

***Engineering Economics, 5e (Fraser)***  
**Chapter 2 Time Value of Money**

**2.1 Multiple Choice Questions**

- 1) The price of money can be captured through
- A) the difference between benefits and costs that occur at different times.
  - B) the future worth of an investment.
  - C) the present worth of an investment.
  - D) the interest rate.
  - E) the consumer price index.

Answer: D

Diff: 1 Type: MC Page Ref: 19

Topic: 2.2 Interest and Interest Rates

Skill: Recall

User1: Qualitative

- 2) What makes one dollar in the future less desirable than one dollar today?
- A) variable interest rate
  - B) a forgone opportunity of investment
  - C) a diminishing purchasing power of money over time
  - D) a growing inflation
  - E) accumulated welfare of people

Answer: B

Diff: 1 Type: MC Page Ref: 20

Topic: 2.2 Interest and Interest Rates

Skill: Recall

User1: Qualitative

- 3) The principal amount is
- A) the present value of money.
  - B) the future value of money.
  - C) the amount of money invested at the prime interest rate.
  - D) the annual equivalent value of money.
  - E) the difference between the amount of money lent and the amount of money later repaid.

Answer: A

Diff: 1 Type: MC Page Ref: 20

Topic: 2.3 Compound and Simple Interest

Skill: Recall

User1: Qualitative

4) Bill wants to buy a new car in three years from now. He expects that the price of a car will be \$15 000 in three years. How much money should Bill put in his savings account now if a bank pays 5% interest rate on this account?

- A) \$11 629
- B) \$12 104
- C) \$12 958
- D) \$13 465
- E) \$14 286

Answer: C

Diff: 2 Type: MC Page Ref: 21

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

5) Milo has just inherited \$6 500 and immediately spent the money purchasing an investment certificate. He decided to use the investment certificate to finance his return to the university that he left because of the financial problems at the time. Milo calculated that the interest rate the bank would pay on his investment certificate would allow him to accumulate the \$7 600 he would need over 4 years. What interest rate does the bank pay?

- A) 2.0
- B) 2.5
- C) 3.0
- D) 3.5
- E) 4.0

Answer: E

Diff: 2 Type: MC Page Ref: 21

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Qualitative

6) It is known that the total interest paid over a 5-year period is \$2 081.13. What was the principal amount borrowed at a 6% nominal interest rate compounded quarterly?

- A) \$3 000
- B) \$4 000
- C) \$5 000
- D) \$6 000
- E) \$7 000

Answer: D

Diff: 3 Type: MC Page Ref: 26-27

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

7) Nominal interest rate is calculated by

A) summing up all interest rates for all compounding periods.

B) converting a given interest rate with a compounding period to an equivalent interest rate with a one-year compounding period.

C) dividing the interest rate per compounding period by the number of compounding periods per year.

D) multiplying the simple interest rate by the number of years.

E) multiplying the interest rate per compounding period by the number of compounding periods per year.

Answer: E

Diff: 2 Type: MC Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Recall

User1: Qualitative

8) Your credit card statement says that your card charges 0.0562% interest per day. What is the actual interest rate per year?

A) 11.6%

B) 14.5%

C) 18.3%

D) 20.1%

E) 22.8%

Answer: E

Diff: 2 Type: MC Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

9) If an interest rate is 18% per year, what is the equivalent interest rate per quarter?

A) 3.8%

B) 4.5%

C) 4.8%

D) 6.2%

E) 8.6%

Answer: B

Diff: 2 Type: MC Page Ref: 25

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

10) How many compounding periods are needed to obtain an effective interest rate of 25% if the interest rate per sub-compounding period is 1.88%?

- A) 13
- B) 12
- C) 11
- D) 10
- E) 9

Answer: B

Diff: 2 Type: MC Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

11) What does a cash flow diagram of a project represent?

