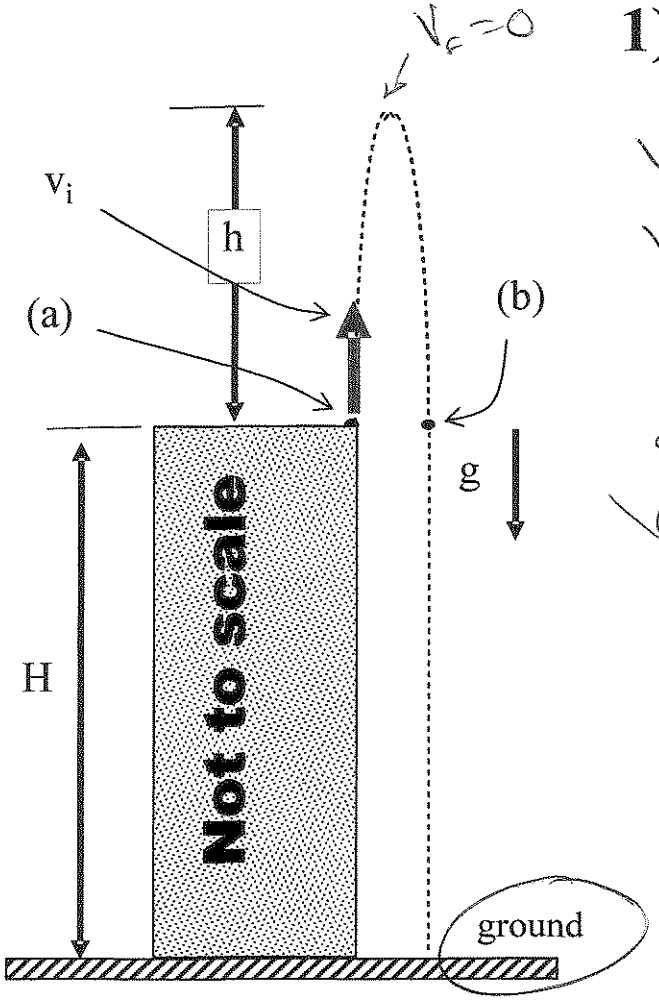
v_i =30 m/s

H = 50 m ← diff height.

g = -9.8 ms^{-2}



1) Max height ball rises above the ground

$V_i = 30\ ms^{-1}$

$V_f = 0$

$a = -9.8\ ms^{-2}$

$d = ?$

\ ≠ ignore

↑ up is +ve

use $V_f^2 = V_i^2 + 2ad$

$0 = 30^2 + 2 \times -9.8\, d$

$d = \dfrac{30^2}{2 \times 9.8}$

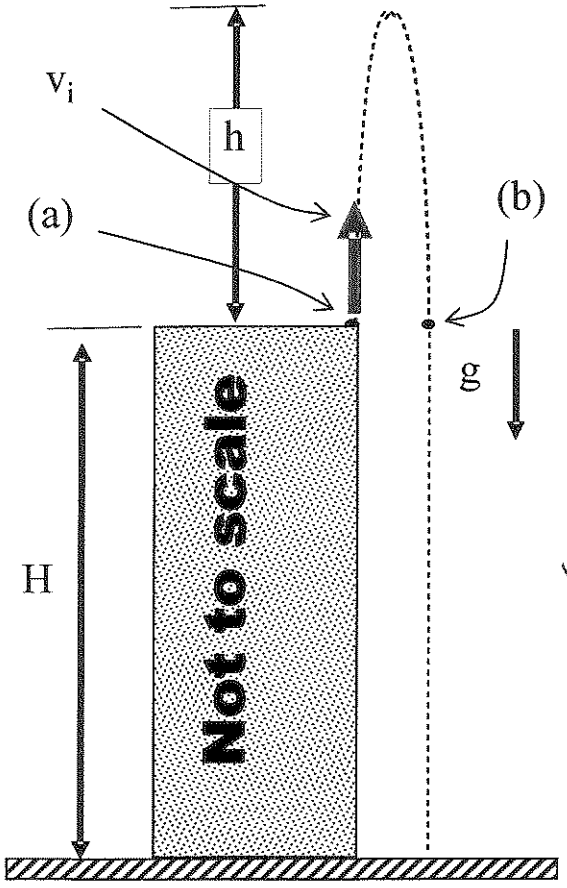
$= 45.9$

$= 46$ m 2sf

Max height = 46 + 50 = 96

v_i =30 m/s H = 50 m g = -9.8 ms^{-2}

2)Time for ball to rise to maximum height



V_i = 30 ms^{-1}

V_F = 0

a = -9.8 ms^{-2}

d = 45.9 m ← from Qu 1

t = ?

