R11. Percentages

Compound Interest-Growth and Decay

OCR

19 Karl and Lisa invest £5800 in a savings account.

The account pays a fixed rate of 2.3% per year compound interest for 5 years.

(a) Karl calculates that they will have £5162.98 in the account at the end of 5 years.

Without working out the correct answer, explain how you can tell that Karl's calculation is wrong.

.....

..... **[1]**

(b) Here is Lisa's calculation to work out how much they will have at the end of 5 years.

$£5800 \times 2.3^5 = £373\,307.89$

Explain what Lisa has done wrong.

.....

..... **[1]**

19 Karl and Lisa invest £5800 in a savings account.

The account pays a fixed rate of 2.3% per year compound interest for 5 years.

(a) Karl calculates that they will have £5162.98 in the account at the end of 5 years.

Without working out the correct answer, explain how you can tell that Karl's calculation is wrong.

£5162.98 < £5800 It needs to be bigger

.....

.....**[1]**

(b) Here is Lisa's calculation to work out how much they will have at the end of 5 years.

£5800 × 2.3^5 = £373 307.89 ✓ ✓

Explain what Lisa has done wrong.

she should have multiplied by $\times 1.023^5$

.....

.....**[1]**

add on 2.3%.

Karl and Lisa invest £5800 in a savings account.

The account pays a fixed rate of 2.3% per year compound interest for 5 years.

(c) Calculate how much they will have in the account at the end of 5 years.

(c) £ ..... **[3]**

Karl and Lisa invest £5800 in a savings account.

The account pays a fixed rate of 2.3% per year compound interest for 5 years.

(c) Calculate how much they will have in the account at the end of 5 years.

$£5800 \times 1.023^{5} =$

2.3% of £5800 =

(c) £ 6498.40 **[3]**

17 Ella bought a ring for £3000.
The value of the ring increased by 4% for **each** of the next 3 years.

(a) Show that the value of the ring after 3 years is £3375, correct to the nearest pound.

[3]

(b) After 3 years, Ella sold the ring for £3375.

Calculate her overall percentage profit.

(b) ..... % **[3]**

17 Ella bought a ring for £3000.
The value of the ring increased by 4% for **each** of the next 3 years.

(a) Show that the value of the ring after 3 years is £3375, correct to the nearest pound.

[3]

£3000 × 1.04 × 1.04 × 1.04

$\times 1.04^3$ = £3374.59

= £3375 ✓

(b) After 3 years, Ella sold the ring for £3375.

Calculate her overall percentage profit.

$\frac{\text{diff}}{\text{original}} \times 100$ $\frac{375}{3000} \times 100$

= 12.5 %

(b) ..... % **[3]**

Video created by W Neill

17 At the start of 2014 Priya's house was worth £240 000.
The value of her house increased by 5% every year.

Work out the value of her house at the start of 2017.

£ ..... **[3]**

Video created by W Neill

17 At the start of 2014 Priya's house was worth £240000.
The value of her house increased by 5% every year.

Work out the value of her house at the start of 2017.

start 2014

£240,000 × 1·05 × 1·05 × 1·05

£ 277830 **[3]**

£240000 × 1.05^3

15 Luka invests £1500.
At the end of the first year, 2% interest is added.
At the end of the second year, after interest has been added, the investment is worth £1606.50.

Show that 5% interest has been added at the end of the second year. **[4]**

15 Luka invests £1500.
At the end of the first year, 2% interest is added.
At the end of the second year, after interest has been added, the investment is worth £1606.50.

Show that 5% interest has been added at the end of the second year. **[4]**

£1500 → 1530 (+£76.50) = £1606.50

2% of £1500 =

5% of £1530 = £76.50

£1500 × 1.02 × 1.05 =

23 Here are the interest rates for two bank accounts.

R10
R11

Northern Savings Bank (NSB)	Central Alliance Bank (CAB)
2.5% per year **compound interest**	2.7% per year **simple interest**

Mia puts £6400 in each account.

Calculate the difference in value between the two accounts after 8 years.
Give your answer correct to the nearest penny.

£ ..... **[6]**

Video created by W Neill

23 Here are the interest rates for two bank accounts.

R10
R11

Northern Savings Bank (NSB)	Central Alliance Bank (CAB)
2.5% per year **compound interest**	2.7% per year **simple interest**

Mia puts £6400 in each account.