- A) summary of benefits and costs of a project
- B) summary of the timing and magnitude of payments and receipts as they occur over time
- C) magnitude of cash flows at a given period of time
- D) summary of present, future, and annual worths of a project
- E) change in value of money at different interest rates at various compounding periods

Answer: B

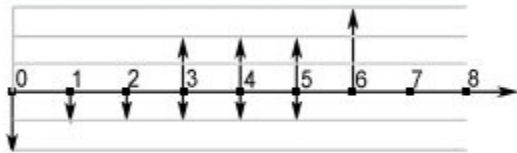
Diff: 2 Type: MC Page Ref: 29-31

Topic: 2.6 Cash Flow Diagrams

Skill: Recall

User1: Qualitative

12) A project is represented by the following cash flow diagram:



What are the project's cash flows?

- A) receipts = \$45 000; disbursements = \$25 000; project life = 6 years
- B) receipts = \$35 000; disbursements = \$45 000; project life = 6 years
- C) receipts = \$45 000; disbursements = \$35 000; project life = 6 years
- D) receipts = \$45 000; disbursements = \$35 000; project life = 7 years
- E) receipts = \$35 000; disbursements = \$45 000; project life = 7 years

Answer: C

Diff: 2 Type: MC Page Ref: 29-31

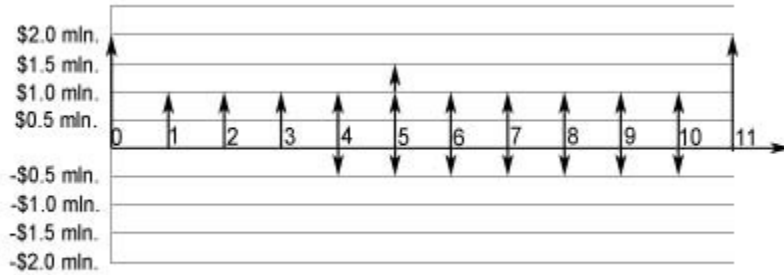
Topic: 2.6 Cash Flow Diagrams

Skill: Applied

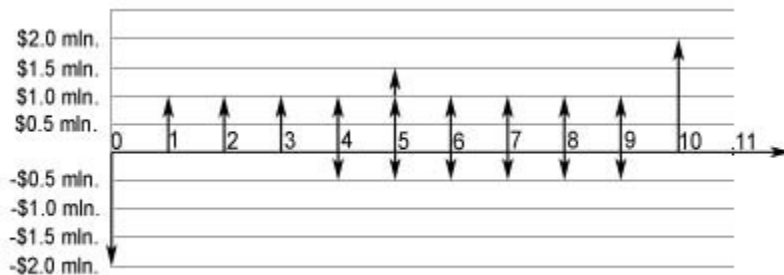
User1: Quantitative

13) J.D.Irving Ltd. is considering a construction project with \$2 million initial investment that will last for 10 years. The duration of the construction phase is one year. Once the construction is over, the project starts yielding a constant annual revenue of \$1.0 million. By the end of the fifth year the project generates \$0.5 million extra revenue. The annual operation and maintenance expenses of \$0.5 million will start at year four and last till the end of the project's life. At the very end of the 10-year project the used equipment can be sold for \$1.5 million. What cash flow diagram represents this project?

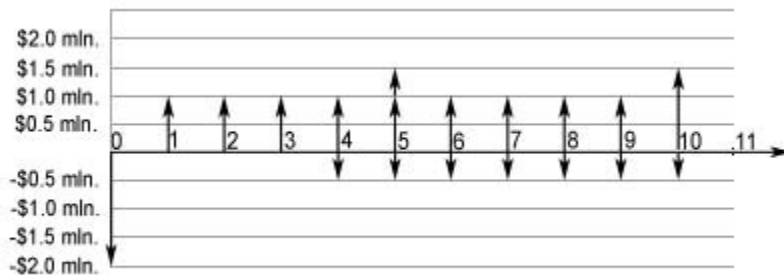
A)



