SIMPLE INTEREST

Q1

SOLUTION

01. How much interest will be earned on Rs 2000 at 6% simple interest for 2 years

$SI = 2000 \times 2 \times \frac{6}{100} \rightarrow SI = 240$

02. How much interest will be earned on Rs 4000 at 6% simple interest for 2 years

$SI = 4000 \times 2 \times \frac{6}{100} \rightarrow SI = 480$

03. Sania deposited Rs 50,000 in a bank for 2 years with the interest rate of 5.5% p.a. How much interest would she earn

$SI = 50000 \times 2 \times \frac{5.5}{100} \rightarrow SI = 5500$

04. Sachin deposited 1,00,000 in a bank for 2 years with the interest at 6 % p.a. How much interest would he earn . What will be the final value of deposit

$SI = 100000 \times 2 \times \frac{6}{100} \rightarrow SI = 12000$ $\quad A = P + SI = 1,12,000$

05. A deposited 1,00,000 in a bank for 2 years with the interest at 5.5 % p.a. What will be the final value of investment

$A = 100000\left(1 + \frac{2(5.5)}{100}\right) \rightarrow A = 1,11,000$

06. sum required to earn quarterly interest of ₹ 3600 at 18% p.a SI

$3600 = P.\frac{4}{12}.\frac{18}{100} \rightarrow P = 60,000$

07. sum required to earn monthly interest of ₹ 1200 at 18% p.a SI

$1200 = P.\frac{1}{12}.\frac{18}{100} \rightarrow P = 80,000$

08. What sum of money would produce Rs 28,600 as an interest in 3 years and 3 months at 2.5% p.a. SI

$28600 = P \times \frac{39}{12} \times \frac{2.5}{100}$ OR $28600 = P \times 3.25 \times \frac{2.5}{100}$ $\quad P = 3,52,000$

09. Kapil deposited some amount in a bank for 7 ½ years at the rate of 6% p.a simple interest . Kapil received 1,01,500 at the end of the term . Compute initial deposit of Kapil

$101500 = P\left(1 + 7.5\ \frac{6}{100}\right) \rightarrow P = 70,000$

10. A certain sum of money Q was deposited for 5 years and 4 months at 4.5% SI and amounted to 248 , then the value of Q is

$248 = Q\left(1 + \frac{64}{12}\frac{4.5}{100}\right) \rightarrow Q = 200$

11. a bike is purchased by making a down payment of Rs 15000 and balance to be paid alongside interest at 5% for 2 yrs . Total amount paid is 28200 . Find the cash price of the bike

Loan amount P borrowed at the time of purchase amounted to repayment of A= 13200 incl. the interest at 5% for 2 years

$13200 = P\left(1+\frac{2(5)}{100}\right) \quad P = 12{,}000$

Cash Price of the bike = Down payment of 15000 + P = 27,000

Q2

01. Find rate of interest if the amount owed after 6 months is ₹ 2100 , borrowed amount being ₹ 2000

$2100 = 2000\left(1+\frac{6}{12}\frac{r}{100}\right) \rightarrow r = 10\%\text{p.a.}$

02. Find rate of interest if the amount owed after 6 months is ₹ 1050 , borrowed amount being ₹ 1000

$1050 = 1000\left(1+\frac{6}{12}\frac{r}{100}\right) \rightarrow r = 10\%\text{p.a.}$

03. 46875 was lent out at SI and at end of 1 yr 8 months , total amount was 50,000 . Find rate of interest p.a.

$50000 = 46875\left(1+\frac{20}{12}\frac{r}{100}\right) \rightarrow r = 4\%\text{p.a.}$

04. If a sum triples in 15 years at simple rate of interest , the rate of interest p.a. will be

$3P = P\left(1+\frac{15r}{100}\right) \quad r = 13.33\%\text{p.a.}$

Q3

01. In how much time would SI on a certain sum be 0.125 times the principal at 10% p.a.

$0.125P = P\ n.\frac{10}{100} \rightarrow n = 1.25 \text{ yrs} = 1 \text{ yr } 3 \text{ months}$

02. Find number of years in which a sum doubles itself at the rate of 8% p.a.

$2P = P\left(1+n\frac{(8)}{100}\right) \rightarrow n = 12.5\text{yrs}$

03. In what time will ₹ 85000 amount to ₹ 1,57,675 at 4.5%p.a. SI

$157675 = 85000\left(1+n\frac{4.5}{100}\right) \rightarrow n = 19 \text{ years .}$

04. Rahul invested 70,000 in a bank at the rate of 6.5% p.a. SI . He received 85,925 after the end of term . Find out the period for which sum was invested by Rahul

$85925 = 70000\left(1+n\frac{6.5}{100}\right) \rightarrow n = 3.5 \text{ years .}$

Q4

01. sum doubles itself in 20 yrs . In how many years it will become 7 times

$2P = P\left(1+\frac{20r}{100}\right) \rightarrow r = 5\%\text{p.a.} \rightarrow 7P = P\left(1+\frac{n(5)}{100}\right)$ $\quad n = 120\text{yrs}$

02. sum doubles itself in 10 yrs . In how many years it will treble itself

$2P = P\left(1+\frac{10r}{100}\right) \rightarrow r = 10\%\text{p.a.} \rightarrow 3P = P\left(1+\frac{n(10)}{100}\right)$ $\quad n = 20\text{yrs}$

03. A sum of 3402 amounts to 6804 in 20 years . What sum will amount to 5200 in 6 years at same rate .

$6804 = 3402\left(1+\frac{20r}{100}\right) \rightarrow r = 5\%\text{p.a} \rightarrow 5200 = P\left(1+\frac{6(5)}{100}\right)$ $\quad P = 4000$

04. 8000 become 10000 in 2 yrs at simple interest . The amount that will become 6,875 in 3 yrs at the same rate of interest

$10000 = 8000\left(1+\frac{2r}{100}\right) \rightarrow r = 12.5\%\text{p.a} \rightarrow 6875 = P\left(1+\frac{3(12.5)}{100}\right)$ $\quad P = 5000$

Q5

01. A person lends 6000 for 4 years and 8000 for 3 years at simple interest . If he gets 2400 as total interest the rate of interest is

$2400 = 6000.4.\frac{r}{100} + 8000.3.\frac{r}{100} \rightarrow 2400 = 240r+240r \rightarrow r = 5\%\text{p.a.}$

