**Problem 1:** We consider two goods, apples (A) and bananas (B). The prices are given by  $p_A = 2$  and  $p_B = 4$ .

- (a) Suppose that Pete has an income y = 20. Derive his budget constraint and draw it into a diagram.
- (b) How does the budget constraint of Pete change if
  - (i) a quantity tax of 2 is levied on apples
  - (ii) a value tax of 25% is levied on bananas
  - (iii) his mom forbids him to buy more than 5 apples
  - (iv) mom increases Petes income to y = 40
  - (v) prices fall by 50%?
- (c) Suppose that Nicole has 2 apples and 4 bananas. Derive her budget constraint and draw it into a diagram.
- (d) How does the budget constraint of Nicole change if
  - (i) the price of bananas rises by 1
  - (ii) both prices fall by 50%
  - (iii) her initial endowment of fruits is doubled?

**Problem 2:** Antony consumes only apples and bananas. We denote be  $(x_A, x_B)$  the consumption bundle which contains  $x_A$  apples and  $x_B$  bananas. Antony's preferences are described by the utility function:

$$u(x_A, x_B) = \sqrt{x_A x_B}$$

- (a) Explain the term indifference curve. Determine the indifference curves which pass through the points (16, 1) and (4, 9). Draw them in a diagram.
- (b) Antony's initial endowment is (16,1). Would be exchange his initial endowment for the consumption bundle (4,9)? Indicate in your graph those consumption bundles, which Antony prefers to his initial endowment.

- (c) For any consumption bundle, determine the marginal rate of substitution (MRS) for Antony. Explain the meaning of the marginal rate of substitution and check whether Antony's preferences have a falling or an increasing MRS.
- (d) Draw the budget constraint of Antony for prices  $p_A = 10$  and  $p_B = 20$  and income y = 240. Indicate Antony's optimal consumption bundle in your graph.

**Problem 3:** For each of the following utility functions:

$$u(x_1, x_2) = x_1 + 2x_2$$
  

$$u(x_1, x_2) = 2 \ln x_1 + x_2$$
  

$$u(x_1, x_2) = \min\{x_1, x_2\}$$

- (a) derive the equation describing the indifference curve for a given level of utility  $\overline{u}$
- (b) sketch several indifference curves in a graph
- (c) derive the marginal rate of substitution (whenever possible)