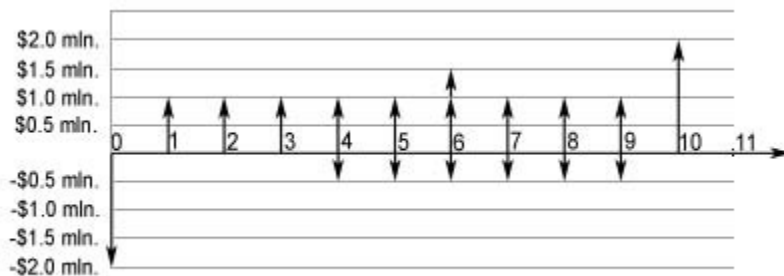
B)



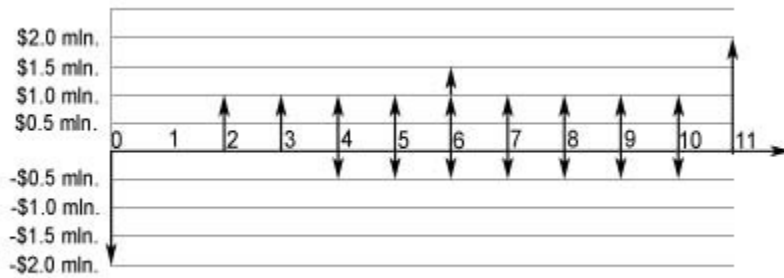
C)



D)



E)



Answer: B

Diff: 3 Type: MC Page Ref: 29-31

Topic: 2.6 Cash Flow Diagrams

Skill: Applied

User1: Quantitative

14) What does the term "market equivalence" imply?

- A) indifference on the part of a decision maker among available choices
- B) the existence of a mathematical relationship between time and money
- C) the ability to exchange one cash flow for another at minimum cost
- D) the ability to exchange one cash flow for another at no cost
- E) the ability to obtain a zero net cash flow

Answer: A

Diff: 2 Type: MC Page Ref: 32

Topic: 2.7 Equivalence

Skill: Recall

User1: Qualitative

15) You invest \$10 000 at 5% interest rate compounded monthly, what is your accumulated interest at the end of year 2?

- A) \$511.62
- B) \$537.79
- C) \$1 025.00
- D) \$1 049.41
- E) \$1 089.41

Answer: D

Diff: 2 Type: MC Page Ref: 26-27

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

16) You would like to have \$8 500 for future spending in three years from now. How much should you deposit in your bank account now if the account pays you 0.4% interest per month?

- A) \$2 071
- B) \$7 362
- C) \$8 102
- D) \$8 399
- E) \$8 429

Answer: B

Diff: 3 Type: MC Page Ref: 35

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

17) The nominal interest rate is 6% per year compounded quarterly. What is the effective annual rate?

- A) 5.74%
- B) 5.84%
- C) 5.94%
- D) 6.04%
- E) 6.14%

Answer: E

Diff: 1 Type: MC Page Ref: 27

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

18) Emily is considering two mutually exclusive financial options: (i) to deposit \$4 000 in her bank's savings account that pays 4.6% annual interest, or (ii) to purchase a \$4 000 one-year guaranteed investment certificate with a monthly interest rate of 0.3%. From an opportunity cost standpoint, by making the decision to deposit \$4 000 in the bank account, Emily will

- A) gain \$37.6 by the end of the year.
- B) lose \$37.6 by the end of the year.
- C) gain \$57.6 by the end of the year.
- D) lose \$57.6 by the end of the year.
- E) make zero economic profit.

Answer: A

Diff: 3 Type: MC Page Ref: 32-34

Topic: 2.1 Introduction

Skill: Applied

User1: Quantitative

19) If you borrow \$2 000 today at 20% interest rate for 5 years, what is your simple interest in this case?

- A) \$2 000
- B) \$4 000
- C) \$4 976.64
- D) \$976.64
- E) \$2 976.64

Answer: A

Diff: 1 Type: MC Page Ref: 24

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

20) COSCO invested \$5.5 million in a project ten years ago. As of today the worth of this project is \$24.9 million. What annual interest rate has the project been earning if interest is compounded monthly?

