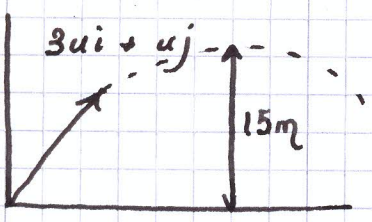
Question 3.



$u_x = 3u$ $\quad u_y = u$

$v_x = 3u$ $\quad v_y = u - gt$

$s_x = 3ut$ $\quad s_y = ut - \frac{1}{2}gt^2$

at max height, $v_y = 0$ $\quad 0 = u - gt$

$\frac{u}{g} = t$

$s_y = 15$ $\quad 15 = u.\frac{u}{g} - \frac{g}{2}\frac{u^2}{g^2}$

$15 = \frac{2u^2 - u^2}{2g}$

$30g = u^2$ $\quad \boxed{u = 17}$

ii. When it hits ground, $s_y = 0 \Rightarrow 0 = 17t - 4.9t^2$

$\underline{t = 3.47}$

$v_x = 3(17)$ $\quad v_y = 17 - 9.8(3.47)$

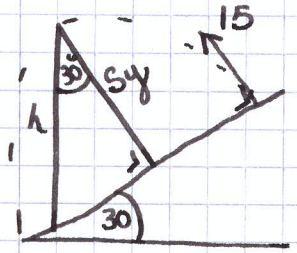
$= 34$ $\quad v_y = -17$

$\vec{v} = 51i - 17j$ $\quad$ magnitude $\sqrt{51^2 + 17^2} = \boxed{54\ ms^{-1}}$

direction $\tan\theta = \frac{17}{51}$ $\quad \theta = 18°26'$

$\boxed{E\ 18°26'\ S}$

b.



$u_x = 0$ $\quad u_y = 15$

$g_x = g\sin 30$ $\quad g_y = -g\cos 30$

$= \frac{g}{2}$ $\quad = -\frac{\sqrt{3}g}{2}$

$v_x = 0 + \frac{g}{2}t$ $\quad v_y = 15 - \frac{\sqrt{3}g}{2}$

$s_x = 0 + \frac{g}{4}t^2$ $\quad \boxed{s_y = 15t - \frac{\sqrt{3}g}{4}t^2}$

$h = s_y / \cos 30$

$= \frac{2}{\sqrt{3}}\left(15t - \frac{\sqrt{3}g}{4}t^2\right)$

$= \frac{30}{\sqrt{3}}t - \frac{g}{2}t^2$ $\quad = \boxed{10\sqrt{3}t - 4.9t^2}$

ii. Max h is at max $s_y \Rightarrow v_y = 0$

$0 = 15 - \frac{\sqrt{3}}{2}gt$

$\frac{10\sqrt{3}}{g} = t$ $\quad h = 10\sqrt{3}\left(\frac{10\sqrt{3}}{g}\right) - \frac{g}{2}\left(\frac{10\sqrt{3}}{g}\right)^2$

$h = \frac{300}{g} - \frac{150}{g}$

$\boxed{h = 15.31}$