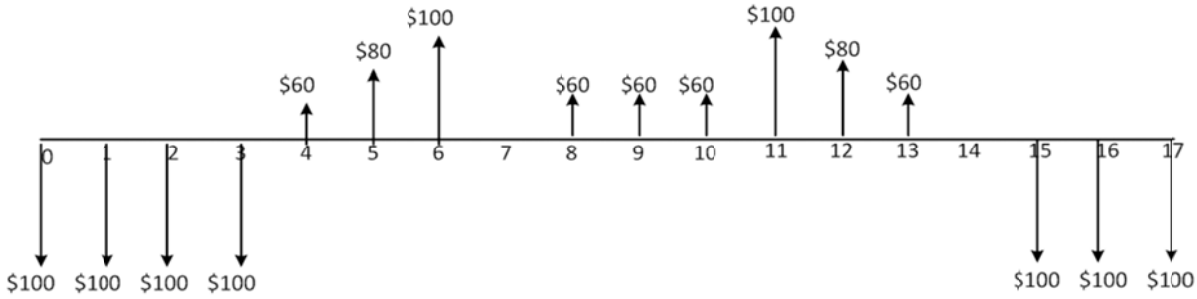
Concordia University
Faculty of Engineering and Computer Science
ENGR 301 Final Exam (time allowed is 3 hours)

Name: _____ ID#: _____

Instructions:

1- **This is a CLOSED BOOK exam. Maximum grade is 55 plus 1 extra credit.**
2- **This is a multiple choice exam, with only one correct answer per question.**
3- **Exam questions booklet is to be returned with the answer booklet.**
4- **Only Faculty of ENCS approved calculators are allowed.**
5- **Mark the corresponding space on the multiple choice answer sheet.**
6- **Only the multiple choice answer sheet will be marked.**

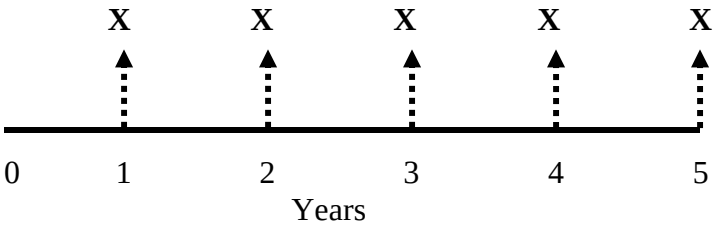
Questions (1-2):
Using the interest rate 10%, please answer the following questions:



(1) Net present worth for the above cash flow is close to:
a) $720 b) –$113 c) –$40 d) –$44

(2) Future worth for the above cash flow is close to:
a) $1435 b) $679 c) –$192 d) –$569

Question (3):



(3) Present worth for the above cash flow at an interest rate of 10% is:
a) 5.2173**X** b) 4.0134**X** c) 2.8932**X** d) 3.7908**X**

Question (4):

(4) The net present worth for the above cash flow, with an interest rate of 12% for years 1 to 4, and 10% thereafter, is close to:

a) –$133 b) –$455 c) $190 d) $136

Questions (5-8):

(5) The purpose of planning is:
a) Defining work tasks and their logic relations
b) Cost monitoring
c) Resource leveling
d) Precedence network diagram

(6) The main advantage of a matrix organizational structure is:
a) High management and administration cost
b) Better communications
c) Risk operating rules
d) Absolute authority to project manager

(7) Lump-sum contract means:
a) Project price is fixed
b) Project price is calculated per area, volume, etc.
c) Owner pays direct cost plus fixed percentage
d) Owner pays direct cost, indirect cost plus fixed percentage

(8) Which statement with respect to the project life cycle is FALSE:
a) Project cost and staffing level begin slowly at the beginning of the project and decrease at a faster rate at the end of the project
b) The cost of changes is lowest at the beginning of the project and increases as the project progresses
c) Stakeholder influence, risk and uncertainty are greatest at the beginning of the project and decrease as the project progresses
d) Stakeholder influence, risk and uncertainty are lowest at the beginning of the project and increase as the project progresses

