# Question Paper

## MANIPAL ACADEMY OF HIGHER EDUCATION

**FIFTH SEMESTER B.TECH. EXAMINATIONS - NOVEMBER / DECEMBER 2023**
**SUBJECT:HUM 3051/HUM-3051- ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT**

**Marks: 50**                                                                 **Duration: 180 mins.**

**Answer all the questions.**

**Interest factor table are provided, for others use formulae**
**Missing data may be suitably assumed.**

1A)     An electrical vehicle is available for purchase at $25,000. The estimated life of the vehicle is 12 years if the average     (3)
distance per year is 20,000 miles. For every 3 years, batteries have to be replaced at a cost $3,000. Batteries have to be
recharged at a cost of $0.015 per mile. It takes $700 per year to maintain the vehicle. The vehicle is valued at $2,000 at
the end of 12 years. If the MARR is 10%, calculate
i) The cost per mile to own.
ii) The cost per mile to operate this vehicle.

**10%**                  **Compound Interest Factors**

| | Single Payment | | Uniform Payment Series | | | | Arithmetic Gradient | |
|---|---|---|---|---|---|---|---|---|
| | Compound Amount Factor Find F Given P | Present Worth Factor Find P Given F | Sinking Fund Factor Find A Given F | Capital Recovery Factor Find A Given P | Compound Amount Factor Find F Given A | Present Worth Factor Find P Given A | Gradient Uniform Series Find A Given G | Gradient Present Worth Find P Given G |
| *n* | *F/P* | *P/F* | *A/F* | *A/P* | *F/A* | *P/A* | *A/G* | *P/G* |
| 1 | 1.100 | .9091 | 1.0000 | 1.1000 | 1.000 | 0.909 | 0 | 0 |
| 2 | 1.210 | .8264 | .4762 | .5762 | 2.100 | 1.736 | 0.476 | 0.826 |
| 3 | 1.331 | .7513 | .3021 | .4021 | 3.310 | 2.487 | 0.937 | 2.329 |
| 4 | 1.464 | .6830 | .2155 | .3155 | 4.641 | 3.170 | 1.381 | 4.378 |
| 5 | 1.611 | .6209 | .1638 | .2638 | 6.105 | 3.791 | 1.810 | 6.862 |
| 6 | 1.772 | .5645 | .1296 | .2296 | 7.716 | 4.355 | 2.224 | 9.684 |
| 7 | 1.949 | .5132 | .1054 | .2054 | 9.487 | 4.868 | 2.622 | 12.763 |
| 8 | 2.144 | .4665 | .0874 | .1874 | 11.436 | 5.335 | 3.004 | 16.029 |
| 9 | 2.358 | .4241 | .0736 | .1736 | 13.579 | 5.759 | 3.372 | 19.421 |
| 10 | 2.594 | .3855 | .0627 | .1627 | 15.937 | 6.145 | 3.725 | 22.891 |
| 11 | 2.853 | .3505 | .0540 | .1540 | 18.531 | 6.495 | 4.064 | 26.396 |
| 12 | 3.138 | .3186 | .0468 | .1468 | 21.384 | 6.814 | 4.388 | 29.901 |
| 13 | 3.452 | .2897 | .0408 | .1408 | 24.523 | 7.103 | 4.699 | 33.377 |
| 14 | 3.797 | .2633 | .0357 | .1357 | 27.975 | 7.367 | 4.996 | 36.801 |
| 15 | 4.177 | .2394 | .0315 | .1315 | 31.772 | 7.606 | 5.279 | 40.152 |

1B)   The B&E Cooling Technology Company, a maker of automobile air-conditioners, faces an uncertain, but impending, deadline to phase out     (4)
the traditional chilling technique, which uses chlorofluorocarbons (CFCs), a family of refrigerant chemicals believed to attack the earth's
protective ozone layer. B&E has been pursuing other means of cooling and refrigeration. As a near-term solution, the engineers recommend
a cold technology known as absorption chiller, which uses plain water as a refrigerant and semiconductors that cool down when charged
with electricity. B&E is considering two options:

- Option 1 Retrofit the plant now to adapt the absorption chiller and continue to be a market leader in cooling technology. Because of
  untested technology on a large scale, it may cost more to operate the new facility while personnel are learning the new system.
- Option 2 Defer the retrofitting until the federal deadline, which is three years away. With expected improvement in cooling
  technology and technical knowhow, the retrofitting cost will be cheaper, but there will be tough market competition, and the revenue
  would be less than that of Option 1.

The financial data for the two options are as follows:

| | Option 1 | Option 2 |
|---|---|---|
| Investment timing | Now | 3 years from now |
| Initial investment | $6 million | $5 million |
| System life | 8 years | 8 years |

| | $ 1 million | $ 2 million |
|---|---|---|
| Salvage value | $ 1 million | $ 2 million |
| Annual revenue | $15 million | $ 11 million |
| Annual operating and maintenance costs | $6 million | $7 million |

If B&E's MARR is 10%, which option is the better choice, based on Annual worth evaluation method?

| 10% | | | | Compound Interest Factors | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Single Payment** | | **Uniform Payment Series** | | | | **Arithmetic Gradient** | | |
| | Compound Amount Factor Find F Given P F/P | Present Worth Factor Find P Given F P/F | Sinking Fund Factor Find A Given F A/F | Capital Recovery Factor Find A Given P A/P | Compound Amount Factor Find F Given A F/A | Present Worth Factor Find P Given A P/A | Gradient Uniform Series Find A Given G A/G | Gradient Present Worth Find P Given G P/G |
| n | | | | | | | | |
| 1 | 1.100 | .9091 | 1.0000 | 1.1000 | 1.000 | 0.909 | 0 | 0 |
| 2 | 1.210 | .8264 | .4762 | .5762 | 2.100 | 1.736 | 0.476 | 0.826 |
| 3 | 1.331 | .7513 | .3021 | .4021 | 3.310 | 2.487 | 0.937 | 2.329 |
| 4 | 1.464 | .6830 | .2155 | .3155 | 4.641 | 3.170 | 1.381 | 4.378 |
| 5 | 1.611 | .6209 | .1638 | .2638 | 6.105 | 3.791 | 1.810 | 6.862 |
| 6 | 1.772 | .5645 | .1296 | .2296 | 7.716 | 4.355 | 2.224 | 9.684 |
| 7 | 1.949 | .5132 | .1054 | .2054 | 9.487 | 4.868 | 2.622 | 12.763 |
| 8 | 2.144 | .4665 | .0874 | .1874 | 11.436 | 5.335 | 3.004 | 16.029 |
| 9 | 2.358 | .4241 | .0736 | .1736 | 13.579 | 5.759 | 3.372 | 19.421 |
| 10 | 2.594 | .3855 | .0627 | .1627 | 15.937 | 6.145 | 3.725 | 22.891 |
| 11 | 2.853 | .3505 | .0540 | .1540 | 18.531 | 6.495 | 4.064 | 26.396 |
| 12 | 3.138 | .3186 | .0468 | .1468 | 21.384 | 6.814 | 4.388 | 29.901 |
| 13 | 3.452 | .2897 | .0408 | .1408 | 24.523 | 7.103 | 4.699 | 33.377 |
| 14 | 3.797 | .2633 | .0357 | .1357 | 27.975 | 7.367 | 4.996 | 36.801 |
| 15 | 4.177 | .2394 | .0315 | .1315 | 31.772 | 7.606 | 5.279 | 40.152 |

1C)    A person is planning to withdraw Rs. 5000 in the tenth year from now and then onwards he increases his withdrawal    (3)
amount by Rs. 250 semi-annually for the next 5 years. For these expenses, he is planning to invest an equal amount every
quarter for 9 years. Find this equal amount that he has to invest if the interest rate is 12% pa, compounded quarterly for the
first 10 years and changes to 12% pa, compounded monthly thereafter.

