UNIVERSITY OF CAMBRIDGE

ECT1
ECONOMICS TRIPOS PART I

Thursday 9 June 2022 1:30 pm - 4:30 pm

Paper 1

MICROECONOMICS

Answer **ALL SIX** questions from Section A and **TWO** questions from Section B.

Section A and B will each carry 50% of the total marks for this paper.

Each question within each section will carry equal weight.

Write your **blind grade number** (not your name) on the cover of each booklet.

Candidates are asked to note that there may be a reduction in marks for scripts with illegible handwriting.

If you identify an error in this paper, please alert the **Invigilator**, who will notify the **Examiner**. A **general** announcement will be made if the error is validated.

**STATIONERY REQUIREMENTS**
20 Page booklet x 2
Rough work pads
Tags

**SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAMINATION**
Calculator - students are permitted to bring an approved calculator

**You may not start to read the questions printed on the subsequent pages of this question paper until instructed that you may do so by the Invigilator.**

## SECTION A

1. Consider a consumer who has a choice between two goods, 1 and 2. The consumer's demand for good 1, $x_1^*$, is a function of prices $p_1, p_2$, and income $m$. Let the own price elasticity be $\epsilon(p_1) = \frac{p_1}{x_1^*}\frac{dx_1^*}{dp_1}$, the income elasticity of demand be $\epsilon_m = \frac{m}{x_1^*}\frac{dx_1^*}{dm}$ and the cross-price elasticity of demand be $\epsilon_{1+2} = \frac{p_2}{x_1^*}\frac{dx_1^*}{dp_2}$.
Is it possible for the sum of the elasticities, $\epsilon(p_1) + \epsilon_m + \epsilon_{1+2}$ to be equal 0.5? Explain your answer.

2. Consider a monopolist who engages in third-degree price discrimination across two markets.
   (a) Can it be optimal for the monopolist to choose to operate on the inelastic part of the demand curve in one of the markets? Explain your answer.
   (b) Is it necessarily true that each consumer is strictly worse off in the case of third-degree price discrimination, as compared to no price discrimination? Explain your answer.

3. The long-run AC curve is a lower envelope for the short-run AC curves. Does the same relation hold for the long-run and short-run MC curves? Explain your answer.

4. Indicate whether the following statements are True/False/Uncertain and explain your answer in detail.
   (a) If there are constant returns to scale in an industry, then in a competitive equilibrium, profits in that industry must necessarily be zero.
   (b) Let there be two people and two goods. Person A has comparative advantage in the production of good 1 if and only if it takes person A less time to produce good 1 than it takes person B.
   (c) Competition based on low wages in poor countries puts workers in rich countries out of a job.

5. Consider an economy with two goods: cheese and wine. Agent $A$ has 80 units of cheese and 20 units of wine. Agent $B$ has 20 units of cheese and 30 units of wine. $A$ and $B$ have identical utility functions. We write person $i$'s utility function as

$$u_i(x_c^i, x_w^i) = \frac{1}{4}\ln x_c^i + \frac{1}{4}\ln x_w^i,$$

where $i \in \{A, B\}$, and $x_c^i$ and $x_w^i$ are person $i$'s consumption of cheese and wine respectively.

(a) Draw the Edgeworth box illustrating the initial endowments and indifference curves of both agents.

(b) Give the definition of a Pareto efficient allocation and check whether the endowment allocation is Pareto efficient.

(c) Find the competitive equilibrium prices and allocation (final consumptions). Mark the competitive equilibrium allocation on the Edgeworth box.

(d) Show that the competitive equilibrium allocation is Pareto efficient.

6. Consider two individuals $A$ and $B$, living in a household. Individual $A$ likes smoking. Her utility from smoking $c$ cigarettes (net of their cost) is given by

$$u_A(c) = 2\ln(c) - 2c.$$

Individual $B$ likes orange juice and her utility is adversely affected by individual $A$'s consumption of cigarettes $c$. In particular, when consuming amount $x$ of orange juice, individual $B$'s utility function (net of cost of orange juice) is given by

$$u_B(x, c) = x - 2c - \frac{1}{2}(x - c)^2.$$

(a) Find consumption of cigarettes $c^*$ that maximizes the utility of individual $A$ and the optimal amount of orange juice $x^*$ consumed by individual $B$ (assuming $c = c^*$).

(b) Find the allocation which a social planner, who maximizes the total utility of $A$ and $B$, would choose. Is the socially optimal level of $c$ larger or smaller than the value of $c^*$ derived in part (a)? Explain.

(c) Suppose the government can impose a tax of $t$ per unit of consumption on either cigarettes or juice (or both). How should the government set the tax in order to achieve the socially optimal quantities of consumption?

