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.

$1500 \times 0.03 = 45$

$45 \times 6 = 270$

$1500 + 270 = 1770$

$ 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,

$500 \times 0.03 = 15$

$15 \times 7 = 105$

$ 105 [2]

(ii) compound interest is paid.

$500 \times 1.03^7 = 614.94$

$614.94 - 500 = 114.94$

$ 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.

$1800 \times 1{\cdot}021^{15} = 2458.43$

\$ 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.

$4000 \times 1{\cdot}026^{3} = 4320.18$

$4320.18 - 4000 = 320.18$

\$ 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.

$1{\cdot}6 \times 1{\cdot}024^{5} = 1{\cdot}80$ 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.

$45\,000 \times 1{\cdot}016^5 = 48\,717$

$= 48\,700$

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.

$500 \times 0{\cdot}017 = 8{\cdot}5$

$8{\cdot}5 \times 10 = 85$

\$ 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.]

$200 \times 1{\cdot}000035^{365} = 202{\cdot}57$

\$ 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. ← 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.

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

$= 23\,903$

23903 [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.

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

$= 229\,500$

229500 [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.

$9500 \times 0.991^5 = 9080.13$

$ 9080·13 [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: $x \times 0.65 \times 1.4$

$= x \times 0.91$

↑ = 91%, so 9% decrease

9% decrease ..... % [3]

(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.

$x \times 0.97^{10}$

$= x \times 0.737$

$= 73.7\%$

$100 - 73.7 = 26.3\%$ decrease

26.3 % [2]

**(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):

$50 = 100 \times 0.97^{x}$

$\div 100 \quad \div 100$

$0.5 = 0.97^{x}$

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 $R$.

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

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

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

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

$= 1.0399$

$1.0399 = 103.99\%$

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:

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

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

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

→ 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 $r$.

$6130 \times x^5 = 6669$

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

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

$= 1.0170$

$1.0170 = 101.70\%$

$\rightarrow r = 1.70\%$

$r =$ 1.70% [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: $6000 + 621.70 = 6621.70$

$6000 \times x^8 = 6621.70$

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

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

$= 1.0124$

$1.0124 = 101.24\%$

$\rightarrow r = 1.24\%$

$r =$ 1.24% [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% [3]

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

↳ $100\% - 10\% = 90\%$

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 [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.

$1500 \times 1{\cdot}042^5 = 1842{\cdot}59$

$ 1842.59 [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:

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

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

$y^{11} = 2$

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

$= 1{\cdot}0650$

$1{\cdot}0650 = 106{\cdot}50\%$

$x = 6{\cdot}50\%$

$x =$ 6.50% [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]

**(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 $r$.

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

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

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

$x = 1.0280$

$1.0280 = 102.80\%$

$\rightarrow r = 2.80\%$

$r =$ 2.80% ..... [3]

**(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: $x$

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: $x \times 1.04^3 = 1631$

$x = \frac{1631}{1.04^3}$ .....1450..... [3]

$= 1449.95...$

$= 1450$

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: $2000 \times x^5 = 2125$

$x^5 = \frac{2125}{2000}$

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

$= 1.0122$

$1.0122 = 101.22\%$

$r = 1.22\%$

$r =$ 1.22% [5]

**(b)** Virat has $100 to spend.

In February he spends $\$x$ .
In March he spends 10% more than he spends in February. ← 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: $100 - 3.31x = 33.8$

$-100 \quad -100$

$-3.31x = -66.2$

$\div -3.31 \quad \div -3.31$

$x = 20$

$x =$ 20 [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.

$500 \times x^{17} = 700 \cdot 13$

$x^{17} = \frac{700 \cdot 13}{500}$

$x = \sqrt[17]{\frac{700 \cdot 13}{500}}$

$= 1 \cdot 0200$ $(r = 2\%)$

STORE full answer

$500 \times 1 \cdot 02^{20} = 742 \cdot 99$

(unrounded, using calculator memory)

$ 742.99 [4]