- A) 14.2%
- B) 14.8%
- C) 15.2%
- D) 15.8%
- E) 16.2%

Answer: C

Diff: 3 Type: MC Page Ref: 27

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

21) Equivalence is a condition that exists when

- A) the value of a cost at one time is numerically equal to the value of the related benefits received at a different time.
- B) the present worth of a cost equals the future worth of a cost at any point in time.
- C) the present worth of all costs and benefits equals the future worth of these costs and benefits at any point in time.
- D) the project breaks even, meaning costs equal benefits at a certain point in time.
- E) a decision-maker assesses two sets of cashflows as equally attractive.

Answer: E

Diff: 1 Type: MC Page Ref: 32

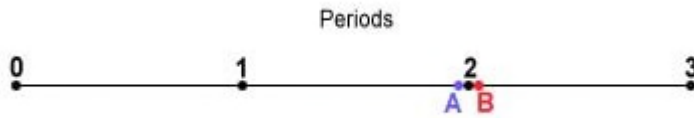
Topic: 2.7 Equivalence

Skill: Recall

User1: Qualitative



22) A project has the timing illustrated by the following cash flow diagram:



Which of the following statements about this cash flow diagram is correct?

- A) Year 1 ends at point A and year 2 begins at point B.
- B) Year 1 ends at point 2 and year 2 begins at point B.
- C) Year 1 ends at point 2 and year 2 begins at point 2.
- D) A project has four periods.
- E) First cost should be put at point 1.

Answer: C

Diff: 1 Type: MC Page Ref: 29-31

Topic: 2.6 Cash Flow Diagrams

Skill: Applied

User1: Quantitative

23) An effective interest rate has

- A) an arbitrary compounding period.
- B) a compounding period that is normally less than a year.
- C) an exogenously given compounding period.
- D) a one-year compounding period.
- E) no compounding periods.

Answer: A

Diff: 1 Type: MC Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Recall

User1: Qualitative

24) Jennifer lends \$2 000 to her friend who is launching a small business. Her friend promises to pay her 9% per year compounding interest. How much interest would Jennifer get at the end of four years?

- A) \$823
- B) \$1 284
- C) \$1 892
- D) \$2 324
- E) \$2 823

Answer: A

Diff: 2 Type: MC Page Ref: 24

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

25) At some point in time Peter had \$3 000 in spare cash. He deposited this money in his bank account that pays a 1.1% annual interest rate. After one year he was approached by his friend who said that he could offer Peter an investment deal for a two-year period. What would the market equivalence be of Peter's money?

- A) \$3 000
- B) \$3 033
- C) \$3 066
- D) \$3 100
- E) \$3 133

Answer: D

Diff: 3 Type: MC Page Ref: 32-33

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

26) In general, an interest rate is

- A) the difference between the amount of money lent and the amount of money repaid later.
- B) a percentage change in the time value of money.
- C) the ratio of the amount of money lent to the amount of money repaid later.
- D) the future worth of the money.
- E) the rate of return on direct investment.

Answer: A

Diff: 1 Type: MC Page Ref: 20-21

Topic: 2.2 Interest and Interest Rates

Skill: Recall

User1: Qualitative

27) Nominal interest rate is

- A) the actual but not usually stated interest rate.
- B) the actual and usually stated interest rate.
- C) the conventional method of stating the annual interest rate.
- D) the key interest rate in an economy.
- E) the overnight interest rate.

Answer: C

Diff: 1 Type: MC Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Recall

User1: Qualitative

28) If the effective equivalent annual interest rate is 16.2%, and interest is compounded daily, what is the corresponding nominal annual interest rate?

- A) 11%
- B) 13%
- C) 15%
- D) 17%
- E) 19%

Answer: C

Diff: 3 Type: MC Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

29) If you borrow \$1 000 now at 10% interest for 5 years, what is the compound interest owed at the end of the fifth year?

