एकाइ (Unit): 4

जनसङ्ख्या बृद्धि र मिश्रहास

Population Growth and Compound Depreciation

4.1 जनसंख्या बृद्धि (Population Growth)

केही महत्वपूर्ण सूत्रहरू (Some Important Formulae)

- यदि शुरुको जनसंख्या (P_0) जनसंख्या वृद्धिदर = R%
  समय = T वर्ष, T वर्ष पछिको जनसंख्या = P_t भए
  If initial population = P_0
  population growth rate = R%
  Time = T years and Total population after T years = P_T

  $$\therefore \quad P_T = P_0\left(1+\frac{R}{100}\right)^T$$

  Increase population (P) = $P_T - P_0 = P\left[\left(1+\frac{R}{100}\right)^T - 1\right]$

- यदि कोरा जन्मदर = R_1% र कोरामृत्युदर = R_2%
  र जनसंख्या वृद्धिदर = R% भए R% = R_2% – R_2%
  If crude birth rate = R_1%, crude deathrate = R_1%
  and population Growth rate = R%
  Population growth rate (R%) = R_1% – R_2% (R_1% > R_2%)

  यदि शुरुको जनसंख्या = P_0 समय = T वर्ष वृद्धि दर = R%, T वर्षपछि मृत्यु भएको संख्या = D^T वर्ष पछि वसाई सराईबाट प्रवेश संख्या M_{in} T वर्ष पछि बसाई सराई बाट अन्यत्र गएको संख्या = M_{out} र T वर्ष पछिको जनसंख्या = P_T भए
  If initial population = p_0 Time = T years, growth rate = R% No. of death ager at years = D No. of migrateentered after T years = M_{in} No. of rate left after T years = M_{out} total population at the end of T years = P_T

  $$\therefore \quad P_T = P_0\left(1+\frac{R}{100}\right)^T + M_{in} - M_{out} - D$$

- यदि पहिलो तीन वर्षको जनसंख्या वृद्धिदर क्रमश R_1%, R_2% र R_3% भए
  If the growth rate of the population fore, first three years be R_1% R_2% and R_3%

  $$\therefore \quad P_T = P_0\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right)$$

- यदि R% प्रतिवर्ष घट्दो दर भए T वर्षपछि जनसंख्या = P_T भए
  If R% be the constant decrease in population per annum then total population of after T years.

  $$\therefore \quad P_T = P_0\left(1-\frac{R}{100}\right)^T$$

Very Short Questions

1. कुनै शहरको हालको जनसंख्या P छ । यदि प्रत्येक वर्ष जनसंख्या R% ले वृद्धिहुन्छ भने T वर्ष पछिको जनसंख्या कतिहोला ?
   The present population of a town is p. of the population increased by R% every ejear, what will be the population of the town after 7 yrs, Write it.

2. कुनै एउटा गाउँको जनसंख्या एकवर्ष पलि 5400 थियो । त्यहाँको जनसंख्या वृद्धिदर 2.5% छ भने हालको जनसंख्या निकाल्नुहोस् ।
   The population of a village was 5000 one year ago. If the population growth rate of the village is 2.5% find the population at present. (Ans:25535

3. कुनै गाउँको एक वर्ष पहिले को जनसंख्या कति थियो होला ? यदि जनसंख्यावृद्धि दर 30% को दरले अहिलेको जनसंख्या 7217 हुन्छ ।
   What was the for population fo a village one year ago. If the population gowth rate 3.1% of the village the present population is 7217. (Ans: 7000)
4. एउटा टोलको जनसंख्या 2000 थियो एक वर्ष भित्र 3% जन्मदरको कारण वृद्धि र 2% स्थानान्तरणबाट टोलमा थपिए भने सो टोलको जनसंख्या कति पुग्यो होला ?
   The population of a fole was 2000 within a year the population is increased 3% by birthrate and 2% by miagratia, how much population was there now. (Ans: 2100)
5. कुनै गाउँको जनसंख्या एकवर्ष पहिले 10,000 थियो । अहिलेको जनसंख्या 10210 छ भने जनसंख्या वृद्धिदर निकाल्नुहोस् ।
   The population of a village was 10,000 are year ago. The population at present is 10210 find the population growth rate. (Ans: 2%)
6. कुनै एउटा गाउँको कुल जनसंख्या 7200 थियो । एकवर्ष भित्र कुलजनसंख्या 5% वसाई सराई र 2% विविध कारण ले मृत्यु भएको थियो भने एकवर्ष पछिको जनसंख्या कति होला ?
   The population of a village was 7200. 5% of the population was migrated and 2% died due to different cases with in agear what would be the population of the village after a year ? (Ans: 6696)

Short Questions

Model 1

एउटा शहरको अहिलेको जनसंख्या 1,70,000 छ । यदि यो वार्षिक 2% का दरले वढ्छ भने 2 वर्ष पछिको जनसंख्या पत्ता लगाउनुहोस् ।

The population of a city at present is, 170,000 and its grows at the rate of 2% per year what will be the population after 2 years.

Solution:

Here, The present population of city (P_0) = 170,000
Rate of growth (R) = 2%
Time (T) = 2 years

$\therefore \quad P_T = P_0\left(1+\frac{R}{100}\right)^T$

or, $P_2 = 170{,}000\left(1+\frac{R}{100}\right)^2$

or, $P_2 = 1{,}70{,}000\ (1 + 0.02)2$
or, $P_2 = 1{,}70{,}000\ (1.002)2$
or, $P_2\ 1{,}70{,}000 \times 1.0404$
$\therefore \quad P_2 = 176868$
$\therefore$ After 2 years total population of city (P_2) = 176868

Model 2:

एउटा गाउँको अहिलेको जनसंख्या 10,816 छ । यदि वार्षिक वृद्धिदर 4% भए उक्त गाउँको 2 वर्ष अगाडिको जनसंख्या पत्ता लगाउनुहोस् ।

The present population of a village is 10836 if the annual growth rate 4%, find the population of the village 2 years before.

Solution:

Here, the present population of village (P_2) = 10816

Rate of growth (R%) = 4
Time (T) = 2 years
after 2 years ago, the population of village (p_0) = ?

