1.10 Pure: Vectors: Test Pack

EDEXCEL 9MA0 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Write down -2(3i - 5j) as a single vector.

(Total for Question 1 is 1 mark)

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2 Two forces acting on a particle are F1 = (2i + 5j) N and F2 = (-6i + j) N.

(a) Find the resultant force F1 + F2, giving your answer in the form π + qj. **(2)**

(b) Find the magnitude of the resultant force, giving your answer in newtons to 3 significant figures. **(2)**

(c) Find the angle the resultant force makes with the vector i, measured anticlockwise from the positive i direction, giving your answer in degrees to 1 decimal place. **(3)**

(Total for Question 2 is 7 marks)

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3 c = 3i - 4j + 12k. Find |c|.

(Total for Question 3 is 1 mark)

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4 Relative to a fixed origin O, the points A and B have position vectors OA = i + 2j - 3k and OB = 5i - 2j + 9k.

(a) Find the vector AB. **(2)**

(b) Find |AB|, giving your answer as an exact simplified surd. **(2)**

(c) M is the midpoint of AB. Find the position vector of M. **(2)**

(d) The point C has position vector OC = 13i - 10j + 33k. Show that A, B and C are collinear, and find the ratio AB : BC. **(4)**

(Total for Question 4 is 10 marks)

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5 Relative to a fixed origin O, OA = 5i + 2j and OB = -i + 10j. Find the vector AB, and its magnitude.

(Total for Question 5 is 2 marks)

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6 The vector $p = 3i + 4j$. The vector $q = 2n\,i + (n+5)\,j$, where n is a constant.

(a) Given that p and q are parallel, find the value of n. **(3)**

(b) When $n = 3$, state whether p and q act in the same or opposite direction, giving a reason. **(2)**

(c) Given that $|p| = 5$, find the possible values of n, other than $n = 3$, for which $|q| = 2|p|$. **(5)**

(Total for Question 6 is 10 marks)

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7 Relative to a fixed origin O, points A and B have position vectors $OA = 2i + j$ and $OB = 6i + 3j$. Show that O, A and B are collinear, and find the ratio OA : AB.

(Total for Question 7 is 3 marks)

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8 A harbourmaster models three navigation buoys A, B and C using position vectors relative to a fixed origin O (the harbour), with distances in metres: $OA = 4i + 2j$, $OB = 16i + 8j$, $OC = 22i - 4j$.

(a) Show that O, A and B are collinear, and find the ratio OA : AB. **(3)**

(b) Find the vectors BC and AC, and show that $|AB|^2 = |BC|^2 = 180$ and $|AC|^2 = 360$. **(5)**

(c) Hence show that triangle ABC is a right-angled isosceles triangle, stating clearly where the right angle is located. **(3)**

(d) Find the exact perimeter of triangle ABC, in metres. **(2)**

(Total for Question 8 is 13 marks)

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Mark scheme · 1.10 Pure: Vectors: Test Pack

Question 1

-6i + 10j cao **B1**

Answer: -6i + 10j

Question 2

(a) add corresponding components **M1**

(a) = -4i + 6j (N) cao **A1**

(a) Answer: -4i + 6j (N)

(b) $\sqrt{(-4)^2 + 6^2}$ **M1**

(b) awrt 7.21 N **A1**

(b) Answer: awrt 7.21 N

(c) attempt reference angle = arctan(6/4) **M1**

(c) adjust for 2nd quadrant: 180 - reference angle **dM1**

(c) awrt 123.7 degrees **A1**

(c) Answer: awrt 123.7 degrees

Question 3

|c| = 13 cao **B1**

Answer: 13

Question 4

(a) OB - OA **M1**

(a) = 4i - 4j + 12k cao **A1**

(a) Answer: AB = 4i - 4j + 12k

(b) $\sqrt{4^2 + (-4)^2 + 12^2}$ **M1**

(b) = $4\sqrt{11}$ cao (exact) **A1**

(b) Answer: $4\sqrt{11}$

(c) (OA + OB)/2 **M1**

(c) = 3i + 0j + 3k oe (3,0,3) **A1**

(c) Answer: OM = 3i + 3k

(d) find BC = OC - OB **M1**

(d) BC = 8i - 8j + 24k **A1**

(d) recognise BC = 2 x AB (scalar multiple, so BC parallel to AB) **M1**

(d) cso: common point B, so A, B, C collinear; ratio AB : BC = 1 : 2 **A1**

(d) Answer: A, B, C collinear; AB : BC = 1 : 2

Question 5

AB = OB - OA = -6i + 8j **M1**

|AB| = $\sqrt{36+64}$ = 10 cao **A1**

Answer: AB = -6i + 8j, |AB| = 10

Question 6

(a) set up (2n)/3 = (n+5)/4 oe from parallel condition **M1**

(a) solve: 8n = 3n + 15 **M1**

(a) n = 3 cao **A1**

(a) Answer: n = 3

(b) same direction **B1**

(b) reason: q = 2p, a positive scalar multiple of p **B1**

(b) Answer: Same direction, since q = 2p

(c) form $|q|^2 = (2n)^2 + (n+5)^2$ **M1**

(c) = $5n^2 + 10n + 25$ **A1**

(c) set equal to $(2x5)^2 = 100$ and simplify to $n^2 + 2n - 15 = 0$ **M1**

(c) solve the quadratic, e.g. (n+5)(n-3) = 0 **dM1**

(c) n = -5 (rejecting the given n = 3) cao **A1**

(c) Answer: n = -5

Question 7

find AB = OB - OA **M1**

AB = 4i + 2j = 2 x OA (scalar multiple, common point O), so O, A, B are collinear **A1**

ratio OA : AB = 1 : 2 cao **A1**

Answer: O, A, B collinear; OA : AB = 1 : 2

Question 8

(a) attempt OB in terms of OA (or find AB) **M1**

(a) cso: OB = 4 x OA shown, hence O, A, B collinear (common point O, scalar multiple) **A1**

(a) ratio OA : AB = 1 : 3 **B1**

(a) Answer: OB = 4OA, so O, A, B collinear; OA : AB = 1 : 3

(b) BC = OC - OB **M1**

(b) BC = 6i - 12j **A1**

(b) AC = OC - OA **M1**

(b) AC = 18i - 6j **A1**

(b) cso: $|AB|^2$=144+36=180, $|BC|^2$=36+144=180, $|AC|^2$=324+36=360, as required **A1**

(b) Answer: BC = 6i - 12j, AC = 18i - 6j; $|AB|^2 = |BC|^2 = 180$, $|AC|^2 = 360$

(c) test 180 + 180 against 360 (converse of Pythagoras with correct pairing of sides) **M1**

(c) cso: $|AB|^2 + |BC|^2 = |AC|^2$, so angle ABC = 90 degrees (right angle at B) **A1**

(c) isosceles since |AB| = |BC| (both = $6\sqrt{5}$) **B1**

(c) Answer: Right angle at B; triangle ABC is right-angled isosceles

(d) sum the three exact side lengths $6\sqrt{5} + 6\sqrt{5} + 6\sqrt{10}$ **M1**

(d) cao: $12\sqrt{5} + 6\sqrt{10}$ m **A1**

(d) Answer: $12\sqrt{5} + 6\sqrt{10}$ metres

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