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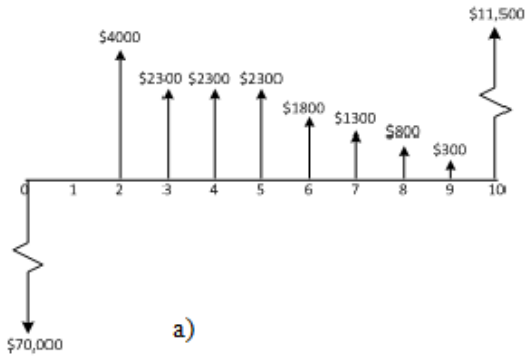
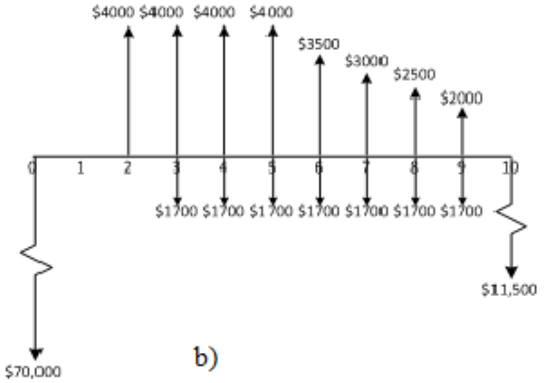
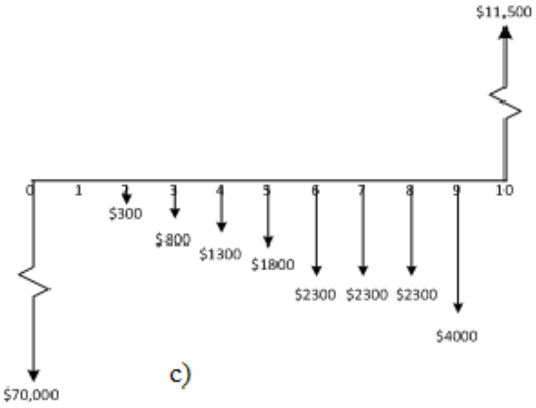
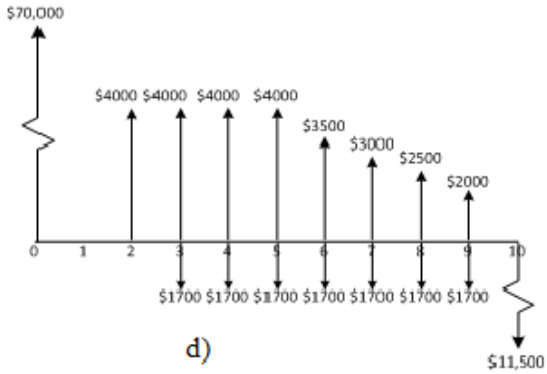
Question (9):
Sirius-7 engineering company intends to purchase an alternative energy generating system to reduce its energy costs. It has estimated that the purchase price of the alternative energy system will be $70,000 and it will have a useful life of 10 years, after which it will be sold for $10,000. The company expects to begin to realize savings in its energy costs two years after acquiring the system. In this regard, it expects that initial savings will be $4000 a year for four years and will decrease by $500 a year until the useful life of the energy system has been reached. The company expects to perform annual maintenance on the alternative energy system at a cost of $1700 commencing on the 3rd year and ending on the 9th year.

Which one of the following cash flow diagrams represents the company's cash transactions with respect to the alternative energy generating system over the next 10 years?









Questions (10-11):
An investor can make 3 end of year payments of $15,000, starting this year, which will generate a receipt of $10,000 at the end of year 4, which will increase annually by $2500 for the following 4 years. The investment will earn a return of 10%.