- A) \$1 000
- B) \$1 100
- C) \$1 610.51
- D) \$610.51
- E) \$500

Answer: D

Diff: 2 Type: MC Page Ref: 24-25

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

30) Suppose that you just paid \$9.91 monthly interest compounded daily on an outstanding balance of \$1 000 on your credit card. What is the nominal annual interest rate in this case?

- A) 9%
- B) 10%
- C) 11%
- D) 12%
- E) 13%

Answer: D

Diff: 3 Type: MC Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

31) Suppose the nominal rate is 10% per year and interest is compounded every two years. Use Equation 2.4 to calculate the effective annual rate.

- A) 4.88%
- B) 9.54%
- C) 10.25%
- D) 21%
- E) 44%,

Answer: B

Diff: 3 Type: MC Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

32) If the nominal annual interest rate is 10% and interest is continuously compounded, what is the effective annual interest rate?

- A) 9%
- B) 9.52%
- C) 10.52%
- D) 11%
- E) 11.52%

Answer: C

Diff: 2 Type: MC Page Ref: 28

Topic: 2.5 Continuous Compounding

Skill: Applied

User1: Quantitative

33) If the effective annual interest rate is 10% and interest is continuously compounded, what is the nominal annual interest rate?

- A) 9.00%
- B) 9.53%
- C) 10.53%
- D) 11.53%
- E) 12.53%

Answer: B

Diff: 3 Type: MC Page Ref: 28

Topic: 2.5 Continuous Compounding

Skill: Applied

User1: Quantitative

34) You have \$100 to deposit. Bank A offers 20% simple interest, Bank B offers 15% interest compounded annually. How many years would you have to keep your money in the bank for Bank B to be a better choice than Bank A?

- A) Bank B is always better.
- B) 4 years
- C) 5 years
- D) 6 years
- E) Bank B will never be better.

Answer: C

Diff: 2 Type: MC Page Ref: 22

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

35) You have \$100 to deposit. Bank A offers 16% interest, compounded annually, Bank B offers 15% interest, compounded monthly. How many years would you have to keep your money in the bank for Bank B to be a better choice?

- A) Bank B is always better.
- B) 4 years
- C) 5 years
- D) 6 years
- E) Bank B is never better.

Answer: A

Diff: 2 Type: MC Page Ref: 27

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

36) You need to borrow \$1 000 for a period of 10 years. Bank A will lend you the money at 10% interest, compounded annually, whereas Bank B will lend you the money at 10% interest, compounded monthly. At the end of ten years, how much more interest will you owe if you borrow from Bank B instead of Bank A?

- A) \$74.59
- B) \$92.50
- C) \$113.30
- D) \$137.39
- E) \$148.12

Answer: C

Diff: 2 Type: MC Page Ref: 22-24

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

37) You need to borrow \$1 000. Bank A will lend you the money at 5% interest, compounded annually, whereas Bank B will lend you the money at 5% interest, compounded monthly. Bank B also offers you a free cell phone, valued at \$100, if you do business with them. What is the longest duration of the loan for which Bank B would be a better choice?

- A) 10 years
- B) 15 years
- C) 20 Years
- D) 25 years
- E) 30 years

Answer: D

Diff: 2 Type: MC Page Ref: 22-24

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

## 2.2 Short Answer Questions

1) Michael is indifferent about paying \$1 500 for a new computer now and \$2 000 two years from now. Define Michael's implied interest rate.

Answer: The implied interest rate can be defined from the following mathematical equivalence:

$$1\,500 \times (1 + i)^2 = 2\,000 \text{ and } i = 15.5\%.$$

Diff: 1 Type: SA Page Ref: 32-33

Topic: 2.7 Equivalence

Skill: Applied

User1: Quantitative

2) When you borrow money from your bank, you pay a higher interest rate on that money compared with the interest rate offered on money in your savings account. How is this circumstance consistent with principles of engineering economics?

