IM-095 · Vectors I: column vectors and calculating with vectors

IGCSE Mathematics (0580) · HomiLabs: Maths · Ep 095

Extended only (E7.2; vectors were removed from Core in 2025). Column vectors are written here as (x over y): x on top, y underneath. In your answers, write column vectors in a tall bracket with no fraction line, and underline vector letters (a).

Set A · Fluency

1. Write as a column vector: (a) a move of 4 left and 3 up (b) a move of 5 down.

2. A is (4, −3) and B is (−1, 2). Write AB (arrow) and BA (arrow) as column vectors.

3. a = (3 over −2) and b = (−5 over 4). Find a + b.

4. For the same a and b, find (a) a − b (b) b − a.

5. u = (4 over −1) and v = (−2 over 3). Find 3u − 2v.

6. a = (−2 over 6). Find (a) ½a (b) −3a.

7. Which of these vectors are parallel to (3 over −1)? (−6 over 2), (9 over −3), (3 over 1). Give the scalar multiple for each one that is.

8. Find x and y if (x over −2) − 3(2 over y) = (1 over 10).

Set B · Exam style

1. (Paper 1/2 · no calculator) (E) p = (2 over −5) and q = (−3 over 1).
   (a) Find 2p − q. [2]
   (b) The vector (6 over k) is parallel to p. Find k. [2]

2. (Paper 1/2 · no calculator) (E) ABCD is a parallelogram with A(1, 1), B(5, 2) and C(7, 5).
   (a) Write AB (arrow) as a column vector. [1]
   (b) Use AD = BC (vectors) to find the coordinates of D. [2]
   (c) Show that AC = AB + BC (vectors). [1]

3. (Paper 1/2 · no calculator) (E) a = (4 over −2) and b = (1 over 3). Find the numbers m and n such that ma + nb = (7 over −7). [3]

Challenge

(E, links to Ep 30 and Ep 31)
(a) a = (k over 3) and b = (2 over k + 1). Find the two values of k for which a is parallel to b, and write down a and b in each case.
(b) Find s and t such that s(3 over 1) + t(1 over −2) = (11 over −8).

Answers

Set A

1. (a) (−4 over 3) (b) (0 over −5).

2. AB = (−5 over 5); BA = (5 over −5).

3. (−2 over 2).

4. (a) (8 over −6) (b) (−8 over 6).

5. (12 over −3) − (−4 over 6) = (16 over −9).

6. (a) (−1 over 3) (b) (6 over −18).

7. (−6 over 2) = −2(3 over −1) ✓; (9 over −3) = 3(3 over −1) ✓; (3 over 1) is not parallel (×1 on top, ×(−1) below).

8. Tops: x − 6 = 1, x = 7. Bottoms: −2 − 3y = 10, y = −4.

Set B

1. (a) 2p = (4 over −10) M1; 2p − q = (7 over −11) A1.
   (b) 6 = 3 × 2, so the vector is 3p M1; k = 3 × (−5) = −15 A1.

2. (a) (4 over 1) B1.
   (b) BC = (2 over 3) M1; D = (1 + 2, 1 + 3) = (3, 4) A1.
   (c) AC = (6 over 4) and (4 over 1) + (2 over 3) = (6 over 4) B1.

3. 4m + n = 7 and −2m + 3n = −7 M1; solving: n = 7 − 4m, −2m + 21 − 12m = −7, m = 2 M1; n = −1 A1. (Check: 2a − b = (8 − 1 over −4 − 3) = (7 over −7).)

Challenge

(a) a = tb gives k = 2t and 3 = t(k + 1), so k(k + 1) = 6, $k^2 + k - 6 = 0$, (k + 3)(k − 2) = 0. k = 2: a = b = (2 over 3). k = −3: a = (−3 over 3), b = (2 over −2), and a = −1.5b.
(b) 3s + t = 11 and s − 2t = −8, so s = 2, t = 5. (Check: (6 over 2) + (5 over −10) = (11 over −8).)