1. Consider vectors $\mathbf{A}$ and $\mathbf{B}$ in the sketch.

A. Sketch the sum $\mathbf{S} = \mathbf{A} + \mathbf{B}$ and the difference $\mathbf{D} = \mathbf{A} - \mathbf{B}$.

B. What are the $x$ and $y$ components of $\mathbf{S}$?

C. Rank the magnitudes of the vectors $|\mathbf{A}|$, $|\mathbf{B}|$, $|\mathbf{D}|$, $|\mathbf{S}|$ (use $>$, $<$, $=$). Justify your answer.

D. What is the dot product $\mathbf{A} \cdot \mathbf{B}$?

E. What is the cross product $\mathbf{A} \times \mathbf{B}$? In which direction does it point?
2. Consider a point particle at rest at the origin with mass $m = 9 \times 10^{-31}$ kg. A force $\vec{F} = 1.8 \times 10^{-15} N \hat{x}$ acts on the particle from time $0 \leq t < 10^{-9}$ sec. There is no force on the particle for $t < 0$ sec or $t \geq 10^{-9}$ sec. (This is similar to an electron in the electric field across a light socket).

A. What are the acceleration vector $\mathbf{a}$, velocity vector $\mathbf{v}$ and displacement vector $\mathbf{x}$ at times:

i) $t_1 = -0.5$ nsec

ii) $t_2 = +0.5$ nsec

iii) $t_3 = +1.0$ nsec

iv) $t_4 = +2.0$ nsec

B. What is the kinetic energy at time $t = 1.0$ sec?

C. Find the work done on the particle.
3. Consider a point particle with mass \( m = 9 \times 10^{-31} \) kg moving with constant velocity in the x-direction: \( \vec{v} = v_0 \hat{x} = 3.3 \times 10^{16} \ m / s \ \hat{x} \). A force \( \vec{F} = -4.5 \times 10^{-17} \ N \ \hat{y} \) acts on the particle over a 10 cm path. (This is similar to an electron moving through the deflection plates in TV or computer monitor)

A. On the drawing below, sketch the path taken by the particle. Label parts of the path as straight lines, parabolas, circular arcs, etc.

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V
P  10 cm  Q
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B. What is the time \( t_0 \) taken by the particle to travel through the force region (10 cm wide)?

C. What is the x-component of the velocity as the particle passes through plane Q?

D. What is the z-component of the velocity at plane Q?

E. What is the y-component of the velocity at plane Q?
4. A point particle is acted on by a force that is always perpendicular to its velocity, $\mathbf{F} = \mathbf{v} \times \mathbf{G}$ (G is a vector. In the case at the right, G is perpendicular to v).
(This happens when an electron moves through a magnetic field)

A. Does this force do work on the particle? Why or why not?

B. The particle will follow a circular path. Why?

C. Find the radius of the circular path in terms of the mass $m$, the velocity $v$ and the force generating field $G$. 