p66 17, 21

(17)

x	y
$u_x = 3.5\ ms^{-1}$	$u_y = 0$
$x = ?$	$a = -9.81\ ms^{-2}$
$t = 1.33\ s$	$y = -6.5\ m$
	$t = ?$

$u_x = \frac{x}{t}$

$x = u_x t$

$= (3.5\ ms^{-1})(1.15\ s)$

$x = 4.0\ m$

$y = ut + \frac{1}{2}at^2$

$t = \sqrt{\frac{2y}{a}} = \sqrt{\frac{2(-6.5\ m)}{-9.81\ ms^{-2}}} = 1.15\ s$

(21)

x	y
$u_x = ?$	$u_y = 0$
$x = 24.0\ m$	$a = -9.81\ ms^{-2}$
$t = 3.03\ s$	$y = -45.0\ m$
	$t = ?$

$u_x = \frac{x}{t}$

$= \frac{24.0\ m}{3.03\ s}$

$u_x = 7.92\ ms^{-1}$

$y = ut + \frac{1}{2}at^2$

$t = \sqrt{\frac{2y}{a}} = \sqrt{\frac{2(-45.0\ m)}{-9.81\ ms^{-2}}} = 3.03\ s$

p66 23, 27, 29, 31, 35, 53, 61, 63, 65, 67, 69, 71, 75

(23)

x	y
$u_x = 22.2\ ms^{-1}$	$u_y = 0$
$s_x = 36.0\ m$	$a_y = -9.81\ ms^{-2}$
$t = ?$	$s_y = ?$
	$t = 1.62\ s$

$u_x = \frac{s_x}{t}$

$t = \frac{s_x}{u_x} = \frac{36.0\ m}{22.2\ ms^{-1}} = 1.62\ s$

$s_y = ut + \frac{1}{2}at^2$

$= \frac{1}{2}(-9.81\ ms^{-2})(1.62\ s)^2$

$= -12.87$

∴ The building is 12.9 m tall.

(27)

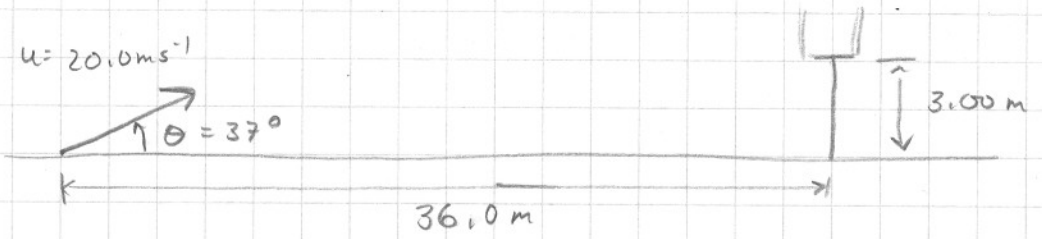
x	y
$u_x = 180\ kmh^{-1} = 50\ ms^{-1}$	$u_y = 0$
	$a_y = -9.81\ ms^{-2}$
	$s_y = -160\ m$
	$t =$

$s_y = ut + \frac{1}{2}a_y t^2$

$t = \sqrt{\frac{2s_y}{a_y}} = \sqrt{\frac{2(-160\ m)}{-9.81\ ms^{-2}}}$

$t = 5.75$

(29)



x	y
$u_x = u\cos\theta = 20\cos 37$	$u_y = u\sin\theta = 20\sin 37$
$s_x = 36.0\,m$	$a_y = -9.81\,ms^{-2}$
$t = ?$	$s_y = ?$
	$t = 2.25\,s$

$u_x = \frac{s_x}{t}$

$t = \frac{s_x}{u_x} = \frac{36\,m}{20\cos 37} = 2.25\,s$

$s_y = u_y t + \frac{1}{2}at^2$

$= 20\sin 37(2.25s) + \frac{1}{2}(-9.81 ms^{-2})(2.25s)^2$

$= 2.25\,m$

∴ It will <u>not</u> be a field goal.