$\therefore \quad P_T = P_0\left(1\frac{R}{100}\right)^T$

or, $P_2 = P_0\left(1+\frac{21}{100}\right)^2$

or, $10816 = P_0\,(1+0.04)^2$

or, $10816 = P_0 \times (1.04)^2$

or, $10816 = P_0\,1.0816$

$\therefore \quad P_0 = \frac{10816}{1.0816} = 10{,}000$

2 years ago the total population of a village (P_0) = 10,000

Model 3:

एउटा शहरको जनसंख्या 80,000 छ । यदि जनसंख्या वृद्धिदरको कारणले 2% र अन्यत्रबाट बसाई सराई गरी यहाँ आएको कारण 3% को दरले जनसंख्या वृद्धि हुँदा 2 वर्ष पछि उक्त शहरको जनसंख्या पत्ता लगाउनुहोस् ।

The present population of a town is 80,000 if the population increase 2% by birth and 3% by migration. What will be the population of the town after 2 years.

Solution:

Here, the present population of city (P_0) = 80,000
Rate of birth (R_1) = 2% and Rate of miagration (R_2) = 3%
Rate of growth (R%) = $R_1\% + R_2\%$
= 2% + 3% = 5%
Time (T) = 2years

$\therefore \quad P_T = P_0\left(1+\frac{R}{100}\right)^T$

or, $P_2 = 80{,}000\left(1+\frac{5}{100}\right)^2$

or, $P_2 = 80{,}000\,(1+0.05)^2$

or, $P_2 = 80{,}000\,(1.05)2$

or, $P_2 = 80{,}000 \times 1.1025$

$\therefore \quad P_2 = 88200$

After 2 years the total population of city (P_2) = 88200

Model 4:

वि.स. 2067 र वि.स. 2069 मा एउटा शहरको जनसंख्या क्रमश 40,000 र 44100 थियो भने वार्षिक जनसंख्या वृद्धिदर निकाल्नुहोस् ।

In 2067 and in 2069 BS the population of a town was 40,000 and 44100 respectively find the annual population growth rate.

Solution:

Here, In BS 2067 population town (p_0) = 40,000
Difference time(T) = (2069 – 2067)
= 2 years
In BS 2069 population of a town (p_2) = 44100
Rate of gwoth (R) = ?

$\therefore \quad P_T = P_0\left(1+\frac{R}{100}\right)^T$

or, $P_2 = 40{,}000\left(1+\frac{R}{100}\right)^2$

or, $44100 = 40{,}000\left(1+\frac{R}{100}\right)^2$

or, $\frac{44100}{40,000} = \left(1 + \frac{R}{100}\right)^2$

or, $1.1025 = \left(1 + \frac{R}{100}\right)$

or, $(1.05) = \left(1 + \frac{R}{100}\right)^T$

or, $1.05 = 1 + \frac{R}{100}$

or, $(1.05 - 1) = \frac{R}{100}$

or, $0.05 \times 100 = R$

$\therefore$ $R = 5\%$

Rate growth (R%) = 5%

Model 5

40,000 जनसंख्या भएको एउटा शहरको जनसंख्या वृद्धिदर 4% प्रतिवर्ष छ भने कति वर्षमा उक्त शहरको जनसंख्या बडेर 43264 पुग्ला ? पत्ता लगाउनुहोस् ।

The population of town is 40,000 and the population growth rate is 4% peryear. in how many years will be population of the town be 43264.

Soltuion:

Here, the present population town (p_0) = 40,000

Rate of growth (R) = 4%

Let the time be T years

after T years the population of town (P_T) = 43264

$\therefore$ $P_T = P_0 \left(1 + \frac{R}{100}\right)^T$

or, $P_T = 40,000 \left(1 + \frac{4}{100}\right)^T$

or, $43264 = 40,000\ (1 + 0.04)^T$

or, $\frac{43264}{40,000} = (1.04)^T$

or, $1.0816 = (1.04)^T$

or, $(1.04)2 = (1.04)^T$

$\therefore$ T =2 years.

The required time (T) = 2 years

Model 6:

एउटा शहरको हालको जनसंख्या 125000 छ । 2 वर्ष पछिको जनसंख्या निकाल्नुहोस् । यदि पहिलो वर्ष र दोस्रो वर्षको जनसंख्या वृद्धिदर क्रमश 4% र 5% छ ।

The present population of a town is 125000 find the population after 2 years of the the rate of increase for the two years are 4% ad 5% repectively.

Soltuion:

Here, the present population of town (P_0) = Rs 125000

For two yrs Rate of first year (R_1) = 4%

Rate of 2nd year (R_2) = 5%

After two years total population (P_2) = ?

$\therefore$ $P_T = P \left(1 + \frac{R_1}{100}\right) \left(1 + \frac{R_2}{100}\right)$

