考生做答須知：

一、本試卷總共 4 大題，每題配分標示於題後，總分一百分。

二、請於答案卷上依題號次序做答，題號務必標示清楚，並書寫計算過程，否則不
　　予計分。

1. An operator is in charge of the operations of three automatic machines. After each machine completes a batch run, the operator must reset it before a new batch is started. The time to complete a batch run is exponential with a mean of 30 minutes. The setup time is also exponential with a mean of 10 minutes. Analyze the following questions based on queueing theory.

   (1) Construct the corresponding state transition diagram and develop the balance equations. (10 pts.)

   (2) Compute the probability that all machine are working. (10 pts.)

   (3) Determine the expected number of machines that are awaiting setup or are being set up. (10 pts.)

2. The hotel, CCUBA, uses an external laundry service to provide clean towels. CCUBA generates 500 soiled towels a day. The laundry service picks up the soiled towels and replaces them with clean ones at regular intervals. There is a fixed charge of $120 for each pickup and delivery service, in addition to the variable cost of $0.6 per towel. It costs CCUBA $0.02 a day to store a soiled towel and $0.01 per day to store a clean one. Analyze the following questions based on inventory theory.

   (1) Formulate the total incurred cost per day. (10 pts.)

   (2) How often should CCUBA use the pickup and delivery service such that the total cost per day is minimized? (10 pts.)

3. Consider the following simple product mix problem (30 pts.):

	Product 1 Units needed	Product 2 Units needed	Total units available
Resource A	3	1	36
Resource B	2	2	48

For example, it needs 3 units of Resource A and 2 units of Resource B to produce one unit of Product 1. There are 36 units of Resource A and 48 units of Resource B available. Assume unit profits of Product 1 and 2 are $2 and $1, respectively.

(1) Give the LP formulation for the above problem in which total profit is maximized. *(5%)*

(2) Use the simplex method to solve the LP model in (1). *(10%)*

(3) What is the new maximum profit if units of Resource B are increased by 6? *(5%)*

(4) Assume unit profit of Product 1 is increased. Explain under what condition Product 2 won't be produced at all. *(10%)*

4. Consider the following 6-node, 11-arc network (20 pts.):
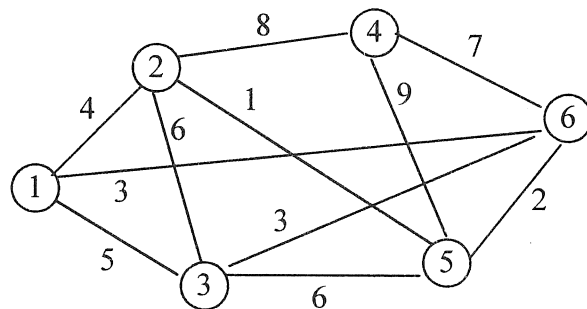
(1) Find the minimal spanning tree of the above network.

(2) Give the LP formulation for the minimal spanning tree problem in (1).