2020년 1학기 수학2 1주차 손과제(공통) 학과: ____________ 학번: ____________ 성명: ____________ (총 2페이지)

제출 마감일: 2020년 4월 3일 자정까지

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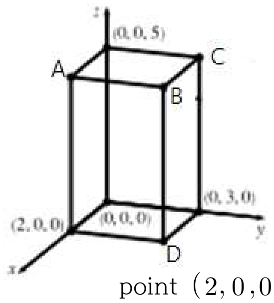
### Section 12.1 3-Dimensional Coordinates Systems

1. (a) Find the coordinates of the vertices $A$, $B$, $C$, $D$ of the rectangular box shown.




$A$ ( ___ , ___ , ___ )

$B$ ( ___ , ___ , ___ )

$C$ ( ___ , ___ , ___ )

$D$ ( ___ , ___ , ___ )

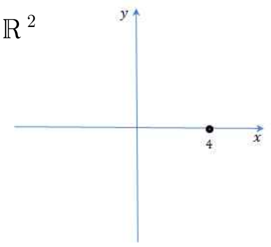
(b) The distance between the point $(2,0,0)$ and the point $C$ is ________

2. Find the distance from the point $P(-2,1,7)$ to the point $Q(1,3,-5)$.

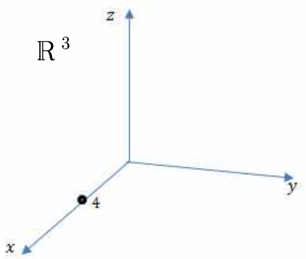
$|PQ|$ = ______________________________

3. What does the equation $x=4$ represent in $\mathbb{R}^2$? What does the equation $x=4$ represent in $\mathbb{R}^3$? Illustrate with sketches.

$\mathbb{R}^2$




$\mathbb{R}^3$




4. Find an equation of the sphere with center $(1,4,-3)$ and radius 5.(식을 정리하지 않아도 됨)

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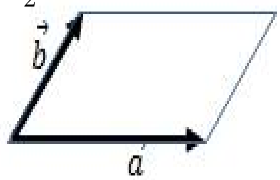
### Section 12.2 Vectors

1. Draw the following vectors in the parallelogram shown.

1) $\vec{a}+\vec{b}$ 2) $\vec{a}-\vec{b}$ 3) $\frac{1}{2}\vec{a}$ 4) $-2\vec{a}$




2. If two points are given $A(0, 3, 1)$ and $B(2, 3, -1)$, then $\overrightarrow{AB} = \langle$ ___ , ___ , ___ $\rangle$.

3. Find the vector $\vec{v}$ that has the same direction $\vec{a} = \langle 8, 1, -4 \rangle$, but has length 4.

4. Let $\vec{a} = 4\mathrm{i} - 3\mathrm{j} + 2\mathrm{k}$ and $\vec{b} = 2\mathrm{i} - 4\mathrm{k}$.

Then, $\vec{a} = \langle$ ___ , ___ , ___ $\rangle$ and

$\vec{b} = \langle$ ___ , ___ , ___ $\rangle$.

Find the following:

1) $\vec{a}+\vec{b} = \langle$ ___ , ___ , ___ $\rangle$

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

3) $|\vec{a}|$ = _____ 4) $|\vec{a}-\vec{b}|$ = ________

5) The unit vector $\vec{u}$ that has the same direction as the vector $\vec{a}$ is $\vec{u}$ = ______________________.

### Section 12.3 Dot Product

1. Let $\vec{a} = \langle 4, 3, -2 \rangle$, $\vec{b} = \langle 2, -1, 1 \rangle$. Then

1) $\vec{a} \cdot \vec{b}$ = ____________

2) Find the angle $\theta$ between the vectors $\vec{a}$ and $\vec{b}$ .

2. Find the values of $x$ such that the angle between the vectors $\langle 2, 1, -1 \rangle$ and $\langle 1, x, 0 \rangle$ is $45^\circ$.

3. Let $\vec{a} = \langle -1, 4, 8 \rangle$, $\vec{b} = \langle 12, 1, 2 \rangle$. Then

(a) the <u>scalar projection</u> of $\vec{b}$ onto $\vec{a}$ is

$\mathrm{comp}_{\vec{a}}\vec{b}$ = ______________

(b) the <u>vector projection</u> of $\vec{b}$ onto $\vec{a}$ is

$\mathrm{proj}_{\vec{a}}\vec{b}$ = ______________

4. Find the **work** done by a force $\vec{F} = \langle 8, -6, 9 \rangle$ that an object from the point $P(0, 10, 8)$ to the point $Q(6, 12, 20)$ along a straight line.

