MT-01, prob 1

$$[x] = [6At^5] \Rightarrow [A] = \frac{L}{T^5} = LT^{-5}$$

$$[x] = [3Bt^2] \Rightarrow [B] = \frac{L}{T^2} = LT^{-2}$$

MT-01, prob 2

(a) $\Delta x = \dfrac{v_f^2 - v_i^2}{2a} = \dfrac{10^2 - (-5)^2}{2\times 5} = 7.5\ m$

(b) $d = |\Delta x_1| + |\Delta x_2|$

$= 10 + 2.5$

$= 12.5\ m$

$\Delta x_1 = \dfrac{0^2 - (-5)^2}{2\times 5} = -2.5\ m$

$\Delta x_2 = \dfrac{10^2 - 0^2}{2\times 5} = +10\ m.$

MT-01, prob 3

(a) $v_f = v_i + a\Delta t$

$0 = v_i - gT \Rightarrow v_i = gT$

(b) $\Delta x = v_f \Delta t - \frac{1}{2} a \Delta t^2$

$h = 0 - \frac{1}{2}(-g)T^2 \Rightarrow h = \frac{1}{2}gT^2$

MT-01, prob 4

$x(t) = 75t - t^3$

$v(t) = 75 - 3t^2$

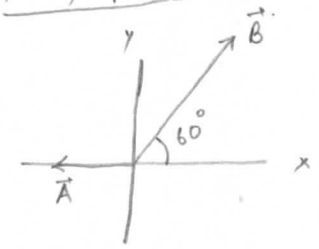
$a(t) = -6t$

It momentarily stops when $v(t) = 0$. That is,

$75 - 3t^2 = 0 \Rightarrow t = \pm 5$ seconds.

Thus, $a(5) = -6\times 5 = -30\ \frac{m}{s^2}$

MT-01, prob 5



$$\vec{A} = -5\,\hat{i} + 0\,\hat{j}$$

$$\vec{B} = 10\cos 60\,\hat{i} + 10\sin 60\,\hat{j}$$

$$= 5\,\hat{i} + 5\sqrt{3}\,\hat{j}$$

$$\vec{A} + \vec{B} = 0\,\hat{i} + 5\sqrt{3}\,\hat{j}$$

$$= 0\,\hat{i} + 8.66\,\hat{j}$$

MT-01, prob 6

$$\vec{A} - \vec{B} = 2\vec{C}$$

$$\vec{A} + \vec{B} = 4\vec{C}$$

Adding we obtain $2\vec{A} = 6\vec{C} \Rightarrow \vec{A} = 3\vec{C} = 9\,\hat{i} + 12\,\hat{j}$

Subtracting we obtain $2\vec{B} = 2\vec{C} \Rightarrow \vec{B} = \vec{C} = 3\,\hat{i} + 4\,\hat{j}$

MT-01, prob 7

$$\vec{r}(t) = \left[b + \tfrac{1}{2}at^2\right]\hat{i} + \left[d + ct\right]\hat{j}$$

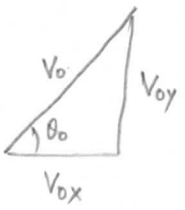
$$\vec{v}(t) = \frac{d}{dt}\vec{r}(t)$$

$$= at\,\hat{i} + c\,\hat{j}$$

MT-01, prob 8

(e)

MT-01, prob 9



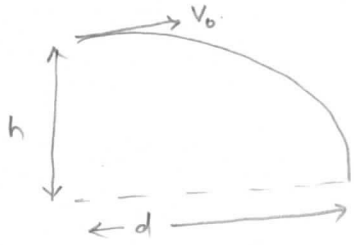
Since V_{0x} does not change it is the speed at maximum height. Thus we are given

$$\frac{V_0}{V_{0x}} = 5$$

$$\cos\theta_0 = \frac{V_{0x}}{V_0} = \frac{1}{5}$$

$$\theta_0 = \cos^{-1}\left(\frac{1}{5}\right) = 78.5^\circ$$

MT-01, prob 10



x-dir

$V_0 = 150 \frac{km}{h}$ =

$= \frac{150000}{3600} = 41.67 \frac{m}{s}$

Δt =

$\Delta x = d = ?$

y-dir

Δt =

$\Delta y = -h = -500\ m$

$V_{iy} = 0$

V_{fy} =

$a_y = -g = -10 \frac{m}{s^2}$.

$$\Delta y = V_{iy}\Delta t + \frac{1}{2} a_y \Delta t^2.$$

$$-h = 0 - \frac{1}{2} g \Delta t^2.$$

$$\Delta t = \sqrt{\frac{2h}{g}}$$

$$d = V_0 \Delta t$$

$$= V_0 \sqrt{\frac{2h}{g}}$$

$$= 41.67 \sqrt{\frac{2 \times 500}{10}}$$

$$= 416.7\ m$$