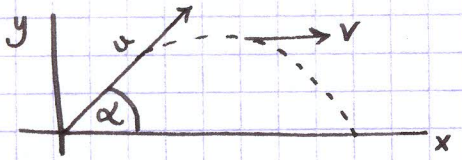
PROJECTILES

① ON A HORIZONTAL PLANE



for a particle projected with initial speed u projected at an angle of α to the horizon.

NB x direction : g does not act
y direction : g slows particle down.

	horizontal, x	Vertical, y
u	$u_x = u\cos\alpha$	$u_y = u\sin\alpha$
a	$\ddot{x} = 0$	$\ddot{y} = -g$
v	$v_x = u\cos\alpha$	$v_y = u\sin\alpha - gt$
s	$s_x = (u\cos\alpha)t$	$s_y = (u\sin\alpha)t - \frac{1}{2}gt^2$

NB if given a vector which has been resolved into i + j remember:
coefficient i = u_x
coefficient j = u_y

FIXED VALUES :

time of flight (t) $s_y = 0$

* highest point of flight $v_y = 0$

** Range, s_x $s_y = 0$ (or - height cliff)

* greatest height

$s_y = (u\sin\alpha)t - \frac{1}{2}gt^2$ $v_y = 0$

$0 = u\sin\alpha - gt$

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

$s_y = (u\sin\alpha)\left(\frac{u\sin\alpha}{g}\right) - \frac{1}{2}g\left(\frac{u\sin\alpha}{g}\right)^2$

$s_y = \frac{u^2\sin^2\alpha}{2g}$ max height

** Range (greatest s_x)

$s_x = u\cos\alpha\, t$ $s_y = 0$

$(u\sin\alpha)t - \frac{1}{2}gt^2 = 0$

$t(u\sin\alpha - \frac{1}{2}gt) = 0$

$u\sin\alpha = \frac{1}{2}gt$

$\frac{2u\sin\alpha}{g} = t$

$s_x = u\cos\alpha\left(\frac{2u\sin\alpha}{g}\right)$

$s_x = \frac{u^2\, 2\cos\alpha\sin\alpha}{g}$

$s_x = \frac{u^2\sin 2\alpha}{g}$ Range

using these 2 formulae you dont need t but you must derive them first (as above)