This exam is closed to books and notes, but you may use a calculator. You have 75 minutes. Your exam contains 5 questions and 6 pages. Please make sure you print your name and sign the honor code below.

I acknowledge that I have neither given nor received aid on this examination nor have I concealed any violation of the Honor Code.

(SIGNED)_________________________________________
1. A fully discrete 3-year term insurance policy was issued to a person \( (x) \). The death benefit is $0 for the first year; $6000 for the second year; $5000 for the third year. The interest rate is \( i = 6\% \) and mortality rates are given by

\[
q_x = 0.2, \quad q_{x+1} = 0.1, \quad q_{x+2} = 0.097
\]

(a) (10 pts.) Calculate the level benefit premium for this insurance.

(b) (10 pts.) Find \( \text{Var}[L|K(x) \geq 1] \), the variance of the prospective loss at the end of year 1.
2. A fully continuous whole life insurance on (45) provides an increasing benefit $b_t = t$ at the time of death $t$. Mortality follows De Moivres law with $\omega = 105$ and the interest rate is $i = 10\%$.

(a) (10 pts.) Calculate the level benefit premium for this insurance.

(b) (10 pts.) Find $\nu V$, the benefit reserve at the end of year 5.
3. A fully discrete 3-year endowment insurance on (75) provides, in case of death within 3 years, a payment of 1000 plus the benefit reserve. The maturity value is 1000. The interest rate is \( i = 10\% \) and mortality rates are given by

\[
q_{75} = 0.0516911, \quad q_{76} = 0.0564708, \quad q_{77} = 0.0616840
\]

(a) (10 pts.) Calculate the level benefit premium for this insurance.

(b) (10 pts.) Find \( V_1 \), the benefit reserve at the end of year 1.
4. (20 pts.) A 5-payment 10-year term insurance with a decreasing benefit was issued on a fully discrete basis to a person age 60. The death benefit payable in the \((k + 1)\)th policy year is \(b_{k+1}\) given in (\(\ast\)). Level benefit premiums are payable for five years and equal 218.15 each. Mortality rates for \((60)\) are given by (\(\ast\)) and the interest rate is \(i = 6\%\).

\[
\begin{align*}
\ast & \quad b_{k+1} = 1000(10 - k), \quad k = 0, 1, 2, \ldots, 9 \\
\ast \ast & \quad q_{60+k} = 0.02 + 0.001k, \quad k = 0, 1, 2, \ldots, 9
\end{align*}
\]

Calculate \(2V\), the benefit reserve at the end of year 2.
5. A fully discrete whole life insurance policy was issued to a person \((x)\). The death benefit and annual benefit premiums for this insurance are shown in the table below. The interest rate is \(i = 6\%\).

<table>
<thead>
<tr>
<th>(k)</th>
<th>Net annual Premium at beginning of year (k)</th>
<th>Death benefit at end of year (k)</th>
<th>(q_{x+k-1})</th>
<th>(kV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>12</td>
<td>120</td>
<td>0.098</td>
<td>84</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>240</td>
<td>—</td>
<td>96</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
<td>360</td>
<td>0.101</td>
<td>—</td>
</tr>
</tbody>
</table>

(a) (10 pts.) Calculate the mortality rate \(q_{x+2}\).

(b) (10 pts.) Calculate \(4V\), the benefit reserve at the end of year 4.