

Exam 2 review sheet

Thursday April 30, 1-4pm or 5-9pm.¹ Choose a 3 hour (or 1+2) block of time. This is a closed book, closed note, no calculator exam.

No equations will be provided for part 1. A few equations will be provided for part 2.

Present clear and complete answers. Show your work in some coherent fashion. Unjustified answers will earn no points. Well-reasoned answers can receive partial credit. Start all solutions with definitions, facts, or commonly used equations. Include calculations, explanations, and diagrams when appropriate.

Ch 6 and 7

1. Use the calculus of variations, particularly Euler's equation, to determine (a) the geodesic for a particular surface, (b) the shortest time path between two points in a region with a gravitational field, and (c) to determine, in general, the function that minimizes a given integral.
2. What is Hamilton's principle? In addition to text, use relevant equations or examples in your explanation.
3. Be able to (a) write the Lagrangian and (b) determine the equations of motion for a given system.
4. Be able to use undetermined multipliers to determine the forces of constraint in a system.
5. Starting with Lagrange's equations for a single particle, show that the Lagrangian and Newtonian formulation of mechanics are equivalent. Your answer should be a derivation that includes text to state any assumptions made and to explain significant steps.
6. Show that if the Lagrangian is invariant with respect to translations in space in a certain direction, then the linear momentum of the of the system in that direction is conserved. Your answer should be a derivation that includes text to state any assumptions made and to explain significant steps.
7. How are generalized momenta defined? How many are there for a given system?

¹Make-up exams will only be arranged if you can provide (1) advance notice and (2) a reasonable and documentable excuse.

8. Be able to (a) write the Hamiltonian and (b) determine Hamilton's equations of motion for a given system.
 9. Be able to determine if the Hamiltonian (a) is equal to the total energy of a system and (b) whether the Hamiltonian and/or the total energy are/is conserved.
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Equations provided for Part 2

Lagrange's equation (7.18)

Lagrange's equation with undetermined multipliers (7.65)

Equations you should know

Euler's equation (6.57)

Lagrange's equation (7.18)

the Hamiltonian (7.155)

Hamilton's equations of motion (7.160, 7.161)

simple integrals and derivatives such as x^n , $\ln x$, e^x , $\sin(ax)$, $\cos(ax)$. you should also be able to perform simple substitutions ($u = 1 + x^2$, $du = 2x$).

sin, cos and tan definitions ($\sin \theta = \text{opp/adj} \dots$)
relationship between angle, radius and arc ($s = r\theta$)