(31)

x	y
$u_x = u\cos\theta = 65\cos 37$	$u_y = u\sin\theta = 65\sin 37$
$s_x = ?$	$s_y = -125\,m$
$t = 10.42s$	$a = -9.81 ms^{-2}$
	$t = ?$

$u_x = \frac{s_x}{t}$

$s_x = u_x t$

$= (65\cos 37)(10.42s)$

(b) $s_x = \underline{541\,m}$

$s_y = u_y t + \frac{1}{2}at^2$

$-125 = 65\sin 37\, t + \frac{1}{2}(-9.81)t^2$

$4.905t^2 - 39.118t - 125 = 0$

(a) $t = 10.42 = \underline{10.4\,s}$

$v_x = u_x = 65\cos 37$

(c$_x$) $v_x = \underline{51.9\,ms^{-1}}$

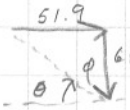
$v_y = u_y + at$

$= 65\sin 37 + -9.81 ms^{-2}(10.42s)$

(c$_y$) $v_y = \underline{-63.1\,ms^{-1}}$

$v = \sqrt{(51.9)^2 + (-63.1)^2} = \underline{81.7\,ms^{-1}}$

(e)



$\tan\varphi = \frac{51.9}{63.1}$ $\varphi = 39.4°$ $\theta = 90 - 39.4 = \underline{50.6°}$

31-(f)

y

$u_y = 65 \sin 37$

$v_y = 0$

$s_y = ?$

$a = -9.81\ ms^{-2}$

$v_y^2 = u_y^2 + 2as_y$

$s_y = \dfrac{-u_y^2}{2a} = \dfrac{-(65\sin 37)^2}{2(-9.81\ ms^{-2})}$

$s_y = 78.0\ m$

(35) (a)

x

$u_x = 69.4\ ms^{-1}$

$s_x = ?$

$t = 6.92\ s$

$u_x = \dfrac{s_x}{t}$

$s_x = u_x t$

$= (69.4\ ms^{-1})(6.92\ s)$

$= 480\ m$

y

$u_y = 0$

$s_y = -235\ m$

$a = -9.81\ ms^{-2}$

$t = ?$

$s_y = u_y t + \frac{1}{2} a_y t^2$

$t = \sqrt{\dfrac{2s_y}{a_y}} = \sqrt{\dfrac{2(-235\ m)}{-9.81\ ms^{-2}}} = 6.92\ s$

(b)

x

$u_x = 69.4\ ms^{-1}$

$s_x = 425\ m$

$t = ?$

$u_x = \dfrac{s_x}{t}$

$t = \dfrac{s_x}{u_x} = \dfrac{425\ m}{69.4\ ms^{-1}}$

$t = 6.12\ s$

y

$u_y = ?$

$s_y = -235\ m$

$a = -9.81\ ms^{-2}$

$t = 6.12\ s$

$s_y = u_y t + \frac{1}{2} a_y t^2$

$u_y = \dfrac{s_y - \frac{1}{2} a_y t^2}{t} = \dfrac{-235\ m - \frac{1}{2}(-9.81\ ms^{-2})(6.12\ s)^2}{6.12\ s}$

$u_y = -8.38 = -8.4\ ms^{-1}$

(c) $v_x = u_x = 69.4\ ms^{-1}$

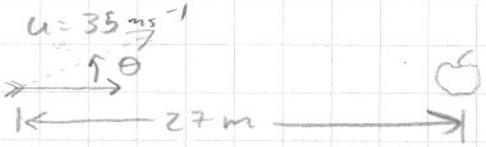
$v_y = u_y + at$

$= -8.38\ ms^{-1} + (-9.81\ ms^{-2})(6.12\ s)$

$= -68.42\ ms^{-1}$

$v = \sqrt{(69.4\ ms^{-1})^2 + (-68.42\ ms^{-1})^2} = 97\ ms^{-1}$ $(350\ km\,h^{-1})$

(53)



X

$u_x = 35\cos\theta$

$s_x = 27\ m$

$t = ?$

$u_x = \frac{s_x}{t}$

$t = \frac{s_x}{u_x} = \frac{27\ m}{35\cos\theta}$

y

$u_y = 35\sin\theta$

$s_y = 0$

$a = -9.81\ ms^{-2}$

$t = ?$

$s_y = u_y t + \frac{1}{2} a_y t^2$

$0 = 35\sin\theta\, t + \frac{1}{2}(-9.81\ ms^{-2})\, t^2$

$t = \frac{2(35)\sin\theta}{9.81\ ms^{-2}}$

$\frac{27}{35\cos\theta} = \frac{70\sin\theta}{9.81}$

$\sin 2\theta = 2\sin\theta\cos\theta$

$0.10811 = \sin\theta\cos\theta$

$.21622 = 2\sin\theta\cos\theta$

$.21622 = \sin 2\theta$

$2\theta = 12.487^\circ$

$\theta = 6.2^\circ$

(61)