02. Mr X takes a loan of 7000 for 8 yrs . After 3 yrs he takes a loan of 3000 more .Total interest paid at the end of 8 yrs is 3550 . Find the rate of interest

$3550 = 7000(\frac{8}{100})r + 3000(\frac{5}{100})r$ $\quad r = 5\%\text{p.a.}$

03. the rate of simple interest on sum of money is 6% p.a. for first 3 years , 8% for the next 5 years and 10% for yrs beyond 8 yrs . If the simple interest accrued by the sum for a period of 10 yrs is 1560 . The sum is

$1560 = P\frac{3(6)}{100} + P\frac{5(8)}{100} + P(2)\frac{10}{100}$

$156000 = 18P + 40P + 20P$

$156000 = 78P \quad P = 2000$

Q6

01. A person borrows 5000 for 2 years at 4% p.a. simple interest . He immediately lends it to another person at 6 ¼% p.a. for 2 years . Find his gain in the transaction per year

$\text{Gain} = 5000.2.\frac{(6.25)}{100} - 5000.\frac{2.(4)}{100} = 5000 . \frac{2}{100} .(6.25-4) = 225 \text{ in 2 years}$

Gain/year = 112.50

02. Two equal sum was lent at simple interest at 11% p.a. for 3 ½ yrs and 4 ½ yrs respectively . If the difference in interest for two periods was 412.50 , then each sum is

$$412.50 = P.(4.5)\frac{11}{100} - P(3.5)\frac{11}{100}$$

$$41250 = 11P[4.5-3.5]$$

$$P = 3750$$

03. A certain sum of money was invested at simple rate of interest for 3 years . If the same had been invested at the rate that was 7 percent higher , the interest amount would have been Rs 882 more . The amount of sum invested is

$$882 = P.3\frac{(r+7)}{100} - P.3\frac{r}{100}$$

$$88200 = 3Pr + 21P - 3Pr \qquad P = 4200$$

04. if SI on 1400 for 3 yrs is less than SI on 1800 for same period by Rs 80 , then rate of interest

$$80 = 1800.3\frac{r}{100} - 1400.3\frac{r}{100}$$

$$80 = 54r - 42r \qquad r = 6.67\%$$

05 Mr X invest 90,500 in post office at 7.5% p.a. SI . While calculating the rate was wrongly taken as 5.7% p.a. . The difference in amounts of maturity is 9774 . Find the period for which the sum was invested .

NOTE – Difference in amounts of maturity is basically the difference in SI accrued as the principal remains same through

$$9774 = 90500.n.\frac{(7.5)}{100} - 90500.n.\frac{(5.7)}{100}$$

$$9774 = 905n\,[7.5-5.7]$$

$$9774 = 1629n \qquad n = 6 \text{ years}$$

Q7

01. a certain sum amounts to 7400 in 3 yrs and 8600 in 4 yrs . Find the sum and rate of interest

$$7400 = P + \frac{P3r}{100} \ldots.(1)$$

$$8600 = P + \frac{P4r}{100} \ldots..(2)$$

$$1200 = \frac{Pr}{100} \ldots..(3)$$

subs in (1)

P = 3800 , Subs in (3), r = 31.57%

02. What is the rate of simple interest if a sum of money amounts to 2784 in 4 yrs & 2688 in 3 yrs

$2784 = P + \frac{P4r}{100}$ ....(1)

$2688 = P + \frac{P3r}{100}$ .....(2)

$96 = \frac{Pr}{100}$ .....(3) subs in (1) P = 2400 , subs in (3) r = 4%

03. a certain sum amounts to 2800 in 2 yrs and 3250 in 5 yrs . Find the sum and rate of interest

$2800 = P + \frac{P2r}{100}$ ....(1)

$3250 = P + \frac{P5r}{100}$ .....(2)

$450 = \frac{3Pr}{100}$

$150 = \frac{Pr}{100}$ .....(3)

subs in (1) P = 2500 , Subs in (3), r = 6%

Q8

01. If a simple interest on a sum of money at 6% p.a. for 7 years is equal to TWICE of simple interest on another sum for 9 years at 5% p.a. . The ratio of sum invested will be

$SI_1 = 2SI_2 \rightarrow P_1.7.\frac{6}{100} = 2\ P_2.9.\frac{5}{100} \rightarrow 42P_1 = 90P_2 \rightarrow P_1:P_2 = 15:7$

02. a man invests an amount of 15680 in the names of his three sons A , B and C in such a way that they get the same SI after 2 , 3 and 4 years respectively . If the rate of interest is 5% , then the ratio of amount invested in the name of A , B and C is

$P_1.2.\frac{(5)}{100} = P_2.3.\frac{(5)}{100} = P_3.4.\frac{(5)}{100}$

$10P_1 = 15P_2 = 20P_3$

$2P_1 = 3P_2 = 4P_3 = 12$(say)

$P_1 : P_2 : P_3$
$6 : 4 : 3$

03. a sum of 44000 is divided into three parts such that the corresponding interest earned after 2 years , 3 years and 6 years may be equal . If the rates of simple interest are 6%p.a. , 8%p.a. and 6%p.a. respectively , then the smallest part of the sum will be

$SI_1 = SI_2 = SI_3$

$P_1.2.\frac{6}{100} = P_2.3.\frac{8}{100} = P_3.6.\frac{6}{100}$

$12P_1 = 24P_2 = 36P_3$

$P_1 = 2P_2 = 3P_3 = 6$(say)

$P_1 : P_2 : P_3$
$6 : 3 : 2 : 11$
x 4000 x 4000
8000 44000

04. Johnson left 1,00,000 with the direction that it should be divided in such a way that his minor sons Tom , Dick and Harry aged 9 , 12 and 15 years should each receive equally after attaining the age 25 years . Rate of interest 3.5% , how much each son receive after getting 25 years old

