A fully discrete $20$-payment whole life insurance of $1000$ on $(x)$, you are given:

(i) $i = 0.06$.

(ii) $q_{x+19} = 0.01254$.

(iii) The level annual benefit premium is $13.72$.

(iv) The benefit reserve at the end of year $19$ is $342.03$.

Calculate $1000P_{x+20}$, the level annual benefit premium for a fully discrete whole life insurance of $1000$ on $(x + 20)$.

A. 27 B. 29 C. 31 D. 33 E. 35

Solution.

For a 20-pay whole life insurance, the 20-th year terminal reserve is $1,000A_{x+20}$. The basic reserve recursive formula gives us

$$
\frac{(342.03 + 13.72) \cdot 1.06 = 355.75 \cdot 1.06 = q_{x+19} \cdot 1,000 + p_{x+19} \cdot (1,000 \cdot \frac{20}{20}V_x)}{
\text{19th year terminal reserve plus premium}}.
$$

Substituting $q_{x+19} = 0.01254$, we calculate the 20-th year terminal reserve as $369.18$. As stated above, this is the same as $1,000A_{x+20}$. This gives

$$
1,000P_{x+20} = \frac{1000 \cdot A_{x+20}}{\bar{d}_{x+20}} = \frac{d \cdot 1000A_{x+20}}{1 - A_{x+20}} = \frac{0.06 \cdot 369.18}{1 - 0.36918} = 33.13.
$$

Answer D.