Answer: This situation means that the interest rate associated with borrowing is higher than the one associated with saving. When you borrow, you convert future worth into present worth. However, when you save you convert present worth into future worth. As this example shows, conversion from present to future worth and vice versa in real life is not the same. This is inconsistent with market equivalence in engineering economics. Market equivalence is based on the idea that there is a market for money that permits cash flows in the future to be exchanged for cash flows in the present and vice versa at the same interest rate.

Diff: 1 Type: SA Page Ref: 32-33

Topic: 2.7 Equivalence

Skill: Recall

User1: Qualitative

3) Stan has invested \$1 000 into mutual fund at a 5% annual rate of return, compounded daily. What are the nominal and effective interest rates in this case? Discuss how these two interest rates affect Stan's investment?

Answer: The 5% annual rate of return is a nominal interest rate. The effective interest rate is the actual rate used in financial calculations. In order to convert the 5% nominal interest rate into effective interest rate, we have to use the following formula:

$$i_e = \left(1 + \frac{0.05}{365}\right)^{365} - 1 = 0.05127 \text{ or } 5.127\%.$$

Therefore, when calculating the real return on his investment, Stan should use 5.127% interest rate instead of 5%.

Diff: 2 Type: SA Page Ref: 26

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Qualitative

4) Mary just earned \$1 000 and wants to invest the money in Canada Savings Bonds. These bonds pay a 3% annual interest rate and have a ten-year maturity period. How much interest will Mary receive at the bonds' maturity? In addition, compute simple interest and compare with actual interest.

Answer:

By the end of tenth year, \$1 000 at 3% annual interest rate will become

$1\,000 \times (1 + 0.03)^{10} = \$1\,343.92$  and therefore, the accumulated interest is  
 $\$1\,343.92 - 1\,000 = \$343.92$ .

It is also possible to directly apply the formula (2.2) on page 23 for compound interest rate

$$I_c = P(1 + i)^N - P = 1\,000 \times (1 + 0.03)^{10} - 1\,000 = \$343.92$$

Simple interest can be defined as

$$I_s = P \times i \times N = 1\,000 \times 0.03 \times 10 = \$300 \text{ (formula on page 24)}$$

Real interest is larger by \$43.93

Diff: 2 Type: SA Page Ref: 24

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Qualitative

5) Suppose that the effective interest rate associated with a VISA credit card is 20.9% while the nominal interest rate is 18.9%. What are the card's terms with respect to compounding?

Answer: The following relationship between effective interest rate  $i_e$  and nominal interest rate  $r$  should be used in this case:

$$i_e = \left(1 + \frac{r}{m}\right)^m - 1 \text{ where } m \text{ is the number of compounding periods per year.}$$

Plugging in values of  $i_e$  and  $r$

$$0.213 = \left(1 + \frac{0.189}{m}\right)^m - 1 \text{ and solving for } m \text{ by trial and error:}$$

Trying  $m = 2$  (semiannual), 4 (quarterly), 12 (monthly) and 365 (daily) compounding, it turns out that  $m = 365$  or nominal interest rate of 18.9% is compounded daily.

Diff: 3 Type: SA Page Ref: 25-27

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

6) Paul just bought a car for \$15 000 and paid in cash. Calculate Paul's opportunity cost as "funds tied up in the car" if you know that otherwise it was possible to invest the money at a 5% annual interest rate compounded monthly for five years.

Answer: Opportunity cost in this case is the money forgone as a result of the car purchase, which is forgone interest. If this sum of money was invested under the specified conditions, it would earn the following interest in five years

$$I_c = P(1 + i_e)^N - P$$

where  $i_e$  is the effective interest rate. In this case, the effective interest rate is

$$i_e = \left(1 + \frac{0.05}{12}\right)^{12} - 1 = 0.05116 \text{ or } 5.116\%.$$

Therefore, interest forgone is

$$I_c = 15\,000 \times (1 + 0.05116)^5 - 15\,000 = \$4\,250.21$$

Diff: 3 Type: SA Page Ref: 23-24

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative

7) Suppose you invested \$1 000 in a new savings account with an annual interest rate of 3% compounded daily. What is your accumulated interest at the end of the first year?

