UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Exam: **ECON4910 – Environmental Economics**

Date of exam: Tuesday, May 26, 2015   **Grades are given: June 9, 2015**

Time for exam: 2.30 p.m. – 5.30 p.m.

The problem set covers 3 pages

Resources allowed:
- No resources allowed (except if you have been granted use of a dictionary from the Faculty of Social Sciences)

The grades given: A-F, with A as the best and E as the weakest passing grade. F is fail.

Part 1   (35pts)

There is a large number N of polluting firms in the economy, each having the same abatement cost function $c(a_i, y_i)$, where a_i and y_i denote the abatement and technology level of firm *i*, respectively. With zero abatement each firm's emissions are assumed equal to $\bar{e}$.

1. What do you consider to be reasonable properties of the function $c(a_i, y_i)$?

2. The technology level of firm *i* is given by $y_i = x_i + \gamma \sum_{j \neq i} x_j$ where x_i is the number of useful ideas firm *i* purchases from the R&D sector, and γ is a parameter satisfying $0 < \gamma < 1$. Give an interpretation of this equation.

3. The R&D sector produces ideas at a fixed cost *f* per idea. Assume that there is one firm per produced idea in the R&D sector, and that there are zero profits in this sector in equilibrium. Assume also that the polluting firms face an exogenous emission price *p* (tax or quota price). Show that the market equilibrium in this case is characterized by the equations $c_a(a_i, y_i) = p$ and $-c_y(a_i, y_i) = f$ for all *i*. Give an interpretation of these equations.

4. The government has an environmental cost function $D(E)$ with properties $D' > 0$ and $D'' \geq 0$, where *E* denotes total emissions. Derive the socially optimal levels of abatement and technology of each firm, and give an interpretation of your result.

Part 2   (35pts)

The objective of the UN Climate Change Conference in Paris later this year is to achieve a universal and legally binding agreement. Predictions based on economic theory have often been pessimistic about the chances of success. Explain the reasons for this pessimism and give your own opinion about the chances of success.

Part 3   (Multiple Choice – 30pts)

You get 6pts for a correct answer and -2pt for a wrong answer. You don't need to give reasons for your answer, they will not be considered.)

Question 1: Consider the following table of payouts for different choices (A or B) under different states of the world (1, 2, or 3). Which one of the following statements is **correct**?

(a) Under a "maxi-min" decision rule, choice A is preferred
(b) Under a "maxi-max" decision rule, choice B is preferred
(c) Under a "mini-max regret" decision rule, choice A is preferred
(d) Under a "maxi-max" decision rule, no choice is strictly preferred

	State 1	State 2	State 3
Choice A	20	10	1
Choice B	3	5	20

Question 2: Which one of the following statements is **not correct**? (Assume that everything which is not specified explicitly in the statement, conforms to the most simple baseline case)

(a) Under full certainty and identical firms, an emission quota is not preferred to an emission tax.
(b) Under uncertainty about the marginal benefits from emission, a tax is preferred when the slope of the marginal benefit curve is relatively steeper than the marginal damage curve.
(c) Under uncertainty about the marginal damages from emission, there is no difference between tax- or quota instruments.
(d) Under full certainty and heterogeneous firms, a tradable emission quota is preferred to an emission tax.

Question 3: A common problem with contingent valuation is that respondents overstate their true willingness to pay because they do not really have to pay this amount. What is the **correct** name of this bias?

(a) Present bias
(b) Omitted-variable bias
(c) Hypothetical bias
(d) Strategic bias

Question 4: Consider a stock pollution problem where the stock $S(t)$ changes over time according to $\dot{S}(t) = x(t) - \delta S(t)$, where $x(t)$ denotes emissions and $\delta \geq 0$. Environmental damage is given by the function $D(S(t))$ with the properties $D' > 0$ and $D'' \geq 0$. Which one of the following statements is **not correct**? (Assume that everything which is not specified explicitly in the statement, conforms to the most simple baseline case)

(a) If $\delta = 0$ and $D'' > 0$ for all S, the optimal emission tax is rising as long as $x(t) > 0$.
(b) If $\delta = 0$ and $D'' > 0$ for all S, the present value of the optimal emission tax is declining as long as $x(t) > 0$.
(c) If $D'' = 0$ for all S, the optimal emission tax is constant.
(d) If $D'' = 0$ for $S \leq \bar{S}$ and $D'' > 0$ for $S > \bar{S}$, the optimal emission tax is constant for $S \leq \bar{S}$.

Question 5: Fossil energy and renewable energy are assumed to be perfect substitutes. Marginal costs of fossil energy are assumed to be constant, while marginal costs of renewable energy are assumed to be increasing in the production of renewable energy. Which one of the following statements is **not correct**? (Assume that everything which is not specified explicitly in the statement, conforms to the most simple baseline case)

(a) A tax on fossil energy reduces total energy production.
(b) A subsidy to renewable energy increases total energy production.
(c) A renewable portfolio standard is equivalent to a tax revenue neutral combination of a tax on fossil energy and a subsidy to renewable energy.
(d) A renewable portfolio standard reduces total energy production.