9. Profit (or Loss) = Total revenue – Total cost
   = (100 -0.1D)D – (17500 + 40D)
   = -0.1D^2 + 60D – 17,500

\[
\frac{d(\text{Profit})}{dD} = -0.2D + 60 = 0; \quad D^* = (60 / 0.2) = 300 \text{ units/month}
\]

\[
\frac{d^2(\text{Profit})}{d^2D} = -0.2; \text{ thus } D^* \text{ is a maximum value}
\]

Is (a-cv) > 0? (100-40) = 60 > 0

Is (Total revenue – Total cost) > 0 at D = D* = 300 units/month?

\[-0.1(300)^2 + 60(300) – 17,500 = -8,500/\text{month (loss)}\]

Therefore, even though D* = 300 units/month is the optimal demand, the company would incur a loss at this production volume. Do not produce the new product.

11. a) D = 500 – 5p; p = 100 – 0.2D

Profit / Loss = Total Revenue – Total Cost
   = (100 – 0.2D)D – (1,000 + 20D)
   = -0.2D^2 + 80D – 1,000

\[
\frac{d(\text{Profit})}{dD} = -0.4D + 80 = 0
\]

\[
D^* = 80/0.4 = 200 \text{ units/month}
\]

\[
\frac{d^2(\text{Profit})}{d^2D} = -0.4; \text{ thus } D^* \text{ is a maximum value}
\]
b) Profit/Loss = \(-0.2D^2 + 80D - 1,000\)
   Let \(D = D^* = 200\) units per month
   Profit/Loss = \(-0.2(200)^2 + 80(200) - 1000\) = $7,000/month

c) Total Revenue = Total Cost (at Breakeven Point)

\[
D' = \frac{-80 \pm \sqrt{[80^2 - 4(-0.2)(-1000)]}}{2(-0.2)}
\]

\[
D_1' = \frac{-80 + 74.83}{-0.4} = 13 \text{ units/month}
\]

\[
D_2' = \frac{-80 - 74.83}{-0.4} = 387 \text{ units/month}
\]

Profitable Range is 13 to 387

19.

a) Total Annual Cost (TAC) = Fixed Cost + Cost of Heat Loss = \(350X + 4.80/(X^{3/2})\)

\[
d(TAC)/dX = 0 = 350 - 2.40(X^{3/2})
\]

\[
X^{3/2} = \frac{2.4}{350} = 0.006857
\]

\[
X = 0.0361 \text{ meters}
\]

b) \(d^2 (TAC) / dX^2 = 3.6 / X^{5/2} > 0 \) for \(X > 0\)

Since the second derivative is positive, \(X^* = 0.0361\) is a minimum cost thickness

c) The cost of the extra insulation (a directly varying cost) is being traded-off against the value of reduction in lost head (an indirectly varying cost)
37.
a.  F
b.  F
c.  T
d.  T
e.  T
f.  F
g.  T
h.  T
i.  F
j.  T
k.  T
l.  F
m.  T
n.  F
o.  T
p.  T