PHY 2048 Exam 1 .Spring 2016.

Name Answers VID_____

Write your final answer(s) in the space provided. You must show ALL of your work to recieve full credit.

1) A person on a diet loses 0.860 kg in a week. How many micrograms/second (μg/s) are lost? ($1\mu g = 10^{-6} g$) Express your answer in scientific notation with the correct number of signifiacant digits.

1.42*10^3 µg/s

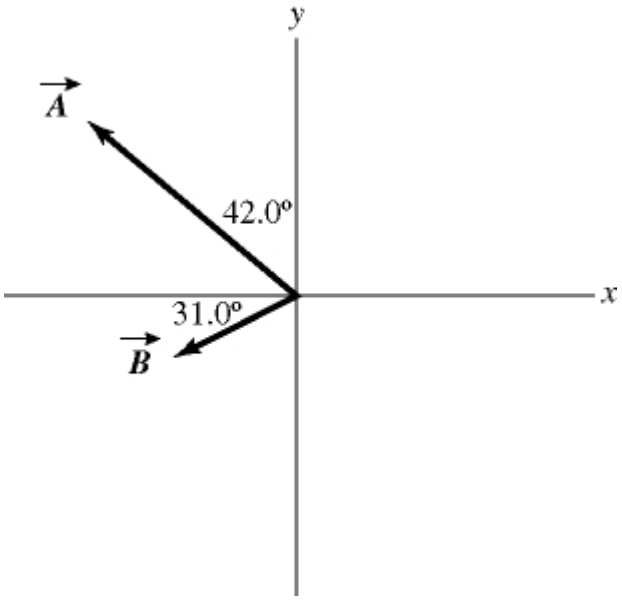
2) Vectors $\vec{A}$ and $\vec{B}$ are shown in the figure. Vector $\vec{C}$ is given by $\vec{C} = \vec{B} + \vec{A}$. The magnitude of vector $\vec{A}$ is 16.0 units, and the magnitude of vector $\vec{B}$ is 7.00 units.

(a) What is the ***magnitude*** of vector $\vec{C}$?

(b) What is the ***angle*** of vector $\vec{C}$ measured counterclockwise from the +x axis?

(c) What is the *magnitude* and *direction* of $\vec{R} = \vec{B} \times \vec{A}$?

(The angle of $\vec{A}$ is measured from the +y -axis and the angle of $\vec{B}$ is measured from the -x -axis)



Find components of A and B and add like components giving Cx = -16.71 and Cy = 8.28. Use Pythagorean Thm. to get (a) |C| = 18.65
(b) angle = arctan(Cy/Cx) but since its in the 2nd quadrant we must subtract this from 180º giving 153.6º
(c) |R| = |A|*|B|*sinθ where θ is the smallest angle between A and B: θ = 79º
|R| = 109.9 units^2 and points out of the page

3) Use the scalar product to determine the angle between the vector $\vec{A} = +3\hat{i} - 2\hat{j} - 3\hat{k}$ and the $\vec{B} = +1\hat{j}$?

Using 2 definitions of scalar product: |A|*|B|*cosθ = AxBx + AyBy + AzBz, solve for cosθ and take arccos of answer to get θ:

|A| = 4.69 |B| = 1, AxBx+AyBy+AzBz = -2 so cosθ = -2/(4.69) and θ = 115.2º

4) The velocity vector of a particle in a particle accelerator as a function of time is given by $\vec{v}(t) = (3.7\text{m/s}^3(t^2) + 1.4\text{m/s})\,\hat{i} + 7.8\text{m/s}\,\hat{j}$. The the initial position to be $\vec{r}(t=0) = 2.0\text{m}\,\hat{i} + 3.0\text{m}\,\hat{j}$.

(a) Determine the *vector* position of the particle at t=2.0 s.

(b) Determine the *magnitude* of the velocity vector $|\vec{v}|$ at t = 2.0s.

(c) Determine the *magnitude* of the acceleration vector $|\vec{a}|$ at t = 2.0s.

