HIGHER

8.10 Vectors Proof Questions: Test Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Vectors OA = <3, 2> and OB = <-1, 4>. Work out the vector AB.

(Total for Question 1 is 1 mark)

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2 OA = <2, 0>, OB = <8, 6>, OC = <5, 3>. Prove that A, B and C are collinear.

(Total for Question 2 is 2 marks)

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3 OA = <1, 2>, OB = <4, 3>, OC = <7, 4>. Prove that A, B and C are collinear by showing AC is a multiple of AB.

(Total for Question 3 is 2 marks)

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4 a and b are vectors.

(a) Simplify fully: 3(2a - b) + 2(a + 3b) - 4a **(2)**

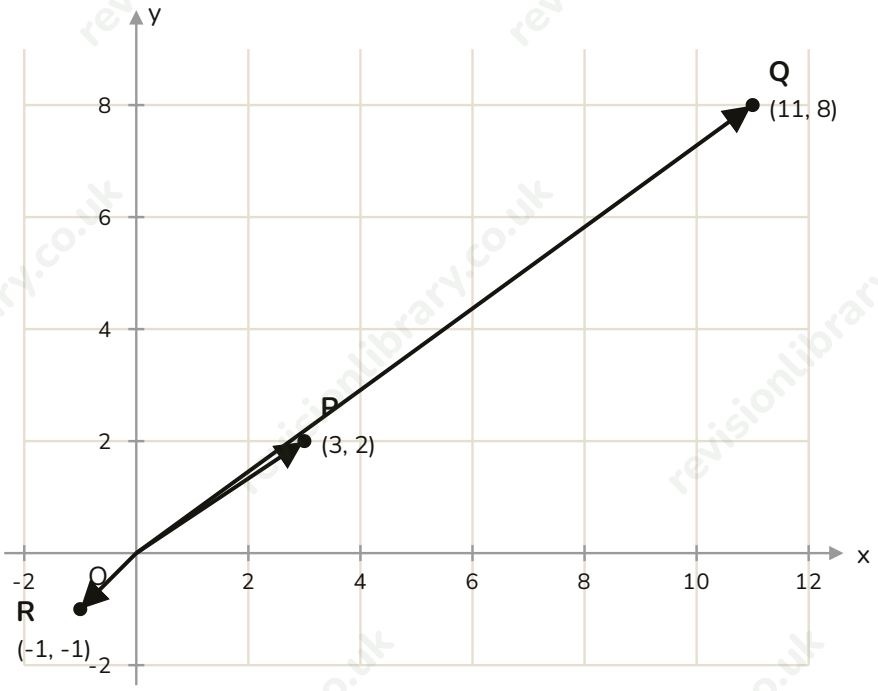
(b) Simplify fully: (1/2)(4a + 6b) - (a - 2b) **(2)**

(Total for Question 4 is 4 marks)

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5 The position vectors of points P, Q and R, relative to the origin O, are OP = (3, 2), OQ = (11, 8) and OR = (-1, -1).

Diagram NOT accurately drawn



(a) Find the vector PQ. **(1)**

(b) Find the vector PR. **(1)**

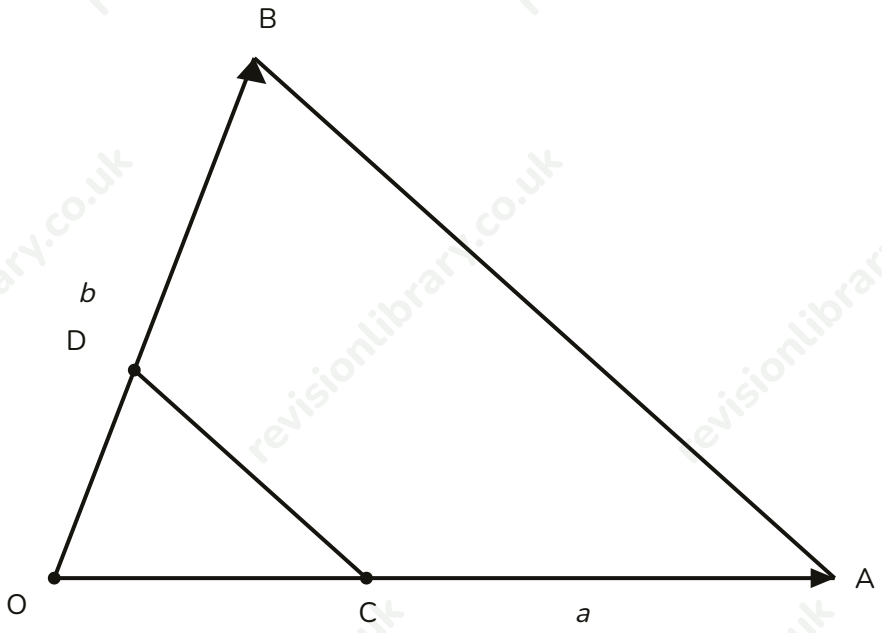
(c) Prove that P, Q and R lie on a straight line. **(2)**

