Exam 1 Review

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Question 1

a. Engineering economy deals with the evaluation of various types of necessary technical trade-offs made during the design and operation of engineering systems. F

b. $(A/F, i\%, N) = (A/P, i\%, N) + i$ F

c. Simple interest ignores the time value of money principle. F

d. Cash-flow diagrams represent cash inflows by upward arrows. T

e. $1,791 ten years from now are equivalent to $900 now if the interest rate is 8% per year. F

f. It is always true that $i > r$ when $M > 2$. T

Question 1

g. Suppose that a lump sum of $1,000 is in-vested at a 10% APR for eight years. The future equivalent is greater for daily compounding than it is for monthly compounding.   T

h. For a fixed amount, F dollars, that is received at EOY N, the "A equivalent" increases as the interest rate increases.   F

i. For a specified value of F at EOY N, P at time zero will be larger for r = 10% per year than it will be for r = 10% per year, compounded monthly.   T

j. Considering certain principal value today, earned compound interest will be always higher than earned simple interest after the same period.   F

Question 2

Bank A offers an annual, compound interest rate of 6%. Bank B offers an annual, simple interest rate of 7%. If you deposit $3,000 with each bank, what will be the difference in account balances after three years? **(Answer: $56.95)**
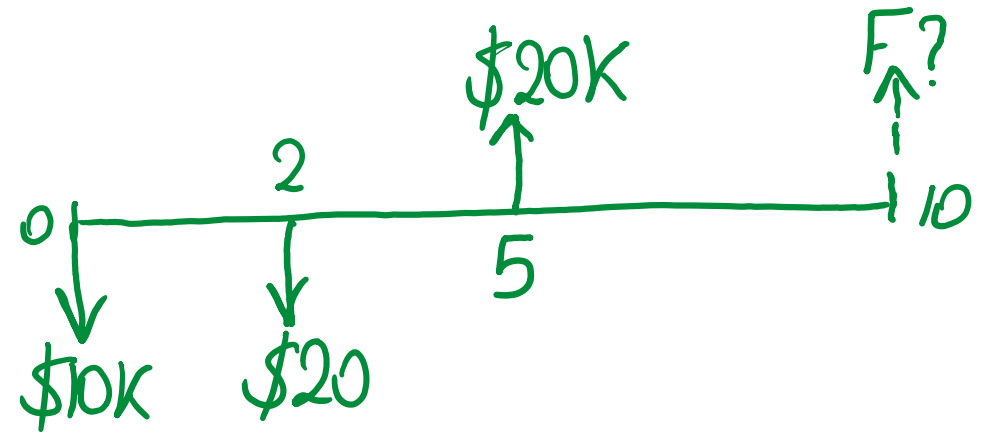
$F_A = \$3,000 \ (F/P, 6\%, 3) = \$3,573.05$

$F_B = \$3,000 + 3,000 * 3 * 0.07 = \$3,630$

$Diff. = \$56.95$

Question 3

Andy deposits $10,000 into an account today, earning 10% interest, and he deposits $20,000 two years from now. He plans to withdraw $20,000 at the end of the fifth year. How much will Andy have in the account at the end of 10 years? **(Answer: $36,599)**

