GSE Precalculus Practice Worksheet

Dot Product

1. Compute **u•v**

a. **u** = <2,3> and **v** = <0,5>

$(2\cdot0)+(3\cdot5)$
$0+15$
15

b. **u** = <3,0> and **v** = <0,-2>

$(3\cdot0)+(0\cdot-2)$
$0+0$
0

c. **u** = <-2,1> and **v** = <2,4>

$(-2\cdot2)+(1\cdot4)$
$-4+4$
0

d. **u** = 2i – 5j and **v** = -4i + 10j

$(2\cdot-4)+(-5\cdot10)$
$-8+-50$
-58

2. Which of the vectors in #1 are orthogonal? Which of them are parallel?

Use the vectors **u** = $\mathbf{u}=\langle 1,-2\rangle$, $\mathbf{v}=\langle -9,-1\rangle$ and $\mathbf{w}=\langle 3,4\rangle$ to find the indicated quantity. Show all work.

3. $(\mathbf{u}\bullet\mathbf{v})\mathbf{v}$ $\langle 63,7\rangle$

$(1\cdot-9)+(-2\cdot-1)$ $\langle -9,-1\rangle$
$(-9+2)$ $\langle -9,-1\rangle$
$-7\langle -9,-1\rangle$

4. $4\mathbf{u}\bullet\mathbf{v}$ -28

$4\mathbf{u}$
$\langle 4,-8\rangle\cdot\langle -9,-1\rangle$
$(4\cdot-9)+(-8\cdot-1)$
$-36+8$
-28

5. $-3\mathbf{w}\bullet\mathbf{v}$ 93

$\langle -9,-12\rangle\cdot\langle -9,-1\rangle$
$(-9\cdot-9)+(-12\cdot-1)$
$81+12$
93

6. $(\mathbf{v}\bullet\mathbf{u})-(\mathbf{w}\bullet\mathbf{v})$ 24

$(1\cdot-9)+(-2\cdot-1)$ $(3\cdot-9)+(4\cdot-1)$
$-9+2$ $-27+-4$
$-7 \quad - \quad -31$
24

7. $-3(\mathbf{w}\bullet\mathbf{v})$ 93 93

$-3[(-9\cdot3)+(-1\cdot4)]$
$-3(-27+-4)$ → $-3(-31)$

8. $\mathbf{u}(\mathbf{v}\bullet\mathbf{v})$ $\langle 82,-164\rangle$

$\langle 1,-2\rangle[(-9\cdot-9)+(-1\cdot-1)]$
$\langle 1,-2\rangle[81+1]$
$\langle 1,-2\rangle(82)$

Find the angle between the vectors **u** and **v**

9. $\mathbf{u}=\langle 1,4\rangle$ and $\mathbf{v}=\langle 5,-3\rangle$

$\cos^{-1}\left(\frac{(1\cdot5)+(4\cdot-3)}{\sqrt{1^2+4^2}\sqrt{5^2+3^2}}\right)$
$\cos^{-1}\left(\frac{-7}{\sqrt{17}\sqrt{34}}\right)\approx 106.9^\circ$

10. $u=-8i+j$ and $v=2i+6j$

$\cos^{-1}\left(\frac{(-8\cdot2)+(1\cdot6)}{\sqrt{8^2+1^2}\sqrt{2^2+6^2}}\right)$
$\cos^{-1}\left(\frac{-10}{\sqrt{65}\sqrt{40}}\right)\approx 101.3^\circ$

GSE Precalculus Practice Worksheet

Dot Product

Determine whether the following vectors are orthogonal, parallel, or neither.

1. $u = \langle -12, 30 \rangle$ and $v = \langle 8, -20 \rangle$

NOT ORTHOGONAL
PARALLEL

$u \cdot v = (-12 \cdot 8) + (30 \cdot -20)$

$-96 + -600$

-696

$\sqrt{12^2+30^2} \cdot \sqrt{8^2+20^2}$

$\rightarrow 696$ ✓

2. $u = \langle 2, -3 \rangle$ and $v = \langle 6, 4 \rangle$

$u \cdot v = (2 \cdot 6) + (-3 \cdot 4)$

$12 + -12$

0 ORTHOGONAL

3. $u = \langle -2, 1 \rangle$ and $v = \langle 2, 4 \rangle$

$u \cdot v = (-2 \cdot 2) + (1 \cdot 4)$

$-4 + 4$

0 ORTHOGONAL

4. $u = 2i - 5j$ and $v = 4i + 7j$

$u \cdot v = (2 \cdot 4) + (-5 \cdot 7)$

$8 + -35$

-27 NOT ORTHOGONAL

NEITHER

$\sqrt{2^2+5^2} \sqrt{4^2+7^2}$ NOT PARALLEL

$\sqrt{29} \sqrt{65} \neq 27$

Find the work done using the formula *work* = *force* • *displacement*

5. A constant force $F = \langle 2, 5 \rangle$ moves an object along the vector $\langle -1, 5 \rangle$. Find the work done during this process.

$(2 \cdot -1) + (5 \cdot 5)$

$-2 + 25$

23 joules

6. Find the work done by the force $F = -2i + 3j$ in moving an object from the point (1,4) to the point (3,-5)

$\langle -2, 3 \rangle \cdot \langle 2, -9 \rangle$

$(-2 \cdot 2) + (3 \cdot -9)$

$-4 + -27$

-31 joules

$i \quad +.$

$\langle 3-1, -5-4 \rangle$

$\langle 2, -9 \rangle$

7. A 36 N force acting at 36° moves a box 20 m horizontally. Find the work done.

$\langle 36 \cos 36^\circ, 36 \sin 36^\circ \rangle$

$\langle 29.1, 21.2 \rangle \cdot \langle 20, 0 \rangle$

$(29.1 \cdot 20) + (21.2 \cdot 0)$

$582 + 0$

582 joules

8. Bob is carrying a pack of books from the table to the shelf with a force of 35 pounds at a 28° angle. If the distance from the table to the shelf is 20 feet horizontally. How much work has Bob done when he carries these books?

$\langle 35 \cos 28^\circ, 35 \sin 28^\circ \rangle$

$\langle 30.9, 16.4 \rangle \cdot \langle 20, 0 \rangle$

$(30.9 \cdot 20) + (16.4 \cdot 0)$

$618 + 0$

618 joules

9. How much work is done by a force $F = \langle 9, 7 \rangle$ in moving an object from (-1, 6) to (2, 9)?

$\langle 9, 7 \rangle \cdot \langle 3, 3 \rangle$

$(9 \cdot 3) + (7 \cdot 3)$

$27 + 21$

48 joules

$\langle 2 - -1, 9 - 6 \rangle$

$\langle 3, 3 \rangle$

10. A 50 N force acting at 260° moves an object 14 m at 215°. Find the work done.

$\langle 50 \cos 260^\circ, 50 \sin 260^\circ \rangle$ $\langle 14 \cos 215^\circ, 14 \sin 215^\circ \rangle$

$\langle -8.7, -49.2 \rangle \cdot \langle -11.5, -8.0 \rangle$

$(-8.7 \cdot -11.5) + (-49.2 \cdot -8.0)$

$100.05 + 393.6$

493.65 joules