

A Simple and Compound Interest

- 5 Jo invests \$600 for 7 years at a rate of 1.5% per year simple interest.

Calculate the total interest earned during the 7 years.

$$600 \times 0.015 = 9$$
$$9 \times 7 = 63$$

\$ 63 [2]

- 4 Shubhu invests \$750 in a savings account for 5 years.
The account pays simple interest at a rate of 1.8% per year.

Calculate the total interest she earns during the 5 years.

$$750 \times 0.018 = 13.5$$
$$13.5 \times 5 = 67.5$$

\$ 67.50 [2]

- 12 (a) Sanjay invests \$700 in an account paying simple interest at a rate of 2.5% per year.

Calculate the value of his investment at the end of 6 years.

$$700 \times 0.025 = 17.5$$
$$17.5 \times 6 = 105$$
$$700 + 105 = 805$$

\$ 805 [3]

- (b) Ali invests \$600 at a rate of 2% per year simple interest.

Calculate the value of Ali's investment at the end of 5 years.

$$600 \times 0.02 = 12$$
$$12 \times 5 = 60$$
$$600 + 60 = 660$$

\$ 660 [3]

- 3 Sally invests \$1500 at 3% per year simple interest.

Work out the total value of her investment at the end of 6 years.

$$\begin{aligned}1500 \times 0.03 &= 45 \\45 \times 6 &= 270 \\1500 + 270 &= 1770\end{aligned}$$

\$ 1770 [3]

- 5 (a) \$500 is invested at a rate of 3% per year.

Calculate the total interest earned at the end of 7 years when

- (i) simple interest is paid,

$$\begin{aligned}500 \times 0.03 &= 15 \\15 \times 7 &= 105\end{aligned}$$

\$ 105 [2]

- (ii) compound interest is paid.

$$\begin{aligned}500 \times 1.03^7 &= 614.94 \\614.94 - 500 &= 114.94\end{aligned}$$

\$ 114.94 [3]

- (d) Malena invests \$1800 at a rate of 2.1% per year compound interest.

Calculate the value of her investment at the end of 15 years.

$$1800 \times 1.021^{15} = 2458.43$$

\$ 2458.43 [2]

- 12 Keita invests \$4000 at a rate of 2.6% per year compound interest.

Work out the interest earned on the investment at the end of 3 years.

$$4000 \times 1.026^3 = 4320.18$$

$$4320.18 - 4000 = 320.18$$

\$ 320.18 [3]

- (d) In 2015, a charity raised a total of \$1.6 million.
After 2015, this amount increased exponentially by 2.4% each year for the next 5 years.

Work out the amount raised by the charity in 2020.

$$1.6 \times 1.024^5 = 1.80 \text{ million}$$

\$ 1.80 million [2]

10. A town has a population of 45 000.
This population increases exponentially at a rate of 1.6% per year.

Find the population of the town at the end of 5 years.
Give your answer correct to the nearest hundred.

$$45\,000 \times 1.016^5 = 48\,717$$
$$= 48\,700$$

48 700 [3]

- (c) (i) Dean invests \$500 for 10 years at a rate of 1.7% per year simple interest.

Calculate the total interest earned during the 10 years.

$$500 \times 0.017 = 8.5$$
$$8.5 \times 10 = 85$$

\$ 85 [2]

- (ii) Ollie invests \$200 at a rate of 0.0035% per day compound interest.

Calculate the value of Ollie's investment at the end of 1 year.
[1 year = 365 days.]

$$200 \times 1.000035^{365} = 202.57$$

\$ 202.57 [2]

- 13 At the end of 2021 there were 27 000 rhinos living in the wild.
The number of rhinos is expected to decrease exponentially by 3% each year. $\leftarrow 100\% - 3\% = 97\%$

Work out the number of rhinos expected to be living in the wild 4 years later, at the end of 2025.
Give your answer correct to the nearest whole number.

$$27\,000 \times 0.97^4 = 23\,902.9$$
$$= 23\,903$$

..... 23 903 [3]

- 13 The population of one variety of butterfly is decreasing exponentially at a rate of 34% per year.
At the end of 2014, the population was 125.9 million.

$$100\% - 34\% = 66\%$$

Calculate the population at the end of 2019.