$$F_{10} = 10,000(F/P, 10\%, 10) + 20,000(F/P, 10\%, 8)$$
$$- 20,000(F/P, 10\%, 5) = \$36,599$$

Question 4

A local headline blared "Bo Smith Signed for $30 Million." A reading of the article revealed that on April 1, 2015, Bo Smith, the former record-breaking running back from Football University, signed a $30 million package with the Dallas Rangers. The terms of the contract were $3 million immediately, $2.4 million per year for the first five years (with the first payment after one year from now), and $3 million per year for the next five years (with the first payment at the end of year 6). If Bo's interest rate is 8% per year, what is his contract worth at the time he signs it? Compare that to the number announced "$30 Million". **(Answer: $20,734,774)**
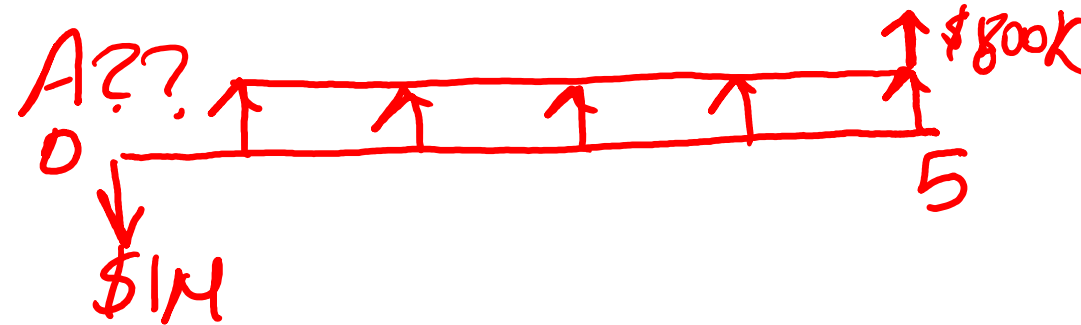
Question 4
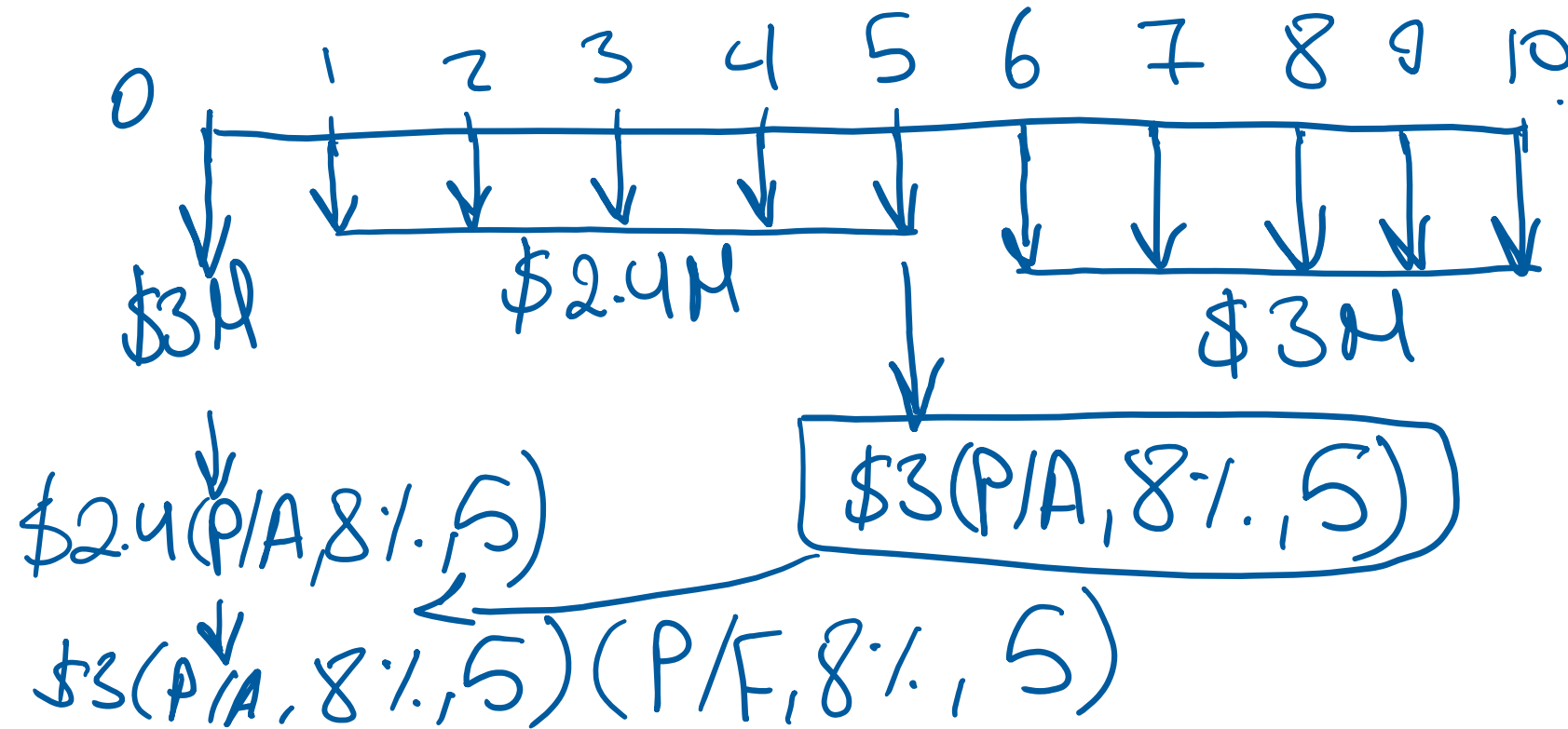
$$P = \$3 + \$2.4(P/A, 8\%, 5) + \$3(P/A, 8\%, 5)(P/F, 8\%, 5)$$

