# 32 True Discount

## IMPORTANT CONCEPTS

Suppose a man has to pay ₹ 156 after 4 years and the rate of interest is 14% per annum. Clearly, ₹ 100 at 14% will amount to ₹ 156 in 4 years. So, the payment of ₹ 100 now will clear off the debt of ₹ 156 due 4 years hence. We say that :

Sum due = ₹ 156 due 4 years hence;

Present Worth (P.W.) = ₹ 100;

True Discount (T.D.) = ₹ (156 – 100) = ₹ 56 = (Sum due) – (P.W.).

We define : ***T.D. = Interest on P.W.***

***Amount* = (*P.W.*) + (*T.D.*).**

Interest is reckoned on P.W. and true discount is reckoned on the amount.

## IMPORTANT FORMULAE

Let rate = R% per annum and Time = T years. Then,

**I.** $\text{P.W.} = \dfrac{100 \times \text{Amount}}{100 + (\text{R} \times \text{T})} = \dfrac{100 \times \text{T.D.}}{\text{R} \times \text{T}}$ **II.** $\text{T.D.} = \dfrac{(\text{P.W.}) \times \text{R} \times \text{T}}{100} = \dfrac{\text{Amount} \times \text{R} \times \text{T}}{100 + (\text{R} \times \text{T})}$

**III.** $\text{Sum} = \dfrac{(\text{S.I.}) \times (\text{T.D.})}{(\text{S.I.}) - (\text{T.D.})}$ **IV.** (S.I.) – (T.D.) = S.I. on T.D.

**V.** When the sum is put at compound interest, then $\text{P.W.} = \dfrac{\text{Amount}}{\left(1 + \dfrac{\text{R}}{100}\right)^{\text{T}}}$.

## SOLVED EXAMPLES

**Ex. 1.** ***Find the present worth of ₹ 930 due 3 years hence at 8% per annum. Also find the discount.***

**Sol.** $\text{P.W.} = \dfrac{100 \times \text{Amount}}{100 + (\text{R} \times \text{T})} = ₹\left[\dfrac{100 \times 930}{100 + (8 \times 3)}\right] = ₹\left(\dfrac{100 \times 930}{124}\right) = ₹\,750.$

T.D. = (Amount) – (P.W.) = ₹ (930 – 750) = ₹ 180.

**Ex. 2.** ***The true discount on a bill due 9 months hence at 12% per annum is ₹ 540. Find the amount of the bill and its present worth.***

**Sol.** Let amount be ₹ $x$. Then,

$$\frac{x \times \text{R} \times \text{T}}{100 + (\text{R} \times \text{T})} = \text{T.D.} \Rightarrow \frac{x \times 12 \times \frac{3}{4}}{100 + \left(12 \times \frac{3}{4}\right)} = 540 \Rightarrow x = \left(\frac{540 \times 109}{9}\right) = ₹\,6540.$$

$\therefore$ Amount = ₹ 6540.

P.W. = ₹ (6540 – 540) = ₹ 6000.

**Ex. 3.** ***The true discount on a certain sum of money due 3 years hence is ₹ 250 and the simple interest on the same sum for the same time and at the same rate is ₹ 375. Find the sum and the rate percent.***

**Sol.** T.D. = ₹ 250 and S.I. = ₹ 375.

$$\therefore \quad \text{Sum due} = \frac{\text{S.I.} \times \text{T.D.}}{(\text{S.I.}) - (\text{T.D.})} = ₹\left(\frac{375 \times 250}{375 - 250}\right) = ₹\,750.$$

$$\text{Rate} = \left(\frac{100 \times 375}{750 \times 3}\right)\% = 16\frac{2}{3}\%.$$

**Ex. 4.** *The difference between the simple interest and true discount on a certain sum of money for 6 months at* $12\frac{1}{2}\%$ *per annum is ₹ 25. Find the sum.*

**Sol.** Let the sum be ₹ $x$. Then,

$$\text{T.D.} = \frac{x \times \frac{25}{2} \times \frac{1}{2}}{100 + \left(\frac{25}{2} \times \frac{1}{2}\right)} = \left(x \times \frac{25}{4} \times \frac{4}{425}\right) = \frac{x}{17}.$$

$$\text{S.I.} = \left(x \times \frac{25}{2} \times \frac{1}{2} \times \frac{1}{100}\right) = \frac{x}{16}.$$

$$\therefore \quad \frac{x}{16} - \frac{x}{17} = 25 \Rightarrow 17x - 16x = 25 \times 16 \times 17 \Rightarrow x = 6800.$$

Hence, sum due = ₹ 6800.

