(2)

a)

$12 + 3 + \frac{Q}{10} + \frac{Q^2}{25} = 30 - Q$

$\frac{Q^2}{25} + \frac{11}{10}Q - 15 = 0$

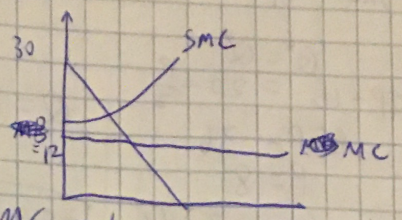
$Q = \frac{-\frac{11}{10} \pm \sqrt{\frac{121}{100} - 4 \cdot \frac{1}{25} \cdot -15}}{\frac{2}{25}}$

$\boxed{Q = 10}$

$MB = MC$

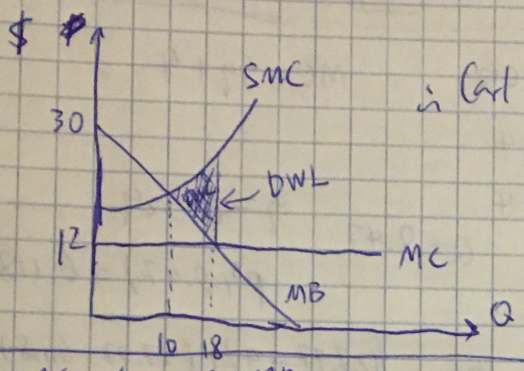
$30 - Q = 12$

$\boxed{Q = 18}$



∴ Socially efficient is 10, and the EMC make sense since the quatratic formula takes the negative externality into consideration.

b)



∴ Carl actually garden for 18 hours

c)

Raise MC to SMC = MB

Condition: SMC = MB

$SMC(10) = 15 + \frac{10}{10} + \frac{100}{25} = 20$

fee = 20 − 12 = $\boxed{8}$

d)

$MB_{new} = 30 - Q + 10 = 40 - Q$

$15 + \frac{Q}{10} + \frac{Q^2}{25} = 40 - Q$

$\frac{Q^2}{25} + \frac{11}{10}Q - 25 = 0$

$Q = \frac{-\frac{11}{10} \pm \sqrt{\frac{121}{100} - 4 \cdot \frac{1}{25} \cdot -25}}{\frac{2}{25}}$

$Q = 14.78$

$SMC(14.78) =$

new $EMC = 3 - 10 + \frac{Q}{10} + \frac{Q^2}{25}$

$-7 + 12 + \frac{Q}{10} + \frac{Q^2}{25} = 30 - Q$

$\frac{Q^2}{25} + \frac{11}{10}Q - 25 = 0$

$Q = \frac{-\frac{11}{10} \pm \sqrt{\frac{121}{100} - 4 \cdot \frac{1}{25} \cdot -25}}{\frac{2}{25}}$

$Q = 14.78$

$SMC(15) + \frac{14.78}{10} + \frac{14.78^2}{25} = 15.21$

$Fee = 15.21 - 12 = \boxed{3.22}$

100C : PS 6

① a) $MC = 4q + 4 = P$ $\quad q^S = \frac{P}{4} - 1$ $\quad Q^S = 4P - 16$ $\quad P(0) = 4$

$Q^S = Q^D$

$4P - 16 = 20 - \frac{P}{2}$ $\quad P^S = \frac{Q}{4} + 4$ $\quad P^D = -2Q + 40$

$4.5P = 36$ $\quad Q = 16$ $\quad \begin{cases} P = 8 \\ Q = 16 \end{cases}$ $\quad P^S(0) = 4$ $\quad P^D(0) = 40$

$P = 8$

$CS = \frac{(40 - 8)16}{2} = \boxed{256}$ $\quad PS = \frac{(8 - 4)16}{2} = \boxed{32}$

$\pi = TR - TC = 8\left(\frac{16}{16}\right) - 2 - 4 - 1 = \boxed{1}$

b) $MR = MC_i$ $\quad TR = P^D \cdot Q = -2Q^2 + 40Q$ $\quad MC = 4q + 4$

$MR = -4Q + 40 = 4q + 4$

$-4Q + 40 = \frac{Q}{4} + 4$ $\quad q = 0.529$

$-4.25Q = -36$ $\quad Q = 8.47$ $\quad P^S(8.47) = 6.118$

$P^D(6.118) = 27.77$

$CS = (40 - 27.77)\frac{8.47}{2} = \boxed{51.79}$ $\quad PS = \left[(27.77 - 4) + (27.77 - 6.118)\right] \cdot \frac{8.47}{2} = \boxed{192.36}$

$DWL = (27.77 - 6.118)(16 - 8.47) \cdot \frac{1}{2} = \boxed{81.52}$

c) $q^D = \frac{Q^D}{N} = 125 - \frac{P}{32}$ $\quad P^D = 40 - 32q$, $\quad TR = 40q - 32q^2$

$MR = 40 - 64q$ $\quad 40 - 64q = 4q + 4 \Rightarrow -68q = -36 \Rightarrow q = 0.529$

~~$P = 6.117$~~ $\quad P^D = 40 - 32 \times 0.529 = 23.07$

$\pi = TR - TC = 23.07(0.529) - 2(0.529)^2 + 4(0.529) + 1 = \boxed{10.523}$

∴ This should be easier to enforce than the original cartel

d) If the SMC intercept the P^D at the same point of which the monopoly will set price and quantity, then this outcome is socially optimal. Since the SMC is resulted by certain negative externalities.