

PHY 107: Fall 2018

HW 1

Due dates

SECTION 1 and SECTION 2 : Oct 23, 2018

SECTION 3 and SECTION 4 : Oct 24, 2018

NOTE This is HW 1 based on the materials from **Measurement** and **Vector/Scalar**. Please, read each question carefully and answer. You must show all of your working to get full credit. Students can discuss with other students, but each student must submit his/her own work.

Q1

List any 5 base quantities and their units. [10]

What is a derived quantity? Give three examples. [2+3]

What is the prefix for the factor 10^{-12} ? [1]

Write the following in scientific notation

a. 45000000 [1]

b. 0.0000311 [1]

Define density. What is the density of water in $\frac{kg}{m^3}$? [1+1]

Q2

(1) A rectangular building lot is 100 ft by 150 ft. What is the area of the lot in m^2 ? [2]

(2) The tropical year, the time from vernal equinox to the next vernal equinox, is the basis for our calendar. It contains 365.242199 days. Find the number of seconds in a tropical year. [2]

(3) A particle has acceleration (a) while moving with uniform speed v in a circle of radius r. Start with $a \propto r^n v^m$. Derive the relationship between a, r and v using dimensional analysis. [4]

(4) Explain accuracy and precision. A student measured the mass of a wooden block several times and got the following values: **2.150 kg, 2.160 kg, 2.145 kg, 2.152 kg, 2.156 kg**. But the true mass of the block is 2.85 kg. Comment on the situation in terms of accuracy and the precision of the measurements. [2]

Q3

Two 3D vectors are given

$$\vec{a} = 4\hat{i} - 3\hat{j} + 1\hat{k}$$

$$\vec{b} = -1\hat{i} + 1\hat{j} + 4\hat{k}$$

Find

(a) $\vec{a} + \vec{b}$ [1]

(b) $\vec{a} - \vec{b}$ [1]

(c) $\vec{k} \cdot \vec{k} - 2\vec{a} + 3\vec{b} = 0$ [3]

(d) $\vec{a} \cdot \vec{b}$ [2]

(e) $\vec{a} \times \vec{b}$ [3]

Q4

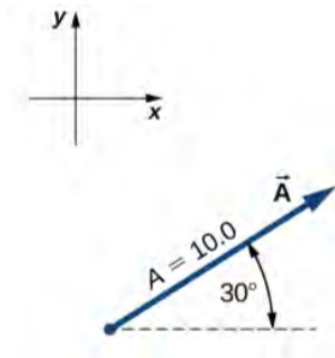
There are two vectors \vec{X} and \vec{Y} . What is the angle between the two vectors if $|\vec{X}| = |\vec{Y}| = 5$ units and $\vec{X} + \vec{Y} = 5\sqrt{2}\hat{j}$? [5]

Q5

(i) Given: $\vec{a} = -\hat{i} - 4\hat{j}$ and $\vec{b} = -3\hat{i} - 2\hat{j}$

Compute the magnitude and direction angle of $\vec{a} + \vec{b}$. [2+2]

(ii) Find the x and y component of \vec{A} shown below [2+2]

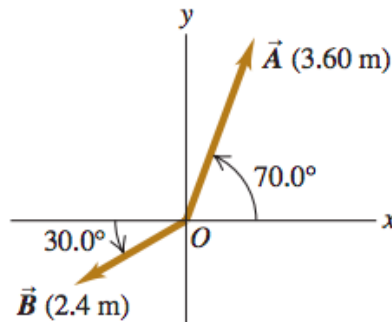


Q6

(i) Given: $\vec{a} = 5\hat{i} - 6.5\hat{j}$ and $\vec{b} = -3.5\hat{i} + 7\hat{j}$

If $\vec{c} \perp \vec{a}$ and $\vec{c} \cdot \vec{b} = 15$, what are the components of \vec{c} ? [5]

Q7



(1) Write the vector \vec{A} and \vec{B} in terms of unit vectors \hat{i} and \hat{j} . [2]

(2) Express \vec{C} , where $\vec{C} = 3\vec{A} - 4\vec{B}$ [2]

(3) What is the magnitude and direction of \vec{C} ? [3]