A. Calculation of Demand Elasticity

Suppose the following demand relationship between the number of automobiles (Q) and its per-unit price (P) is identified by your analyst:

\[ Q = 300,000 - 20P \]

1. How many automobiles would be demanded at a price of $2,000?
   
   a. 40,000
   b. 80,000
   c. 120,000
   d. 260,000
   e. 300,000

2. The number of automobiles demanded (Q₁) at a price of $4,000 is _______, and the same (Q₂) at a price of $6,000 is _______.
   
   a. Q₁ = 220,000; and Q₂ = 180,000
   b. Q₁ = 180,000; and Q₂ = 220,000
   c. Q₁ = 220,000; and Q₂ = 220,000
   d. Q₁ = 180,000; and Q₂ = 180,000
   e. none of the above

3. Given the equation for the point own price elasticity of demand as:

\[ |\varepsilon| = \frac{dQ}{dP} \cdot \frac{P}{Q} \]

Calculate the point own price elasticity of demand at P=$2,000.

   a. -20 ⇒ 20
   b. -0.1538 ⇒ 0.1538
   c. -130 ⇒ 130
   d. -6.5 ⇒ 6.5
   e. not calculable

4. Given the equation for the point own price elasticity of demand as in Problem 3 above, calculate the point own price elasticity of demand at P=$4,000.
a. -20 $\rightarrow$ 20  
b. -0.3636 $\rightarrow$ 0.3636  
c. -55 $\rightarrow$ 55  
d. -2.75 $\rightarrow$ 2.75  
e. not calculable

5. Given the arc own price elasticity of demand as:

$$ |e_e| = \frac{dQ}{dP} \frac{\bar{P}}{\bar{Q}} $$

where $\bar{P} =$ average of two prices

and $\bar{Q} =$ average of two quantities

Calculate the arc own price elasticity of demand between $P$=$2,000$ and $P$=$4,000$.  

a. -0.3636 $\rightarrow$ 0.3636  
b. -0.1538 $\rightarrow$ 0.1538  
c. -0.25 $\rightarrow$ 0.25  
d. -4 $\rightarrow$ 4  
e. not calculable

6. Given the equation for the arc own price elasticity of demand as in Problem 5 above, calculate the arc own price elasticity of demand between $P$=$4,000$ and $P$=$6,000$.  

a. -0.3636 $\rightarrow$ 0.3636  
b. -0.6667 $\rightarrow$ 0.6667  
c. -0.5 $\rightarrow$ 0.5  
d. -2 $\rightarrow$ 2  
e. not calculable

7. If 200,000 automobiles were demanded and sold last year, what was the (per-unit) price of the automobiles?  

a. $20,000  
b. $15,000  
c. $10,000  
d. $5,000  
e. not calculable

B. Advanced Problems in Demand Elasticity - 1

Given the following demand equation for Love Chocolate Bars (Q),
\[ Q = 10 - 5P + 2I - 3P_c \]

where \( P \) = the price of a Love Chocolate Bar; \( I \) = average disposable income of the consumers ($\) for chocolate bars; and \( P_c \) = the price of a competitor's chocolate bar

Given a generic elasticity of demand as:

\[ \varepsilon_X = \frac{\partial Q}{\partial X} \frac{X}{Q} \]

8. The point own price elasticity of demand at \( P=2 \), given \( I = 20 \) and \( P_c = 1 \), is equal to ______.
   a. -0.27 \( \rightarrow \) 0.27
   b. -0.6667 \( \rightarrow \) 0.6667
   c. -3.7 \( \rightarrow \) 3.7
   d. -2.7 \( \rightarrow \) 2.7
   e. none of the above

9. The point income elasticity of demand at \( I = 10 \), given \( P=2 \) and \( P_c = 1 \), is equal to ______.
   a. -1.176
   b. 1.176
   c. -0.85
   d. 0.85
   e. none of the above

10. The point cross-price elasticity of demand at \( P_c = 2 \), given \( I = 10 \) and \( P=3 \), is equal to ______.
    a. -3
    b. -1.5
    c. -0.667
    d. 0.667
    e. none of the above

C. Advanced Problems in Demand Elasticity - 2

Given the following demand equation for Love chocolate bars \( Q \),

\[ Q = 10P^{-2}I^3A^{-1}P_c \]
where \( P \) = the price of a Love chocolate bar; \( I \) = average disposable income of the consumers ($); \( A \) = advertising expense for Love chocolate bars, and \( P_c \) = the price of a competitor's chocolate bar.

