MATH-253: HW1

Due on 1/22/2024

Prof. Oleksandr Bobrovnikov (Sasha), Spring 2024, 1/22/2024

Kaleb Burris

2.1

4

a) $\overrightarrow{RP} = \langle -1-(-3), 3-7 \rangle = \underline{\langle 2, -4 \rangle}$

b) $\overrightarrow{PQ} = \underline{2\vec{i} - 4\vec{j}}$

7

a) $\overrightarrow{PQ} = \langle 2, 2 \rangle$, $\overrightarrow{PR} = -\overrightarrow{RP} = \langle -2, 4 \rangle$. Therefore:

$$\begin{aligned} 2\overrightarrow{PQ} - 2\overrightarrow{PR} &= 2 \cdot \langle 2, 2 \rangle - 2 \cdot (-2, 4) \\ &= \langle 4, 4 \rangle - (-4, 8) \\ &= \underline{\langle 8, -4 \rangle} \end{aligned}$$

b) $\underline{8\vec{i} - 4\vec{j}}$

9

$\|\overrightarrow{PQ}\| = \sqrt{2^2 + 2^2} = \sqrt{8} = 2\sqrt{2}$

a) $\underline{\langle 1, 1 \rangle}$

b) $\underline{\vec{i} + \vec{j}}$

12

$$\vec{v} = \langle 2-(-1), 1-(-3) \rangle = \langle 3, 4 \rangle$$

$$\|\langle v \rangle\| = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5$$

$$\underline{\left\langle \frac{3}{5}, \frac{4}{5} \right\rangle}$$

14

$$\vec{v} = \langle x-1, 0-1 \rangle = \langle x-1, -1 \rangle$$

$$\|\vec{v}\| = \sqrt{10} = \sqrt{(x-1)^2 + (-1)^2} = \sqrt{x^2 - 2x + 2}$$

$$10 = x^2 - 2x + 2$$

$$0 = x^2 - 2x - 8$$

$$0 = (x+2) \cdot (x-4)$$

$$x = 2, -4$$

$$x \text{ must be} -4 : \underline{Q(-2, 0)}$$

17

a)

$$\vec{a} = \langle -2, 4 \rangle \quad \vec{b} = \langle -2, 2 \rangle$$

$$-3\langle -2, 4 \rangle + \langle -2, 2 \rangle - 4i + j = \langle 6, 12 \rangle + \langle -2, 2 \rangle + \langle -4, 0 \rangle + \langle 0, 1 \rangle$$

$$= \langle 0, 15 \rangle; \quad \|\langle 0, 15 \rangle\| = \underline{15}$$

26

$$\|v\| = 3, u = \langle -2, 5 \rangle$$

$$\sqrt{(-2)^2 + 5^2} = \sqrt{29}$$

$$3\left\langle \frac{-2}{\sqrt{29}}, \frac{5}{\sqrt{29}} \right\rangle = \underline{\left\langle \frac{-6}{\sqrt{29}}, \frac{15}{\sqrt{29}} \right\rangle}$$

30

$$\vec{u} = 6\left\langle \cos\left(60^\circ\right), \sin\left(60^\circ\right) \right\rangle = \underline{\left\langle 3, 3\sqrt{3} \right\rangle}$$

32

$$\vec{u} = 8\langle -1, 0 \rangle = \underline{\langle -8, 0 \rangle}$$

38

$$\alpha = 0; \beta = 0$$

$$\alpha = 2\beta$$

$$\underline{\alpha \in \mathbb{R}; \beta = 2\alpha}$$

40

a) $$f'(x) = 4x^3; f'(1) = 4$$
$$y = 4x + 1 \Rightarrow y = 4 + 1 = 5$$
$$\underline{Q(2, 5)}$$

b) $\overrightarrow{PQ} = \langle 2 - 1, 5 - 1 \rangle = \langle 1, 4 \rangle; \|u\| = \sqrt{1^2 + 4^2} = \sqrt{17}$
$$\underline{\vec{u} = \left\langle \frac{1}{\sqrt{17}}, \frac{4}{\sqrt{17}} \right\rangle}$$

46

$$\theta = 30^\circ$$
$$\vec{v} = 100\langle \cos(30^\circ), \sin(30^\circ) \rangle = \left\langle 50, 50\sqrt{3} \right\rangle$$
$$\underline{\text{Horizontal: 50.00 mph, Vertical: 86.60 mph}}$$