Problem 1

	Buyer's Surplus (BS)	Seller's Surplus (SS)	Total Surplus (TS)
Ex post	*V(I)-p*	*p-c*	*V(I)-c*
Ex ante	*V(I)-p*	*p-c-I*	*V(I)-c-I*

a) Solving (max $TS_{\text{ex-ante}}$) $\max_I aI - bI^2 - c - I$ $(+\mathbf{2}\ \boldsymbol{pts})$, we get $I^* = \begin{cases} \frac{a-1}{2b} & if \quad c \le \frac{(a-1)^2}{4b} \ (+\mathbf{6}\ \boldsymbol{pts}) \\ 0 & if \quad c > \frac{(a-1)^2}{4b} \ (+\mathbf{2}\ \boldsymbol{pts}) \end{cases}$

b) $SS_{\text{ex-post}}=BS_{\text{ex-post}}$ => v-p=p-c => p*=(v+c)/2 $(+\mathbf{2}\ \boldsymbol{pts})$. Solving (max $SS_{\text{ex-ante}}$) $\max_{I\ge 0} \frac{aI-bI^2+c}{2} - c - I$, we get $I^{**} = \frac{a-2}{2b}$ provided that $p - c - I > 0$ $(+\mathbf{6}\ \boldsymbol{pts})$. Notice that $I^{**} < I^*$ from a). This implies that investment is always no larger than the efficient level. Thus the level of investment is generally inefficient, but it may happen that $c > \frac{(a-1)^2}{4b}$, which would mean that both the efficient and the actual investment are zero. $(+\mathbf{2}\ \boldsymbol{pts})$

c) The seller will set $p = v$ to appropriate the whole surplus $(+\mathbf{2}\ \boldsymbol{pts})$. Then she solves $\max_{I\ge 0} aI - bI^2 - c - I$, which is identical to a), and hence the outcome is necessarily efficient. $(+\mathbf{8}\ \boldsymbol{pts})$

d) The buyer will set $p = c$ $(+\mathbf{2}\ \boldsymbol{pts})$, and hence the seller will have no incentive to invest as $\max_{I\ge 0} c - c - I$ results in $I^{***} = 0$. $(+\mathbf{8}\ \boldsymbol{pts})$

e) As $\Delta W^{seller} = 1.75 - 0.5c$, this is the maximum she will be ready to pay. $\frac{\partial\, \Delta W^{seller}}{\partial c} < 0$ means that the seller will be ready to pay less if c increases. This is not a surprise given that c is avoidable part of the total cost, which will be definitely compensated by the buyer. Higher c means less scope for 'unfair' division of the proceeds from I. $(+\mathbf{10}\ \boldsymbol{pts})$

Problem 2

a) Assuming one month horizon, the cost function is $C(n) = f + nb + 2 * 500 * \left\lceil \frac{n}{20} \right\rceil$, where n is the number of operations in a given month, f is the monthly leasing fee, b is the cost of surgery necessitates per operation, $\lceil\cdot\rceil$ is the ceiling (or round up) operator (therefore, $2 * 500 * \left\lceil \frac{n}{20} \right\rceil$ is the expense on the electrodes). Average cost is $AC(n) = \frac{f}{n} + b + \frac{2*500}{n}\left\lceil \frac{n}{20} \right\rceil$. Note that f is obviously a fixed cost, bn is a variable cost, whereas $2 * 500 * \left\lceil \frac{n}{20} \right\rceil$ is a semi-variable (or, equivalently, semi-fixed) cost. $(\boldsymbol{correct\ identification\ of\ cost\ type}\ + \mathbf{4}\ \boldsymbol{pts}, \boldsymbol{explanation}\ + \mathbf{2}\ \boldsymbol{pts}, \boldsymbol{correct\ costs\ functions}\ + \mathbf{2}\ \boldsymbol{pts}, \boldsymbol{graphs}\ + \mathbf{2}\ \boldsymbol{pts})$

b) Unlike Lasik surgery, cosmetic surgery does not have such sizeable semi-variable cost component. Therefore, cosmetic surgeons face economies of scale after they paid the leasing cost (which is fixed) $(+\mathbf{10}\ \boldsymbol{pts})$

Problem 3

Measure of Economies of scale (EoS) is:

$$S(q) = \frac{AC}{MC}.$$

If $S(q) > 1$ EoS exists.

$$AC = \frac{f}{q} + cq; MC = 2cq$$

Solving $S(q) > 1$ and given that $f, c \; and \; q$ are positive numbers, we get EoS if $q < \sqrt{\frac{f}{c}}$, Diseconomies of scale if $q > \sqrt{\frac{f}{c}}$ and constant return to scale if $q = \sqrt{\frac{f}{c}}$ $(\boldsymbol{each\ case}\ +\mathbf{8}\ \boldsymbol{pts};\ +\mathbf{24}\ \boldsymbol{pts\ in\ total})$. If $f = 0$, there is no positive range of output, where EoS exists $(+\mathbf{6}\ \boldsymbol{pts})$.