$$= \$20,734,774$$

Question 5

A widow just received $1,000,000 from an insurance company after her husband's death. She will deposit this amount (today) in a savings account that earns interest at a rate of 6% compounded annually. She wishes to withdraw a constant amount over the next five years that will leave her with $800,000 in the account at the end of the 5 years of withdrawals. What constant amount can she withdraw, at the end of each year (beginning one year from now), for the next five years? **(Answer: $95,470.52)**

$$1,000,000 = A(P/A, 6\%, 5) + 800,000(P/F, 6\%, 5)$$

A = $95,470.52

Question 6

A city that was planning an addition to its water supply and distribution system contracted to supply water to a large industrial user for 10 years under the following conditions: The first 5 years of service were to be paid for in advance (time zero), and the last 5 years at a rate of $45,000 per year, payable at the beginning of each year (beginning of years 6 – 10). Two years after the system is in operation (i.e., end of year 2) the city finds itself in need of funds and desires that the company pay off the entire contract so that the city can avoid a bond issue. If the city uses 8% interest compounded annually in calculating a fair receipt on the contract, what amount can they expect to receive from their industrial user? **(Answer: $154,032.38)**
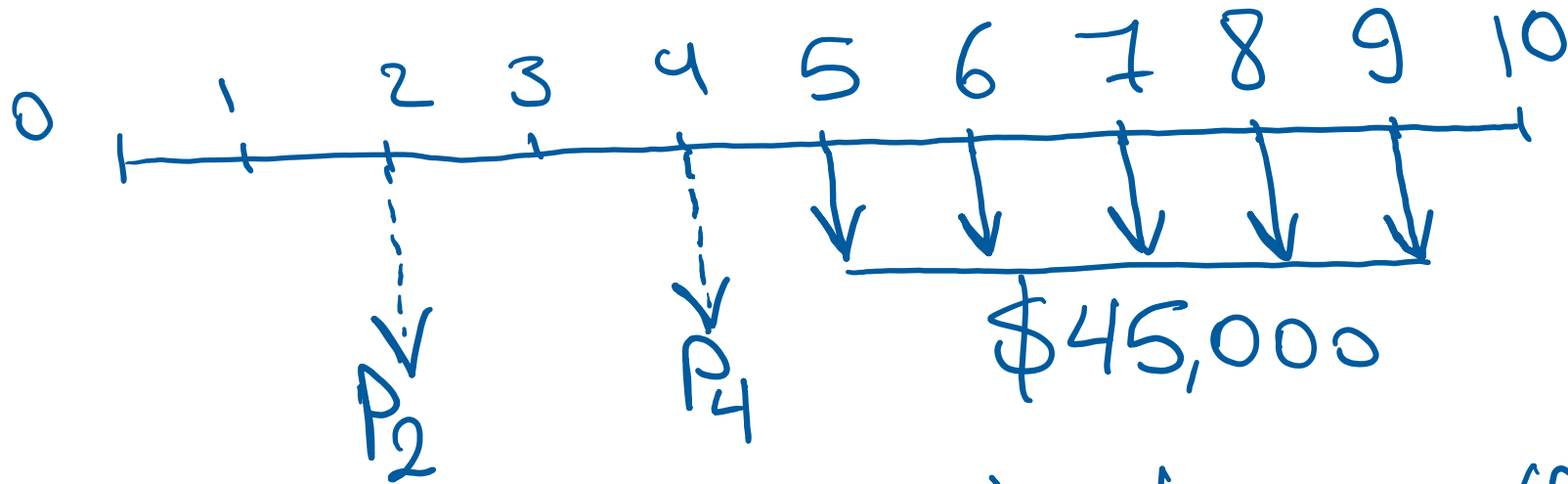
$$P_4 = \$45{,}000\,(P/A, i\%, N) = \$45{,}000\,(P/A, 8\%, 5)$$

$$P_2 = P_4\,(P/F, i\%, N)$$

$$= \$45{,}000\,(P/A, 8\%, 5)(P/F, 8\%, 2)$$

$$= \$154{,}040$$

Question 7

You have a lump sum of cash, $25,000, in an account earning 10% compound interest.

