1.16 Pure: Vectors and Numerical Methods Depth: 30-minute Pack

Total Marks

EDEXCEL 9MA0 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Relative to a fixed origin O, the points A and B have position vectors OA = -5i + 7j and OB = 2i - 3j + 8k.

(a) Find the vector AB and the exact length |AB|. **(4)**

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

(c) The point C lies on the line AB, with AC = 1/2 AB. Find the position vector of C. **(2)**

(d) The point D has position vector -12i + 17j - 8k. Show that D lies on the line AB and find the ratio AD : AB. **(3)**

(Total for Question 1 is 11 marks)

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2 The table shows values of y = ln(x + 3), rounded to 4 decimal places, for equally spaced values of x.

x	0	1	2	3	4
y	1.0986	1.3863	1.6094	1.7918	1.9459

(a) Use the trapezium rule with 4 strips to estimate the integral from x = 0 to x = 4 of ln(x + 3) dx, giving your answer to 4 decimal places. **(4)**

(b) State, with a reason, whether the trapezium rule gives an overestimate or an underestimate. **(2)**

(c) Find the percentage error in your estimate, given that the exact value is 6.3255, to 2 significant figures. **(2)**

(Total for Question 2 is 8 marks)

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3 Relative to a fixed origin O, the points P and Q have position vectors OP = 3i + 5j and OQ = 11i - 3j.

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

(b) The point R lies on PQ such that PR:RQ = 3:1. Find the position vector of R. **(3)**

(c) The point S has position vector 18i - 2j. Show that O, R and S are collinear. **(2)**

(Total for Question 3 is 7 marks)

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Mark scheme · 1.16 Pure: Vectors and Numerical Methods Depth: 30-minute Pack

Question 1

(a) AB = OB - OA **M1**

(a) AB = 7i - 10j + 8k **A1**

(a) uses Pythagoras in three dimensions **M1**

(a) $|AB| = \sqrt{213}$ **A1**

(a) Answer: AB = 7i - 10j + 8k, $|AB| = \sqrt{213}$

(b) (1/2)(OA + OB) **M1**

(b) -(3/2)i + 2j + 4k **A1**

(b) Answer: -(3/2)i + 2j + 4k

(c) OC = OA + 1/2 AB **M1**

(c) -(3/2)i + 2j + 4k **A1**

(c) Answer: -(3/2)i + 2j + 4k

(d) finds AD = OD - OA **M1**

(d) AD = -7i + 10j - 8k = -1 AB, a multiple of AB, so D lies on the line AB **A1**

(d) AD : AB = 1 : 1 (D is on the opposite side of A from B) **B1**

(d) Answer: AD = -1 AB, so AD : AB = 1 : 1

Question 2

(a) h = 4/4 = 1 **B1**

(a) trapezium rule: $(h/2)[y_0 + y_n + 2(\text{sum of the middle values})]$ **M1**

(a) sum of middle values = 4.7875 **A1**

(a) 6.3098 **A1**

(a) Answer: 6.3098

(b) underestimate **B1**

(b) the curve is concave (concave down), so the chords lie below the curve **B1**

(b) Answer: underestimate

(c) |estimate - exact|/exact x 100 **M1**

(c) 0.25% **A1**

(c) Answer: 0.25%

Question 3

(a) attempts OQ - OP **M1**

(a) PQ = 8i - 8j oe **A1**

(a) Answer: PQ = 8i - 8j

(b) correct method OR = OP + (3/4)PQ, or equivalent ratio approach **M1**

(b) correct substitution (3i+5j) + (3/4)(8i-8j) **A1**

(b) OR = 9i - j oe **A1**

(b) Answer: OR = 9i - j

(c) shows OS = 2 OR, i.e. 18i - 2j = 2(9i - j) **M1**

(c) valid conclusion: since OS is a scalar multiple of OR, OR and OS are parallel and share the common point O, so O, R, S are collinear cso **A1**

(c) Answer: OS = 2 OR, so O, R and S are collinear

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