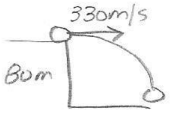
SOLUTIONS
PROJECTILE PROBLEMS

330
39.598
$\sqrt{330^2 + 39.598^2}$
332 m/s at 6.8° down from Horiz
$\theta = \tan^{-1}\left(\frac{39.598}{330}\right) = 6.8°$

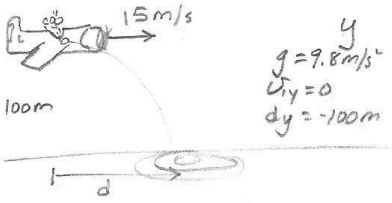
① 

y: $g = 9.80 m/s^2$, $v_{y_1} = 0$, $d_y = -80m$
x: $a_x = 0$, $v_x = 330 m/s$

Ⓐ $t = \sqrt{\frac{2d}{g}} = \sqrt{\frac{2(-80m)}{-9.80 m/s^2}} = 4.04s$

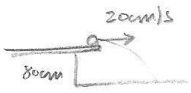
Ⓑ $d_x = v_x t = (330 m/s)(4.04s) = 1333m$

Ⓒ $v_x = 330 m/s$
$v_{y_2} = v_{y_1} + g t$
$0 + (-9.80 m/s^2)(4.04s) = 39.598 m/s$

② 

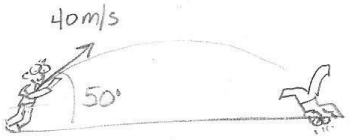
y: $g = 9.8 m/s^2$, $v_{y_1} = 0$, $d_y = -100m$
x: $a_x = 0$, $v_x = 15 m/s$

$t = \sqrt{\frac{2d}{g}} = \sqrt{\frac{2(-100m)}{-9.8 m/s^2}} = 4.52 sec$
$d_x = v_x t = (15 m/s)(4.52s) = 67.76 m$

③ 

y: $g = -9.8 m/s^2$, $v_{y_1} = 0$, $d_y = .80m$
x: $a_x = 0$, $v_x = .20 m/s$

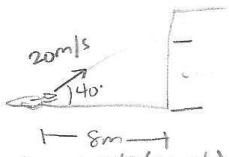
$t = \sqrt{\frac{2d}{g}} = \sqrt{\frac{2(-.80m)}{-9.8 m/s^2}} = .404s$
$d_x = v_x t = (.20 m/s)(.404s) = .0808 m$

④ 

$v_y = \sin 50 (40 m/s) = 30.64 m/s$
$v_x = \cos 50 (40 m/s) = 25.71 m/s$

y: $g = -9.8 m/s^2$, $v_{y_1} = 30.64 m/s$, $v_{y_2} = -30.64 m/s$
x: $a_x = 0$, $v_x = 25.71 m/s$

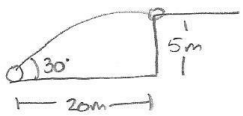
$t = \frac{v_{y_2} - v_{y_1}}{g} = \frac{-30.64 - 30.64}{-9.8 m/s^2} = 6.25 s$
$d_x = v_x t = (25.71)(6.25s) = 161 m$
$\theta = 50°$

⑤ 

$v_{y_1} = \sin 40 (20 m/s) = 12.856 m/s$
$v_x = \cos 40 (20 m/s) = 15.321 m/s$

y: $g = -9.8 m/s^2$, $v_y = 12.856 m/s$
x: $a_x = 0$, $v_x = 15.321 m/s$, $d_x = 8m$

$t = \frac{d_x}{v_x} = \frac{8m}{15.321 m/s} = .522 sec$
$d_y = v_{y_1} t + \frac{1}{2} g t^2$
$= (12.856)(.522s) + \frac{1}{2}(-98)(.522)^2$
$d_y = 5.37 m$

⑥ 

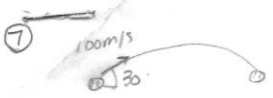
y: $g = -9.8 m/s^2$, $d_y = 5m$
x: $a_x = 0$, $d_x = 20m$

$v_y = \sin 30 v_0$
$v_x = \cos 30 v_0$
$t = \frac{d_x}{v_x} = \frac{d_x}{\cos 30 v_0}$

$d_y = v_{y_1} t + \frac{1}{2} g t^2$
$d_y = \sin 30 v_0 \left(\frac{d_x}{\cos 30 v_0}\right) + -4.9 m/s^2 \left(\frac{d_x}{\cos 30 v_0}\right)^2$
$5m = \frac{\sin 30}{\cos 30}(20m) + -4.9 m/s^2 \frac{(20m)^2}{(\cos 30)^2 v_0^2}$
$5 = 11.54 + \frac{-2613.3}{v_0^2}$

