

Sample Exam Questions - Module 1

1) Explain Figure 1 and derive the result obtained in this theorem using Newton's original arguments.

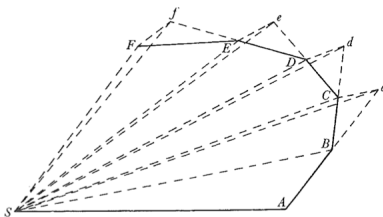


Figure 1: Theorem 1 - Newton's De Motu

2) Figure 2 is essential to understand how Newton solved the inverse Kepler problem. Explain its meaning and derive the general expression for the centripetal force, which is the paradigm used in the solution of the subsequent Problems 1, 2 and 3.

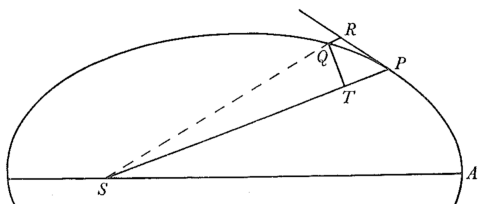


Figure 2: Theorem 3 - Newton's De Motu

3) In Problem 1 (Figure 3) Newton solves the rather unrealistic problem of finding the force law for a circular orbit with the sun located in its periphery. Show how he obtains the relation $F(r) \propto r^5$. Why do you think Newton solved this physically “meaningless” problem?

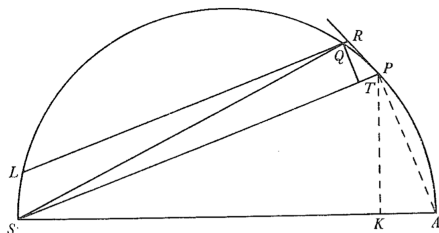


Figure 3: Problem 1 - Newton's De Motu

4) Problem 3 is the reason Halley visited Newton and arguably the most important problem solved in the *Principia*. Explain the main challenges to solve this problem and sketch appropriate steps for its solution.

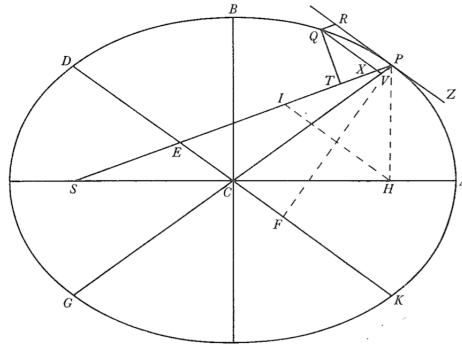


Figure 4: Problem 3 - Newton's De Motu

5) Explain how Newton derives the dependence of centripetal force on the arc and radius in Theorem 2. What is the importance of Corollary 5?

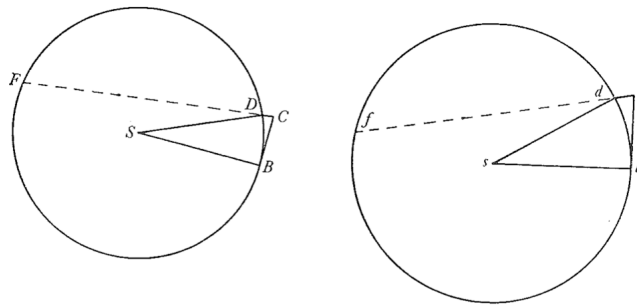


Figure 5: Theorem 2 - Newton's De Motu

6) What are the main differences between Newton's original solution and the way we solve Kepler's problems today? What was gained and what was lost?

7) Why do you think Newton used geometry in his proofs instead of the analytical methods he invented earlier (e.g. Method of fluxions)?