**Ex. 5.** *A bill falls due in 1 year. The creditor agrees to accept immediate payment of the half and to defer the payment of the other half for 2 years. By this arrangement he gains ₹ 40. What is the amount of the bill, if the money be worth* $12\frac{1}{2}\%$*?*

**Sol.** Let the sum be ₹ $x$. Then,

$$\left[\frac{x}{2} + \frac{\frac{x}{2} \times 100}{100 + \left(\frac{25}{2} \times 2\right)}\right] - \frac{x \times 100}{100 + \left(\frac{25}{2} \times 1\right)} = 40 \Rightarrow \frac{x}{2} + \frac{2x}{5} - \frac{8x}{9} = 40 \Rightarrow x = 3600.$$

$\therefore$ Amount of the bill = ₹ 3600.

## EXERCISE

## (OBJECTIVE TYPE QUESTIONS)

**Directions:** *Mark (✓) against the correct answer:*

**1.** The present worth of ₹ 2310 due $2\frac{1}{2}$ years hence, the rate of interest being 15% per annum, is

(*a*) ₹ 1750 (*b*) ₹ 1680

(*c*) ₹ 1840 (*d*) ₹ 1443.75

**2.** If the true discount on a sum due 2 years hence at 14% per annum be ₹ 168, the sum due is

(*a*) ₹ 768 (*b*) ₹ 968

(*c*) ₹ 1960 (*d*) ₹ 2400

**3.** The true discount on ₹ 2562 due 4 months hence is ₹ 122. The rate percent is

(*a*) 12% (*b*) $13\frac{1}{3}\%$

(*c*) 15% (*d*) 14%

**4.** The true discount on ₹ 1760 due after a certain time at 12% per annum is ₹ 160. The time after which it is due is

(*a*) 6 months (*b*) 8 months

(*c*) 9 months (*d*) 10 months

**5.** The true discount on a bill due 9 months hence at 16% per annum is ₹ 189. The amount of the bill is

(*a*) ₹ 1386 (*b*) ₹ 1764

(*c*) ₹ 1575 (*d*) ₹ 2268

**6.** The interest on ₹ 750 for 2 years is the same as the true discount on ₹ 960 due 2 years hence. If the rate of interest is the same in both cases, it is

(*a*) 12% (*b*) 14%

(*c*) 15% (*d*) $16\frac{2}{3}\%$

**7.** The simple interest and the true discount on a certain sum for a given time and at a given rate are ₹ 85 and ₹ 80 respectively. The sum is
(*a*) ₹ 1800 (*b*) ₹ 1450
(*c*) ₹ 1360 (*d*) ₹ 6800

**8.** If ₹ 10 be allowed as true discount on a bill of ₹ 110 due at the end of a certain time, then the discount allowed on the same sum due at the end of double the time is
(*a*) ₹ 20 (*b*) ₹ 21.81
(*c*) ₹ 22 (*d*) ₹ 18.33

**9.** A man wants to sell his scooter. There are two offers, one at ₹ 12,000 cash and the other at a credit of ₹ 12,880 to be paid after 8 months, money being at 18% per annum. Which is the better offer?
(*a*) ₹ 12,000 in cash (*b*) ₹ 12,880 at credit
(*c*) Both are equally good

**10.** Goods were bought for ₹ 600 and sold the same day for ₹ 688.50 at a credit of 9 months and thus gaining 2%. The rate of interest per annum is
(*a*) $16\frac{2}{3}\%$ (*b*) $14\frac{1}{2}\%$
(*c*) $13\frac{1}{3}\%$ (*d*) 15%

