

## 3.10: Vectors (Answers)

### Check Your Understanding

2.1. a. not equal because they are orthogonal;

b. not equal because they have different magnitudes;

c. not equal because they have different magnitudes and directions;

d. not equal because they are antiparallel;

e. equal.

2.2. 16 m;  $\vec{D} = -16m\hat{u}$

2.3.  $G = 28.2$  cm,  $\theta_G = 291^\circ$

2.4.  $\vec{D} = (-5.0\hat{i} - 3.0\hat{j})\text{cm}$ ; the fly moved 5.0 cm to the left and 3.0 cm down from its landing site.

2.5. 5.83 cm,  $211^\circ$

2.6.  $\vec{D} = (-20m)\hat{j}$

2.7. 35.1 m/s = 126.4 km/h

2.8.  $\vec{G} = (10.25\hat{i} - 26.22\hat{j})\text{cm}$

2.9.  $D = 55.7$  N; direction  $65.7^\circ$  north of east

2.10.  $\hat{v} = 0.8\hat{i} + 0.6\hat{j}$ ,  $36.87^\circ$  north of east

2.11.  $\vec{A} \cdot \vec{B} = -57.3$ ,  $\vec{F} \cdot \vec{C} = 27.8$

2.13.  $131.9^\circ$

2.14.  $W_1 = 1.5J$ ,  $W_2 = 0.3J$

2.15.  $\vec{A} \times \vec{B} = -40.1\hat{k}$  or, equivalently,  $|\vec{A} \times \vec{B}| = 40.1$ , and the direction is into the page;  $\vec{C} \times \vec{F} = +157.6\hat{k}$  or, equivalently,  $|\vec{C} \times \vec{F}| = 157.6$ , and the direction is out of the page.

2.16. a.  $-2\hat{k}$ ,

b. 2,

c.  $153.4^\circ$ ,

d.  $135^\circ$

### Conceptual Questions

1. scalar

3. answers may vary

5. parallel, sum of magnitudes, antiparallel, zero

7. no, yes

9. zero, yes

11. no

13. equal, equal, the same

15. a unit vector of the x-axis

17. They are equal.

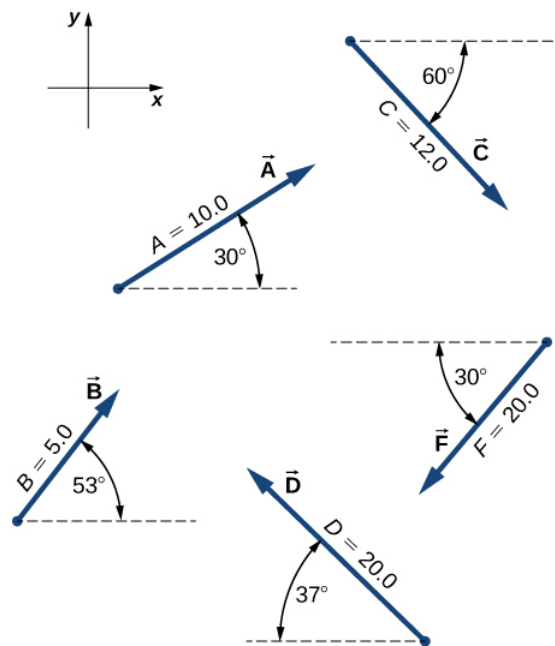
19. yes

21. a.  $C = \vec{A} \cdot \vec{B}$   
b.  $\vec{C} = \vec{A} \cdot \vec{B}$  or  $\vec{C} = \vec{A} - \vec{B}$   
c.  $\vec{C} = \vec{A} \times \vec{B}$ ,  
d.  $\vec{C} = A\vec{B}$ ,  
e.  $\vec{C} + 2\vec{A} = \vec{B}$ ,  
f.  $\vec{C} = \vec{A} \times \vec{B}$ ,  
g. left side is a scalar and right side is a vector,  
h.  $\vec{C} = 2\vec{A} \times \vec{B}$ ,  
i.  $\vec{C} = \vec{A}/B$ ,  
j.  $\vec{C} = \vec{A}/B$

23. They are orthogonal.

### Problems

25.  $\vec{h} = -49m\hat{u}, 49\text{ m}$   
27. 30.8 m,  $35.7^\circ$  west of north  
29. 134 km,  $80^\circ$   
31. 7.34 km,  $63.5^\circ$  south of east  
33. 3.8 km east, 3.2 km north, 7.0 km  
35. 14.3 km,  $65^\circ$   
37. a.  $\vec{A} = +8.66\hat{i} + 5.00\hat{j}$ ,  
b.  $\vec{B} = +3.01\hat{i} + 3.99\hat{j}$ ,  
c.  $\vec{C} = +6.00\hat{i} - 10.39\hat{j}$ ,  
d.  $\vec{D} = -15.97\hat{i} + 12.04\hat{j}$ ,  
f.  $\vec{F} = -17.32\hat{i} - 10.00\hat{j}$



