AFRICAN ECONOMIC RESEARCH CONSORTIUM

Collaborative PhD Programme in Economics for Sub-Saharan Africa

COMPREHENSIVE EXAMINATIONS IN CORE AND ELECTIVE FIELDS

FEBRUARY – MARCH 2013

ENVIRONMENTAL ECONOMICS

Time: 08:00 – 11:00 GMT **Date: Friday, March 1, 2013**

INSTRUCTIONS:

Answer a total of **FOUR** questions: **ONE** question from **Section A**, **ONE** question from **Section B**, and **TWO** questions from **Section C**.

The sections are weighted as indicated on the paper.

SECTION A (15%)

Answer only ONE Question from this Section

Question 1

(a) What are property rights and what is meant by an efficient property rights structure? **[8 Marks]**

(b) How does the establishment of clearly defined property rights lead to the efficient use of natural and environmental resources? **[7 Marks]**

Question 2

(a) Employ the concepts of Marginal Abatement Cost (MAC) and Marginal Damage Cost (MDC) to explain optimal level of pollution. **[8 Marks]**

(b) Briefly comment on the following statement by a local politician: 'Given that pollution is harmful to our society, only zero level of pollution will be tolerated'. **[7 Marks]**

SECTION B (25%)

Answer only ONE Question from this Section

Question 3

(a) The dynamic resource allocation problem brings out useful insights about the optimal allocation of both renewable and non-renewable resources.

(i) Formulate the dynamic resource allocation problem for the extraction of a non-renewable resource by a competitive firm with discounting in continuous time. Explain carefully what your variables and equations represent. **[4 Marks]**

(ii) State the current value Hamiltonian for the problem and establish the first order conditions. **[3 Marks]**

(iii) Interpret the first order condition relating to the harvest. **[2 Marks]**

(b) Consider the following two-period model of non-renewable resource extraction. The inverse demand function for the resource is $p_t = 22-2q_t$ for t= 0, 1. The total extraction cost (EC) in each period is given by $EC_t = 2q_t$ and costs are independent of the resource stock. The rate of discount is r = 10 percent. The total stock available is 8 units.

(i) Find the dynamically efficient levels of extraction, q_0 and q_1. **[6 Marks]**

(ii) What is the marginal user cost in each period? **[2 Marks]**

(iii) A monopolist facing the same level of demand, costs, discount rate and initial reserves wishes to maximize the present value of profits over the two periods. Compare the monopolist's extraction rates with those from b(i) above. **[4 Marks]**

(iv) Discuss the merits of a proposal that the government should impose a tax or subsidy where a non-renewable resource is supplied monopolistically in order to increase the social net benefit. **[4 marks]**

Question 4

Let the world be a two country one, with X and Y. Pollution control is taken as a public good, that is the benefit of abatement for one country depends on the amount of abatement by the other country. Moreover, symmetry is assumed implying that all countries' optimal abatement is

identical. The total benefits (B) and total costs (C) of emissions abatement (A) are given by the functions:

$$B_X = 8(A_X + A_Y)$$
$$B_Y = 5(A_X + A_Y)$$
$$C_X = 10 + 2A_X + 0.5A_X^2$$
$$C_Y = 10 + 2A_Y + 0.5_Y^2$$

where the subscripts represent the countries.

(a) Show the conditions for an optimal solution under cooperation and non-cooperation. Calculate the non cooperative and cooperative equilibrium levels of abatement for X and Y. **[15 marks]**

(b) Compare the benefits accruing to the two countries under cooperation and non cooperation. **[10 marks]**

SECTION C (60%)

Answer only ONE Question from this Section

Question 5

(a) State the Coase Theorem including its assumptions and limitations. **[10 Marks]**

(b) What are the implications of the Coase Theorem for environmental policy? **[10 Marks]**

(c) Explain the principle of "prior appropriation". Using relevant examples from Africa and graphical illustrations, show how this principle could be applied to solve environmental problems. **[10 Marks]**

Question 6

(a) Revenue from an environmental tax may be used to reduce distortionary taxes elsewhere in the economy such as tax on labour income. Discuss this statement. **[15 Marks]**

(b) In what way should you take into consideration the "double-dividend" of environmental taxation? Illustrate using an appropriate diagram. **[15 Marks]**

Question 7

(a) Define the concept of cost effectiveness in the Kyoto Protocol. **[3 Marks]**

(b) Briefly assess how cost effectiveness is handled in the following Kyoto Protocol's flexible mechanisms:

(i) Clean Development Mechanism **[6 Marks]**

(ii) Joint Implementation **[6 Marks]**

(iii) Market for pollution permits. **[6 Marks]**

(c) Give a brief assessment of the success and failure of the Kyoto Protocol in reducing green house gas emissions to date. What issues should be considered in a post-2012 Kyoto Protocol? **[9 Marks]**

Question 8

Whether the attainment of economic sustainability, in terms of non-declining per capita consumption through time, is feasible or not depends on the ease with which reproducible capital can be substituted for exhaustible resources in production. Elaborate on this statement by discussing the relationship between the production function $Q = Q(K,R)$, where K is the (reproducible) capital stock and R is the rate of exhaustible resource use. Assume zero population growth and no technical progress. **[30 Marks]**