**11.** The present worth of ₹ 1404 due in two equal half-yearly instalments at 8% per annum simple interest is
(*a*) ₹ 1325 (*b*) ₹ 1300
(*c*) ₹ 1350 (*d*) ₹ 1500

**12.** A trader owes a merchant ₹ 10,028 due 1 year hence. The trader wants to settle the account after 3 months. If the rate of interest is 12% per annum, how much cash should he pay?
(*a*) ₹ 9025.20 (*b*) ₹ 9200
(*c*) ₹ 9600 (*d*) ₹ 9560

**13.** A man buys a watch for ₹ 1950 in cash and sells it for ₹ 2200 at a credit of 1 year. If the rate of interest is 10% per annum, the man
(*a*) gains ₹ 55 (*b*) gains ₹ 50
(*c*) loses ₹ 30 (*d*) gains ₹ 30

**14.** A man purchased a cow for ₹ 3000 and sold it the same day for ₹ 3600, allowing the buyer a credit of 2 years. If the rate of interest be 10% per annum, then the man has a gain of
(*a*) 0% (*b*) 5%
(*c*) 7.5% (*d*) 10%

**15.** A owes B, ₹ 1573 payable $1\frac{1}{2}$ years hence. Also B owes A, ₹ 1444.50 payable 6 months hence. If they want to settle the account forthwith, keeping 14% as the rate of interest, then who should pay and how much? **(M.A.T. 2006; G.B.O., 2007)**
(*a*) A, ₹ 28.50 (*b*) B, ₹ 37.50
(*c*) A, ₹ 50 (*d*) B, ₹ 50

**16.** A has to pay ₹ 220 to B after 1 year. B asks A to pay ₹ 110 in cash and defer the payment of ₹ 110 for 2 years. A agrees to it. If the rate of interest be 10% per annum, in this mode of payment
(*a*) There is no gain or loss to any one
(*b*) A gains ₹ 7.34 (*c*) A loses ₹ 7.34
(*d*) A gains ₹ 11

**17.** ₹ 20 is the true discount on ₹ 260 due after a certain time. What will be the true discount on the same sum due after half of the former time, the rate of interest being the same?
(*a*) ₹ 10 (*b*) ₹ 10.40
(*c*) ₹ 15.20 (*d*) ₹ 13

**18.** The true discount on a certain sum of money due $2\frac{2}{3}$ years hence, is ₹ 150 and the simple interest on the same sum for the same time and at the same rate is ₹ 200. Interest rate per annum is **[MAT, 2011]**
(*a*) 10% (*b*) 12%
(*c*) $12\frac{1}{2}\%$ (*d*) $8\frac{1}{2}\%$

**19.** ₹ 20 is the true discount on ₹ 260 due after a certain time. What will be the true discount on the same sum due after half of the former time, the rate of interest being the same? **[MAT, 2011]**
(*a*) ₹ 15.20 (*b*) ₹ 10.40
(*c*) ₹ 10.83 (*d*) ₹ 13

**20.** The total discount on ₹ 1860 due after a certain time at 5% is ₹ 60. Find the time after which it is due **[SSC—CHSL (10+2) Exam, 2015]**
(*a*) 9 months (*b*) 10 months
(*c*) 7 months (*d*) 8 months

**21.** The difference between simple interest and the true discount on ₹ 2400 due 4 years hence at 5% per annum simple interest is **[SSC—CHSL (10+2) Exam, 2015]**
(*a*) ₹ 70 (*b*) ₹ 30
(*c*) ₹ 50 (*d*) ₹ 80

## ANSWERS

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** (*b*) | **2.** (*a*) | **3.** (*c*) | **4.** (*d*) | **5.** (*b*) | **6.** (*b*) | **7.** (*c*) | **8.** (*d*) | **9.** (*a*) | **10.** (*a*) |
| **11.** (*a*) | **12.** (*b*) | **13.** (*b*) | **14.** (*a*) | **15.** (*d*) | **16.** (*b*) | **17.** (*b*) | **18.** (*c*) | **19.** (*b*) | **20.** (*d*) |
| **21.** (*d*) | | | | | | | | | |

## SOLUTIONS

**1.** P.W. = $₹\left[\frac{100\times 2310}{100+\left(15\times\frac{5}{2}\right)}\right]=₹\,1680.$

**2.** P.W. = $\frac{100\times T.D.}{R\times T}=\frac{100\times 168}{14\times 2}=600.$

$\therefore$ Sum = (P.W. + T.D.) = ₹ (600 + 168) = ₹ 768.