or, $P_2 = 125000 \left(1 + \frac{4}{100}\right) \left(1 + \frac{5}{100}\right)$

or, $P_2 = 125000\ (1 + 0.04)\ (1 + 0.05)$

or, $P_2 = 125000 \times (1.04) \times (1.05)$

$\therefore$ $P_2 = 136500$

$\therefore$ After two years total population of town is 136500

Practice Yourself

1. 2 वर्ष पहिलेको एउटा गाउँको जनसंख्या 16000 थियो । उक्त गाउँको जनसंख्या वृद्धिदर 5% छ भने अहिलेको जनसंख्या कति होला ?
   2 yres ago, the population of a village was 6000, the rate of population of that village is 5% what is the population at present. **(Ans:17640)**
2. कुनै शहरको अहिलेको जनसंख्या 1,05840 छ । यदि प्रत्येक वर्ष जनसंख्या 5% ले बढ्छ, भने 2 वर्ष अगाडिको सो शहरको जनसंख्या कति थियो होला ? पत्ता लगाउनुहोस् ।
   If the present poplation of city is 1,05840. If the population uncrease every year by 5% find what was the population of city bofer 2 yrs. **(Ans: 17640)**
3. एउटा गाउँको जनसंख्या 20,000 थियो । 2 वर्ष भित्र 3% जन्मको कारणले र 2% अत्यन्त्र बाट बसाई सराई गरी यहाँ आएको कारणले जनसंख्या वृद्धि हुन्छ भने 2 वर्ष पछिको जनसंख्या कति पुग्ला ? पत्ता लगाउनुहोस् ।
   The population of a village was 20,000 with in 2 years the population is increased 3% by birth rate and 2% by inmigration. What will be population of town after 2 yrs. Find it. **(Ans: 2250)**
4. 2 वर्ष अगाडि एउटा शहरको जनसंख्या 60,000 थियो । यदि अहिले सो शहरको जनसंख्या 66150 पुग्छ भने वार्षिक वृद्धिदर निकाल्नु होस्।
   Two years ago the population of a town was 60,000 now it becomes 66150. find the growth rate per year. **(Ans: 10%)**
5. कति वर्षमा 5% वार्षिक वृद्धिदरले एउटा गाउँको जनसंख्या 80,000 बढेर 12610 पुग्ला ?
   In how many yrs will be population of a village be 92610 from 80,000 at the growth rate of 5%. **(Ans: 3 yrs)**
6. एउटा विद्यालयको हालको विद्यार्थी संख्या 2000 छ । यदि हरेक 4 जना विद्यार्थीले 1 जना नयाँ विद्यार्थी रहेक वर्ष ल्याए भने 2 वर्ष पछि बढ्ने विद्यार्थीको संख्या पत्ता लगाउनुहोस्।
   The present number of students of students of achool as 1000. If per 4 studntts carry 1 new student per year, find the number of students increased after 2 yrs. **(Ans: 125)**
7. यदि एउटा गाउँ जनसख्या 2 वर्षको अवधिमा 4 गुणा हुन्छ भने प्रति वर्ष जनसंख्या वृद्धिदर कति होला ?
   If the population avillage becomes 4 times in a period of 2 yrs what is the growth rate of population per year. **(Ans: 10%)**
8. शहरतिरको वसाई सराईले गर्दा एउटा गाउँको जनसंख्या प्रति वर्ष 4% ले घट्दै गयो गएछ । यदि अहिले जनसंख्या 5760 रहेछ भने 2 बर्ष पहिले जनसंख्या कति रहेछ ? पत्ता लगानउहोस् ।
   Due to migration to cities, the population of a village decrease at the rate of 4% per annum. If its present population is 5760 what it was 2 yrs ago ? Find its. **(Ans: 6250**
9. एउटा शहरको जनसंख्या 640000 छ । यदि वार्षिक जन्मदर 10.7% र वार्षिक मृत्युदर 3.2% रहेछ भने 3 वर्ष पछिको जनसंख्या पत्ता लगाउनुहोस् ।The presentpopulation of a town 640000. If the annual birth rate is 10.7% and its annual death rate is 3.2% . Calculate the population after 3 years. **(Ans: 795070)**

Long Questions

Model 1:

एउटा शहरको जनसंख्या प्रत्येक 10% दरले बढ्दैजान्छ । यदि दुई वर्ष पछिको अन्त्यमा सो शहरको जनसंख्या 30000 पुगेको थियो । यदि सो संख्यामा 5800 जना अन्तिममा बसाई सराइको थपिएमा थिए भने शुरुको जनसंख्या कति थियो ?

Solution:

Here, Growth rate (R) = 10% per year Time (T) = 2 yrs

After 2 yrs total population = 30,000

Now, according to the question

After two yrs Total population (P_2) = (30,000 – 5800) = 24200

$\therefore \quad P_T = P_0\left(1+\frac{R}{100}\right)^T$

or, $\quad P_2 = P_0\left(1+\frac{10}{100}\right)^T$

or, $\quad \text{Rs } 24200 = P_0 (1 + 0.1)^2$

or, $\quad \text{Rs } 24300 = P_0 (1.1)^2$

or, $\quad 24200 = 1.0 \times 1.21$

$\therefore \quad P_0 = \frac{\text{Rs } 24200}{1.21} = 20{,}000$

$\therefore$ 2 yrs ago total population (P_0) = 20,000

Model 2:

वि.सं. 2065 को शुरुमा एउटा शहरकै जनसंख्या1,00,000 थियो । जनसंख्या वृद्धिदर वर्षेनि 2% छ । वि.स. 2066 सालको सुरुमा 8000 जना अन्यन्त्र ठाउँबाट त्यहाँ बसाई सराई गरेर आए भने वि.सं. 2068 को शुरुमा सो शहरको जनसंख्या कति पुग्ला ?

In the beginning of 2065 BS the population of a town was 100,020 and the rate ofpopulation growth is 2% every year. If in the beginning of 2066 BS 8000 people migrated there from different places. What will be the population of the town in the beginning of 2068 B.S.

Solution:

Here, In 2065BS

Total population town (P_0) = 1,00000

Rate of growth (R) = 2% = every year

Time (T) = (2066 – 2065) = 1 years

After 1 year total population (P_1) = 1,00000 + 2% of 1,00,000

$= 1{,}00000 + \frac{2}{100} \times 1{,}00{,}000$

$= 1{,}00000 + 2000$

$= 10{,}2000$

According to the question

In 2066 BS total population (P_0) $= 10{,}2000 + 8000$

$= 1{,}40{,}000$

Rate of growth (R) = 2%

Time (T) = 2068 – 2066 = 2 yrs

After 2 yrs total population = (p_2) = ?

$\therefore \quad P_T = P_0\left(1+\frac{R}{100}\right)^T$

or, $\quad P_2 = 1{,}00{,}000\left(1+\frac{2}{100}\right)^2$

or, $\quad P_2 = 1{,}10{,}000\ (1 + 0.02)^2$

or, $\quad P_2 = 1{,}10{,}000 \times (1.02)^2$

or, $\quad P_2 = 1{,}10{,}000 \times 1.0404$

$\therefore \quad P_2 = 11{,}4444$

After 2 yrs total population (p_2) = 11,4444

Model 3:

3 वर्ष पहिले एउटा गाउँको जनसंख्या 25000 थियो । प्रत्येक वर्ष जनसंख्या 3% बढ्दै जान्छ । एकवर्ष पहिले 500 जना एउटा महामारी रोगले मर्छन् । अहिले गाउँको जनसंख्या कति होला ?

