

Exercises in Physics  
Assignment 1

Tian Xiaoyang  
26001904581

Q1.

$$v = (1,1), w = (1,5)$$

dot product for 2 perpendicular vector is zero

$$(w - cv) \cdot v = 0$$

$$(w - cv) = (1,5) - (c, c) = (1 - c, 5 - c)$$

$$(1 - c, 5 - c) \cdot (1,1) = (1 - c) \cdot 1 + (5 - c) \cdot 1 = 0$$

$$1 - c + 5 - c = 0$$

$$1 + 5 = 2c$$

$$3 = c$$

Q2.

$$v = (1,0,-1)$$

$$\hat{i} = (1,0,0), \hat{j} = (0,1,0), \hat{k} = (0,0,1)$$

$$\cos\alpha = \frac{a \cdot b}{\sqrt{a \cdot a} \sqrt{b \cdot b}} = \frac{v \cdot \hat{i}}{\sqrt{v \cdot v} \sqrt{\hat{i} \cdot \hat{i}}} = \frac{1}{\sqrt{2} + \sqrt{1}} = 1 + \sqrt{2}$$

$$\cos\beta = \frac{v \cdot \hat{j}}{\sqrt{v \cdot v} \sqrt{\hat{j} \cdot \hat{j}}} = \frac{0}{\sqrt{2} + \sqrt{1}} = 0$$

$$\cos\gamma = \frac{v \cdot \hat{k}}{\sqrt{v \cdot v} \sqrt{\hat{k} \cdot \hat{k}}} = \frac{-1}{\sqrt{2} + \sqrt{1}} = 1 - \sqrt{2}$$

Q3.

Unit vectors: a, b, c

$$a + b + c = 0$$

$$a \cdot b + b \cdot c + c \cdot a$$

$$a \cdot (b + c) + b \cdot (a + c) + c \cdot (a + b) = a \cdot b + a \cdot c + a \cdot b + b \cdot c + a \cdot c + b \cdot c$$

Q4.

(a)

$$a = i - j + k, b = -i + j - k$$

$$a \cdot b = (1 \times -1) + (-1 \times 1) + (1 \times -1) = -i - j - k$$

(b)

$$a = 6i + j, b = 3i - 2j$$

$$a \cdot b = (6 \times 3) + (1 \times -2) = 18i - 2j$$

(c)

$$a = i + j + k, b = j$$

$$a \cdot b = (1 \times 0) + (1 \times 1) + (1 \times 0) = j$$

Q5.