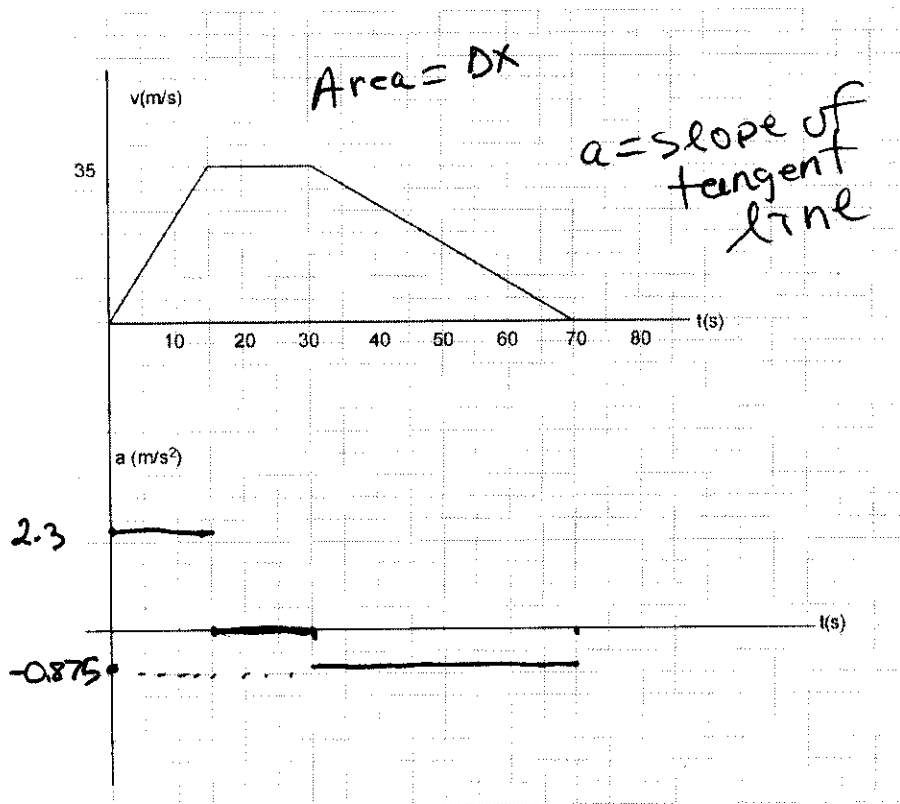Name: **KEY**

Physics 50/W10

<u>Quiz 4</u>

Make sure to show all work in complete detail. NO CREDIT will be given if no work is shown!!!

1. Consider the v vs. t graph for the motion of a particle below.

Area = Δx

a = slope of tangent line

a) Draw the graph for the a vs. t. (5 pts)
b) Calculate the position of the particle at t = 70 s if x = 5 m at t = 0. (5 pts)

a) $a_1 = \dfrac{35 \text{ m/s}}{15 \text{ s}} = +2.3 \text{ m/s}^2$

$a_2 = \dfrac{0}{15} = 0 \text{ m/s}^2$

$a_3 = \dfrac{-35 \text{ m/s}}{40 \text{ s}} = -0.875 \text{ m/s}^2$

b) Δx = Area
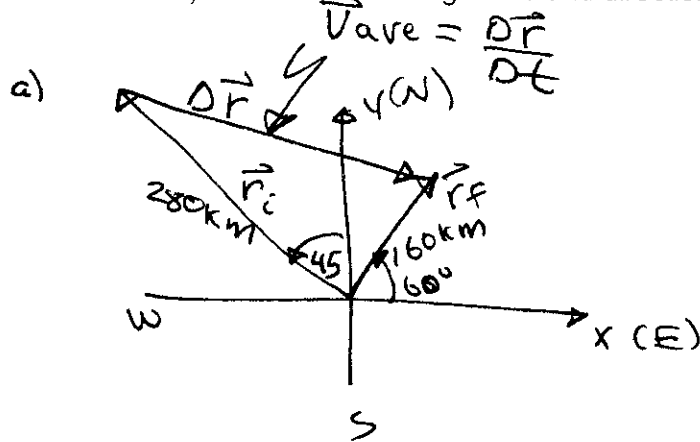
$x - x_0 = \frac{1}{2}(15)(35) + (15)(35) + \frac{1}{2}(40)(35)$

$x - 5 = 1488 \text{ m}$

$\boxed{x = 1593 m}$

2. An air traffic controller observes an airplane. The displacement from the control tower to the plane is given by vector r_i which has a magnitude of 280 km and points in a direction of 45° west of north. The displacement 6.0s later (also relative to the control tower) is given by vector r_f and has a magnitude of 160 km in a direction of 60° north of east. (10 pts)

   a) Sketch the vectors r_i, r_f, and $\Delta r = r_f - r_i$.
   b) Indicate the direction of the vector V_{ave} on the diagram in part (a).
   c) Calculate the displacement vector in unit vector notation.
   d) Calculate the average velocity vector in unit vector notation during the 6.0 s interval.
   e) Calculate the magnitude and direction of V_{ave}.

a)

$$\vec{V}_{ave} = \frac{\Delta \vec{r}}{\Delta t}$$

b) see graph

c) $\Delta \vec{r} = \vec{r}_f - \vec{r}_r$

$$= \left(160\cos 60\,\hat{\imath} + 160\sin 60\,\hat{\jmath}\right)$$

$$- \left(-280\sin 45\,\hat{\imath} + 280\cos 45\,\hat{\jmath}\right)$$

$$\boxed{\Delta \vec{r} = 278\,\hat{\imath} - 58.4\,\hat{\jmath}} \ (km)$$

d) $\vec{V}_{ave} = \frac{\Delta \vec{r}}{\Delta t} = \boxed{46.3\,\hat{\imath} - 9.9\,\hat{\jmath}} \ \left(\frac{km}{s}\right)$

e) $|\vec{V}_{ave}| = \sqrt{(46.3)^2 + (-9.9)^2} = \boxed{47.3 \ km/s}$

$\theta = \tan^{-1}\left(\frac{-9.9}{46.3}\right) = \boxed{12°}$