Calculate the difference in value between the two accounts after 8 years.
Give your answer ~~correct~~ to the nearest penny.

6400×1.025^8

$= £7797.78$

2.7% of £6400 = £172.80

$\times 8$

$+$

$= £7782.40$ → £1382.40

£ 15.38 ✓ **[6]**

Video created by W Neill

10 On 1st November 2015 there were 4200 trees planted in a wood.
On 1st November 2016, only 3948 of these trees were still alive.

It is assumed that the number of trees still alive is given by

$$N = ar^t$$

where N is the number of trees still alive t years after 1st November 2015.

(a) Write down the value of a.

(a) ..... **[1]**

(b) Show that r is 0.94. **[2]**

Video created by W Neill

(c) Show that on 1st November 2030 the number of trees still alive is predicted to have decreased by over 60% compared with 1st November 2015. **[3]**

Video created by W Neill

10 On 1st November 2015 there were 4200 trees planted in a wood.
On 1st November 2016, only 3948 of these trees were still alive.

It is assumed that the number of trees still alive is given by

$$N = ar^t$$

where N is the number of trees still alive t years after 1st November 2015.

(a) Write down the value of a.

RII

(a) 4200 ..... **[1]**

(b) Show that r is 0.94. **[2]**

RII

$ar^t =$

$4200 \times 0.94^1 = 3948$

Video created by W Neill

(c) Show that on 1st November 2030 the number of trees still alive is predicted to have decreased by over 60% compared with 1st November 2015. **[3]**

RII / RB

2030 .... $4200 \times 0.94^{15} = 1660.225$ trees

$\simeq 1660$

60% of 4200 = 2520 trees

60%

2540 > 2520

decreased by more than 60%

$$\begin{array}{r} 4200 \\ -\ 1660 \\ \hline 2540 \end{array}$$ fallen

Video created by W Neill

4 Rashid invests money into an account which pays a fixed rate of compound interest each year.
The value, £V, of his investment after t years is given by the formula

$$V = 1250 \times 1.03^{t}.$$

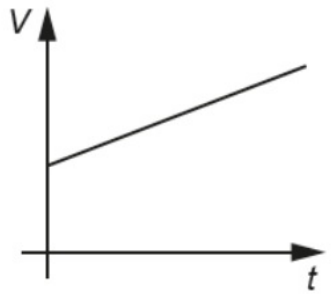
(a) How much money did Rashid invest?

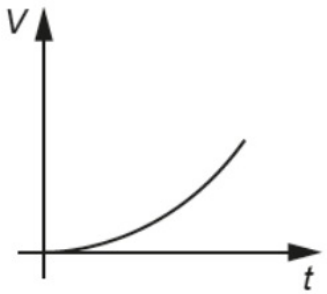
(a) £ ..... **[1]**

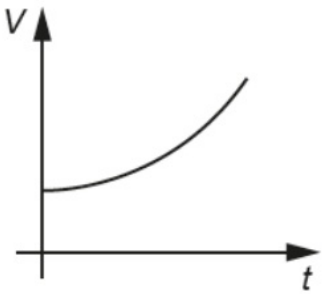
(b) What rate of compound interest is paid each year?

(b) ..... % **[1]**

(c) Circle the graph that best represents the growth in Rashid's account.







Video created by W Neill

4 Rashid invests money into an account which pays a fixed rate of compound interest each year.
The value, £V, of his investment after t years is given by the formula

R11

$$V = 1250 \times 1.03^t.$$

100%

(a) How much money did Rashid invest?

(a) £ 1250 **[1]**

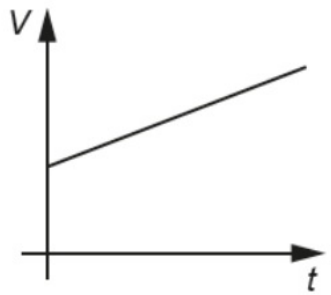
(b) What rate of compound interest is paid each year?