$$125.9 \times 0.66^5 = 15.767 \text{ million}$$
$$= 15.8 \text{ million}$$

..... 15.8 million [2]

- 15 The number of trees in a forest is decreasing exponentially at a rate of 1.75% per year.
Eleven years ago there were 980 trees.

$$100\% - 1.75\% = 98.25\%$$

Calculate the number of trees in the forest now.
Give your answer correct to the nearest integer.

$$980 \times 0.9825^{11} = 807$$

..... 807 [2]

- 12 The population of a town decreases exponentially at a rate of 1.7% per year.
The population now is 250 000.

$$100\% - 1.7\% = 98.3\%$$

Calculate the population at the end of 5 years.
Give your answer correct to the nearest hundred.

$$250\,000 \times 0.983^5 = 229\,460$$
$$= 229\,500$$

$$\underline{229\,500} \quad [3]$$

- 12 The profit a company makes decreases exponentially at a rate of 0.9% per year.
In 2014, the profit was \$9500.

$$100\% - 0.9\% = 99.1\%$$

Calculate the profit in 2019.

$$9500 \times 0.991^5 = 9080.13$$

$$\underline{\$ 9080.13} \quad [2]$$

- 12 Chai invests some money. x
 By the end of the first year, the value of the investment has decreased by 35%.
 By the end of the second year, the value of the investment has increased by 40% of its value at the end of the first year.

Find the overall percentage change in the value of the investment.

end of 1st year: $x \times 0.65$

end of 2nd year: $x \times 0.65 \times 1.4$
 $= x \times 0.91$

$\uparrow$
 $= 91\%$, so 9% decrease % [3]
9% decrease

- (c) Anil invests \$3500 in an account that pays a rate of 2.4% per year compound interest.

- (i) Calculate the total interest earned at the end of 5 years.

$$3500 \times 1.024^5 = 3940.65$$

$$3940.65 - 3500 = 440.65$$

\$ 440.65 [3]

- (ii) Find the number of complete years before Anil has at least \$5000 in this account.

Trial and improvement:

$$3500 \times 1.024^{10} = 4436.78$$

$$3500 \times 1.024^{15} = 4995.37$$

$$3500 \times 1.024^{16} = 5115.26$$

16 years [3]

(d) The mass of a radioactive substance decreases exponentially at a rate of 3% each day.

(i) Find the overall percentage decrease at the end of 10 days.

$$\begin{aligned} & x \times 0.97^{10} \\ &= x \times 0.737 \\ & \quad \uparrow = 73.7\% \\ & 100 - 73.7 = 26.3\% \text{ decrease } \underline{26.3} \% [2] \end{aligned}$$

(ii) Find the number of whole days it takes until the mass of this substance is one half of its original amount.

Try using a number (e.g. 100):

$$\begin{aligned} 50 &= 100 \times 0.97^x \\ \div 100 & \quad \div 100 \end{aligned}$$

$$0.5 = 0.97^x$$

Trial and Improvement:

$$0.97^{20} = 0.544$$

$$0.97^{22} = 0.512$$

$$0.97^{23} = 0.496$$

23 days [3]

- 4 (a) (i) Zak invests \$500 at a rate of 2% per year simple interest.

Calculate the value of Zak's investment at the end of 5 years.

$$500 \times 0.02 = 10$$

$$10 \times 5 = 50$$

$$500 + 50 = 550$$

\$ 550 [3]

- (ii) Yasmin invests \$500 at a rate of 1.8% per year compound interest.

Calculate the value of Yasmin's investment at the end of 5 years.

$$500 \times 1.018^5 = 546.65$$

\$ 546.65 [2]

(iii) Zak and Yasmin continue with these investments.

How many **more complete** years is it before the value of Yasmin's investment is greater than the value of Zak's investment?

Year	Zak	Yasmin
5	$500 + 10 \times 5 = 550$	$500 \times 1.018^5 = 546.25$ ✗
10	$500 + 10 \times 10 = 600$	$500 \times 1.018^{10} = 597.65$ ✗
12	$500 + 10 \times 12 = 620$	$500 \times 1.018^{12} = 619.36$ ✗
13	$500 + 10 \times 13 = 630$	$500 \times 1.018^{13} = 630.51$ ✓

Year 13, so 8 more years.

