Physics x141 Exam 1

1. Over the weekend at Morro rock I watched a surfer accelerate from rest in 2.0 s to catch a wave which she rode at constant velocity for 4.0 s, then jumped off her board coming to a stop in 0.5 s. I was able to determine her stopping acceleration to be 10 m/s². You may assume all accelerations are constant.
   a) Make sketches of position vs. time, velocity vs. time and acceleration vs. time being sure to label the graphs with relevant known and unknown information.
   b) Using only the geometry of the graphs (no kinematic equations) determine the initial acceleration of the surfer and her total distance traveled. Be sure to clearly justify your reasoning.
2. Bill and his younger brother John are going to have a foot race. Since John is smaller, Bill allows him to have a running start. That is, John starts the race at full speed, 4.5 m/s, while Bill starts the race from rest. Bill accelerates at 1 m/s\(^2\) until he reaches his maximum velocity (which he does in half the time it takes him to reach the finish line) and maintains that velocity for the remainder of the race. Both Bill and John reach the finish line at the same time. How long does the race last? Over what distance did the race cover? Be sure to construct a pictorial model.
3. Consider the following incomplete motion diagram.

a) Complete the motion diagram with velocity and acceleration vectors (clearly labeled).

b) Show how you determined the direction of the acceleration vectors at either point 3, 4, or 5. Be sure to justify your reasoning with an equation or two.
4. Consider the force table experiment we performed in class. Suppose that the following three forces act on the ring:

\[ \vec{F}_1 = (3.00 \text{ N} @ 30^\circ) \quad \vec{F}_2 = (2.00 \text{ N} @ 90^\circ) \quad \vec{F}_3 = (2.50 \text{ N} @ 225^\circ) \]

a) Doing the best you can without a protractor or a ruler, find the sum of the three vectors by adding them **graphically** by use of the tail-to-tip method.

b) By considering the sum of forces algebraically (use the convention of positive x-axis corresponding with 0° and positive y-axis corresponding with 90°), determine what additional force \( \vec{F}_4 \) must be added to keep the ring stationary. Express your result for \( \vec{F}_4 \) first in component form (unit vector notation), then in terms of a magnitude and direction.