Finance: Growth & Decay (Grade 11)

MARKING GUIDELINE

MARKS	DURATION	QUESTIONS
48	1 hour 15 minutes	4

Name: _____ Class: _____

Date: _____

MARK ____ / 48

INSTRUCTIONS AND INFORMATION

1. Answer **ALL** the questions in this question paper.
2. Answer QUESTION 1 by **circling** the letter (A–D) in the answer grid at the end of that section.
3. Show **ALL** calculations clearly.
4. Show all units where applicable.
5. Number the answers correctly according to the numbering system used in this question paper.
6. A non-programmable calculator may be used, unless stated otherwise.
7. Write neatly and legibly.

QUESTION 1 [10 MARKS]

Four options are given as possible answers to the following questions. Choose the correct answer and circle the letter (A–D) in the grid at the end of this section. If you want to change your choice, put a cross through the wrong letter and circle your new choice.

1.1 R15 000 is invested at 9% p.a. compounded annually for 5 years. The final amount is ... (1)

A) R8 079,36 **B)** R21 750

C) R23 079,36 ✓ **D)** R16 350

Answer: C — $A = P(1+i)^n = 15\,000(1{,}09)^5 = R23\,079{,}36$.

- **A** — that is the INTEREST earned, not the final amount
- **B** — used SIMPLE interest: $15\,000(1 + 0{,}45)$
- **D** — compounded for one year only

1.2 R80 000 depreciates at 15% p.a. on the REDUCING-BALANCE method. After 4 years it is worth ... (1)

A) R57 800 **B)** R38 239,50

C) R32 000 **D) R41 760,50 ✓**

Answer: D — $A = P(1-i)^n = 80\,000(0{,}85)^4 = R41\,760{,}50$.

- **A** — depreciated for two years instead of four
- **B** — that is the value LOST, not the value left
- **C** — used the STRAIGHT-LINE method: $80\,000(1 - 0{,}6)$

1.3 Interest compounded QUARTERLY at 8% p.a. for 3 years uses ... (1)

A) $i = 0{,}08$ and $n = 12$ **B)** $i = 0{,}08$ and $n = 3$

C) $i = 0{,}02$ and $n = 12$ ✓ **D)** $i = 0{,}02$ and $n = 3$

Answer: C — Divide the annual rate by 4 and multiply the number of years by 4.

- **A** — adjusted the periods but left the rate annual
- **B** — those are the annual values, which ignore the quarterly compounding
- **D** — adjusted the rate but left the number of periods at 3

1.4 A NOMINAL rate differs from an EFFECTIVE rate because ... (1)

A) **the nominal rate is quoted per year but compounded more often than yearly** ✓

B) they mean the same thing

C) the nominal rate includes inflation

D) the effective rate is always the lower of the two

> **Answer: A** — Compounding more often than once a year makes the real yearly growth exceed the quoted rate.
>
> - **B** — they differ whenever compounding happens more than once a year
> - **C** — inflation is a separate calculation entirely
> - **D** — the effective rate is HIGHER when compounding is more frequent

1.5 12% p.a. compounded MONTHLY has an effective annual rate of ... (1)

A) 1%

B) 12,55%

C) 12%

D) **12,68%** ✓

> **Answer: D** — $(1 + 0{,}12 \div 12)^{12} - 1 = 0{,}1268$.
>
> - **A** — that is the MONTHLY rate, not the annual one
> - **B** — used quarterly compounding instead of monthly
> - **C** — that is the NOMINAL rate, before compounding is accounted for

1.6 What principal grows to R50 000 in 6 years at 7% p.a. compounded annually? (1)

A) R46 728,97

B) R35 211,27

C) R75 036,52

D) **R33 317,11** ✓

> **Answer: D** — $P = A \div (1 + i)^n = 50\,000 \div (1{,}07)^6 = \text{R}33\,317{,}11$.
>
> - **A** — divided by 1,07 once instead of six times
> - **B** — used simple interest and divided by 1,42
> - **C** — MULTIPLIED by $(1{,}07)^6$ instead of dividing by it

