**The Background:** Skip to page 2 if your are impatient. (This section has been set aside for the pending "Racer Design" activity)

The Racing and Design Association of Veloren 7 "RADAV" hosts an annual rally through their course among 21 moons around a designated gas giant. A different gas giant is chosen each year. The Veloren course specifies one 50 km altitude "Touch and go" intercept at each of 21 selected natural satellites. Competitors start from a randomly selected moon. The course ends upon returning to the starting position. eg. If you start at B3, you must finish at B3. The shortest time (Most efficient propellant usage) wins. It takes a minimum of four orbits to complete the course.

Only Newtonian reaction thrust and optical navigation is permitted. So dust off your sextant and slide rule. Ship's mass (dry + propellant), computer processor, thruster tech, and power plant are limited by the Kayak Class standard (historically referred to as "Estes") TL-5.5?

These featherweight single/double occupant craft vary widely in configuration and design choice. Factors crucial in previous championships have been, heat management, propellant conservation, attitude control, and power source decisions. Innovation is strongly encouraged.
The winners receive fabulous prizes, but all competitors gain fame and prestige. No gambling!
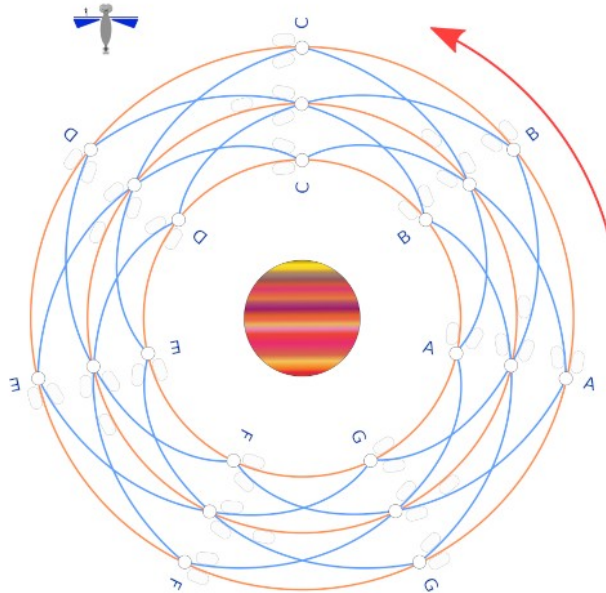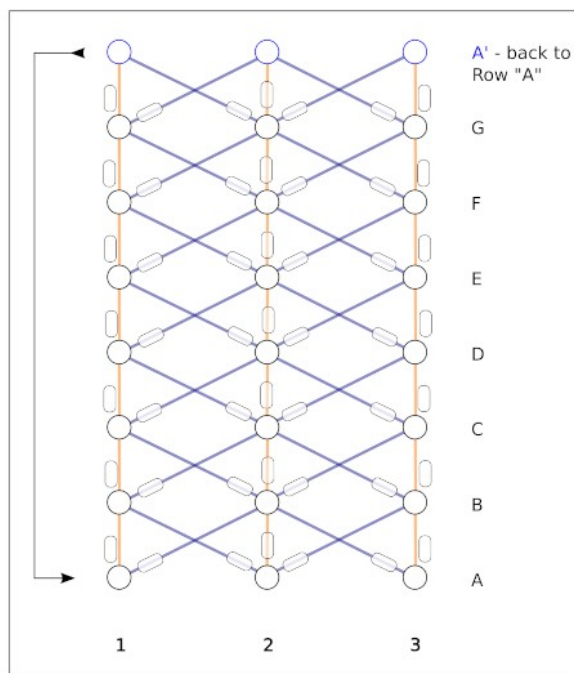
The Game:

There are 21 moons orbiting a gas giant arranged on a 7 by 3 grid in rows A-G, and columns 1,2,3.
There are 7 trajectories from each row to the next for a total of 49 per orbit.
This gives 2 to 3 choices per moon for a total of over 20 billion variations over 4 orbits.*
Each trajectory requires a fixed propellant mass in Kg. (This is equivalent to Time, or Delta-Vee)

- **Step 0)**
  Lay out the course trajectory values. (Kg propellant)
  Roll one D6x2 (2,4,6,8,10,12) for each of the 49 trajectories
  and record the Kg values in the boxes on each trajectory line.
  These values will not change for this competition.
  You may keep using this course, or create a new one for each annual event.

