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Last Name First Name Student Number

UNIVERSITY OF SASKATCHEWAN

COLLEGE OF ENGINEERING

GE 348 ENGINEERING ECONOMICS

MIDTERM EXAM

THURSDAY, OCTOBER 8, 2020

Instructions:

- Exam Duration: 1.5 hours
- This Exam is Open Book.
- A formula sheet is provided as the last page.
- The student should work on this exam individually. The assessment is to inform the instructor the current learning outcomes. It would help the instructor to support you develop essential professional skills in the rest of the term.
- Students must ask permission to leave the examination room
- Show all your work.
- **Please underline or box your final answer.**
- **Show Cash Flow Diagrams where applicable.**

Part I: Multiple Choices

1. When comparing multiple alternatives:
    a. Choose the alternative with the greatest Future Value over the planning horizon
    b. Choose the alternative with the greatest Present Value over the planning horizon
    c. Check our assumptions about the MARR, as this could impact our decision
    d. All the above

2. The present value equivalent of an irregular series of cash flows may be calculated by:
    a. Summing the present value of each individual cash flow in the series
    b. Summing each individual cash flow in the series
    c. Converting each cash flow in the series to a future value
    d. Multiplying the number of cash flows by the number of years

3. The amount a lender charges to borrow money is called the:
    a. Cost of Borrowing
    b. Annual Percentage Rate
    c. Principal
    d. Remaining Balance

4. Rather than changing by a constant amount each period as with the gradient series, the geometric series changes by a constant percentage each period. True or False?
    a. True
    b. False

5. When comparing multiple alternatives, the Discounted PayBack Period (DPBP) can lead to wrong conclusions regarding the maximum economic worth. True or False?
    a. True
    b. False

6. Consider the following cash flow diagram. Which of the expressions is not valid for the present worth?

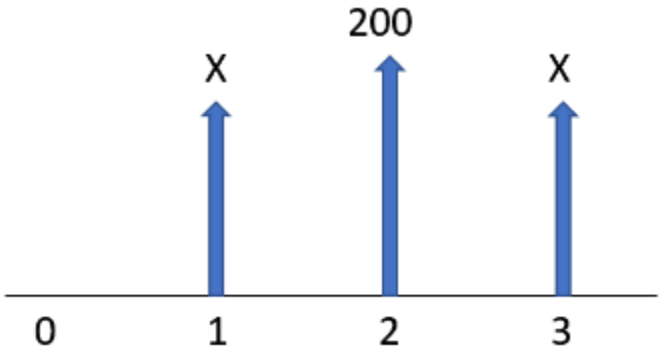
a. P = 100(P|A 10%,6) + 50(P|G 10%,3) + 150(P|A 10%,3)(P|F 10%,3)

b. P = 100(P|A 10%,3) + 50(P|G 10%,3) + 250(P|A 10%,3)(P|F 10%,3)

c. P = 250(P|A 10%,6) − 50(P|G 10%,3)

d. P = 100(P|A 10%,4) + 50(P|G 10%,4) + 250(P|A 10%,2)(P|F 10%,4)

7. Consider the following cash flow diagram. What is the value of *X* if the present worth of the diagram is $500 and the interest rate is 15% compounded annually?



8.

a. 228

b. 163

c. 146

d. 150

9. The overhead costs in a highly automated factory are expected to increase at an annual compound rate of 10% for the next 7 years. The overhead cost at the end of the first year is $200,000. What is the annual value of the overhead costs for the 7-year period? The time value of money rate is 8%/year.

a. $263,250

b. $231,520

c. $200,000

d. $187,020

10. If the internal rate of return (IRR) of a well-behaved investment alternative is equal to MARR, which of the following statements about the other measures of worth for this alternative must be true?

I. PV= 0

II. AEV = 0

a. Both I and II

b. I only

c. II only

d. Neither I nor II

Part II: Numerical Questions

1. CTL (Concrete Testing Lab) borrowed $80,000 for new equipment at APR 8% per year, compounded quarterly. It is to be paid back over 3 years in equal quarterly payments.

    a. **[1 Point]** How much interest is in the 6th payment?

Solution:

    b. **[1 Point]** How much principal is in the 6th payment?

Solution:

2. **[1 Point]** At an interest rate of 10% and using the Rule of 72, how long will it take to double the value of a lump sum invested today? How long will it take after that until the account grows to four times the initial investment? Given the power of compounding, shouldn't it take less time for the money to double the second time?

Solution:

3. **[2 Point]** An environmental consultant is considering the installation of a water storage tank for a client. The tank is estimated to have an initial cost of $426,000, and annual maintenance costs are estimated to be $6,400 per year. As an alternative, a holding pond can be provided a short distance away at an initial cost of $180,000 for the pond plus $90,000 for pumps and piping. Annual operating and maintenance costs for the pumps and holding pond are estimated to be $17,000. The planning horizon is 20 years, and at that time, neither alternative has any salvage value. Determine the preferred alternative based on a present value analysis with a MARR of 20%/year.

Solution:

4. Grammarly is a startup company that offers a software as a service (SaaS). It can check and correct grammar mistakes for its customers. Its individual plan has three tiers:

Monthly	29.95/month	Billed at the beginning of each month as one payment of 29.95	
Quarterly	19.98/month	Billed at the beginning of each quarter as one payment of 59.95	Save 33%
Annual	11.66/month	Billed at the beginning of year as one payment of 139.95	Save 61%

   a. **[1 Point]** Please use the economics theory from this class to explain why the company may prefer the annual plan billed as one payment despite deep discount.

Solution:

b. **[1 Point]** Assume the annual plan and monthly plan are equivalent economically, what is the time value of money (internal rate of return) for the company.

Solution:

5. **[1 Point]** You are considering two investment opportunities, both of which make total payments of $10,000 over their respective lives. Which would be worth more today: Investment A, which pays $1,000 at the end of each year for the next 10 years, or Investment B, which pays $775 at the end of the first year, but the payment increases by $50 each year, reaching $1,225 at the end of year 10? Are there any circumstances in which you would be indifferent between the two? Explain.

Solution: