



## LOCKED OUT MATH: EXTRACTION ON EPSILON-8

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Welcome to Locked Out Math: Extraction on Epsilon-8. This is a fun, escape room experience that is alien-horror themed. This locked room is designed for grade 10+ students. Some of the main concepts students will **need** to solve the puzzles are listed below:

- Kinematics (acceleration, velocity, displacement)
- Vectors
- Logic and reasoning
- Angles
- Coordinate geometry
- Unit Conversion

Completing the entire escape room is intended to take 60-120 minutes (depending on strength of students). This document includes instructions for each of the three parts, and all printable files. Answer sheet includes scannable QR codes, so students may continue to play along for homework.

## INSTRUCTIONS

The room is split up in to three main parts. The description and goal of each is listed below:

1. Unlock the missile targeting system (logic puzzle)
2. Locate marines position (velocity/displacement/time problems)
3. Program the missile target system (missile casing/material/fuel selection and parabolic motion problems)

These are all the materials included and directions on how to use them:

- **Description:** This gives students the story of what is going on. Groups play as marine crews investigating a distress call on the planet Epsilon-8.
- **Emergency Transmission:** This is the distress signal from Epsilon-8. You should print one large copy for everyone participating. It includes information on how to override the missile system, and the vertical projection angle ( $30^\circ$ ).
- **Origin Labs:** This shows the alien infested facility with clues about the marines positions, gravitational test fire, and more. One large copy should be printed for everyone participating.
- **Missile Field Journal:** This includes data to help select the right missile casing, material, and fuel.
- **Answers:** Answers to all puzzles are written here. There is also solutions to the algebra/probability problems. This particular escape room has been play tested many times.

## EPSILON-8 EXTRACTION

Your squad of marines has been deployed to Epsilon-8 in response to a distress signal from Dr. Veylen Deltais, a scientist stationed at Origin Labs, an underground research facility.

Two teams were sent in response. Marine Crew 2 landed near the surface beacon and began tracking the aliens across the barren landscape. Meanwhile, your crew descended into the underground research facility.

The deeper you go, the clearer the grim reality becomes. The base is in ruins. The bodies of scientists and security personnel litter the halls, their wounds unnatural. The air is thick with decay, and something skitters just beyond the flickering emergency lights.

Worse, the missile defense system has gone into lockdown, leaving the colony on Epsilon-8 vulnerable. Marine Crew 2 is transmitting their position using their communications transponder, but for some reason, the planet's interference is preventing them from sending precise GPS coordinates. Messages are spotty and sporadic. You don't know exactly where they are—only that they're out there, moving fast, and they're not alone.

Your objectives are clear: Override the lockdown. Fire the missile at the alien hive. Transmit extraction coordinates to evacuate Marine Crew 2.

Time is running out. The facility isn't safe. The planet isn't safe. The only question is—will you make it out alive?

Subject: \*\*\*URGENT\*\*\* – FACILITY UNDER ATTACK

This is Dr. Veylen Deltais –

The aliens are here. They are everywhere. They have breached Origin Labs defenses, and they are killing everyone – Everyone.

The facility is in chaos, and there is no time left. If you do not act now, the hive will spread, and Epsilon-8 will be lost forever. You must not let the hive survive –

The missile defense system is locked down, but you can override it. You need to find the systems panel. It is located near the central core room. It is easy to spot – composed of bright LED lights, and plugs –

To override the system you will need to use breaker plugs– Insert breakers into the system panel's plugs, but be careful–there must be exactly one breaker vertically or horizontally adjacent to each LED light. Be sure to place the correct number of breakers into each row and column. The breakers cannot be put into adjacent plugs –

The gravitational calibration test launch was the last time a missile was fired – You should still be able to rotate the cannons to fire in any direction, but the vertical projection angle jammed at 30° – We shouldn't have tried adjusting it following the test launch. – Missiles are always fired at the same speed –

I'm forwarding a photo so you know what you're up against. It's crucial that you recognize the danger. If you fail, the lockdown will remain, and the aliens will only grow stronger. The future of the mission is in your hands –





# Communications Transponder

8:00

**Marine Crew 2:** We've been rucking through the alien landscape, traveling straight north. The terrain is harsh, and the air is thick with an unsettling tension. Along the way, we discovered dead human remains—the bodies were viciously torn apart. The aliens are getting closer. We've set our course to track them back to their hive, no matter the cost. Our speed will remain constant to maintain steady progress, and we will send updates if we change position. We've transmitted our current GPS coordinates to the lab, but the interference we're experiencing seems to be caused by the planet's magnetic fields, which are preventing further GPS pings from reaching the satellite. It's a challenge, but we'll keep going.

## Gravitational calibration test fire

Missile Direction

$$\vec{s} = \begin{bmatrix} s_{\text{East/West}} \\ s_{\text{North/South}} \end{bmatrix} = \begin{bmatrix} 17 \\ 7 \end{bmatrix}$$

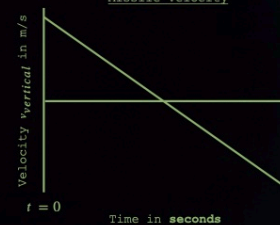
Initial Velocity

$$\vec{v}_i = \begin{bmatrix} v_{\text{horizontal}} = 300 \text{ m/s} \\ v_{\text{vertical}} = 400 \text{ m/s} \end{bmatrix}$$

Vertical Position



Missile velocity



Fuel Used: 50 L

$\vec{g} = \dots$  loading ...