- **Step 1)**
  Players may dump propellant to lighten their craft to gain a scoring & attack advantage.
  This is done openly, and repeated till all players are ready to start the race. Each player may dump
  once more at the end of their first lap at their home row. You start with 200 kg. How low can you go?

- **Step 2) ****
  Players start on a random moon (home) on either an Inner or Outer orbital. (col 1 or col 3) and must
  visit every moon at least once. Every turn consists of three trajectory Burns to intercept three moons.
  Players must intercept all 21 moons and return home. It takes a minimum of four orbits around the
  gas giant to visit all 21 moons and get back home. Movement is forward only on marked trajectories.

- **Step 3)**
  Moving through a trajectory to the next moon is referred to as a "Burn". Players start with 200 Kg of
  propellant and subtract the value listed from their tank for each burn. Don't run out before the end!
  The player with the most efficient propellant score wins.*

- **Step 4)**
  Each turn consists of 3 Burns to 3 moons. Players may engage one "Risky Maneuver" per turn at the
  end of any one of their three Burns. Rolling 10-12 on Burn-3 applies to Burn-1 of your next turn. To
  engage a risky maneuver, roll 2D6, add your dump/jamming modifiers, and apply the table results.

- **Step 5)**
  Jamming. In place of a "Risky Maneuver" a player may attempt an illegal* jamming attack on any
  opponent. The Attacker rolls 1D6 and adds 1 for every 10kg propellant dumped. The Defender does
  the same. The higher roll wins. The loser subtracts 1 from all future "Risky Maneuver" rolls.
  Jamming hits are cumulative. 3 hits subtracts 3 from all future risk rolls. Failed rolls backfire on the
  Attacker. Only one attack per turn. Jamming damage cannot be repaired in-flight.

- **Finish Line**
  The Final Score is the total propellant burnt Minus twice the total you dumped.
  The lower the score, the more efficiently you piloted. Lowest score wins.

RISKY MANEUVER TABLE (These effects are not cumulative. Only #3 is permanent)

2* -- Missed Target. (1/36) Failed to intercept **this** moon on **this** orbit. (catch it the next time)
3 -- Navigation Fault. (2/36) You intercepted this moon but its trajectories are now off limits to you.
4, 5 -- Thruster Misalignment. (7/36) Add 4 Kg penalty points.
6, 7 -- Successful Maneuver (11/36)
8, 9 -- Efficiency Bonus. (9/36) Cut 2 Kg penalty points.
10, 11 – Favorable Syzygy (5/36) Cut the **next** Kg penalty by half.
12 – "Slingshot ! " (1/36) next trajectory is free !
* (Any modified roll below a 2 results in a 'Missed Target')

Clarifications:

A racer can visit any moon as many times as necessary. (Unless a "Risky Maneuver 3" has blocked it.)
A navigation fault only applies to the racer that rolled it.
Racers record their moves and the propellant penalties on their provided score cards.
To speed up the bookkeeping, give each racer 4 copies of the rectangular grid and label them;
    First Orbit, Second Orbit, Third Orbit, Fourth Orbit.
    Racers tick off each moon as it is visited and record all kg penalties/bonuses.
    A highlighter over the flightpath seems to help.

Everyone can see everyone else's propellant and ship status. Like a chess game, nothing is hidden.
Bookkeeping might be easier by giving out 200 candies to each player and . . . oh wait, that's too much
candy. Maybe 200 walnuts. It's definitely more fun when everyone sees the scores dropping at each
move. And it helps in deciding when to engage a "Risky Maneuver" or "Jamming Attack".

The fractions in parenthesis are the odds in a 2D6 roll (36/36) = 100%

The moon diagrams show three orbital rings; 1=Inner, 2=Center, 3=Outer.
In the rectangular score card diagram, row A is repeated at the top as A' (A-Prime).
Move game pieces at A' back down to the bottom row "A" to start the next orbit. Or use a new card.
See the round orbital diagram for clarity.