use either $V_F = V_i + at$ or $d = \frac{(V_i + V_F)}{2} t$

or $d = V_i t + \frac{1}{2} a t^2$

easiest!

hard will involve quadratics

$V_F = V_i + at$

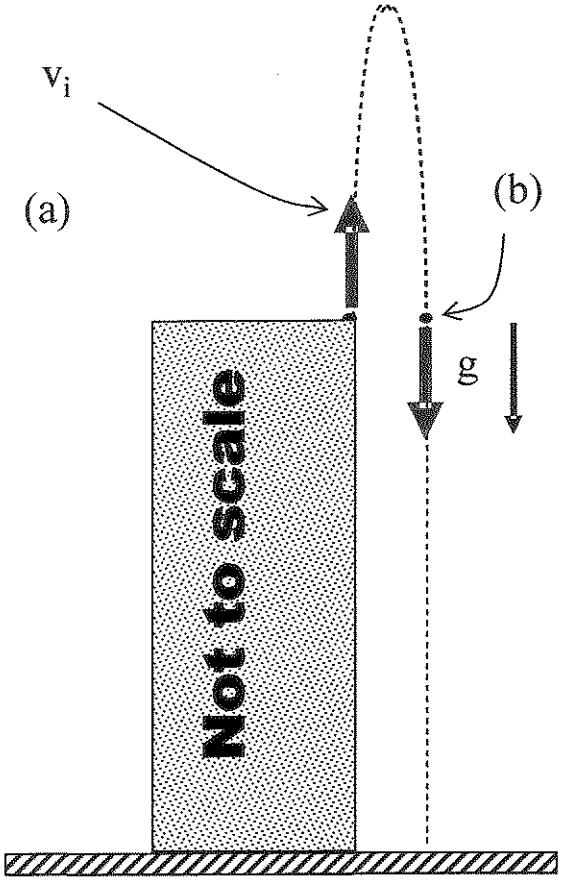
$0 = 30 + -9.8t$

$t = \frac{30}{9.8} = 3.06$

$= 3.1$ s (2 SF)

v_i =30 m/s H = 50 m g = -9.8 ms^{-2}

3)Velocity of ball at (b)



at (b) →
$V_i = 30\,ms^{-1}$
$V_F = ?$
$d = 0$
$a = -9.8\,ms^{-1}$
$t = 2 \times 3.06 = 6.1\,s$

answer => $-30\,ms^{-1}$ by logic - Symmetrical path up & down.

or $V_F = V_i + at$

$V_F = 30 + -9.8 \times 6.1$

$= -30\,ms^{-1}$

displacement vector

Note $d = 0$

or $V_F^2 = V_i^2 + 2ad$

$V_F^2 = 30^2 + 2 \times -9.8 \times 0$

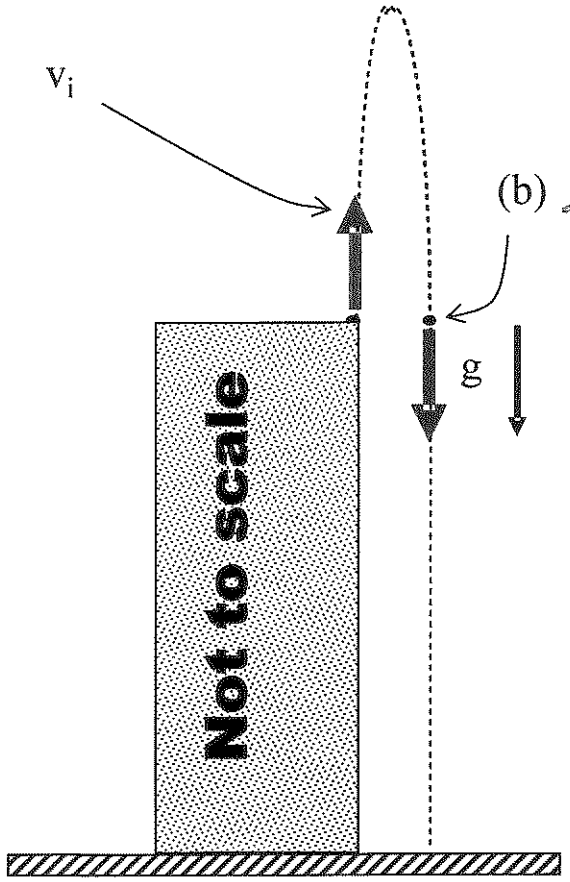
$V_F^2 = 30^2$

$V_F = \pm 30 \Rightarrow -30\,ms^{-1}$

as direction is down!

