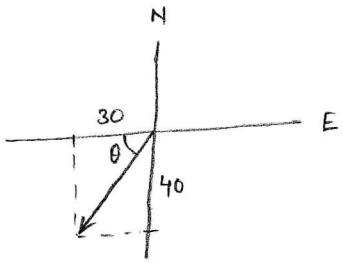
Solutions PHYS-203A (Midterm Exam 01) 2018 Spring

Prob. 1



$$\vec{A} = -30.0\hat{i} - 40.0\hat{j}$$

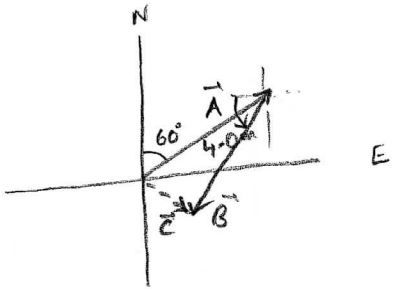
$$|\vec{A}| = \sqrt{30^2 + 40^2} = 50.0 \text{ km}$$

$$\theta = \tan^{-1}\left(\frac{40}{30}\right) = 53.1^\circ$$

shortest length : 50.0 km

direction : 53.1° South of West.

Prob. 2



$$\vec{A} = +4.0\sin 60\,\hat{i} + 4.0\cos 60\,\hat{j}$$

$$= +3.46\,\hat{i} + 2.0\,\hat{j}$$

$$\vec{B} = -3.0\cos 70\,\hat{i} - 3.0\sin 70\,\hat{j}$$

$$= -1.03\,\hat{i} - 2.82\,\hat{j}$$

$$\vec{C} = \vec{A} + \vec{B} = +2.43\,\hat{i} - 0.82\,\hat{j}$$

$|\vec{C}| = 2.57\text{m}$ → magnitude

direction: $\theta = \tan^{-1}\left(\frac{0.82}{2.43}\right) = 18.7^\circ$ South of East.

Prob. 3

$\Delta y = 0$ $\quad V_i = ?$ $\quad a = -9.8\frac{m}{s^2}$

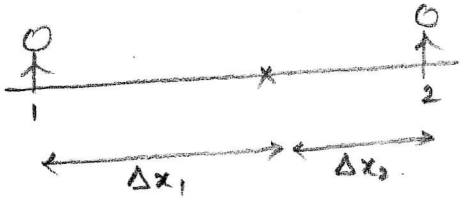
$\Delta t = 8.8s$ $\quad V_f =$

$$\Delta y = V_i \Delta t + \frac{1}{2} a \Delta t^2$$

$$0 = V_i(8.8) + \frac{1}{2}(-9.8)(8.8)^2$$

$$V_i = 43\ \frac{m}{s}$$

Prob. 4



$$\Delta x_1 + \Delta x_2 = 40.0\,m$$

$$\Delta x_1 = v_{1i}\,\Delta t + \frac{1}{2} a_1 \Delta t^2$$

$$= 0 + \frac{1}{2}(0.50)\,\Delta t^2$$

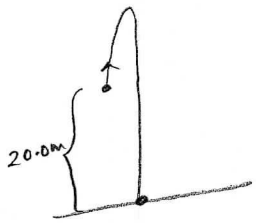
$$\Delta x_2 = v_{2i}\,\Delta t + \frac{1}{2} a_2 \Delta t^2$$

$$= 0 + \frac{1}{2}(0.20)\,\Delta t^2$$

$$40.0 = \frac{1}{2}(0.50)\,\Delta t^2 + \frac{1}{2}(0.20)\,\Delta t^2 \Rightarrow \Delta t = \sqrt{\frac{(40.0)\,2}{(0.50+0.20)}} = 10.7\,s.$$

$$\Delta x_1 = \frac{1}{2}(0.50)\,(10.7)^2 = 29\,m$$

Prob. 5



$\Delta y = -20.0\,m$ $\quad v_i = +4.00\,\frac{m}{s}$ $\quad a = -9.8\,\frac{m}{s^2}$

$\Delta t = ?$ $\quad v_f =$

$$\Delta y = v_i\,\Delta t + \frac{1}{2} a\,\Delta t^2$$

$$-20.0 = 4.00\,\Delta t + \frac{1}{2}(-9.8)\,\Delta t^2$$

$$4.9\,\Delta t^2 - 4.00\,\Delta t - 20.0 = 0$$

$$\Delta t = \frac{+4.00 \pm \sqrt{(-4.00)^2 - 4(4.9)(-20.0)}}{2(4.9)}$$

$$= \frac{+4.00 \pm 20.2}{9.8} = +2.5\,s \quad (\text{OR}) \quad -1.7\,s$$

↳ correct solution.

Prob. 6

$\Delta x = 20.0\,m$

$\Delta t = \boxed{0.714\,s}$

$V_{xi} = 28.0\,\frac{m}{s}$

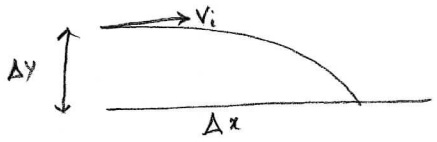
$\Delta y = ?$

$\Delta t = \boxed{0.714\,s}$

$a = -9.8\,\frac{m}{s^2}$

$V_{yi} = 0$

$V_{yf} =$



$$\frac{\Delta x}{\Delta t} = V_{xi}$$

$$\frac{20.0}{\Delta t} = 28.0$$

$$\Rightarrow \Delta t = 0.714\,s$$

$$\Delta y = V_{yi}\Delta t + \frac{1}{2} a \Delta t^2$$

$$= 0 + \frac{1}{2}(-9.8)(0.714)^2$$

$$= 2.5\,m$$

Prob. 7

$\Delta x = 32.0\,m$

$\Delta t = \boxed{1.85\,s}$

$V_{xi} = 20.0 \cos 30$

$= 17.3\,\frac{m}{s}$

$\Delta y = ?$

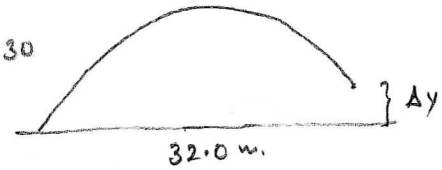
$\Delta t = \boxed{1.85\,s}$

$a = -9.8\,\frac{m}{s^2}$

$V_{yi} = 20.0 \sin 30$

$= 10.0\,\frac{m}{s}$

$V_{yf} =$



$$\frac{\Delta x}{\Delta t} = V_{xi}$$

$$\frac{32.0}{\Delta t} = 17.3$$

$$\Rightarrow \Delta t = 1.85\,s$$

$$\Delta y = V_{yi}\Delta t + \frac{1}{2} a \Delta t^2$$

$$= (10.0)(1.85) + \frac{1}{2}(-9.8)(1.85)^2$$

$$= 18.5 - 16.8$$

$$= 1.7\,m$$