Use a spreadsheet to generate the 49 kg values. The formula is: =2 * FLOOR(RAND() * 6 + 1)

Three choices over 28 burns (four orbits) gives $3 \wedge 28$ or $2 * 10^{13}$ = ~20 billion variations

Why does page one waste time talking about the spacecraft design when there isn't any in the game?
I had to split that off into a separate activity as it was getting bogged down in development. I will re-
write page one after I get some more feedback from the play-testers. The Racer Design mechanic will
probably end up as . . .   (Sorry, I ran out of Double Mochaspressos) Zzzzzz...

As applied to Traveller Campaigns:

The game mechanic is based on the well known "Travelling Salesman Problem", and the Delta-V Budget maps compiled by Nasa/JPL. Picking the shortest route wins the game barring bad die rolls. It's harder than it looks. There are over 20 billion permutations. Taking risks has rewards.

"So, your Travellers need a break and would like to attend a rally. They can role-play the racers, they can bet on the outcome, they can run afoul of the local crime boss or the wealthy oligarchs watching from their super-yachts. Perhaps the job was to transport one of the racers and her craft (conceled under a tarp – No peeking !) to the competition in secret to avoid industrial espionage, sabotage, or other hazards. Maybe she is a teenage primadonna daughter of someone with lots of tattoos and a missing finger. Good luck keeping her happy and out of trouble."

Kayak Class ?
The ships used for racing are specialty designs and have no equivalent in the Traveller inventory. They are stripped down, light weight, low-tech toys for the super rich. No two look alike and there's lots of shiny dichroic glass and multi-spectral metalline lacquer. Even the losers look cool. Think of them as Formula-One or Drag Racers. You never see those anywhere off the track.

There is absolutely no wagering permitted at Veloren competitions.
Betting on racing events is a violation of local laws and will incur a hefty fine levied by the "Association of Legitimate Businessmen". The persistent rumours that gambling takes place in shady orbiting sky-hotels and nearby super-yachts run by organized crime syndicates and corrupt oligarchs are completely false and anyone overheard talking about it will get their nose broken. Capiche? [wink]

It takes at least 4 complete orbits of the gas giant to finish the course.
The choices of trajectories at each row determine the final total propellant Kg expended.
The winner demonstrates the most efficient use of their limited propellant.

*Yes, jamming is illegal, but it's hard to prove, everyone does it, and no one reports it.

The game is designed to be highly configurable. You may shorten or lengthen the course by adding or subtracting rows and columns. The "Risky Maneuver" table may be altered to suit the player's preferences. Game masters may include a timer to keep the game moving quickly. A larger orbital map suits as a game board for miniatures and role play.

Premium features are being planned and may include; Box Art, STL spacecraft files, Data Cards with art, Large Format Courses/Posters, Software for generating courses and keeping score, and other digital goodies.

A companion activity is currently under development where players will design their racing craft based on modular components and style points. (This project is in early stages. Give it another year.)

Strategies and Hazards:

On your first orbit, every moon you visit is a new one. Take the shortest trajectories and play it safe.

On your final orbit, risky maneuvers save propellant and the only significant hazard is rolling a 2 on a moon you need.

Be careful not to paint yourself into a corner. On your final orbit, there's no way to touch two moons on the same row or get from row-1 to row-3 in one burn. Too many navigation faults can block off needed moons permanently or box you in. A navigation fault on your home moon knocks you out of the race!

Dumping propellant before the race (and after lap 1) is a way to brag about your skill. It makes your racer lighter and more maneuverable. This modifies dice rolls for "Risky Maneuver" and "Jamming Attacks". There is an acompanying hazard though, you might not have left yourself enough propellant to finish the course. How exciting !

The scoring system where you subtract double the propellant you dumped from the total you burnt is meant to encourage risk taking and "Enthusiastic Competition". The system may need adjusting.

** Starting at a random moon might make the score cards overly complex to fill out. I may alter this so that it is more like a rally where all racers start at A2 but one turn behind. I think this is called "Staggered Starts" and is common practice in timed events.

If you borrowed wagering money from a man in an expensive suit, pay him back straight away. Else an attorney named Mister Knuckles esq. from the firm of "Knuckles, Truncheon & Groin" (no relation) will hand deliver a notice of inquiry; "Ubi Est Pecunia Lebowski ?"