3 yrs ago, the population of a village was 25000. The rate growth of population is 3% are year ago 500 people died of epidamic disease. What is the present population of the village ?

Solution:

Here, Time (T) = 3 yrs

Total population (P_0) = 25000, Rate of growth (R)= 3%

According to the question.

Time (T) = 2 yrs

After 2 yrs total population (P_2) = ?

$\therefore \quad P_T = P_0\left(1+\frac{R}{100}\right)^T$

$P_2 = 25000\left(1+\frac{3}{100}\right)^2 = 25000 \times (1+0.03) = 25000 \times (1.05)^2 = 25000 \times 1.0609 = 26523$

After two yrs total population (P_2) = 26523

remaning time (T) = 1 year

Growth rate ® = 3%

$P_T = P_0\left(1+\frac{R}{100}\right)^T$

or, $P_1 = \left(1+\frac{3}{100}\right)^1 = 26023 \times \frac{103}{100} = 26804$ [26803.69]

$\therefore$ After 3 yrs total population (P_3) = 26804

Model 4:

एउटा शहरमा अहिले जनसंख्या 177366 छ । यदि गएको तीन वर्षमा क्रमश 3% 2.5% र 5% ले बढेको भए सो शहरको 3 वर्ष पहिलेको जनसंख्या पत्ता लगाउनहोस् ।

The population of a town is 177366. If it had increased by 3% 2.5% and 5% in last htree yrs find the poplation of the town three years ago .

Solution:

Here, the present total population (P_3) = 1777366

Rate of growth are R_1% R_2% and R_3%

R_1% = 3% R_2 = 2.5% and R_3% = 5%

Time (T) = 3 yrs

Three yrs ago total population (p_0) = ?

$\therefore \quad P_T = P_0\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right)$

or, $P_3 = P_0\left(1+\frac{3}{100}\right)\left(1+\frac{2.5}{100}\right)\left(1+\frac{5}{100}\right)$

or, $177366 = P_0\,(1.03 \times 1/025 \times 1.05)$

or, $177366 = P_0 \times 2.10625$

or, $P_0 = \frac{177366}{1.1085375}$

$\therefore \quad P_0 = 160000$

3 yrs ago total population (P_0) = 160000

Model 5:

एउटा शहरको जनसंख्या प्रतिवर्ष 10% दरले बृद्धि हुन्छ । यदि हालको जनसंख्या 2662000 भए यसको 3 वर्ष पछि र 3 वर्ष पहिलेको जनसंख्या पत्ता लगाउनुहोस् ।

The population of a city increase by 10% every year of the present population is 2662000, find its population after 3 yrs and 3 yrs ago.

Solution:

Here, Rate growth (R) = 10% every year

Present population of city (p_0) = 2662000
Time (T) = 3 yrs
After 3 yrs total population (P_3) = ?

$$P_T = P_0\left(1+\frac{R}{100}\right)^T$$

or, $P_3 = 2662000\left(1+\frac{10}{100}\right)^3$

or, $P_3 = 2662000\ (1 + 0.1)3$

or, $P_3 = 2662000 \times (1.1)3$

or, $P_3 = 2662000 \times 1.331$

$\therefore$ $P_3 = 543122$

After 3 yrs total population (p_3) = 3543122
Again present population (P_T) = 2662000
Rate of growth (R) = 10%
After 3 yrs ago (P_0) = ?

$$P_T = P_0\left(1+\frac{R}{100}\right)^T$$

or, $2662000 = P_0\left(1+\frac{10}{100}\right)^3$

or, $2662000 = P_0\ (1 + 0.1)3$

or, $2662000 = P_0 \times (1.1)3$

or, $2662000 + P_0 \times 1.331$

$\therefore$ $P_0 = \frac{2662000}{1.331} = 20{,}00000$

After 3 yrs ago, total population (P_0) = 20,00000

Practice Yourself

1. एउटा गाउँको जनसंख्या प्रत्येक वर्ष 5% ले बढदैजान्छ । यदि 2 वर्षको अन्त्यमा 1025 जना बसाई सराई गरेर अन्यत्र जाँदा गाँउको जनसंख्या 10,000 भयो भने सुरुमा सो गाउँको जनसंख्या कति थियो ।
   The population of a village increase year by 5% At the end of 2 yrs the total population of village was 10,000. If 1025 were migrated to other places what was the population of a village in the beginning.
   (Ans : 10,000)
2. रामकोट गाउँमा जनसंख्या प्रत्येक वर्ष 2.5% ले वृद्धि हुन्छ । दुई वर्षको अन्त्यमा सो गाउँको जनसंख्या 24895 थियो । यदि 320 मानिस अर्को गाउँमा वसाई सराई गरी गए भने सुरुमा सो गाउँमा कुल जनसंख्या कति थियो होला ? पत्ता लगाउनुहोस् ।
   The population of Ramkot village increase every year by 2.5%. At the emd of 2 yrs the total population of village was 24895 if 320 people were migrated to other village what was the population of the village in the beginning? Find it. **(Ans: 24000)**
3. 3 वर्ष पहिले कुनै शहरको जनसंख्या 120,000 थियो । जनसंख्या वृद्धिदर 2.5% छ । एक वर्ष पहिले महामारी रोगको कारण 2875 मानिसको मृत्यु भयो भने सोही वृद्धि अनुसार तीन वर्षपछिको जनसंख्या पत्तालगाउनुहोस् ।
   3yrs ago, the population of any town was 120,000. The rate of growth of the population of the population is 2.5% 1 year ago, 2875 people died of epidemic disease, find the population of town after 3 yrs.
4. 3 वर्ष अगाडि एउटा शहरको जनसंख्या 10,00000 थियो । जनसंख्या वार्षिक वृद्धिदर 2% थियो । तीन वर्षको अन्त्यमा 750 जना मानिसहरू अन्य ठाउँमा बसाइसराई गरेर गए र शूरुको जनसंख्याको 1% मानिसहरू वसाई सराई आए भने उक्त शहरको जनसंख्या हालको जनसंख्या पत्ता लगाउनुहोस् ।
   The population of a town before 3 yrs was 10,00,000 and the rate of annual growth of migrate to other place and the number of in migrants is 1% of the original population find the present population of the town. **(Ans: 10,70458)**

5. 2055 सालको शुरुमा कुनै शहरको जनसंख्या 10,00000 वृद्धदर 4% प्रतिवर्ष थियो । 2056 सालको शुरुमा 20,000 मानिस अन्यन्त्रबाट बसाई सराई गरी यहाँ स्थायी वसोवास गर्न आए भने 2085 सालको शुरुमा जनसंख्या कति होला ?