#### Communications Transponder

12:15

**Marine Crew 2:** We've picked up the scent and adjusted our velocity to match the aliens' movements. We are now traveling at the velocity vector given below:

$$\vec{v} = \begin{bmatrix} v_{\text{East/West}} = -1\frac{2}{3} \text{ m/s} \\ v_{\text{North/South}} = 2\frac{2}{3} \text{ km/hr} \end{bmatrix}$$

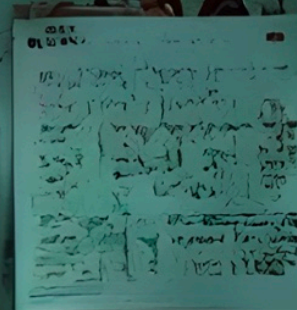
We're making good time with the planet's gravity, we're pushing forward – we can feel the hive is close. If we continue on this course, we'll be there soon.



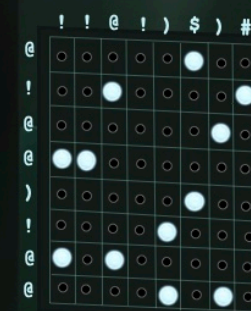
Communications Transponder

18:15

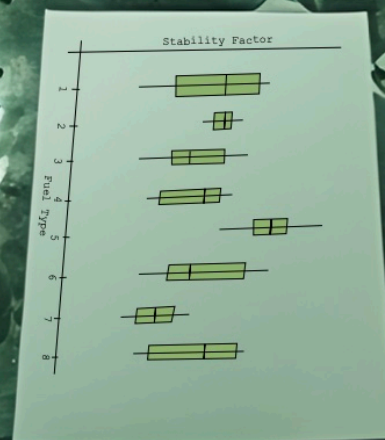
**Marine Crew 2:** We stopped right over the hive! It's time to make a break for it. We are headed straight West! The team accelerated at a constant  $1/6 \text{ m/s}^2$  for 30 seconds straight, then kept steady at that pace for exactly 119 minutes and 45 seconds, not a second longer. After that, we'll hunker down, dig in, and await extraction. We'll make sure everything is ready, but it's going to be a dangerous wait.



