Instructions.

1. Please turn off your cell phones and place them under your chair. Any student caught with mobile phones on during the exam will be considered under the cheating rules of the University.

2. If you need to leave the room, please do so quietly so not to disturb others taking the test. No two person can leave the room at the same time. No extra time will be provided for the time missed outside the classroom.

3. Only materials provided by the instructor can be present on the table during the exam.

4. Use the blank portions of each page for your work. Extra blank pages can be provided if necessary. If you use an extra page, indicate clearly what problem you are working on.

5. Only answers supported by work will be considered. Unsupported guesses will not be graded.

6. While every attempt is made to avoid defective questions, sometimes they do occur. In the rare event that you believe a question is defective, the instructor cannot give you any guidance beyond these instructions.

7. Mobile calculators, I-pad, or communicable devices are disallowed. Use regular scientific calculators or financial calculators only. Write important steps to arrive at the solution of the following problems.

8. Do not spend too much time on any one question. If a question seems too difficult, leave it and go on.

The test is 150 minutes, GOOD LUCK, and you may begin now!

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<tr>
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1. (6 points) A portfolio contains 49 independent policies with benefit amount $B = 1$ each. For each policy the probability $q$ of a claim is $1/7$. Let $S$ be the total claims for the portfolio. Using a normal approximation, estimate $\Pr(S > 10)$.

Work shown (6 points):

2. (6 points) An insurer has issued a policy paying 1 unit at the end of the year of death in exchange for the payment of $\pi$ at the beginning of each year, provided the life survives. Assume that the insured is still alive 1 year after entering into the contract. Further assume the insurer uses $i = 0.05$ and the following mortality assumption for $K$:

$$k|q_0 = 0.2 \quad k = 0, 1, 2, 3, 4.$$ 

With a level premium of 0.30272, find the reserve $1V$ under the equivalence principle.

Work shown (6 points):
3. (1+5=6 points) You are given

(i) \( e_{30:40} = 27.3016 \)
(ii) \( S(x) = 1 - x/\omega, \ 0 \leq x \leq \omega \)
(iii) \( T(x) \) is the future lifetime random variable for \( x \).

Calculate \( \text{Var}(T(30)) \).

a) 331  
b) 352  
c) 372  
d) 393  
e) 410

Work Shown (5 points).

4. (1+5=6 points) \( Y \) is the present value random variable for a special 3-year temporary life annuity-due on \( (x) \). You are given:

(i) \( t_p_x = 0.9^t, \ t \geq 0 \)
(ii) \( K \) is the curtate future lifetime random variable for \( (x) \)
(iii) \( Y = \begin{cases} 
1.00 & K = 0 \\
1.87 & K = 1 \\
2.72 & K = 2, 3, ... 
\end{cases} \)

Calculate \( \text{Var}(Y) \).

a) 0.19  
b) 0.30  
c) 0.37  
d) 0.46  
e) 0.55

Work Shown (5 points)
5. (1+5 = 6 marks) For a fully continuous whole life insurance of 1 on (30), you are given:

(i) The force of mortality is 0.05 in the first 10 years and 0.08 thereafter
(ii) $\delta = 0.08$

Calculate the **benefit reserve** at time 10 for this insurance.

a) 0.188
b) 0.177
c) 0.166
d) 0.155
e) 0.144

Work Shown (5 points)

Hence the answer is ___

6. (1+4 = 5 marks) For a whole life annuity-due of 1 on $(x)$, payable annually:

(i) $q_x = 0.01$
(ii) $q_{x+1} = 0.05$
(iii) $i = 0.05$
(iv) $\bar{a}_{x+1} = 6.591$

Calculate the change in the actuarial present value of this annuity-due if $p_{x+1}$ is increased by 0.03

a) 0.16
b) 0.17
c) 0.18
d) 0.19
e) 0.20

Work shown (4 points):
7. (1+4 = 5 marks) You are given:

(i) \( k \cdot q_x = \frac{0.9^{k+1}}{9} \)

(ii) \( i = 0.08 \)

(iii) The force of mortality is constant

Calculate \( 1000 \left[ P \left( A_x \right) - P_x \right] \)

a) 11.34  
b) 11.94  
c) 12.77  
d) 13.17

Work shown (4 points):

8. (1+4 = 5 marks) For a fully discrete whole life insurance of 25000 on (25), you are given

(i) \( P_{25} = 0.01128 \)

(ii) \( P_{25:15} = 0.05107 \)

(iii) \( P_{25:15} = 0.05332 \)

Calculate \( 25000 \cdot V_{25} \).

a) 4540  
b) 4500  
c) 4460  
d) 4420  
e) 4380

Work shown (4 points):
9. (1+4 = 5 marks) For a special fully discrete 2-year endowment insurance on (x):

(i) The pure endowment is 2000

(ii) The death benefit for year $k$ is $(1000k)$ plus the benefit reserve at the end of year $k$, $k = 1, 2$.

(iii) $\pi$ is the level annual benefit premium

(iv) $i = 0.08$

(v) $p_{x+k-1} = 0.9$, $k = 1, 2$

Calculate $\pi$.

a) 1027
b) 1047
c) 1067
d) 1087
e) 1107

Work Shown (4 points)

Hence the answer is ___