

# 6.6 Flat rate depreciation

go up in value  
↑ over time.

Some items such as antiques, jewellery and real estate increase in value (appreciate or increase in capital gain). Computers, vehicles or machinery decrease in value (depreciate) with time due to wear and tear, advances in technology or lack of demand.

↳ Think mobile phones.

↳ go down in value.

Depreciation is the estimated loss in value of assets. The estimated value of an item at a point in time is called its future value (book value).

Future or Book

When the value becomes zero, the item is written off. At the end of an item's useful life its future value is called its scrap value.

↳ taken off the company's books (no longer an asset)

Future value = cost price – total depreciation to that time  
When book value = \$0, then the item is said to be written off.  
Scrap value is the book value of an item at the end of its useful life.

There are 3 methods in which to calculate depreciation:

- 1. flat rate depreciation → 6.6 (This section).
- 2. reducing balance depreciation → 6.7 (next section).
- 3. unit cost depreciation → 6.8

## Flat rate (straight line depreciation)

If an item depreciated by the flat rate method, then the value decreases by a fixed amount each time interval. It may be expressed in dollars or as a percentage of the original cost price.

As the depreciation value is the same for each interval, it is an example of straight line decay. This relationship can be expressed in the following recurrence relation:

$$V_{n+1} = V_n - d$$

where  $V_n$  is the value of the asset after  $n$  depreciating periods and  $d$  is the depreciation each time period.

↓  
loss of value is linear  
as it goes down by the same amount

The future value can also be calculated after  $n$  periods of depreciation.

$$V_n = V_0 - nd$$

We can use the above relationship or a depreciation schedule (table) to analyse flat rate depreciation.

### Worked Example 13

Fast Word Printing Company bought a new printing press for \$15 000 and chose to depreciate it by the flat rate method. The depreciation was 15% of the prime cost each year and its useful life was 5 years.

a) Find the annual depreciation.

Write down initial value  $V_0 = \$15,000$

depreciation per period. (here it's years)  $\rightarrow d = V_0 \times \frac{r}{100}$ , where  $r = 15\%$

$$d = 15000 \times \frac{15}{100} = \$2250$$

$d = \$2250$  depreciation per year.

b) Set up a recurrence relation to represent the depreciation

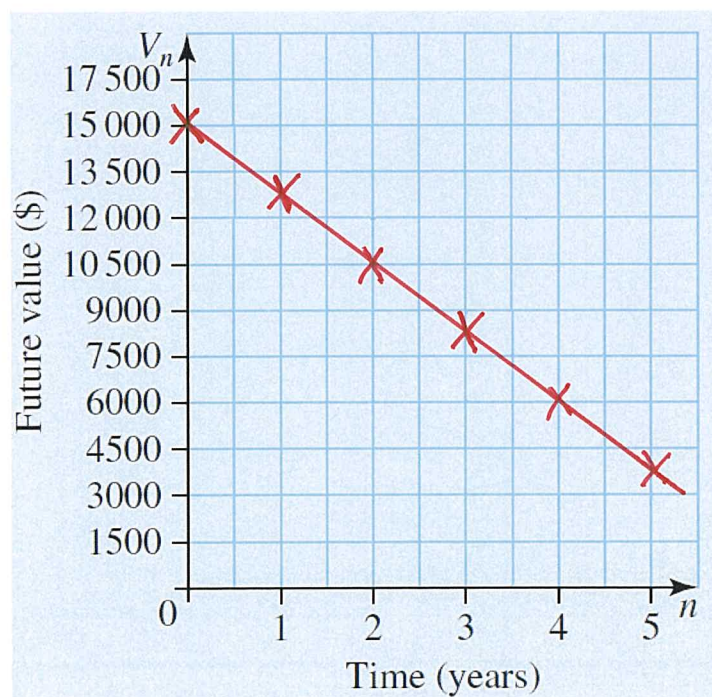
Write the general depreciation recurrence relation  $V_{n+1} = V_n - d$   
 write down the specific form.

$$V_0 = \$15000, V_{n+1} = V_n - 2250$$

Recall that a recurrence relation has a starting value and a relation (equation).

c) Draw a depreciation schedule for the useful life of the press and use it to draw a graph of book value against time.

Time $n$ (years)	Depreciation $d$ (\$)	Future value $V_n$ (\$)
0	—	\$15000
1	2250	$V_1 = V_0 - d, 15000 - 2250 = 12750$
2	2250	$V_2 = V_1 - d, 12750 - 2250 = 10500$
3	2250	$V_3 = V_2 - d, 10500 - 2250 = 8250$
4	2250	$V_4 = V_3 - d, 8250 - 2250 = 6000$
5	2250	$V_5 = V_4 - d, 6000 - 2250 = 3750$



d) Generate the relationship between the book value and time and use it to find the scrap value.

Write down the Flat rate depreciation Future value  
 Formula:  $V_n = V_0 - nd$ .  
 where  $d = 2250$  (annual depreciation),  $V_0 = \$15000$ ,  $n = 5$  years  
 So,  $V_n = 15000 - (5 \times 2250)$   
 $= \$3750$  So, the scrap value is  $\$3750$ .

