1) Given that $\vec{u} = \langle 2,1,-2 \rangle$ and $\vec{v} = \mathbf{i} - 3\mathbf{j} + 2\mathbf{k}$ find the following:

a) $\vec{u} \cdot \vec{v}$ $\boxed{-5}$

b) $\vec{u} \cdot \vec{u}$ $\boxed{9}$

c) $\|\vec{u}\|^2$ $\boxed{9}$

d) $(\vec{u} \cdot \vec{v})\vec{v}$ $\boxed{\langle -5,15,-10 \rangle}$

e) $\vec{u} \cdot (2\vec{v})$ $\boxed{-10}$

2) Given that $\|\vec{u}\| = 8$, $\|\vec{v}\| = 5$, and the angle between $\vec{u}$ and $\vec{v}$ is $\frac{\pi}{3}$. Find $\vec{u} \cdot \vec{v}$.

$\boxed{20}$

3) A street vendor sells a apples, b oranges, and c mangos, on a given day. He charges \$2 for apples, \$1.50 for oranges, and \$1 for mangos. If $\vec{v} = \langle a,b,c \rangle$ and $\vec{p} = \langle 2,1.5,1 \rangle$, what is the meaning of the dot product $\vec{v} \cdot \vec{p}$?

$\boxed{\textit{Total}\ \text{Revenue}}$

4) Find the angle θ between the vectors:

a) $\vec{u} = \cos\left(\frac{\pi}{6}\right)\mathbf{i} + \sin\left(\frac{\pi}{6}\right)\mathbf{j}$ and $\vec{v} = \cos\left(\frac{3\pi}{4}\right)\mathbf{i} + \sin\left(\frac{3\pi}{4}\right)\mathbf{j}$

b) $\vec{u} = \langle 1,1,1 \rangle$ and $\vec{v} = 2\mathbf{i} + \mathbf{j} + -\mathbf{k}$

a) $\boxed{105°}$

b) $\boxed{\approx 61.9°}$

5) Determine whether $\vec{u}$ and $\vec{v}$ are orthogonal, parallel, or neither.

a) $\vec{u} = \mathbf{j} + 6\mathbf{k}$ and $\vec{v} = \mathbf{i} - 2\mathbf{j} - \mathbf{k}$

b) $\vec{u} = \langle 2, -3, 1 \rangle$ and $\vec{v} = \langle -1, -1, -1 \rangle$

c) $\vec{u} = \langle \cos\theta, \sin\theta, -1 \rangle$ and $\vec{v} = \langle \sin\theta, -\cos\theta, 0 \rangle$

a) $\boxed{Neither}$

b) $\boxed{Orthogonal}$

c) $\boxed{Orthogonal}$

6) For what values of b are the vectors $\langle -6, b, 2 \rangle$ and $\langle b, b^2, b \rangle$ orthogonal?

$$\boxed{b = 0 \text{ or } b = \pm 2}$$

7) The vertices of a triangle are $(2, -7, 3)$, $(-1, 5, 8)$, and $(4, 6, -1)$. Determine whether the triangle is an acute triangle, an obtuse triangle, or a right triangle. Explain your reasoning.

$$\boxed{Acute}$$

8) Find the direction cosines of $\vec{u}$ and demonstrate that the sum of the squares of the direction cosines is equal to 1

a) $\vec{u} = \mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$

b) $\vec{u} = \langle a, b, c \rangle$

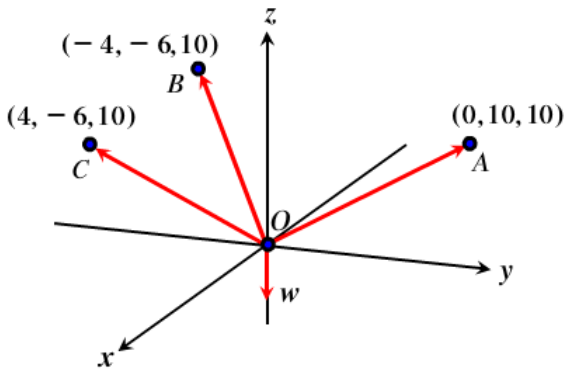
a) $\boxed{\cos\alpha = \frac{1}{3}, \ \cos\beta = \frac{2}{3}, \ \cos\gamma = \frac{2}{3}}$

b) $\boxed{\cos\alpha = \frac{a}{\sqrt{a^2 + b^2 + c^2}}, \ \cos\beta = \frac{b}{\sqrt{a^2 + b^2 + c^2}}, \ \cos\gamma = \frac{c}{\sqrt{a^2 + b^2 + c^2}}}$

9) Find the direction angles of $\vec{u} = \langle -2, 6, 1 \rangle$.

$$\boxed{\alpha = 108.2°, \quad \beta = 20.4°, \quad \gamma = 81.0°}$$

10) A load is supported by three cables, as shown in the figure below. The tension in the cable OA is 200 Newtons. Determine the weight of the load w.



$$\boxed{\frac{800\sqrt{2}}{3}\ N}$$

11) Given that $\vec{u} = \langle 8, 2, 0 \rangle$ and $\vec{v} = \langle 2, 1, -1 \rangle$ find the following:

a) The projection of $\vec{u}$ onto $\vec{v}$.

b) Find the vector component of $\vec{u}$ orthogonal to $\vec{v}$.

a) $\boxed{\langle 6, 3, -3 \rangle}$

b) $\boxed{\langle 2, -1, 3 \rangle}$

12) An object is pulled 10 feet across a floor, using a force of 85 pounds. The direction of the force is $60°$ above the horizontal. Find the work done.

$$\boxed{425\ ft \cdot lb}$$

13) Find the work done by a force $\vec{F} = 10\mathbf{i} + 18\mathbf{j} - 6\mathbf{k}$ that moves an object from the point $(2,3,0)$ to the point $(4,9,15)$ along a straight line. The distance in measured in meters and the force in newtons.

$$\boxed{38\,m \cdot N}$$

14) Find the angle between a cube's diagonal and one of its edges.

$$\boxed{\approx 54.7°}$$

15) Find the angle between the diagonal of a cube and the diagonal of one of its sides.

$$\boxed{\approx 35.26°}$$

16) Given the functions $f(x) = x^2$ and $g(x) = x^{1/3}$ find the following:

a) All the points of intersection of the two functions.
b) The unit tangent vectors to each curve at their points of intersection.
c) The acute angles between the curves at their points of intersection.

a) $\boxed{(0,0)\ and\ (1,1)}$

b) $$\boxed{\begin{array}{l} at\,(0,0) : \pm\langle 1,0\rangle\, is\ \text{tangent}\ to\ f(x)\ and \pm\langle 0,1\rangle\, is\ \text{tangent}\ to\ g(x). \\ at\,(1,1) : \pm\dfrac{1}{\sqrt{5}}\langle 1,2\rangle\, is\ \text{tangent}\ to\ f(x)\ and \pm\dfrac{1}{\sqrt{10}}\langle 3,1\rangle\, is\ \text{tangent}\ to\ g(x). \end{array}}$$

c) $$\boxed{\begin{array}{l} at\,(0,0) : 90° \\ at\,(1,1) : 45° \end{array}}$$