1 (16 pts). For the function $f(x) = x^4 - 2x^2$,

find all critical points and inflection points. Identify each critical point as a local maximum, local minimum, or neither.

2 (12 pts). Find the exact global maximum and minimum values of the function

$$f(x) = x^3 - 3x^2 - 9x + 15$$

on the closed interval $-5 \leq x \leq 4$. 
3 (12 pts). The demand equation for a quantity $q$ of a product at a price $p$, in dollars, is $p = -4q + 4004$. The company producing the product reports the cost $C$, in dollars, to produce a quantity $q$ is $C = 4q + 5$ dollars.

(a) (4 pts). Express the company’s profit, in dollars, as a function of $q$.

(b) (4 pts). What production level earns the largest possible profit?

(c) (4 pts). What is the largest possible profit?
4 (12 pts). You are the manager of a company that produces slippers that sell for $20 per slipper. You are producing 1200 slippers each month, at an average cost of $2 per slipper. The marginal cost at a production level of 1200 is $3 per slipper.

(a) (4 pts). Are you making or losing money?

(b) (8 pts). Will increasing production increase or decrease your average cost?

5 (12 pts). The demand for yams is given by \( q = 5000 - 10p^2 \), where \( q \) is in pounds of yams and \( p \) is the price, in dollars, of a pound of yams.

(a) (4 pts). If the current price of yams is $2 per pound, how many pounds will be sold?

(b) (8 pts). Is the demand at $2 per pound elastic or inelastic?
6 (12 pts). In the spring of 2003, the disease SARS spread in accordance with the logistic function

\[ P = \frac{1760}{1 + 17.53e^{-0.1408t}} \]

where \( P = P(t) \) is the total number of SARS cases reported in Hong Kong \( t \) days after March 17, 2003.

(a) (4 pts). How many SARS cases were reported in Hong Kong on March 17, 2003?

(b) (4 pts). What limiting value of \( P \) does this function predict?

(c) (4 pts). How many days after March 17, 2003, was the disease spreading most rapidly?
7 (12 pts). The temperature adjusted for wind-chill is a temperature which tells you how cold it feels, as a result of the combination of wind and temperature. See the following table.

<table>
<thead>
<tr>
<th>temperature (°F)</th>
<th>5</th>
<th>31</th>
<th>25</th>
<th>19</th>
<th>13</th>
<th>7</th>
<th>1</th>
<th>-5</th>
<th>-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>wind speed (mph)</td>
<td>10</td>
<td>27</td>
<td>21</td>
<td>15</td>
<td>9</td>
<td>3</td>
<td>-4</td>
<td>-10</td>
<td>-16</td>
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<tr>
<td>wind speed (mph)</td>
<td>15</td>
<td>25</td>
<td>19</td>
<td>13</td>
<td>6</td>
<td>0</td>
<td>-7</td>
<td>-13</td>
<td>-19</td>
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<tr>
<td>wind speed (mph)</td>
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<td>24</td>
<td>17</td>
<td>11</td>
<td>4</td>
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<td>-9</td>
<td>-15</td>
<td>-22</td>
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<tr>
<td>wind speed (mph)</td>
<td>25</td>
<td>23</td>
<td>16</td>
<td>9</td>
<td>-4</td>
<td>-11</td>
<td>-17</td>
<td>-24</td>
<td></td>
</tr>
</tbody>
</table>

For example, if the temperature is 0 °F and the wind speed is 15 mph, then it feels like -19 °F.

(a) (3 pts). If the temperature is 35 °F, what wind speed makes it feel like 24 °F?

(b) (3 pts). If the temperature is 20 °F, what wind speed makes it feel like 9 °F?

(c) (3 pts). If the wind is blowing at 15 mph, what temperature feels like 0 °F?

(d) (3 pts). If the wind is blowing at 20 mph, what temperature makes it feel like -15 °F?
8 (12 pts). Sketch a contour diagram for the function $f(x,y) = y - x^2$ with at least four labeled contours.