Show all work for full credit, use correct notation, and clearly mark your answer.

1. For a fully discrete whole life insurance of 1000 on (50), you are given:
   (i) The annual per policy expense is 1.
   (ii) There is an additional first year expense of 15.
   (iii) The claim settlement expense of 50 is payable when the claim is paid.
   (iv) All expenses, except the claim settlement expense, are paid at BOY.
   (v) Actuarial assumptions follow the Illustrative Life Table.
   (a) (10 points) Calculate the level gross premium using the equivalence principle.
   (b) (10 points) Calculate the expense load (i.e. the expense premium).

2. (10 points) For a fully discrete whole life insurance of 1000 on (60), you are given:
   (i) The expenses, payable at BOY, are:

<table>
<thead>
<tr>
<th>Expense Type</th>
<th>First Year</th>
<th>Renewal Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of Premium</td>
<td>20%</td>
<td>6%</td>
</tr>
<tr>
<td>Per Policy</td>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>

   (ii) The level gross premium is 41.20
   (iii) \( i = 0.05 \)
   (iv) \( _0L \) is the present value of the loss random variable at issue

   Calculate the value of \( _0L \) if the insured dies in the third policy year.
3. (10 points) For a special fully discrete 10-payment whole life insurance on (30) with level annual net premium $\pi$:

   (i) The death benefit is equal to 1000 plus the refund, without interest, of the net premiums paid.

   (ii) $A_{30} = 0.102$

   (iii) $\overset{10}{\overline{A}_{30}} = 0.088$

   (iv) $(IA)_{30:10}^{-1} = 0.078$

   (v) $\ddot{a}_{30:10} = 7.747$

   Calculate $\pi$.

4. (10 points) For a fully discrete whole life insurance of 100,000 on each of 10,000 lives age 60, you are given:

   (i) The future lifetimes are independent.

   (ii) Mortality follows the Illustrative Life Table.

   (iii) $i = 0.06$.

   (iv) $\pi$ is the premium for each insurance of 100,000.

   Using the normal approximation, calculate $\pi$, such that the probability of a positive total loss is 1%.
   
   (Note: The $99^{th}$ percentile of the standard normal distribution is 2.326.)