    a. How much can you withdraw each year, for six years, if you assume your last withdrawal empties the account? **(Answer: $5,740)**

    b. If you left the money alone (i.e., no withdrawals) how much would you have in the account at the end of 10 years? **(Answer: $64,842.5)**

a. $A = \$25,000\,(A/P, 10\%, 6) = \$5,740$

b. $F = \$25,000\,(F/P, 10\%, 10) =$ **$64,842.5**

Question 8

A retail outlet is being designed in a strip mall in Stillwater, Oklahoma. For this outlet the installed fiberglass insulation to protect against heat loss in the winter and heat gain in the summer will cost an estimated $100,000. The annual savings in energy cost due to the insulation will be $18,000 at the end of year 1 in the 10 year life of the outlet, and these savings will increase by 8% each year thereafter. If the annual interest rate is 12%, is the initial cost of the proposed amount of insulation justified? **(Answer: $137,175.39)**

$$P = \frac{18,000\left[1 - (P/F, 12\%, 10)(F/P, 8\%, 10)\right]}{0.12 - 0.08}$$

$$= \$137,175.39$$

Question 9

Suppose that the parents of a young child decide to make annual deposits into a savings account, with the first deposit being made on the child's fifth birthday and the last deposit being made on her 15th birthday. Then, starting on the child's 18th birthday, withdrawals will be made, $20,000 on her 18th birthday, $24,000 on her 19th, $32,000 on her 20th, and finally $40,000 on her 21st birthday. If the annual interest rate is 8% during this period of time, what are the equal, annual deposits required on her 5th-15th birthdays in order to fund the withdrawals, so that the last withdrawal empties the account? **(Answer: $4,836)**
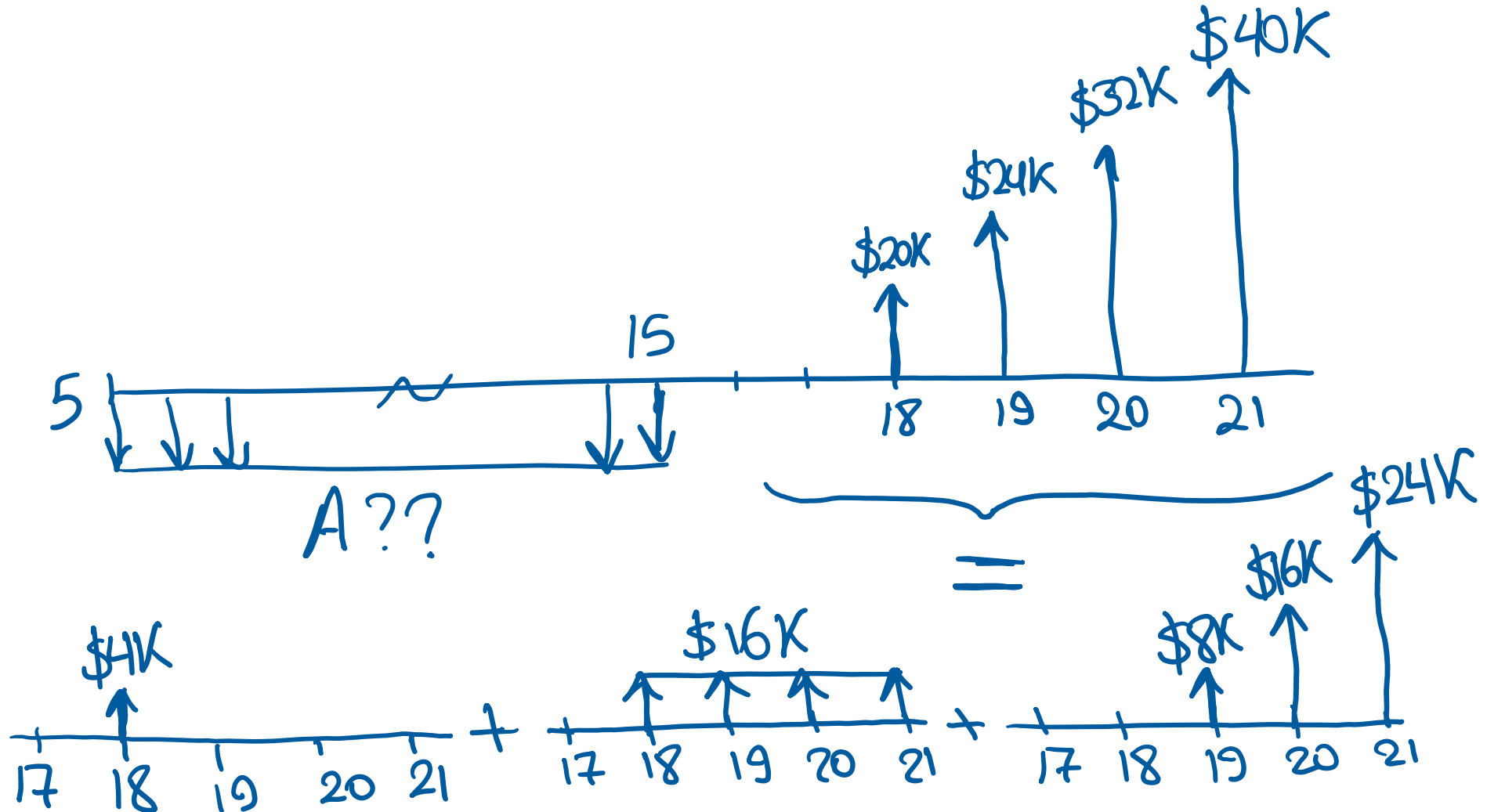
Question 9