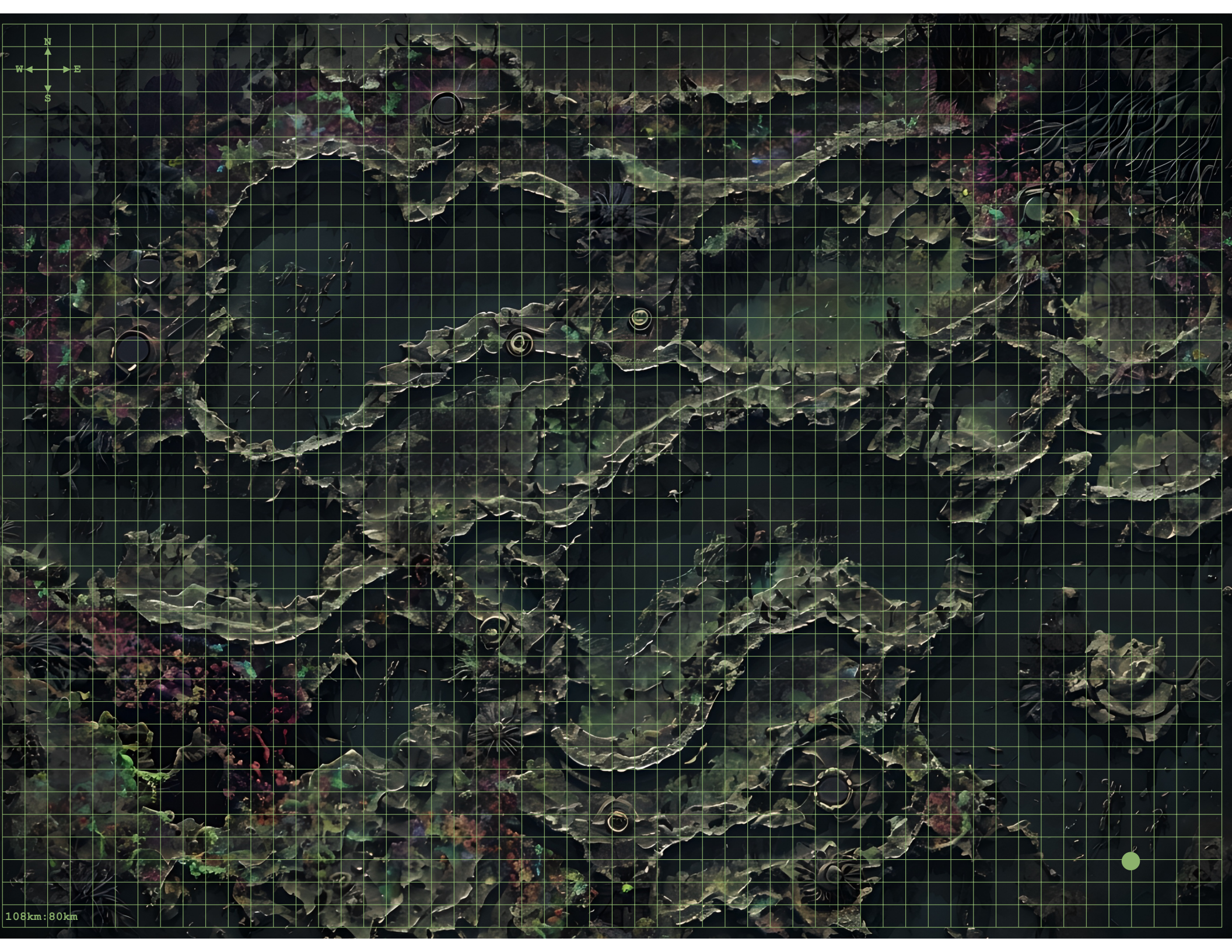
1130





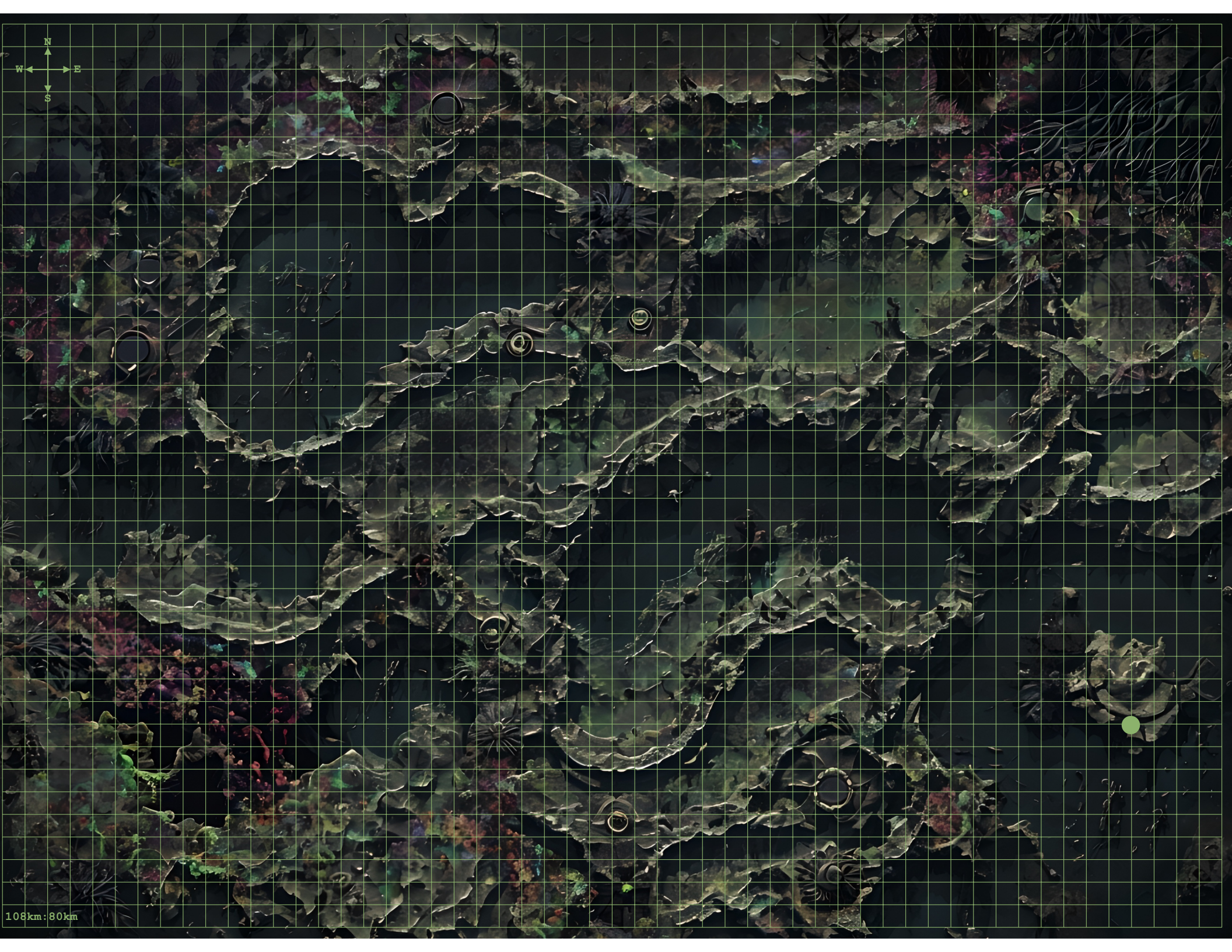






108km:80km







## Classified Research Notes – Secure Access Only

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Through extensive missile trials and statistical analysis, it has become evident that the choice of casing plays a pivotal role in launch success. Structural integrity under high-pressure conditions, resistance to atmospheric interference, and thermal resilience have all been tested rigorously. After evaluating the results, it is clear that the casing which maximizes the chance of a successful launch is determined by (in lowest terms) the conditional probability:

$$P(\text{Casing} \mid \text{Success}) = \frac{a}{b}$$

Only the casing that maximizes this probability should be selected, ensuring the missile is built for optimal performance in the harsh conditions of Epsilon-8.