v_i =30 m/s H = 50 m g = -9.8 ms^{-2}

4)Time for ball to travel from (a) to (b)



$V_i = 30 ms^{-1}$

$V_F = -30 ms^{-1}$

at (b) $a = -9.8 ms^{-1}$

$d = 0$

$t = ?$

could also use logic

ie double answer from quadratic !

ie $t = 2 \times 3.06$

$= 6.1 s$

use $V_F = V_i + at$

$-30 = 30 + -9.8 \times t$

$-60 = -9.8t$

$t = \frac{60}{9.8}$

$= 6.1$ s 2sf

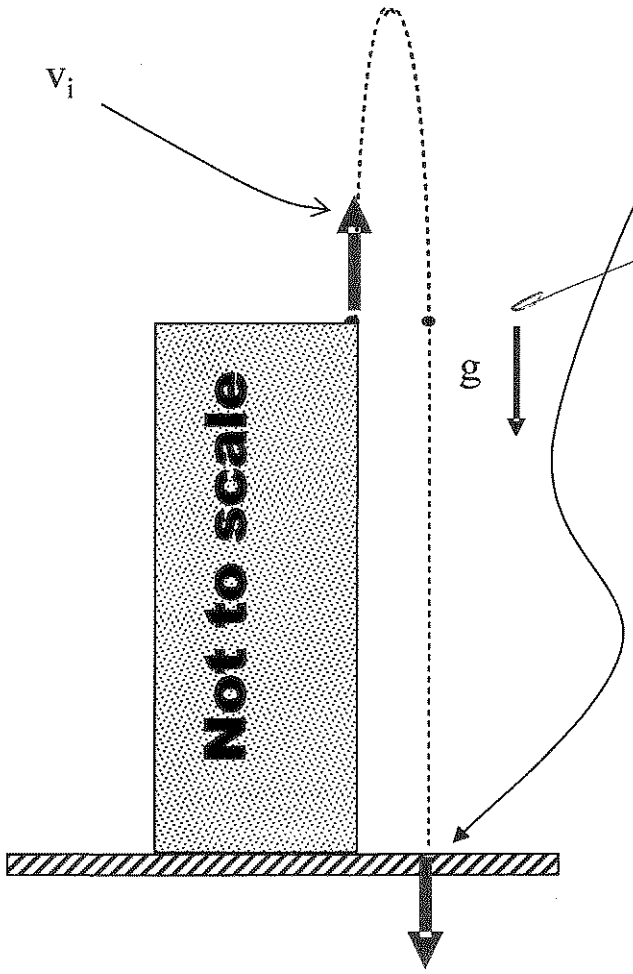
or $d = v_i t + \frac{1}{2} a t^2$

hard!

involves quadratics

v_i =30 m/s H = 50 m g = -9.8 m/s^2

5) Maximum speed of ball → ie impact speed



lots of options!

① $u = -30 ms^{-1}$
$v = ?$
$s = -50m$
t & b ignore
$a = -9.8 ms^{-2}$

-ve as is going down!

$v^2 = u^2 + 2as$
$= (-30)^2 + 2 \times -9.8 \times -50$
$= 900 + 980 =$
$v = 1880$
$v = 43.36$
$= 43m$ (2sf)

② from the top!

$u = 0$
$v = ?$
$s = -50 + -45.9$
$= -95.9m$
$a = -9.8 ms^{-2}$
t → ignore

$v^2 = u^2 + 2as$
$= 0 + 2 \times 9.8 \times -95.9$
$= 1879.64$
$v = 43.35$
$= 43m$