2A)    Your company is considering the purchase of a second-hand scanning microscope at a cost of $10,500, with an estimated    (3)
salvage value of $500 and a projected useful life of four years. Determine the straight-line (SL), sum of years digits
(SOYD), and double declining balance (DDB) depreciation schedules.

2B)    Find the balance sheet of PQR firm as of 31st March 2021.    (4)

| Liabilities | Amount (in Rs.) | Assets | Amount (in Rs) |
|---|---|---|---|
| Equity share capital | 10,000 | Fixed Assets (less | 26,000 |
| 7% Preference share capital | 2,000 | depreciation Rs.10,000) | |
| Reserves and Surplus | 8,000 | Current Assets: | |
| 6% Mortgage Debentures | 14,000 | Cash | 1,000 |
| Current Liabilities: | | Investments (10%) | 3,000 |
| Creditors | 1,200 | Sundry debtors | 4,000 |
| Bills payable | 2,000 | Stock | 6,000 |
| Outstanding expenses | 200 | | |
| Tax provisions | 2,600 | | |

Other information includes: Net Sales ₹60,000, Cost of goods sold ₹51,600, Net Income before Tax ₹4,000, Net Income

after tax ₹2,000

Estimate:

1) Turnover ratios viz. Stock Turnover ratios and Debtors Turnover ratio.

2) Debt-Equity ratio, Gross Profit Ratio, Interest Coverage ratio, Current ratio

**2C)** Hoppy Hops, Inc. purchased hop harvesting machinery for $150,000 four years ago. Due to a change in the method of harvesting the machine was recently sold for $37,500. Determine the MACRS deprecation schedule for the machinery for the four years of ownership. Assume a five year property class. What is the recaptured depreciation or loss on the sale of the machinery? **(3)**

**3A)** Consider the following data on the asset. **(2)**

| Cost of the asset | Rs. 160,000 |
|---|---|
| Useful life | 5 years |
| Salvage value | Rs. 30,000 |

Compute the annual depreciation allowances and the resulting book values using the Straight-line depreciation method.

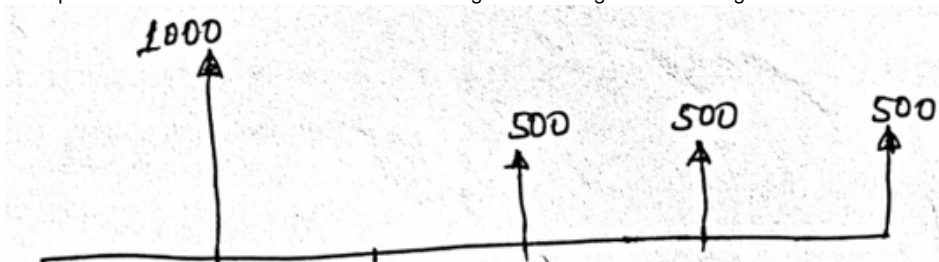**3B)** The following asset is depreciated according to the Double Declining Balance method **(4)**

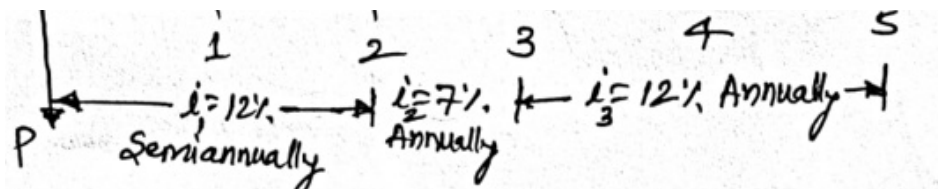| Cost of the asset | Rs. 250,000 |
|---|---|
| Useful life | 10 years |
| Salvage value | Rs. 30,000 |

i) What is the Rate of Depreciation?

ii) What is the amount of depreciation for the 4th and 6th year?

iii) What is the book value of the asset at the end of 7th and 8th years?

iv) If the Market value of the asset at the end of year 7 is Rs. 40,000, did the company incur a sunk loss or capital gain? What is the amount of Capital gain/ Sunk loss incurred?

**3C)** A small mining coal company is trying to decide whether it should purchase or lease a new clamshell. If purchased, the shell will cost $150,000 and is expected to have a $65,000 salvage value in 6 years. Alternatively, the company can lease a clamshell for $30,000 per year, but the lease payment will have to be made at the beginning of each year. If the clamshell is purchased, it will be leased to other mining companies whenever possible, an activity that is expected to yield revenues of $12,000 per year. If the company's minimum attractive rate of return is 15% per year, should the clamshell be purchased or leased on the basis of Future worth analysis? **(4)**

| 15% | | | | Compound Interest Factors | | | | | 15% |
|---|---|---|---|---|---|---|---|---|---|
| | **Single Payment** | | **Uniform Payment Series** | | | | **Arithmetic Gradient** | | |
| | Compound Amount Factor Find F Given P | Present Worth Factor Find P Given F | Sinking Fund Factor Find A Given F | Capital Recovery Factor Find A Given P | Compound Amount Factor Find F Given A | Present Worth Factor Find P Given A | Gradient Uniform Series Find A Given G | Gradient Present Worth Find P Given G | |
| n | F/P | P/F | A/F | A/P | F/A | P/A | A/G | P/G | n |
| 1 | 1.150 | .8696 | 1.0000 | 1.1500 | 1.000 | 0.870 | 0 | 0 | 1 |
| 2 | 1.322 | .7561 | .4651 | .6151 | 2.150 | 1.626 | 0.465 | 0.756 | 2 |
| 3 | 1.521 | .6575 | .2880 | .4380 | 3.472 | 2.283 | 0.907 | 2.071 | 3 |
| 4 | 1.749 | .5718 | .2003 | .3503 | 4.993 | 2.855 | 1.326 | 3.786 | 4 |
| 5 | 2.011 | .4972 | .1483 | .2983 | 6.742 | 3.352 | 1.723 | 5.775 | 5 |
| 6 | 2.313 | .4323 | .1142 | .2642 | 8.754 | 3.784 | 2.097 | 7.937 | 6 |
| 7 | 2.660 | .3759 | .0904 | .2404 | 11.067 | 4.160 | 2.450 | 10.192 | 7 |
| 8 | 3.059 | .3269 | .0729 | .2229 | 13.727 | 4.487 | 2.781 | 12.481 | 8 |
| 9 | 3.518 | .2843 | .0596 | .2096 | 16.786 | 4.772 | 3.092 | 14.755 | 9 |
| 10 | 4.046 | .2472 | .0493 | .1993 | 20.304 | 5.019 | 3.383 | 16.979 | 10 |
| 11 | 4.652 | .2149 | .0411 | .1911 | 24.349 | 5.234 | 3.655 | 19.129 | 11 |
| 12 | 5.350 | .1869 | .0345 | .1845 | 29.002 | 5.421 | 3.908 | 21.185 | 12 |
| 13 | 6.153 | .1625 | .0291 | .1791 | 34.352 | 5.583 | 4.144 | 23.135 | 13 |
| 14 | 7.076 | .1413 | .0247 | .1747 | 40.505 | 5.724 | 4.362 | 24.972 | 14 |
| 15 | 8.137 | .1229 | .0210 | .1710 | 47.580 | 5.847 | 4.565 | 26.693 | 15 |