Answer: First, calculate the effective interest rate since 3% is nominal interest rate:  $i_e = (1 + 0.03/365)^{365} - 1 = 0.03045$  or it is 3.045%. Interest is given by the difference between future worth of the investment and its present worth which is  $\$1\,000 * (1 + 0.003045) - \$1\,000 = \$30.45$ .

Diff: 2 Type: SA Page Ref: 25-27

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative



8) Maria borrowed \$2 000 for five years at a simple interest rate of 6% per year. How much money will Maria repay at the end of five years?

Answer: Simple interest rate is a method of computing interest where interest earned during an interest period is not added to the principal amount used to calculate interest in the next period (p. 23).

Therefore, the interest for each of five years is

Interest per year =  $2,000 \times 0.06 = \$120/\text{year}$

Total interest =  $120 \times 5 = \$600$

The amount due after five years =  $2\,000 + 600 = \$2\,600$ .

Diff: 1 Type: SA Page Ref: 24

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

9) Explain why equivalences are just convenient assumptions. Give examples of two real world financial situations in which these equivalences do not hold

Answer: Equivalences are needed to calculate and compare different costs and benefits over time. They are simplifications which capture the basic properties of cash flows without over-complicating the problem. They may not hold precisely true in the real world. For example, we borrow at a higher interest rate compared to savings. It means that in real life when we move along a time line in a cash flow diagram we might see different rates moving in two different directions; however, equivalences assume that the rate is the same. Another example is the cost of information. We assume (until Chapter 12) that information is free, while in real life information is costly.

Diff: 3 Type: SA Page Ref: 32-34

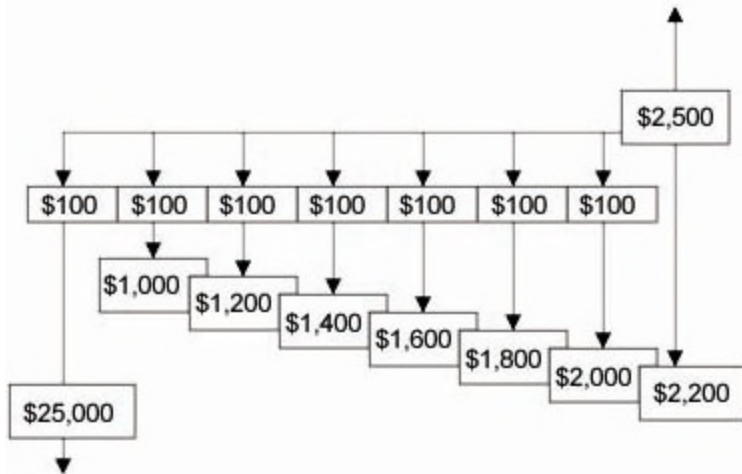
Topic: 2.7 Equivalence

Skill: Applied

User1: Qualitative

10) A transportation company just bought a new truck for \$25 000. The service life of the truck is seven years. The company has to pay a \$100 registration fee at the beginning of every year plus maintenance costs of \$1 000 in the first year and \$200 at the beginning of the second year. At the end of the truck's service life, it will be sold at 10% of its purchase price. Construct a cash flow diagram from the company's perspective.

Answer:



Diff: 2 Type: SA Page Ref: 29-31

Topic: 2.6 Cash Flow Diagrams

Skill: Applied

User1: Quantitative

11) Consider the following statement: "Financial data are collected based on discrete time periods. However, in real life time is continuous. The error when using discrete compounding instead of continuous compounding is smaller the briefer the discrete compounding period is". Do you agree or disagree with this statement and why?