1.7 The growth of a town's population is worked out with ... (1)

A) $A = P(1 + ni)$

B) **$A = P(1 + i)^n$** ✓

C) $A = P(1 - ni)$

D) $A = P(1 - i)^n$

> **Answer: B** — Growth compounds, so each year's increase is worked out on the new total.
>
> - **A** — that is SIMPLE growth, with no compounding
> - **C** — that is straight-line DEPRECIATION
> - **D** — that is DECAY on the reducing-balance method

1.8 R2 000 is deposited at the START of each year for 3 years at 10% p.a. compounded annually. Just after the third deposit the value is ... (1)

A) **R6 620** ✓

B) R6 200

C) R6 000

D) R7 282

> **Answer: A** — The first deposit grows for 2 years, the second for 1 and the third not at all: 2 420 + 2 200 + 2 000.
>
> - **B** — grew only ONE of the three deposits
> - **C** — added the three deposits with no growth at all
> - **D** — grew every deposit for a full three years

1.9 If a car's value HALVES in 5 years on the reducing-balance method, the annual rate is about ... (1)

A) 50% **B) 12,94% ✓**

C) 10% **D)** 20%

> **Answer: B** — $(1-i)^5 = 0{,}5$ gives $1-i = 0{,}5^{0{,}2} = 0{,}8706$, so $i = 0{,}1294$.
>
> - **A** — that is the TOTAL loss over five years, not the annual rate
> - **C** — used $50\% \div 5$, which ignores the compounding
> - **D** — used $100\% \div 5$ instead of solving the equation

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1.10 Inflation runs at 5,5% p.a. In 10 years, goods costing R1 000 today will cost ... (1)

A) R550 **B) R1 708,14 ✓**

C) R1 550 **D)** R1 055

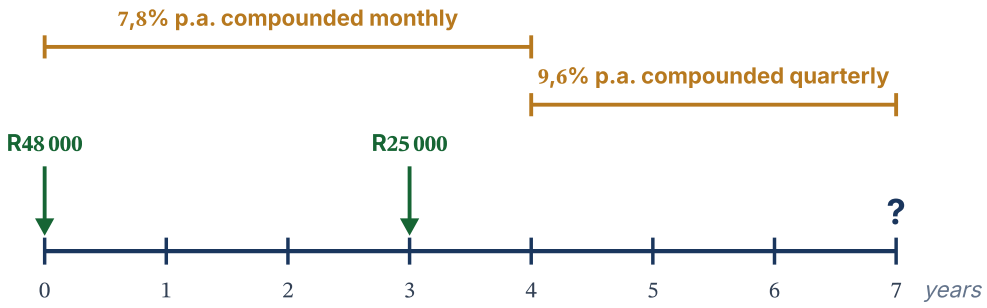
> **Answer: B** — $A = 1\,000(1{,}055)^{10} = \text{R}1\,708{,}14$.
>
> - **A** — that is a percentage figure, not an amount
> - **C** — used simple growth: $1\,000(1 + 10 \times 0{,}055)$
> - **D** — grew the price for one year only

ANSWER GRID — MARKING GUIDELINE

1.1	A	B	**C**	D
1.2	A	B	C	**D**
1.3	A	B	**C**	D
1.4	**A**	B	C	D
1.5	A	B	C	**D**
1.6	A	B	C	**D**
1.7	A	**B**	C	D
1.8	**A**	B	C	D
1.9	A	**B**	C	D
1.10	A	**B**	C	D

QUESTION 2 [12 MARKS]

Nomsa deposited R48 000 into an account paying interest at 7,8% p.a. compounded monthly. Exactly three years later she deposited a further R25 000 into the same account. Four years after her INITIAL deposit the interest rate changed to 9,6% p.a. compounded quarterly. The timeline below represents this information.