**4A)** Justify the statement" When cashflows are converted to their equivalences from one period to another, interest rate during each period must be taken into consideration using the following cash flow diagram: **(5)**

$i_1 = 12\%$ Semiannually — $i_2 = 7\%$ Annually — $i_3 = 12\%$ Annually

P

**6.0%**

| | Single Payment | | Equal Payment Series | | | | Gradient Series | | |
|---|---|---|---|---|---|---|---|---|---|
| | Compound Amount Factor | Present Worth Factor | Compound Amount Factor | Sinking Fund Factor | Present Worth Factor | Capital Recovery Factor | Gradient Uniform Series | Gradient Present Worth | |
| N | (F/P,i,N) | (P/F,i,N) | (F/A,i,N) | (A/F,i,N) | (P/A,i,N) | (A/P,i,N) | (A/G,i,N) | (P/G,i,N) | N |
| 1 | 1.0600 | 0.9434 | 1.0000 | 1.0000 | 0.9434 | 1.0600 | 0.0000 | 0.0000 | 1 |
| 2 | 1.1236 | 0.8900 | 2.0600 | 0.4854 | 1.8334 | 0.5454 | 0.4854 | 0.8900 | 2 |
| 3 | 1.1910 | 0.8396 | 3.1836 | 0.3141 | 2.6730 | 0.3741 | 0.9612 | 2.5692 | 3 |
| 4 | 1.2625 | 0.7921 | 4.3746 | 0.2286 | 3.4651 | 0.2886 | 1.4272 | 4.9455 | 4 |
| 5 | 1.3382 | 0.7473 | 5.6371 | 0.1774 | 4.2124 | 0.2374 | 1.8836 | 7.9345 | 5 |
| 6 | 1.4185 | 0.7050 | 6.9753 | 0.1434 | 4.9173 | 0.2034 | 2.3304 | 11.4594 | 6 |
| 7 | 1.5036 | 0.6651 | 8.3938 | 0.1191 | 5.5824 | 0.1791 | 2.7676 | 15.4497 | 7 |
| 8 | 1.5938 | 0.6274 | 9.8975 | 0.1010 | 6.2098 | 0.1610 | 3.1952 | 19.8416 | 8 |
| 9 | 1.6895 | 0.5919 | 11.4913 | 0.0870 | 6.8017 | 0.1470 | 3.6133 | 24.5768 | 9 |
| 10 | 1.7908 | 0.5584 | 13.1808 | 0.0759 | 7.3601 | 0.1359 | 4.0220 | 29.6023 | 10 |
| 11 | 1.8983 | 0.5268 | 14.9716 | 0.0668 | 7.8869 | 0.1268 | 4.4213 | 34.8702 | 11 |
| 12 | 2.0122 | 0.4970 | 16.8699 | 0.0593 | 8.3838 | 0.1193 | 4.8113 | 40.3369 | 12 |
| 13 | 2.1329 | 0.4688 | 18.8821 | 0.0530 | 8.8527 | 0.1130 | 5.1920 | 45.9629 | 13 |
| 14 | 2.2609 | 0.4423 | 21.0151 | 0.0476 | 9.2950 | 0.1076 | 5.5635 | 51.7128 | 14 |
| 15 | 2.3966 | 0.4173 | 23.2760 | 0.0430 | 9.7122 | 0.1030 | 5.9260 | 57.5546 | 15 |
| 16 | 2.5404 | 0.3936 | 25.6725 | 0.0390 | 10.1059 | 0.0990 | 6.2794 | 63.4592 | 16 |
| 17 | 2.6928 | 0.3714 | 28.2129 | 0.0354 | 10.4773 | 0.0954 | 6.6240 | 69.4011 | 17 |
| 18 | 2.8543 | 0.3503 | 30.9057 | 0.0324 | 10.8276 | 0.0924 | 6.9597 | 75.3569 | 18 |
| 19 | 3.0256 | 0.3305 | 33.7600 | 0.0296 | 11.1581 | 0.0896 | 7.2867 | 81.3062 | 19 |
| 20 | 3.2071 | 0.3118 | 36.7856 | 0.0272 | 11.4699 | 0.0872 | 7.6051 | 87.2304 | 20 |
| 21 | 3.3996 | 0.2942 | 39.9927 | 0.0250 | 11.7641 | 0.0850 | 7.9151 | 93.1136 | 21 |
| 22 | 3.6035 | 0.2775 | 43.3923 | 0.0230 | 12.0416 | 0.0830 | 8.2166 | 98.9412 | 22 |
| 23 | 3.8197 | 0.2618 | 46.9958 | 0.0213 | 12.3034 | 0.0813 | 8.5099 | 104.7007 | 23 |
| 24 | 4.0489 | 0.2470 | 50.8156 | 0.0197 | 12.5504 | 0.0797 | 8.7951 | 110.3812 | 24 |
| 25 | 4.2919 | 0.2330 | 54.8645 | 0.0182 | 12.7834 | 0.0782 | 9.0722 | 115.9732 | 25 |
| 26 | 4.5494 | 0.2198 | 59.1564 | 0.0169 | 13.0032 | 0.0769 | 9.3414 | 121.4684 | 26 |
| 27 | 4.8223 | 0.2074 | 63.7058 | 0.0157 | 13.2105 | 0.0757 | 9.6029 | 126.8600 | 27 |
| 28 | 5.1117 | 0.1956 | 68.5281 | 0.0146 | 13.4062 | 0.0746 | 9.8568 | 132.1420 | 28 |
| 29 | 5.4184 | 0.1846 | 73.6398 | 0.0136 | 13.5907 | 0.0736 | 10.1032 | 137.3096 | 29 |
| 30 | 5.7435 | 0.1741 | 79.0582 | 0.0126 | 13.7648 | 0.0726 | 10.3422 | 142.3588 | 30 |
| 31 | 6.0881 | 0.1643 | 84.8017 | 0.0118 | 13.9291 | 0.0718 | 10.5740 | 147.2864 | 31 |
| 32 | 6.4534 | 0.1550 | 90.8898 | 0.0110 | 14.0840 | 0.0710 | 10.7988 | 152.0901 | 32 |
| 33 | 6.8406 | 0.1462 | 97.3432 | 0.0103 | 14.2302 | 0.0703 | 11.0166 | 156.7681 | 33 |
| 34 | 7.2510 | 0.1379 | 104.1838 | 0.0096 | 14.3681 | 0.0696 | 11.2276 | 161.3192 | 34 |
| 35 | 7.6861 | 0.1301 | 111.4348 | 0.0090 | 14.4982 | 0.0690 | 11.4319 | 165.7427 | 35 |
| 40 | 10.2857 | 0.0972 | 154.7620 | 0.0065 | 15.0463 | 0.0665 | 12.3590 | 185.9568 | 40 |
| 45 | 13.7646 | 0.0727 | 212.7435 | 0.0047 | 15.4558 | 0.0647 | 13.1413 | 203.1096 | 45 |
| 50 | 18.4202 | 0.0543 | 290.3359 | 0.0034 | 15.7619 | 0.0634 | 13.7964 | 217.4574 | 50 |
| 55 | 24.6503 | 0.0406 | 394.1720 | 0.0025 | 15.9905 | 0.0625 | 14.3411 | 229.3222 | 55 |
| 60 | 32.9877 | 0.0303 | 533.1282 | 0.0019 | 16.1614 | 0.0619 | 14.7909 | 239.0428 | 60 |