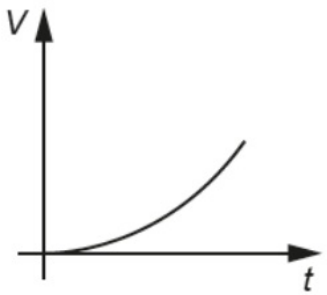
0·03 = 3%

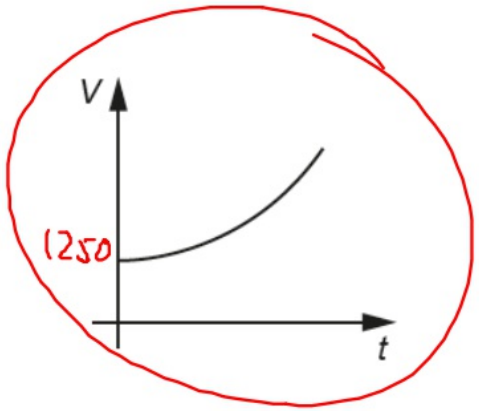
(b) 3% **[1]**

(c) Circle the graph that best represents the growth in Rashid's account.

A74







11 Amelia buys a new car.

R11 The expected future value of this car, £V, is given by

$$V = 16000 \times 0.75^{t}$$

where t is the age of the car in complete years.

(a) (i) Write down the value of the car when new.

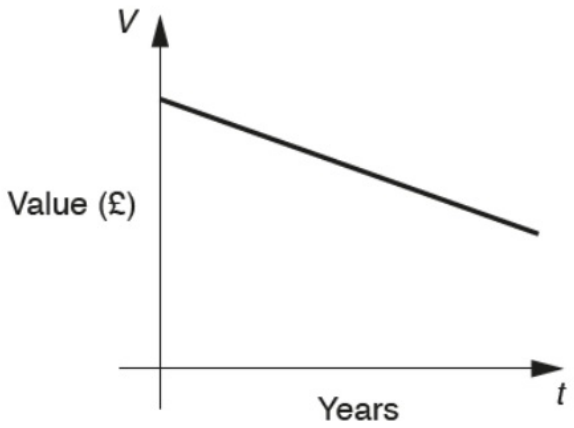
(i) £ ..... **[1]**

(ii) Write down the annual percentage decrease in the expected value of the car.

(ii) ..... % **[1]**

(iii) Show that the expected value of the car when 2 years old is £9000. **[2]**

(b) Amelia sketches a graph to show the expected value of her car as it gets older.



Explain how you know that Amelia's graph is incorrect.

.....

..... **[1]**

(c) Amelia assumes that her car will have no value at all after 20 years.

Explain why her assumption is mathematically incorrect.

.....

..... **[1]**

11 Amelia buys a new car.

R11 The expected future value of this car, £V, is given by

$$V = 16000 \times 0.75^{t}$$

where t is the age of the car in complete years.

(a) (i) Write down the value of the car when new.

(i) £ £16,000 **[1]**

(ii) Write down the annual percentage decrease in the expected value of the car.

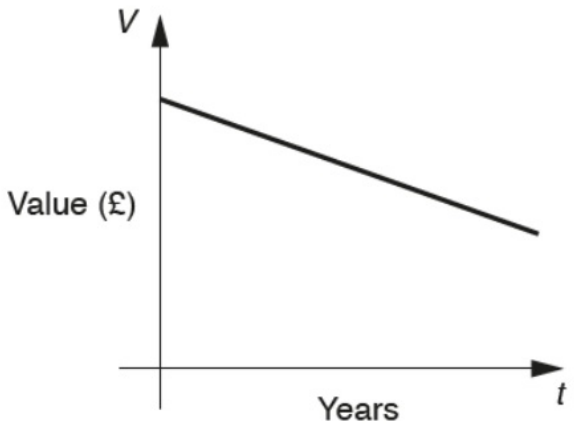
(ii) 25 % **[1]**

(iii) Show that the expected value of the car when 2 years old is £9000. **[2]**

£16000 - 25% = £12000 - 25% = £9000

- £4000 - £3000

(b) Amelia sketches a graph to show the expected value of her car as it gets older.



Explain how you know that Amelia's graph is incorrect.

falls by a slower amount each year so it is not a straight line

[1]

(c) Amelia assumes that her car will have no value at all after 20 years.

Explain why her assumption is mathematically incorrect.

