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Curriculum Analysis:
Planetary Motion Homework Analysis from the Perspective of Metacognition and Motivation

The homework document provides the textbook section from which students are expected to read and 5 homework problems from this section. The textbook selection for this assignment is chapter 10 from "An Introduction to Mechanics" by Kleppner and Kolenkow. I intend to analyze this document from the perspective of metacognition and motivation strategies.

The homework document did several things well. It asked questions at an appropriate challenge level, allowing students to remain motivated (How Learning Works, Chapter 3, What Factors Motivate Students to Learn?). It also provided a reasonable amount of work, which can also help students stay motivated. The document itself does not overwhelm or distract; it is very straightforward and clear.

The minimalist design of the homework document may provide students with some difficulty in assessing the demands of the assignment (How Learning Works, Chapter 7, How Do Students Become Self-Directed Learners?). I would support students' understanding of the necessary effort by directly providing the homework questions in the given document to allow students to conceptualize how long the assignment will take. I would also encourage students to plan their approach to the homework by asking them to explicitly write a plan for question 10.2 (a 3-part question about the effective potential energy of an orbiting particle) and providing a homework grading rubric that specifically includes this plan as a grading criterion. One of the key differences between experts and novices is the proportional amount of time spent planning (How Learning Works, Chapter 7, How Do Students Become Self-Directed Learners?). By modeling my expectations for the students' problem-solving process, I can help support their development as physicists. Since the concept from question 10.2 directly relates to a concept that students struggled with on the midterm, I would provide explicit scaffolding by asking students to draw an effective potential energy diagram as part of their conceptual plan for this question. I would also provide an opportunity for students to reflect on their performance on the homework before providing feedback, and an opportunity to fix their submission based on the feedback. This would allow them to practice academic metacognitive skills (How Learning Works, Chapter 7, How Do Students Become Self-Directed Learners?).

I would also include a problem of my own creation that directly relates the material to astronomy and astrophysics in a way that the students might find exciting, because connecting the material to students' interests can boost motivation (How Learning Works, Chapter 3, What Factors Motivate Students to Learn?). I would replace question 10.8 (a general case question about the maximum height of a projectile fired from Earth) with a very similar question that relates the concept to something the students might find more exciting. I might phrase the question as follows: "You are an astronaut on the International Space Station, which is 400 kilometers above sea level. NASA is planning to send you some research equipment, but to reduce costs, they plan to launch the equipment as a projectile from an aircraft at height h above sea level and angle α from the vertical. If the initial speed of the projectile v_0 is equal to $\sqrt{\frac{GM_e}{R_e}}$, how high above sea level does the aircraft need to be for the research equipment to reach you at the ISS? Provide

your answer in general terms and neglect air resistance and the Earth's rotation. It may be helpful to first consider how high the projectile rises when launched from the ground." By relating the general question to a specific application where students can place themselves in the shoes of an accomplished scientist, we can boost student motivation and self-esteem.