

**Problem 1.**

A.  $P = A(P/A, i\%, n)$   
 $P = 15,000(P/A, 6\%, 20)$

$$(P/A, 6\%, 20) = \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{(1+.06)^{20} - 1}{.06(1+.06)^{20}} = 11.4697$$

$$P = \$172,046$$

B.  $A_{3m} = P(A/P, i/n\%, 4n)$   
 $A_{3m} = 280,000(A/P, 2\%, 32) =$

$$(A/P, 2\%, 32) = \frac{i(1+i)^n}{(1+i)^n - 1} = \frac{.02(1+.02)^{32}}{(1+.02)^{32} - 1} = .04261$$

$$A_{3m} = \$11,931$$

C.  $36,000 = A_1(P/A, 8\%, 4) + A_1(P/A, 8\%, 8)$

$$(P/A, 8\%, 4) = \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{(1+.08)^4 - 1}{.08(1+.08)^4} = 3.3123$$

$$(P/A, 8\%, 8) = \frac{(1+i)^n - 1}{i(1+i)^n} = \frac{(1+.08)^8 - 1}{.08(1+.08)^8} = 5.7466$$

$$36,000 = A_1(3.3123) + A_1(5.7466)$$

$$A_1 = 36,000/9.0589$$

$$A_1 = 3,974$$

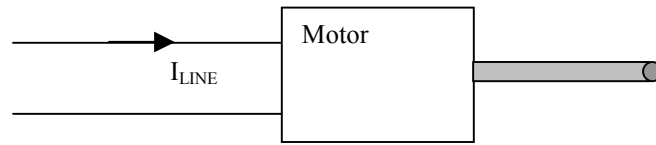
$$\text{First Payment} = 2A_1 = \$7,948$$

*Other solutions exist, for example*

$$36,000 = 2B(P/A, 8\%, 4) + B(P/A, 8\%, 4)(P/F, 8\%, 4)$$

$$\text{First Payment} = 2B = \$7,948$$

**Problem 2.**



- A. Cost = input power in kilowatts x \$.06/KW-hr x 360 days/year x 12 hours/day

$$\text{Cost} = 40\text{KW}/.8 \times \$.06/\text{KW-hr} \times 360\text{days/year} \times 12\text{hours/day} = \$12,960$$

- B. Maintenance Cost = \$800 (P/F<sub>1</sub>, 8%, 5%, 8)

$$(P/F_1, 8\%, 5\%, 8) = \frac{(1+i)^n - (1+g)^n}{(i-g)(1+i)^n} = \frac{(1+.08)^8 - (1+.05)^8}{(.08-.05)(1+.08)^8} = 6.7258$$

$$\text{Maintenance Cost} = \$800 (6.7258) = \$5,381$$

- C. Lifecycle Cost = Purchase cost+ present value of the power cost + present value of the maintenance cost- present value of the salvage value.

$$\text{Lifecycle cost} = 20,000 + 12,960(P/A, 8\%, 8) + 5381 - 4,000(P/F, 8\%, 8)$$

$$\text{Lifecycle cost} = 20,000 + 12,960(5.7466) + 5381 - 4,000(.5403)$$

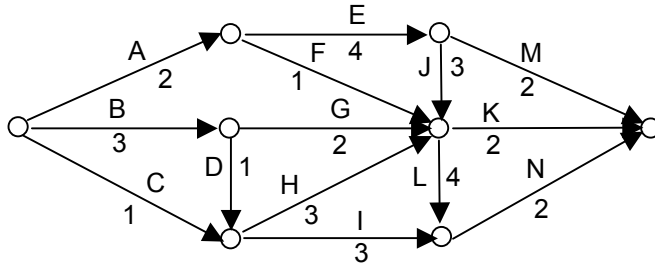
$$\text{Lifecycle cost} = \$97,696$$

**Problem 3. (12 points)**

- A. The project completion time for a PERT Chart is assumed to be a normally distributed random variable. This assumption is most closely related to the concept that the individual activity times are uncorrelated random variables, and the central limit theorem applies to the sum. (b)
- B. The term reuse refers to putting a device, or a modular part of a device, into service again. If there is a change in technology, the reuse process may become uneconomical. (a)

**Problem 4. (22 points)**

A.



Critical Path = longest path = AEJLN

Project Duration = length of critical path = 15

B. (i) Float for Activity E=0, since all activities on the critical path have a float of zero.

(ii) Activity G: Latest start = Project duration-length of longest backward path

Latest start for Activity G=15-8=7

Earliest start for Activity G=3

Float for Activity G=7-3=4

C. (5 points) Project duration = 18 months  
 standard deviation = 9 months.

Probability that the project will require greater than 15 months to complete obtained from tail-end Z distribution.

$$Z = (15 - 18) / 9 = -.333$$

$$P(Z > -.333) = 1 - Z(.333) = 1 - .37 = .63$$

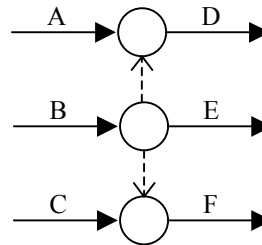
Probability = .63

D. The PERT chart described in Part C has a set of logical precedence relations described by the following:

Activity A and B must be done before activity D

Activities B must be done before activity E

Activities B and C must be done before activity F



**Problem 5. (9 points)**

- A. Between is used when there are two persons or items; among is used when there are more than two: between the two students, among the two students. Effect may be used as a verb, meaning “to bring about,” as in “to effect a solution.” #1
- B. Less applies to matters of reduced degree; fewer applies to items that are countable. One would say “fewer children,” as opposed to “less children”, which is incorrect. Periods of time can be described using either less or fewer: “fewer than six hours” is correct. #1
- C. Biannual means occurring either every two years or twice a year; semiannual means twice a year, or every six months. #2

**Problem 6. (9 points)**

- A. For the accelerated cost recovery method of depreciation, the depreciation expense charged is determined by multiplying the unadjusted basis times a percentage. The percentage is determined by law for each class of property. Salvage value and actual predicted lifetime of usage is irrelevant. (False)
- B. In the design process, one of the major advantages of partitioning is the ability to separate tasks, such that a shorter calendar time to completion is obtained, even at the expense of having to use more people.(False)
- C. In group decision-making, the number of possible communication interactions is not linearly proportional to the number of group members. If the group has N members, each member can interact with N-1 others. By considering each member, there are  $N(N-1)/2$  possible interactions, with the 2 in the denominator preventing double counting. For large N, the leading term is  $N^2/2$ . (False)

**Problem 7. (10 points)**

Specification:  $T > 1000$ . Two batches of 10,000 fasteners

Batch A: mean  $T = 1,400$

Standard deviation  $T = 200$

Batch B: mean  $T = 1,900$

Standard deviation  $T = 600$

Fraction of expected defects,  $A = Z((1400-1000)/200) = Z(2) = .0228$

Fraction of expected defects,  $B = Z((1900-1000)/600) = Z(1.5) = .0668$

A has the lower fraction

Number of expected defects,  $A = .0228(10,000) = 228$