



**CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY**

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| Name(s) Michael H. Cassel | Project Number 22679 |
| Project Title Can Rocket Simulations Accurately Predict the Flight Characteristics of Model Rockets? | |
| <div style="display: flex; justify-content: space-between;"> <div>Objectives/Goals</div> <div>Abstract</div> </div> <p>My objective was to find out if rocket simulations are accurate. My hypothesis was that rocket simulations would be accurate to 20% of the actual measured values.</p> <p>Methods/Materials</p> <p>Material List: 6 Drafts of Rockets 1 Calculator 1 Triple Beam Balance Scale 6 rockets 2 Estes Altitude Finders 1 Estes Porta-Pad# II 1 Electronic Beam Launch controller 2 Stopwatches 6 Estes A8-3 Engines</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Obtain Materials on Material list 2. Determine The Mass of rocket by weighing it on scale 3. Determine diameter of rocket using draft 4. Determine the Area of rocket in Square Meters using the following equation: $A=d*(0.5*(diameter\ in\ inches/12)*.3048)^2= dr^2$ 5. Determine engine thrust and impulse from engine specifications 6. Compute Burn Time for the engine: $impulse/thrust$ 7. Determine k: $k= (0.5*1.2\ kg/cubic\ meter*.75*area)$ 8. Compute Gravitational force: $Mass*9.8\ m/sec=M*g$ 9. Calculate velocity at burn out: $velocity=q[1-exp(-x*(impulse/thrust)) / [1+ exp (-x*(impulse/thrust))]$, where $x =2*k*q/Mass$ 10. Calculate altitude at end of boost = $[-Mass/2*k] * ln[Thrust-mass*9.8\ m/sec*velocity^2]/mass*9.8\ meters/sec$ 11. Calculate altitude at end of coast phase: $[Mass/2*k]*ln(Mass*9.8\ meters/sec+k*velocity^2)/Mass*9.8\ meters/sec$ 12. Sum steps 9 and 10 to come up with final altitude 13. Calculate using the following equations: $qa = sqrt(M*g / k)$, $qb = sqrt(g*k / M)$, $ta = arctan(v / qa) / qb$ 14. Add burn time to ta to come up with time to apogee 15. Divide altitude by time to apogee to come up with speed in feet per second | |
| Summary Statement This project is about determining the accuracy of mathematical simulations using model rockets. | |
| Help Received Mom and Dad helped build board, Teacher helped correct papers. | |