**The Robin Hood Bandits**

**Teacher walkthrough**

This document will guide the teacher through the steps of the task, with advice on what to look out for and key values the investigators should get. I strongly recommend you read this before delivering the lesson to familiarise yourself with the structure of steps required.

This resource is a SUVAT centred lesson, but also deeply involves picking out important information from context. All working involved uses SUVAT in one dimension only and should therefore be accessible to Year 12. I have trialled this with a group predicted As to C’s and with a bit of guidance they were able to complete the task in about 90 minutes. Depending on their strength you can give the class tips on what to look for next. If they do go wrong somewhere and find an incorrect value, I would recommend letting them know as soon as possible as this can spiral out of control very quickly. For a weak group, encourage them to log the time everything takes as they go as this is quite a time consuming activity at the end.

Begin the task by handing out all resources except for the interview transcript (to be handed out after the maximum braking distance is discovered - step 1). The pack should include their briefing, a map of the tower, the snippet from the Wikipedia home page (although this can be excluded and left for detectives to find on their own using the internet), the news article, key suspects details and finally the 0-60 times and braking statistics of vans.

Once they have read the information on the suspects, the interactive PowerPoint can be opened to reveal those suspects. Detectives can eliminate suspects by clicking on the ‘Innocent?’ button. This will place a red cross in front of the suspects’ image. To undo this, they can then click on the ‘Guilty?’ button. Detectives should be encouraged to use as accurate solutions as possible (with final critical values needing to be at least to 2dp).

**Step 1** - detectives start by working out the deceleration required for the Van to stop in time before reaching the white tower.

**Find the maximum braking distance of the van**

detectives will need to first find the distance from the bloody gates to the white tower using the map (**50m**) – ensure this is the value they find as all future calculation will be based on this.

They will then need to convert 60 miles per hour to meters per second (**26.8224)** this is their ‘u’

v = 0

this leaves **a=-7.1944114176**

detectives then need to convert this to a braking distance from 50 miles per hour

this works out to be **34.72222222…** which should eliminate the following suspects

**Sarah, Chris, Miles Dwayne, Clark, Danielle, James Gwen.**

**Step 2**

**Find the minimum rope length**

Once they have found the breaking distance, tell the detectives that a new piece of evidence has just come to light and hand out the interview transcript. Be careful that they do not rule out all women – this is a red herring as the main suspect was always in disguise.

The transcript gives key details that the grapple hook must be travelling with a speed of **10 meters** per second on the way back down.

the detectives can use this to work out the minimum rope length required

s=s, u=0 (turning point), v=10, a =9.8 (gravity), t=t

**s= 5.10204081632653**

Add this to the height of the white tower (to be googled or handed out as part of the Wikipedia page (**27 meters**)

the rope must be at least **32.10204081632653** in length

this eliminates the following suspects

**Michael, Rhys, Amy, Joe**

**Step 3**

**Find the minimum grapple gun speed**

Now the detectives can work out how powerful the gun needs to be to propel the grapple gun to the required height

s= 32.102…, u=u, v=0, a=-9.8

which gives initial velocity as **25.083859352181**

this eliminates the following suspects

**Zoe and John**

**Step 4**

**Find the minimum vehicle acceleration.**

The detectives now need to calculate how fast the van was able to accelerate away. This is done by taking the total time of the heist away from 180 seconds (3 minutes). This is the longest step and requires a lot of accurate solutions to be combined.

First the time taken for the van to stop **3.728227153424**

It then takes **2 seconds** to get out of the van, and a further **10 seconds** to prepare for the ascent. This information is in the interview transcript.

the total time for the grapple to go up (2.55…) and then come back down(1.02…) gives a time of **3.579985648**

For the ascent, the video referred to in the interview will need to be watched. This tells the detectives that the maximum speed of ascending is **2 meters per second**. The only 2 remaining suspects both have a winch acceleration of **0.2 meters per second per second**. The detectives must first calculate the distance travelled to get to the maximum speed and note the time this takes, before then calculating the time taken to reach the top at this maximum speed.

to reach maximum speed, **10 meters** have been travelled (**leaving 17**) and this has taken **10 seconds.** The final 17 meters takes **8.5 seconds** giving a total climbing time of **18.5 seconds.**

It then takes the robbers **110 seconds** to conduct the heist and a **10 further seconds** to prepare for descending down.

On the descent, the thieves fall freely under gravity until they reach the maximum speed of 5 meters per second (from the interview). The detectives need to calculate the time to reach this maximal speed and then the remaining time to get back to earth.

To get to max velocity

s=s, u=0, v=5, a=9.8, t=t

**s= 1.27551020408163** and **t=0.510204081632653**

leaving a distance of **25.72448979591837** to descend at 5 meters per second. This takes **5.144897959183674** seconds for a total descent time of **5.655102040816327** seconds.

it then takes **10 seconds** to detach the rope and get in the van with their loot (from the interview), leaving **6.536685158** seconds to go before 3 minutes have past.

s=50, u=0, v=v, a=a, t= 6.536685158

giving **a= 2.34037184576166**

This should now be converted to be used with the table of 0-60 times of vans

s=s, u=0, v=26.8224, a=2.34…

the maximum time to get from 0-60 would be **11.4607428937306**

this eliminates **Bob** and leaves **Vicky** as the only remaining suspect.