Classical Dynamics Part II
Easter 2015
Revision Guide to past exam questions

In order to help you to organize your revisions I have collated the questions from 2009-14 by topic, giving reference to a corresponding example sheet questions, where appropriate. The key is YEAR/Paper/Section/Question. *This document should not be interpreted as a guide to which topics are examinable.*

1 The Principle of Least Action, Euler-Lagrange Equations, Generalized Coordinates, Conserved Quantities

(a) Example Sheet 1, q.2-7,9,10; ES2 q.2,3,6; ES3 q.8

(b) 2015/2/II/15 - (see how it is related to ES1, q.3).

(c) 2013/2/II/15 - standard bookwork in (i)

(d) 2012/2/I/9 - (a) is bookwork, (b) is example sheet 1, q.3(a); 2012/4/II/15 - parts (a) and (b).

(e) 2010/4/I/9 - *hint: for the last two identities consider general linearised variations of the path, i.e. vary q_F and then fix both q_I and q_F and vary T - time it takes for the system to end up in q_F. Then think of S as a function of q and t.*

1.1 Effective Potential

(a) 2012/4/II/15 - parts (c) and (d).

2 Small Oscillations and Normal Modes

(a) Example sheet 2, q. 1,2,3 and 4.

(b) 2014/2/II/15 - part (a)(iv).

(c) 2013/3/I/9 - quite standard; parts of 2013/2/II/15 are relevant.

(d) 2012/4/II/15 - part (e) is relevant.

(e) 2011/2/I/9

(f) 2010/2/I/9 - this is a little trickier - notice transverse vibrations.

(g) 2009/2/I/9

There is plenty of typical questions in pre-2009 papers, e.g. 2006/2/I/9.

3 Euler Angles, Heavy Symmetric Top

(a) Example Sheet 3, q.2,6 and 7.

(b) 2014/4/I/9 - standard book work.

(c) 2013/4/I/9 - standard book work: part (ii) is very much like q.7 on Example Sheet 3.

(d) 2012/1/I/9 - mostly standard bookwork.

(e) 2011/1/I/9 - mostly standard bookwork.

(f) 2010/3/I/9 - this has an unseen part in the end.

(g) 2010/2/II/15

(h) 2009/2/II/15

4   Euler's Equations for torque-free motion

(a) Example Sheet 3, q.3,4 and 5.

(b) 2014/2/I/9 - standard bookwork.

(c) 2013/2/I/9 - standard bookwork in (i),(ii), see also the handout in Euler's equations.

(d) 2012/2/II/15 - parts (a), (b).

(e) 2011/2/II/15

(f) 2010/3/I/9 - first part is standard bookwork, the last part is very much in the spirit of ES3, q.4.

(g) 2009/3/I/9 - part (b)

5   Tensor of Inertia, Principal Moments of Inertia

(a) ES2 q.5,6,7; ES3 q.1

(b) 2014/2/I/9

(c) 2012/2/II/15 - parts (c). *Hint on how to deal with holes: you might remember a related question from 1A Dynamics, where holes were treated as bodies with negative mass. Also, do not forget, that M is the mass of a uniform cylinder. The volume of a cylinder changes once the holes have been drilled.*

(d) 2009/3/I/9 - part (a)

6   Hamiltonian, Hamilton's Equations

Many questions listed in other sections ask about Hamiltonian.

(a) ES3 q.1,7,8.

(b) 2014/3/I/9

(c) 2009/1/I/9 - 1st part standard bookwork on derivation of Ham. Eqns.

7   Poisson brackets, Canonical Transformations, Constants of Motion

(a) Example Sheet 4, q.1-6, 12.

(b) 2014/1/I/9

(c) 2013/1/I/9

(d) 2011/4/I/9

(e) 2011/4/II/15 - only the first part on CT is relevant. I am sure you can manage to do the rest of the question but note that *although I gave an optional lecture on the Hamilton-Jacobi equations, it is not on schedules this year and therefore is non examinable!*

(f) 2010/Paper 4/II/15 - this was replicated in the example sheet 4.

(g) 2009/4/I/9 - this might appear as unseen, but in fact I explained this idea in lecture 20. It does not appear in printed notes though. Look for Invariance of Poisson brackets under Canonical Transformations in your written notes.

8 Motion of a charged particle in an electromagnetic field in Lagrangian Formalism and Hamiltonian Formalism.

Beware of alternate use of SI and Gaussian systems in part Tripos questions. I used SI system in the lectures and example sheets.

(a) Example Sheet 1, q.8.

(b) 2014/3/I/9 - part (b).

(c) 2013/4/II/15 - Adiabatic Invariants in part (v).

(d) 2012/3/I/9

(e) 2011/1/I/9

(f) 2010/1/I/9

(g) 2009/4/II/15

9 Angle-Action variables, Adiabatic Invariants

(a) Example Sheet 4, q.8-11

(b) 2014/4/II/15 - see also example sheet 3, q.10,11.

(c) 2013/4/II/15 - part (v)

(d) 2010/Paper 4/II/15 - last part

(e) 2009/4/II/15 - last part