5. Find the acute angle between the lines $x+2y=7$ and $5x-y=7$.

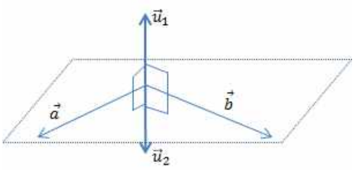
## Section 12.4 Cross Product

1. Let $\vec{a} = \langle 4, 3, -2 \rangle$, $\vec{b} = \langle 2, -1, 1 \rangle$.

(a) $\vec{a} \times \vec{b} =$ ______________________

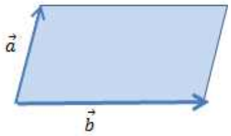
(b) $\vec{b} \times \vec{a} =$ ______________________

(c) Find two **unit** vectors $\vec{u}_1$ and $\vec{u}_2$ that are perpendicular(orthogonal) to both of $\vec{a}$ and $\vec{b}$.




2. Let $\vec{a} = \langle -1, 2, 1 \rangle$, $\vec{b} = \langle 3, 1, -1 \rangle$ and $\vec{c} = \langle 4, -3, 2 \rangle$.

(1) Find the **area** of a parallelogram with $\vec{a}$ and $\vec{b}$ as adjacent sides.




(2) Find the **volume** of the parallelepiped determined by the vectors $\vec{a}$, $\vec{b}$, and $\vec{c}$.

3. Determine whether the given vectors are **orthogonal**, **parallel**, or **neither**.

(a) $\vec{a} = \langle 9, 3 \rangle$, $\vec{b} = \langle -2, 6 \rangle$ (__________)

(b) $\vec{a} = \langle -5, 4, -2 \rangle$, $\vec{b} = \langle 3, 4, -1 \rangle$ (__________)

(c) $\vec{a} = \langle 9, -6, 3 \rangle$, $\vec{b} = \langle -6, 4, -2 \rangle$ (__________)

(d) $\vec{a} = \langle c, c, c \rangle$, $\vec{b} = \langle c, 0, -c \rangle$ (__________)

4. Suppose that $|\vec{u}| = 7$ and $|\vec{v}| = 10$ and the angle between $\vec{u}$ and $\vec{v}$ is $150^\circ$.

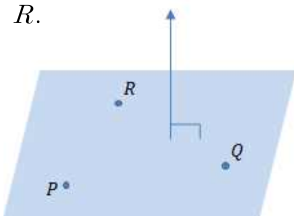

Then,

(a) $\vec{u} \cdot \vec{v} =$ ______________________________

(b) $|\vec{u} \times \vec{v}| =$ ______________________________

5. Let $P(1, 0, 1)$, $Q(-2, 1, 3)$, $R(4, 2, 5)$ be the points.

(a) Find a nonzero vector orthogonal to the plane through the points $P$, $Q$, and $R$.

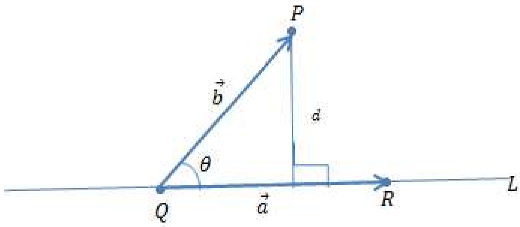



(b) Find the area of triangle with $PQR$ as vertices.

연습문제 45번. (a) Let $P$ be a point not on the line $L$ that passes through the points $Q$ and $R$. Show that the distance $d$ from the point $P$ to the line $L$ is

$$d = \frac{|\vec{a} \times \vec{b}|}{|\vec{a}|}$$

where $\vec{a} = \overrightarrow{QR}$ and $\vec{b} = \overrightarrow{QP}$.




**Solution**. If $\theta$ is angle between $\vec{a}$ and $\vec{b}$, then

$$\begin{aligned} d &= |\vec{b}| \sin\theta, \qquad 0 \leq \theta \leq \pi \\ &= |\vec{b}| \frac{|\vec{a} \times \vec{b}|}{|\vec{a}||\vec{b}|} \\ &= \frac{|\vec{a} \times \vec{b}|}{|\vec{a}|}. \end{aligned}$$

(b) Use the formula in part (a) to find the distance from the point $P(1, 1, 1)$ to the line through the points $Q(-2, 1, 3)$ and $R(4, 2, 5)$.