

PYL127: Classical Mechanics

Minor Online Examination

Nov 9, 2020

8:00 AM – 9:30 AM

Instructions

1. Read the Instructions carefully
2. On the first page, at the top, write your name, your entry code and your date of birth in dd/mm/yyyy format. Also write down the pincode of your residence. This is important.
3. Answer all the parts of a question in one place
4. Calculations, rough work, and answer for each question must all be together and submitted.
5. Cite all the sources consulted: books, web, fully.
6. All answers must be justified, howsoever short.
Otherwise no credit will be given

Question 1. In the question below, $n = 0, 1, 2$, and equals the sum of all digits in your date of birth, mod 3.

- (a) (10 marks) Two particles experience an interaction with a potential whose functional form is given by

$$V(\vec{r}_1, \vec{r}_2) = V(r_1^{n+1}, r_2^{n-1}, |\vec{r}_1 + (-1)^n \vec{r}_2|)$$

Identify all the symmetries obeyed by the interaction.

- (b) (10 marks) Set up the lagrangian for the above interaction with the most appropriate generalised coordinates and identify all the ignorable coordinates. Identify the conserved quantities and match with the previous part.

Question 2. In this problem, $n = 0, \dots, 3$ is the product of all nonzero numbers in your entry code, mod 4. Similarly, m equals the sum of all digits in your pincode, mod 2. A particle is constrained to move on a surface defined by $(x^2 + (-1)^m y^2)^{n+1} = 3z^k$ where $k = (-1)^m$

- (a) (2 marks) Identify the type to which the constraint belongs.
(b) (3 marks) Set up a suitable coordinate system.
(c) (5 marks) Use the method of Lagrange multipliers to deduce the form of the reaction force.