Q. 1:
An oil refinery blends four raw gasoline types (A, B, C, and D) to produce two grades (standard and premium) of automobile fuel. The cost per barrel of different gasoline types, performance rating and number of barrels available each day is given in Table 1. The premium should have a rating greater than 90 while the standard

Table 1: Cost, Performance Rating, and Production Level of Different Gasoline Types

Raw Fuel	Cost/Barrel	Performance Rating	Barrels/Day
A	60	75	3000
B	65	85	4000
C	70	90	5000
D	80	95	4000

fuel should have a performance rating in excess of 80. The selling prices per barrel of standard and premium fuel are 90 dollars and 100 dollars, respectively. The company should produce at least 6000 barrels of fuel per day. Formulate an optimization problem to determine the quantity of fuel (of each type) should be produced to maximize profit?

Q. 2:
The cost of a solar energy system depends on the surface area of the collector (A) and the volume of the storage (V) as follow:

$$U = 35A + 208V \tag{1}$$

Owing to energy balance considerations, the following relation between A and V is to be satisfied:

$$A\left(290 - \frac{100}{V}\right) = 5833.3 \tag{2}$$

and the design variable T is related to V as

$$V = \frac{50}{T - 20} \tag{3}$$

The variable T has to be restricted between 40^oC and 90^oC. Formulate an optimization problem to minimize the cost (U).

Q. 3:
We are interested to produce P in the reaction $A \rightarrow P$ using a continuous reactor at $v = 240$ liters/hr with $C_{A_0} = 3$ moles/liter. However, it is noticed that an undesired product R may also be produced through a second reaction $P \rightarrow R$. Consider that both reactions are irreversible and first order with $k_1 = 0.45$ min^{-1} and $k_2 = 0.1$ min^{-1}. Derive the objective function for finding maximum yield of P.

Q. 4:
A chemical company has acquired a site for their new plant. They required to enclose that field with a fence. They have 700 meter of fencing material with a building on one side of the field where fencing is not needed. Formulate an optimization problem and determine the maximum area of the field that can be enclosed by the fence.

Q. 5:
Determine the area of the largest rectangle that can be inscribed in a circle of radius 5 cm. Formulate this as an optimization problem by writing down the objective function and the constraint. Solve the problem using the graphical method.