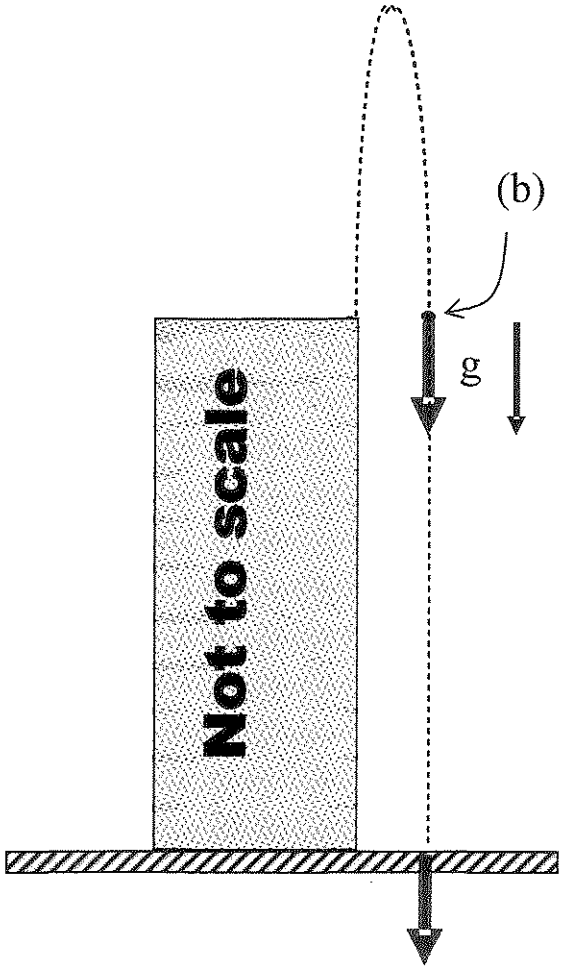
↑

① ↑

v_i =30 m/s H = 50 m g = -9.8 ms^{-2} v_{max} = 43.~~36~~ m/s

(2sf) ✓

6)Time for ball to fall from (b) to the ground



for Q5)

V_i = -30 ms^{-1}

V_F = -43.4 ms^{-1}

a = -9.8 ms^{-2}

s = -50 m

t = ?

use $V_F = V_i + at$ or $s = \frac{(V_i + V_F)}{2} t$

$-43.4 = -30 + -9.8t$

$-13.4 = -9.8t$

$t = \frac{-13.4}{-9.8}$

$= 1.36$

$= 1.4$ s

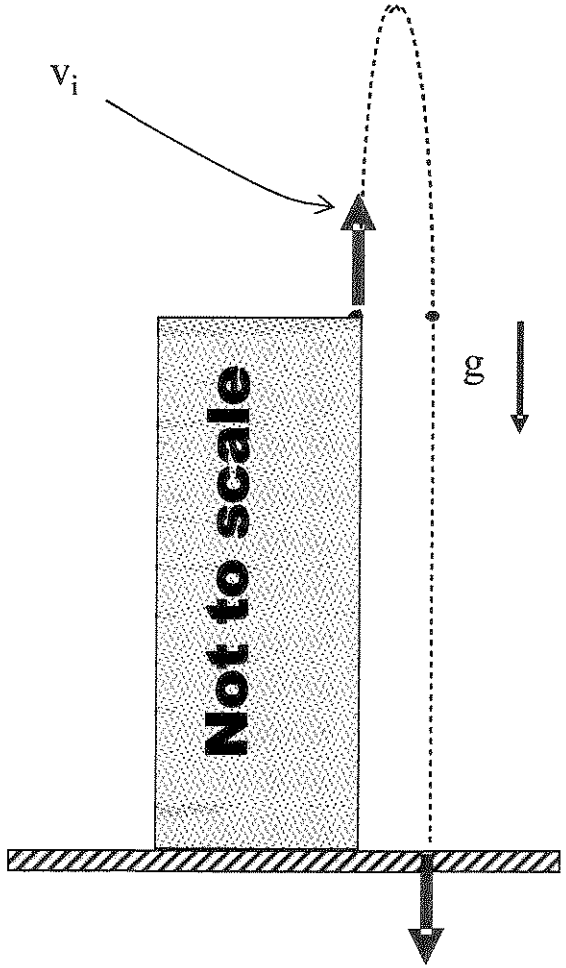
could try

$s = v_i t + \frac{1}{2} a t^2$

too hard!

v_i =30 m/s v_{max} = ~~44~~ 43 m/s g = -9.8 ms^{-2} t_1 = 6.12 s t_2 = 1.37 s

7)Total time the ball is in the air



~~$t_T = t_1 + t_2$~~ add times from Q4 & Q6 = 6.1 + 1.4

= 7.5 s

or use kinematics!

v_f = -43 ms^{-1}
u_i = 30 ms^{-1}
a = -9.8 ms^{-2}
s = -50 m
t = ?

easiest → $v_f = u_i + at$

$-43 = 30 + -9.8t$

$-73 = -9.8t$

$t = \frac{-73}{-9.8}$

$t = 7.446$

$= 7.45$

↗

3 0.1 s rounding error?