a. I.e. determine a full vertical parabola given angle of projection θ and the initial speed, stated in terms of a sublimity
b. If not stated in terms of a sublimity, then require specific value of vertical acceleration g to determine the parabola
c. Tan(θ) = 2∗*alt*/*amp* = 4∗*alt*/*range* = *range*/(4*p*)
d. {The mathematics required for oblique projection may have given Galileo trouble, necessitating his appeal to symmetry here without proof; Toricelli supplied the missing proof in the early 1640s, published in his *De Motu Gravium Naturaliter Descendentium et Projectorem*}

4. Galileo has two ways of specifying the full parabola without having to know the acceleration g:
    a. Given θ and *p*, with the latter representing the initial horizontal speed and impetus
    b. Or given range and θ, can infer *p* from above
    c. (All in the absence of resistance effects)
5. The analogy with Kepler is now complete: for a repeatable initial impetus, can measure angle of launch and range, from which the complete trajectory can be determined
    a. Can even recover time if measure time until projectile lands -- the correlate of the Period -- so that the complete trajectory in time is determined for a given initial angle and unknown, but uniformly repeatable impetus -- e.g. the impetus from a given amount of powder in a cannon
    b. Indeed, if measure time as well as range and initial angle, can infer acceleration of gravity g -- i.e. fall in first second -- (from *h*) and the unknown initial speed of projection (from *p* or from *a*)
    c. Thus a way of measuring fall in first second, if resistance effects are negligible

B. Mathematical Consequences of the Theory
1. The mathematical development of the theory of projectile motion, although somewhat more limited in terms of the number of results, is even more impressive in some of the entailed claims
2. Proposition VII and Corollary: for a given initial impetus, the maximum range is achieved when θ = 45 deg
    a. Something that had been observed in practice, and had been noted by Tartaglia
    b. As Galileo remarks, now being explained (and shown to be nomological)
    c. And explanation shows that it has nothing as such to do with air resistance effects, but instead comes from uniform horizontal and uniformly accelerated vertical compounded
    d. Notice how much evidential weight Galileo attaches to the result in these remarks
3. Proposition VIII: for a given initial impetus, the range varies symmetrically as θ varies on either side of 45 deg
    a. E.g. get the same range for θ=30 and θ=60 deg
    b. Empirical claim that Galileo says had not yet been observed in practice
    c. A potential confirming experiment, if can achieve repeatable initial impetuses

4. Proposition X: impetus at impact is impetus resulting in vertical fall from a height equal to the sublimity + the altitude -- thus relating the speed (and impact effects) of a projectile to that of same projectile in free fall
5. Propositions XI and XII relate altitude and amplitude for a given initial impetus, yielding a table of (relative) amplitudes and hence ranges as a function of θ and a table of (relative) altitudes as a function of θ
    a. Tables 1 and 2, [304], with amplitudes normalized to an amplitude of 10000, and altitudes normalized to an altitude of 5000, respectively for θ = 45 deg
    b. Tables can be used to determine relative magnitudes under the assumption of same impetus, but different θ
6. Proposition XIV relating altitude and sublimity for a given range, yielding a table of (relative) altitudes and sublimities as functions of θ
    a. Table 3, [307], with distances normalized to an amplitude of 10000 and hence a range of 20000.
    b. Tabulated values slightly inexact -- Galileo does not bother to carry enough significant figures; better calculations would preserve the strict symmetry that the theory entails

C. The Form and Content of Galileo's Table

1. As the tables and the accompanying Propositions attest, the mathematical theory allows a large number of problems to be solved, extending beyond those that can only be solved geometrically
    a. Problems of the form, given certain quantities, determine others
    b. I.e. the theory again yields a reasonably rich question-answering device
2. Since tables are given in the form of relative quantities, will in general need to know something in order to obtain a specific result from them
    a. Values tabulated represent such things as *range*(θ)/ *range*(45) for a fixed impetus and *altitude*(θ)/ *range*(θ) and *sublimity*(θ)/*range*(θ) for a fixed impetus
    b. Hence, can perform calculations as soon as know e.g. range(45) for the impetus in question -- something that will have the effect of pinning down the impetus in a preferred way
3. The obvious question is why not table with absolute, rather than relative quantities
    a. Answer: doesn't have precise values of g -- i.e. fall in first sec -- or initial horizontal speed, v_0
    b. The precise value of g, as we have seen, is a little hard to come by, but poses little problem when put alongside that of determining the precise value of muzzle velocity
    c. If could ignore resistance effects, could infer muzzle velocity (and g) from actual trajectories
    d. Question: conduct repeated experiments to see if obtain uniform value of g via measurement of range, θ and time, along with values of muzzle velocity; if not, then theory offers a basis for reaching some conclusions about resistance effects
4. One practical virtue of giving relative values in the tables is that error associated with resistance effects tends in practical applications to be canceled out to some extent