2.1 Calculate the amount in the account at the end of the fourth year. **(5)**

The first deposit earns interest for $4 \times 12 = 48$ months *(1)*
the second deposit for $1 \times 12 = 12$ months only *(1)*

$$A = R48\,000(1 + \frac{0{,}078}{12})^{48} + R25\,000(1 + \frac{0{,}078}{12})^{12} \quad (1)$$

$= R65\,509{,}25 + R27\,021{,}25$ *(1)*
$= \mathbf{R92\,530{,}50}$ *(1)*

2.2 Hence calculate the value of the investment at the end of the seventh year. **(4)**

For the last 3 years the rate is 9,6% p.a. compounded quarterly *(1)*
$n = 3 \times 4 = 12$ quarters *(1)*

$$A = R92\,530{,}50(1 + \frac{0{,}096}{4})^{12} \quad (1)$$

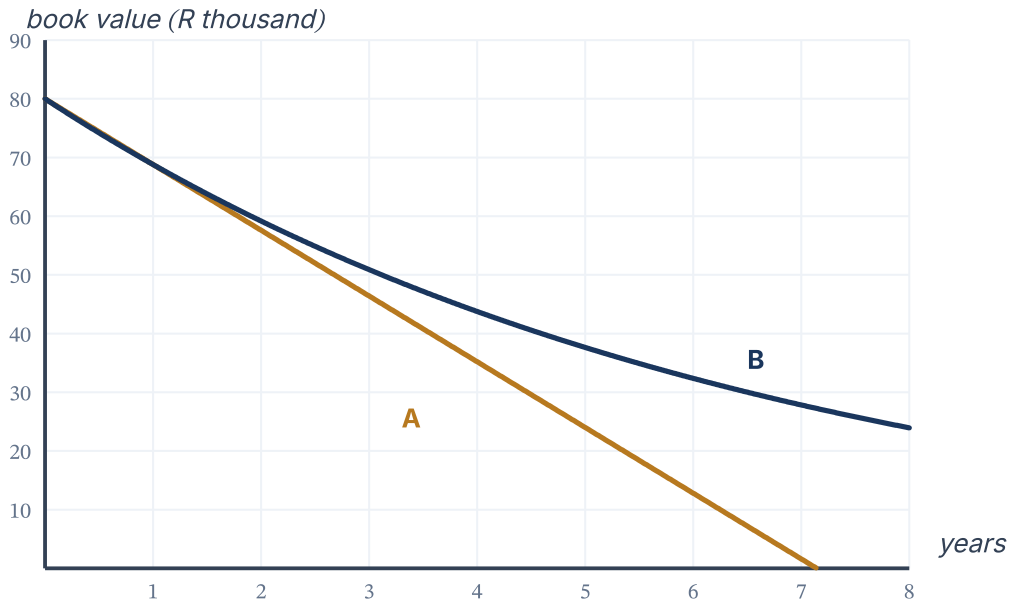
$= \mathbf{R122\,994{,}13}$ *(1)*

2.3 At the end of the seventh year Nomsa needs R135 000 as a deposit on a flat. Calculate how much MORE she still needs. **(3)**

$R135\,000 - R122\,994{,}13$ *(1)*
$= \mathbf{R12\,005{,}87}$ *(1)*
so she is short by roughly R12 006 *(1)*

QUESTION 3 [15 MARKS]

A machine is bought for R80 000. The graph below shows its book value over the first eight years under two different depreciation methods, A and B. Both use a rate of 14% p.a.