Answer: This statement is correct. With an increase in the number of discrete time periods, the error decreases. This can be seen by comparing two effective interest rates—compounded daily and continuously compounded—using the same nominal interest rate. In this case, the error is negligible.

Diff: 2 Type: SA Page Ref: 28-29

Topic: 2.5 Continuous Compounding

Skill: Applied

User1: Qualitative

12) Joan is deciding whether she should remodel her house now or one year from now. If she does it now, the cost will be \$1 500. If she waits one year, the cost is expected to be \$1 600. At current interest rate of 5.6%, should Joan remodel her house now or one year from now?

Answer: To compare the two alternatives, the concept of mathematical equivalence must be applied. According to the concept, \$1 500 now is equivalent to  $1\,500 \times (1 + 0.056) = \$1\,584$  one year from now. This is less than \$1 600 and therefore Joan should remodel her house now.

Diff: 1 Type: SA Page Ref: 32

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

13) George wants to buy a car. In order to accumulate money for a down payment, he decides to save \$200 per month at 5% annual interest rate compounded monthly. How much money will Paul have for his down payment at the end of the first year?

Answer: First, it is necessary to define monthly interest rate. It is  $0.05/12 = 0.0041666$ . Each of Georges' \$200 payments should be compounded to the end of the year using this interest rate:

$$\$200 * (1 + 0.0041666)^{11} + \$200 * (1 + 0.0041666)^{10} + \dots + \$200 = \$2\,455.78$$

Diff: 3 Type: SA Page Ref: 22

Topic: 2.3 Compound and Simple Interest

Skill: Applied

User1: Quantitative

14) Suppose that a power plant project requires \$10 million in period zero, has operating costs of \$1 million per year over 10 years, and brings revenue of \$2 million per year over that period of time. Based on this information and the concept of time value of money, comment on whether this is a profit generating project or not?

Answer: If we forget about time value of money, then each year we have \$2 million - \$1 million = \$1 million in net savings. Over 10 years it comes to \$10 million. So, we invest \$10 million now, and we will get \$10 million in net savings over 10 years. However, if we take into account time value of money, net savings each year should be divided by some discount factor which means that net savings are less than \$10 million. This project is not a good investment

Diff: 3 Type: SA Page Ref: 25-27

Topic: 2.1 Introduction

Skill: Applied

User1: Quantitative

15) Suppose that the nominal interest rate is 18%. Calculate the effective interest rate when interest is compounded:

- (i) Annually
- (ii) Semiannually
- (iii) Quarterly
- (iv) Monthly
- (v) Biweekly
- (vi) Weekly
- (vii) Daily
- (viii) Continuously

Answer:

Basic formula for (i) - (vii) is  $i_e = (1 + \frac{r}{m})^m - 1$  where  $r$  is nominal interest rate and  $m$  is the number of sub-periods in the whole compounding period.

Therefore:

(i) Annually ( $m = 1$ ):  $i_s = r = 0.18$  or 18%

(ii) Semiannually ( $m = 2$ ):  $i_e = (1 + \frac{0.18}{2})^2 - 1 = 0.1881$  or 18.81%

(iii) Quarterly ( $m = 4$ ):  $i_e = (1 + \frac{0.18}{4})^4 - 1 = 0.1925$  or 19.25%

(iv) Monthly ( $m = 12$ ):  $i_e = (1 + \frac{0.18}{12})^{12} - 1 = 0.1956$  or 19.56%

(v) Biweekly ( $m = 26$ ):  $i_e = (1 + \frac{0.18}{26})^{26} - 1 = 0.1965$  or 19.65%

(vi) Weekly ( $m = 52$ ):  $i_e = (1 + \frac{0.18}{52})^{52} - 1 = 0.1968$  or 19.68%

(vii) Continuously:  $i_e = e^r - 1 = 2.7182^{0.18} - 1 = 0.1972$  or 19.72%

Diff: 2 Type: SA Page Ref: 25-27

Topic: 2.4 Effective and Nominal Interest Rates

Skill: Applied

User1: Quantitative