It will always have a value as decreasing by 25% each year will never get to zero.

[1]

12 The value of a car, £V, is given by

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$$V = 16\,500 \times 0.82^{n}$$

where n is the number of years after it is bought from new.

(a) Write down the value of the car when new.

(a) £ ..... **[1]**

(b) Write down the annual percentage decrease in the value of the car.

(b) ..... % **[1]**

(c) Show that the value of the car after 4 years is less than half its value when new. **[2]**

12 The value of a car, £V, is given by

Created by W Neill

$$V = 16\,500 \times 0.82^{n}$$

where n is the number of years after it is bought from new.

(a) Write down the value of the car when new.

(a) £ 16 500 **[1]**

(b) Write down the annual percentage decrease in the value of the car.

0·82

(b) 18% decrease % **[1]**

(c) Show that the value of the car after 4 years is less than half its value when new. **[2]**

$16500 \times 0.82^{4} = £7460$

½ = £8250

7460 < 8250 ✓

Edexcel

25 Neil bought a house for £235 000

In the first year the value of the house depreciated by 4%
In each of years 2 and 3 the value of the house increased by 6%

Work out the value of the house at the end of year 3

£.....

(Total for Question 25 is 3 marks)

25 Neil bought a house for £235 000

In the first year the value of the house depreciated by 4%
In each of years 2 and 3 the value of the house increased by 6%

Work out the value of the house at the end of year 3

£235000 × 0.96 × 1.06 × 1.06

subtract 4%. increase by 6%.

4% of 235000 =

£253484.16

(Total for Question 25 is 3 marks)

Video created by W Neill

23 Becky buys a new car for £25 000

The value of this car will depreciate

R11

by 20% at the end of the first year
and then by 12% at the end of every year after the first year.

Work out the value of the car at the end of 3 years.

£.....

(Total for Question 23 is 3 marks)

23 Becky buys a new car for £25 000

£25000 x 0·8 x 0·88²

The value of this car will depreciate

R11

by 20% at the end of the first year
and then by 12% at the end of every year after the first year.

Work out the value of the car at the end of 3 years.

£25,000 x 0·8 x 0·88 x 0·88

£ 15488

(Total for Question ` is 3 marks)

Video created by W Neill

22 Anil wants to invest £25 000 for 3 years in a bank.

Personal Bank	**Secure Bank**
Compound Interest	Compound Interest
2% for each year	4.3% for the first year 0.9% for each extra year

Which bank will give Anil the most interest at the end of 3 years?
You must show all your working.

22 Anil wants to invest £25 000 for 3 years in a bank.

Video created by W Neill

-2% 0.98

Personal Bank	**Secure Bank**
Compound Interest	Compound Interest
2% for each year	4.3% for the first year 0.9% for each extra year

Which bank will give Anil the most interest at the end of 3 years?
You must show all your working.

PB ↓+2%

£25000 x 1·02 x1·02 x1·02

25000×1.02^3

= 26530·20

£25000 x 1·043 x 1·009 x 1·009

=£26546.46 ✔

Secure bank will pay out most money.

Video Created by W Neill

23 Northern Bank has two types of account.
Both accounts pay compound interest.

R11

Cash savings account
Interest
2.5% per annum

Shares account
Interest
3.5% per annum

Ali invests £2000 in the cash savings account.
Ben invests £1600 in the shares account.

(a) Work out who will get the most interest by the end of 3 years.
You must show all your working.

(4)

In the 3rd year the rate of interest for the shares account is changed to 4% per annum.

(b) Does this affect who will get the most interest by the end of 3 years?
Give a reason for your answer.

.....

(1)

Video Created by W Neill

23 Northern Bank has two types of account.
Both accounts pay compound interest.

R11

Cash savings account
Interest
2.5% per annum

Shares account
Interest
3.5% per annum

Ali invests £2000 in the cash savings account.
Ben invests £1600 in the shares account.

(a) Work out who will get the most interest by the end of 3 years.
You must show all your working.

CSA 2000×1.025^3

$= £2153.78$

Int $= £153.78$ Ali

SA $£1600 \times 1.035^3 = £1773.98$

Ben int $= £173.98$

Ben gets most interest ✓ (4)

In the 3rd year the rate of interest for the shares account is changed to 4% per annum.