**7.0%**

| | Single Payment | | Equal Payment Series | | | | Gradient Series | | |
|---|---|---|---|---|---|---|---|---|---|
| | Compound Amount Factor | Present Worth Factor | Compound Amount Factor | Sinking Fund Factor | Present Worth Factor | Capital Recovery Factor | Gradient Uniform Series | Gradient Present Worth | |
| N | (F/P,i,N) | (P/F,i,N) | (F/A,i,N) | (A/F,i,N) | (P/A,i,N) | (A/P,i,N) | (A/G,i,N) | (P/G,i,N) | N |
| 1 | 1.0700 | 0.9346 | 1.0000 | 1.0000 | 0.9346 | 1.0700 | 0.0000 | 0.0000 | 1 |
| 2 | 1.1449 | 0.8734 | 2.0700 | 0.4831 | 1.8080 | 0.5531 | 0.4831 | 0.8734 | 2 |
| 3 | 1.2250 | 0.8163 | 3.2149 | 0.3111 | 2.6243 | 0.3811 | 0.9549 | 2.5060 | 3 |
| 4 | 1.3108 | 0.7629 | 4.4399 | 0.2252 | 3.3872 | 0.2952 | 1.4155 | 4.7947 | 4 |
| 5 | 1.4026 | 0.7130 | 5.7507 | 0.1739 | 4.1002 | 0.2439 | 1.8650 | 7.6467 | 5 |
| 6 | 1.5007 | 0.6663 | 7.1533 | 0.1398 | 4.7665 | 0.2098 | 2.3032 | 10.9784 | 6 |
| 7 | 1.6058 | 0.6227 | 8.6540 | 0.1156 | 5.3893 | 0.1856 | 2.7304 | 14.7149 | 7 |
| 8 | 1.7182 | 0.5820 | 10.2598 | 0.0975 | 5.9713 | 0.1675 | 3.1465 | 18.7889 | 8 |
| 9 | 1.8385 | 0.5439 | 11.9780 | 0.0835 | 6.5152 | 0.1535 | 3.5517 | 23.1404 | 9 |
| 10 | 1.9672 | 0.5083 | 13.8164 | 0.0724 | 7.0236 | 0.1424 | 3.9461 | 27.7156 | 10 |
| 11 | 2.1049 | 0.4751 | 15.7836 | 0.0634 | 7.4987 | 0.1334 | 4.3296 | 32.4665 | 11 |
| 12 | 2.2522 | 0.4440 | 17.8885 | 0.0559 | 7.9427 | 0.1259 | 4.7025 | 37.3506 | 12 |
| 13 | 2.4098 | 0.4150 | 20.1406 | 0.0497 | 8.3577 | 0.1197 | 5.0648 | 42.3302 | 13 |
| 14 | 2.5785 | 0.3878 | 22.5505 | 0.0443 | 8.7455 | 0.1143 | 5.4167 | 47.3718 | 14 |
| 15 | 2.7590 | 0.3624 | 25.1290 | 0.0398 | 9.1079 | 0.1098 | 5.7583 | 52.4461 | 15 |
| 16 | 2.9522 | 0.3387 | 27.8881 | 0.0359 | 9.4466 | 0.1059 | 6.0897 | 57.5271 | 16 |
| 17 | 3.1588 | 0.3166 | 30.8402 | 0.0324 | 9.7632 | 0.1024 | 6.4110 | 62.5923 | 17 |
| 18 | 3.3799 | 0.2959 | 33.9990 | 0.0294 | 10.0591 | 0.0994 | 6.7225 | 67.6219 | 18 |
| 19 | 3.6165 | 0.2765 | 37.3790 | 0.0268 | 10.3356 | 0.0968 | 7.0242 | 72.5991 | 19 |
| 20 | 3.8697 | 0.2584 | 40.9955 | 0.0244 | 10.5940 | 0.0944 | 7.3163 | 77.5091 | 20 |
| 21 | 4.1406 | 0.2415 | 44.8652 | 0.0223 | 10.8355 | 0.0923 | 7.5990 | 82.3393 | 21 |
| 22 | 4.4304 | 0.2257 | 49.0057 | 0.0204 | 11.0612 | 0.0904 | 7.8725 | 87.0793 | 22 |
| 23 | 4.7405 | 0.2109 | 53.4361 | 0.0187 | 11.2722 | 0.0887 | 8.1369 | 91.7201 | 23 |
| 24 | 5.0724 | 0.1971 | 58.1767 | 0.0172 | 11.4693 | 0.0872 | 8.3923 | 96.2545 | 24 |
| 25 | 5.4274 | 0.1842 | 63.2490 | 0.0158 | 11.6536 | 0.0858 | 8.6391 | 100.6765 | 25 |
| 26 | 5.8074 | 0.1722 | 68.6765 | 0.0146 | 11.8258 | 0.0846 | 8.8773 | 104.9814 | 26 |
| 27 | 6.2139 | 0.1609 | 74.4838 | 0.0134 | 11.9867 | 0.0834 | 9.1072 | 109.1656 | 27 |
| 28 | 6.6488 | 0.1504 | 80.6977 | 0.0124 | 12.1371 | 0.9824 | 9.3289 | 113.2264 | 28 |
| 29 | 7.1143 | 0.1406 | 87.3465 | 0.0114 | 12.2777 | 0.0814 | 9.5427 | 117.1622 | 29 |
| 30 | 7.6123 | 0.1314 | 94.4608 | 0.0106 | 12.4090 | 0.0806 | 9.7487 | 120.9718 | 30 |
| 31 | 8.1451 | 0.1228 | 102.0730 | 0.0098 | 12.5318 | 0.0798 | 9.9471 | 124.6550 | 31 |
| 32 | 8.7153 | 0.1147 | 110.2182 | 0.0091 | 12.6466 | 0.0791 | 10.1381 | 128.2120 | 32 |
| 33 | 9.3253 | 0.1072 | 118.9334 | 0.0084 | 12.7538 | 0.0784 | 10.3219 | 131.6435 | 33 |
| 34 | 9.9781 | 0.1002 | 128.2588 | 0.0078 | 12.8540 | 0.0778 | 10.4987 | 134.9507 | 34 |
| 35 | 10.6766 | 0.0937 | 138.2369 | 0.0072 | 12.9477 | 0.0772 | 10.6687 | 138.1353 | 35 |
| 40 | 14.9745 | 0.0668 | 199.6351 | 0.0050 | 13.3317 | 0.0750 | 11.4233 | 152.2928 | 40 |
| 45 | 21.0025 | 0.0476 | 285.7493 | 0.0035 | 13.6055 | 0.0735 | 12.0360 | 163.7559 | 45 |
| 50 | 29.4570 | 0.0339 | 406.5289 | 0.0025 | 13.8007 | 0.0725 | 12.5287 | 172.9051 | 50 |
| 55 | 41.3150 | 0.0242 | 575.9286 | 0.0017 | 13.9399 | 0.0717 | 12.9215 | 180.1243 | 55 |
| 60 | 57.9464 | 0.0173 | 813.5204 | 0.0012 | 14.0392 | 0.0712 | 13.2321 | 185.7677 | 60 |