## SECTION B

7. Alice has the utility function

$$u_A(x_1, x_2) = \sqrt{x_1} + \sqrt{x_2}$$

where $x_1$ and $x_2$ are the amounts of the first and the second good respectively. Alice's income is $m = 6$, the price of the first good is $p_1 = 2$, and the price of the second good is $p_2 = 1$.

(a) Find Alice's optimal consumption.

(b) Assume the government plans to introduce subsidies to the production of the first good. As a result, the price of the first good would have changed to $p_1' = 1$. Find Alice's optimal consumption after the price change.

(c) Find the equivalent and the compensating variations, EV and CV, corresponding to the price change from $p_1$ to $p_1'$.

Now assume that the government plans to introduce subsidy $s_1$, $0 < s_1 < 2$, to the production of the first good, as well as tax $t_2 > 0$ to the production of the second good. The resulting prices of the goods would become $p_1 - s_1$ and $p_2 + t_2$, respectively. The government runs zero deficit, if, at the new optimal choice of Alice, $x_1^*, x_2^*$, the revenue from tax equals spending on subsidies: $s_1 x_1^* = t_2 x_2^*$.

(d) Is it possible for the government to increase Alice's utility, as compared to part (a), assuming that it has to run zero deficit? Explain your answer.

8. Suppose that a firm has access to a machine, which produces $q$ units of a good at the following cost:

$$C(q) = 8 + 4q^2$$

where 8 is the cost of purchasing the machine, and $4q^2$ is the cost of operating the machine to produce $q$ units.

(a) Suppose firm A sells the good in a competitive market, and it can purchase one machine. Find the supply curve of firm A.

(b) Now suppose that another firm B can purchase up to two copies of the machine. Derive the cost function of firm B.

(c) Now assume that the cost of operating the machine has been reduced from $4q^2$ to $\frac{22}{10}q^2$. How would the cost function of firm B change, as compared to part (b)?

(d) Assume that firm B is a monopolist, and denote its profit-maximizing price by $p$. Is it possible that $p$ would increase after the cost reduction in part (c)? Explain your answer (a diagram would suffice).

9. Consider the following Ricardo model of trade. There are two countries, $A$ and $B$, and two goods, $x$ and $y$, each produced using labour input with a constant-returns technology. In $A$ the labour requirement for one unit of $x$ is $1/12$ and for one unit of $y$ is $1/6$. The corresponding quantities in $B$ are $1/2$ and $1/8$. Each agent in $A$ supplies one unit of labour inelastically and has utility function

$$u_A(x_A, y_A) = 2ln(x_A) + ln(y_A).$$

Each agent in $B$ supplies one unit of labour inelastically and has utility function

$$u_B(x_B, y_B) = ln(x_B) + ln(y_B).$$

All firms in a particular country are owned equally by the agents in that country. The populations of the two countries are equal. Trade is allowed but labour migration between the two countries is not allowed.

i. Solve for the competitive equilibrium prices and quantities.
ii. Explain how each of the following scenarios will affect the competitive equilibrium and the pattern of trade derived in part i.:
   A. The government in country $B$ imposes a 25% tax on firm profits;
   B. The government in country $A$ imposes a 25% income tax on every worker's labor income;
   C. The government in country $A$ imposes a payroll tax of 25% on every firm's labor cost;
   D. In country $B$ the labour requirement for producing one unit of $x$ decreases to $1/6$.

10. Consider a couple, $A$ and $B$, living in a household, who have separate wealth levels and budget constraints. They derive utility from their own consumption ($m$) and the educational attainment of their child ($G$). Increasing the educational attainment is costly (such as paying for a private tutor). Let the cost of educational attainment $G$ be $c(G) = G$. Let $M_i$ be the amount of initial wealth for individual $i \in \{A, B\}$. $A$ has utility function $u_A(m_A, G)$ and $B$ has utility function $u_B(m_B, G)$. Assume that the marginal utilities of consumption and of educational attainment are strictly positive, and the preferences are convex.
    i. Write down the condition for Pareto efficiency, and compare it with the condition for Pareto efficiency if $G$ were a private good. Assume that Pareto efficiency requires strictly positive amounts of both goods.
    ii. Suppose the two individuals each decide, separately, how much money to contribute towards their child. Let $g_i$ be person $i$'s contribution to the educational attainment, where $G = g_A + g_B$. Assume that each person is correct about the other person's contribution. Derive the optimal choice of $g_A$ and $g_B$. Is the total spending of the couple on the child ($G$) lower or higher than the Pareto-efficient amount? Explain.

**END OF PAPER**