 1*(7,1) = (0,0)$.**