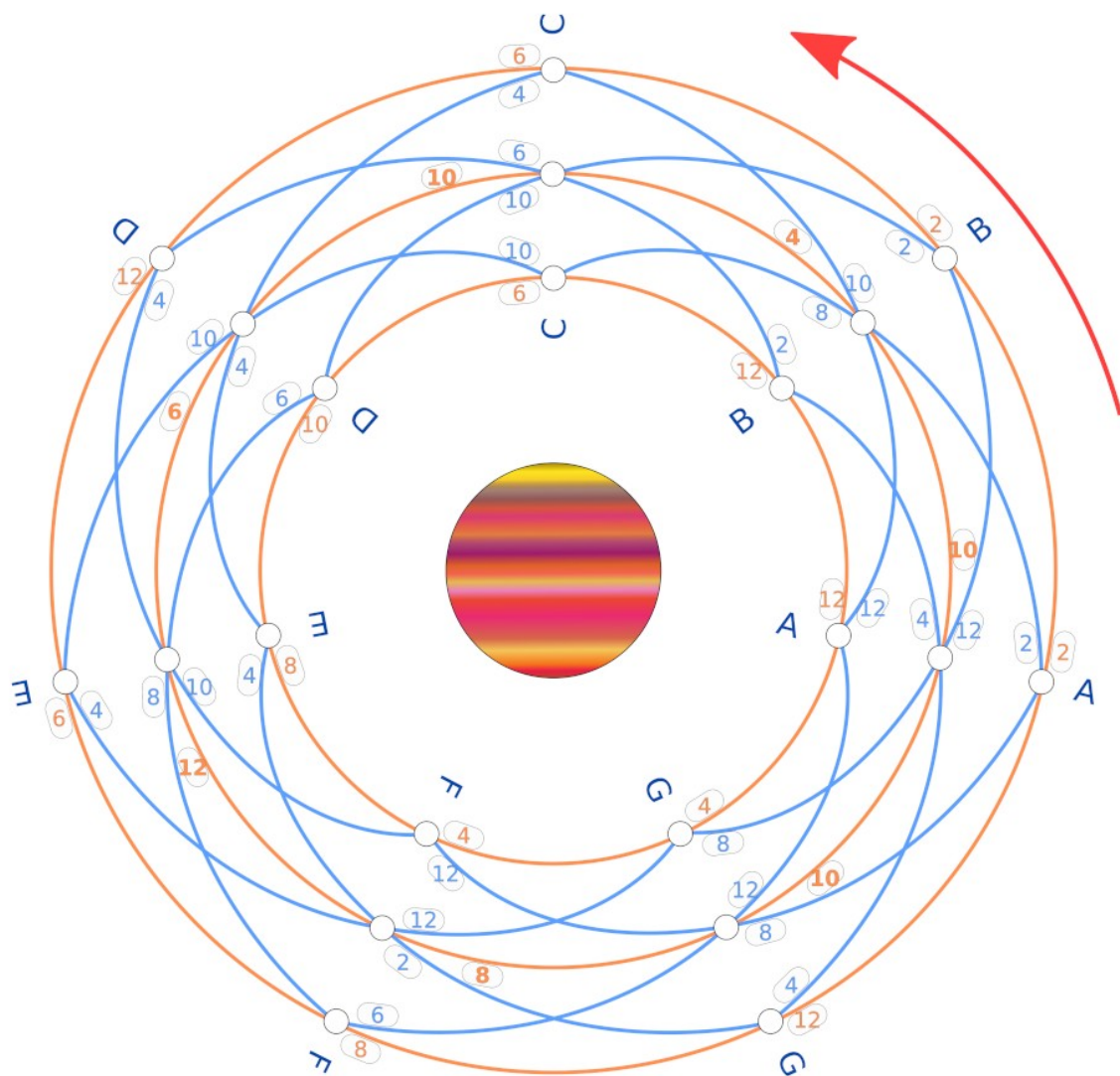Enjoy the game in character. Modify it freely. Avoid