A = amount recvd by each son on attaining the age 25 yrs

SON 1 – $A = P_1[1+16(0.035)] = 1.56P_1$ $P_1 = A/1.56$

SON 2 – $A = P_2[1+13(0.035)] = 1.455P_2$ $P_2 = A/1.455$

SON 3 – $A = P_3[1+10(0.035)] = 1.35P_3$ $P_3 = A/1.35$

$P_1 + P_2 + P_3 = 100000$

$A(0.6410) + A(0.6873) + A(0.7407) = 100000$

$A(0.6410 + 0.6873 + 0.7407) = 100000$

$A = 48,332.53$

COMPOUND INTEREST

Q1

01. Find amount for a sum of Rs 4000 at 8% p.a. for 5 yrs compounded annually

A = $4000[1+0.08]^5$ = ₹ 5877

02. Find CI for a sum of 16000 at 10% p.a. for 1 ½ yrs payable HALF YEARLY

Since compounded HALF YEARLY , i = = 5% = 0.05 , n = 3

CI = $16000[1.05^3 - 1]$ = ₹ 2522

03. Find CI for a sum of 8000 at 4% p.a. for 6 yrs compounded HALF YEARLY

Since compounded HALF YEARLY , i = = 2% = 0.02 , n = 12

CI = $8000[1.02^{12} - 1]$ = ₹ 2145.9 ≈ ₹ 2146

04. Find CI for a sum of 4000 for 6 months at 12% p.a. payable QUARTERLY

Since compounded QUARTERLY , i = = 3% = 0.03 , n = 2

CI = $4000[1.03^2 - 1]$ = ₹ 243.60

05. Find CI for a sum of 40000 at 10% p.a. for 1 yr , interest payable QUARTERLY

Since compounded QUARTERLY , i = = 2.5% = 0.025 , n = 4

CI = $40000[1.025^4 - 1]$ = ₹ 4152.51

06. Find amount & CI for a sum of 6000 at 12% p.a. for 3 yrs compounded QUARTERLY

Since compounded QUARTERLY , i = 3% = 0.03 , n = 12

CI = $6000[1.03^{12} - 1]$ = ₹ 2554.6

07. Find amount for a sum of 10000 at 6% p.a. for 2 years compounded monthly

Since compounded MONTHLY , i = 0.5% = 0.005 , n = 24

A = $10000[1+0.005]^{24}$ = ₹ 11271.6 ≈ ₹ 11271

08. An investment of 20000 on interest of 6% p.a. for first 4 yrs , 5% p.a. for next 3 yrs and 4% p.a. for next 2 yrs . Find value of investment after 9 yrs where interest is compounded annually

A = 20000 $[1.06^4].[1.05^3][1.04^2]$ = ₹ 31614.62

09. The compound interest on half yearly basis on 10,000 the rate for the first and second years being 6% and for third year 9% p.a. is

FOR FIRST 2 YEARS - i = 0.03 , n = 4 …… COMPOUNDING SEMI ANNUALLY

FOR THIRD YEAR - i = 0.045 , n = 2 ….. COMPOUNDING SEMI ANNUALLY

CI = 20000 [$(1.03)^4$. $(1.045)^2$ –1] = ₹ 2290.84

10. A person deposited 5000 in a bank . The deposit was left to accumulate at 6% compounded quarterly for first 5 years and at 8% compounded semi-annually for next 8 years . The compound amount at the end of 13 years is

For first 5 years - i = 0.015 , n = 20 …. COMPOUNING QUARTERLY

For next 8 years - i = 0.04 , n = 16 …. COMPOUNDING SEMI ANNUALLY

A = 5000 [1.015^{20}]. [1.04^{16}] = ₹ 12613.17

11. CI on any sum at the rate of 5% for two years is ₹ 512.50 then the sum would be

512.50 = P[1.05^2–1] → P = ₹ 5,000

12. CI on any sum at the rate of 4% for two years is ₹ 102 . Find SI for the same period , same rate on the same sum

102 = P[1.04^2–1] → P = ₹ 1250

SI = 1250 .2.(0.04) = ₹ 100

Q2

01. Find present value of 10000 due in 2 yrs at 5% p.a. compound interest paid ANNUALLY .

10000 = P$[1.05]^2$ → P = ₹ 9070.3

02. A certain sum invested at 4% p.a. compounded semi annually amounts to 78,030 at the end of one year . Find the sum .

Since compounded HALF YEARLY , n = 2 , i = 2% = 0.02

78030 = P$[1.02]^2$ → P = ₹ 75000

03. Find present value of 20000 due in 3 yrs at 6% p.a. CI paid HALF YEARLY .

Since compounded HALF YEARLY , n = 6 , i = 3% = 0.03

20000 = P$[1.03]^6$ → P = ₹ 16749.68

Q3

01. Difference between CI and SI at 5% p.a. for 2 yrs on a sum of 6000 is

$CI - SI = 6000[1.05^2 - 1] - 6000\ 2\ (0.05)$

$= 6000\ [1.05^2 - 1 - 0.1] \qquad = ₹\ 15$

02. Difference between CI and SI at 8% p.a. for 3 yrs on a sum of 50000 is

$CI - SI = 50000[1.08^3 - 1] - 50000\ 3\ (0.08)$

$= 50000[1.08^3 - 1 - 0.24] \qquad = ₹\ 985.6$

03. Difference between CI and SI at 5% p.a. for 4 yrs on a sum of 10000 is

$CI - SI = 10000[1.05^4 - 1] - 10000\ 4\ (0.05)$

$= 10000[1.05^4 - 1 - 0.20] \qquad = ₹\ 155.06$

04. Difference between SI and CI on 2400 at 5% p.a. for 2 yrs

$CI - SI = 2400[1.05^2 - 1] - 2400\ 2\ (0.05)$

$= 2400[1.05^2 - 1 - 0.10] \qquad = ₹\ 6$

05. the difference between SI and CI on a certain sum for 2 years at 10% p.a. is ₹ 10. Find the sum

$CI - SI = 10$

$P[1.1^2 - 1 - 2(0.1)] = 10 \qquad P = ₹\ 1000$

06. a compound interest on a sum for 2 years is 30 more than the simple interest at the rate of 5% p.a. , then sum is

$CI - SI = 30$

$P[1.05^2 - 1 - 2(0.05)] = 30 \qquad P = ₹\ 12000$

07. the difference between SI and CI on a certain sum invested for 3 years at 6% p.a. is ₹ 110.16 Find the sum

$CI - SI = 110.16$

$P[1.06^3 - 1 - 3(0.06)] = 110.16 \qquad P = ₹\ 10000$

08. the difference between SI and CI on a certain sum for 3 years at 5% p.a. is ₹ 228.75 . The compound interest on the sum for 2 years at 5% p.a. is

CI − SI = 228.75

$P[1.05^3 - 1 - 3(0.5)] = 228.75 \quad \rightarrow P = ₹\ 30000$

$CI = 30000[1.05^2 - 1] = ₹\ 3075$

Q4

01. A machinery is depreciated at 10% p.a. for 3 years costing Rs 50,000 . Find scrap value

Scarp val (Depreciated val.)