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Similarly, the choice of missile material has shown significant impact on structural durability and energy transfer efficiency upon detonation. The correct material must be capable of withstanding extreme acceleration forces while maintaining its integrity upon impact. Through controlled test fires, it has been determined that the material which maximizes the probability of success can be identified (in lowest terms) by:

$$P(\text{Success} \mid \text{Material}) = \frac{c}{d}$$

The test results must be carefully analyzed to isolate the optimal material, ensuring the missile delivers its payload effectively. Any deviation from the correct selection could compromise the mission.

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Missile fuel stability has proven to be another decisive factor. After extensive trials, the most reliable fuel is consistently the one with the lowest variance in stability factor. Deviations in fuel consistency have led to catastrophic failures. Only the most stable fuel should be used. We have been experimenting with several different fuels:

1. Dark Matter Infused – 2.3 g/mL
  2. Exotic Metal Fuel – 2.4 g/mL
  3. Hyper-Oxidized Gel – 1.8 g/mL
  4. Ionized Hydrogen – 0.07 g/mL
  5. Neutron-Rich Solvent – 3.5 g/mL
  6. Plasma-Fission Blend – 2.9 g/mL
  7. Solid Oxygen – 1.14 g/mL
  8. Thermoplastic – 2.6 g/mL
- 

With the correct casing, material, and fuel selected, the missile will be ready for launch. The initial speed of a launched missile is always the same. Precision is paramount—any errors in selection could compromise the mission. Proceed with caution.

## Missile Test Launch Data - Classified

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|    | Missile.Casing    | Missile.Material       | Outcome |
|----|-------------------|------------------------|---------|
| 1  | Plasma-Reinforced | Carbon Composite       | Success |
| 2  | Titanium X        | Carbon Composite       | Success |
| 3  | Plasma-Reinforced | Plasma-Fused Nanometal | Success |
| 4  | Titanium X        | Plasma-Fused Nanometal | Success |
| 5  | Ceramic-Stealth   | Tungsten Alloy         | Success |
| 6  | Titanium X        | Carbon Composite       | Success |
| 7  | Ceramic-Stealth   | Carbon Composite       | Failure |
| 8  | Titanium X        | Plasma-Fused Nanometal | Success |
| 9  | Ceramic-Stealth   | Plasma-Fused Nanometal | Failure |
| 10 | Plasma-Reinforced | Tungsten Alloy         | Success |
| 11 | Plasma-Reinforced | Carbon Composite       | Success |
| 12 | Plasma-Reinforced | Plasma-Fused Nanometal | Success |
| 13 | Plasma-Reinforced | Tungsten Alloy         | Failure |
| 14 | Ceramic-Stealth   | Tungsten Alloy         | Success |
| 15 | Ceramic-Stealth   | Carbon Composite       | Failure |
| 16 | Plasma-Reinforced | Plasma-Fused Nanometal | Success |
| 17 | Plasma-Reinforced | Plasma-Fused Nanometal | Failure |
| 18 | Ceramic-Stealth   | Tungsten Alloy         | Success |
| 19 | Ceramic-Stealth   | Tungsten Alloy         | Failure |
| 20 | Titanium X        | Plasma-Fused Nanometal | Success |
| 21 | Ceramic-Stealth   | Tungsten Alloy         | Failure |
| 22 | Ceramic-Stealth   | Plasma-Fused Nanometal | Failure |
| 23 | Ceramic-Stealth   | Plasma-Fused Nanometal | Failure |
| 24 | Ceramic-Stealth   | Carbon Composite       | Failure |
| 25 | Ceramic-Stealth   | Plasma-Fused Nanometal | Failure |
| 26 | Ceramic-Stealth   | Carbon Composite       | Failure |
| 27 | Titanium X        | Carbon Composite       | Success |
| 28 | Titanium X        | Carbon Composite       | Success |
| 29 | Titanium X        | Carbon Composite       | Success |
| 30 | Plasma-Reinforced | Plasma-Fused Nanometal | Success |
| 31 | Plasma-Reinforced | Plasma-Fused Nanometal | Success |
| 32 | Titanium X        | Tungsten Alloy         | Success |
| 33 | Titanium X        | Plasma-Fused Nanometal | Success |
| 34 | Ceramic-Stealth   | Carbon Composite       | Success |
| 35 | Plasma-Reinforced | Tungsten Alloy         | Success |
| 36 | Plasma-Reinforced | Tungsten Alloy         | Failure |
| 37 | Titanium X        | Plasma-Fused Nanometal | Success |
| 38 | Ceramic-Stealth   | Plasma-Fused Nanometal | Failure |
| 39 | Ceramic-Stealth   | Plasma-Fused Nanometal | Failure |
| 40 | Plasma-Reinforced | Plasma-Fused Nanometal | Success |
| 41 | Plasma-Reinforced | Tungsten Alloy         | Success |
| 42 | Titanium X        | Plasma-Fused Nanometal | Success |
| 43 | Plasma-Reinforced | Carbon Composite       | Success |
| 44 | Ceramic-Stealth   | Carbon Composite       | Failure |
| 45 | Titanium X        | Plasma-Fused Nanometal | Success |
| 46 | Titanium X        | Plasma-Fused Nanometal | Success |
| 47 | Ceramic-Stealth   | Tungsten Alloy         | Failure |
| 48 | Ceramic-Stealth   | Carbon Composite       | Success |
| 49 | Ceramic-Stealth   | Tungsten Alloy         | Failure |
| 50 | Ceramic-Stealth   | Plasma-Fused Nanometal | Failure |

