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

All questions use the following:

For a fully discrete whole insurance of 40,000 on (40), you are given:

(i) \( A_{40} = 0.2 \quad \bar{\alpha}_x = \frac{1 - 0.2}{0.5} = 1.6 \)

(ii) \( A_{50} = 0.3 \quad \bar{\alpha}_x = \frac{1 - 0.3}{0.5} = 1.7 \)

(iii) \( d = 0.05 \)

(iv) The annual gross premium is 1.2 times the annual net premium.

(v) A settlement expense of 500 is owed at the time the death benefit is paid.

(vi) Per policy expense are:
100 in the first year; 10 in renewal years

(vi) Percent of premium expenses are:
50% in the first year; 5% in renewal years

(vii) \( p_{40} = 0.995 \)

(viii) \( p_{50} = 0.990 \)

\[
\text{Net premium} = \frac{40000 \cdot A_{40}}{\bar{\alpha}_{40}} = \frac{40000 \cdot A_{40} \cdot d}{1 - A_{40}} = 500
\]

\[
\text{Net settlement} = 1.2 \times 500 = 600
\]

\[
\text{B&E}
\]
1. Show that the gross premium reserve at time $t = 10$ is 4310.

\[
10 V^g = 40,500 \cdot A_{50}^g + 40 \cdot \ddot{a}_{50}^g - 600 \cdot \ddot{a}_{50}^g
\]

\[
= 4310
\]

2. Show that the net premium reserve at time $t = 10$ is 5000.

\[
10 V^n = 40,000 \cdot A_{50}^n - 500 \cdot \ddot{a}_{50}^n = 5000
\]

3. Calculate the expense reserve at time $t = 10$.

\[
10 V^e = 10 V^g - 10 V^n = -690
\]

4. Calculate the full preliminary term reserve at time $t = 10$, $10 V^{FPT}$.

\[
10 V_{40}^{FPT} = q V^n_{41} = 40,000 \left(1 - \frac{\ddot{a}_{50}^q}{\ddot{a}_{41}^q}\right)
\]

\[
\ddot{a}_{40}^q = 1 + V_{40}^q \cdot \ddot{a}_{41}^q
\]

\[
\Rightarrow \ddot{a}_{41}^q = 15.868817
\]

\[
\Rightarrow 10 V^{FPT} = 4710.67
\]

(OR)

\[
10 V^{FPT} = 40,000 \cdot A_{50}^q - \frac{\ddot{a}_{50}^q}{\ddot{a}_{41}^q}
\]

\[
\Rightarrow 10 V^{FPT} = 4710.67
\]

5. Use 1-year recursion to calculate the gross premium reserve at time $t = 11$.

\[
11 V^g = 40,500 \cdot A_{50}^g + 40 \cdot \ddot{a}_{50}^g - 600 \cdot A_{50}^g + \frac{\ddot{a}_{50}^g}{\ddot{a}_{41}^g} = \frac{40,000}{0.95} = 41,041.67
\]

\[
11 V^g = 40,500(0.95)(0.01) - 600 + 11 V^g(0.95)(0.99)
\]

\[
\Rightarrow 11 V^g = 4769.01
\]