**3.** P.W. = ₹ (2562 − 122) = ₹ 2440.

$\therefore$ S.I. on ₹ 2440 for 4 months = ₹ 122.

$\therefore$ Rate = $\left(\frac{100\times 122}{2440\times\frac{1}{3}}\right)\%=15\%.$

**4.** P.W. = ₹ (1760 − 160) = ₹ 1600.

$\therefore$ S.I. on ₹ 1600 at 12% = ₹ 160.

$\therefore$ Time = $\left(\frac{100\times 160}{1600\times 12}\right)=\frac{5}{6}\text{ years}=\left(\frac{5}{6}\times 12\right)\text{months}$

= 10 minutes.

**5.** Let P.W. be ₹ $x$.

Then, S.I. on ₹ $x$ at 16% for 9 months = ₹ 189.

$\therefore$ $x\times 16\times\frac{9}{12}\times\frac{1}{100}=189$ or $x$ = 1575.

$\therefore$ P.W. = ₹ 1575.

$\therefore$ Sum due = P.W. + T.D. = ₹ (1575 + 189) = ₹ 1764.

**6.** S.I. on ₹ 750 = T.D. on ₹ 960.

This means P.W. of ₹ 960 due 2 years hence is ₹ 750.

$\therefore$ T.D. = ₹ (960 − 750) = ₹ 210.

Thus, S.I. on ₹ 750 for 2 years is ₹ 210.

$\therefore$ Rate = $\left(\frac{100\times 210}{750\times 2}\right)\%=14\%.$

**7.** Sum = $\frac{S.I.\times T.D.}{(S.I.)-(T.D.)}=\frac{85\times 80}{(85-80)}=₹\,1360.$

**8.** S.I. on ₹ (110 − 10) for a certain time = ₹ 10.

S.I. on ₹ 100 for double the time = ₹ 20.

T.D. on ₹ 120 = ₹ (120 − 100) = ₹ 20.

T.D. on ₹ 110 = $₹\left(\frac{20}{120}\times 110\right)=₹18.33.$

**9.** P.W. of ₹ 12,880 due 8 months hence

$= ₹\left[\frac{12880\times 100}{100+\left(18\times\frac{8}{12}\right)}\right]=₹\left(\frac{12880\times 100}{112}\right)=₹\,11500.$

Clearly, ₹ 12,000 in cash is a better offer.

**10.** S.P = 102% of ₹ 600 = $₹\left(\frac{102}{100}\times 600\right)=₹\,612.$

Now, P.W. = ₹ 612 and sum = ₹ 688.50.

$\therefore$ T.D. = ₹ (688.50 − 612) = ₹ 76.50.

Thus, S.I. on ₹ 612 for 9 months is ₹ 76.50.

$\therefore$ Rate = $\left(\frac{100\times 76.50}{612\times\frac{3}{4}}\right)\%=16\frac{2}{3}\%.$

**11.** Required sum = P.W. of ₹ 702 due 6 months hence + P.W. of ₹ 702 due 1 year hence

$= ₹\left[\left(\frac{100\times 702}{100+8\times\frac{1}{2}}\right)+\left(\frac{100\times 702}{100+(8\times 1)}\right)\right]$ = ₹ (675 + 650)

= ₹ 1325.