At the beginning of 2055 the population of any town was 10,00,000 and population growth rate was 4% At the beginning of 2956 20,000 people come in town by migration and settle permanently, what will be population of town at the beginning of 2058 BS. **(Ans: 1146496)**

4.2 मिश्रह्रास (Compound Depreciation)

केहि महत्वपूर्ण सूत्रहरू **(Some Important Formulae)**

यदी शुरुको मूल्य = V_0 ह्रासदर = R% प्रतिवर्ष

समय अवधि = T वर्ष

T वर्ष पछिको मूल्य = V_T भए

If initial price = V_0 Rate of depreciation = R%

Time = T years and value of after T yrs = V_T

$$\therefore \quad V_T = V_0\left(1-\frac{R}{100}\right)^T$$

यदि घटेको मूल्य (If depreciaton value) = D_T भए,

$$\therefore \quad D_T = V_T - V_T$$

$$\text{or,} \quad D_T = sV_o - V_o\left(1-\left(1-(\frac{R}{100})\right)\right.$$

$$\therefore \quad D_T = V_o\left(1-(\frac{R}{100})\right)$$

यदि शुरुको मूल्य = V_0 वर्षेनि ह्रासदर तीन वर्षसम्म क्रमश R_1%, R_2% र R_3% तीन वर्ष पछिको मूल्य = V_3 भए

If Initial price = V_0, depreciation rate annually R_1%, R_2% and R_3% respectively at the three yrs and price of after three yrs = V_T

$$\therefore \quad V_T = V_0\left(1-\frac{R_1}{100}\right)\left(1-\frac{R_2}{100}\right)\left(1-\frac{R_3}{100}\right)$$

Very short Questions

1. यदि $v_I = V_o\left(1-\frac{R}{100}\right)$ ले मिश्रह्रासको सुत्रमा V_o ले के जनाउछ ।

   If $V_T = V_0\left(1-\frac{R}{100}\right)^t$ formula of compound deprecided , what is represented Vo.

2. साधारण ह्रास र मिश्रधनह्रास वीचमा हुने एउटा भिन्नता लेख्नुहोस्। Write the any ne differrnce between the dimple deprecitelin and the compound deprecitian.

3. यदि शुरूको मूल्य = V_0 समय = T मूल्यह्रास = R% प्रतिवर्ष र ह्रास पछिको मूल्य = V_T भए तीनीहरू वीचको सम्बन्ध के होला ? If the initial price = V_0 Time = T compound depreciatiaon = R% and price after depreciate = V_T , write the relation between them.

4. यदि शुरूको मूल्य = V_0 समय = T मूल्य ह्रास दर = R% र ह्रासमूल्य = D_T भए तिनीहरूको बीचको सम्बन्ध लेख्नुहोस्। If initial price =V_0, Time = T compound depreciation = R% per year and price of compound depriction = D_T, write the releation between them.

5. रू. 1200 पर्ने सामानको मूल्य प्रति वर्ष 10% ह्रास हुन्छ भने त्यसको ह्रास मूल्य कति होला ? पत्ता लगाउनुहोस्। If the price of an article is Rs. 1200 deprecicted by 10% per year. What is the compound depreciation price. Find it.

6. यदि रू. 45000 मा किनेको एउटा TV., सेट केही समय पछि रू. 15,500 ले मूल्य ह्रास भएछ भने सो सामानको विकी मूल्य कति होला ? If a TV set bought at Rs. 45000 is sold after some time so that depreciation camoung was Rs. 15500 . Whati is the sell price of its article?

Short Questions

Model 1:

एउटा मेशिनको मूल्य रु 2,50,000 छ । प्रति वर्ष 10% दरले मूल्य ह्रास कहाँ हुन्छ भने 2 वर्ष पछिको मूल्य पत्ता लगाउनुहोस् ।

Find the price of after 2 yrs the present price of a machine is Rs 2,50000 it is depreciated at the rate of 10% p.a.

Solution:

Here, the present price of machine (V_0) = Rs 2,50,000
Rate of depreciated (R) = 10%
Time (T) = 2 yrs
Price of machine after 2 yrs (V_2) = ?

$\therefore \quad V_T = V_0\left(1-\frac{R}{100}\right)^T$

or, $V_2 = \text{Rs. } 2{,}50{,}000\left(1-\frac{10}{100}\right)^2$

or, $V_2 = \text{Rs. } 2{,}50{,}000\ (1-0.1)^2$

or, $V_2 = \text{Rs. } 2{,}50{,}000 \times (0.9)^2$

or, $V_2 = \text{Rs. } 2{,}50{,}000 \times 0.8$

$\therefore \quad V_2 = \text{Rs. } 202500$

$\therefore$ Price of machine after 2 yrs (V_2) = Rs. 202500

Model 2 :

प्रतिवर्ष 10% का दरले मूल्यह्रास हुदाँ एउटा मोटर साइकलको मूल्य 3 वर्ष पछि रु 92583 हुन्छ भने सो मोटरसाइकलको शुरुको मूल्य पत्ता लगाउनुहोस् ।

If the cost is depreciated at the rate of 10% per annum, the cost of a motor cycle after3 yrs becomes Rs. 92583. Calculate the the original price of the motor cycle.

