20 $S(q) = q^{7/2} + 4q^{5/2} + 55$, $q_0 = 4$

Equilibrium price $(p_0) = S(4) = 4^{7/2} + 4 \cdot 4^{5/2} + 55$

$$= 2^7 + 4 \cdot 2^5 + 55$$
$$= 128 + 128 + 55$$
$$= 256 + 55 = 311$$

Producers' surplus $= \displaystyle\int_0^{q_0} \left[p_0 - S(q)\right] dq$

$$= \int_0^4 \left[311 - \left(q^{7/2} + 4q^{5/2} + 55\right)\right] dq$$

$$= \int_0^4 \left(256 - q^{7/2} - 4q^{5/2}\right) dq$$

$$= \int_0^4 256\, dq - \int_0^4 q^{7/2}\, dq - 4\int_0^4 q^{5/2}\, dq$$

$$= 256q \Big|_0^4 - \frac{q^{9/2}}{9/2}\Big|_0^4 - \frac{4 \cdot q^{7/2}}{7/2}\Big|_0^4$$

$$= 256 \cdot 4 - \frac{2 \cdot 4^{9/2}}{9} - \frac{8}{7} \cdot 4^{7/2}$$

$$= 1024 - \frac{2 \cdot 2^9}{9} - \frac{8 \cdot 2^7}{7}$$

$$= 1024 - \frac{1024}{9} - \frac{8 \cdot 128}{7}$$

$$= 1024 - \frac{1024}{9} - \frac{1024}{7}$$

$$= 1024\left(1 - \frac{1}{9} - \frac{1}{7}\right) = 1024 \cdot (0.746)$$

$$= \boxed{763.94}$$