$A = 50000[1-0.1]^3 = ₹\ 36450$

02. Find depreciation if machinery worth ₹ 12000 is depreciated at 6% p.a. for 4 years

Depreciated value $A = 12000[1-0.06]^4 = ₹\ 9369$

Depreciation = P − A = 12000 − 9369 = ₹ 2631

03. The useful life of a machine is estimated to be 10 years and cost 10,000 . Rate of depreciation is 10%p.a. The scrap value at the end of its life is

Depreciated value $A = 10000[1-0.1]^{10} = ₹\ 3468.78$

04. A machinery worth 10000 is depreciated at the rate of 10% p.a. for first 3 years , 8%p.a for next 2 years. Find its value after 5 years

Depreciated value $A = 10000[1-0.1]^3[1-0.08]^2 = ₹\ 6170.26$

Q5

01. A sum of money at 5% p.a. CI doubles in

$2P = P[1.05]^n \qquad n = 14$ years (approx.)

02. a sum at a certain rate of interest compounded annually doubles in 5 yrs . In how many years will it become 8 times

$2P = P[1+i]^5 \rightarrow 2 = [1+i]^5 \rightarrow 8 = [1+i]^{15} \qquad n = 15$ years

ALTERNATE METHOD

t	0	5	10	15	years
A	P	2P	4P	8P	

03. a sum at a certain rate of interest compounded annually doubles in 4 yrs . In how many years will it become 32 times

$2P = P[1+i]^4 \rightarrow 2 = [1+i]^4 \rightarrow 2^5 = \left([1+i]^4\right)^5 \rightarrow 32 = [1+i]^{20}$ n = 20 years

ALTERNATE METHOD

t	0	4	8	12	16	20	years
A	P	2P	4P	8P	16P	32P	

04. A sum amounts to 1331 at a principal of 1000 at 10% compounded annually . Find the time

$1331 = 1000[1.1]^n \rightarrow 1.1^n = 1.331 \rightarrow n = 3$ yrs

05. the population of a town increases every year by 2% of the population at the beginning of that year. The number of years by which the total increase of population be 40% is

$1.4P = P[1.02]^n \rightarrow 1.02^n = 1.4 \rightarrow n = 17$ yrs

06. annual birth and death rates per 1000 are 39.4 and 19.4 respectively . The number of years in which the population will be doubled assuming there is no immigration or emigration

NET Growth rate = 39.4 – 19.4 = 20 per thousand = 2/100 , i = 0.02

$2P = P[1.02]^n$ n = 35 years

07. In what time will 8000 amount to 8820 at 10% p.a. interest compounded half yearly

Since compounding is done semi annually , i = 0.05 , n – no. of half years

$8820 = 8000[1.05]^n$

$1.1025 = 1.05^n \rightarrow n = 2$ (HALF YEARS) = 1 yrs

08. 16000 invested at 10%p.a. compounded semi annually amounts to 18522 . Find the time period of investment

Since compounding is done semi annually , i = 0.05 , n – no of half years

$18522 = 16000[1.05]^n$

$1.157625 = 1.05^n \rightarrow n = 3$ (HALF YEARS) = 1 ½ yrs

09. In what time will ₹ 390625 amount to ₹ 456976 at 8% p.a. when the interest is compounded semi – annually

Since compounding is done semi annually , i = 0.04 , n – no. of half years

$456976 = 390625[1.04]^n$

$1.1699 = 1.04^n \rightarrow n = 4$ (HALF YEARS) = 2 yrs

10. In how many years a sum of money trebles at 5%p.a CI payable on half yearly basis

Since compounding is done HALF YEARLY , i = 0.025 , n – no. of half years

$3P = P[1.025]^n$

$3 = [1.025]^n$

$44 < n < 45$ HALF YEARS

$22 < n < 22.5$ YRS SELECT THE OPTION ACCORDINGLY

11. How long will 12000 take to amount to 14000 at 5% p.a. converted quarterly

Since compounding is done quarterly , i = 5%/4 = 1.25% , n – no of Quarters

$14000 = 12000[1.0125]^n$

$1.1667 = 1.0125^n$

12 Quarters $< n <$ 13 Quarters

3 years $< n <$ 3.25 years SELECT THE OPTION ACCORDINGLY

12. A machine is depreciated at the rate of 20% on reducing balance . The original cost of the machine was 1,00,000 and its ultimate scrap value was 30,000 . The effective life of the machine

$30000 = 100000[1-0.2]^n$

$0.8^n = 0.3$

5 years $< n <$ 6 years SELECT THE OPTION ACCORDINGLY

13. a machine depreciates at 10% of its value at the beginning of a year . The cost and scrap value realized at the time of sale being 23240 and 9000 respectively . For how many years the machine was put to use

$9000 = 23240[1-0.1]^n$

$0.9^n = 0.38726$

n = 9 years

14. a machine worth 4,90,740 depreciates at 15% on its opening value each year . When its value would reduce to 2,00,000
a) 4 yrs , 6 months b) 4 yrs , 7 months c) 4 yrs , 5 months d) 5 yrs , 7 months

$200000 = 490740[1-0.15]^n$

$0.85^n = 0.4075$

5 years $< n <$ 6 years OPTION d

15. a machine worth 4,90,740 depreciates at 15% on its opening value each year . When its value would reduce by 90%

a) 11 yrs , 6 months b) 11 yrs , 7 months c) 11 yrs , 8 months d) 14 yrs , 2 months

$49074 = 490740[1-0.15]^n$

$0.85^n = 0.1$

14 years < n < 15 years OPTION d

Q6

01. At what rate of CI will a sum of money become 16 times in four years if interest is calculated compounding annually

$16P = P[1+i]^4$

$2^4 = [1+i]^4$

$1+i = 2 \quad \therefore i = 1 \quad r = 100\%$ p.a.