Solution:

Rate of deprecited (R) = 10% perannum
Time (T) = 3yrs
After 3 yrs price of motorcycle (V_3) = Rs 92583
Initial price of motorcycle (V_0) = ?

$\therefore \quad V_T = V_0\left(1-\frac{R}{100}\right)^T$

or, $\text{Rs. } 92583 = V_0\left(1-\frac{10}{100}\right)^T$

or, $\text{Rs. } 92583 = V_0\ (0.9)^3$

or, $\text{Rs. } 92583 = V_0 \times 0.729$

or, $V_0 = \frac{\text{Rs } 92583}{0.729}$

or, $V_0 = \text{Rs. } 1{,}27000$

The original price of motorcycle (V_0) = Rs. 1,20,000

Model 3:

एउटा सामानको मूल्य दुई वर्षमा रु 18000 बाट घटेर रु 14580 कायम भएछ भने ह्रास दर पत्ता लगाउनुहोस् ।

The Value of an article deprecited from Rs 18000 to Rs 14580 in two yrs. Find the rate of depreciation.

Solution:

Here, The price of article (V_0) = Rs 18000
Time (T) = 2 yrs
After 2 yrs the price of an article (V_2) = Rs 14580
Rate of depreciation (R) = ?

$\therefore \quad V_T = V_0\left(1-\frac{R}{100}\right)^T$

or, $V_2 = \text{Rs } 18000\left(1-\frac{R}{100}\right)^2$

or, $\text{Rs } 14580 = \text{Rs } 18000\left(1-\frac{R}{100}\right)^2$

or, $\frac{\text{Rs. } 14580}{\text{Rs } 18000} = \left(1-\frac{R}{100}\right)^2$

or, $0.81 = \left(1-\frac{R}{100}\right)^2$

or, $(0.9)^2 = \left(1-\frac{R}{100}\right)^2$

or, $0.9 = 1-\frac{R}{100}$

or, $\frac{R}{100} = (1-0.9)$

or, $R = 0.1 \times 100$

$\therefore \quad R = 10\%$

Rate of deprecited (R) = 10%

Model 4:

एउटा कारखाना केहि वर्ष पहिले रु 4,00,000 मा किनिएको थियो । अहिले यसको मूल्य रु 1,96000 छ । यदि कारखानाको मूल्य प्रति वर्ष 30% दरले ह्रास भएको थियो भने सो कारखाना कहिले किनिएको थियो होला ?

A factory bought for Rs 4,00,000 some yrs ago and how its value Rs 196,000. If The value of the factory is depreciated at 30% p.a. when was the factory bought.

Solution:

Here, Initial price of factory (V_0)) = Rs 400,000
Rate od depneclated (R) = 30% per year
Time = T yrs
After t yrs price of factory (V_T) = Rs 1,96000

$\therefore \quad V_T = V_0\left(1-\frac{R}{100}\right)^T$

or, $V_T = \text{Rs } 400{,}00\left(1-\frac{30}{100}\right)^T$

or, $\text{Rs } 196000 = \text{Rs } 4{,}00{,}000\ (1-0.3)^T$

or, $\frac{\text{Rs } 196000}{\text{Rs } 400{,}000} = (0.7)^T$

or, $0.49 = (0.7)^T$

or, $(0.7)^2 = (0.7)^T$

$\therefore \quad T = 2 \text{ yrs}$

The requird time (T) = 2 yrs

Model 5:

एउटा मेशिनको हालको मूल्य रू. 7,50,000 छ । प्रतिवर्ष 10% दरले मुल्य ह्रासका कारण कम हुन्छ भने 2 वर्षपछिको ह्रास कति हुन्छ पत्ता लगाउनुहोस्। Find the price of compound depreciated vaue after 2years , the current price of a machine is Rs. 6,50,000. I its depreciated the rate is 10% per year.

Solution: The present price of machine (V%) = Rs. 6,50,000

Rate of compound depreciated (R) = 10%, Time (T) = 2yrs

Value of compound depreciated (D_T) = ?

$\therefore V_T = V_0\left[(1-\frac{R}{100})\right]^T$

or, $V_2 = \text{Rs } 6{,}5000\left[1-\frac{10}{100}\right]^2$

or, $V_2 = \text{Rs. } 6{,}500\,[1-0.1]^2$

or, $V_2 = \text{Rs. } 65000 \times [0.9]^2$

$\therefore V_2 = \text{Rs. } 65000 \times [\,081] = \text{Rs. } 52650$

$\therefore D_2 = V_0 - V_2 = \text{Rs. } 65{,}000 - \text{Rs.}52650 = \text{Rs. } 12350$

Aternate method

Now, $D_T = V_0\left[1-(1-\frac{R}{100})\right]^T = \text{Rs. } 65000\left[1-\left(1-\frac{10}{100}\right)^2\right]$

$= \text{Rs. } 65000\ [1-(1-0.1)^2] = \text{Rs. } 65000\ [1-(0.9)^2] = \text{Rs. } 65000 \times 0.19 = \text{Rs. } 12350$

