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Business Mathematics

Problem 1	**25 marks**

A monopolist has the demand function

$$p(x) = 42 - \frac{5}{2}x - \frac{1}{3}x^2$$

and the cost function

$$C(x) = 6x + 25$$

1. Determine the production level for which the monopolist maximises his profit, his maximum profit, and the price to be charged.
2. Find the elasticity of price depending on demand for $x = 3$.

Problem 2	**25 marks**

A monopolist sells two commodities, a fashionable type of sweater and a fashionable type of jackets.
He has the following demand functions

$$x_1 = 230 - 2p_1 - p_2, \qquad x_2 = 220 - p_1 - 2p_2$$

Suppose it costs him 20 € to produce a sweater and 30 € to produce a jacket.

1. How many sweaters and how many jackets can he sell in order to maximise his profit.
2. Find the corresponding prices and the maximum profit,

Problem 3	**25 marks**

A small firm builds two types of garden shed. Type S_1 requires 2 hours of machine time and 5 times of craftsman time. Type S_2 requires 3 hours of machine time and 5 hours of craftsman time. Each day there are 30 hours of machine time available and 60 hours of craftsman time. The profit on each type S_1 shed is \$60 and on each type S_2 shed is \$84. The firm would like to maximize its profit.

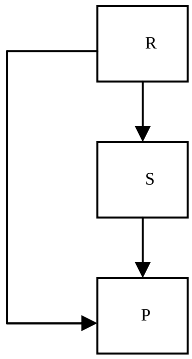
1. Formulate the problem as a linear optimisation model.
2. Solve the model by the simplex method.
3. How many hours of craftsman time will not be used?
4. How will the maximum profit be affected if it will be found that 31 hours of machine time are available?

Choose *exactly one* of the following two problems. *Strike out* the one which you have *not* chosen.

Problem 4	**25 marks**

The following chart represents the production process of a firm. Denote by

R: the raw material block,
S: the semi-product block
P: the final product block.



The final products are produced partially *directly* and partially *indirectly* via the semi-products. Following input-output tables are available

Direct input-output coefficients

	P_1	P_2
R_1	2	0
R_2	1	3

	P_1	P_2
S_1	0	1
S_2	2	4

Final input-output coefficients

	P_1	P_2
R_1	6	9
R_2	9	22

1. Describe the above tables as matrices.
2. Represent the production process as a matrix equation.
3. How many units of raw materials will be required to produce one unit of the semi-products?
4. How many units of raw materials will be required for the following production programme?

$$P_1:\ 25 \text{ units};\qquad P_2:\ 10 \text{ units}.$$

Problem 5	**25 marks**

A company that rents small moving trucks wants to purchase 25 trucks with a combined capacity of 28000 cubic feet. Three different types of truck are available: a 10-foot truck with a capacity of 350 cubic feet, a 14-foot truck with a capacity of 700 cubic feet, and a 24-feet truck with a capacity of 1400 cubic feet.
How many of each of trucks should the company purchase?