| | Single Payment | | Equal Payment Series | | | | Gradient Series | | | 12.0% |
| | Compound Amount Factor | Present Worth Factor | Compound Amount Factor | Sinking Fund Factor | Present Worth Factor | Capital Recovery Factor | Gradient Uniform Series | Gradient Present Worth | | |
| N | (F/P,i,N) | (P/F,i,N) | (F/A,i,N) | (A/F,i,N) | (P/A,i,N) | (A/P,i,N) | (A/G,i,N) | (P/G,i,N) | N | |
| 1 | 1.1200 | 0.8929 | 1.0000 | 1.0000 | 0.8929 | 1.1200 | 0.0000 | 0.0000 | 1 | |
| 2 | 1.2544 | 0.7972 | 2.1200 | 0.4717 | 1.6901 | 0.5917 | 0.4717 | 0.7972 | 2 | |
| 3 | 1.4049 | 0.7118 | 3.3744 | 0.2963 | 2.4018 | 0.4163 | 0.9246 | 2.2208 | 3 | |
| 4 | 1.5735 | 0.6355 | 4.7793 | 0.2092 | 3.0373 | 0.3292 | 1.3589 | 4.1273 | 4 | |
| 5 | 1.7623 | 0.5674 | 6.3528 | 0.1574 | 3.6048 | 0.2774 | 1.7746 | 6.3970 | 5 | |
| 6 | 1.9738 | 0.5066 | 8.1152 | 0.1232 | 4.1114 | 0.2432 | 2.1720 | 8.9302 | 6 | |
| 7 | 2.2107 | 0.4523 | 10.0890 | 0.0991 | 4.5638 | 0.2191 | 2.5515 | 11.6443 | 7 | |
| 8 | 2.4760 | 0.4039 | 12.2997 | 0.0813 | 4.9676 | 0.2013 | 2.9131 | 14.4714 | 8 | |
| 9 | 2.7731 | 0.3606 | 14.7757 | 0.0677 | 5.3282 | 0.1877 | 3.2574 | 17.3563 | 9 | |
| 10 | 3.1058 | 0.3220 | 17.5487 | 0.0570 | 5.6502 | 0.1770 | 3.5847 | 20.2541 | 10 | |
| 11 | 3.4785 | 0.2875 | 20.6546 | 0.0484 | 5.9377 | 0.1684 | 3.8953 | 23.1288 | 11 | |
| 12 | 3.8960 | 0.2567 | 24.1331 | 0.0414 | 6.1944 | 0.1614 | 4.1897 | 25.9523 | 12 | |
| 13 | 4.3635 | 0.2292 | 28.0291 | 0.0357 | 6.4235 | 0.1557 | 4.4683 | 28.7024 | 13 | |
| 14 | 4.8871 | 0.2046 | 32.3926 | 0.0309 | 6.6282 | 0.1509 | 4.7317 | 31.3624 | 14 | |
| 15 | 5.4736 | 0.1827 | 37.2797 | 0.0268 | 6.8109 | 0.1468 | 4.9803 | 33.9202 | 15 | |
| 16 | 6.1304 | 0.1631 | 42.7533 | 0.0234 | 6.9740 | 0.1434 | 5.2147 | 36.3670 | 16 | |
| 17 | 6.8660 | 0.1456 | 48.8837 | 0.0205 | 7.1196 | 0.1405 | 5.4353 | 38.6973 | 17 | |
| 18 | 7.6900 | 0.1300 | 55.7497 | 0.0179 | 7.2497 | 0.1379 | 5.6427 | 40.9080 | 81 | |
| 19 | 8.6128 | 0.1161 | 63.4397 | 0.0158 | 7.3658 | 0.1358 | 5.8375 | 42.9979 | 19 | |
| 20 | 9.6463 | 0.1037 | 72.0524 | 0.0139 | 7.4694 | 0.1339 | 6.0202 | 44.9676 | 20 | |
| 21 | 10.8038 | 0.0926 | 81.6987 | 0.0122 | 7.5620 | 0.1322 | 6.1913 | 46.8188 | 21 | |
| 22 | 12.1003 | 0.0826 | 92.5026 | 0.0108 | 7.6446 | 0.1308 | 6.3514 | 48.5543 | 22 | |
| 23 | 13.5523 | 0.0738 | 104.6029 | 0.0096 | 7.7184 | 0.1296 | 6.5010 | 50.1776 | 23 | |
| 24 | 15.1786 | 0.0659 | 118.1552 | 0.0085 | 7.7843 | 0.1285 | 6.6406 | 51.6929 | 24 | |
| 25 | 17.0001 | 0.0588 | 133.3339 | 0.0075 | 7.8431 | 0.1275 | 6.7708 | 53.1046 | 25 | |
| 26 | 19.0401 | 0.0525 | 150.3339 | 0.0067 | 7.8957 | 0.1267 | 6.8921 | 54.4177 | 26 | |
| 27 | 21.3249 | 0.0469 | 169.3740 | 0.0059 | 7.9426 | 0.1259 | 7.0049 | 55.6369 | 27 | |
| 28 | 23.8839 | 0.0419 | 190.6989 | 0.0052 | 7.9844 | 0.1252 | 7.1098 | 56.7674 | 28 | |
| 29 | 26.7499 | 0.0374 | 214.5828 | 0.0047 | 8.0218 | 0.1247 | 7.2071 | 57.8141 | 29 | |
| 30 | 29.9599 | 0.0334 | 241.3327 | 0.0041 | 8.0552 | 0.1241 | 7.2974 | 58.7821 | 30 | |

4B)  Estimate the single amount at the end of the 5th year that is equivalent to a uniform annual series of ₹1,000 per year for 12  (2) years. The interest rate is 12% compounded annually.