8

..... [3]

- 9 (a) Janna and Kamal each invest \$8000.
At the end of 12 years, they each have \$12800.

(i) Janna invests in an account that pays simple interest at a rate of $r\%$ per year.

Calculate the value of r .

Total interest: $12800 - 8000 = 4800$

Interest per year: $\frac{4800}{12} = 400$

Interest rate: $\frac{400}{8000} \times 100 = 5\%$

$r = 5\%$ [3]

(ii) Kamal invests in an account that pays compound interest at a rate of $R\%$ per year.

Calculate the value of R .

$$8000 \times x^{12} = 12800$$

$$x^{12} = \frac{12800}{8000}$$

$$x^{12} = \frac{8}{5}$$

$$x = \sqrt[12]{\frac{8}{5}}$$

$$= 1.0399$$

$$1.0399 = 103.99\%$$

$$\text{so } R = 3.99\%$$

$R = 3.99\%$ [3]

- (b) The population of a city is growing exponentially at a rate of 1.8% per year.
The population now is 260 000.

Find the number of complete years from now when the population will first be more than 300 000.

Trial and Improvement:

$$260\,000 \times 1.018^5 = 284\,258 \quad \times$$

$$260\,000 \times 1.018^8 = 299\,886 \quad \times$$

$$260\,000 \times 1.018^9 = 305\,284 \quad \checkmark$$

→ 9 years

9

years [3]

- (c) Kamal invests \$6130 at a rate of $r\%$ per year compound interest.
The value of his investment at the end of 5 years is \$6669.

Calculate the value of r .

$$6130 \times x^5 = 6669$$

$$x^5 = \frac{6669}{6130}$$

$$x = \sqrt[5]{\frac{6669}{6130}}$$

$$= 1.0170$$

$$1.0170 = 101.70\%$$

$$\rightarrow r = 1.70\%$$

$$r = \underline{1.70\%} \quad [3]$$

- 13 Anya invests \$6000 in an account that pays compound interest at a rate of $r\%$ per year.
At the end of 8 years, the account has earned \$621.70 in interest.

Calculate the value of r .

Value of investment: $6000 + 621.70 = 6621.70$

$$6000 \times x^8 = 6621.70$$

$$x^8 = \frac{6621.70}{6000}$$

$$x = \sqrt[8]{\frac{6621.70}{6000}}$$

$$= 1.0124$$

$$1.0124 = 101.24\%$$

$$\rightarrow r = 1.24\%$$

$$r = \underline{1.24\%} \quad [3]$$

- 14 Carlos invests \$4540 at a rate of $r\%$ per year compound interest.
At the end of 10 years he has earned \$1328.54 in interest.

Calculate the value of r .

Value of Investment: $4540 + 1328.54 = 5868.54$

$$4540 \times x^{10} = 5868.54$$

$$x^{10} = \frac{5868.54}{4540}$$

$$x = \sqrt[10]{\frac{5868.54}{4540}}$$

$$= 1.0260$$

$$1.0260 = 102.60\%$$

$$\rightarrow r = 2.60\%$$

$$r = 2.60\% \quad [3]$$

- (b) The value of a car decreases exponentially by 10% each year.
The value now is \$6269.40.

$$\hookrightarrow 100\% - 10\% = 90\%$$

Calculate the value of the car 3 years ago.

$$x \times 0.9^3 = 6269.40$$

$$x \times 0.729 = 6269.40$$

$$x = \frac{6269.40}{0.729}$$

$$= 8600$$

$$\$ 8600 \quad [3]$$

- 11 (a) Midhil invests \$1500 at a rate of 4.2% per year compound interest.

Calculate the value of the investment at the end of 5 years.

$$1500 \times 1.042^5 = 1842.59$$

$$\$ \dots\dots\dots 1842.59 \dots\dots\dots [2]$$

- (b) Hitanshi invests some money at a rate of $x\%$ per year compound interest.
At the end of 11 years the value of the investment has doubled.

Calculate the value of x .