(10) The uniform annual worth of the investment is close to:
a) $1397 b) $2942 c) $762 d) $22,488

(11) At year 5, the entire investment is close to:
a) $6549 b) $15,414 c) $12,500 d) $816

Question (12):
A company has expanded its business to include the assembly of sewing machines. The 3rd sewing machine took 75 hours to be assembled and the 12th sewing machine took 59 hours. Based on the learning curve equation and a labour cost of $95/hour, the estimated cost of the 20th sewing machine is close to:

(12) a) $3245 b) $4254 c) $5137 d) $7230

Questions (13-17):
Consider the following investment alternatives and 10% interest rate:

Alternatives Cash Flow ($)

n	A	B	C	D
0	–$2000	–$4000	–$3000	–$9000
1	$400	$3000	–$2000	$2000
2	$500	$2000	$4000	$4000
3	$600	$1000	$2000	$8000
4	$700	$500	$4000	$8000
5	$800	$500	$2000	$4000

(13) Equivalent annual worth of alternative (A) is close to:
a) $53 b) $200 c) $250 d) $70

(14) Equivalent annual worth of alternative (B) is close to:
a) $500 b) $480 c) $470 d) $601

(15) Equivalent annual worth of alternative (C) is close to:
a) $1400 b) $1045 c) –$1045 d) $100

(16) Equivalent annual worth of alternative (D) is close to:
a) $3400 b) $2659 c) $3002 d) $2640

(17) The best alternative is:
a) A b) B c) C d) D

Questions (18-24):
Consider the following two investments A and B with the following sequences of cash flows:

	Net Cash Flow	
n	**A**	**B**
0	–$120,000	–$100,000
1	$20,000	$15,000
2	$20,000	$15,000
3	$120,000	$130,000

(18) If i = 10%, then PW for alternative A is close to:
a) $4870 b) $5875 c) $8902 d) $6001

(19) If i = 20%, then PW for alternative A is close to:
a) –$23,087 b) $25,689 c) $22,892 d) –$20,010

(20) Based on the above questions (18) and (19), the IRR for alternative A is close to:
a) 12.5% b) 13.8% c) 15.9% d) 11.7%

(21) If i = 10%, then PW for alternative B is close to:
a) $27,603 b) $22,730 c) $23,704 d) $20,986

(22) If i = 20%, then PW for alternative B is close to:
a) –$1859 b) $2869 c) –$1973 d) –$1925

(23) Based on the above questions (21) and (22), the IRR for alternative B is close to:
a) 15.4% b) 17.8% c) 10.7% d) 19.3%

(24) If MARR is 15%, which alternative is acceptable?
a) Alternative A b) Alternative B
c) Reject both alternatives d) Both alternatives A&B are equally preferable

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Questions (25-28):
(25) A project management office (PMO) can take many forms. Which of the following describes the weather station form of PMO?
a) Focusses on developing methods for continually improving project management skills by identifying what is working, where the shortcomings exist, and how to resolve ongoing problems
b) Is used only for tracking and monitoring projects without directly attempting to influence and control them
c) Is used to maintain and provide a cadre of trained and skilled project professionals as they are needed
d) Both a) and c)

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(26) Which of the following is true about the WBS?
a) The WBS is deliverable-oriented.
b) The WBS is an unstructured list of activities in chart form.
c) The WBS is the same as an Organizational Breakdown Structure.
d) The WBS refers to the Bill of Material (BOM).

(27) Organizations performing projects may divide each project into phases. Collectively, project phases are known as the:
a) Project waterfall
b) Project life cycle
c) Project life stages
d) Project life quality circle

(28) In engineering economic analysis sunk costs refer to:
a) Costs that cannot be recovered and are therefore losses
b) The loss in value of a depreciated asset
c) All costs that point downwards on a cash flow diagram
d) Money spent in the past

Questions (29-35): See the network on the following page.
(Please solve this problem in this paper and attach the exam book to your answer book)
Using the CPM method, calculate early start (ES), late start (LS), early finish (EF), late finish (LF) and float (F) for each activity in the network on the following page and answer the following questions? Note: D in the legend indicates activity duration.