moon

X

$u_x = u\cos\theta$

$s_{x_m} = 180\ m$

$t_m = ?$

$u_x = \frac{s_{x_m}}{t_m}$

$t_m = \frac{s_{x_m}}{u_x} = \frac{180}{u\cos\theta}$

y

$u_y = u\sin\theta$

$a_{y_m} = ?$

$s_y = 0$

$t_m = ?$

$s_y = u_y t + \frac{1}{2} a t^2$

$0 = u\sin\theta\, t + \frac{1}{2} a t^2$

$t_m = \frac{-2u\sin\theta}{a_m}$

$\frac{180}{u\cos\theta} = \frac{-2u\sin\theta}{a_m}$

$-180\, a_m = 2u^2\sin\theta\cos\theta$

Earth.

X

$u_x = u\cos\theta$

$s_{x_E} = 35\ m$

$t_E = ?$

$t_m = \frac{35}{u\cos\theta}$

y

$u_y = u\sin\theta$

$a_{y_E} = -9.81\ ms^{-2}$

$s_y = 0$

$t_E = ?$

$t_m = \frac{-2u\sin\theta}{-9.81\ ms^{-2}}$

$\frac{35}{u\cos\theta} = \frac{2u\sin\theta}{9.81\ ms^{-2}}$

$343.35 = 2u^2\sin\theta\cos\theta$

$-180\, a_m = 343.35$

$a_m = -1.9\ ms^{-2}$

(63)

x	y
$u_x = ?$	$u_y = 0$
$s_x = 5\,m$	$s_y = -35\,m$
$t = ?\ 2.67\,s$	$a_y = -9.81\,ms^{-2}$
	$t = ?$

$$u_x = \frac{s_x}{t}$$

$$= \frac{5\,m}{2.67\,s}$$

$$u_x = 1.9\,ms^{-1}$$

$$s_y = \cancel{u_y t} + \frac{1}{2}at^2$$

$$t = \sqrt{\frac{2s_y}{a}} = \sqrt{\frac{2(-35\,m)}{-9.81\,ms^{-2}}} = 2.67\,s$$

in the air for 2.7 s

(65) relative velocity of helicopter $= 215\,kmh^{-1} - 155\,kmh^{-1} = 60\,kmh^{-1}$

x	y
$u_x = 60\,kmh^{-1} = 16.67\,ms^{-1}$	$u_y = 0$
$s_x = ?$	$s_y = -78\,m$
$t = ?\ 3.99\,s$	$a = -9.81\,ms^{-2}$
	$t = ?$

$$u_x = \frac{s_x}{t}$$

$$s_x = u_x t$$

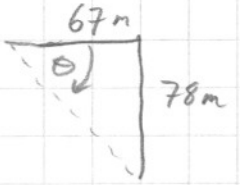
$$= (16.67\,ms^{-1})(3.99\,s)$$

$$s_x = 67\,m$$

$$s_y = \cancel{u_y t} + \frac{1}{2}a_y t^2$$

$$t = \sqrt{\frac{2s_y}{a_y}} = \sqrt{\frac{2(-78\,m)}{-9.81\,ms^{-2}}}$$

$$t = 3.99\,s$$



$$\tan\theta = \frac{78}{67}$$

$$\theta = 49°$$

(67)

x

$u_x = u\cos\theta$

$s_x = 195\text{m}$

$t = 7.6\text{s}$

$u_x = \frac{s_x}{t}$

$u\cos\theta = \frac{195\text{m}}{7.6\text{s}} = 25.66$

y

$u_y = u\sin\theta$

$s_y = 155\text{m}$

$a_y = -9.81\text{ms}^{-2}$

$t = 7.6\text{s}$

$s_y = u_y t + \frac{1}{2}at^2$

$u_y = \frac{s_y - \frac{1}{2}at^2}{t}$

$u\sin\theta = \frac{155\text{m} - \frac{1}{2}(-9.81\text{ms}^{-2})(7.6\text{s})^2}{7.6\text{s}}$

$u\sin\theta = 57.67$

$\frac{u\sin\theta}{u\cos\theta} = \frac{57.67}{25.66}$

$\tan\theta = 2.2475$

$\theta = 66°$

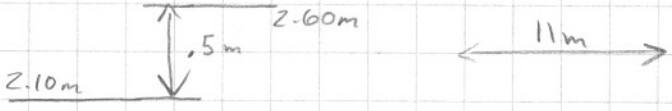
$u\sin\theta = 57.67$

$u\sin(66) = 57.67$

$u = 63\text{ ms}^{-1}$

initial velocity is 63ms^{-1} at $66°$ from the ground.