#### 4) Program the missile system and fire at the hive

##### Missile Control Schematics

|                                  |                   |
|----------------------------------|-------------------|
| Clockwise angle of rotation      | $\theta =$        |
| Vertical angle of projection     | $\phi = 30^\circ$ |
| Epsilon-8 Gravitational Constant | $\vec{g} =$       |

Displacement components from lab to target

$$\vec{s} = \begin{bmatrix} s_{East/West} \\ s_{North/South} \end{bmatrix} = \begin{bmatrix} \phantom{0} \\ \phantom{0} \end{bmatrix}$$

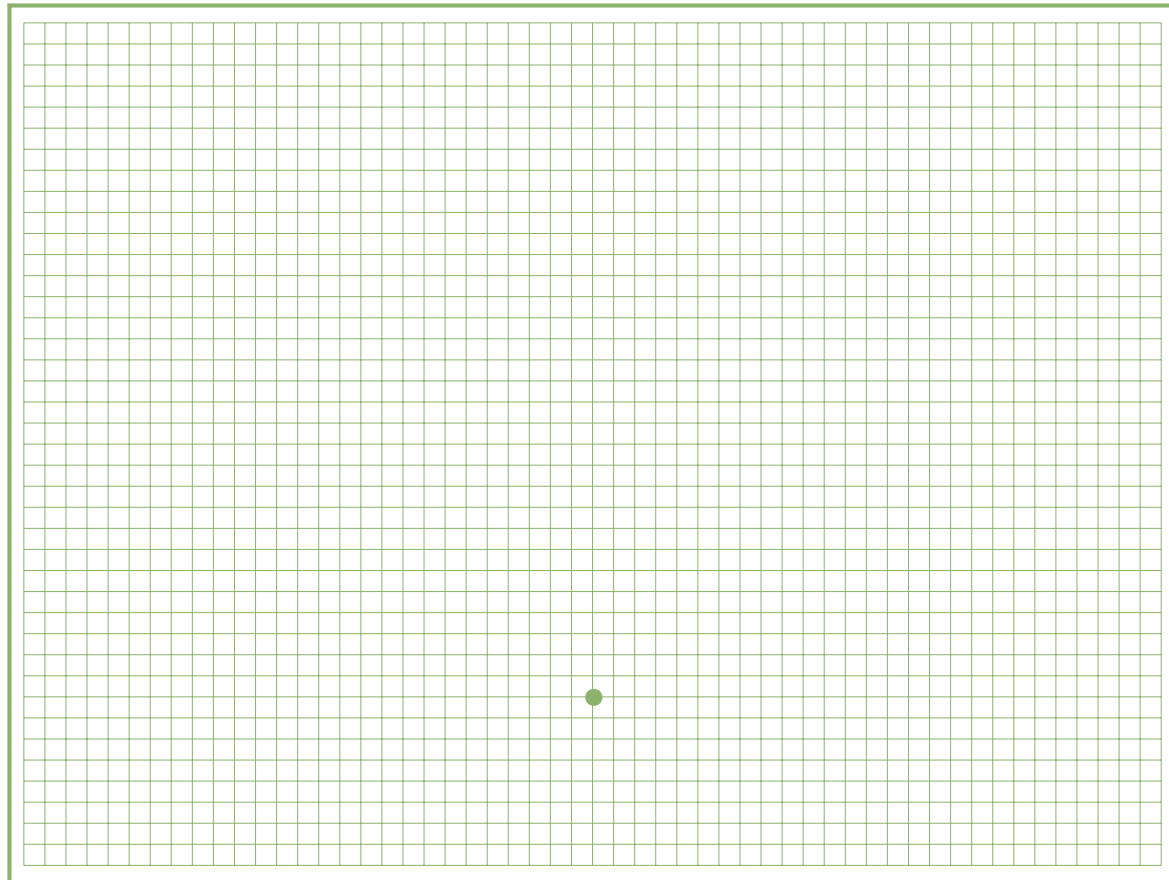
Initial velocity components (m/s)

$$\vec{v} = \begin{bmatrix} v_{horizontal} \\ v_{vertical} \end{bmatrix} = \begin{bmatrix} \phantom{0} \\ \phantom{0} \end{bmatrix}$$