Value of depreciated (D_T) = Rs. 12350

Practice Yourself

1. एकजना मानिसले रु 44100 तिरेर किनेको कम्प्युटर 2 वर्ष पछि रु 40,000 मा विक्री गऱ्यो भने कम्प्युटरको मिश्रह्रासदर पत्ता लगाउनुहोस् ।
   A man bought a computer for Rs. 441000 and after using it for 2 yrs he sild if Rs. 40,000 find the ratio of compounded depreiation of the computer. (Ans: $4\frac{16}{21}\%$)
2. दुई वर्षको अगाडि किनेको घर यस वर्ष 2.5% ह्रास कतिको दरले विक्री गर्दा रु 12168000 आउँछ भने सो घर पहिले कतिमा किनेको रहेछ ?
   A house which was boutht two yrs ago sied Rs 12168000 after depreciation at the rate of 2.5% compound depreciation. At what price of was the house bought two yrs ago. (Ans: Rs 12800,000)
3. एउटा मेशिनको मूल्य वार्षिक 10% को दरले ह्रास हुन्छ । यदि यसको सुरुको मूल्य रु 6500 भए 2 वर्ष पछिको मूल्य पत्ता लगाउनुहोस् ।
   The value of a machine is depreciated by 10% annually. If its original price is Rs 8500, find its value of after 2 yrs. (Ans: Rs 6885)
4. रु 50,000 तिरेर किनिएको एउटा कम्प्युटर मूल्य वार्षिक 10% दरले ह्रास हुन्छ । कति समय पछि सो कम्प्युटरको मूल्य रु 40500 होला ? पत्ता लगाउनुहोस् ।
   The value of a computer bought for Rs. 50,000 is depreciating at the rate of 10% perannum. After what time after yrs the value of computer will be Rs. 405000. (Ans: 2 yrs)
5. यदि प्रतिवर्ष 12% का दरले एउटा ल्यापटपको मूल्य ह्रास हुदा 2 वर्षमा रू. 92928 हुन्छ भने सो ल्यापटपको शुरूको मूल्य पत्ता लगाउनुहोस्। If the cast of depreciated at the rate of per annum the cost of laptop computer becomes Rs. 929228n after 2 years find the original price of te laptop . (Ans: 1,20,000)
6. एउटा सामानको मूल्य 2 वर्षमा रू. 40000 बाट घटेर रू. 32400 भयो भने मिश्रह्रास पत्ता लगाउनुहोस्।
   The value of article is depreciated from the Rs. 40000 ton Rs. 32400 in tow yrs, find the rate of compounded depreciation. (Ans. 10%)
7. एउटा मोटरसाइकलको हालको मूल्य रू. 2,25,000 छ । यदि सोल मूल्यमा प्रतिवर्ष 8% का दरले वार्षिक ह्रास हुन्छ भने कति वर्ष पछि मोटरसाइकलको मूल्य रू. 1,75,204.80 होला ? पत्ता लगाउनुहोस्। The present price of motorcycle is Rs. 2,25000. If its price is depreciated per year by 8% after how many yrs will the price of the motorcycle be Rs. 1,75204.80 ? Find it. (Ans: 3 yrs)

Long Questions

Model 1:

एउटा कम्प्युटरको मूल्य रु 35000 छ । यदि यसको मूल्य पहिले वर्ष 8% ले ह्रास र दोस्रो वर्ष 10% ले ह्रास हुन्छ भने यसको 2 वर्ष पछिको मूल्य निकाल्नुहोस् ।

The present value of computer is Rs 35000. If its depreciated by 8% in the first year and by 10% in the second year, find the its value after 2 yrs.

Solution:

Here, present price of a computer (V_0) = Rs 35000
Rate of deprecited in first year (R_1) = 8%
Rate of deprecited in 2nd year (R_2) = 10%
Value of computer after 2 yrs (V_2) = ?

$$\therefore \quad V_T = V_0\left(1-\frac{R_1}{100}\right)\left(1-\frac{R_2}{100}\right)$$

$$\text{or,} \quad V_2 = \text{Rs. } 35000\left(1-\frac{8}{100}\right)\left(1-\frac{10}{100}\right)$$

$$\text{or,} \quad V_2 = \text{Rs. } 35000\ (1-0.08)\times(1-0.1)$$

$$\text{or,} \quad V_2 = \text{Rs. } 35000\times(0.92\times 0.9)$$

$$\therefore \quad V_2 = \text{Rs. } 28980$$

After 2 yrs, price of computer (V_2) = Rs. 28980

Model 2:

एउटा फाइनान्स कम्पनीको सेयरमा 2 वर्ष सम्म 5% दरले चक्रिय अवमूल्यन भए पछि अहिले सेयर मूल्य रु 36100 छ । 2 वर्ष अघि प्रति रु 100 मा शेयर कति वटा बेचिएको रहेछ ?

After the compounded depaciation of the cost xhares of a fiancé company at 5% per annum for 2 yrs. The total shares cost Rs 36100 at present. How many shares were sold at Rs 100 per share before 2 yrs.

Solution:

Here, compound depreciation Rate (R) = 5% per year
Time (T) = 2 yrs
After 2 yrs price of shones (V_2) = Rs 36100

$$\therefore \quad V_T = V_0\left(1-\frac{R}{100}\right)^T$$

$$\text{or,} \quad V_2 = V_0\left(1-\frac{5}{100}\right)^2$$

$$\text{or,} \quad \text{Rs. } 36100 = V_0\ (1-0.5)^2$$

$$\text{or,} \quad \text{Rs. } 36100 = V_0\times(0.95)^2$$

$$\text{or,} \quad \text{Rs. } 36100 = V_0\times 0.9025$$

$$\text{or,} \quad V_0 = \frac{36100}{0.9025}$$

$$\therefore \quad V_0 = \text{Rs. } 40{,}000$$

Price of shares 2 yrs ago = Rs. 40,000
Price of per share = Rs. 100

$$\text{Number of share} = \frac{\text{Rs}40{,}000}{\text{Rs } 100} = 400$$

Model 3

एउटा कम्पनीलाई रु1,20,00000 मा सुरु गरियो स्थापना कालदेखि 3 वर्षमा कम्पनीले Rs 7500,000 नाफा कमायो तर कम्पनीको मूल्यमा भने वर्षेनि 3% दरले ह्रास भयो भने कम्पनीलाई के कति नाफा वा नोक्सान भयो ? पत्ता लगाउनुहोस् ।

A company was estabhoshed on Rs 120,00,000. It earned Rs 7500,000 profit during 3 yrs and its value is deprecated at the rate of. 3% per annum, what is prifit or loss of the company?