(9)



−.22m

$u_x = u\cos\theta$

$s_x = 10.78\text{m}$

$t = ?$

$u_x = \frac{s_x}{t}$

$t = \frac{s_x}{u_x} = \frac{10.78\text{m}}{u\cos 38} = \frac{13.68}{u}$

x

+.22m

$u_x = u\cos\theta$

$s_x = 11.22$

$t = ?$

$t = \frac{11.22}{u\cos 38} = \frac{14.24}{u}$

y

$u_y = u\sin\theta$

$s_y = .5\text{m}$

$a = -9.81\text{ms}^{-2}$

$t = ?$

$s_y = ut + \frac{1}{2}at^2$

$.5 = u\sin 38\, t + \frac{1}{2}(-9.81)t^2$

−.22m: $.5 = \frac{u(.6157)(13.68)}{u} - 4.905\left(\frac{13.68}{u}\right)^2$

$.5 = 8.4228 - \frac{917.93}{u^2}$

$u = 10.8\text{ms}^{-1}$

22m: $.5 = \frac{u(.6157)(14.24)}{u} - 4.905\left(\frac{14.24}{u}\right)^2$

$.5 = 8.7676 - \frac{994.62}{u^2}$

$u = 11.0\text{ ms}^{-1}$

(71) (a)

x	y
$u_x = ?$	$u_y = 0$
$s_x = 20\,m$	$s_y = -1.5\,m$
$t = ?$ $0.553s$	$a = -9.81\,ms^{-2}$
	$t = ?$

$$u_x = \frac{s_x}{t}$$

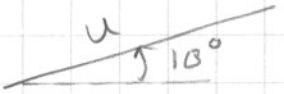
$$= \frac{20\,m}{0.553s}$$

$$u_x = 36.17 = \underline{40\,ms^{-1}}$$

$$s_y = u_y t + \frac{1}{2}at^2$$

$$t = \sqrt{\frac{2s_y}{a_v}} = \sqrt{\frac{2(-1.5m)}{-9.81ms^{-2}}} = 0.553s$$

(b)



x	y
$u_x = u\cos 10$	$u_y = u\sin 10$
$s_x = 20\,m$	$s_y = -1.5\,m$
$t = ?$	$a = -9.81\,ms^{-2}$
	$t = ?$

$$u_x = \frac{s_x}{t}$$

$$t = \frac{s_x}{u_x} = \frac{20}{u\cos 10}$$

$$s_y = u_y t + \frac{1}{2}at^2$$

$$-1.5 = u\sin 10\left(\frac{20}{u\cos 10}\right) + \frac{1}{2}(-9.81)\left(\frac{20}{u\cos 10}\right)^2$$

$$-1.5 = 3.527 - \frac{4.905(412.44)}{u^2}$$

$$u^2 = \frac{-4.905(412.44)}{-1.5(3.527)}$$

$$u = 19.55 = \underline{20\,ms^{-1}}$$

(75) find the muzzle velocity.

$u_y = ?$
$s_y = 0$
$a = -9.81\ ms^{-2}$
$t = 4.0s$

$s_y = ut + \frac{1}{2}at^2$

$u_y = -\frac{1}{2}at$

$= -\frac{1}{2}(-9.81\ ms^{-2})(4.0s)$

$u_y = 19.62\ ms^{-1}$

for maximum horizontal range, dart would be launched at 45°.

x

$u_x = 19.62 \cos 45 = 13.87 ms^{-1}$
$s_x = ?$
$t = ?\ 2.83s$

$u_x = \frac{s_x}{t}$

$s_x = u_x t$

$= (13.87 ms^{-1})(2.83s)$

$s_x = 39\ m$

y

$u_y = 19.62 \sin 45 = 13.87\ ms^{-1}$
$s_y = 0$
$a_y = -9.81\ ms^{-2}$
$t = ?$

$s_y = u_y t + \frac{1}{2}a_y t^2$

$t = \frac{-2u_y}{a_y} = \frac{-2(13.87 ms^{-1})}{-9.81 ms^{-2}}$

$t = 2.83s$