

**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.