Mr. Knuckles esq.
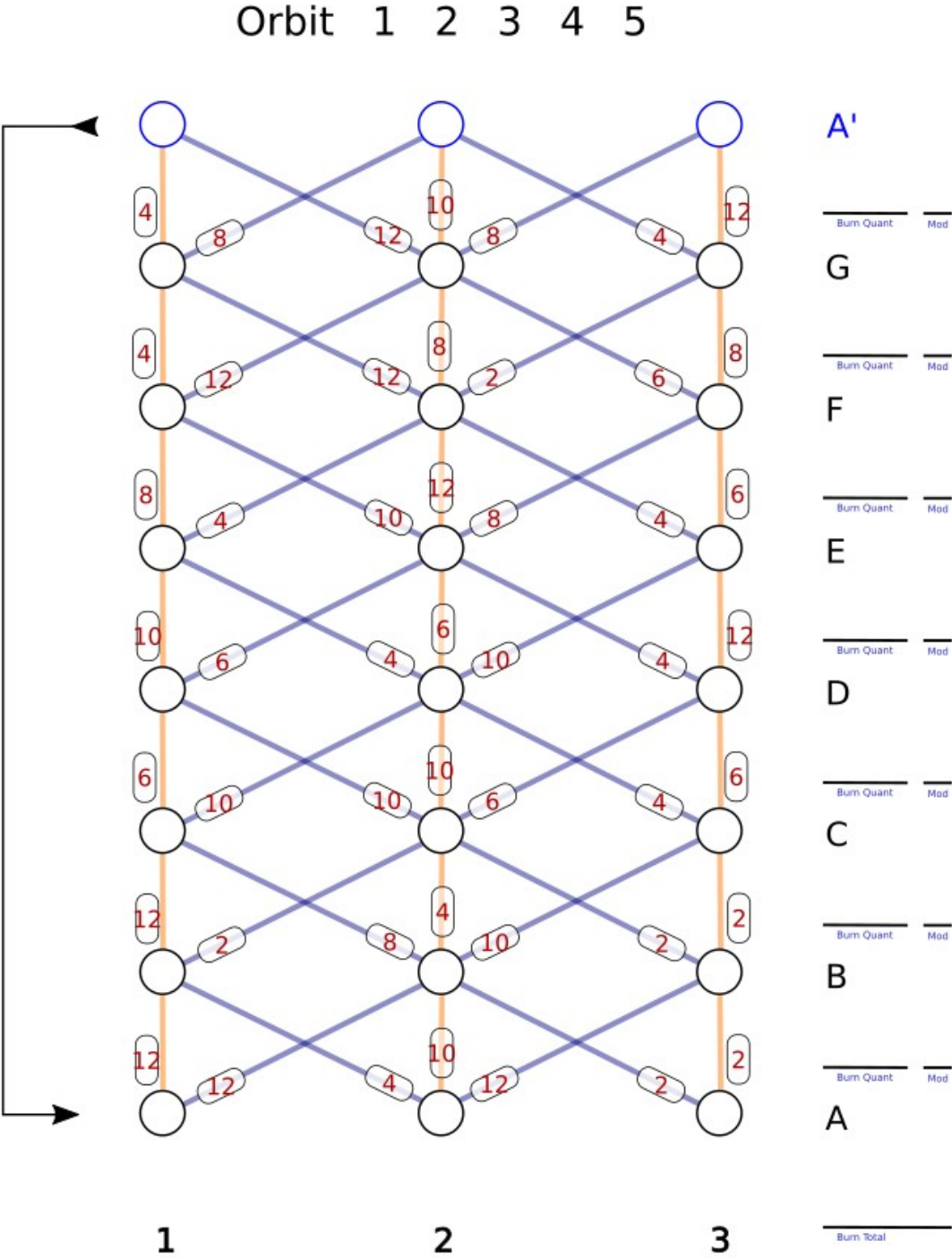
BLANK FORM; ORBITAL MAP