Solution:

Here, Initial price of company (V_0) = rs 1,20,00,000
Rate of deprecited (R) = 3%
Time (T) = 3 yrs

$\therefore \quad V_T = V_0\left(1-\frac{R}{100}\right)^T$

or, $V_3 = \text{Rs } 1{,}20{,}00000\left(1-\frac{3}{100}\right)^3$

or, $V_3 = \text{Rs } 1{,}20{,}000{,}00\ (1-0.03)^3$

or, $V_3 = \text{Rs } 1{,}20{,}00000\ (0.97)^3$

or, $V_3 = \text{Rs } 1{,}20{,}00000 \times 0.912623$

$\therefore \quad V_3 = \text{Rs } 0{,}0952076$

Profit amount of 3 yrs = Rs. 7500000
Total amount = Rs. 1095 2076 + 7500000 = Rs. 1845276
Now, profit amount = Rs. 84.522076 – Rs. 120,00000 = Rs 6452076

Model 4:

3 वर्ष पहिले रु. 12500,000 मा किनेको 4 रोपनि जग्गाको अहिले बिक्री गर्दा प्रति रोपनी रु 160,0000 मात्र प्राप्त गर्न सकिन्छ भने 1 वर्ष पछि कति रकम प्राप्त गर्न सकिन्छ ?

Four ropani of land was bought for Rs 12500000 in 3 yrs ago. If one ropani of land be sold for Rs 160,00,00 at present, How much price will be its after 1 year?

Solution:

Here, Time(T) = 3yrs
Price of land = Rs 1,25,00,000

Price of 4 ropani per ropani land (V_0) = $\frac{\text{Rs}1{,}25{,}00{,}000}{4}$ = Rs. 3125000

After 3 yrs, prince of land (V_3) = Rs. 1,60,0000

$\therefore \quad V_T = V_0\left(1-\frac{R}{100}\right)^T$

or, $V_3 = \text{Rs } 3125000\left(1-\frac{R}{100}\right)^3$

or, $\text{Rs. } 160{,}0000 = \text{Rs. } 3{,}125000\left(1-\frac{R}{100}\right)^3$

or, $\frac{\text{Rs } 160{,}0000}{\text{Rs } 3{,}\ 125000} = \left(1-\frac{R}{100}\right)^3$

or, $0.512 = \left(1-\frac{R}{100}\right)^3$

or, $(0.8)^3 = \left(1-\frac{R}{100}\right)^3$

or, $0.8 = 1-\frac{R}{100}$

or, $\frac{R}{100} = 1-0.8$

or, $\frac{R}{100} = 0.2$

$\therefore \quad R = 20\%$

Rate of depreciated (R) = 20%
Time (T) = 1 year

$V_T = V_0\left(1-\frac{R}{100}\right)^T$

or, $V_1 = \text{Rs } 1,60,0000\left(1-\frac{20}{100}\right)^1$

or, $V_1 = \text{Es } 1,60,0000\ (1-0.2)$

or, $V_1 = \text{Rs } 1,60,0000 \times 0.8$

$\therefore$ $V_1 = \text{Rs } 128,00,00$

After one year price of land (V_1) = Rs 1,28,00,00

Practice Yourself

1. एउटा सेकेन्डहयाण्ड टयाक्सीलाई रु 3,60,000 पर्छ । पहिलो वर्षमा 10% दरले यसको मूल्यमा ह्रास हुन्छ । यसपछि प्रतिवर्ष 20% को दरले मूल्यमा ह्रास हुन्छ । सुरुदेखि कति वर्षमा सो टयाक्सीको मूल्य रु 186,624 पुग्ला ?
   A second hand taxi cast Rs, 3,60,000. Its price depreciation at the rate of 10% at first year and at the rate of 20% a year there after in wht time the price will be Rs 1,86,624 from the beganing.
   (Ans: 4 yrs.)
2. एउटा व्यापारले शुरुमा रु 5,00,000 लगानी गरेर व्यापारमा लगानी गरेछ । पहिलो वर्ष उसले 4% घाटा सहनु पऱ्यो तर दोस्रो वर्षमा 5% नाफा आर्जन गरेर तेस्रो वर्षमा बढेर 10% पुग्यो भने तीन वर्षमा उसले गरेको नाफा पत्ता लगाउनुहोस् ।
   A businessman started the business with an intial investment of Rs 5,00,000. In the first year the in curret at loss 4%. how ever during the 2nd year he earned profit 5% and which is 3rd year rise in 10% find the he net profit during period of 3yrs. **(Ans Rs 54400)**
3. एउटा मेसिनको मूल्य पहिलो वर्षमा 10% ले वृद्धि भयो, दोस्रो वर्षमा 10% मूल्यह्रास भयो र तेस्रो वर्षमा 10% वृद्धि भयो र तेस्रो वर्षको अन्तमा सो मेसिनको मूल्य रु 1,63,350 कायम रहयो भने सो मेसिनको सुरुको मूल्य कति थियो ?
   The value of machinery plant increased by 10% in the first year, depreciated by 10% in the second year, and again increased by 10% in the third year. If at the end of third year the value of machinery plant was Rs 1,63,350 find the original value of the machinery plant.
4. रु. 4000000 मा किनेको घरको मूल्य पहिलो 2 वर्षमा 5% र पछिल्लो 1 वर्षमा 10% दरले मूल्यमा ह्रास हुँदा 3 वर्षमा यसको मूल्य कति कमायम होला ?
   A house bought for Rs 4000000 depreciates by 5% in 2 years and then by 10% in \next 1 year what will be its values after 3 years ? **(Ans: 1,50,000)**
5. एउटा व्यापारीले रु 312550 मा एउटा ट्याक्सी किन्यो । 2 वर्षमा उसले 125000 नाफा कमायो । यदि 2 वर्षपछि उसले 4% ह्रासको दरले बेचेमा उसको नाफा वा नोक्सान पत्ता लगाउनुहोस् ।
   A business man bought a taxi for Rs 312500. He earns a profit of Rs 125000 in 2 years. If he sold it after 2 years at 4% rate of compound depreciation, find his profit loss. **(Ans: Rs 100500)**
6. कुनै फाइनान्स कम्पनीको सेयर वार्षिक 10% को दरले 2 वर्षसम्म ह्रास हुन्छ । यदि रु.4860 सेयर बेचेर प्राप्त भयो भने कति ओटा रु. 200 का सेयरहरू पहिले कतिओटा बेचिएके होला ?
   The share price of a finance company depreciated at 10% per annum for 2 years. if Rs 4860 was obtained by selling the shares, how many shares each of Rs 200 were sold at first. **(Ans: 30)**