(29) The ES of activity H is:
a) 18 b) 22 c) 5 d) 2

(30) The LF of activity B is:
a) 20 b) 22 c) 18 d) 19

(31) The F of activity A is:
a) 5 b) 17 c) 18 d) 13

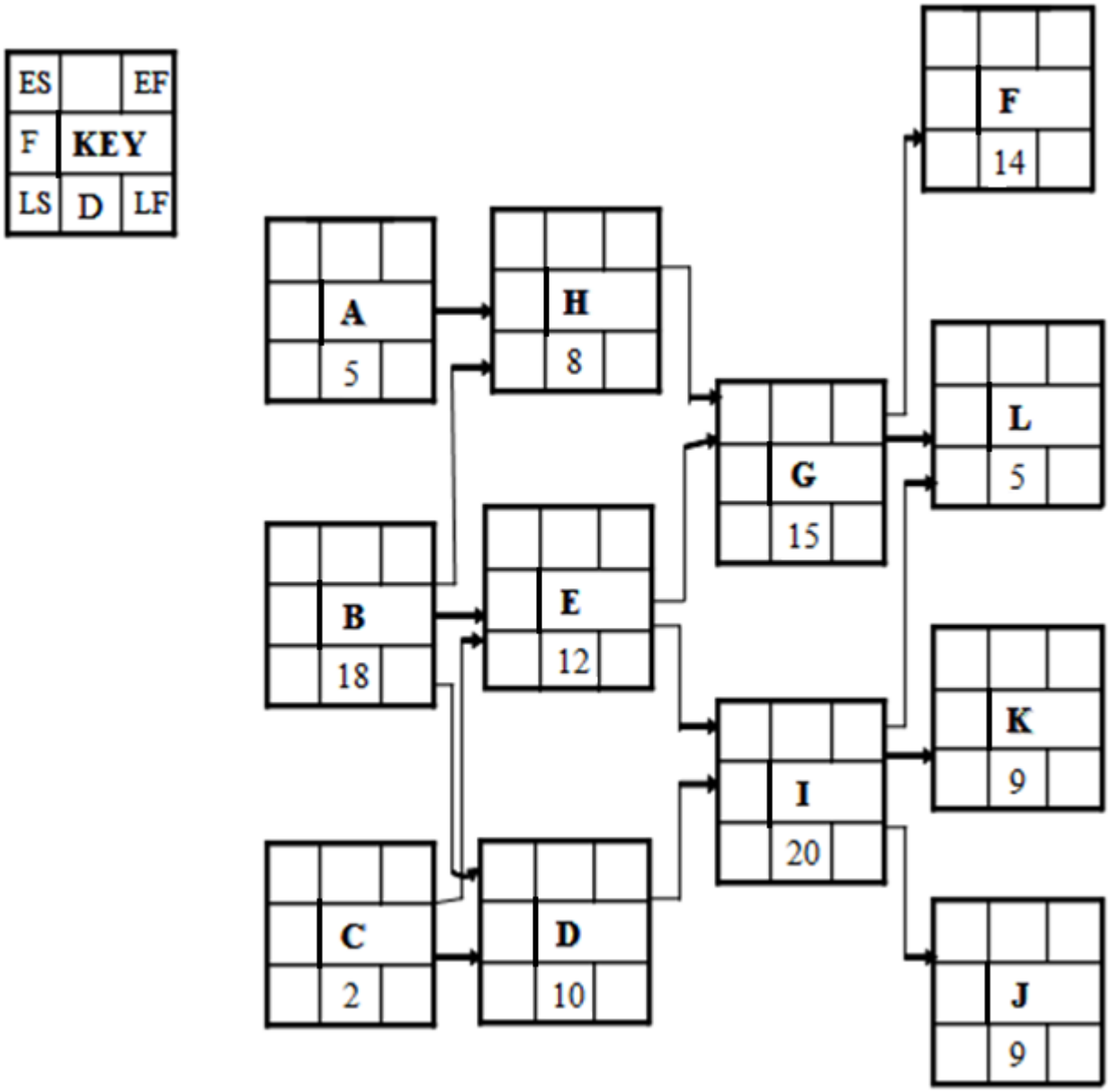
(32) The project duration is:
a) 58 b) 60 c) 61 d) 59

(33) The critical path(s) is (are):
a) B-E-G-F b) B-E-I-J c) B-E-I-K d) All previous

(34) The LS of activity L is:
a) 54 b) 45 c) 50 d) 59

(35) The F of activity C is:
a) 0 b) 14 c) 16 d) 15

Network Diagram for questions (29-35): ***Note: You may make notes in this diagram***