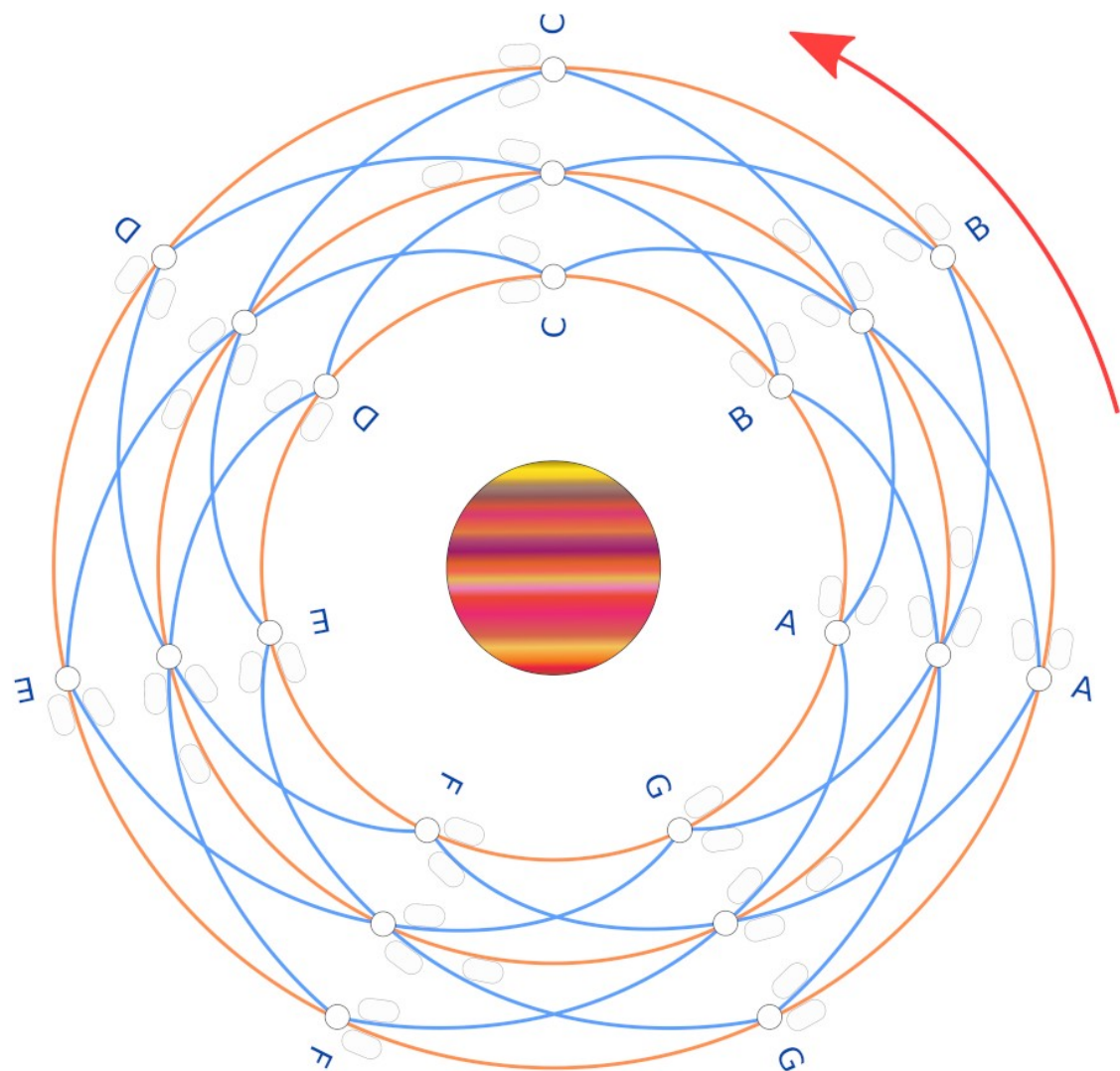
BLANK FORM; SCORE-CARD, PRINT ONE FOR EACH OF FOUR ORBITS. PER PLAYER