$$P_{17} = \$16,000\,(P/A, 8\%, 4) + \$8,000\,(P/G, 8\%, 4)$$
$$+ \$4,000\,(P/F, 8\%, 1) = \$93,898$$

$$P_{15} = 93,898\,(P/F, 8\%, 2) = \$80,502.81$$

$$A = 80,502.81\,(A/F, 8\%, 11) = \$4,836.31$$

Question 10

The manager of a large crude oil refinery just purchased a particular heat exchanger, which has an operational life of 10 years. The initial cost of the exchanger is $520,000, which includes maintenance for years 1-5. In the sixth year the company must begin to provide the maintenance. The cost to provide the maintenance is $175,000 at the end of year 6 and increases by 8% each year through the end of year 9 (obviously no maintenance would be performed at the end of year 10). The interest rate for the refinery is 12%.

a. What is the economically equivalent total cost of ownership (initial cost plus maintenance costs) at time zero? **(Answer: $856,119.16)**

b. The manager is considering borrowing the money to purchase the exchanger and also borrowing enough to cover the cost of the future maintenance (so, cover all costs). If the cost of borrowing this money (interest rate) is also 12%, how much are the loan payments if the loan is to be repaid with payments at the end of the year, ending at the end of year seven, with the first payment at the origination of the loan (time zero)? **(Answer: $153,862)**
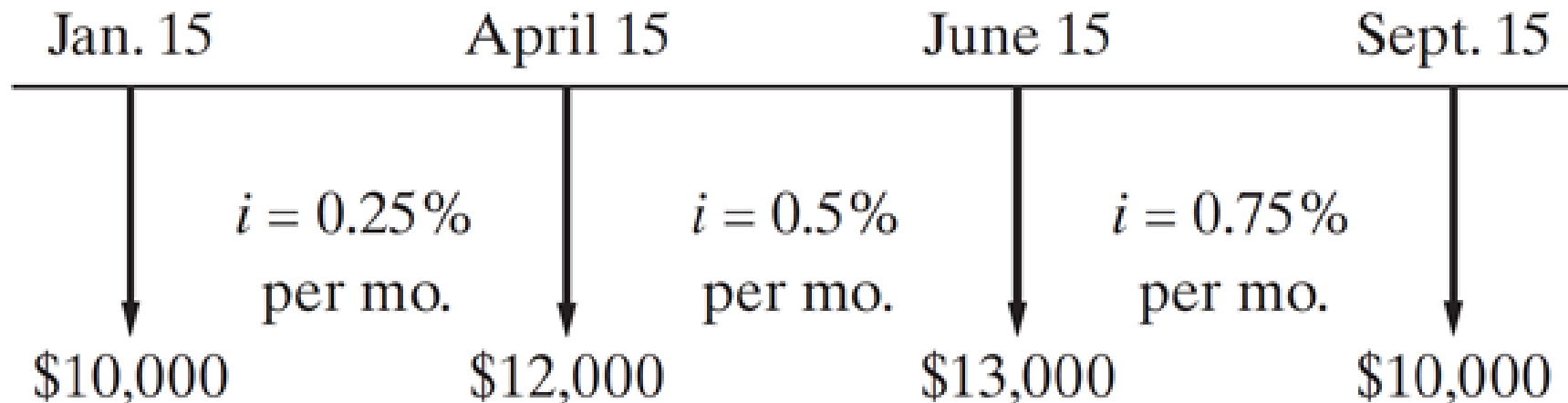
$$a. \quad P_0 = 520,000 + \frac{175,000[1-(P/F,12\%,4)(F/P,8\%,4)]}{0.12-0.08} * (P/F,12\%,5)$$