Questions (36-41):
The purchase price of a machine is $7500, its estimated salvage value is $3000, and its service life is 5 years. Please answer the following questions:

Using the straight line (SL) method:

(36) The yearly depreciation amount is:
a) $1000 b) $900 c) $850 d) $990

(37) The book value of the machine at the end of year 3 is:
a) $5700 b) $3900 c) $4800 d) $4700

Using the double declining balance (DDB) method:

(38) The depreciation amount in the second year is close to:
a) $1800 b) $1250 c) $1300 d) $1370

(39) The book value of the machine at the end of year 4 is close to:
a) $1080 b) $925 c) $972 d) $900

Using the sum of years' digits (SOYD) method:

(40) The depreciation amount in the fourth year is close to:
a) $700 b) $650 c) $600 d) $670

(41) The book value of the machine at the end of year 4 is close to:
a) $3000 b) $3300 c) $3800 d) $3700

Question (42):
Over a period of 10 years, an investor deposits $1500 at the end of each year in a savings account that pays 8% interest, compounded quarterly.

(42) The amount available in his account immediately before the 10^{th} deposit is close to:
a) $20,500 b) $19,500 c) $21,000 d) $20,000

Questions (43-44):
An engineer wants to purchase a house for $100,000 and has $20,000 cash to use as the down payment. The bank offers a loan for the remainder at 6% nominal interest with the term of the loan being 20 years.

(43) Assuming the payment is the same for all months, the monthly loan payment is close to:
a) $6976 b) $353 c) $500 d) $573

(44) The effective interest rate is close to:
a) 5.9% b) 6.0% c) 6.1% d) 6.2%

Questions (45-48):
Willis and Gouw manufacturing company produces PVC pipes and drainage ducts for use in the agriculture industry. The table below shows a list of the major equipment currently owned by the company and current book value.

Equipment	*Book Value*	*CCA Class*	*CCA Rate*
2 Trucks	$30,000	16	40%
1 Fork Lift	$14,000	38	30%
Poly Vinyl Patent	$10,000	44	25%
1 Factory Building	$240,000	1	4%

(45) The company's undepreciated capital cost at the beginning of the current year is close to:
a) $114,700 b) $294,000 c) $291,060 d) $186,000

(46) The total depreciation deduction permitted at the end of the current year is close to:
a) $2,940 b) $265,700 c) $114,700 d) $28,300

(47) If the company purchases a second forklift for $12,000 at the beginning of next year, the depreciation deduction for asset class 38 at the end of next year is close to:
a) $7,800 b) $4,740 c) $6,000 d) $3,600

(48) Considering the purchase of the 2nd forklift, the book value of the company's assets at the end of next year is close to:
a) $244,485 b) $242,669 c) $288,149 d) $254,900

Question (49)

The cost of a medium sized lathe in 2006 was $18,450. The Industrial Equipment Price Index in 2006 was 125. If the current price index is 174, the estimated cost of a similar size lathe is close to:

(49) a) $13,254 b) $25,682 c) $27,490 d) $14,354

Question (50)

At the beginning of 2004, your company purchased 15 tons of raw materials for $320,000. In January 2013, the same 15 tons of raw materials cost $385,000. The average inflation rate over this period is close to:

(50) a) 1.7% b) 1.9% c) 1.8% d) 2.0%

Questions (51-56):
PARC Co. has asked you to recommend a new nutcracker machine. After months of hard research, you have collected the following data:

Data	**KRAX**	**SPLIT-NUT**
Life, Years	6	9
First Cost (FC)	$202,000	$285,000
Annual Benefit (AB)	73,000	88,000
AB Gradient (AB_G)	1,200	1,300
Annual Maintenance & Operating Cost (M&O)	18,000	34,000
M&O Gradient ($M\&O_G$)	600	1,100
Salvage Value	42,000	48,000

Discussions with the accounting department reveal that a loan must be secured to purchase any machine. The loan data are as follows:

Data	**KRAX**	**SPLIT-NUT**
Down Payment (% of FC)	30%	30%
Loan Period, Years	6	9
Loan Payment	$34,392.11	$37,441.93