| | Single Payment | | Equal Payment Series | | | | Gradient Series | | | **12.0%** |
| | Compound Amount Factor | Present Worth Factor | Compound Amount Factor | Sinking Fund Factor | Present Worth Factor | Capital Recovery Factor | Gradient Uniform Series | Gradient Present Worth | | |
| N | (F/P,i,N) | (P/F,i,N) | (F/A,i,N) | (A/F,i,N) | (P/A,i,N) | (A/P,i,N) | (A/G,i,N) | (P/G,i,N) | N | |
| 1 | 1.1200 | 0.8929 | 1.0000 | 1.0000 | 0.8929 | 1.1200 | 0.0000 | 0.0000 | 1 | |
| 2 | 1.2544 | 0.7972 | 2.1200 | 0.4717 | 1.6901 | 0.5917 | 0.4717 | 0.7972 | 2 | |
| 3 | 1.4049 | 0.7118 | 3.3744 | 0.2963 | 2.4018 | 0.4163 | 0.9246 | 2.2208 | 3 | |
| 4 | 1.5735 | 0.6355 | 4.7793 | 0.2092 | 3.0373 | 0.3292 | 1.3589 | 4.1273 | 4 | |
| 5 | 1.7623 | 0.5674 | 6.3528 | 0.1574 | 3.6048 | 0.2774 | 1.7746 | 6.3970 | 5 | |
| 6 | 1.9738 | 0.5066 | 8.1152 | 0.1232 | 4.1114 | 0.2432 | 2.1720 | 8.9302 | 6 | |
| 7 | 2.2107 | 0.4523 | 10.0890 | 0.0991 | 4.5638 | 0.2191 | 2.5515 | 11.6443 | 7 | |
| 8 | 2.4760 | 0.4039 | 12.2997 | 0.0813 | 4.9676 | 0.2013 | 2.9131 | 14.4714 | 8 | |
| 9 | 2.7731 | 0.3606 | 14.7757 | 0.0677 | 5.3282 | 0.1877 | 3.2574 | 17.3563 | 9 | |
| 10 | 3.1058 | 0.3220 | 17.5487 | 0.0570 | 5.6502 | 0.1770 | 3.5847 | 20.2541 | 10 | |
| 11 | 3.4785 | 0.2875 | 20.6546 | 0.0484 | 5.9377 | 0.1684 | 3.8953 | 23.1288 | 11 | |
| 12 | 3.8960 | 0.2567 | 24.1331 | 0.0414 | 6.1944 | 0.1614 | 4.1897 | 25.9523 | 12 | |
| 13 | 4.3635 | 0.2292 | 28.0291 | 0.0357 | 6.4235 | 0.1557 | 4.4683 | 28.7024 | 13 | |
| 14 | 4.8871 | 0.2046 | 32.3926 | 0.0309 | 6.6282 | 0.1509 | 4.7317 | 31.3624 | 14 | |
| 15 | 5.4736 | 0.1827 | 37.2797 | 0.0268 | 6.8109 | 0.1468 | 4.9803 | 33.9202 | 15 | |
| 16 | 6.1304 | 0.1631 | 42.7533 | 0.0234 | 6.9740 | 0.1434 | 5.2147 | 36.3670 | 16 | |
| 17 | 6.8660 | 0.1456 | 48.8837 | 0.0205 | 7.1196 | 0.1405 | 5.4353 | 38.6973 | 17 | |
| 18 | 7.6900 | 0.1300 | 55.7497 | 0.0179 | 7.2497 | 0.1379 | 5.6427 | 40.9080 | 81 | |
| 19 | 8.6128 | 0.1161 | 63.4397 | 0.0158 | 7.3658 | 0.1358 | 5.8375 | 42.9979 | 19 | |
| 20 | 9.6463 | 0.1037 | 72.0524 | 0.0139 | 7.4694 | 0.1339 | 6.0202 | 44.9676 | 20 | |
| 21 | 10.8038 | 0.0926 | 81.6987 | 0.0122 | 7.5620 | 0.1322 | 6.1913 | 46.8188 | 21 | |
| 22 | 12.1003 | 0.0826 | 92.5026 | 0.0108 | 7.6446 | 0.1308 | 6.3514 | 48.5543 | 22 | |
| 23 | 13.5523 | 0.0738 | 104.6029 | 0.0096 | 7.7184 | 0.1296 | 6.5010 | 50.1776 | 23 | |
| 24 | 15.1786 | 0.0659 | 118.1552 | 0.0085 | 7.7843 | 0.1285 | 6.6406 | 51.6929 | 24 | |
| 25 | 17.0001 | 0.0588 | 133.3339 | 0.0075 | 7.8431 | 0.1275 | 6.7708 | 53.1046 | 25 | |
| 26 | 19.0401 | 0.0525 | 150.3339 | 0.0067 | 7.8957 | 0.1267 | 6.8921 | 54.4177 | 26 | |
| 27 | 21.3249 | 0.0469 | 169.3740 | 0.0059 | 7.9426 | 0.1259 | 7.0049 | 55.6369 | 27 | |
| 28 | 23.8839 | 0.0419 | 190.6989 | 0.0052 | 7.9844 | 0.1252 | 7.1098 | 56.7674 | 28 | |
| 29 | 26.7499 | 0.0374 | 214.5828 | 0.0047 | 8.0218 | 0.1247 | 7.2071 | 57.8141 | 29 | |
| 30 | 29.9599 | 0.0334 | 241.3327 | 0.0041 | 8.0552 | 0.1241 | 7.2974 | 58.7821 | 30 | |

4C) A person is planning to save ₹5,000 from income during this year and can increase this amount by ₹1000 for each of the following nine years. At an interest rate of 8% compounded annually, determine an equal-annual series beginning at the end of year 1 that would produce the same accumulation at the end of year 10 as would be realized from the gradient series. (3)

| | Single Payment | | Equal Payment Series | | | | Gradient Series | | | **8.0%** |
| | Compound Amount Factor | Present Worth Factor | Compound Amount Factor | Sinking Fund Factor | Present Worth Factor | Capital Recovery Factor | Gradient Uniform Series | Gradient Present Worth | | |
| N | (F/P,i,N) | (P/F,i,N) | (F/A,i,N) | (A/F,i,N) | (P/A,i,N) | (A/P,i,N) | (A/G,i,N) | (P/G,i,N) | N | |
| 1 | 1.0800 | 0.9259 | 1.0000 | 1.0000 | 0.9259 | 1.0800 | 0.0000 | 0.0000 | 1 | |
| 2 | 1.1664 | 0.8573 | 2.0800 | 0.4808 | 1.7833 | 0.5608 | 0.4808 | 0.8573 | 2 | |
| 3 | 1.2597 | 0.7938 | 3.2464 | 0.3080 | 2.5771 | 0.3880 | 0.9487 | 2.4450 | 3 | |
| 4 | 1.3605 | 0.7350 | 4.5061 | 0.2219 | 3.3121 | 0.3019 | 1.4040 | 4.6501 | 4 | |
| 5 | 1.4693 | 0.6806 | 5.8666 | 0.1705 | 3.9927 | 0.2505 | 1.8465 | 7.3724 | 5 | |

