HIGHER

3.1 Vector Geometry: Proof and Ratio Problems: Test Pack

Total Marks

EDEXCEL 4MA1 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 In the plane with origin O, point A has position vector a = (3, 1). Write down the column vector OA.

(Total for Question 1 is 1 mark)

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2 OAB is a triangle. OA = a and OB = b. The point M lies on OA such that OM : MA = 3 : 2. The point N lies on OB such that ON : NB = 3 : 2.

(a) Find MN in terms of a and b.

(b) What does your answer show about MN and AB?

(Total for Question 2 is 4 marks)

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3 OAB is a triangle. OA = a and OB = b. M is the midpoint of AB. The point P lies on OM such that OP : PM = 2 : 3.

Find AP in terms of a and b.

(Total for Question 3 is 4 marks)

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4 Vector p = (4, 2). Find 3p and -1/2 p.

(Total for Question 4 is 2 marks)

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5 OAB is a triangle. OA = a and OB = b. M is the midpoint of AB. The point P lies on OM such that OP : PM = 3 : 1.
Find BP in terms of a and b.

(Total for Question 5 is 4 marks)

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6 OABC is a trapezium with CB parallel to OA. OA = a, OC = b and CB = 3a.
Find AB in terms of a and b.

(Total for Question 6 is 2 marks)

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7 OA = a and OB = b. The points P, Q and R have position vectors OP = 4a - 3b, OQ = -2b and OR = 11a - 5b relative to O.
Show whether P, Q and R lie on a straight line. Give a reason.

(Total for Question 7 is 5 marks)

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8 OAB is a triangle. OA = a and OB = b. The point M lies on OA such that OM : MA = 1 : 1. The point N lies on OB such that ON : NB = 1 : 1.

(a) Find MN in terms of a and b.

(b) What does your answer show about MN and AB?

(Total for Question 8 is 4 marks)

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9 OABC is a trapezium with CB parallel to OA. OA = a, OC = b and CB = 1/2a.
Find OB and AC in terms of a and b.

(Total for Question 9 is 4 marks)

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10 Given vectors a = (2, 3) and b = (6, 9), show whether a and b are parallel and explain briefly.

(Total for Question 10 is 3 marks)

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11 In triangle ABC, OA = (1, 2), OB = (4, 0) and OC = (5, 6). Use vectors to find AB and AC, then use those to decide whether triangle ABC is isosceles (state which sides, if any, are equal).

(Total for Question 11 is 4 marks)

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12 Points P, Q and R have position vectors OP = (2, 1), OQ = (5, 4) and OR = (8, 7). Using vectors, determine whether P, Q and R are collinear.

(Total for Question 12 is 4 marks)

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Mark scheme · 3.1 Vector Geometry: Proof and Ratio Problems: Test Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

OA = (3, 1) cao	**B1**

Answer: OA = (3, 1)

Question 2

OM = 3/5a and ON = 3/5b	**M1**
MN = MO + ON = -OM + ON	**M1**
MN = -(3/5)a + (3/5)b = 3/5(b - a)	**A1**
AB = b - a so MN = 3/5AB: MN is parallel to AB and 3/5 of its length	**B1**

Answer: (a) MN = -(3/5)a + (3/5)b; (b) MN is parallel to AB and 3/5 of its length

Question 3

OM = OA + (1/2)AB = (1/2)(a + b)	**M1**
OP = (2/5)OM = (1/5)a + (1/5)b	**M1**
AP = AO + OP	**M1**
AP = -(4/5)a + (1/5)b	**A1**

Answer: -(4/5)a + (1/5)b

Question 4

correct scalar multiple for one entry, e.g. 3p = (12, 6) or -1/2 p = (-2, -1) seen	**M1**
3p = (12, 6) and -1/2 p = (-2, -1) cao	**A1**

Answer: 3p = (12, 6); -1/2 p = (-2, -1)

Question 5

OM = OA + (1/2)AB = (1/2)(a + b)	**M1**
OP = (3/4)OM = (3/8)a + (3/8)b	**M1**
BP = BO + OP	**M1**
BP = (3/8)a - (5/8)b	**A1**

Answer: (3/8)a - (5/8)b

Question 6

AB = AO + OC + CB	**M1**
AB = 2a + b	**A1**

Answer: 2a + b

Question 7

PQ = OQ - OP	**M1**
PQ = -4a + b	**A1**
PR = OR - OP	**M1**
PR = 7a - 2b	**A1**
PR is not a scalar multiple of PQ, so the points are not on a straight line	**B1**

Answer: Not collinear: PR is not a multiple of PQ

Question 8

OM = 1/2a and ON = 1/2b	**M1**
MN = MO + ON = -OM + ON	**M1**
MN = -(1/2)a + (1/2)b = 1/2(b - a)	**A1**
AB = b - a so MN = 1/2AB: MN is parallel to AB and 1/2 of its length	**B1**

Answer: (a) MN = -(1/2)a + (1/2)b; (b) MN is parallel to AB and 1/2 of its length

Question 9

OB = OC + CB	**M1**
OB = (1/2)a + b	**A1**
AC = AO + OC	**M1**
AC = -a + b	**A1**

Answer: OB = (1/2)a + b; AC = -a + b

Question 10

shows b is a scalar multiple of a, e.g. b = 3a or 6/2 = 9/3	**M1**
states scalar multiple correctly, e.g. b = 3a	**M1**
conclusion that a and b are parallel cao	**A1**

Answer: b = 3a, so a and b are parallel

Question 11

finds AB = OB - OA = (3, -2) and AC = OC - OA = (4, 4)	**M1**
finds BC = OC - OB = (1, 6) or computes magnitudes	**M1**
states magnitudes: $\|AB\| = \sqrt{13}$, $\|AC\| = \sqrt{32}$, $\|BC\| = \sqrt{37}$ or equivalent	**A1**
conclusion that no two sides are equal so triangle is not isosceles cao	**A1**

Answer: AB = (3, -2), AC = (4,4), BC = (1,6); lengths $\sqrt{13}$, $\sqrt{32}$, $\sqrt{37}$; not isosceles

Question 12

finds PQ = OQ - OP = (3,3) or PR = OR - OP = (6,6)	**M1**
shows PR = 2 * PQ or PR is scalar multiple of PQ	**M1**
concludes P, Q, R are collinear cao	**A1**
gives a brief correct justification, e.g. vectors lie on same line through scalar multiple	**A1**

Answer: PQ = (3,3), PR = (6,6) = 2 PQ, so collinear

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