Use an amount to make calculations easier, e.g. 1000:

$$1000 \times y^{11} = 2000$$

$$y^{11} = \frac{2000}{1000}$$

$$y^{11} = 2$$

$$y = \sqrt[11]{2}$$

$$= 1.0650$$

$$1.0650 = 106.50\%$$

$$x = 6.50\%$$

$$x = \dots\dots\dots 6.50\% \dots\dots\dots [3]$$

- (b) Alain invests \$5000 at a rate of $r\%$ per year compound interest.
At the end of 15 years, the value of the investment is \$7566.

Find the value of r .

$$5000 \times x^{15} = 7566$$

$$x^{15} = \frac{7566}{5000}$$

$$x = \sqrt[15]{\frac{7566}{5000}}$$

$$x = 1.0280$$

$$1.0280 = 102.80\%$$

$$\rightarrow r = 2.80\%$$

$$r = \dots\dots\dots 2.80\% \dots\dots\dots [3]$$

- (c) Feri invests some money. → e.g. 1000

The rate of interest for the first year is 2.5%.

At the end of the second year the overall percentage increase of Feri's investment is 6.6%.

Find the rate of interest for the second year.

Find value of investment at end of second year:

$$1000 \times 1.066 = 1066$$

Set up equation:

$$1000 \times 1.025 \times x = 1066$$

↑ year 1 ↑ year 2

$$1025 \times x = 1066$$

$$x = \frac{1066}{1025}$$

$$x = 1.04 \\ = 104\%$$

4 % [2]

- (e) The value of the campsite has increased exponentially by 1.5% every year since it opened 30 years ago.

Calculate the value of the campsite now as a percentage of its value 30 years ago.

Original value: x

$$\text{new value: } x \times 1.015^{30} \\ = x \times 1.56308...$$

$$\frac{\text{new}}{\text{original}} \times 100$$

$$\frac{x \times 1.56308}{x} \times 100 = 156.3\%$$

156 % [2]

- (iv) The average attendance increased exponentially by 4% each year for the three years from 2016 to 2019.

In 2019 the average attendance was 1631.

Find the average attendance for 2016.

2016 attendance: x

2019 attendance: $x \times 1.04^3 = 1631$

$$\begin{aligned} x &= \frac{1631}{1.04^3} \\ &= 1449.45... \\ &= \underline{1450} \end{aligned} \quad [3]$$

- 16 Paddy and Anna each invest \$2000 for 5 years.

Paddy earns simple interest at a rate of 1.25% per year.

Anna earns compound interest at a rate of $r\%$ per year.

At the end of 5 years, Paddy's investment is worth the same as Anna's investment.

Calculate the value of r .

Paddy: $0.0125 \times 2000 = 25$
 $25 \times 5 = 125$

Value of Investment:

$$2000 + 125 = 2125$$

Anna: $2000 \times x^5 = 2125$
 $x^5 = \frac{2125}{2000}$

$$x = \sqrt[5]{\frac{2125}{2000}}$$

$$= 1.0122$$

$$1.0122 = 101.22\%$$

$$r = 1.22\%$$

$$r = \underline{1.22\%} \quad [5]$$

- (b) Virat has \$100 to spend.

In February he spends \$x.

In March he spends 10% more than he spends in February. $\leftarrow 100\% + 10\% = 110\%$

In April he spends 10% more than he spends in March.

At the end of April, Virat has \$33.80 remaining.

Find the value of x.

Feb: x

March: $1.1 \times x$

April: $1.1 \times 1.1 \times x = 1.21x$

Amount Spent: $x + 1.1x + 1.21x = 3.31x$

Set up equation: $100 - 3.31x = 33.8$
 $-100 \quad -100$

$$-3.31x = -66.2$$

$\div -3.31$

$\div -3.31$

$$x = 20$$

$x = \dots\dots\dots 20 \dots\dots\dots [3]$

- (c) Bobbie invests \$500 in an account that pays compound interest each year.
At the end of 17 years, the value of Bobbie's investment is \$700.13.

Find the value of Bobbie's investment at the end of 20 years.

$$500 \times x^{17} = 700.13$$

$$x^{17} = \frac{700.13}{500}$$

$$x = \sqrt[17]{\frac{700.13}{500}}$$

$$= 1.0200 \quad (r=2\%)$$

STORE full
answer

$$500 \times 1.02^{20} = 742.99$$

$\uparrow$
(unrounded,
using calculator
memory)

\$ $\dots\dots\dots 742.99 \dots\dots\dots [4]$