(b) Does this affect who will get the most interest by the end of 3 years?
Give a reason for your answer.

No, as Ben (invests smallest amount) will continue to get most interest (1)

Ali would stay same ✓

9 Jean invests £12 000 in an account paying compound interest for 2 years.

R11 In the first year the rate of interest is $x\%$

R30 At the end of the first year the value of Jean's investment is £12 336

In the second year the rate of interest is $\frac{x}{2}\%$

What is the value of Jean's investment at the end of 2 years?

£.....

(Total for Question 9 is 4 marks)

9 Jean invests £12 000 in an account paying compound interest for 2 years.

R11 In the first year the rate of interest is x%

R30 At the end of the first year the value of Jean's investment is £12 336

$\frac{x}{2} = 1.4i.$

In the second year the rate of interest is $\frac{x}{2}$%

What is the value of Jean's investment at the end of 2 years?

Yr 1

$12000 \times \boxed{x\%} = £12336$

1.028

$2.8i.x$

Yr 2

$£12336 \times 1.014 =$

£ 12508.70 ✓

(Total for Question 9 is 4 marks)

Video Created by W Neill

13 The number of animals in a population at the start of year t is P_t
The number of animals at the start of year 1 is 400

R11

Given that

$$P_{t+1} = 1.01P_t$$

work out the number of animals at the start of year 3

.....

(Total for Question 13 is 2 marks)

Video Created by W Neill

13 The number of animals in a population at the start of year t is P_t
The number of animals at the start of year 1 is 400

R11

Given that

$$P_{t+1} = 1.01P_t$$

work out the number of animals at the start of year 3

Year 1 Year 2 Year 3

$400 \times 1.01 \times 1.01 = 408.04$

408 ✓

(Total for Question 13 is 2 marks)

AQA

26

R7

R11

Investment A — Save £150 per month for 2 years.
2.5% interest is added to the total amount saved.

Investment B — Invest £3500
Compound interest is added at 3% per year.

After 2 years, how much **more** is investment B worth than investment A?

[4 marks]

R7
R11

Investment A	Save £150 per month for 2 years. 2.5% interest is added to the total amount saved.
Investment B	Invest £3500 Compound interest is added at 3% per year.

After 2 years, how much **more** is investment B worth than investment A?

[4 marks]

A £150 × 24 months

= £3600

2.5% of 3600 = £90

= 3600 + 90 = £3690

B…

3500×1.03^2

= £3713.15

Ans £3713.15 − 3690

= £23.15 ✓

Video created by W Neill

25 Doug owes an amount of £600

He wants to pay back this amount in five months.

R7
R9a
R11

He says,

"Each month, I will pay back 20% of the amount I still owe."

Show working to check if his method is correct.

[3 marks]

25 Doug owes an amount of £600

He wants to pay back this amount in five months.

R7
R9a
R11

He says,

"Each month, I will pay back 20% of the amount I still owe."

Show working to check if his method is correct.

[3 marks]

1st 20%. 2nd month

£600 -120

=£480

£600 × 0·8^5 = £196

so won't have it paid.

=

Video created by W Neill

16 The value of a new car is £18 000

R11 The value of the car decreases by

25% in the first year

12% in each of the next 4 years.

Work out the value of the car after 5 years.

[3 marks]

Answer £ _____

Video created by W Neill

16 The value of a new car is £18 000

R11 The value of the car decreases by

25% in the first year

12% in each of the next 4 years.

Work out the value of the car after 5 years.

[3 marks]

1 - 25%.

1 - 0·25 = 0·75

£ 18,000 × 0·75 × 0·88^4

Answer £ 8095.89 ✓

Video created by W Neill

15 Mirek invests £6000 at a compound interest rate of 1.5% per year.

He wants to earn more than £1000 interest.

R11

Work out the **least** time, in whole years, that this will take.

[3 marks]

Answer _____ years

Video created by W Neill

15 Mirek invests £6000 at a compound interest rate of 1.5% per year.

He wants to earn more than £1000 interest.

R11

Work out the **least** time, in whole years, that this will take.

[3 marks]

11

$6000 \times 1.015^{11} = 7000\uparrow$

Answer 11 ✓ years