$v_0 = 19.99 m/s$

⑦



$U_y = \sin 30(100\,m/s) = 50\,m/s$

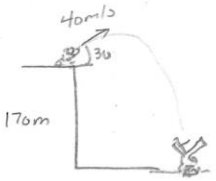
$U_x = \cos 30(100\,m/s) = 86.6\,m/s$

y	x
$g = -9.8\,m/s^2$	$a_x = 0$
$U_{y_1} = 50\,m/s$	$U_x = 86.6\,m/s$
$U_{y_2} = -50\,m/s$	

$$t = \frac{U_{y_2} - U_{y_1}}{g} = \frac{-50\,m/s - 50\,m/s}{-9.8\,m/s^2} = 10.2\,s$$

$$d_x = U_x t = (86.6\,m/s)(10.2\,s) = 883.67\,m$$

⑧



$U_y = \sin 30(40\,m/s) = 20\,m/s$

$U_x = \cos 30(40\,m/s) = 34.64\,m/s$

y	x
$g = -9.8\,m/s^2$	$a_x = 0$
$U_{y_1} = 20\,m/s$	$U_x = 34.64\,m/s$
$d_y = -170\,m$	

A) $d_y = U_{y_1} t + \frac{1}{2} g t^2$

$-170\,m = 20\,m/s\, t + -4.9\,m/s^2\, t^2$

$t = 8.2745\,s$

B) $d_x = U_x t = (34.64\,m/s)(8.27\,s) = 287\,m$

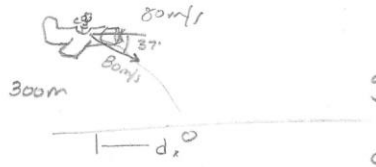
C) $U_x = 34.64\,m/s$

$U_y = \sqrt{U_{y_1}^2 + 2gd} = \sqrt{20\,m/s^2 + 2(-9.8)(-170\,m)}$

$U_y = 61.09\,m/s$

$\theta = \tan\left(\frac{61.09\,m/s}{34.64\,m/s}\right) = 60°$

⑨



$U_{y_1} = \sin 37(80\,m/s) = 48.14\,m/s$

$U_x = \cos 37(80\,m/s) = 63.89\,m/s$

y	x
$g = -9.8\,m/s^2$	$a_x = 0$
$U_{y_1} = 48.14\,m/s$	$U_x = 63.89\,m/s$
$d_y = 300\,m$	

$d_y = U_{y_1} t + \frac{1}{2} g t^2$

$-300\,m = -48.14\,m/s\, t + -4.9\,m/s^2\, t^2$

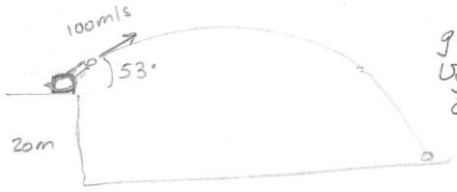
$t = 4.32\,s$

$d_x = U_x t =$

$(63.89\,m/s)(4.32\,s)$

$d_x = 276\,m$

⑩



$U_{y_1} = \sin 53°(100\,m/s) = 79.86\,m/s$

$U_x = \cos 53°(100\,m/s) = 60.18\,m/s$

y	x
$g = -9.8\,m/s^2$	$a_x = 0$
$U_{y_1} = 79.86\,m/s$	$U_x = 60.18\,m/s$
$d_y = -20\,m$	

A) $d_y = U_{y_1} t + \frac{1}{2} g t^2$

$-20\,m = 79.86\,m/s\, t + -4.9\,m/s^2\, t^2$

$t = 16.54\,s$

B) $d_x = U_x t = (60.18\,m/s)(16.54\,s)$

$d_x = 995\,m$

C) $d_{y\,max}$

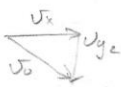
$U_{2y}^2 = U_{1y}^2 + 2g\, d_{y\,max}$

$$d_{y\,max} = \frac{U_{2y}^2 - U_{1y}^2}{2g} = \frac{0 - (79.86)^2}{2(-9.8)} = 325\,m$$

D) $d_y = U_{1y} t + \frac{1}{2} g t^2$ $\quad 40\,m = (79.86)\, t + -4.9\, t^2$

$t_1 = 15.78\,sec$

$t_2 = .517\,sec$



E) $U_x = 60.18$ $\quad U_y^2 = U_{y_1}^2 + 2ad$ $\quad U_y = \sqrt{79.86^2 + 2(-9.8)(-20\,m)} = 82.28$

102 m/s 53.3° from horizontal $U = \sqrt{U_x^2 + U_{y_2}^2} = \sqrt{(60.18)^2 + (82.28)^2} = 101.9\,m/s$

$\theta = \tan^{-1}\frac{82.28}{60.18} = 53.82°$