(Total for Question 5 is 4 marks)

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6 OAB is a triangle. C is the point on OA such that OC:CA = 2:3. D is the point on OB such that OD:DB = 2:3. OA = a and OB = b.

Diagram NOT accurately drawn



(a) Find CD in terms of a and b. **(2)**

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(b) Given that the area of triangle OAB is 75 cm², find the area of triangle OCD. **(2)**

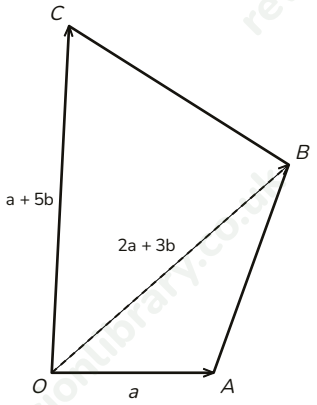
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(Total for Question 6 is 4 marks)

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7 OABC is a quadrilateral with OA = a, OB = 2a + 3b and OC = a + 5b, where O is the origin.
A student claims that OA is parallel to BC.
Determine, showing your working, whether the student's claim is correct.

Diagram NOT accurately drawn



(Total for Question 7 is 3 marks)

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8 OAB is a triangle. OA = a and OB = b. P is the point on OA such that OP:PA = 5:1 and Q is the point on OB such that OQ:QB = 5:1. Show that PQ is parallel to AB and state the value of k in PQ = k AB.

(Total for Question 8 is 4 marks)

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9 OP = -4a - 2b, OQ = 5a and OR = -22a - 6b. Show that P, Q and R lie on a straight line.

(Total for Question 9 is 4 marks)

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10 OABC is a parallelogram. OA = a and OC = b. M is the point on AB such that AM:MB = 1:3. Find CM in terms of a and b.

(Total for Question 10 is 3 marks)

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11 OAB is a triangle. OA = a and OB = b. P is the point on AB such that AP:PB = 1:2. Find OP in terms of a and b. Give your answer in its simplest form.

(Total for Question 11 is 3 marks)

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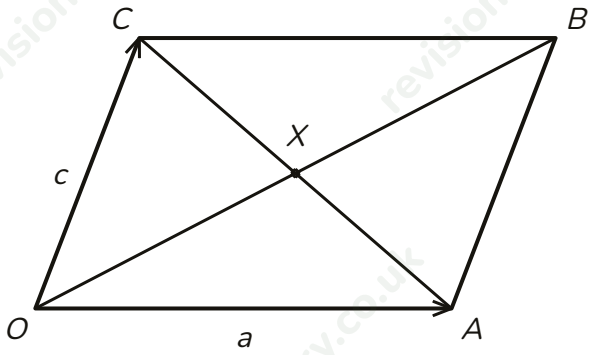
12 OAB is a triangle. OA = a and OB = b. P is the point on OA such that OP:PA = 4:3. Q is the point on OB such that OQ:QB = 3:1. Find PQ in terms of a and b.

(Total for Question 12 is 2 marks)

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13 OABC is a parallelogram with OA = a and OC = c. The diagonals OB and AC intersect at X.

Diagram NOT accurately drawn



(a) Write OB in terms of a and c. **(1)**

.....

(b) Write AC in terms of a and c. **(1)**

.....

(c) By expressing OX in two different ways, prove that X is the midpoint of AC. **(4)**

(Total for Question 13 is 6 marks)

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14 OA = a and OB = b. D is a point on AB such that AD = 2 DB. Show that OD = (1/3) a + (2/3) b.

(Total for Question 14 is 3 marks)

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Mark scheme · 8.10 Vectors Proof Questions: Test Pack

Question 1

AB = <-4, 2> cao **B1**

Answer: AB = OB - OA = <-4, 2>.

Question 2

calculate AB = <6,6> and AC = <3,3> and show AC = 1/2 AB oe **M1**

state A, B and C are collinear cao **A1**

Answer: Collinear, since AC = 1/2 AB.

