Solutions to Midterm Exam 01 (2015 Summer, PHYS 203 A)

prob. 1, MT01

$$F = \frac{G m_1 m_2}{r^2}$$

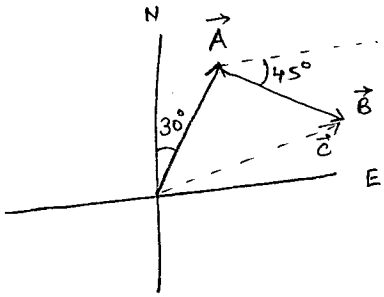
$$G = \frac{[F][r]^2}{[m]^2} = \frac{M L T^{-2} L^2}{M^2} = \frac{L^3}{M T^2}$$

prob. 2, MT01

$$2.0 \frac{m}{s^2} = 2.0 \frac{m}{s^2} \frac{1 \text{ mile}}{1609 \text{ m}} \frac{60 \times 60 \text{ sec}}{1 \text{ hour}} \frac{60 \times 60 \text{ sec}}{1 \text{ hour}}$$

$$= 2.0 \frac{60^2 \times 60^2}{1609} \frac{\text{mile}}{\text{hour}^2} = 1.6 \times 10^4 \frac{\text{mile}}{\text{hour}^2}$$

prob. 3, MT01



$$\vec{A} = 150 \sin 30 \, \hat{i} + 150 \cos 30 \, \hat{j}$$

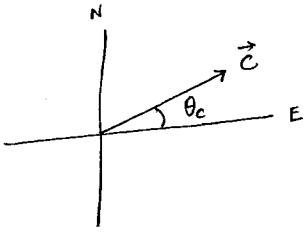
$$= 75 \, \hat{i} + 130 \, \hat{j}$$

$$\vec{B} = 100 \cos 45 \, \hat{i} - 100 \sin 45 \, \hat{j}$$

$$= 71 \, \hat{i} - 71 \, \hat{j}$$

$$\vec{C} = \vec{A} + \vec{B}$$

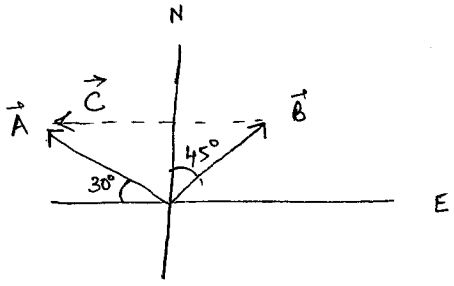
$$= 146 \, \hat{i} + 59 \, \hat{j}$$



$$|\vec{C}| = \sqrt{146^2 + 59^2} = 157 \text{ m}$$

$$\theta_c = \tan^{-1}\left(\frac{59}{146}\right) = 22^\circ \text{ N of E.}$$

prob. 4, MT01



$\vec{A} = -35\cos 30\,\hat{i} + 35\sin 30\,\hat{j}$

$= -30.3\,\hat{i} + 17.5\,\hat{j}$

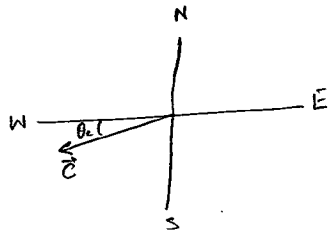
$\vec{B} = 32\sin 45\,\hat{i} + 32\sin 45\,\hat{j}$

$= 22.6\,\hat{i} + 22.6\,\hat{j}$

$\vec{A} = \vec{B} + \vec{C}$

$\vec{C} = \vec{A} - \vec{B}$

$= -52.9\,\hat{i} - 5.1\,\hat{j}$



$|\vec{C}| = \sqrt{(-52.9)^2 + (-5.1)^2} = 53.1$ km

$\theta_c = \tan^{-1}\left(\frac{5.1}{52.9}\right) = 5.5°$ S of W.

prob. 5, MT01

$v_i = +\cancel{6}\ \frac{m}{s}$ $\quad \Delta x = -50m$ $\quad a = -9.8\ \frac{m}{s^2}$.

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

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

$-50 = \cancel{6}\,\Delta t + \frac{1}{2}(-9.8)\,\Delta t^2$

$4.9\,\Delta t^2 - \cancel{6}\,\Delta t - 50 = 0$

$\Delta t = \dfrac{\cancel{6} \pm \sqrt{(-\cancel{6})^2 - 4(4.9)(-50)}}{2 \times 4.9}$

$= +3.9$ sec or -2.6 sec. → happens in the past.

Correct solution : $+3.9$ sec

prob. 6, MT01

speeder

$\Delta X_s = V \Delta t$

$\Delta X_s = 40 \Delta t$

cop

$\Delta X_c = \cancel{V_i^{=0}} \Delta t + \frac{1}{2} a \Delta t^2$

$= \frac{1}{2} a \Delta t^2$.

$\Delta X_c = \frac{1}{2} \times 3 \Delta t^2$.

$\Delta X_s = \Delta X_c$ and Δt is common while overtaking

$\Delta X = \frac{3}{2} \left(\frac{\Delta X}{40}\right)^2$

~~$\neq 0$~~

$\frac{2}{3} \times 40^2 = \Delta X$

$\Delta X = 1067 \text{ m}$

prob. 7, MT01

$V_i = 0$

$V_f = 30 \frac{m}{s}$

$\Delta X =$

$\Delta t =$

$a = +2.36 \frac{m}{s^2}$.

$2 a \Delta X = V_f^2 - V_i^2$.

$2 \times 2.36 \times \Delta X = 30^2 - 0^2$

$\Rightarrow \Delta X = 190.7 \text{ m}$

prob. 8, MT01

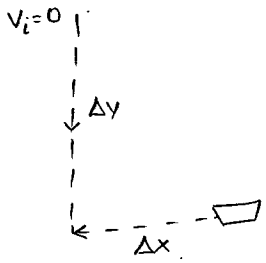
key: $\Delta y = -46 \text{ m}$

$\Delta t =$

$V_i = 0$

$V_f =$

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



$\Delta y = \cancel{V_i^{=0}} \Delta t + \frac{1}{2} a \Delta t^2$

$-46 = -4.9 \Delta t^2 \Rightarrow \Delta t = 3.1 \text{ sec}$.

Boat: $V = \frac{\Delta X}{\Delta t} = \frac{11 \text{ m}}{3.1 \text{ sec}} = 3.6 \frac{m}{s}$