Worked Example 13(c) and (d) on CAS calculator

13(c) On a lists & spreadsheet page

- Label column A "n" and column B "V<sub>n</sub>"
- Enter 0 to 4 in the n column and the starting value 15000 (V<sub>0</sub>) in cell b1.

A	n	B	V <sub>n</sub>	C	D
1	0.		15000.		
2	1.				
3	2.				
4	3.				
5	4.				

In cell b2

- Enter the equation "=b1-2250"

This equation is just  $V_{n+1} = V_n - 2250$  found in part (b)

Note: the 2250 is the **annual depreciation** found in part (a)

A	n	B	V <sub>n</sub>	C	D
1	0.		15000.		
2	1.		=b1-2250		
3	2.				
4	3.				
5	4.				

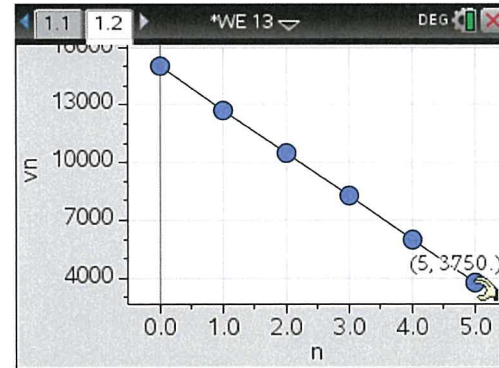
Press enter, then

- fill down (menu 3 3) until n=5
- $V_n = 3750$  when  $n=5$ . So, this is the scrap value

A	n	B	V <sub>n</sub>	C	D
2	1.		12750.		
3	2.		10500.		
4	3.		8250.		
5	4.		6000.		
6	5.		3750.		

Add a Data & Statistics page

- Label the x-axis "n" and the y-axis "V<sub>n</sub>"



In this worked example the depreciation schedule gives the scrap value, when  $n=5$   $V_n = \$3750$ . This can also be seen in the graph of book value against time, since it is only drawn for the item's useful life and its end point is the scrap value.

Businesses need to keep records of depreciation of all their assets on a year- to-year basis, for tax purposes.



What if you want to investigate the rate at which an item has depreciated over many years? A car, computer or mobile phone? If a straight line depreciation model is chosen, then the following example demonstrates its application.



**Worked Example 14**

Jarrold bought his car 5 years ago for \$15 000. Its current market value is \$7500. Assuming straight line depreciation, find:



- a) the car's annual depreciation rate

Total depreciation = cost price - current value.

= \$15,000 - \$7500 = \$7500

Rate of depreciation =  $\frac{\text{total depreciation}}{\text{number of years}} = \frac{7500}{5} = \$1500$  per year

- b) the relationship between the future value and time, and use it to find when the car will have a value of \$3000.

Write Future Value formula  $V_n = V_0 - 1500n$

where  $V_n = \$3000$  and  $V_0 = \$15,000$

So,  $3,000 = 15,000 - 1500 \times n$

$\Rightarrow n = \frac{3000 - 15000}{-1500}$   
 $= \frac{-12,000}{-1500} = 8$

Find when is the time (in the future)

**Answer**

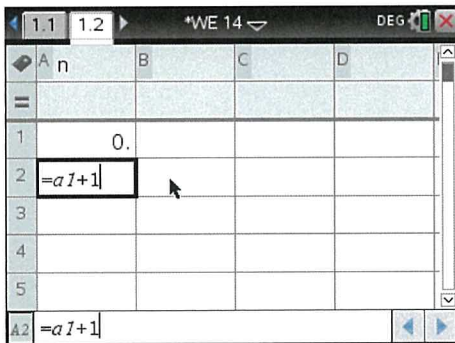
The depreciation equation is  $V_n = 15000 - 1500n$

The Future Value will reach \$3000 when the car is 8 years old

**Worked Example 14 on CAS calculator**

On a lists & spreadsheet page

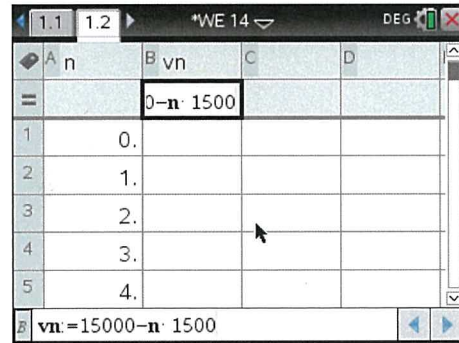
- Label column A "n" and enter 0 in cell a1, 1 in cell a2 etc, or in cell a2 enter "=a1+1" and fill down until n=10.



Label column B "V<sub>n</sub>" in cell b2

- Enter the equation = 15000 - n×1500

This equation is just  $V_{n+1} = V_n - n \times d$ , where  $d=1500$  and  $V_0=15000$



Press enter, the CAS needs to know if "n" is column n or a variable, IT IS A VARIABLE

- Click OK and the values for V<sub>n</sub> will be shown
- Scroll down until it is 3000, and the value of n is 8