| n | F/P | P/F | F/A | A/F | P/A | A/P | A/G | P/G | n |
|---|------|------|------|------|------|------|------|------|---|
| 6 | 1.5869 | 0.6302 | 7.3359 | 0.1363 | 4.6229 | 0.2163 | 2.2763 | 10.5233 | 6 |
| 7 | 1.7138 | 0.5835 | 8.9228 | 0.1121 | 5.2064 | 0.1921 | 2.6937 | 14.0242 | 7 |
| 8 | 1.8509 | 0.5403 | 10.6366 | 0.0940 | 5.7466 | 0.1740 | 3.0985 | 17.8061 | 8 |
| 9 | 1.9990 | 0.5002 | 12.4876 | 0.0801 | 6.2469 | 0.1601 | 3.4910 | 21.8081 | 9 |
| 10 | 2.1589 | 0.4632 | 14.4866 | 0.0690 | 6.7101 | 0.1490 | 3.8713 | 25.9768 | 10 |
| 11 | 2.3316 | 0.4289 | 16.6455 | 0.0601 | 7.1390 | 0.1401 | 4.2395 | 30.2657 | 11 |
| 12 | 2.5182 | 0.3971 | 18.9771 | 0.0527 | 7.5361 | 0.1327 | 4.5957 | 34.6339 | 12 |
| 13 | 2.7196 | 0.3677 | 21.4953 | 0.0465 | 7.9038 | 0.1265 | 4.9402 | 39.0463 | 13 |
| 14 | 2.9372 | 0.3405 | 24.2149 | 0.0413 | 8.2442 | 0.1213 | 5.2731 | 43.4723 | 14 |
| 15 | 3.1722 | 0.3152 | 27.1521 | 0.0368 | 8.5595 | 0.1168 | 5.5945 | 47.8857 | 15 |
| 16 | 3.4259 | 0.2919 | 30.3243 | 0.0330 | 8.8514 | 0.1130 | 5.9046 | 52.2640 | 16 |
| 17 | 3.7000 | 0.2703 | 33.7502 | 0.0296 | 9.1216 | 0.1096 | 6.2037 | 56.5883 | 17 |
| 18 | 3.9960 | 0.2502 | 37.4502 | 0.0267 | 9.3719 | 0.1067 | 6.4920 | 60.8426 | 18 |
| 19 | 4.3157 | 0.2317 | 41.4463 | 0.0241 | 9.6036 | 0.1041 | 6.7697 | 65.0134 | 19 |
| 20 | 4.6610 | 0.2145 | 45.7620 | 0.0219 | 9.8181 | 0.1019 | 7.0369 | 69.0898 | 20 |
| 21 | 5.0338 | 0.1987 | 50.4229 | 0.0198 | 10.0168 | 0.0998 | 7.2940 | 73.0629 | 21 |
| 22 | 5.4365 | 0.1839 | 55.4568 | 0.0180 | 10.2007 | 0.0980 | 7.5412 | 76.9257 | 22 |
| 23 | 5.8715 | 0.1703 | 60.8933 | 0.0164 | 10.3711 | 0.0964 | 7.7786 | 80.6726 | 23 |
| 24 | 6.3412 | 0.1577 | 66.7648 | 0.0150 | 10.5288 | 0.0950 | 8.0066 | 84.2997 | 24 |
| 25 | 6.8485 | 0.1460 | 73.1059 | 0.0137 | 10.6748 | 0.0937 | 8.2254 | 87.8041 | 25 |
| 26 | 7.3964 | 0.1352 | 79.9544 | 0.0125 | 10.8100 | 0.0925 | 8.4352 | 91.1842 | 26 |
| 27 | 7.9881 | 0.1252 | 87.3508 | 0.0114 | 10.9352 | 0.0914 | 8.6363 | 94.4390 | 27 |
| 78 | 8.6271 | 0.1159 | 95.3388 | 0.0105 | 11.0511 | 0.0905 | 8.8289 | 97.5687 | 28 |
| 29 | 9.3173 | 0.1073 | 103.9659 | 0.0096 | 11.1584 | 0.0896 | 9.0133 | 100.5738 | 29 |
| 30 | 10.0627 | 0.0994 | 113.2832 | 0.0088 | 11.2578 | 0.0888 | 9.1897 | 103.4558 | 30 |
| 31 | 10.8677 | 0.0920 | 123.3459 | 0.0081 | 11.3498 | 0.0881 | 9.3584 | 106.2163 | 31 |
| 32 | 11.7371 | 0.0852 | 134.2135 | 0.0075 | 11.4350 | 0.0875 | 9.5197 | 108.8575 | 32 |
| 33 | 12.6760 | 0.0789 | 145.9506 | 0.0069 | 11.5139 | 0.0869 | 9.6737 | 111.3819 | 33 |
| 34 | 13.6901 | 0.0730 | 158.6267 | 0.0063 | 11.5869 | 0.0863 | 9.8208 | 113.7924 | 34 |
| 35 | 14.7853 | 0.0676 | 172.3168 | 0.0058 | 11.6546 | 0.0858 | 9.9611 | 116.0920 | 35 |
| 40 | 21.7245 | 0.0460 | 259.0565 | 0.0039 | 11.9246 | 0.0839 | 10.5699 | 126.0422 | 40 |
| 45 | 31.9204 | 0.0313 | 386.5056 | 0.0026 | 12.1084 | 0.0826 | 11.0447 | 133.7331 | 45 |
| 50 | 46.9016 | 0.0213 | 573.7702 | 0.0017 | 12.2335 | 0.0817 | 11.4107 | 139.5928 | 50 |
| 55 | 68.9139 | 0.0145 | 848.9232 | 0.0012 | 12.3186 | 0.0812 | 11.6902 | 144.0065 | 55 |
| 60 | 101.2571 | 0.0099 | 1253.2133 | 0.0008 | 12.3766 | 0.0808 | 11.9015 | 147.3000 | 60 |

5A)   A motor with a 200-horsepower output is needed in the factory for intermittent use. A Graybar motor costs $7000 and has an   (3)
operating cost of $12.07 per hour. A Blueball motor costs $6000 and has an operating cost of $12.64 per hour. Neither motor would have any salvage value, since the cost to remove it would equal its scrap value at the end of its life of 8 years. The annual maintenance cost for either motor is estimated at $300 per year. If a 10% interest rate is used in the calculations, what is the number of hours that makes the two alternatives equivalent?