3.1 Write down which graph, A or B, represents depreciation on the REDUCING BALANCE, and give a reason for your answer. **(2)**

> **Graph B** *(1)*
> It is a curve that gets less steep each year, because 14% is taken off a SMALLER amount every year; straight-line depreciation removes the same rand amount each year and so plots as a straight line *(1)*

3.2 Calculate the book value of the machine after 6 years using EACH of the two methods, and hence the difference between them. **(5)**

> Reducing balance: $A = R80\,000(1 - 0{,}14)^6 =$ **R32 365,38** *(2)*
> Straight line: $A = R80\,000(1 - 0{,}14 \times 6)$ *(1)*
> $= R12\,800{,}00$ *(1)*
> Difference $= R32\,365{,}38 - R12\,800{,}00 =$ **R19 565,38** *(1)*

3.3 Calculate after how many years the STRAIGHT-LINE book value reaches zero, and explain why the reducing-balance graph never reaches zero. **(4)**

> $0 = R80\,000(1 - 0{,}14n)$ *(1)*
> $0{,}14n = 1$, so $n =$ **7,14 years** *(1)*
> On the reducing balance the machine keeps 86% of its value each year *(1)*
> and 86% of a positive number is always positive, so the value approaches zero without ever reaching it *(1)*

3.4 Instead of buying the machine, the company invests the R80 000 at x% p.a., compounded monthly. Calculate x, correct to TWO decimal places, given that this gives an effective annual interest rate of 9,3%. **(4)**

The effective rate is what ONE year of monthly compounding gives. With $i = \frac{x}{100}$, the nominal rate as a decimal:

$1{,}093 = (1 + \frac{i}{12})^{12}$ *(1)*

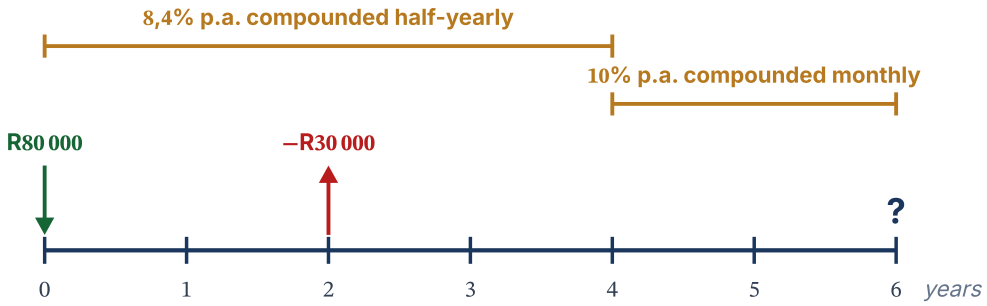
$(1{,}093)^{\frac{1}{12}} = 1 + \frac{i}{12} = 1{,}007438...$ *(1)*

$i = 12(1{,}007438... - 1) = 0{,}089256...$ *(1)*

$x =$ **8,93**, so the nominal rate is 8,93% p.a. *(1)*

QUESTION 4 [11 MARKS]

Sipho invested R80 000 in an account. Exactly two years later he withdrew R30 000 from the account. For the first four years the account paid interest at 8,4% p.a. compounded half-yearly, after which the rate changed to 10% p.a. compounded monthly. The timeline below represents this information.



4.1 Calculate the balance in the account immediately AFTER the withdrawal. **(3)**

A = R80 000$(1 + \frac{0{,}084}{2})^4$ = R94 310,68 *(2)*

Balance after the withdrawal = R94 310,68 − R30 000 = **R64 310,68** *(1)*

4.2 Calculate the value of the investment at the end of the sixth year. **(5)**

Years 2 to 4, still at 8,4% p.a. half-yearly ($n = 4$): *(1)*

A = R64 310,68$(1 + \frac{0{,}084}{2})^4$ = R75 814,79 *(1)*

Years 4 to 6, at 10% p.a. monthly ($n = 24$): *(1)*

A = R75 814,79$(1 + \frac{0{,}1}{12})^{24}$ *(1)*

= **R92 523,69** *(1)*

4.3 Hence calculate the TOTAL interest that Sipho earned over the six years. **(3)**

Interest = (what is left + what was taken out) − what was put in *(1)*

= R92 523,69 + R30 000 − R80 000 *(1)*

= **R42 523,69** *(1)*

TOTAL: 48 marks

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