Classical Mechanics 2019: Diagnostic Test

Name: _____   Department: _____

Email:_____

Self-assessment of familiarity with the following topics:
(1: Don't know much, 2: Know fairly well, 3: Know very well)

Lagrangian mechanics   ___
Central force   ___
Oscillations   ___
Rigid body motion   ___

Quick questions:

1. A package is released from a plane flying at a height.
(a) Qualitatively sketch the trajectory of the stone (no need to calculate).
(b) Draw the forces acting on the package, at some point during its descent.

2. Draw all the external forces acting on the following objects
(only show directions, no need to calculate):
(a) a stationary ladder reclining against a wall
(b) a wheel rolling without slipping on a flat plane
(c) A fly sitting on a rotating LP record

3. A frictionless inclined plane, making an angle β with the horizontal, is attached to the top of a car, initially at rest. A block B of mass *m*, when kept on the plane, starts sliding down. When the car starts from rest with an acceleration *a*, the sliding slows down.

(a) Is the inclined plane facing to the front of the car or to the rear of the car ?

(b) Draw a figure showing forces acting on the block B, and write down its equations of motion, when the car is accelerating.

4. The shape of a cricket bat is completely known. How many more independent numbers are needed to describe the positions (at a fixed time t) of all the 10^{27} particles that constitute the bat ?

5. Write down the Lagrangian for a mass m, suspended from the ceiling by a spring with the spring constant k. Write down the Euler-Lagrange equation of motion, and hence calculate the time period of oscillations. What is the Hamiltonian ?

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