Given a generic elasticity of demand as:

\[
\varepsilon = \frac{\frac{\partial Q}{\partial X}}{\frac{Q}{X}}
\]

11. The point own price elasticity of demand is _____ and the point income elasticity of demand is _____.
   a. -0.2 → 0.2; -3
   b. -0.5 → 0.5; 3
   c. -3.7 → 3.7; -3
   d. -2 → 2; 3
   e. none of the above

12. The point advertising elasticity of demand is _____ and the point cross-price elasticity of demand is _____.
   a. 4; -1
   b. -4; -1
   c. 4; 1
   d. -4; 1
   e. none of the above

D. Optimization Techniques for Profit Maximization - 1

If a firm sells its product at a fixed price of $121 per unit and has the following total cost function,

\[
TC = 0.02Q^3 - 3Q^2 + 175Q + 500
\]

13. The profit-maximizing output, \( Q \), is _____ and the corresponding maximum profit level is ____. (2 points)
   a. 10; -760
   b. 100; 7600
   c. 90; 4360
   d. 90; -4360
   e. none of the above

14. The marginal revenue (MR) function is _____ and the marginal cost (MC) function is ______.
a. \( MR = 121; \ MC = 0.06Q^3 - 6Q + 175 \)
b. \( MR = 121Q; \ MC = 0.06Q^3 - 6Q \)
c. \( MR = 121; \ MC = 0.02Q^3 - 3Q^2 + 175Q + 500 \)
d. \( MR = 121Q; \ MC = 0.02Q^3 - 3Q^2 + 175Q \)
e. none of the above

15. By using the fundamental principle of profit maximizing, the profit maximizing output level, \( Q \), is found to be ______ and the corresponding maximum profit is ______.

a. 10; -760
b. 100; 7600
c. 90; 4360
d. 90; -4360
e. none of the above

E. Optimization Techniques for Profit Maximization — 2

Given the following demand function,

\[ Q = 300 - 3P \]

and total cost function,

\[ TC = \frac{1}{600}Q^3 - \frac{1}{3}Q^3 + 50Q + \frac{1000}{3} \]

16. The profit-maximizing output, \( Q \), is ______ and the maximum profit level is ______. (3 points)

a. 10; -165
b. 10; 165
c. 30; 1121.67
d. 100; 300
e. none of the above

17. The marginal revenue function is ______ and the marginal cost function is ______.

a. \( MR = \frac{1}{200}Q^2 - \frac{2}{3}Q + 50 \)
b. \( MR = 100 - \frac{2}{3}Q; \ MC = \frac{1}{200}Q^2 - \frac{2}{3}Q + 50 \)
c. \( MR = \frac{2}{3} \); \( MC = \frac{1}{200}Q^2 - \frac{2}{3}Q + 50 \)
d. \( MR = 100 - \frac{2}{3}Q \); \( MC = 0.005Q^2 - 6Q + 50 \)
e. none of the above

18. By using the fundamental principle of profit maximizing, the profit maximizing output level, \( Q \), is found to be _______ and the corresponding maximum profit is ________.

   a. 10; -165
   b. 10; 165
   c. 30; 1121.67
   d. 100; 300
   e. none of the above

F. Optimization Techniques for Profit Maximization – 3

19. A firm has a fixed cost of $5000 and per unit cost of production of $2. Also, the firm has the following demand function.

   \[
   Q = 10,000 - 1,000P
   \]

   This firm’s total revenue (TR) function is _______ and total cost (TC) function is _______.

   a. \( TR = 10Q - \frac{Q^2}{1000}; \; TC = 2Q \)
   b. \( TR = 10Q - \frac{Q^2}{1000}; \; TC = 5000 \)
   c. \( TR = 10Q - \frac{Q^2}{1000}; \; TC = 2Q + 5000 \)
   d. \( TR = 10,000 - \frac{Q^2}{1000}; \; TC = 2Q + 5000 \)
   e. none of the above

20. The profit-maximizing output, \( Q \), is _______ and the maximum profit level is _______. (3 points)

   a. 400; -$1,960
   b. 4000; +$11,000
   c. 400; -$24,000
   d. 4000; +$13,000
   e. none of the above