39. a. 1.94 km, 7.24 km;

b. proof

41. 3.8 km east, 3.2 km north, 2.0 km,  $\vec{D} = (3.8\hat{i} + 3.2\hat{j})\text{km}$

43.  $P_1(2.165m, 1.250m)$ ,  $P_2(-1.900m, 3.290m)$ , 5.27m

45. 8.60 m,  $A(2\sqrt{5}m, 0.647\pi)$ ,  $B(3\sqrt{2}m, 0.75\pi)$

47. a.  $\vec{A} + \vec{B} = -4\hat{i} - 6\hat{j}$ ,  $|\vec{A} + \vec{B}| = 7.211$ ,  $\theta = 236.3^\circ$ ;

b.  $\vec{A} - \vec{B} = -2\hat{i} + 2\hat{j}$ ,  $|\vec{A} - \vec{B}| = 2\sqrt{2}$ ,  $\theta = 135^\circ$

49. a.  $\vec{C} = (5.0\hat{i} - 1.0\hat{j} - 3.0\hat{k})m$ ,  $C = 5.92m$ ;

b.  $\vec{D} = (4.0\hat{i} - 11.0\hat{j} + 15.0\hat{k})m$ ,  $D = 19.03m$ .

51.  $\vec{D} = (3.3\hat{i} - 6.6\hat{j})km$ ,  $\hat{i}$  is to the east, 7.34km,  $-63.5^\circ$

53. a.  $\vec{R} = -1.35\hat{i} - 22.04\hat{j}$ ,

b.  $\vec{R} = -17.98\hat{i} + 0.89\hat{j}$

55.  $\vec{D} = (200\hat{i} + 300\hat{j})yd$ ,  $D = 360.5$  yd,  $56.3^\circ$  north of east; The numerical answers would stay the same but the physical unit would be meters. The physical meaning and distances would be about the same because 1 yd is comparable with 1 m.

57.  $\vec{R} = -3\hat{i} - 16\hat{j}$

59.  $\vec{E} = E\hat{E}$ ,  $E_x = +178.9V/m$ ,  $E_y = -357.8V/m$ ,  $E_z = 0.0V/m$ ,  $\theta_E = -\tan^{-1}(2)$

61. a.  $\vec{R}_B = (12.278\hat{i} + 7.089\hat{j} + 2.500\hat{k})km$ ,  $\vec{R}_D = (-0.262\hat{i} + 3.000\hat{k})km$ ;

b.  $|\vec{R}_B - \vec{R}_D| = 14.414km$   $|R \rightarrow B - R \rightarrow D| = 14.414km$

63. a. 8.66,

b. 10.39,

c. 0.866,

d. 17.32

65.  $\theta_i = 64.12^\circ$ ,  $\theta_j = 150.79^\circ$ ,  $\theta_k = 77.39^\circ$

67. a.  $-119.98\hat{k}$

b.  $0\hat{k}$ ,

c.  $+93.69\hat{k}$ ,

d.  $-240.0\hat{k}$ ,

e.  $+3.993\hat{k}$ ,

f.  $-3.009\hat{k}$ ,

g.  $+14.99\hat{k}$ ,

h. 0

69. a. 0,

b. 173,194,

c.  $+199,993\hat{k}$

### Additional Problems

71. a. 18.4 km and 26.2 km,

b. 31.5 km and 5.56 km

73. a.  $(r, \varphi + \pi/2)$ ,

b.  $(2r, \varphi + 2\pi)$ ,

c.  $(3r, -\varphi)$

75.  $d_{PM} = 33.12\text{ nmi} = 61.34\text{ km}$ ,  $d_{NP} = 35.47\text{ nmi} = 65.69\text{ km}$

77. proof

79. a. 10.00 m,

b.  $5\pi\text{ m}$ ,

c. 0

81. 22.2 km/h,  $35.8^\circ$  south of west

83. 240.2 m,  $2.2^\circ$  south of west

85.  $\vec{B} = -4.0\hat{i} + 3.0\hat{j}$  or  $\vec{B} = 4.0\hat{i} - 3.0\hat{j}$

87. proof

### Challenge Problems

89.  $G_\perp = 2375\sqrt{17} \approx 9792$

91. proof

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