

## Exercises: Computing with Vectors

### Problem 1.

Every three-dimensional vector can be written in components and in as the sum of scalings of  $\mathbf{i}$ ,  $\mathbf{j}$ , and  $\mathbf{k}$ . For example,  $\langle 3, 1, 5 \rangle = 3\mathbf{i} + \mathbf{j} + 5\mathbf{k}$ . Compute the following vectors and write the result in terms of coordinates and the standard basis vectors.

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|--|--|
| (a) $\langle 4, 5, 0 \rangle + \langle 3, 1, 2 \rangle$              | (k) $\langle 1, 1, -5 \rangle + 3\mathbf{i} - 4\mathbf{j}$                           |
| (b) $\langle 1, 2, -1 \rangle + 3\langle 2, -2, 1 \rangle$           | (l) $-\mathbf{k} + \langle 0, 0, 1 \rangle + 4\mathbf{i}$                            |
| (c) $10\langle 2, 3, 4 \rangle + 4\langle -1, 0, -2 \rangle$         | (m) $\mathbf{i} + 4\mathbf{k} - \langle 3, 2, -1 \rangle$                            |
| (d) $5\langle 1, 1, 1 \rangle - \langle 1, 1, -3 \rangle$            | (n) $3\mathbf{j} + 4\mathbf{j} - 2\mathbf{j} - 5\mathbf{j} + 11\mathbf{j}$           |
| (e) $\pi\langle 2, 1, -1 \rangle + \sqrt{2}\langle -1, 4, 5 \rangle$ | (o) $36\mathbf{i} + 5\mathbf{j} - 6\mathbf{k}$                                       |
| (f) $6\langle -1, 3, 10 \rangle - 6\langle 1, -3, -10 \rangle$       | (p) $-7\mathbf{i} + 8\mathbf{j} + 3\mathbf{k}$                                       |
| (g) $-\langle 3, 3, 3 \rangle + 4\langle 5, 5, 5 \rangle$            | (q) $4\langle 2, 4, 5 \rangle - 5\langle 2, 4, 5 \rangle + 6\langle 2, 4, 5 \rangle$ |
| (h) $-\langle -2, -1, -3 \rangle - 3\langle -1, -2, -1 \rangle$      | (r) $2\langle 2, 2, 2 \rangle + 3\langle 1, 1, 1 \rangle$                            |
| (i) $5\langle 1, 1, 1 \rangle - \langle 1, 1, -3 \rangle$            | (s) $3\langle 4, 4, 4 \rangle + 5\langle -2, -2, -2 \rangle$                         |
| (j) $5\langle 1, 1, 1 \rangle - 4\langle 2, 2, 2 \rangle$            | (t) $-6\langle 2, 2, 2 \rangle - 5\langle -2, -2, -2 \rangle$                        |

### Problem 2.

Every three-dimensional vector can be written in components and in as the sum of scalings of  $\mathbf{i}$ ,  $\mathbf{j}$ , and  $\mathbf{k}$ . For example,  $\langle -2, -1, 4 \rangle = -2\mathbf{i} - \mathbf{j} + 4\mathbf{k}$ . Compute the following vectors and write the result in terms of coordinates and the standard basis vectors.

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|---|---|
| (a) $3\langle 2, 3, 1 \rangle + (\langle 2, 3, 3 \rangle + \langle -5, 3, -1 \rangle)$    | (f) $\mathbf{i} + 3\mathbf{j} + 5(\mathbf{j} - 3\mathbf{k})$  |
| (b) $-\langle 4, 2, 8 \rangle + 5(\langle 1, -4, 2 \rangle + \langle -1, 2, 1 \rangle)$   | (g) $2\mathbf{j} + 2\mathbf{k} + (\mathbf{k} - \mathbf{i})$   |
| (c) $2\langle 1, 3, 9 \rangle - 5(2\langle 2, 1, 0 \rangle + 2\langle 0, 1, 2 \rangle)$   | (h) $(\mathbf{j} - \mathbf{k}) - (\mathbf{k} + (\mathbf{j} - \mathbf{i}))$                              |
| (d) $2(3\langle -1, 1, 1 \rangle - 4\langle 1, 0, 1 \rangle) - 3\langle 2, -1, 1 \rangle$ | (i) $5\mathbf{i} - (2\mathbf{k} - 3\mathbf{k}) - (\mathbf{i} + (\mathbf{i} - \mathbf{k}) - \mathbf{i})$ |
| (e) $-3\langle -1, 2, -1 \rangle - 2\langle 1, -1, 1 \rangle - 3\langle 2, -1, 1 \rangle$ | (j) $3\mathbf{i} - 2\mathbf{j} + 4\mathbf{k} - \mathbf{j} + 5\mathbf{k} + 3\mathbf{i}$                  |