Work quickly and carefully, following directions closely.

§ I. TRUE AND / OR FALSE. Circle your answer. There are 2 questions at 2 points each.

1. TRUE or FALSE: The effective interest rate is the annual rate divided by 12 months.

2. TRUE or FALSE: The exponential function $e^x$ is its own derivative.

§II. MULTIPLE CHOICE. Circle your answer. There are 3 question at 5 points each.

1. The derivative of the function $y = e^{(2x^3)}$ is
   (a) $y' = e^{(6x^2)}$  
   (b) $y' = 6x^2 e^{(2x^3)}$  
   (c) $y' = 2x^3 e^{(2x^3-1)}$  
   (d) none of the above  
   (e) all of the above

2. A maximum of the function $S(t) = \frac{2t^2 e^{(-t^2)}}{3!}$ is at
   (a) $t = 0$  
   (b) $t = 1$  
   (c) both  
   (d) neither

3. The present value of $1,000 invested at 10% compounded quarterly for 7 years is
   (a) $1,000  
   (b) $1,996.50  
   (c) both  
   (d) neither
§ III. PROBLEMS. You **must** show your work to receive credit. There are 5 problems at 10 points each.

1. Consider the cash flow at the right. What is the present value of the total at the end of the fifth year if the interest is 5% compounded annually.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Year</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Deposit</td>
<td>1200</td>
<td>1300</td>
<td>1150</td>
<td>1450</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

1996 North Carolina Tax Rate Schedule: NC Tax Income (NCTI) is $50,000 or more.

<table>
<thead>
<tr>
<th>Filing Status</th>
<th>NC Taxable income is more than</th>
<th>NC Taxable income is not over</th>
<th>The Tax is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>$0</td>
<td>$12,750</td>
<td>6% of NCTI</td>
</tr>
<tr>
<td></td>
<td>$12,750</td>
<td>$60,000</td>
<td>$765 + 7% of NCTI over $12,750</td>
</tr>
<tr>
<td></td>
<td>$60,000</td>
<td>---------</td>
<td>$4072.50 + 7.75% of NCTI over $60,000</td>
</tr>
</tbody>
</table>

2. a. Use the **last four digits** of your soc. sec. number **times** 1000 to be your annual NC taxable income (your NCTI). Use the tax table above to calculate your NC State Income Tax.

   NCTI ____________________ ,   Tax ____________________

b. Is the NC tax function is discontinuous? If so, where are the discontinuities and what kind are they?

EC: Who wrote the poem “Whales Weep Not!”? __________________________
3. Graph the function \( y = \frac{x^2 - 4}{x + 2} \). Label any discontinuities and give their type.

4. Jean-Luc propitiously decides to save for retirement. On his 30\(^{th}\) birthday he begins to deposit $100 per month at 6.5%. A stroke of ill fortune causes Jean-Luc to stop making deposits on his 40\(^{th}\) birthday, but his luck isn’t all bad, and the interest rates to climb to 7.25%. On his 65\(^{th}\) birthday how much money is in Jean-Luc’s account if he made no withdrawals before then?

5. a. What are the payments for a 30 year $150,000 mortgage at 7\(\frac{3}{4}\) % ?

b. Determine how many months early the mortgage will be paid off if the mortgagee pays $75 extra each month.