02. Find the rate percent p.a. if 2,00,000 amount to 2,31,525 in 1 ½ year interest being compounded half yearly .

Since compounding is done semi annually , i = half yearly rate , n = 3

$231525 = 200000[1+i]^3$

$1.157625 = [1+i]^3.$

$1.05^3 = [1+i]^3.$ $1+i = 1.05$, $i = 0.05 = 5\%$ (HALF YEARLY RATE)

10% p.a.

Q7

01. Effective annual rate of interest compounding at nominal rate at 6% p.a. payable half yearly is

Since compounding is done semi annually , i = 3% , n = 2 (FOR ONE YEAR)

$E = (1+i)^n - 1 = (1.03)^2 - 1 = 0.0609 = 6.09\%$

02. Effective annual rate of interest compounding at nominal rate at 8% p.a. payable half yearly is

Since compounding is done semi annually , i = 4% , n = 2 (FOR ONE YEAR)

$E = (1+i)^n - 1 = (1.04)^2 - 1 = 0.0816 = 8.16\%$

03. Effective annual rate of interest of 6% p.a. converted Quarterly

Since compounding is done Quarterly , $i = {}^{6\%}/_4 = 1.5\%$, n = 4 (FOR ONE YEAR)

$E = (1+i)^n - 1 = (1.015)^4 - 1 = 0.0614 = 6.14\%$

04. Effective annual rate of interest of 7% p.a. converted Quarterly

Since compounding is done Quarterly , $i = {}^{7\%}/_4 = 1.75\%$, n = 4 (FOR ONE YEAR)

$E = (1+i)^n - 1 = (1.0175)^4 - 1 = 0.0718 = 7.18\%$

05. Effective annual rate of interest of 8% p.a. converted monthly

Since compounding is done monthly , $i = {}^{8\%}/_{12} = 0.67\%$, $n = 12$ (FOR ONE YEAR)

$E = (1+i)^n - 1 = (1.0067)^{12} - 1 = 0.0834 = 8.34\%$

06. Which is better investment

a) 9% p.a. compounded half yearly

b) 9.23%p.a. SI

Since compounding is done semi annually , $i = 4.5\%$, $n = 2$ (FOR ONE YEAR)

$E = (1+i)^n - 1 = (1.045)^2 - 1 = 0.0920 = 9.20\% < 9.23\%$p.a. SI

Hence OPTION (b) is better investment

07. Which is better investment

a) 3% p.a. compounded monthly

b) 3.2%p.a. SI

Since compounding is done monthly , $i = {}^{3\%}/_{12} = 0.25\%$, $n = 12$ (FOR ONE YEAR)

$E = (1+i)^n - 1 = (1.0025)^{12} - 1 = 0.0304 = 3.04\% < 3.2\%$p.a. SI

Hence OPTION (b) is better investment

ANNUITY

Q1 ACCUMULATED AMOUNT OF ANNUITY (A)

01. The amount of annuity of ₹ 2000 payable at the end of each year for 5 years 8%p.a.

P = 2000 , i = 8% , n = 5

$A = 2000\left[\frac{1.08^5-1}{0.08}\right] = 11733.20$

02. The future value of an annuity of ₹ 5000 is made annually for 8 years at interest rate of 9% compounded annually [$1.09^8 = 1.99256$]

P = 5000 , i = 9% , n = 8

$F.V. = 5000\left[\frac{1.09^8-1}{0.09}\right] = 55142.22$

03. The future value of an annuity of ₹ 1500 is made annually for 5 years at interest rate of 10% compounded annually

P = 1500 , i = 10% , n = 5

$F.V. = 1500\left[\frac{1.1^5-1}{0.10}\right] = 9157.65$

04. The future value of an annuity of ₹ 1000 is made annually for 5 years at interest rate of 14% compounded annually

P = 1000 , i = 14% , n = 5

$F.V. = 1000\left[\frac{1.14^5-1}{0.14}\right] = 6610.10$

05. Mr Bean deposits ₹ 25000 at the end of every year at 12% p.a. CI . What amount would he receive at the end of 10 years

P = 25000 , i = 12% , n = 10

$A = 25000\left[\frac{1.12^{10}-1}{0.12}\right] = 438718.38$

06. A person invests ₹ 500 at the end of each year with a bank which pays interest at 10% CI annually . The amount standing to his credit one year after he has made his yearly investment for the 12^{th} time

P = 500 , i = 10% , n = 12

amount at the end of 12^{th} year $A = 500\left[\frac{1.1^{12}-1}{0.1}\right] = 10,692.14$

Amount at the end of 13^{th} year = 10692.14 x(1.1) = 11,761.36

07. The amount of annuity of ₹ 6000 payable at the end of each 3 months for 4 years compounded Quarterly at 8%p.a.

P = 6000 , i = 2% , n = 16

$$A = 6000\left[\frac{1.02^{16}-1}{0.02}\right] = 111835.7$$

08. The value of amount at the end of 12 years of an annuity of ₹ 1200 payable at the BEGINNING of each year for 12 yrs at 8%p.a. CI

ANNUITY DUE / ANNUITY IMMEDIATE

P = 1200 , i = 8% , n = 12

$$A = 1200\left[\frac{1.08^{12}-1}{0.08}\right](1.08) = 24,594.35$$

09. Mr Piyush invest ₹ 10000 every year STARTING FROM TODAY for next 10 yrs rate of interest is 8% p.a. Find FV of annuity

ANNUITY DUE / ANNUITY IMMEDIATE

P = 10000 , i = 8% , n = 10

$$A = 10000\left[\frac{1.08^{10}-1}{0.08}\right](1.08) = 156,454.87$$

Q2 GIVEN ACCUMULATED AMOUNT OF ANNUITY (A) – FINDING THE INSTALMENT SIZE

01. How much amount is required to be invested every year as to accumulate ₹ 6,00,000 at the end of 10 years , if interest is compounded annually at 10% rate of interest
(GIVEN $(1.1)^{10} = 2.59374$)

A = 6,00,000 , i = 10% , n = 10

$$600000 = P\left[\frac{1.1^{10}-1}{0.1}\right] \qquad P = 37647.30 \approx 37,647$$

02. a company establishes a sinking fund to provide for the payment of ₹ 2,00,000 debt maturing in 20 years . Contributions to the fund are to be made at the end of every year . Find the amount of each annual deposit if interest is 5% p.a.

