Battle of the Hornburg: Assault on Helm's Deep

After Lurtz's failure at Amon Hen to destroy the Fellowship of the Ring and recapture the Ring for Sauron you have been chosen to replace him as leader of the Uruk-hai and Saruman's army due to your strategic genius and tactician-like attention to detail.

Gríma Wormtongue has informed you that King Théoden and the Rohirrim (people of Rohan) will flee to Helm's Deep and you must now prepare for battle. As the military mastermind of Saruman's army it is your job to make sure every detail of the assault is planned and to ensure your army the best chance of succeeding.

You have decided to utilize the vast skill sets you have available in your army, due to the large variety of races within your troops, and have laid out a plan that includes the use of grappling hooks, archers, catapults and 55-foot ladders. You have differentiated your troops and will have your weakest troops (the half-orcs and Wild Men of Dunland) storm the walls using grappling hooks, while your elite fighters, the Black Uruk, storm in on 55-foot ladders. The orcs will provide ballistic support by utilizing the 20-foot catapults you have built in preparation for this battle. Meanwhile the Uruk-hai will be providing archery support until the gate falls and your full-on ground assault can begin.

Unfortunately, your troops are comprised of orc races and Wild Men so you will need to lay out your plans as specifically as possible using quadratic equations as a means of expressing exactly where they should launch their attacks, the angle of the attacks, and with what velocity they should be firing their weapons. Despite Sauron's hatred for Gríma Wormtongue his information has proved invaluable, as he has given you an incredibly precise layout of the Hornburg (the fortress in front of Helm's Deep). From this intelligence you know the following:

- The front walls stand 50 feet tall
- Behind the 2 foot think wall stands a 3 foot thick platform standing 4 feet below the top of the wall
- After the wall there is a 15-foot gap that will be filled with ground troops prepared for hand-to-hand combat once the walls are breached.
- After this gap there is a 40-foot tall platform that will be covered with archers
- Behind these archers stands the gates to Helm's Deep

Below in the rough sketch Gríma Wormtongue has drawn for you:

Using Wormtongue's drawing you were able to attribute coordinates to different locations that you need your troops to hit. Use these coordinates to determine the quadratic equations each troop needs to launch their weapons at.

Half-Orcs and Wild Men of Dunland – Grappling hooks
- Fire from (16,6)
- Pass over the wall the (20,50)
- Land at (24,46)

Black Uruk – Ladders
- Peak of ladder's arc at (10, 55)
- Ladder lands at (20.8, 54)

Orcs – Catapult
- Begins launches just above the ground at (-470,1.2)
- Must pass through (20,60) in order to clear the wall t a safe distance
- Land at (40,42)

Uruk-hai – Archers
- Fire from (-40,6)
- Pass over the wall 106 feet in the air (20, 106)
- Land (30,6)

On graph paper sketch your battle plans and label all key points with the appropriate name and coordinate (x-intercept, vertex, etc.)

The Ringwraiths want to be able to ride their Winged Nazgûl into battle and provide aerial support, but are nervous about getting hit with stones from the catapult. Find the range of the catapult function so the Ringwraiths know how high to fly. The Ringwraiths will only come if they can fly at an altitude of 150 feet, determine whether they will be able join your troops on the battlefield.

In prepping for battle it will also be useful to know how far your catapults can launch their stones, find the domain **AND** the x-intercepts of the catapult function.

Unfortunately, the Black Uruk are a dense group of soldiers and the equation alone may not be enough to ensure they will place the ladders correctly. Using the base of the ladder (10,0) and location it should land at (20,50) create a linear function that describes the position of the ladder then sketch it on your graph.

If the Half-Orcs and Wild Men foolishly stand directly underneath the ladders they will hit the ladders and potentially kill the Black Uruks. Using the linear equation for the ladder and the quadratic equation for the grappling hooks find where the two intersect so the Black Uruks know where not to stand.

The Uruk-hai are impressive archers that shoot their arrows at over 200 miles/hr. In just 2 seconds their arrows travel 300 feet. Using the quadratic equation you found for the Uruk-hai find the coordinates of the arrows 2 seconds after the Uruk-hai release them.

Project Checklist:
- ☐ Equations for the four troop units (6.3)
- ☐ Sketch the graph for the four equations (6.6)
- ☐ Domain and Range for catapult function (6.1)
- ☐ Ladder linear equation and sketch (6.2)
- ☐ Ladder and Grappling hook intersection (6.7)
- ☐ Location of Uruk-hai arrows (1.6)

	10	**8**	**7**	**5**	**3**	**0**
Wild Men Equation	• Correct equation • All work Shown	• Correct equation, but work hard to follow	• Incorrect equation due to minor mistake	• Correct Equation, but no work	• Incorrect equation and minimal or confusing work	• No solution provided
Black Uruk Equation	See Wild Men	See Wild Men	See Wild Men	See Wild Men	See Wild Men	See Wild Men
Orcs Equation	See Wild Men	See Wild Men	See Wild Men	See Wild Men	See Wild Men	See Wild Men
Uruk-hai Equation	See Wild Men	See Wild Men	See Wild Men	See Wild Men	See Wild Men	See Wild Men
Catapult Domain & Range	• Correct D&R • Answers question	• Correct D&R • No Work _OR_ • Question unanswered	• Variables flipped, otherwise correct	• Variables flipped • Question unanswered	• Multitude of mistakes	• Section missing • Variables flipped & errors
Sketch of Battle	• Graphs for all 5 eqns correct • All key points labeled w/coordinres	• Up to 2 minor mistakes or omissions	• Missing eqn • Graphed incorrectly • Same key pt missed repeatedly	• Several key points missing/ omitted • 2 equations not graphs	• Rampant errors • Missing >2 graphs	• No graph presented in battle plans
Ladder Equation	See Wild Men	See Wild Men	See Wild Men	See Wild Men	See Wild Men	See Wild Men
Uruk-hai Arrows	• Correct solution with work shown	• Correct solution w/ minimal to no work	• Values entered into wrong location	• Incorrect result due to few errors	• Rampant mistakes in work	• No solution provided
Hook and Ladder Intersection	• Correct solution with work shown	• Correct solution w/ minimal to no work	• Incorrect solution due to minor mistake	• Correct procedure, but incorrect solution	• Incorrect solution and minimal or confusing work	• No solution provided • Overcome with errors
Presentation	• Easy to follow • Information presented in a creative manner	• Easy to follow • Engaging • Logically laid out	• Unengaging • Rationale behind layout	• Bare minimum done to improve presentation	• Hard to follow	• Confusing with parts missing

TOTAL: _____ / 100

1.6 **SWBAT… Use calculator to solve linear equations in two variables and quadratic equations**
Mastery Score: ___ / 10
6.1 **SWBAT… Interpret a function as a mathematical model and determine domain and range.**
Mastery Score: ___ / 10
6.2 **SWBAT… Create linear functions and their graphs.**
Mastery Score: ___ / 10
6.3 **SWBAT… Create quadratic models and their graphs using properties of quadratics**
Mastery Score: ___ / 10
6.6 **SWBAT… Ability to accurately create graphs, sketch graphs from provided information, and interpreting graphs including for addition and subtraction of functions.**
Mastery Score: ___ / 10
6.7 **SWBAT… Use calculator to solve equations involving any combination of function types.**
Mastery Score: ___ / 10