Orbit 1 2 3 4 5
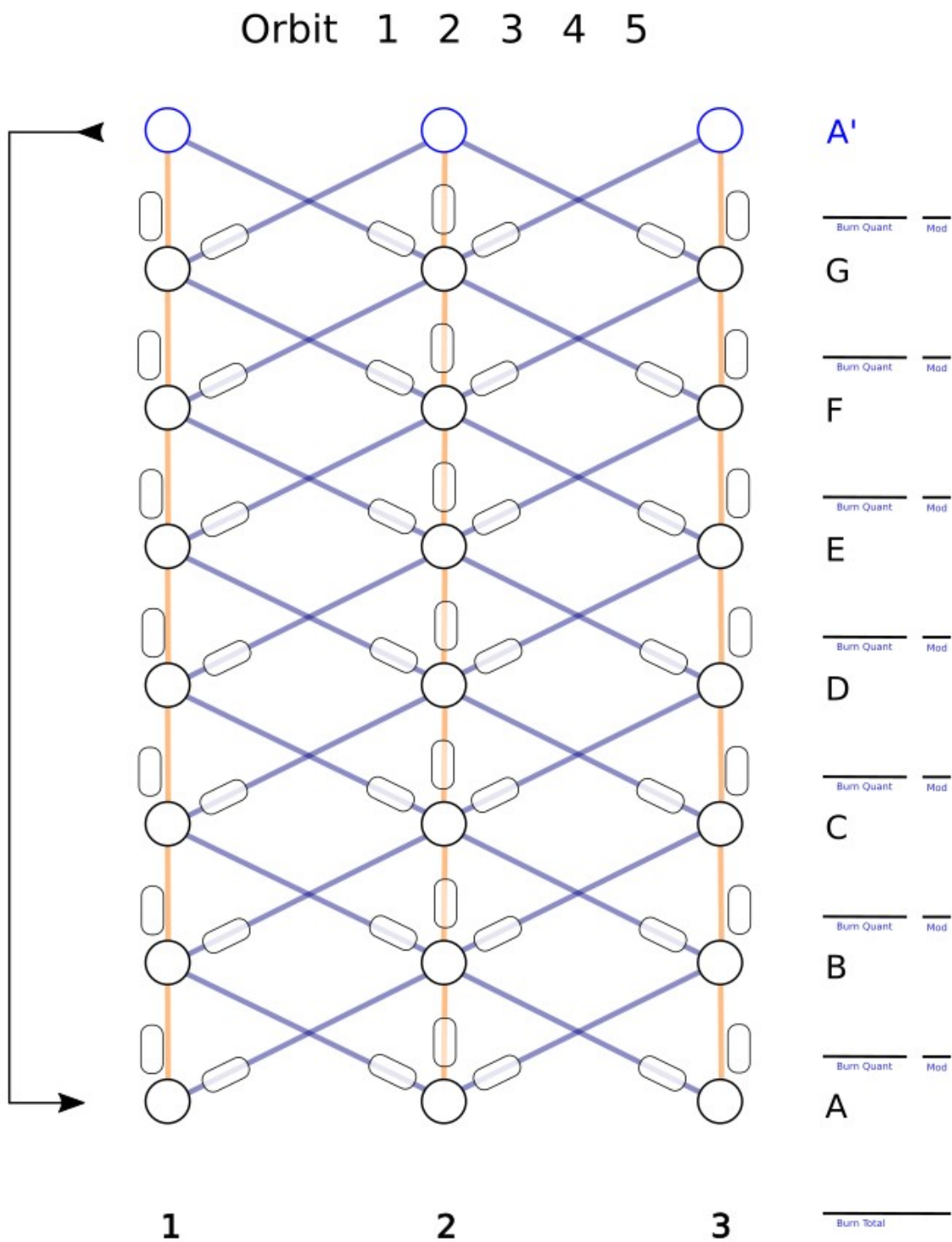
PRE-FORMATTED EXAMPLES

Example Game: Starting at A3, in four orbits. 21 tagged moons in red:

Orbit-1	Burn	Orbit-2	Burn	Orbit-3	Burn	Orbit-4	Burn	
A3	-							
B3	2	**B1**	4	**B2**	10	B1	12	
C3	2	**C2**	2	**C1**	8	C2	2	
D2	4	**D3**	6	**D1**	6	D3	6	
E1	4	**E2**	4	E1	10	**E3**	12	
F2	4	**F3**	8	**F1**	8	F2	4	
G1	12	**G2**	6	G1	4	**G3**	2	
A2	8	A2	10	**A1**	4	**A3**	12	Home !
	36		40		50		50	

Total Cost = 36 + 40 + 50+ 50 = 176 kg propellent used, 24 kg remaining.
176 kg Burnt, minus twice 0 kg Dumped = Final Score 176

I played this game without any "Risky Maneuvers" or "Propellant Dumps".
Can you beat my score?

Links:
The Travelling Salesman Problem
https://en.wikipedia.org/wiki/Travelling_salesman_problem

Delta-V Maps:
https://en.wikipedia.org/wiki/Delta-v_budget

Delta-V Budgets for Moons of Jupiter and Saturn:
https://www.projectrho.com/public_html/rocket/appmissiontable.php#id--
Erik_Max_Francis'_Mission_Tables--Delta_V_Required_for_Travel_Using_Hohmann_Orbits--
Moons_of_Jupiter

Example Filled out Scorecards Totaling 176