The loan payments will be made annually with 12% interest. PARC Co. assumes MARR = 15%. Using the Net Present Worth (NPW) analysis, answer the following questions:

(51) The analysis period if you are going to use NPW is close to:
a) 24 years b) 21 years c) 12 years d) 18 years

(52) The interest rate that you are going to use in the calculation is:
a) 12% b) 15% c) 30% d) 13%

(53) The NPW for KRAX type, using only 6 years cash flow, is close to:
a) $40,500 b) $15,500 c) $11,000 d) $10,110

(54) The NPW for SPLIT-NUT type, using only 9 years cash flow, is close to:
a) $10,500 b) $12,500 c) $11,200 d) $10,100

(55) The NPW for KRAX type, in the analysis period, is close to:
a) $10,510 b) $65,300 c) $61,900 d) $14,250

(56) Recommend which machine to purchase:
a) SPLIT-NUT b) KRAX c) Both d) None

Summary of Useful Formulas for Discrete Models

Name	**Symbol and Formula**
Compound amount factor	$(F/P,i,N) = (1+i)^N$
Present worth factor	$(P/F,i,N) = \frac{1}{(1+i)^N}$
Sinking fund factor	$(A/F,i,N) = \frac{i}{(1+i)^N - 1}$
Uniform series compound amount factor	$(F/A,i,N) = \frac{(1+i)^N - 1}{i}$
Capital recovery factor	$(A/P,i,N) = \frac{i(1+i)^N}{(1+i)^N - 1}$
Series present worth factor	$(P/A,i,N) = \frac{(1+i)^N - 1}{i(1+i)^N}$
Arithmetic gradient to annuity conversion factor	$(A/G,i,N) = \frac{1}{i} - \frac{N}{(1+i)^N - 1}$
Arithmetic gradient to present worth conversion factor	$(P/G,i,N) = \frac{(1+i)^N - iN - 1}{i^2(1+i)^N}$
Geometric gradient to present worth conversion factor	$(P/A,g,i,N) = \frac{(P/A,i^o,N)}{1+g}$ $(P/A,g,i,N) = \left(\frac{(1+i^o)^N - 1}{i^o(1+i^o)^N}\right)\frac{1}{1+g}$ $i^o = \frac{1+i}{1+g} - 1$
Capitalized value formula	$P = \frac{A}{i}$
Capital recovery formula	$A = (P-S)(A/P,i,N) + Si$

Effective interest rate per year: $i_e = (1+r/m)^m - 1$

where r = nominal interest rate per year
m = number of compounding periods per year

Learning curve: $T_N = T_1 N^b$

where T_N = time required to produce the N^{th} unit
b = log(learning rate)/log(2)