**12.** Required money = P.W. of ₹ 10028 due 9 months hence

$= ₹\left[\frac{10028\times 100}{100+\left(12\times\frac{9}{12}\right)}\right]=₹\,9200.$

**13.** S.P. = P.W. of ₹ 2200 due 1 year hence

$= ₹\left[\frac{2200\times 100}{100+(10\times 1)}\right]=₹\,2000.$

$\therefore$ Gain = ₹ (2000 − 1950) = ₹ 50.

**14.** C.P. = ₹ 3000.

S.P. = $₹\left[\frac{3600\times 100}{100+(10\times 2)}\right]=₹\,3000.$

Gain = 0%.

**15.** A owes = P.W. of ₹ 1573 due $\frac{3}{2}$ years hence

$= ₹\left[\frac{1573\times 100}{100+\left(14\times\frac{3}{2}\right)}\right]=₹\left(\frac{1573\times 100}{121}\right)=₹\,1300.$

B owes = P.W. of ₹ 1444.50 due 6 months hence

$= ₹\left[\frac{1444.50\times 100}{100+\left(14\times\frac{1}{2}\right)}\right]=₹\left(\frac{1444.50\times 100}{107}\right)=₹\,1350.$

$\therefore$ B must pay ₹ 50 to A.

**16.** A has to pay = P.W. of ₹ 220 due 1 year hence

$= ₹\left[\frac{220\times 100}{100+(10\times 1)}\right]=₹\,200.$

A actually pays = ₹ 110 + P.W. of ₹ 110 due 2 years hence

$=\left[110+\frac{110\times 100}{100+(10\times 2)}\right]=₹192.66.$

$\therefore$ A gains = ₹ (200 − 192.66) = ₹ 7.34.

**17.** S.I. on ₹ (260 − 20) for a given time = ₹ 20.

S.I. on ₹ 240 for half the time = ₹ 10.

T.D. on ₹ 250 = ₹ 10.

$\therefore$ T.D. on ₹ 260 = $₹\left(\frac{10}{250}\times 260\right)=₹\,10.40.$

**18.** TD = ₹ 150 and SI = ₹ 200

$$\text{Sum due} = \frac{\text{SI} \times \text{TD}}{(\text{SI}) - (\text{TD})}$$

$$= ₹ \left(\frac{200 \times 150}{200 - 150}\right) = ₹\ 600$$

$$\text{Rate} = \left(\frac{100 \times 200}{600 \times \frac{8}{3}}\right)\%$$

$$= \left(\frac{20000}{1600}\right)\%$$

$$= \left(\frac{200}{16}\right)\%$$

$$= 12\frac{1}{2}\%$$

**19.** SI on ₹ (260 – 20) for a given time = ₹ 20

SI on ₹ 240 for half the time = ₹ 20

TD on ₹ 250 = ₹ 10

TD on ₹ 260 $= \frac{10}{250} \times 260 =$ ₹ 10.40

**20.** Here, A = 1860, R = 5%

TD = 60

$$\therefore \text{TD} = \frac{\text{A} \times \text{R} \times \text{T}}{100 + \text{R} \times \text{T}}$$

$$\Rightarrow 60 = \frac{1860 \times 5 \times \text{T}}{100 + 5\text{T}}$$

$$\Rightarrow 6000 + 300\text{T} = 9300\text{T}$$

$$\Rightarrow 6000 = 9300\text{T} - 300\text{T}$$

$$\Rightarrow 6000 = 9000\text{T}$$

$$\Rightarrow \text{T} = \frac{6000}{9000}$$

$$\Rightarrow T = \frac{2}{3} \text{ year}$$

$$\Rightarrow T = \frac{2}{3} \times 12 = 8 \text{ months}$$

**21.** Given A = 2400, R = 5%, T = 4 year

$$\therefore \text{TD} = \frac{\text{A} \times \text{R} \times \text{T}}{100 + \text{R} \times \text{T}}$$

$$= \frac{2400 \times 4 \times 5}{100 + 20} = ₹\ 400$$

$$\therefore \text{SI} - \text{TD} = \frac{\text{TD} \times \text{R} \times \text{T}}{100}$$

$$= \frac{400 \times 5 \times 4}{100} = ₹\ 80$$