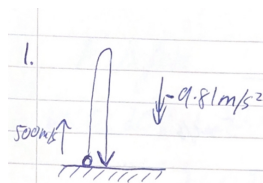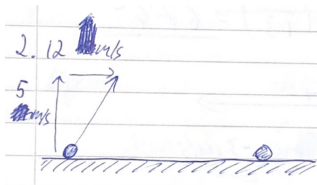# Linear Motion Problems

December 13, 2020

1. If a bullet is fired upwards from ground level at 500m/s how long will it take to hit the ground? What assumptions have you made for this calculation?

In the handwritten working:

$$S = 0 \quad \leftarrow \text{Easy to forget!}$$
$$u = 500$$
$$V = -500 \quad \leftarrow \text{by conservation of energy}$$
$$a = -9.8$$
$$t = ?$$

$$V = u + at$$
$$-500 = 500 + (-9.8)t$$
$$-1000 = -9.8t$$
$$t = 102 \text{ seconds}$$

(with diagram showing 500m/s upwards and -9.81m/s^2 downward acceleration)

2. If a football is kicked with a horizontal velocity of 12m/s and a vertical velocity of 5m/s how far away will it land and for how long will it be in flight?

2. 12 m/s

5 m/s

Horizontal	Vertical
$S = ?$	$S = 0$
$u = 12$	$u = 5$
$v = 12$	$v = -5$
$a = 0$	$a = -9.81$
$t = ?$ $1.02s$	$t = ?$
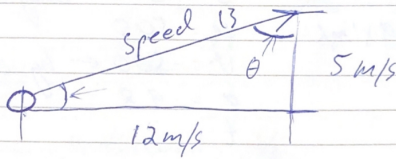
$$S = ut + \tfrac{1}{2}at^2$$

$$t = \frac{\Delta v}{a} = \frac{-10}{-9.81} = \underline{1.02s}$$

$$S = 12(1.02)$$
$$= \underline{12.2m}$$

3. In the previous question what was the ball's starting speed and starting direction measured in degrees from vertical?

3.

speed 13

θ 5 m/s

12 m/s

$$Speed = \sqrt{12^2 + 5^2} = \sqrt{144 + 25}$$
$$= \underline{13 m/s}$$

$$\theta = Sin^{-1}\left(\frac{O}{H}\right) = Sin^{-1}\left(\frac{12}{13}\right) = \underline{67.4^e}$$