1. As no interest is paid on withdrawals on March 31 and September 30, these withdrawals have the same time value as withdrawals on Jan and June. Hence, we can regard the withdrawals as semiannual at times, 0, 0.5, 1, 1.5, ..., 10 of amounts 100, 200, 200, ..., 200, 100. The equation of value is

\[ X = 100 + 200a_{|10|} + 100v^{20} \]

which implies \( X = 3156.81 \).

Ans: D

2. The value at time \( t = 4 \) is

\[ a(4) \left[ \frac{1}{a(1)} + \frac{1}{a(2)} + \frac{1}{a(3)} + \frac{1}{a(4)} \right] \]

Now

\[ a(t) = \exp \left( \int_0^t \frac{1}{s-t} \, ds \right) = \exp \left( \ln \frac{5}{5-t} \right) = \frac{5}{5-t} \]

Hence, the answer is

\[ 5 \left( \frac{4}{5} + \frac{3}{5} + \frac{2}{5} + \frac{1}{5} \right) = 10. \]

Ans: C

3. Interest earned in the 5th coupon is \( B_4(1 + i) \). The BV after the 4th coupon is

\[ B_4 = 100(1.05)^4 - Xs_{|10|} \]

Hence,

\[ 0.05B_4 = 0.05(100(1.05)^4 - Xs_{|10|}) = 4.85 \Rightarrow X = 5.7 \]

Ans: C

4. The effective rate of quarter year is \( j = (1.04)^{0.25} - 1 = 0.0098534 \). Hence,

\[ K = \frac{10}{jv^j} = 842.37. \]

Ans: D
5. First, note that \( i = \frac{100}{1000} = 0.1 \). The balance at year 11 is
\[
B_{11} = 1000(1.1)^{11} - (120s_{\overline{8}|}) - 20 = 649.38
\]
and hence
\[
I_{12} = (0.1)(649.38) = 64.94.
\]
**Ans: B**

6. The equation of value is
\[
220a_{\overline{5}|} - 110a_{\overline{10}|} = 200(a_{\overline{15}|} - a_{\overline{10}|}) + K(a_{\overline{10}|} - a_{\overline{5}|}) + 100a_{\overline{5}|}
\]
from which we obtain \( K = 138.60 \).
**Ans: C**

7. The PV of the payments is
\[
PV = 100(1 + 1.05v^3 + 1.05^2v^6 + \cdots + 1.05^9v^{27}) \text{ at } i = 0.05
\]
\[
= (100(1 + v^2 + v^4 + \cdots + v^{18}))
\]
\[
= \frac{100[1 - (v^2)^{10}]}{1 - v^2} = 670.
\]
**Ans: D**

8. We have
\[
\frac{(1 + X + 0.01)^2}{1 + X} = 1.035,
\]
which implies \( X^2 + 0.985X - 0.0149 \) and \( X = 1.49\% \).
**Ans: E**

9. The answer is
\[
1000(1.08)^{-2} \exp \left( -\int_2^5 0.015t \, dt \right) (1 - 0.06)^3 (1.025)^{-8} = 499.28
\]
**Ans: D**

10. The DWRR is
\[
X = \frac{1200 - 1000}{100 - 600 \times \frac{8}{12} + 600 \times \frac{4}{12}} = \frac{200}{800} = 0.25
\]
and the TWRR is
\[
Y = \left( \frac{1100}{1000} \right) \left( \frac{400}{500} \right) \left( \frac{1200}{1000} \right) - 1 = 0.056,
\]
so that \( X - Y = 0.194 \).
**Ans: D**
11. Note that \( d^{(2)} < \delta < i^{(2)} < i \) at the same rate of interest. Hence, the increasing order is: (i), (iii), (ii), (iv).

12. Let \( A \) be salary 20 years ago. The mean annual salary for the 20 years is

\[
\frac{A[1 + (1 + p) + (1 + p)^2 \cdots + (1 + p)^{19}]}{20} = \frac{As_{20}}{20}
\]

The mean salary for the last 10 years is

\[
\frac{A[(1 + p)^{10} + (1 + p)^{11} \cdots + (1 + p)^{19}]}{10} = \frac{A(s_{20} - s_{10})}{10}
\]

Taking their ratio, we obtain

\[
\frac{s_{20}}{s_{20}} - \frac{s_{10}}{s_{20}} = \frac{1.182}{2} \Rightarrow \frac{s_{20}}{s_{20}} = 2.444988
\]

which implies

\[
\frac{s_{20}}{s_{20}} = (1 + p)^{10} + 1 = 2.444988
\]

and \( p = 0.0375 \).

13. The modified duration of an \( n \)-year bond with annual coupons that sells and matures at par is \( a_{\pi} \). Thus, \( a_{\pi} = 5.913877 \) and \( a_{2\pi} = 9.292143 \), which implies

\[
\frac{a_{2\pi}}{a_{\pi}} = \frac{9.292143}{5.913877} = 1 + v^n
\]

so that \( v^n = 0.571244 \) and \( i = 0.0725 \).

14. The conditions are: \( S \geq 0 \), \( S' = 0 \) and \( S'' > 0 \).