**Given name:**____________________ **Family name:**____________________

**Student number:**____________________ **Signature:**__________________________

**UNIVERSITY OF TORONTO**
**Faculty of Arts and Science**

**ECO 326 H Section L0101 (Advanced Economic Theory—Micro)**
Instructor: Martin J. Osborne

**TERM TEST 1**
**October 2004**

**Duration: 55 minutes**

**No aids allowed**

This examination paper consists of **12** pages and **4** questions. Please bring any discrepancy to the attention of an invigilator. The number in brackets at the start of each question is the number of points the question is worth.

Answer all questions.

**TO OBTAIN CREDIT, YOU MUST GIVE ARGUMENTS TO SUPPORT YOUR ANSWERS.**

For graders' use:

| | Score |
|---|---|
| 1 (21) | |
| 2 (24) | |
| 3 (25) | |
| 4 (30) | |
| Total (100) | |

1. Consider the following two-player strategic game.

| | $L$ | $C$ | $R$ |
|---|---|---|---|
| $T$ | $0, 0$ | $3, 0$ | $0, 0$ |
| $M$ | $0, 3$ | $2, 2$ | $0, 1$ |
| $B$ | $0, 0$ | $4, 1$ | $1, 1$ |

(a) [4] Is any action of either player strictly dominated?

(b) [4] Is any action of either player weakly dominated?

(c) [9] Find the Nash equilibria of the game.

(d) [4] Is any Nash equilibrium a *strict* Nash equilibrium?

2. A group of $n \geq 2$ people use the same road to commute to work at the same time. Each person can drive her own car or take a bus. The bus is large enough to accommodate all $n$ people; it runs even if no one takes it, and takes the same amount of time to drive along the road as does a car. When $k$ cars (and the bus) use the road, each vehicle's travel time is $50 + 2k$ minutes. The total time spent commuting for a person who takes the bus is $m$ minutes more than the travel time of the bus (because she needs to get to the bus stop). Each person cares only about the time she spends commuting.

   (a) [6] Model this situation as a strategic game. (*Note*: $n$ may be *any* integer.)

*Question continues on next page*

(b) [12] Find the Nash equilibrium (equilibria?) of the game for $m = 3$.

*Question continues on next page*

(c) [6] Does the game have any outcome that every player prefers to every Nash equilibrium?

3. [25] Each of two countries chooses a tariff rate to impose on imports. If country 1 chooses the rate $t_1$ and country 2 chooses the rate $t_2$ then country 1's payoff is

$$u_1(t_1, t_2) = t_1(t_2 - t_1 + 2)$$

and country 2's payoff is

$$u_2(t_1, t_2) = t_2(t_1 - t_2 + 8).$$

Find all the Nash equilibria of the strategic game that models this situation.

*Space for answer continues on next page*

4. Consider a variant of Bertrand's duopoly game in which firm 1's cost function is $C_1(q_1) = cq_1$ (as in the example considered in class) and firm 2's cost function is $C_2(q_2) = cq_2 + (q_2)^2$. Assume that if both firms set the same price, *all* consumers buy from firm 1. (The total demand is *not* split between the firms in this case.) The total demand at the price $p$ is $\alpha - p$ if $p \leq \alpha$ and 0 if $p > \alpha$, where $c < \alpha$. [Reminder: in Bertrand's model, each firm produces an amount equal to the demand it faces given the pair of prices chosen; in particular, a firm cannot turn away customers.]

   (a) [7] Is the pair $(c, c)$ of prices a Nash equilibrium?

*Question continues on next page*

(b) [7] Is any pair $(p_1, p_2)$ with $p_1 = p_2 > c$ a Nash equilibrium?

*Question continues on next page*

(c) [8] Is any pair $(p_1, p_2)$ with $p_1 > c$ and $p_2 > c$ and $p_1 \neq p_2$ a Nash equilibrium?

*Question continues on next page*

(d) [8] For every other pair of prices, either argue that the pair is a Nash equilibrium or show that it is not.

**Space for rough work (will not be graded)**

**End of examination**
**Total pages: 12**
**Total marks: 100**