A = 2,00,000 , i = 5% , n = 20

$$200000 = P\left[\frac{1.05^{20}-1}{0.05}\right] \qquad P = 6048.52 \approx 6049$$

03. A company requires ₹ 20,00,000 at the end of 10 yrs to replace one of its assets . It is decided to create a sinking fund by investing a fixed amount every year in securities which gives 10% CI . Yearly investment is

A = 20,00,000 , i = 10% , n = 10

$$2000000 = P\left[\frac{1.1^{10}-1}{0.1}\right] \qquad P = 125,490.79$$

04. a sinking fund is created for redeeming debentures worth ₹ 5 lacs at the end of 25 years . How much provision needs to be made out of profits each year provided the sinking fund investments can earn interest at 4% p.a.

A = 5,00,000 , i = 4% , n = 25

$500000 = P\left[\frac{1.04^{25}-1}{0.04}\right]$ P = 12,006

05. A company issued 10% cumulative debentures of ₹ 100 each , 5000 cumulative debentures are to be redeemed with 10% of interest for 5 yrs . For this a sinking fund is created and invested at 12% rate of CI . Sum to be transferred every year to sinking fund is

Amount to be paid on redemption of debentures

$A = 5000 \times 100 \times (1.1)^5 = 805255$

A = 805255 , i = 12% , n = 5

$805255 = P\left[\frac{1.12^{5}-1}{0.11}\right]$ P = 1,26,755

06. A machine costing ₹ 5,20,000 with an estimated life of 25 years . A sinking fund is created to replace it by new model at 25% higher cost after 25 years with a scrap value realization of ₹ 25000 . What amount should be set aside every year if sinking fund investment at 3.5% CI p.a.

Amount required at the end of 25 years

A = 520000 + 25% – 25000 = 6,25,000

A = 625000 , i = 3.5% , n = 25

$625000 = P\left[\frac{1.035^{25}-1}{0.035}\right]$ P = 16,046.27 CHECK FOR NEAREST OPTION

07. Mr Yash wants ₹ 10,00,000 at the end of 5 yrs It opens recurring account with the post office at 10%p.a CI monthly . What money should be deposited at the end of every month ?

A = 10,00,000 , i = 10/12 = 0.83% , n = 5 x 12 = 60

$1000000 = P\left[\frac{1.0083^{60}-1}{0.0083}\right]$ P = 12,927.37 CHECK FOR NEAREST OPTION

08. Ratan aged 45 wishes his wife Ratna to have 40 lacs at his death . His expectation of life is another 30 years and he starts making equal annual investments COMMENCING NOW at 3% p.a . How much should he invest annually

ANNUITY DUE / ANNUITY IMMEDIATE

A = 40,00,000 , i = 3% , n = 30

$4000000 = P\left[\frac{1.03^{30}-1}{0.03}\right](1.03)$ P = 81,628.20

Q3 PRESENT VALUE OF ANNUITY (V)

01. The present value of an annuity of ₹ 3000 for 15 years at 4.5%p.a. CI is [$1.045^{15} = 1.935282$]

$$V = 3000\left[\frac{1-1.045^{-15}}{0.045}\right] = 32{,}218.63$$

02. The present value of an annuity of ₹ 5000 per annum for 12 years at 4%p.a. CI

$$V = 5000\left[\frac{1-1.04^{-12}}{0.04}\right] = 46{,}925.36$$

03. The present value of an annuity of ₹ 1000 payable at the end of each year for 10 years at 6%p.a. compounding annually [$1.06^{-10} = 0.5584$]

$$V = 1000\left[\frac{1-1.06^{-10}}{0.06}\right] = 7360$$

04. Present value of annuity which pays ₹ 200 at the end of each 3 months for 10 years , assuming money to be worth 5% p.a. converted quarterly

Since quarterly , P = 200 , i = 1.25% , n = 4 x 10 = 40 quarters

$$V = 200\left[\frac{1-1.0125^{-40}}{0.0125}\right] = 6265.38$$

05. Pravin buys a house paying ₹ 50,000 in cash and balance in 20 installments of 8000 each at the end of each year . If interest is at 16% p.a. how much he should have paid if had purchased it cash down

Present value of annuity V = Loan amount borrowed

Down payment 50,000 + V = Present Price of the house

$$V = 8000\left[\frac{1-1.16^{-20}}{0.16}\right] = 47{,}430 \quad , \quad \text{Price of house} = 50000 + 47430 = 97430$$

06. A person bought a house paying ₹ 20,000 cash down and ₹ 4000 at the end of each year for 25 years at 5% p.a. CI . The cash down price is

Loan amount =

$$V = 4000\left[\frac{1-1.05^{-25}}{0.05}\right] = 56{,}375.8 \quad , \quad \text{Price of house} = 20000 + 56{,}376 = 76{,}376$$

07. a car is purchased for ₹ 1,00,000 down payment and an instalment of ₹ 6500 per month for 3 years . If rate of interest is 15% p.a. compound monthly , cash price is

Present value of annuity V = Loan amount borrowed

Loan amount borrowed + down payment = cash price of car

Since monthly repayment , P = 6500, i = 15/12 = 1.25% , n = 3 x 12 = 36 months

$$V = 6500\left[\frac{1-1.0125^{-36}}{0.0125}\right] = 187507.23 \approx 187507$$

Cash price of car (Present price) = 1,00,000 + 187507 = 287507

08. A person retires at 60 years receiving a pension of ₹ 14400 a year paid in half yearly instalments for the rest of his life with his expectation to be 13 years and interest at 4% p.a. payable half yearly . What single sum is equivalent to his pension ?

PENSION OPTIONS :

OPTION 1 - ON RETIREMENT , PERSON RECEIVES 7200 EVERY 6 MONTHS FOR NEXT 13 YEARS

OPTION 2 - SINGLE PAYMENT AT RETIREMENT EQUIVALENT TO ABOVE PENSION
= PRESENT VALUE OF ANNUITY OF 7200 EVERY 6 MONTHS FOR 13 YEARS @ 4%P.A.