$$= \$856119.16 \ (\$856,091.43)$$

$$b. \quad A = 856119.16 \ (P/F,12\%,1)(A/P,12\%,8)$$

$$= \ \mathbf{\$153,862}$$

Question 11

Will must make quarterly estimated income tax payments to the Internal Revenue Service. The amounts and timing of these payments are shown below. Also shown are the monthly interest rates that apply to each interval of time. What is the P-equivalent of Will's payments on January 15? **(Answer: $44,293.35)**

Jan. 15	April 15	June 15	Sept. 15
	$i = 0.25\%$ per mo.	$i = 0.5\%$ per mo.	$i = 0.75\%$ per mo.
$10,000	$12,000	$13,000	$10,000

Question 11

First we discount the September payment of $10,000 for the three months to bring it back to June 15 (and add it to $13,000):

$$P_{June} = \$10{,}000 \ (P/F, \, \tfrac{3}{4}\%, \, 3 \text{ months}) + \$13{,}000$$

$$= \$10{,}000 \ (0.9778) + \$13{,}000$$

$$= \$22{,}778$$

Then we discount $22,778 for two months and add it to $12,000:

$$P_{April} = \$22{,}778 \ (P/F, \, \tfrac{1}{2}\%, \, 2) + \$12{,}000$$

$$= \$22{,}778 \ (0.9901) + \$12{,}000$$

$$= \$34{,}552.50$$

Finally we see that $P_{Jan} = \$34{,}552.50 \ (P/F, \, \tfrac{1}{4}\%, \, 3) + \$10{,}000 = \$44{,}293.35$

Question 12

A mortgage banking company has been evaluating the merits of a 50-year mortgage (in addition to their popular 30-year mortgage). The basic idea is to reduce the monthly payment and make home ownership more affordable. The APR of either mortgage is 6%, and the compounding is monthly. For a mortgage loan of $300,000,

a. What is the difference in the monthly payment for the 30-year mortgage and the 50-year mortgage? **(Answer: $210)**

b. what is the difference in the total accumulated interest for the 30-year mortgage and the 50-year mortgage? **(Answer: $306,000)**

For 30-year: $A = \$309,000 (A/P, 0.5\%, 360) = \$1,800$

For 50-year: $A = \$309,000 (A/P, 0.5\%, 600) = \$1,590$

The diff $= \$210$

b) For 30-year: interest $= 1800(360) - 300,000 =$

~ 50-year: interest $= 1590(600) - 300,000 =$ **$654,000**

Difference = $654,000 - $348,000 = $306,000

Question 13

Find the equivalent present worth and equivalent annual worth of the following cash flows series if i=14% compounded annually.

End of Year	0	1	2	3	4	5	6	7
Cash ($)	-	-	100	200	300	-	500	600

$$P_0 = 100(P/G, 14\%, 7) - 400(P/F, 14\%, 5)$$

$$= \$857.13$$

$$A = \$857.13 \ (A/P, 14\%, 7)$$

$$= \$199.88$$