Initial speed (m/s)

$$\|\vec{v}\| = \boxed{\phantom{000}}$$

Fuel Selection:



Draw the direction vector from your position to the hive, and the test missile direction vector



1) Override the missile target system to fire missile

Place circles where LEDs are located.  
Shade the cells where you plug breakers

3) Select Missile Material/Casing

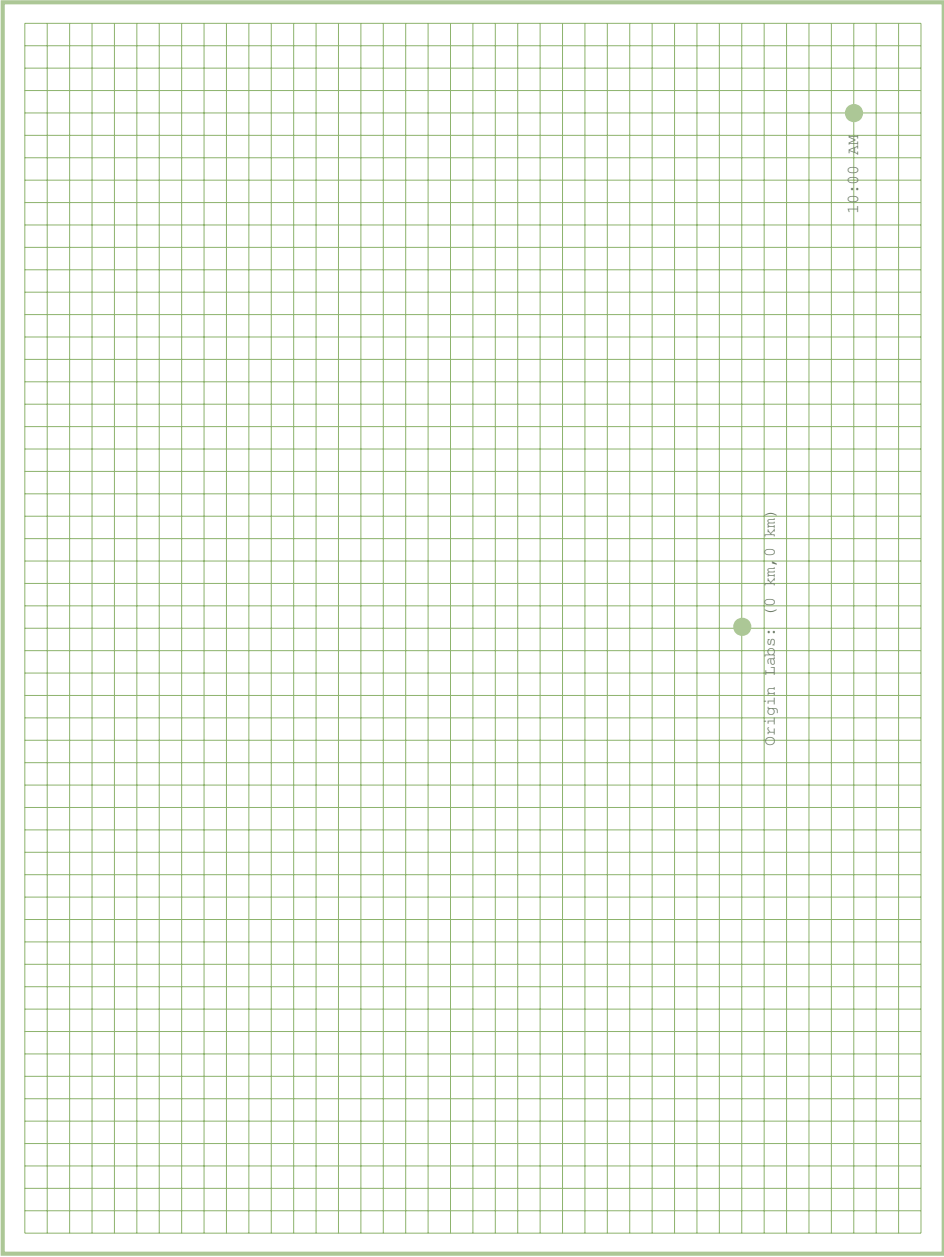
Casing

Casing Selected:  
a+b=

Material

Material Selected:  
c+d=

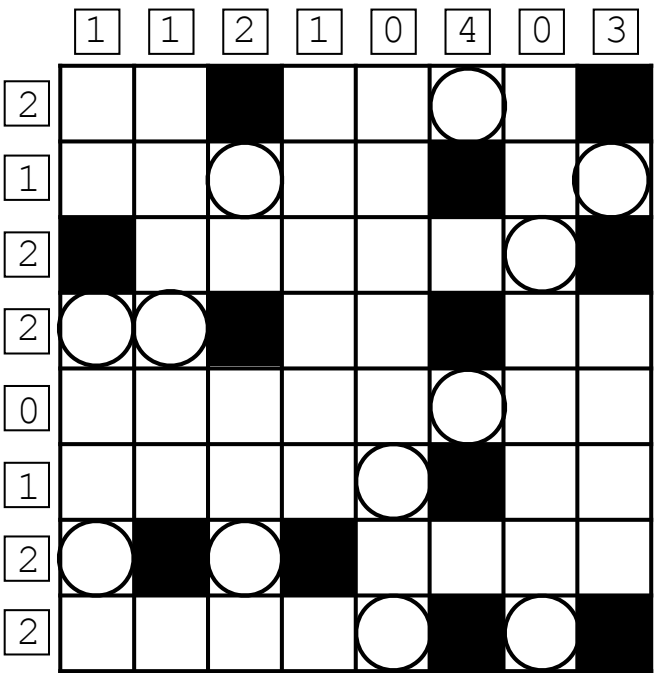
2) Send extraction chopper to Marine Crew 2's coordinates:  $\sigma + \beta =$



