HIGHER

IG.M12 Vectors in Two Dimensions: Notation, Magnitude and Arithmetic

Total Marks

EDEXCEL 4MA1 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A displacement is 3 units to the right and 5 units up in a plane. Write down the column vector that represents this displacement, using column-vector notation for vectors in two dimensions.

(Total for Question 1 is 1 mark)

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2 Vector u is shown in bold notation as u = 4i - 2j. Write u as a column vector, using column-vector notation for two-dimensional vectors.

(Total for Question 2 is 1 mark)

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3 The vector v = [6; 8]. Calculate the magnitude, |v|, of v to 3 significant figures.

(Total for Question 3 is 2 marks)

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4 Given vectors a = [2; -3] and b = [-1; 4], find the vector 3a and give your answer in column-vector form.

(Total for Question 4 is 2 marks)

5 With a = [2; -3] and b = [-1; 4] as above, calculate the vector a + b and give your answer in column form.

(Total for Question 5 is 2 marks)

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6 Vector p = [7; 2] and vector q = [3; -5]. Calculate p - q and give your answer in column-vector form.

(Total for Question 6 is 2 marks)

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7 A triangle has vertices with position vectors from origin O as OA = [1; 2], OB = [4; 1]. Find the vector AB in column form.

(Total for Question 7 is 3 marks)

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8 A translation T maps point P with position vector OP = [2; 5] to point P' with position vector OP' = [6; 2]. Find the translation vector t that describes T, and state t in column-vector form.

(Total for Question 8 is 3 marks)

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9 The vector r = [5; -2]. Calculate the magnitude |r| and give your answer to 3 significant figures.

(Total for Question 9 is 3 marks)

10 Given s = [-2; 6], find -2s and give your answer in column-vector form.

(Total for Question 10 is 2 marks)

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11 Let a = [3; 1] and b = [1; 2]. Express the vector 2a - b in column form, and then simplify the components.

(Total for Question 11 is 3 marks)

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12 Given a = [2; -1] and b = [4; 3], show that 3a + 2b = [14; 3] by calculating and giving working.

(Total for Question 12 is 3 marks)

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13 A translation by vector t = [-3; 5] maps point X with position vector OX = [7; 0] to X'. Find the position vector OX' and give it in column form. Then state the image of the point with position vector [2; -1] under the same translation.

(Total for Question 13 is 3 marks)

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14 Vectors a and b satisfy 2a + 3b = [11; 7] and a - b = [1; -1]. Find a and b by solving the pair of vector equations, giving your answers in column-vector form.

(Total for Question 14 is 4 marks)

15 Write down whether the following pairs of vectors are parallel, perpendicular or neither. (i) [2; 4] and [1; 2] (ii) [3; -6] and [2; 1]

(Total for Question 15 is 2 marks)

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16 Given vectors m = [6; 15] and n = [-2; -5], show that m = -3 n, and hence state whether m and n are parallel. Give working.

(Total for Question 16 is 4 marks)

Mark scheme · IG.M12 Vectors in Two Dimensions: Notation, Magnitude and Arithmetic

Question 1

- **B1** column vector [3; 5] written in column form, cao
- **Answer: [3; 5]**

Question 2

- **B1** u = [4; -2] cao
- **Answer: [4; -2]**

Question 3

- **M1** uses Pythagoras: $|v| = \sqrt{6^2 + 8^2}$
- **A1** correct magnitude 10.0 to 3 s.f., cao
- **Answer: 10.0**

Question 4

- **M1** multiplies each component of a by 3, e.g. shows 3 x 2 and 3 x (-3)
- **A1** 3a = [6; -9] cao
- **Answer: [6; -9]**

Question 5

- **M1** adds corresponding components 2 + (-1) and -3 + 4
- **A1** a + b = [1; 1] cao
- **Answer: [1; 1]**

Question 6

- **M1** subtracts corresponding components: 7 - 3 and 2 - (-5)
- **A1** p - q = [4; 7] cao
- **Answer: [4; 7]**

Question 7

- **M1** uses AB = OB - OA or shows subtraction of position vectors
- **M1** performs components subtraction: [4 - 1; 1 - 2]
- **A1** AB = [3; -1] cao
- **Answer: [3; -1]**

Question 8

- **M1** uses t = OP' - OP or equivalent
- **M1** computes components 6 - 2 and 2 - 5 correctly
- **A1** t = [4; -3] cao
- **Answer: [4; -3]**

Question 9

- **M1** uses Pythagoras: $|r| = \sqrt{5^2 + (-2)^2}$
- **M1** evaluates the square root correctly, e.g. $\sqrt{25+4} = \sqrt{29}$
- **A1** gives |r| = 5.39 to 3 s.f., cao
- **Answer: 5.39**

Question 10

- **M1** multiplies each component of s by -2
- **A1** -2s = [4; -12] cao
- **Answer: [4; -12]**

Question 11

- **M1** shows method: forms 2a and subtracts b, e.g. 2[3;1] - [1;2]
- **M1** performs component arithmetic correctly, e.g. [6;2] - [1;2]
- **A1** gives final simplified vector [5; 0] cao
- **Answer: [5; 0]**

Question 12

- **M1** forms 3a and 2b correctly, e.g. 3[2; -1] and 2[4;3]
- **M1** adds the two resulting vectors componentwise
- **A1** correct result 3a + 2b = [14; 3] cao

Question 13

- **M1** adds t to OX correctly to find OX', and adds t to [2; -1] for the second image
- **M1** computes components correctly for both images
- **A1** OX' = [4; 5] and image of [2; -1] is [-1; 4], cao
- **Answer: [4; 5] and [-1; 4]**

Question 14

- **M1** writes the system of equations for components, or uses vector elimination: from a - b = [1; -1] get a = b + [1; -1]
- **M1** substitutes into 2a + 3b = [11;7] and simplifies to an equation in b, for both components
- **M1** solves for b correctly, giving b = [2; 3]
- **A1** finds a = b + [1; -1] = [3; 2] cao

Question 15

- **B1** i) parallel, ii) neither; both correct statements
- **B1** brief justification implicit in identification, e.g. first is a scalar multiple, second is not scalar multiple nor dot product zero
- **Answer: i) parallel ii) neither**

Question 16

- **M1** compares components and shows factor -3: -3[-2; -5] = [6;15]
- **M1** states the conclusion m = -3 n
- **B1** states that since one is a scalar multiple of the other they are parallel
- **A1** final statement is correct and clear, cao