Compound Interest Factors

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Factor	Gradient Present Factor	
10%	**Find F Given P**	**Find P Given F**	**Find A Given F**	**Find A Given P**	**Find F Given A**	**Find P Given A**	**Find A Given G**	**Find P Given G**	**10%**
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	***n***
1	1.100	0.9091	1.0000	1.1000	1.000	0.909	0.000	0.000	**1**
2	1.210	0.8264	0.4762	0.5762	2.100	1.736	0.476	0.826	**2**
3	1.331	0.7513	0.3021	0.4021	3.310	2.487	0.937	2.329	**3**
4	1.464	0.6830	0.2155	0.3155	4.641	3.170	1.381	4.378	**4**
5	1.611	0.6209	0.1638	0.2638	6.105	3.791	1.810	6.862	**5**
6	1.772	0.5645	0.1296	0.2296	7.716	4.355	2.224	9.684	**6**
7	1.949	0.5132	0.1054	0.2054	9.487	4.868	2.622	12.763	**7**
8	2.144	0.4665	0.0874	0.1874	11.436	5.335	3.004	16.029	**8**
9	2.358	0.4241	0.0736	0.1736	13.579	5.759	3.372	19.421	**9**
10	2.594	0.3855	0.0627	0.1627	15.937	6.145	3.725	22.891	**10**
11	2.853	0.3505	0.0540	0.1540	18.531	6.495	4.064	26.396	**11**
12	3.138	0.3186	0.0468	0.1468	21.384	6.814	4.388	29.901	**12**
13	3.452	0.2897	0.0408	0.1408	24.523	7.103	4.699	33.377	**13**
14	3.797	0.2633	0.0357	0.1357	27.975	7.367	4.996	36.800	**14**
15	4.177	0.2394	0.0315	0.1315	31.772	7.606	5.279	40.152	**15**
16	4.595	0.2176	0.0278	0.1278	35.950	7.824	5.549	43.416	**16**
17	5.054	0.1978	0.0247	0.1247	40.545	8.022	5.807	46.582	**17**
18	5.560	0.1799	0.0219	0.1219	45.599	8.201	6.053	49.640	**18**
19	6.116	0.1635	0.0195	0.1195	51.159	8.365	6.286	52.583	**19**
20	6.727	0.1486	0.0175	0.1175	57.275	8.514	6.508	55.407	**20**
12%	**Find F Given P**	**Find P Given F**	**Find A Given F**	**Find A Given P**	**Find F Given A**	**Find P Given A**	**Find A Given G**	**Find P Given G**	**12%**
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	***n***
1	1.120	0.8929	1.0000	1.1200	1.000	0.893	0.000	0.000	**1**
2	1.254	0.7972	0.4717	0.5917	2.120	1.690	0.472	0.797	**2**
3	1.405	0.7118	0.2963	0.4163	3.374	2.402	0.925	2.221	**3**
4	1.574	0.6355	0.2092	0.3292	4.779	3.037	1.359	4.127	**4**
5	1.762	0.5674	0.1574	0.2774	6.353	3.605	1.775	6.397	**5**
6	1.974	0.5066	0.1232	0.2432	8.115	4.111	2.172	8.930	**6**
7	2.211	0.4523	0.0991	0.2191	10.089	4.564	2.551	11.644	**7**
8	2.476	0.4039	0.0813	0.2013	12.300	4.968	2.913	14.471	**8**
9	2.773	0.3606	0.0677	0.1877	14.776	5.328	3.257	17.356	**9**
10	3.106	0.3220	0.0570	0.1770	17.549	5.650	3.585	20.254	**10**
11	3.479	0.2875	0.0484	0.1684	20.655	5.938	3.895	23.129	**11**
12	3.896	0.2567	0.0414	0.1614	24.133	6.194	4.190	25.952	**12**
13	4.363	0.2292	0.0357	0.1557	28.029	6.424	4.468	28.702	**13**
14	4.887	0.2046	0.0309	0.1509	32.393	6.628	4.732	31.362	**14**
15	5.474	0.1827	0.0268	0.1468	37.280	6.811	4.980	33.920	**15**
16	6.130	0.1631	0.0234	0.1434	42.753	6.974	5.215	36.367	**16**
17	6.866	0.1456	0.0205	0.1405	48.884	7.120	5.435	38.697	**17**
18	7.690	0.1300	0.0179	0.1379	55.750	7.250	5.643	40.908	**18**
19	8.613	0.1161	0.0158	0.1358	63.440	7.366	5.838	42.998	**19**
20	9.646	0.1037	0.0139	0.1339	72.052	7.469	6.020	44.968	**20**