(a) integrate x and y components of velocity vector with respect to t and add x0 and y0 respectively to get x(t = 2.0s) = 14.7m and y(t = 2.0s) = 18.6 m

(b) plug in t = 2s and use pythagorean thm. to get |v| = 18 m/s

(c) take derivative w/ respect to t and use pythagorean thm. Note there is only an x-component so the mag. is this: ax = 14.8m/s^2

5) A dragster starts from rest and travels 402 m in 6.70 s with constant acceleration. What is its velocity when it crosses the finish line?

Use kinematic eq. number (4) to get vf: vf = 120m/s

6) A child throws a ball with an initial speed of 8.00 m/s at an angle of 40.0° above the horizontal. The ball leaves her hand 1.00 m above the ground and experience negligible air resistance.
   (a) How long does it take for the ball to hit the ground?
   (b) How far from the child's feet does the ball land?

x and y components of v0 are v0x = 6.13 m/s and v0y = 5.14 m/s
(a) use y-motion and kinematic eq. (1) to solve for t using quadratic formula: t = 1.22s
(b) since ax = 0 vf = v0 = 6.13m/s and Δx = v*t = 7.45 m

7) An electron moves with a constant horizontal velocity of 3.0×10^6 m/s and no initial vertical velocity as it enters a deflector inside a TV tube. The electron strikes the screen after traveling 0.170 m horizontally and 0.400 m vertically upward with no horizontal acceleration. What is the constant vertical acceleration provided by the deflector? (The effects of gravity can be ignored.)

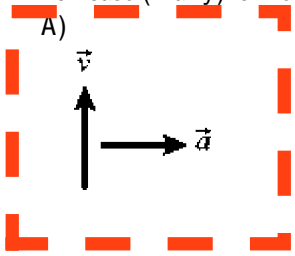
the time it takes to travel the horizontal distance of 0.170m is Δx/v = 5.66*10^-8s. using kinematic eq. (1) a = 2.50*10^10 m/s^2 Wow! (that's accurate)

8) A plane has an eastward heading at a speed of 156 m/s (relative to the air). A 20.0 m/s wind is blowing southward while the plane is flying. What is the velocity of the plane relative to the ground?

Add the two vectors and take magnitude: 157.3 m/s

12) Shown below are the velocity and acceleration vectors for a person in several different types of motion. In which case (if any) is the person moving in a circular arc? If none, write "NONE"

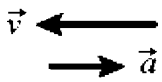
A)



B)

C)

D)



Formulae.

Trigonometry

(1) $\cos(\theta) = \frac{adj}{hyp}, \sin(\theta) = \frac{opp}{hyp}, \tan(\theta) = \frac{opp}{adj}$

(2) $hyp^2 = adj^2 + opp^2$

Quadratic Formula:

$$Ax^2 + Bx + C = 0 \Rightarrow x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$$

Displacement, Velocity, Acceleration:

(1) $\Delta\vec{r} = \vec{r}_f - \vec{r}_0$

(2) $\vec{v}_{avg} = \frac{\Delta\vec{r}}{\Delta t}$

(3) $\vec{a}_{avg} = \frac{\Delta\vec{v}}{\Delta t}$

Kinematic Equations for constant acceleration:

(1) $x_f = x_0 + v_0 t + \frac{1}{2}at^2$

(2) $v_f = v_0 + at$

(3) $v_f^2 = v_0^2 + 2a(x_f - x_0)$

(4) $x_f - x_0 = \frac{1}{2}(v_f + v_0)t$

Newton's Laws:

(1) $\vec{F}_{net} = 0 \Rightarrow \vec{a} = 0$

(2) $\vec{F}_{net} = m\vec{a}$

(3) $\vec{F}_{AB} = -\vec{F}_{BA}$

Vector Products

(1) $\vec{A} \cdot \vec{B} = \left|\vec{A}\right|\left|\vec{B}\right|\cos\phi_{AB} = A_x B_x + A_y B_y + A_z B_z$

(2) $\left|\vec{A} \times \vec{B}\right| = \left|\vec{A}\right|\left|\vec{B}\right|\sin\phi_{AB}$

(3) $\vec{A} \times \vec{B} = \det\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$

(4) $\vec{v}_{inst} = \frac{d\vec{r}}{dt}$

(5) $\vec{a}_{inst} = \frac{d\vec{v}}{dt}$

(6) $\left|\vec{a}_{circular}\right| = \frac{v^2}{r}$

13)