What happens when a projectile does <u>NOT</u> return to its launch height? ("Cliff" problem)

① Ringo the human cannonball is launched from an 18 m high cliff with a velocity of 24 m/s [28° above horizontal]
Determine

(a) Ringo's time of flight

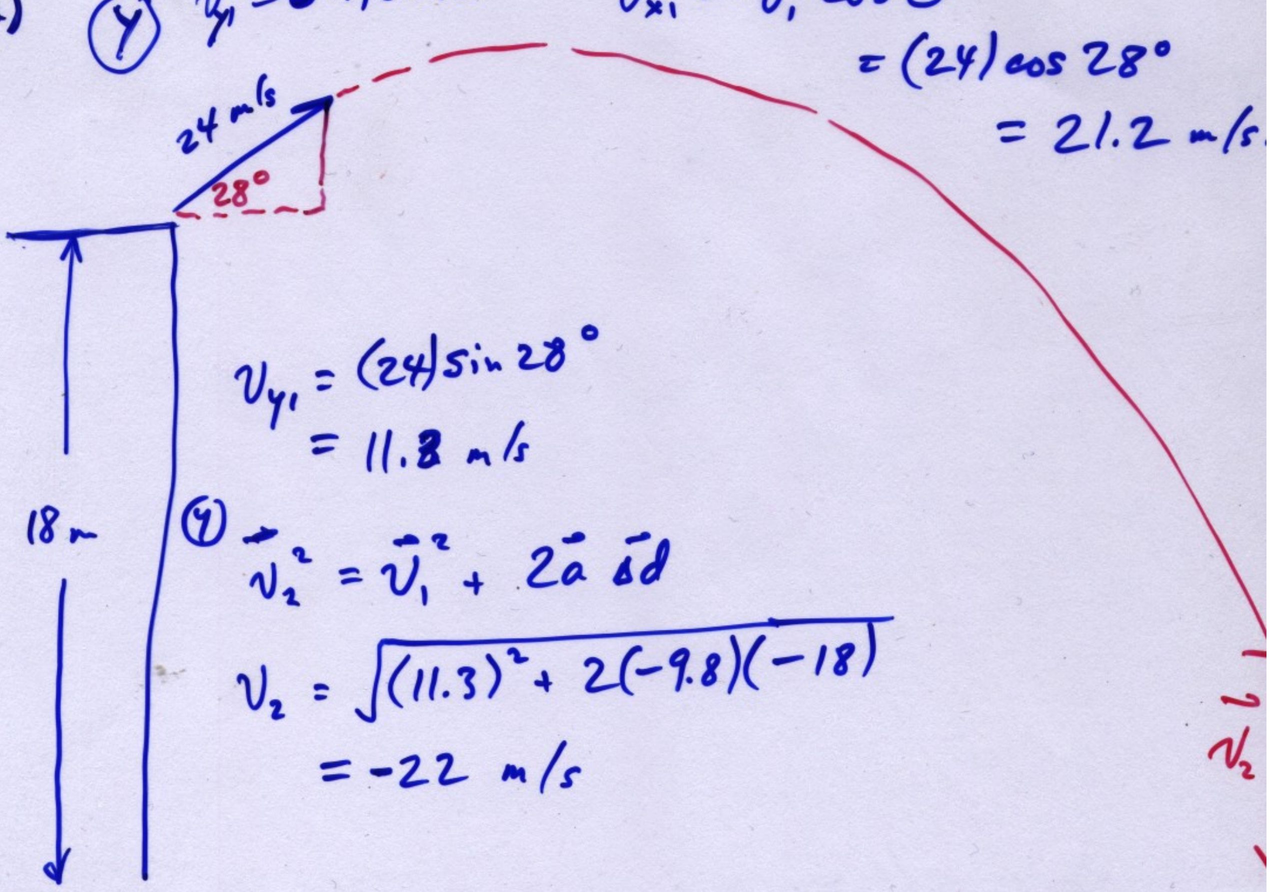
(b) Ringo's velocity when he lands.

(c) Ringo's horizontal distance from the cliff when he lands.

(a) Ⓨ $v_{y_1} = v_1 \sin\theta$ $\qquad v_{x_1} = v_1 \cos\theta$

$= (24)\cos 28°$

$= 21.2$ m/s



$v_{y_1} = (24)\sin 28°$

$= 11.3$ m/s

Ⓨ $\vec{v}_2^{\,2} = \vec{v}_1^{\,2} + 2\vec{a}\,\Delta\vec{d}$

$v_2 = \sqrt{(11.3)^2 + 2(-9.8)(-18)}$

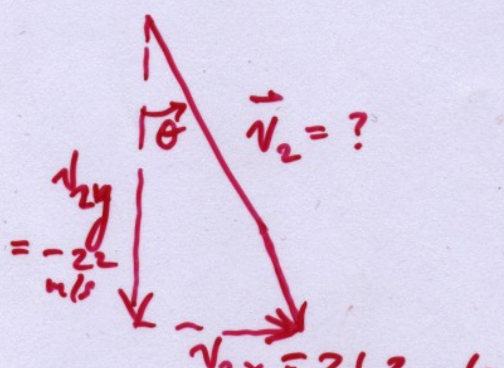
$= -22$ m/s

(Y) $\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$

$-22 = 11.3 + (-9.8)\Delta t$

$\Delta t = 3.4\ s$

(b) $\vec{v}_2 = ?$



$v_2 = \sqrt{(-22)^2 + (21.2)^2}$

$= 30.5\ m/s.$

$\tan\theta = \frac{21.2}{22}$

$\theta = 44°$

$\therefore\ \vec{v}_2 = 30.5\ m/s$ [46° below horizontal]

(c) (x) $\Delta d = v_x \Delta t$

$= (21.2)(3.4)$

$= \underline{72\,m}$