## 10% Compound Interest Factors

| | Single Payment | | Uniform Payment Series | | | | Arithmetic Gradient | |
|---|---|---|---|---|---|---|---|---|
| | Compound Amount Factor Find F Given P | Present Worth Factor Find P Given F | Sinking Fund Factor Find A Given F | Capital Recovery Factor Find A Given P | Compound Amount Factor Find F Given A | Present Worth Factor Find P Given A | Gradient Uniform Series Find A Given G | Gradient Present Worth Find P Given G |
| n | F/P | P/F | A/F | A/P | F/A | P/A | A/G | P/G |
| 1 | 1.100 | .9091 | 1.0000 | 1.1000 | 1.000 | 0.909 | 0 | 0 |
| 2 | 1.210 | .8264 | .4762 | .5762 | 2.100 | 1.736 | 0.476 | 0.826 |
| 3 | 1.331 | .7513 | .3021 | .4021 | 3.310 | 2.487 | 0.937 | 2.329 |
| 4 | 1.464 | .6830 | .2155 | .3155 | 4.641 | 3.170 | 1.381 | 4.378 |
| 5 | 1.611 | .6209 | .1638 | .2638 | 6.105 | 3.791 | 1.810 | 6.862 |
| 6 | 1.772 | .5645 | .1296 | .2296 | 7.716 | 4.355 | 2.224 | 9.684 |
| 7 | 1.949 | .5132 | .1054 | .2054 | 9.487 | 4.868 | 2.622 | 12.763 |
| 8 | 2.144 | .4665 | .0874 | .1874 | 11.436 | 5.335 | 3.004 | 16.029 |
| 9 | 2.358 | .4241 | .0736 | .1736 | 13.579 | 5.759 | 3.372 | 19.421 |
| 10 | 2.594 | .3855 | .0627 | .1627 | 15.937 | 6.145 | 3.725 | 22.891 |
| 11 | 2.853 | .3505 | .0540 | .1540 | 18.531 | 6.495 | 4.064 | 26.396 |
| 12 | 3.138 | .3186 | .0468 | .1468 | 21.384 | 6.814 | 4.388 | 29.901 |

| 13 | 3.452 | .2897 | .0408 | .1408 | 24.523 | 7.103 | 4.699 | 33.377 |
|----|-------|-------|-------|-------|--------|-------|-------|--------|
| 14 | 3.797 | .2633 | .0357 | .1357 | 27.975 | 7.367 | 4.996 | 36.801 |
| 15 | 4.177 | .2394 | .0315 | .1315 | 31.772 | 7.606 | 5.279 | 40.152 |

**5B)** In an automotive parts plant, an engineering team is analysing an improvement project to increase the productivity of a flexible manufacturing centre. The estimated net cash flows for the three feasible alternatives being compared are shown in Table. The analysis period is six years, and MARR for capital investments at the plant is 15% per year. Using the Incremental Rate of Return method, which alternative should be selected? (5)

| End of Period | A | B | C |
|---------------|-----------|-----------|-----------|
| 0 | − $640,000 | −$680,000 | −$755,000 |
| 1 | 262,000 | -$40,000 | 205,000 |
| 2 | 290,000 | 392,000 | 406,000 |
| 3 | 302,000 | 380,000 | 400,000 |
| 4 | 310,000 | 380,000 | 390,000 |
| 5 | 310,000 | 380,000 | 390,000 |
| 6 | 260,000 | 380,000 | 324,000 |

| 15% | | | | Compound Interest Factors | | | | | | 15% |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | **Single Payment** | | **Uniform Payment Series** | | | | **Arithmetic Gradient** | | | |
| | Compound Amount Factor Find F Given P | Present Worth Factor Find P Given F | Sinking Fund Factor Find A Given F | Capital Recovery Factor Find A Given P | Compound Amount Factor Find F Given A | Present Worth Factor Find P Given A | Gradient Uniform Series Find A Given G | Gradient Present Worth Find P Given G | | |
| n | F/P | P/F | A/F | A/P | F/A | P/A | A/G | P/G | n | |
| 1 | 1.150 | .8696 | 1.0000 | 1.1500 | 1.000 | 0.870 | 0 | 0 | 1 | |
| 2 | 1.322 | .7561 | .4651 | .6151 | 2.150 | 1.626 | 0.465 | 0.756 | 2 | |
| 3 | 1.521 | .6575 | .2880 | .4380 | 3.472 | 2.283 | 0.907 | 2.071 | 3 | |
| 4 | 1.749 | .5718 | .2003 | .3503 | 4.993 | 2.855 | 1.326 | 3.786 | 4 | |
| 5 | 2.011 | .4972 | .1483 | .2983 | 6.742 | 3.352 | 1.723 | 5.775 | 5 | |
| 6 | 2.313 | .4323 | .1142 | .2642 | 8.754 | 3.784 | 2.097 | 7.937 | 6 | |
| 7 | 2.660 | .3759 | .0904 | .2404 | 11.067 | 4.160 | 2.450 | 10.192 | 7 | |
| 8 | 3.059 | .3269 | .0729 | .2229 | 13.727 | 4.487 | 2.781 | 12.481 | 8 | |
| 9 | 3.518 | .2843 | .0596 | .2096 | 16.786 | 4.772 | 3.092 | 14.755 | 9 | |
| 10 | 4.046 | .2472 | .0493 | .1993 | 20.304 | 5.019 | 3.383 | 16.979 | 10 | |
| 11 | 4.652 | .2149 | .0411 | .1911 | 24.349 | 5.234 | 3.655 | 19.129 | 11 | |
| 12 | 5.350 | .1869 | .0345 | .1845 | 29.002 | 5.421 | 3.908 | 21.185 | 12 | |
| 13 | 6.153 | .1625 | .0291 | .1791 | 34.352 | 5.583 | 4.144 | 23.135 | 13 | |
| 14 | 7.076 | .1413 | .0247 | .1747 | 40.505 | 5.724 | 4.362 | 24.972 | 14 | |
| 15 | 8.137 | .1229 | .0210 | .1710 | 47.580 | 5.847 | 4.565 | 26.693 | 15 | |

**5C)** A machine has an initial cost of Rs.5,00,000 and salvage value of 10% of initial cost. The operating cost is expected to be Rs. 20,000 at the end of 2nd year which then increases by Rs. 2,000 every year for the next 8 years. Calculate the present worth at 10% interest rate. (2)

| | Single Payment | | Uniform Payment Series | | | | Arithmetic Gradient | |
|---|---|---|---|---|---|---|---|---|
| | Compound Amount Factor Find F Given P | Present Worth Factor Find P Given F | Sinking Fund Factor Find A Given F | Capital Recovery Factor Find A Given P | Compound Amount Factor Find F Given A | Present Worth Factor Find P Given A | Gradient Uniform Series Find A Given G | Gradient Present Worth Find P Given G |
| n | F/P | P/F | A/F | A/P | F/A | P/A | A/G | P/G |
| 1 | 1.100 | .9091 | 1.0000 | 1.1000 | 1.000 | 0.909 | 0 | 0 |
| 2 | 1.210 | .8264 | .4762 | .5762 | 2.100 | 1.736 | 0.476 | 0.826 |
| 3 | 1.331 | .7513 | .3021 | .4021 | 3.310 | 2.487 | 0.937 | 2.329 |
| 4 | 1.464 | .6830 | .2155 | .3155 | 4.641 | 3.170 | 1.381 | 4.378 |
| 5 | 1.611 | .6209 | .1638 | .2638 | 6.105 | 3.791 | 1.810 | 6.862 |
| 6 | 1.772 | .5645 | .1296 | .2296 | 7.716 | 4.355 | 2.224 | 9.684 |
| 7 | 1.949 | .5132 | .1054 | .2054 | 9.487 | 4.868 | 2.622 | 12.763 |
| 8 | 2.144 | .4665 | .0874 | .1874 | 11.436 | 5.335 | 3.004 | 16.029 |
| 9 | 2.358 | .4241 | .0736 | .1736 | 13.579 | 5.759 | 3.372 | 19.421 |
| 10 | 2.594 | .3855 | .0627 | .1627 | 15.937 | 6.145 | 3.725 | 22.891 |

-----End-----