Application of Vectors: Detailed Computational Analysis

Value: 40 Marks

Work in groups of up to three. Answer questions and copy graphs in MS Word.

1. **We will do as a class** Set up a Microsoft Excel spreadsheet to analyze the velocity of an object undergoing a constant acceleration in two dimensions (might help to visualize a boat on the water being blown by the wind).
   a. Make the $\vec{v}_o$ = 15 m/s [E40°N] and $\vec{a}$ = 6.5 m/s^2 [W60°S]
   b. Graph the components of $\vec{v}_f$ versus time on the same set of axis.
   c. Graph the magnitude of $\vec{v}_f$ versus time.

2. Program the Excel sheet from #1 to analyze the final position, $\vec{d}_f$, and its components. Have it so $\vec{d}_o$ can be adjusted, but to start have $\vec{d}_o$ = 0.0 m [E0°N].
   a. Graph $\vec{d}_f$ versus time.
   b. Graph d_{fN} versus d_{fE} (that is the actual path taken by the object; x-axis should be your East data).
   c. Change $\vec{d}_o$ = 35 m [E62°S] and graph d_{fN} versus d_{fE}.
   d. Reset $\vec{d}_o$ to 0.0 [E0°N]. Change the angle of the initial velocity to 60° and then 80°; compare the paths of the boats. Do such paths make sense?
   e. Look at the direction of the velocity and displacement at each time step. Explain why they are not the same.

3. Use Excel to generate data for v_f, v_{fE}, v_{fN}, d_f, d_{fE}, and d_{fN} of the following situation (take $\vec{d}_o$ = 0.0 m [E0°N]) with a 0.5 second t_{step}:
      i. 0 ≤ t ≤ 10: v_o = 50 m/s [E10°N], a = 7.5 m/s^2 [W60°N]
      ii. 10 ≤ t ≤ 25: a = 9.0 m/s^2 [W60°S], (d_f and v_f from i at 10 s are important)
      iii. 25 ≤ t ≤ 50: a = 5.0 m/s^2 [E50°N], (d_f and v_f from ii at 25 s are important)
   b. Plot v_f vs **t**.
   c. Plot d_f vs **t**.
   d. Plot d_{fN} vs d_{fE}.