Since pension recvd is half yearly , P= 7200 , i = 2% , n = 2 x13 = 26

$$V = 7200\left[\frac{1-1.02^{-26}}{0.02}\right] = 144871.45$$

CHECK FOR NEAREST OPTION

Q4 PRESENT VALUE OF ANNUITY – FIND THE INSTALMENT SIZE

01. A loan of ₹ 30,000 at the interest rate of 6% compounded annually is to be amortized by equal payments at the end of each year for 5 years . The annual payment

$$30000 = P\left[\frac{1-1.06^{-5}}{0.06}\right] \qquad P = 7121.89$$

02. A loan of ₹ 10,000 is to be paid back in 30 equal instalments . The amount of each installment to cover the principal and at 4% p.a. CI is

$$10000 = P\left[\frac{1-1.04^{-30}}{0.04}\right] \qquad P = 578.30$$

03. a man purchased house valued at ₹ 3,00,000 by making a payment of ₹ 2,00,000 at the time of purchase and agreed to pay balance with interest at 12% p.a. compounded half yearly in 20 equal half yearly instalments . If first installment is paid after 6 months from the date of purchase then amount of each instalment is

Loan amount V = 1,00,000 , since instalments are paid half yearly i = 6%

$$100000 = P\left[\frac{1-1.06^{-20}}{0.06}\right] \qquad P = 8718.45$$

04. Vipul purchases a car for ₹ 5,50,000 . He gets a loan of ₹ 5,00,000 at 15% p.a. from a bank and balance ₹ 50,000 he pays at the time of purchase . He has to pay the whole amount of loan in 12 monthly instalments with interest starting from end of the first month . The money he has to pay at the end of every month [Given $1.0125^{12} = 1.16075452$]

Loan amount V = 1,00,000 , since instalments are paid monthly i = 15/12% = 1.25%

$$500000 = P\left[\frac{1-1.0125^{-12}}{0.0125}\right] \qquad P = 45{,}129.15$$

CHOOSE THE NEAREST OPTION

05. Mr Paul borrows ₹ 20,000 on condition to repay it with CI at 5% p.a. in annual instalments of 2000 each . The number of years for the debt to be paid off is

a. 10 years b. 12 years c. 11 years d. 14.2 years

$$20000 = 2000\left[\frac{1 - 1.05^{-n}}{0.05}\right] \rightarrow \quad 1.05^{-n} = 0.5$$

$$1.05^{n} = 2$$

$$14 < n < 15 \qquad n = 14.2 \text{ years}$$

Q5

LEASING -

ITS AN ARRANGEMENT UNDER WHICH OWNER OF ASSET (LESSOR) ALLOWS THE USER OF THE ASSET (LESSEE) TO USE THE ASSET FOR A DEFINED PERIOD OF TIME (LEASE PERIOD) BY PAYING FIXED RENT (LEASE RENTAL) OVER A GIVEN PERIOD OF TIME

CAPITAL EXPENDITURE (INVETMENT DECISION)

CAPITAL EXPENDITURE MEANS PURCHASING AN ASSET (WHICH RESULTS IN CASH OUTFLOW) TODAY IN ANTICIPATION OF BENEFITS (CASH INFLOW) EXAMPLE – LEASING AN ASSET ON RENT . IF THE PRESENT VALUE OF CASH INFLOWS IS GREATER THAN PRESENT VALUE OF CASH OUTFLOWS , DECISION SHOULD BE IN THE FAVOUR OF INVESTMENT

01. a company considering a proposal of purchasing a machine either by making a full payment of ₹ 4000 or by leasing it for four years at an annual rate of ₹ 1250 . Which course of action is preferable , if the company can borrow money at 14% compounded annually [$1.14^4 = 1.68896$]

OPTION 1 - Leasing a machine for 4 years @ 1250 p.a

Present value of rental outflows

$$V = 1250\left[\frac{1 - 1.14^{-4}}{0.14}\right] = 3642.14$$

OPTION 2 - Purchasing val. of m/c = ₹ 4000 ,

SINCE THE TOTAL PRESENT VALUE OF ALL THE FUTURE RENTAL OUTFLOWS IS LESS THAN THE PURCHASE VALUE OF M/C , LEASING THE M/c IS PREFERABLE

02. a company may obtain a machine either by leasing it for 5 years (USEFUL LIFE) at an annual rent of ₹ 2000 or by purchasing the machine for ₹ 8100 . If the company can borrow money at 18% p.a. , which alternative is preferable

OPTION 1 - Leasing a machine for 5 years @ annual rent of ₹ 2000

Present value of rental outflows

$$V = 2000\left[\frac{1 - 1.18^{-5}}{0.18}\right] = 6254.34$$

OPTION 2 - Purchasing val. of m/c = ₹ 8100 ,

SINCE PRESENT VALUE OF ALL THE FUTURE RENTAL OUFLOWS IS LESS THAN PURCHASE VALUE OF MACHINE , LEASING THE M/C IS PREFERABLE

03. A person wants to lease out a machine costing 5,00,000 for a 10 year period . It has a fixed rental of 51,272 per annum payable annually starting from the end of first year . Suppose the rate of interest is 10% p.a. compounded annually on which money can be invested . To whom the agreement is favorable – LESSEE OR LESSOR

Present value of rental inflows $V = 51272\left[\frac{1 - 1.1^{-10}}{0.1}\right] = 3,15,044$

Purchase val. of machine = ₹ 5,00,000

AGREEMENT IS NOT FAVORABLE TO LESSOR . SINCE ALL THE RENTAL INFLOWS WHEN DISCOUNTED TO PRESENT DATE SUMED UP TO ₹ 3,15,044 WHICH IS FAR LESS THAN THE PURCHASE VALUE OF M/C ₹ 5,00,000 .

KHADE KHADE AAJ HI LESSOR KO ≈ 1,75,000 KA CHUNA LAG GAYA

AGREEMENT IS FAVORABLE TO LESSEE . SINCE ALL THE RENTAL OUTFLOWS WHEN DISCOUNTED TO PRESENT DATE SUMED UP TO ₹ 3,15,044 WHICH IS FAR LESS THAN THE PURCHASE VALUE OF M/C ₹ 5,00,000 . LESSEE SAYS TO HIMSELF "THEN WHY BUY , JUST LEASE IT – SASTA MEIN NIPTAO"

LESSEE KA FAIDA , LESSOR KO NUKSAAN

04. ABC ltd wants to lease out an asset costing ₹ 360,000 for a 5 year period . It has a fixed rental of ₹ 1,15,000 per annum payable annually starting from the end of first year . Suppose rate of interest is 14% per annum compounded annually on which money can be invested by the company . Is this agreement favorable to the company .?

