PHY 107

HW 1

Due dates

SECTION 4 and SECTION 5 : June 26, 2018
SECTION 6 and SECTION 7 : June 27, 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. Total points for this HW is 80. Score of 60 would mean that he/she will contribute $\frac{60}{80}(5) = 3.75$ towards his/her HW 1.

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

Define vector quantity. Give two examples. [1+2]
Define scalar quantity. Give two examples. [1+2]
Discuss the commutative and associative laws for vector addition. [4]

Q4

Two 3D vectors are given
$\overrightarrow{a} = 4\hat{i} - 3\hat{j} + 1\hat{k}$
$\overrightarrow{b} = -1\hat{i} + 1\hat{j} + 4\hat{k}$
Find
(a) $\overrightarrow{a} + \overrightarrow{b}$ [1]
(b) $\overrightarrow{a} - \overrightarrow{b}$ [1]
(c) $\overrightarrow{k}\ if\ \overrightarrow{k} - 2\overrightarrow{a} + 3\overrightarrow{b} = 0$ [3]
(d) $\overrightarrow{a}.\overrightarrow{b}$ [2]
(e) $\overrightarrow{a}\ X\ \overrightarrow{b}$ [3]

Q5

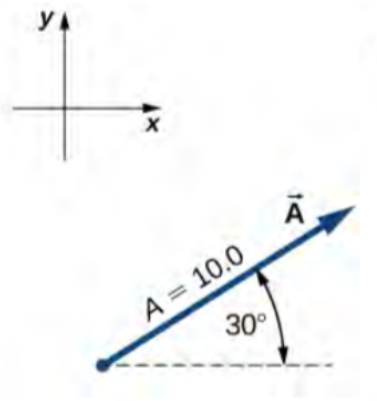
Let's say you have two displacements, one of magnitude 3m and another of magnitude 4m. Show how these two vectors can be combined to give a resultant displacement of magnitude
(a) 7m [1]
(b) 1m [1]
(c) 5m [3]

Q6

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

Q7

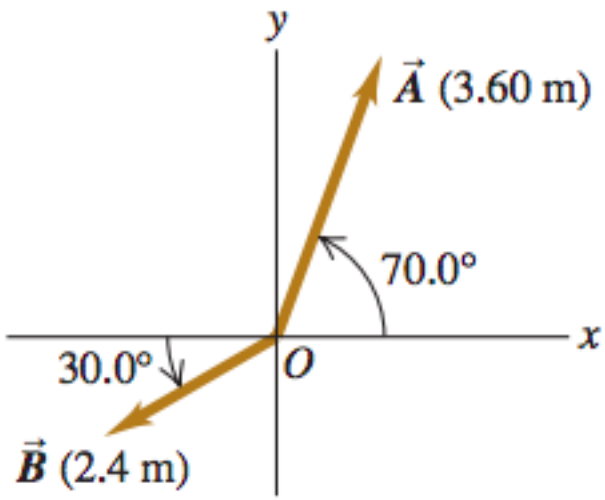
(i) Given: $\overrightarrow{a} = -\hat{i} - 4\hat{j}$ and $\overrightarrow{b} = -3\hat{i} - 2\hat{j}$
Compute the magnitude and direction angle of $\overrightarrow{a} + \overrightarrow{b}$. [2+2]
(ii) Find the x and y component of $\overrightarrow{A}$ shown below [2+2]



Q8

(i) Given: $\overrightarrow{a} = 5\hat{i} - 6.5\hat{j}$ and $\overrightarrow{b} = -3.5\hat{i} + 7\hat{j}$
If $\overrightarrow{c} \perp \overrightarrow{a}$ and $\overrightarrow{c}.\overrightarrow{b} = 15$, what are the components of $\overrightarrow{c}$? [5]

Q9



(1) Write the vector $\overrightarrow{A}$ and $\overrightarrow{B}$ in terms of unit vectors $\hat{i}$ and $\hat{j}$. [2]
(2) Express $\overrightarrow{C}$, where $\overrightarrow{C} = 3\overrightarrow{A} - 4\overrightarrow{B}$ [2]
(3) What is the magnitude and direction of $\overrightarrow{C}$? [3]