NATIONAL UNIVERSITY OF SINGAPORE

EC3322: Industrial Organization I

Semester 1, AY2014/15

Time allowed: 2 hours

_____

MATRICULATION/REGISTRATION NUMBER: _____

### INSTRUCTIONS TO STUDENTS

1. Write your matriculation number in the space provided above RIGHT NOW. Do not write your name on the exam.

2. This assessment paper contains **FIVE (5)** questions and comprises **SIXTEEN (16)** printed pages.

3. Answer all questions.

4. This is a **CLOSED** book assessment.

5. The total mark for this paper is **100**.

6. You MAY NOT use calculators. If you have a calculator on your desk, please remove it.

Questions 1 and 2 are multiple-choice questions. Circle your answer to each question in the answer boxes provided. No explanation is necessary.

1. (10 marks) Consider a Stackelberg model of quantity competition in which two firms with marginal cost $c = 2$ sell a homogeneous product. Inverse demand is $P = 10 - Q$. Which of the following statements is true?

   (a) The deadweight loss is greater than 2.

   (b) The deadweight loss is smaller than if the firms were Cournot competitors in a simultaneous move game.

   (c) The deadweight loss is larger than if the firms were Cournot competitors in a simultaneous move game.

   (d) There is not enough information given to answer this question.

2. (10 marks) Is it possible for the leader in a Stackelberg model of quantity competition to have lower profits than in a Cournot simultaneous move game?

   (a) Yes, if the costs of the leader are higher than the costs of the follower.

   (b) No, never.

   (c) Yes, if the costs of the follower are higher than those of the leader.

   (d) Yes, always.

Write your answers for questions 3, 4, and 5 in the answer boxes. Show your workings for full credit.

3. (15 marks total) Consider the extensive form game below.
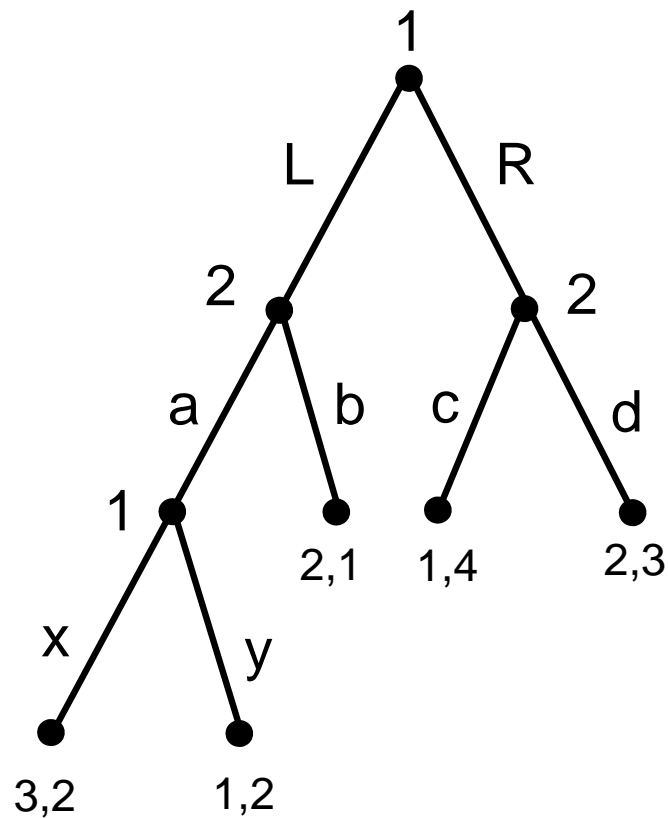
(a) (5 marks) Find the Subgame Perfect Nash Equilibrium.

(b) (10 marks) Find the normal form representation of this game and the Nash Equilibrium (or Equilibria if there is more than one).

4. (25 marks total) Consider a triangular city. In this city, there are 3 firms, A, B, and C, that sell a homogeneous good produced at zero marginal cost. The firms are located at the corners of the triangle as shown below:
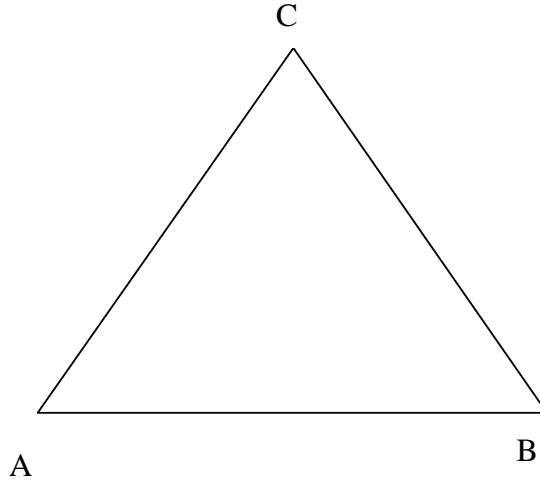
The distance between the firms is 1, and N consumers are uniformly distributed along the three sides of the triangle. Each consumer buys 1 unit of the good from the firm that has the lowest total price (product price plus transportation costs), where transportation costs are td^2 for d distance traveled between the consumer and firm.

(a) (5 marks) Find firm A's demand and profit as a function of prices.

(b) (10 marks) Find the Nash Equilibrium prices.

(c) (10 marks) Suppose now that all N consumers are located exactly at firm C's location. Find the Nash Equilibrium prices. Provide a brief explanation.

5. (40 marks total) Consider a market in which two firms sell a homogeneous good and set quantities simultaneously. Inverse demand is given by $P = 34 - Q$. The marginal cost of firm 1 is $c_1 = 0$. The marginal cost of firm 2 is $c_2 = 2$.

For parts (a) through (d), assume that the firms play the game once.

(a) (5 marks) Find the Cournot Nash Equilibrium and each firm's profits.

(b) (5 marks) Suppose that the firms collude. Since costs differ across firms, the firms collude by maximizing joint profit with the restriction that each firm produces the same amount of output. That is, under the agreement, $q_1 = q_2$. Each firm then earns profit from its allocated amount of quantity. Find each firm's output and profit.

(c) (10 marks) Now consider deviation from the collusive agreement. Determine the quantities that each firm produces and the corresponding profits if i) only firm 1 were to deviate and ii) if only firm 2 were to deviate.

(d) (10 marks) Put your answers from part (a) to (c) in a matrix that contains each firm's choice to collude or to deviate and the corresponding payoffs. Find the Nash Equilibrium. Provide a brief explanation.

(e) (10 marks) Suppose now that the firms play the game repeatedly for an infinite number of periods. Assume that the two firms have the same discount factor and that the probability that the game continues is $p = 1$. Find the threshold discount factor that assures that each firm will stick to the agreement. Explain your findings, including your prediction of what the equilibrium outcome would be.

- END OF PAPER -