Question: Portfolio Management **(48 points)**

You are a financial advisor serving individual investors. Your clients consult you about various aspects of asset management:

a) One of your clients, Mr. X (X) is a 35-year-old public employee and is considering installment-style investment of CU 1 million each year to prepare for his retirement. X heard somewhere that, in terms of lifecycle investment, individual investors have human capital in addition to financial assets, and he asks you what that means.

Explain briefly what "human capital" means. (4 points)

b) X is considering a diversified investment in the global equity fund and domestic public bond fund shown below:

Fig. 1: Characteristics of funds under consideration

	Expected return (annualized)	Risk (standard deviation, annualized)
Global equity fund	7%	20%
Domestic public bond fund	2%	4%

- The correlation between the global equity fund returns and domestic public bond fund returns is -0.20.
- The risk-free interest rate is 1% (annualized).

b1) Calculate the expected return and risk of a portfolio investing 60% in the global equity fund and 40% in the domestic public bond fund. Calculations should be presented as percentages rounded to the first decimal place. (5 points)

b2) X is considering investing CU 1 million and he wants to limit the probability that the portfolio's market value becomes less than CU 800,000 after 1 year, to 5% or below. Calculate whether the portfolio described in b1) (global equity fund 60%; domestic public bond fund 40%) satisfies this condition, and justify your conclusion. Assume that returns follow a normal distribution. Note that according to the cumulative distribution function N of normal distribution, N (0.05) = -1.645. [Note: If you have not attempted b1), assume an expected return and risk of 0% and 12% respectively.] (4 points)

c) X has learned that a hedge fund index has performed very well for the past 5 years, and is considering investing part of his funds in the hedge fund to further diversify his investments.

c1) The calculation of returns of the hedge fund index can have a number of biases. Identify two typical biases and describe them. (4 points)

c2) Identify two typical risks associated with hedge fund investments and describe them. (4 points)

d) X invests CU 1 million in the portfolio studied in b1) and after 1 year makes an additional investment of CU 1.5 million in anticipation of a large market increase. Contrary to his expectations, however, the market decreases during the second year, and at the end of the second year, the portfolio's market value, including the additional funds, is CU 2.57 million, as shown in the table below.

Fig. 2: Market value of investment portfolio

Time	Market Value at the end of the year: V_t (CU million)	Additional funds at the beginning of next year: NC_t (net cash flow) (CU million)	$V_t + NC_t$
Starting year (t = 0)	1.00		1.00
First year (t = 1)	1.30	+1.50	2.80
Second year (t = 2)	2.57		2.57

d1) Calculate the money-weighted rate of return (annualized) over the 2 years in percentages terms rounded to the first decimal place. (4 points)

d2) Calculate the time-weighted rate of return (annualized) over the 2 years in percentages terms rounded to the first decimal place. (4 points)

d3) The additional investment of CU 1.5 million at the beginning of the second year was based upon X's view, anticipating a large market increase. In light of that, which is the better measure of 2-year performance, the money-weighted rate of return or the time-weighted rate of return? Explain briefly why. (4 points)

A few years later, you have become an asset management consultant for a pension fund.

e) You want to explain to the client pension fund the importance of taking pension liabilities into account in asset allocation.

e1) The passages underlined and marked ①~⑤ in the explanation of pension ALM (Asset Liability Management) may contain mistakes. Correct them if they contain mistakes. Otherwise, indicate that they are correct.

Pension ALM is an approach to asset management that takes account of pension liabilities. One form of pension ALM defines the difference between assets and liabilities as the "surplus" and attempts to manage it appropriately. To do this, it is important ① to increase the fluctuation of the surplus return.

You want to begin by explaining the distinctive features of asset classes when pension liabilities are taken into account. In defined benefit pensions (DB), employees are promised pension benefits for a long term into the future. The sponsoring company of the pension fund recognizes these as liabilities and can be deemed to have ② issued bonds corresponding to the average term to maturity (duration) of pension benefits. Given the liability side conditions on the pension fund, for asset side management ③ short-term bonds with short durations are better. On the other hand, stock reflects the long-term growth of the company, and for a DB in which pension benefits are proportional to final wages, stock can be expected to have a ④ negative correlation to wage increases. Alternative investments are ⑤ expected to have a high correlation with bonds and stocks, and should be considered for investment contributing to the diversification effect. Alternative investments include real estate, private equity, and hedge funds. (10 points)

e2) Discuss the problems when alternative investments are added to pension ALM in comparison to traditional assets (bonds and stocks), and identify the points that must be considered. (5 points)