Show all work for full credit, and use correct notation. Simplify answers completely. See other side for additional problems.

1. For a fully discrete whole life insurance of 150,000 issued to (40), you are given:

(i) \( \ddot{a}_{40} = 15 \)
(ii) \( \ddot{a}_{55} = 12 \)
(iii) \( d = 0.06 \)
(iv) \( p_{40} = 0.98 \)
(v) The only expenses are 50 at the beginning of every year

Determine

(a) (10 points) the gross premium using the equivalence principle, and the corresponding gross premium reserve at time \( k = 15 \)

\[
\Pi^g \cdot \ddot{a}_{40} = 150000 \cdot A_{40} + 50 \cdot \ddot{a}_{40} \quad \Rightarrow \quad \Pi^g = 1050
\]

\[
15 \sqrt{g} = 150000 \cdot A_{55} + 50 \cdot \ddot{a}_{55} - 1050 \ddot{a}_{55} = 30000
\]

(b) (10 points) the expense premium and the corresponding expense premium reserve at time \( k = 15 \)

\[
\Pi^e = \frac{150000 \cdot A_{40}}{\ddot{a}_{40}} = 1000 \quad \Rightarrow \quad \Pi^e = \Pi^g - \Pi^\delta = 50
\]

\[
15 \sqrt{e} = 50 \cdot \ddot{a}_{55} - \Pi^e \ddot{a}_{55} = 0
\]

(c) (10 points) the full preliminary term reserve at time \( k = 15 \)

\[
15 \sqrt{FPT} = 14 \sqrt{\delta} = 150000 \left( 1 - \frac{\ddot{a}_{55}}{\ddot{a}_{41}} \right)
\]

\[
\ddot{a}_{40} = 1 + \nu p_{40} \cdot \ddot{a}_{41} \quad \Rightarrow \quad \ddot{a}_{41} = 15.19756...
\]

\[
\therefore \quad 15 \sqrt{FPT} = 31,560
\]
2. For a fully discrete insurance issued to (x) you are given:

(i) the death benefit is 10000
(ii) the annual premium is 750
(ii) \( p_{x+6} = 0.95 \) and \( p_{x+7} = 0.90 \)
(iii) \( i = 4\% \)
(iii) \( v^2 = 3000 \)

Determine \( v^6 \)

\[
v^6 = 10000 v_{x+6}^2 - 10000^2 \cdot p_{x+6} \cdot p_{x+7} - 750 - 750 v \cdot v^3 \cdot p_{x+6} \cdot p_{x+7}
\]

\[
\Rightarrow v^6 = 2,295.488\ldots
\]

3. For a fully discrete whole life insurance of 10000 issued (30), you are given:

(i) the death benefit is paid at the end of the quarter of death
(ii) premiums of 15 are paid at the beginning of each quarter
(iii) \( A_{40} = 0.15 \)
(iv) \( i = 0.05 \)

Assuming a uniform distribution of deaths between integer ages, determine the reserve at time \( k = 10 \).

\[
10V = 10000 A^{(4)}_{40} - 4.15 \cdot A^{(4)}_{40} = 10000 A^{(4)}_{40} - 60 \cdot A^{(4)}_{40}
\]

\[
A^{(4)}_{40} = \frac{i}{i^{(4)}} \cdot A_{40} \quad (1 + i^{(4)} - i) = 1 + i = 1.05
\]

\[
\therefore A^{(4)}_{40} = 0.15278\ldots
\]

\[
A^{(4)}_{40} = \frac{1 - A^{(4)}_{40}}{i^{(4)} - i} \quad (1 - i^{(4)} - i) = 1 + i = 1.05
\]

\[
\therefore A^{(4)}_{40} = 17.4706\ldots
\]

\[
\therefore 10V = 479.602\ldots
\]