Compound Interest Factors

	Single Payment		Uniform Payment Series				Arithmetic Gradient		
	Compound Amount Factor	Present Worth Factor	Sinking Fund Factor	Capital Recovery Factor	Compound Amount Factor	Present Worth Factor	Gradient Uniform Factor	Gradient Present Factor	
15%	**Find F Given P**	**Find P Given F**	**Find A Given F**	**Find A Given P**	**Find F Given A**	**Find P Given A**	**Find A Given G**	**Find P Given G**	**15%**
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	***n***
1	1.150	0.8696	1.0000	1.1500	1.000	0.870	0.000	0.000	**1**
2	1.323	0.7561	0.4651	0.6151	2.150	1.626	0.465	0.756	**2**
3	1.521	0.6575	0.2880	0.4380	3.473	2.283	0.907	2.071	**3**
4	1.749	0.5718	0.2003	0.3503	4.993	2.855	1.326	3.786	**4**
5	2.011	0.4972	0.1483	0.2983	6.742	3.352	1.723	5.775	**5**
6	2.313	0.4323	0.1142	0.2642	8.754	3.784	2.097	7.937	**6**
7	2.660	0.3759	0.0904	0.2404	11.067	4.160	2.450	10.192	**7**
8	3.059	0.3269	0.0729	0.2229	13.727	4.487	2.781	12.481	**8**
9	3.518	0.2843	0.0596	0.2096	16.786	4.772	3.092	14.755	**9**
10	4.046	0.2472	0.0493	0.1993	20.304	5.019	3.383	16.979	**10**
11	4.652	0.2149	0.0411	0.1911	24.349	5.234	3.655	19.129	**11**
12	5.350	0.1869	0.0345	0.1845	29.002	5.421	3.908	21.185	**12**
13	6.153	0.1625	0.0291	0.1791	34.352	5.583	4.144	23.135	**13**
14	7.076	0.1413	0.0247	0.1747	40.505	5.724	4.362	24.972	**14**
15	8.137	0.1229	0.0210	0.1710	47.580	5.847	4.565	26.693	**15**
16	9.358	0.1069	0.0179	0.1679	55.717	5.954	4.752	28.296	**16**
17	10.761	0.0929	0.0154	0.1654	65.075	6.047	4.925	29.783	**17**
18	12.375	0.0808	0.0132	0.1632	75.836	6.128	5.084	31.156	**18**
19	14.232	0.0703	0.0113	0.1613	88.212	6.198	5.231	32.421	**19**
20	16.367	0.0611	0.00976	0.1598	102.444	6.259	5.365	33.582	**20**
20%	**Find F Given P**	**Find P Given F**	**Find A Given F**	**Find A Given P**	**Find F Given A**	**Find P Given A**	**Find A Given G**	**Find P Given G**	**20%**
n	***F/P***	***P/F***	***A/F***	***A/P***	***F/A***	***P/A***	***A/G***	***P/G***	***n***
1	1.200	0.8333	1.0000	1.2000	1.000	0.833	0.000	0.000	**1**
2	1.440	0.6944	0.4545	0.6545	2.200	1.528	0.455	0.694	**2**
3	1.728	0.5787	0.2747	0.4747	3.640	2.106	0.879	1.852	**3**
4	2.074	0.4823	0.1863	0.3863	5.368	2.589	1.274	3.299	**4**
5	2.488	0.4019	0.1344	0.3344	7.442	2.991	1.641	4.906	**5**
6	2.986	0.3349	0.1007	0.3007	9.930	3.326	1.979	6.581	**6**
7	3.583	0.2791	0.0774	0.2774	12.916	3.605	2.290	8.255	**7**
8	4.300	0.2326	0.0606	0.2606	16.499	3.837	2.576	9.883	**8**
9	5.160	0.1938	0.0481	0.2481	20.799	4.031	2.836	11.434	**9**
10	6.192	0.1615	0.0385	0.2385	25.959	4.192	3.074	12.887	**10**
11	7.430	0.1346	0.0311	0.2311	32.150	4.327	3.289	14.233	**11**
12	8.916	0.1122	0.0253	0.2253	39.581	4.439	3.484	15.467	**12**
13	10.699	0.0935	0.0206	0.2206	48.497	4.533	3.660	16.588	**13**
14	12.839	0.0779	0.0169	0.2169	59.196	4.611	3.817	17.601	**14**
15	15.407	0.0649	0.0139	0.2139	72.035	4.675	3.959	18.509	**15**
16	18.488	0.0541	0.0114	0.2114	87.442	4.730	4.085	19.321	**16**
17	22.186	0.0451	0.00944	0.2094	105.931	4.775	4.198	20.042	**17**
18	26.623	0.0376	0.00781	0.2078	128.117	4.812	4.298	20.680	**18**
19	31.948	0.0313	0.00646	0.2065	154.740	4.843	4.386	21.244	**19**
20	38.338	0.0261	0.00536	0.2054	186.688	4.870	4.464	21.739	**20**