Marine Crew 2 is awaiting extraction at  $(\sigma, \beta)$



1) Override the missile target system to fire missile



Place circles where LEDs are located.  
Shade the cells where you plug breakers

3) Select Missile Material/Casing

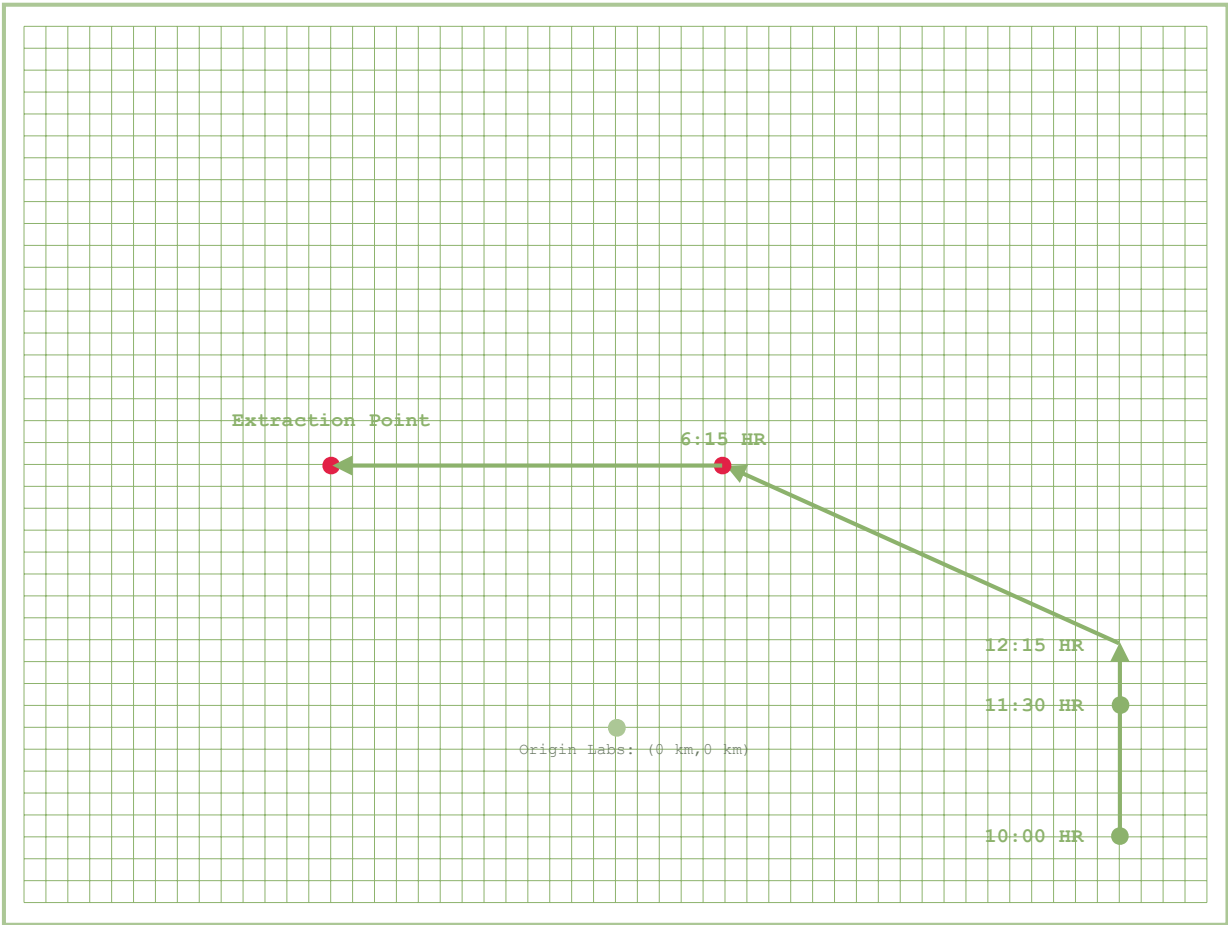
|         |         | Casing  |        |          |
|---------|---------|---------|--------|----------|
|         |         | Ceramic | Plasma | Titanium |
| Outcome | Failure | 16      | 3      | 0        |
|         | Success | 5       | 12     | 14       |
|         |         | 21      | 15     | 14       |

