OPIM 570 – HW2

Part I.

The Hawley Lighting Company manufactures four families of household lighting at its factory. The product families are table lamps, floor lamps, ceiling fixtures, and pendant lamps. The table below shows the average material costs for each of the products.

Product	Table	Floor	Ceiling	Pendant
Material cost	$66	$85	$50	$80

Each product is made in one of two production processes. Table lamps and floor lamps go through the process in Department 1, while ceiling fixtures and pendants go through the process in Department 2. Variable production costs and capacities (measured in units of product) are shown in the table below. Note that there are regular and overtime possibilities for each department.

| | Regular time | | Overtime | |
Process	Unit cost	Capacity (units)	Unit cost	Capacity (units)
Department 1	$16	100,000	$18	25,000
Department 2	$12	90,000	$15	24,000

Average selling prices for the four products are known, and estimates have been made of the market demand for each product at these prices. These figures are shown in the following table.

Product	Table	Floor	Ceiling	Pendant
Selling price	$120	$150	$100	$160
Potential sales	60,000	20,000	100,000	35,000

Each question is worth 1 point. Let's begin by exploring relationships between variables and parameters in this problem.   Let's not worry about the optimal solution just yet.

1) The profit margin (per unit) for table lamps produced using regular time production is

   _____ .

2) The profit margin (per unit) for table lamps produced using overtime production is

   _____ .

3) Using the following variables:

   RT = quantity (in ,000) of table lamps produced using regular time production
   RF = quantity (in ,000) of floor lamps produced using regular time production
   RC = quantity (in ,000) of ceiling fixtures produced using regular time production
   P = quantity (in ,000) of pendant lamps produced using regular time production

   how would you express a constraint (in algebraic notation, but substituting numbers for known parameters) on the Regular Time production in Department 1?   Fill in the blanks below. Recall that all constraints (most constraints, anyway) have the form "LHS sign RHS" where LHS (left hand side) and RHS (right hand side) contain numbers and algebraic expressions and sign is <=, >= or =.

LHS:_____ sign:_____ RHS:_____

Now, let's solve the problem under the assumption that advertising to increase demand is not possible.

4) What is the optimal profit in this case?
   The optimal profit is _____.

5) What is the value of adding 1,000 units of capacity (i.e. marginal value of capacity, because we are measuring everything in thousands) to regular time of department 1?

   Please enter your answer in dollars (not thousands of $)._____

6) What is the value of adding 1,000 units of capacity (i.e. marginal value of capacity, because we are measuring everything in thousands) to regular time of department 2?

   Please enter your answer in dollars (not thousands of $)._____

7) If you had to increase one (and only one) of the production capacities by one unit, which one would you do it for?

   a. Department 1 regular
   b. Department 1 overtime
   c. Department 2 regular
   d. Department 2 overtime

Part II.
Demand levels can be affected by advertising expenditures. Each $1,000 spent on advertising for a particular product raises demand above the base level by the percentage given below. For example, an expenditure of $5,000 on advertising for table lamps would raise demand by 6% (=5×1.2%), or 3,600 units (=60,000x6%). (Expenditures of fractions of $1,000 have proportional effects.) However, there is a budget limit of $18,000 on the total amount to be spent on advertising among all four products and no more than $10,000 can be spent on any one product.

Product	Table	Floor	Ceiling	Pendant
Advertising effect	1.2%	1.0%	0.8%	1.5%

Now let's add advertising to the analysis. For this and the subsequent questions (unless indicated otherwise) please refer to the part II of the problem above, which contains information about advertising.

8) If you spend $2,000 on advertising ceiling fixtures, how many units (in ,000) of extra demand would you generate for them? Please enter your numbers in thousands with the provision of two decimal points (e.g. instead of 1,567 units enter 1.57).

   Increase in demand for ceiling fixtures would be _____.

9) The optimal profit in the model with advertising is _____.