Present value of rental inflows $V = 1,15,000\left[\frac{1 - 1.14^{-5}}{0.14}\right] = 3,94,804.31$

Purchase val. of machine = ₹ 3,60,000

AGREEMENT IS FAVORABLE TO LESSOR . SINCE PRESENT VALUE OF CASH INFLOWS WHEN DISCOUNTED TO PRESENT DATE SUMED UP TO ₹ 3,94,804 WHICH IS MORE THAN THE PURCHASE VALUE OF M/C ₹ 3,60,000 (CASH OUTFLOW) ….. STRAIGHT PROFIT OF 394804 – 360,000 = 34804 AT THE TIME OF PURCHASE OF M/C

05. A machine can be purchased for ₹ 50,000 . Machine will contribute 12000 per year for the next five years . Assume borrowing cost is 10% per annum compounded annually . Determine whether machine should be purchased or not

Present value of annual contribution $V = 12000\left[\frac{1 - 1.1^{-5}}{0.1}\right] = 45{,}489.44$

Purchase val. of machine = ₹ 50,000

PRESENT VALUE OF TOTAL PROFITS CONTRIBUTED BY THE MACHINE IS LESS THAN THE PURCHASE VALUE OF THE MACHINE AND HENCE MACHINE SHOULD NOT BE PURCHASED

IN SHORT – PURCHASE OF MACHINE WILL STRAIGHT BOOK A LOSS OF 50000 – 45490 = 4510 TODAY

06. A machine with a useful life of seven years cost ₹ 10,000 while another machine with useful life of 5 years cost ₹ 8000. The first machine saves labour expenses of ₹ 1900 annually and the second machine saves labour expenses of ₹ 2200 annually . Determine the preferred course of action . Assume cost of borrowing at 10% compounded per annum

MACHINE 1

Present value of annual savings made in 7 years $V = 1900\left[\frac{1 - 1.1^{-7}}{0.1}\right] = 9250 < 10000$ (COST OF M/c)

NET LOSS = 750

MACHINE 2

Present value of annual savings made in 5 years $V = 2200\left[\frac{1 - 1.1^{-5}}{0.1}\right] = 8340 > 8000$ (COST OF M/c)

NET GAIN = 340

HENCE 2ND MACHINE IS PREFERABLE

PERPETUITY -

PERPETUITY IS AN ANNUITY IN WHICH THE PERIODIC PAYMENTS OR RECIEPTS BEGIN ON A FIXED DATE AND CONTINUE INDEFINITELY OR PERPETUALLY . FIXED COUPON PAYMENTS ON PERMANENTLY INVESTED SUM OF MONEY

PRESENT VALUE OF PERPETUITY (ANNUITY INFINITE)

$$PVA_\infty = \frac{R}{1+i} + \frac{R}{(1+i)^2} + \frac{R}{(1+i)^3} + \ldots\ldots \infty = \frac{R/_{1+i}}{1-\frac{1}{1+i}} = \frac{R}{i}$$

FOR AN INFINITE GP

$S_\infty = \frac{a}{1-r}$

GROWING PERPETUITY

RECEIPTS / CASH INFLOWS MUST GROW AT CONSTANT RATE .

LETS UNDERSTAND

EXAMPLE – ASSUMING GROWTH RATE 5% AND FIRST RECEIPT (CASH INFLOW) R = 100 ,

CASH INFLOWS AT THE END OF

1ST YEAR	=	100		
2ND YEAR	=	100(1.05)	=	105
3RD YEAR	=	$100(1.05)^2$	=	110.25
4TH YEAR	=	$100(1.05)^3$	=	115.7625 ……∞

PRESENT VALUE OF GROWING PERPETUITY (ANNUITY INFINITE)

LET i = DISCOUNT RATE , g = GROWTH RATE

$$PVA_\infty = \frac{R}{1+i} + \frac{R(1+g)}{(1+i)^2} + \frac{R(1+g)^2}{(1+i)^3} + \ldots\ldots \infty = \frac{R/_{1+i}}{1-\frac{1+g}{1+i}} = \frac{R}{i-g}$$

FOR AN INFINITE GP

$S_\infty = \frac{a}{1-r}$

01. P.V. of an annuity of ₹ 80 made at the end of each 6 months forever , if money worth 4% p.a is compounded semi- annually

Since cash flow = 80 at end of every 6 months , i = 4%/2 = 2%= 0.02

$$PVA_\infty = \frac{R}{i} = \frac{80}{0.02} = 4000$$

02. A person desires to create a fund to be invested at 10% CI per annum to provide a prize of ₹ 300 every year . Find the deposit the person has to make today

$$PVA_\infty = \frac{R}{i} = \frac{300}{0.1} = 3000$$

03. John wants to create a fund to donate ₹ 1800 every month to a deprived family . Rate of interest being 12% p.a. , find amount to be deposited

Since receipts R = 1800 are received every month , i = $^{12\%}/_{12}$ = 1% = 0.01

$$PVA_\infty = \frac{R}{i} = \frac{1800}{0.01} = 180000$$

04. Determine the present value of perpetuity of ₹ 50,000 per month @ rate of interest 12% p.a. is

Since receipts are made monthly , i = $^{12\%}/_{12}$ = 1% = 0.01

$$PVA_\infty = \frac{R}{i} = \frac{50000}{0.01} = 50,00,000$$

05. Ramesh wants to retire and receive ₹ 3000 a month . He wants to pass this monthly payments to future generations after his death . He can earn an interest of 8% compounded annually . How much will he need to deposit today to start receiving the above starting from the end of first month . Also do find the deposit amount if Ramesh wants the payments to start immediately

Since receipts are made monthly , $i = {}^{8\%}/_{12} = 0.667\% = 0.00667$

$$PVA_\infty = \frac{R}{i} = \frac{3000}{0.00667} = 4,49,775$$

If Ramesh wants payments to start today

$PVA_\infty = 4,49,775 + 3000 = 4,52,775$

The extra 3000 deposit will provide the immediate payment of 3000 and rest 4,49,775 will take care of future 3000 payments

06. If the discount rate is 7% p.a , how much would you pay to receive ₹ 500 growing at 5% annually forever

$$PVA_\infty = \frac{R}{i-g} = \frac{500}{0.07-0.05} = 25000$$