Casing Selected: Titanium X  
a+b= 45

|         |         | Material |        |          |
|---------|---------|----------|--------|----------|
|         |         | Carbon   | Plasma | Tungsten |
| Outcome | Failure | 5        | 8      | 6        |
|         | Success | 10       | 14     | 7        |
|         |         | 15       | 22     | 13       |

Material Selected: Carbon Composite  
c+d= 5

2) Send extraction chopper to Marine Crew 2's coordinates:  $\sigma + \beta =$  2



Marine Crew 2 is awaiting extraction at  $(\sigma, \beta)$

#### 4) Program the missile system and fire at the hive

##### Missile Control Schematics

|                                  |                             |
|----------------------------------|-----------------------------|
| Clockwise angle of rotation      | $\theta = 45^\circ$         |
| Vertical angle of projection     | $\phi = 30^\circ$           |
| Epsilon-8 Gravitational Constant | $\vec{g} = 8 \text{ m/s}^2$ |

Displacement components from lab to target

$$\vec{s} = \begin{bmatrix} s_{\text{East/West}} \\ s_{\text{North/South}} \end{bmatrix} = \begin{bmatrix} 10 \text{ km} \\ 12 \text{ km} \end{bmatrix}$$

Initial velocity components (m/s)

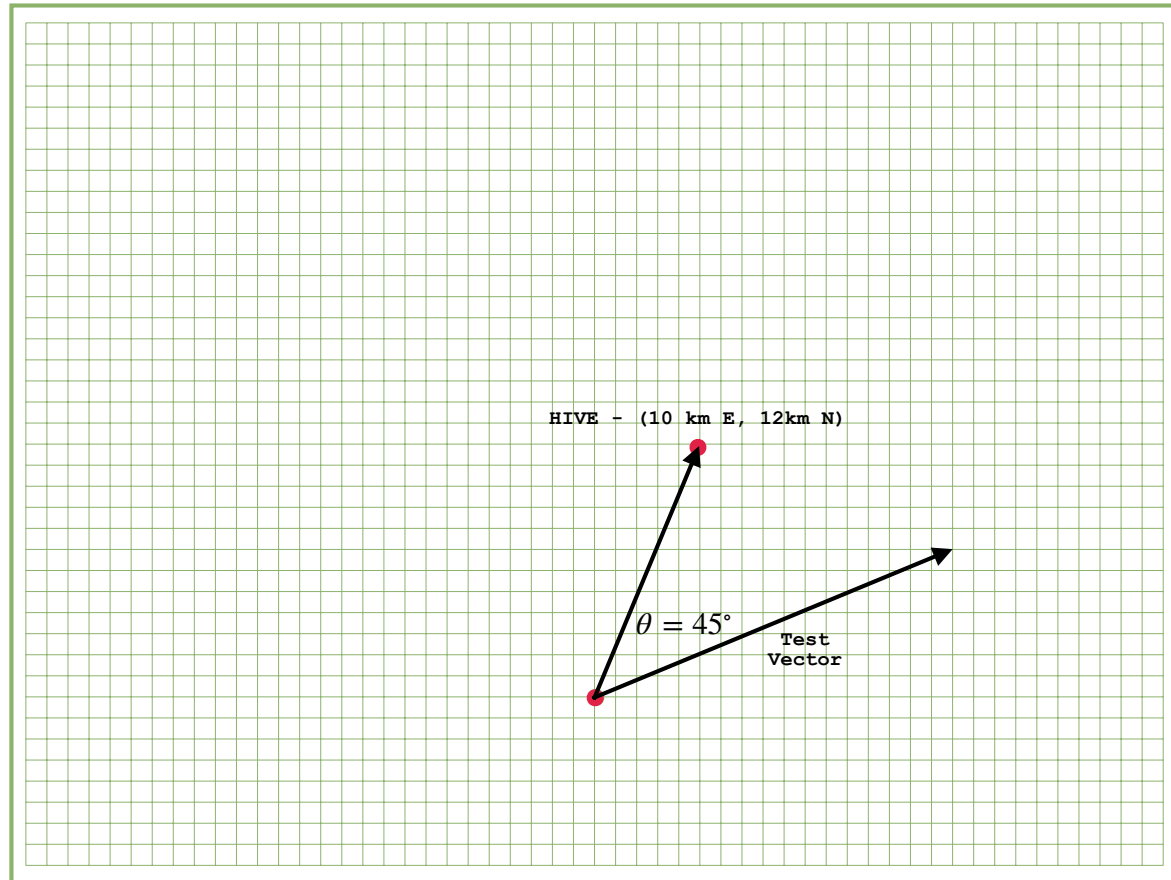
$$\vec{v} = \begin{bmatrix} v_{\text{horizontal}} \\ v_{\text{vertical}} \end{bmatrix} = \begin{bmatrix} 433.0127 \text{ m/s} \\ 250 \text{ m/s} \end{bmatrix}$$

Initial speed (m/s)

$$\|\vec{v}\| = 500 \text{ m/s}$$

Fuel Selection:

Exotic Metal Fuel



Draw the direction vector from your position to the hive, and the test missile direction vector