Question 3

calculate AB = <3,1>, AC = <6,2> and show AC = 2 AB oe **M1**

state A, B and C are collinear cao **A1**

Answer: Collinear because AC = 2 AB.

Question 4

(a) expands brackets correctly, e.g. 6a - 3b + 2a + 6b - 4a **M1**

(a) 4a + 3b (oe) (cao) **A1**

(a) Answer: 4a + 3b

(b) expands correctly, e.g. 2a + 3b - a + 2b **M1**

(b) a + 5b (oe) (cao) **A1**

(b) Answer: a + 5b

Question 5

(a) (8, 6) (cao) **B1**

(a) Answer: PQ = (8, 6)

(b) (-4, -3) (cao) **B1**

(b) Answer: PR = (-4, -3)

(c) compares PR with PQ, e.g. -(1/2) x (8, 6) = (-4, -3) (ft their parts (a) and (b)) **M1**

(c) PR = -(1/2)PQ, so PR is parallel to PQ, and since P is a common point, P, Q and R are collinear (cso) **A1**

(c) Answer: P, Q, R are collinear (PR = -(1/2)PQ)

Question 6

(a) OC = (2/5)a and OD = (2/5)b, so CD = OD - OC **M1**

(a) (2/5)(b - a) (oe) (cao) **A1**

(a) Answer: CD = (2/5)(b - a)

(b) recognises triangles OCD and OAB are similar (common angle O, CD parallel to AB) with linear scale factor 2/5, so uses area scale factor $(2/5)^2 = 4/25$ **M1**

(b) 12 cm² (cao) **A1**

(b) Answer: Area of triangle OCD = 12 cm^2

Question 7

finds BC = OC - OB = -a + 2b (oe) **M1**

compares with OA = a and states that BC cannot equal k*a for any scalar k, since a and b are non-parallel vectors and BC has a non-zero b-component **A1**

correctly concludes the student's claim is incorrect: OA is not parallel to BC (cso) **A1**

Answer: The student is incorrect; OA is not parallel to BC

Question 8

OP = 5/6a and OQ = 5/6b **M1**

PQ = 5/6b - 5/6a = 5/6(b - a) **M1**

AB = b - a **M1**

PQ = (5/6)AB, so PQ is parallel to AB **A1**

Answer: PQ = (5/6)AB, so PQ is parallel to AB

Question 9

PQ = OQ - OP = 9a + 2b **M1**

PR = OR - OP = -18a - 4b **M1**

PR = -2PQ **A1**

common point P and conclusion that P, Q and R are collinear **B1**

Answer: PR = -2PQ, so P, Q and R are collinear

Question 10

AB = OC = b so OB = a + b or OM = a + AM **M1**

AM = 1/4b and CM = OM - OC **M1**

CM = a - (3/4)b oe **A1**

Answer: CM = a - (3/4)b

Question 11

AB = -a + b **M1**

AP = 1/3 of AB **M1**

OP = (2/3)a + (1/3)b oe **A1**

Answer: OP = (2/3)a + (1/3)b

Question 12

PQ = PO + OQ or OQ - OP **M1**

-(4/7)a + (3/4)b oe **A1**

Answer: PQ = -(4/7)a + (3/4)b

Question 13

(a) a + c (oe) (cao) **B1**

(a) Answer: OB = a + c

(b) c - a (oe) (cao) **B1**

(b) Answer: AC = c - a

(c) X lies on OB, so OX = m(a + c) for some scalar m (ft their part (a)) **M1**

(c) X lies on AC, so OX = OA + h.AC = (1-h)a + hc for some scalar h (ft their part (b)) **M1**

(c) equates coefficients of a and c, since a and c are non-parallel: m = 1-h and m = h, giving h = m = 1/2 **dM1**

(c) OX = (1/2)(a+c), so AX = (1/2)(c-a) = (1/2)AC, so X is the midpoint of AC (cso) **A1**

(c) Answer: X is the midpoint of AC (h = 1/2)

Question 14

use AD = 2/3 AB so vector AD = 2/3(b - a) oe **M1**

write OD = OA + AD = a + 2/3(b - a) and simplify oe **M1**

OD = 1/3 a + 2/3 b cso **A1**

Answer: OD = 1/3 a + 2/3 b. (Using AD = 2/3 AB gives OD = a + 2/3(b - a) = 1/3 a + 2/3 b.)

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